I. **Multiple Choice Questions:**

1) The fuse provided in 4.5 KW RRU box for one of 3 phase AC supply is
   a) 6 A HRC   b) 35 A HRC   c) 16 HRC   d) 40 A HRC
2) The field fuse provided in RRU box is
   a) 6 A HRC   b) 35 A HRC   c) 16 HRC   d) 40 A HRC
3) When the coach is loaded with flooded batteries, the voltage setting of the 4.5 KW regulators for passenger train is
   a) 123 V DC   b) 121 V DC   c) 128 ±0.5 V DC   d) 124 V DC
4) For checking of tension of 'V' belt after fitment by
   a) Tension gauge   b) GO gauge   c) NO GO gauge   d) None of these
5) The alternator pulley keyway and key are to be properly matched, otherwise the keyway will be worn out and pulley becomes
   a) loose   b) tight   c) jammed   d) None of these
6) What type of clamp must be provided to stop the movement of alternator suspension pin to avoid worn out of nylon bushes and other parts
   a) rotating clamp   b) anti rotating clamp   c) fixed clamp   d) None of these
7) The battery fuse provided for 120 Ah TL batteries is
   a) 40 Amps HRC   b) 20 Amps HRC   c) 35 Amps HRC   d) 5 Amps HRC
8) The TL 110 V battery should not be discharged less than
   a) 96.2 volts   b) 95.2 volts   c) 97.2 volts   d) 98.8 volts
9) The capacity of HRC fuse provided for fan, light-1 & light-2 & EFT circuits is
   a) 40 Amps   b) 16 Amps   c) 35 Amps   d) 5 Amps
10) The capacity of HRC fuse provided for main negative in Roof junction box is
    a) 40 Amps   b) 16 Amps   c) 35 Amps   d) 5 Amps
11) The capacity of Rotary switch used for controlling lights and fans in roof junction box is
    a) 40 Amps   b) 16 Amps   c) 35 Amps   d) 5 Amps
12) Diode conducts current in
    a) Both direction   b) One direction only   c) does not conduct   d) None of these
13) IR value of TL coaches measured by
    a) Double test lamp   b) Single test lamp   c) Megger   d) All of these
14) When testing the earth leakage of coach with double test lamp, the red lamp and blue will burn equally, then the coach is
    a) healthy   b) not healthy   c) negative   d) positive
15) When testing the earth leakage of coach with double test lamp, the red lamp will not burn and blue lamp burn brightly & the coach is having
a) positive earth b) negative earth c) neutral d) none of these

16) Which Type of Belts are used for driving 110V, 4.5 KW TL Alternators
a) V-Belts b) Flat Belts c) Both a & b d) None of these

17) When testing earth leakage of coach with 500 volt meger, the insulation resistance under healthy weather condition should be more than
a) 2 mega ohms b) 1 mega ohms c) 0.5 mega ohms d) 2.5 mega ohms

18) When testing earth leakage of coach with 500 volt meger, the insulation resistance under bad healthy weather condition should be more than
a) 2 mega ohms b) 1 mega ohms c) 0.5 mega ohms d) 2.5 mega ohms

19) The size of the AL cable used for alternators 3 phase wires are PVC unsheathed is
a) 16 sq mm b) 35 sq mm c) 4 sq mm d) 30 sq mm

20) Capacity of Inverters used in Pantry Car
a) 2 KVA b) 3 KVA c) 2.5 KVA d) None of these

21) The size of the AL cables used for battery to under frame junction box, PVC unsheathed is
a) 16 sq mm b) 35 sq mm c) 4 sq mm d) 30 sq mm

22) The size of the cables used for BCT wires are
a) 16 sq mm b) 35 sq mm c) 4 sq mm d) 30 sq mm

23) The size of the cables used for fan positive, L1 positive, L2 positive, EFT1 positive, EFT2 positive, EFT1 negative and EFT2 negative is
a) 16 sq mm b) 35 sq mm c) 4 sq mm d) 30 sq mm

24) The size of the cable used for branch wiring is
a) 16 sq mm b) 35 sq mm c) 4 sq mm d) 30 sq mm

25) The DC voltage of TL alternator/Regulator is
a) 90 – 100 V b) 110 V – 130 V c) 100 V – 120 V d) None of these

26) The field resistance of TL 110 V 4.5 KW alternator is
a) 2 Ohms b) 4.5 ohms c) 5 ohms d) 3 ohms

27) The resistance between two phases of Alternator is
a) 0.2 ohms b) 4.5 ohms c) 0.5 ohms d) 0.8 ohms

28) How many grooves are there in 4.5 KW TL alternator pulley?
 a) 1 b) 2 c) 3 d) 4

29) The pitch diameter of 4.5 KW alternator pulley is
a) 300 mm ± 0.3 mm b) 200 mm ±0.3 mm
c) 250 mm ±0.3 mm d) 150 mm ± 0.3 mm

30) The pitch diameter of axle pulley is of 110 V TL system is
a) 572.6 mm ± 0.4 mm b) 500 mm ± 0.4 mm
c) 525 mm ± 0.4 mm d) 530 mm ± 0.4 mm

31) The size of V belt used for 110 V TL alternator 4.5 KW is
a) C 122 b) C 121 c) C 120 d) All of the above
32) The number of safety chains provided for TL alternators 4.5 KW is
   a) 1  b) 2  c) 3  d) 4
33) How many terminals available in RRU box board?
   a) 6  b) 7  c) 5  d) 3
34) Hydrometer is used for measuring
   a) Specific Gravity of cells electrolyte  b) Cells Voltage
   c) Earth Leakage  d) None of the above
35) Multimeter is used for measuring
   a) Voltage  b) Resistance  c) Both a & b  d) None of these
36) BLDC fans stands for
   a) AC fans  b) DC motor  c) Brushless DC fans  d) None of these
37) The 3 phase winding of alternator are connected in
   a) Series  b) parallel  c) star  d) delta
38) In Duranto LHB type pantry car how many alternators are available
   a) 1  b) 2  c) 3  d) Nil
39) The battery capacity used in 110 V TL system is
   a) 800 AH  b) 1100 AH  c) 120 AH  d) None of these
40) How many cells are available in flooded battery of 110 V TL system?
   a) 54 cells  b) 56 cells  c) 18 cells  d) None of these
41) Number of V-Belts used for driving 110V 4.5 KW TL Alternators is
   a) 4  b) 6  c) 12  d) None of these
42) Each mono-block battery consists of
   a) 3 cells  b) 6 cells  c) 9 cells  d) 12 cells
43) Each mono-block battery voltage is
   a) 12 volts  b) 6 volts  c) 8 volts  d) 18 volts
44) The open circuit voltage of lead acid cell is
   a) 2 volts  b) 2.2 volts  c) 2.1 volts  d) 1.8 volts
45) The specific gravity of fully charged battery is
   a) 1220  b) 1175  c) 1140  d) 1180
46) Conductors _____________ current.
   a) conduct  b) does not conduct  c) Both a & b  d) None of these
47) Number of Alternator Pulleys are available on 4.5 KW TL Alternator
   a) 1  b) 2  c) 3  d) None of these
48) Types of cables to be used for new coaches for wiring is
   a) Copper  b) Aluminium  c) E-beam  d) None of these
49) Non-contact type thermometer is used for measuring
   a) Voltage  b) Amps  c) Temperature  d) None of these
50) A terminal is said to be unhealthy, if the difference between Ambient temperature &
   temperature on thermometer is
51) TDS of DM water to be used in TL batteries shall be less than
   a) 500 PPM  b) 400 PPM  c) 50 PPM  d) 200 PPM

52) The size of EFT cable of Copper is
   a) 10 Sq.mm  b) 16 Sq.mm  c) 2.5 Sq.mm  d) 6 Sq.mm

53) The length of EFT cable is
   a) 1.6 m  b) 1.5 m  c) 2 m  d) 1m

54) Lux meter is used for measuring
   a) TDS  b) Illumination  c) Resistance  d) None of these

55) TDS meter is used for measuring
   a) Quality of distilled water  b) Specific Gravity of Electrolyte
      c) Illumination  d) None of these

56) For Amaraja maintenance free batteries, the voltage setting is
   a) 126  b) 123  c) 127  d) 128 V ± 0.5

57) TL battery shall be charged during Trip inspection, if load voltage is less than
   a) 110V  b) 96.5V  c) 106V  d) 104V

58) IOH schedule for a coach is done once in
   a) 6 months  b) 9 months  c) 12 months  d) 18 months

59) POH schedule for a coach is done once in
   a) 6 months  b) 9 months  c) 12 months  d) 18 months

60) The container of new mono block batteries is made up of
   a) soft rubber  b) hard rubber  c) PPCP  d) None of these

61) The normal charge current for 120 Ah battery is
   a) 10 amps  b) 12 amps  c) 16 amps  d) 24 amps

62) The charging current for 120 Ah battery should not exceed more than
   a) 10 amps  b) 12 amps  c) 16 amps  d) 24 amps

63) The specific gravity of pure sulfuric acid is
   a) 1.840  b) 1.800  c) 2.000  d) 2.840

64) The positive plate of lead acid battery is made up of
   a) Lead peroxide  b) spongy lead  c) lead  d) None of these

65) The negative plate of lead acid battery is made up of
   a) Lead peroxide  b) spongy lead  c) lead  d) None of these

66) Mark of float guide indicates maximum electrolyte is
   a) Upper mark  b) Lower mark  c) medium mark  d) None of these

67) Cells converts
   a) Chemical energy to electrical energy  b) Mechanical energy to electrical energy
      c) both a & b  d) None of these

68) When cells are connected in series, the
   a) voltage increases  b) voltages decreases  c) capacity increases  d) capacity decreases
69) When cells are connected in parallel, the
   a) voltage increases  b) voltages decreases  c) capacity increases  d) capacity decreases
70) Sulphation occurs due to left battery under discharged condition for
   a) short time  b) idle time  c) long time  d) none of these
71) Over charging of the battery results
   a) High temperature, corrosion of plates, oxidation of separators, loss of water
   b) Irreversible sulphation, reversal of cells and loss of capacity
   c) Battery is in good condition
   d) None of these
72) Undercharging of the battery results
   a) High temperature, corrosion of plates, oxidation of separators, loss of water
   b) Irreversible sulphation, reversal of cells and loss of capacity
   c) None of these
73) Alternator is a device which converts
   a) electrical energy into mechanical energy  b) mechanical energy into electrical energy
   c) kinetic energy into potential energy  d) potential energy into kinetic energy
74) The field supply of alternator is
   a) AC supply  b) DC supply  c) Both a & b  d) None of these
75) " mm " stands for
   a) millimole  b) millimeter  c) millimile  d) None of these
76) The fans used in 110 V TL system are
   a) DC series motor type  b) AC series motor type
   c) both a & b  d) None of these
77) The main parts of lead acid cell are
   a) + ve & - ve plates, electrolyte, container and container lid
   b) Rubber pads, aluminum plates and PVC container lead
   c) MS plates, KOH and Synthetic rubber
   d) None of these
78) The bearing used in 110 V DC fans is
   a) SKF 6200  b) NU 311  c) SKF 6309  d) None of these
79) MCB stands for – Main circuit board
   a) True  b) False  c) None of these
80) PCD stands for – Pitch circle diameter
   a) True  b) False  c) None of these
81) LMS stands for – Load master switch
   a) True  b) False  c) None of these
82) SWG stands for – Steel wire gauge
   a) True  b) False  c) None of these
83) ET stands for – Excitation transformer
   a) True                   b) False                   c) None of these
84) AL stands for – Ampere load
   a) True                   b) False                   c) None of these
85) FCS stands for – First class with coupe and second class
   a) True                   b) False                   c) None of these
86) SLR stands for – Second class luggage van and break van
   a) True                   b) False                   c) None of these
87) WGS stands for – Vestibule second class
   a) True                   b) False                   c) None of these
88) WCB stands for – Pantry car
   a) True                   b) False                   c) None of these
89) BCT stands for – Battery charging terminal
   a) True                   b) False                   c) None of these
90) HRC stands for – High Rate capacity
   a) True                   b) False                   c) None of these
91) UJB stands for – Under slung junction box
   a) True                   b) False                   c) None of these
92) AH stands for – Ampere Hour
   a) True                   b) False                   c) None of these
93) FDB stands for – Fixed distribution board
   a) True                   b) False                   c) None of these
94) The purpose of Alternator used in Railways
   a) Charging the coach battery on train run
   b) Working of lights and fans in the coach during train run
   c) Sharing the load to other coaches in case of emergency
   d) All the above

II. Fill in the blanks: -
1) Field coils of TL coach alternators are located on ____________ (Stator)
2) Type of belts used for driving 110V 4.5 KW TL Alternators ____________ (V-Belts)
3) Field windings are fed by _________________ Voltage. (DC)
4) Residual magnetism retains in _________________ core. (Stator)
5) TL & AC coach 110V alternators are driven by _________________ (Train Axle)
6) The colour of painting recommended by RDSO for 110V TL alternator is ____________ (Canary Yellow)
7) The insulation resistance of alternator when measured with Megger the IR value should not be less than ______.

8) Never replace a blown fuse by a ______________ capacity.

9) The insulation resistance of 110V alternator to be tested with ______________.

10) The diode used to control field voltage/current ______________

11) The diode is used to rectify AC into ______________

12) Voltage measured in units ______________

13) Current measured in units ______________

14) Resistance measured in units ______________

15) The capacity of 120 Ah +ve battery fuse is _______ HRC.

16) To avoid fire in coaches rewiring of coaches shall be planned after ______ years

17) Recommended size of cables used for Fan (-)ve & light (-)ve in TL coaches are ______

18) The DC +ve & DC -ve wires should not be ______________

19) Wattage of TL fan is ______________

20) Current = ______________ / Voltage

21) Current is measured by instrument without disturbing the circuit is ______________

22) Total number of alarm chain pulling indication lights provided in TL coach are ______________

23) 2.5 KVA inverter in pantry car converts DC to ______________

24) Recommended wattage of IC lamps for tail lamp is ______________

25) All cable terminals in UJB,RJB and FDB will be fully tightened & the temperature at the terminals shall not exceed ______________ °c. 60 m ambient temperature.

26) All aluminium lugs should not be hammered, but should be cramped with ______________ tool only.

27) To avoid theft of batteries ______________ is provided for battery box.

28) ______________ size of cables are used for connection EFT.

29) ______________ should be checked on first instance of coach/train arrival for maintenance.

30) BG stands for ______________

31) OEM stands for ______________
32) LED stands for ____________________________  (Light Emitting Diode)
33) BJT stands for ____________________________  (Bi Polar Junction Transistor)
34) MG stands for ____________________________  (Meter Guage)
35) MA stands for ____________________________  (Magnetic Amplifier)
36) ET stands for ____________________________  (Excitation Transformer)
37) KEL stands for ____________________________  (Kerala Electrical & Allied Engineering co. Ltd.)
38) SIL stands for ____________________________  (Stone India Limited)
39) MΩ stands for ____________________________  (Mega Ohms)
40) VRLA stands for ____________________________  (Valve Regulated Lead Acid)
41) LA stands for ____________________________  (Lead Acid Battery)
42) POH stands for ____________________________  (Periodical Over Hauling)
43) IOH stands for ____________________________  (Intermediate Over Hauling)
44) CRB stands for ____________________________  (Chairman Railway Board)
45) RRB stands for ____________________________  (Railway Recruitment Board)
46) PCB stands for ____________________________  (Printed Circuit Board)
47) OVR stands for ____________________________  (Over Voltage Relay)
48) NDE stands for ____________________________  (Non Driving End)
49) DE stands for ____________________________  (Drive End)
50) Z stands for ____________________________  (Zener Diode)

**III. Abbreviations :-**

1) O.V.P. — Over Voltage Protector
2) R.P.M. — Revolutions per minute
3) A.C. — Alternating Current
4) D.C. — Direct Current
5) L.V.R. — Low Voltage Relay
6) E.F.T. — Emergency Feeding Terminal
7) S.W.G. — Standard Wire Gauge
8) E.O.G. — End On Generation
9) AH — Ampere Hour
10) H.R.C. — High Rapturing Capacity
11) L.M.S. — Load Master Switch
12) D.F.B. — Distribution Fuse Board
13) M.C.B. — Miniature Circuit Breaker
14) F.D.B. — Fuse Distribution Board
15) IGBT — Insulated Gate Bi-Polar Transistor
16) RRU — Rectifier cum Regulator Unit
17) ERRU — Electronic Rectifier cum Regulator Unit
18) FRPCPY — Failure Rate Percentage Per Year
19) RJB — Roof Junction Box
20) ELU — Emergency Light Unit
21) PELE — Portable Emergency Lighting Equipments

IV. Indicate True of False

(1) The unit for measuring illuminance is **LUX**. (T / F)
    Ans: TRUE

(2) Full form of CFL is **Compact Floor Lamp**. (T / F)
    Ans: FALSE

(3) Full form of LED lamp is **Light Emitting Diode Lamp**. (T / F)
    Ans: TRUE

(4) DCP type of fire extinguisher used for electrical fire. (T / F)
    Ans: TRUE

(5) The voltage and frequency of domestic power supply system in India is **230V AC and 50 Hz**. (T / F)
    Ans: TRUE

(6) The cut in speed for 4.5 KW alternator used in Sleeper Class Coach is 27 KMPH. (T / F)
    Ans: TRUE

(7) In Sleeper Class Coach, **80 lux** of illumination level is minimum needed. (T / F)
    Ans: FALSE

(8) The EFT in coaches is provided for extending power supply to/from the adjoining Coaches. (T / F)
    Ans: TRUE

(9) Subject of Air conditioning of coaches on Indian Railways comes under the jurisdiction of **CEGE**. (T / F)
    Ans: False

(10) The illumination is measured in terms of **LUX**. (T / F)
    Ans: TRUE

(11) The train lighting system used on EMUs is known as **Head on Generation System**. (T / F)
    Ans: TRUE

(12) The system of power supply used in the Coaches of Rajdhani & Shatabdi Express on IR is known as **End-on-Generation**. (T / F)
ANS: TRUE
(13) Train Lighting on Indian Railways comes under the jurisdiction of CESE (T / F)
ANS: TRUE

V. Short Answers:

1) What is Alternator & explain its usage in coaches?
(A) Alternator is a device which converts mechanical energy into electrical energy with self excitation or separate excitation. Alternator is used in coaches to generate supply to charge batteries & supply to the coach load while running.

2) What are the major parts of 4.5 KW Alternator?
(A) The TL alternator of 4.5 KW consists of (i) Stator (ii) Rotor (iii) Field winding (iv) AC winding

3) How do you find earth leakage of TL coach?
(A) Earth leakage can be detected by double test lamp method or with 500 volts megger.

4) What are the safety items to be checked for TL coaches under frame?
(A) The safety items to be checked for TL coaches under frame are (a) alternator suspension pin with cotor pin, Transmounting bushes level, Safety chains with nut & bolts. (b) Terminal box, lugs, cables insulation & cleat (c) Junction box and running cables with hose pipes.

5) What is the permissible voltage drop in 110 volts in TL systems?
(A) Total voltage drop between the battery and any of the farthest light/fan point shall not exceed 3 volts. For example, If battery voltage 108 volts than the voltage at farthest point should not be less than 105 volts.

6) What are the causes of fires in coaches on electrical account?
(A) Due to short circuits, loose connections, over loading, use of under size cables, by passing of safety devices, use of Over rating HRC fuses & use of overaged cables.

7) How much current does the 120 Ah battery take during normal charging?
(A) The 120 Ah battery take, 10 Amps during normal charging.

8) What is the capacity of inverter used in Pantry cars?
(A) Inverters of 2.5 KVA capacity are used in pantry cars.

9) What happens when cells are connected in series?
(A) Voltage increases if cells are connected in series.

10) What happens when cells are connected in parallel?
(A) Capacity increases if cells are connected in parallel.

11) What is the field supply of alternator?
(A) The field supply of the alternator is D.C.

12) What are the main parts of lead acid cell?
(A) The main parts of lead acid cell are +ve & -ve plates, electrolyte, container and container lid.

13) What type of bearings are used in 110V DC fans?
(A) The bearing used in 110V DC fan is SKF6200
14) What are the reasons for no generation?
   (A) The reasons for no generation are Field may be open, dropping of ‘V’ belts, defective of RSW1 in Power panel, fuses may be blown in regulator, etc.,

15) What is the Specific gravity of pure sulphuric acid?
   (A) The specific gravity of pure sulphuric acid is 1.840.

16) Why control of voltage is required in TL/AC coach alternator?
   (A) The prime mover of TL/AC alternator is train axle whose speed is not constant. Due to variation of train speed the output voltage of alternator is also varies. A constant voltage is required to operate TL/AC loads. Hence voltage control is necessary for TL/AC coach alternators.

17) On what principle TL/AC alternators are working?
   (A) TL/AC alternators are working on Faraday’s laws of electro magnetic induction.

18) How field winding helps to control output voltage/current?
   (A) By varying the field voltage and current, field flux is varied, which in turn controls output voltage/current.

19) Explain Schedule attention on Lead Acid Batteries in FNE schedule?
   (A) Cleaning of ICC, toping up of distilled water, applying of petroleum jelly on terminals posts, nuts, bolts and ICC. Checking of SPG. Providing charging. Checking of ON load and OFF load voltage of individual cells and group.

20) Explain the procedure for through feeding in TL coaches incase of adjacent coach is dark/dim?
   (A) The detailed procedure of emergency feed extension is given as under

   **1.0 Action to be taken in healthy coach**
   1.1 The availability of power supply in the emergency feed terminal should be ensured. If not available check eft RSW in ON –condition, 16A HRC fuse healthy condition, etc.
   1.2 Only one dark coach should be extended feed supply from one healthy coach.
   1.3 Before connecting, the polarity of healthy coach as well as dark coach shall be checked.
   1.4 L-II circuit of the healthy coach shall be switched off before connecting supply to dark coach.
   1.5 The rotary switch of (socket paralleling main) SPM-I and II shall be kept in ON position.

   **2.0 Action to be taken in defective coach and feed extension**
   2.1 L-II and fan circuit of the dark coach shall be switched off before connecting supply from healthy coach.
   2.2 The rotary switch of (socket paralleling main) SPM-I and II shall be kept in ON position.
   2.3 The L-I circuit is having essential/emergency lighting circuit. This includes all lavatory lights 50% of compartment lights, and night lights in all types of IInd class coaches.
   2.4 Remove 35 Amps (-ve) main fuse from Rotary junction box to disconnect the power supply to/from battery.
   2.5 The earth fault shall be checked up with the help of testing lamp. If earth fault is there then feed extension should not be done.
   2.6 The feeding shall be given to L-I circuit only of the dark coach from healthy coach.
   2.7 The defective coach shall be attended and cable should be removed at the first available opportunity by TL staff.
2.8 The size of the cables for the feed extension shall be of 16 sq.mm PVC Aluminium / 2.5 sq.mm elastomeric / 2.5 sq.mm e-beam copper cables.

2.9 The length of the wire for feed extension shall be 2x1.5 meter (for both terminals). The length of the cable shall not be more than 1.5 meter.

2.10 Both ends of the cable shall be provided with suitable size of lug.

2.11 The cable shall be secured tightly by the screws or bolts, nuts and plain washer. The proper tightness of the connections should be ensured.

21) What is the procedure for preparing electrolyte?
(A) (i) Take 3:1 ratio of distilled water and sulphuric acid of 1.870 specific gravity.
(ii) Add slowly acid into distilled water (not vice-versa)
(iii) Mix properly

22) How to detect reversing of cell?
(A) (i) Switch on total load of TL coach.
(ii) Record individual cell voltage of the bank.
(iii) If reverse voltage found, remove cell & provide cell with same make and lug date.

23) What are the advantage of VRLA batteries?
(A) (i) VRLA batteries are supplied to customer in ready to use condition.
(ii) Topping up of water is not required.
(iii) They are compact and can be used in any orientation.
(iv) They do not emit corrosive fumes and gases.

24) What is BCT and why they are provided?
(A) BCT means - Battery Charging Terminal and these are provided at both sides of the coach for external charging of the batteries.

25) What are the causes of Earth in coaches & procedure for removing earth from the coach?
(A) Causes of Earth in the coach:
(i) Failure of insulation resistance of cables.
(ii) Leakage of electrolyte from batteries.
(iii) Due to carbon accumulation in DC carriage fans.
(iv) Loose connections at switches & cables touching metallic parts.
(v) Grounding of fans winding.

Procedure for removing earth from the coach:
(i) Cleaning of DC fan regularly.
(ii) Cleaning of cells regularly.
(iii) Do not allow loose connections at switches.

26) In L-1 circuit of TL coaches what are the areas of coach lighting covered?
(A) L - 1 circuit included lavatory lighting and 50% of compartment lights, door way lights, Night light circuit.

27) What is the colour coding in TL coach cables?
(A) Main Positive cable - Red, Light circuit +ve cable - Yellow, Fan -ve cable - Black & All other negative cables, except fan negative cable - Blue.
28) What are the checks during TRIP INSPECTION for Cells?
(A) (i) Check for by-passing of failed cells. If by-passed cells are found replace these failed cells immediately with the healthy ones.
(ii) Dust accumulation – if observed, clean with dry cotton cloth.
(iii) Cell cover / container cracked or burst – if noted replace the cell with a healthy cell immediately.
(iv) In case of battery terminal / cable overheating sign, check for loose connection at the cell terminal post / cable end. If required replace the cable immediately.
(v) Protective lid on safety valve – if missing provide new one immediately.
(vi) Check for arrival time of the Train. If train has arrived late due to heavy detention en-route due to some reasons, charge the coach battery bank as per Annexure – 1 to bring up the State of Charge of the Battery Bank before putting the AC coaches again in Service.
(vii) Do not boost charge the cells for more than 12 hours.

29) What are the checks during TRIP INSPECTION for Alternator, Axle Pulley & V-belts?
(A) Alternator:
Check the warmness of the alternator on arrival, if found cold check the following:
(i) Check the field fuse of the regulator
(ii) Check the continuity of field winding & phase winding with the help of multimeter or test lamp.
   Ensure windings are not open circuited.
(iii) Check the loss of residual magnetism with the help of Voltmeter across the field terminals, in case of loss of residual magnetism give 12V DC flashing to the field terminals for few seconds to regain lost residual magnetism.
(iv) Check the connection tightness of alternator & regulator terminals.
(v) Remove the V-belt and battery connections & check generation with portable motor drive.
(vi) In case of no generation inform rake incharge.
(vii) Check all other underframe safety items.
Axle Pulley:
(i) Check white marks on axle pulley & ensure pulley has not slipped.
(ii) Tap the pulley with the hammer & judge the tightness or crack by sound.
(iii) Check the lock nuts & split pins.
(iv) Check the gap between two halves of the axle pulley, it should be 3mm.
(v) Check the rubber pad availability.
V-Belts:
(i) Check the condition of V-belts for fraying of edges.
(ii) Check the V-belts for overturn & rectify it.
(iii) Check the belt tension and adjust if required.
Regulator:
(i) Clean regulator externally, oper regulator terminal cover & check for signs of over heating.
(ii) Tighten loose connections

30) If water consumption in a particular cell is more, what are the checks to be done?
(A) Check the following: (i) Over heating of cell (ii) Any crack on lid or container (iii) Leakage from vent plug or float guide (iv) Crack in sealing or pinholes (v) If water consumption is more in all the cells, then charging voltage should be checked (vi) Frequency of topping up should be recorded. (vii) Then matter should be reported to rake in charges.

31) What is the method for Weeding out of defective cell?
(A) If cell voltage is found less than 1.7 Volts it has to be remove from the cell bank.

32) What is significance of Green and Red mark of the float guide of Lead Acid Cells?
(A) The float stem will have markings to indicate the lowest in red and highest in green of permissible electrolyte levels. It should be ensured that the electrolyte level is maintained in service by adding pure distilled / dematerialized water.

33) What are the equipments available in PELE box?
(A) The equipments available in PELE box are:
   (i) TRIPOD STAND
   (ii) HOLDER
   (iii) FLEXIBLE WIRE 25 METERS
   (iv) CROCODILE CLIPS
   (v) BULBS
   (vi) HAND LAMP
   (vii) LOG BOOK
   (viii) LAMP FITTINGS

34) What are the reasons of V-Belts dropping?
(A) Locking of barrel bush, locking of alternator safety chains, misalignments of axle pulleys, Alternator bearing jam and due to cattle run over.

35) What is the gap between the Mounting Bracket to adjustment nut in Tension device & how to adjust?
(A) The gap between the Mounting Bracket to adjustment nut in Tension device is 55 mm & it can be adjusted by opening check nut and adjusting barrel bush.

36) Write about electronic ballast for FL used in TL coaches?
(A) It is an assembly comprising of semiconductors, toroidal transformer and associated electronic and electrical components used for DC to AAC inversion and shall include for stabilized power output, surge suppression, radio frequency suppression and protective circuits adopted for satisfactory performance and reliability of the inverter unit.

37) How do you test working of Emergency Light Unit?
(A) Press the push button and check the Emergency light unit status.
   (i) All four Emergency light unit should glow with Red LED indication "ON" in each unit.
   (ii) If any of the unit is not working then check indications status of LED’s on the unit as under :-
   (a) If green LED is "OFF" it means battery connection inside emergency light unit is not intact. Remove the unit from ceiling and check it on test bench.
   (b) If Red LED is "flashing " it means battery needs to be replaced. Remove unit from ceiling and check battery and if required replace the defective battery.
   (c) If Green LED is "flashing" it means battery is under cyclic discharge mode and is being discharged internally.
38) What are the types of schedule maintenance laid down for TL coaches?
   (A) Trip, Fortnightly, Monthly, Quarterly, IOH & POH.

39) What are the parameters checked to give fire fitness of a coach?
   (A) The following parameters should check to prevent fire in coaches.
      (i) Check the + ve Leakage
      (ii) Check the – ve Leakage
      (iii) Check the heating symptoms at junction box
      (iv) Tightening of loose connections at terminal boards
      (v) Checking of proper rating of HRC fuses
      (vi) Ensuring FNE of cells
      (vii) Checking the Condition of OVP in RRUs

40) What are the parameters to be checked for avoiding V-Belts dropping for TL coaches?
   (A) (i) Ensure gap between two halves of axle pulley to 3.0 ± 0.5 mm and tightening
torque should be upto 30 kg - mtr (maximum)
   (ii) Replace pulleys if grooves are worn out by 0.8 mm depression on sides or
        bottom of groove is uniformly shining.
   (iii) Distance between Axle Pulley face to Wheel Hub to be maintained
         (230+/- 3mm for 25KW, 145+/- 5mm for 4.5KW)
   (iv) Checking of Gap between Tension device supporting plate and Tension Device sleeve
        (50mm for AC and 35mm for Non AC Coaches)
   (v) Tension gear spring length after tensioning (310+5mm for Non AC coaches)
   (vi) Checking of Alignment between Alternator Pulley and Axle Pulley (Tolerance 5 mm)
   (vii) Check Belt Tension Gear Suspension bracket Hole dia (76mm)
   (viii) Check Belt Tension gear suspension bracket length (420mm for AC and 400mm for Non AC Coaches)
   (ix) 100% of V Belts replaced with same grade (set).
VI. DESCRIPTIVE TYPE QUESTIONS:

1) Explain working principle of KEL Alternator /Regulator 120 V, 4.5KW with the help of circuit diagram.

![Circuit Diagram]

<table>
<thead>
<tr>
<th>POWER CIRCUIT (Red Colour)</th>
<th>VOLTAGE SENSING CIRCUIT (Blue Colour)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALT – 3 Phase Brushless Alternator 4.5 KW, 130V, 37.5A Resistance between phases – 0.4 ohms</td>
<td>D5, D6, D7, Auxiliary rectifier diodes, 1A, 1000V PIV</td>
</tr>
<tr>
<td>Field resistance 4.36 Ohms.</td>
<td>DT – Voltage detector, R1 + R2 + r3=14K ohms.</td>
</tr>
<tr>
<td>FI- Phase fuse 35 Amps</td>
<td>R4= 1.12 K ohms R5=R6=11.8 K Ohms.</td>
</tr>
<tr>
<td>PR – 3 phase bridge rectifier (Normal Polarity 70 Amp, 1200 IV)</td>
<td>D8 is zener diode 100V, 3,</td>
</tr>
<tr>
<td>CI-C6 Capacitor(Surge Voltage Protection)</td>
<td>RSW – Rotary switch 1 pole 3 way</td>
</tr>
<tr>
<td>C7-Filter Capacitor</td>
<td>VR – Variable resistance</td>
</tr>
<tr>
<td>C8-High Frequency Protection Capacitor</td>
<td>CW (10-11) - Voltage control winding of MA 13.8 Ohms</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FIELD CIRCUIT (Green Colour)</th>
<th>CURRENT SENSING CIRCUIT: (Brow Colour)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F2 – Field fuse 6 amps</td>
<td>SHR – Shunt resistance</td>
</tr>
<tr>
<td>ET – Excitation transformer</td>
<td>CW(26-27) Current control winding MA</td>
</tr>
<tr>
<td>DS-D3 – Field diode 6 amps 600V PIV</td>
<td>D1- Shunt diode, 6A, 100V, PIV</td>
</tr>
<tr>
<td>EX+, EX- - Field terminals</td>
<td>MA – Magnetic Amplifier</td>
</tr>
<tr>
<td>MA – Magnetic Amplifier</td>
<td>Resistance of MA load windings 1.1 Ohms</td>
</tr>
<tr>
<td>Resistance of gain winding – Negligible</td>
<td>Resistance of gain winding – Negligible</td>
</tr>
</tbody>
</table>

Magnetic Amplifier Rectifier cum Regulator Circuit 4.5 KW 110V DC KEL Make:
Fro easy understanding of KEL 4.5 KW alternator / rectifier regulator, circuit diagram was divided into four sub circuits. They are
(1) Power supply circuit.
(2) Field Circuit.
(3) Voltage Control Circuit.
(4) Current control Circuit/

1. **Power supply circuit**: The circuit consists of 3 phase alternator (ALT) & 3 phase bridge rectifier (PR). Three phase AC supply (13,14,15 terminals) produced by alternator is led to 3 phase bridge rectifier consist of 6 silicon power diodes through fuse f1. The bridge is protected against voltage surges by 6 numbers of capacitors (c1 to c6). Capacitor (C7) and Capacitor(C8) are provided across the bridge for filtering DC output and protection against high frequency surges respectively. Shunt resistance (SHR) is provided in series to DC output voltage positive (+L) terminal for sensing output current. DC output voltage terminals are (+L.C)

**Function**: When the field coils are excited and rotor is rotated the variation in reluctance offered by the rotor teeth arrangement causes the flux produced by the field coil to pulsate. This pulsation of flux linked with AC coils and induces e.m.f. in the AC windings. The induced e.m.f. in the 3 phase winding is rectified by the 3 phase bridge rectifier. The bridge rectifier also serves the purpose of maintaining the constant polarity in both the directions of the train and prevents current flowing from battery to alternator, when the coach is stable condition.

2. **Field Circuit**: Field circuit consists of Excitation transformer (ET) Magnetic amplifier load windings, Field rectifier (D2, D3) and Free wheeling diode (D4). An ET is two winding step down center tapped transformer. It has two functions 1. It steps down the voltage for good regulation of output voltage and current. 2. Its secondary winding is center tapped used for full wave rectification with two diodes and accommodates load windings of MA.

Magnetic Amplifier is used to control the field voltage and field current, thereby controlling the output voltage and output current. It has six windings. Two are load windings connected in series to the field circuit. One winding is used for voltage control and one more winding is used for current control and other winding used as gain winding to boost output voltage when train is in slow speeds. One more winding is spare. Free wheeling diode is provided to eliminate the surge voltages produced in the field coil. Cathode of free wheeling diode connected to field positive and anode to field negative.

Two phase AC supply of Alternator given to ET primary (14 & 15 terminals) through field fuse F2. The center tap secondary terminal (19) is connected to field rectifier (-EX) of alternator. The end terminals of ET secondary (19 &161) are connected to full wave rectifier (D2 D3) through MA load windings (18, 16 and 161.17) The rectified DC fed to field positive (+EX) of alternator through gain winding (40 and 20). Free wheeling diode is connected across field terminals (19 and 2) is reverse direction.

**Function**: The purpose of field circuit is to feed rectified DC supply for field for excitation. Two phase supply of alternator is stepped down by ET and rectified by full wave rectifier.
This rectified DC is fed to field winding through gain winding. Free wheeling diode is provided to dissipate energy produced in the field, in other way to eliminate surge voltages produced in the field coil.

3. **Voltage Control Circuit**: The circuit consists of auxiliary rectifier (D5, D6, D7) voltage detector (DT) and voltage control winding of magnetic amplifier (10,11). The voltage detector consists of resistance network (R1, R2, R3, R4, R5, R6) and zener diode D8, 450 Ohms variable resistance (VR) is connected across the resistances R5 and R6 with voltage selector switch (RSW) to set 120, 122, 124 volts output settings. Voltage detector serves the purpose of providing DC signal to the control winding of MA.

**Function**: When the output voltage exceeds the preset value, the drop across R1, R2 and R3 is sufficient to conduct Zener diode and allows a DC signal to the voltage control winding of MA. The DC flux product in control winding will oppose the AC flux of load windings and increases impedance of the field circuit. This increase of impedance, results in decrease of field voltage and field current thereby decreasing output voltage. This process is continuous to maintain the output voltage constant.

4. **Current Control Circuit**: This circuit consists of shunt resistance (SHR 26, 28 terminals), shunt diode (D1) and current control winding of M.A. (26 and 27). For sensing output current, SHR is provided in the DC output voltage of alternator. Shunt leads are not connected to MA current control winding through shunt diode.

**Function**: When preset value of current is supplied by the alternator exceeds, the voltage drop across the shunt is sufficient to conduct shunt diode. When shunt diode conducts, it sends a DC signal to current control winding of MA. This DC signal induces DC flux in the current control winding. This DC flux opposes the AC flux of load windings and increases the impedance of the field circuit. Increase of impedance in field circuit reduces the field voltage and field current thereby decreasing the output voltage and output current. This process repeats when the output current exceeds and maintains the alternator current within preset limits. The current setting can be varied by varying the shunt resistance.

2) **How do you provide & maintain correct tension of new ‘V’ belts on bogie transom mounted alternator of non-AC coaches?**

**Ans:**

1. Provide alternator on the bogie
2. Provide axle pulley on the wheel.
   
   (3) Provide ‘V’ belt of matching set between grade 48 & 52 on wheel axle, on which, the axle pulley is provided.
3. After lowering and completion of buffer head adjustments of bogie, provide ‘V’ belts over alternator and the axle pulley.
4. After completion of provision of V belt, remove the split pin check nut and barrel bush (pipe) of free end side tension device.
5. Free the check nut and fixing nut of ‘U’ Clamp side of tension device and
6. Now insert the tension device assembly between the bogie supporting bracket and Eye (leg) of the alternator.
(8) Provide belt for ‘U’ Clamp of tension rod and eye of the alternator.
(9) Provide bush(pipe) and check nut at free end to hold the tension device firmly.
(10) Then slowly tighten the fixing nut(U clamp side) until the tension in V-belts coincide with the spring tightening caller. Found correct as per 4 Kg weight and steel rule procedure.
(11) Then adjust the gap between coach bracket bush(pipe) caller leaving a gap of 50mm for AC coaches and 35mm for non-AC coaches. Now lock the bush with check nut and provide split pin.
(12) Then observe the tension of belt. Remember that always tightening and loosening of belts will be done with nut provided near the fort eye of alternator only. Never use bush nut provided at free end of tension device for tightening and loosening of belts.

3) How do you avoid phases/field wires cut/burnt in TL alternators?
Ans:
(a) Use of cleats on the terminal box of 4.5 KW alternator.
(b) Use of Nylon/Rubber grommets in place of cable glands.
(c) Proper clamping/cleating of cable to the junction box on the coach body.
(d) Use of U type washer & spring washer to prevent level movement of sockets as well as loosing of sockets.
(e) Use of proper crimping tool and sockets by the staff
(f) Provision of Terminal Box cover in all the alternators.
(g) Setting the current controlling shunt to rated value of current to avoid overloading in the RRU Box.
(h) Avoid running the alternators in service with separately exciting the filed as it will generate uncontrolled voltage and current. Only in emergency it is allowed.
(i) Avoid running of alternators with defective regulator, as it will cause heavy over loading on phase/field winding of alternator.
(j) Using proper HRC fuse instead of thick wire in phase/field.

4) DC supply is not available for alternator. What may be the reasons? Or No generation from the alternator. What may be the reason?
Ans:
a) No residual magnetism.
b) Field winding may be open/short/burnt.
c) Field wires coming from RR unit open/short.
d) Free wheeling diode may short.
e) Gain winding may be open.
f) Field diodes may be open/short.
g) ET Primary/secondary may be open/short.
h) MA load windings may be open/short.
i) Field fuse may be blown/open.
j) Main fuse may be blown/open.
k) Alternator 3 phase winding open/short/burnt.
l) Alternator leads going to RR unit may open/short.
m) Zener diode/shunt diode may be short.
n) Voltage/current sensing circuits defective.
o) Control voltage may available at MA , control windings.
p) Field supply is not available.
q) Field wires are connected in reverse.
r) Power rectifier defective.
s) Power rectifier circuit is defective.

5) What are the advantages of ERRU?
   Ans:
   (1) Control circuit is Modular type design.
   (2) Auto identification of alternator ratings and indications.
   (3) Auto setting of parameter of voltage, load current, battery current, over voltage and current limited for the regulators of 4.5 KW, 18 KW and 25 KW.
   (4) UVC is interchangeable with all types of electronic regulators from 4.5 KW to 25 KW.
   (5) Close regulation of voltage +/-2V over the entire range of load and speed to have uniform charging of batteries.
   (6) Less voltage end current ripple on battery charging current.
   (7) Controlled battery charging current to have longer life of batteries.
   (8) Moulded Hall sensors for current sensing and setting current limit.
   (9) Static over voltage protection and latching without battery.
   (10) Isolated power packs directly mounted on the heat sinks to have better heat dissipation.
   (11) Moulded PCBs to avoid dust and vibration problems.
   (12) Separate interface unit for monitoring the parameters like DC Voltage, DC Current, Battery charging and discharging currents, Amps Hours etc.
   (13) This interface facilities to store AH.IN and AH.OUT generation and non-generation time, total distance travelled by coach and faults occurred in the regulator.
   (14) This interface also has Emergency unit. In case of failure of one control unit, the other control unit will take care of both regulators.

6) Write about UVC (Universal Voltage Controller)
   Ans:

**UNIVERSAL VOLTAGE CONTROLLER (UVC):** This is an electronic controller unit having microprocessor/micro-controller/PWM controller which is common for all ratings ie., 25 KW/18 KW & 4.5 KW of alternators and respective ERRU having different power circuits. UVC should be able to identify the rating of the alternator and automatically adjusting the setting parameter as per this specification according to the rating of the alternator and battery.

The UVC controls the field current to maintain the set output voltage of the alternator. The field circuit is provided with IGBT. The gate of the IGBT is controlled by micro-controller,
which is programmed with all data as per the requirements of the specification. UVC gets the power from power supply modular.

Universal Voltage Controller shall be equipped with micro processor / micro controller/PWM controller to meet the various requirements laid down. Wherever possible adequate design redundancy to take care of controller failure from total system failure/hanging. The design of every UVC shall have provision to ensure proper load sharing between two alternators provided on the same AC coach and the difference of load sharing shall not be more than 10A enabling to achieve high reliability of alternators avoiding continuous overloading of one alternator. There shall able be a provision of communication between two ERRU running in parallel. The UVC of ERRU of different rating ie., 4.5 KW and 25 KW shall have universal application with a common design to achieve inter changeability among the same make.

The manufacturer shall have to declare their design and its capacity. The UVC shall be suitable to work with 25 KW & 4.5 KW capacity alternators is the existing field conditions. UVC shall preferably have following features for improving reliability.

- UVC shall preferably equipped with minimum of 16 bit industrial micro process / micro controller with built in USB and PWM control ports.
- No through hold type of micro processor / micro controller should be used for high reliability.
- External programme memory should not be used with micro processor / Imicro controller for highest reliability of memory fetching.
- The PCB design of UVC shall be done only on single card to eliminate the inter connection between PCB and easy service on card replacement basis.
- Only sealed membrane key pads should be used alongwith UVC for highest reliability.
- The discrete power supply for powering the UVC micro processor/ micro controller must be electrically isolated from coach battery DC power. Following indication shall be available on UVC/display unit in case of 4.5 KW whereas for 25 KW ERRU UVC and CIP.
- Capacity of alternator.
- Healthness of UVC.
7) Explain working principal of HMTD ERRU?

Ans:

For easy understanding the circuit was divided into five circuit. They are power circuit, field circuit, voltage control circuit, current sensing circuit, over voltage protection circuit.

**Power circuit:** This circuit consists of 3 phase alternator, phase fuses, 3 phase bridge rectifier, filter circuit, hall sensor for total load and battery load. Phase fuses are provided in V and W phases. Hall sensor H₁ is provided for battery load.

**Working:** 3 phase supply produced by the alternator is fed to 3 phase bridge rectifier through fuses. DC supply produced by the bridge rectifier is filtered by the filter circuit C₁ and R. To sense the alternator current hall sensor H₁ is provided in series to the DC positive. To sense the battery current hall sensor H₂ is provided in series to the battery positive.

**Field circuit:** It consists of field transformer, LC circuit, IGBT OVP relay and single phase bridge rectifier and field fuse FD. The DC supply required for field excitation is drawn from one phase of alternator and rectified by single phase bridge rectifier. This field supply is controlled by IGBT and UVC. The UVC controls the field current to maintain the set output voltage of the alternator. The gate of the IGBT is controlled by a micro controller, which is programmed with all data as per the requirements of the specification. The micro controller gets the power and information through A/D converter, multiplexer and isolation amplifier.

**Universal Voltage Control circuit:** Output voltage is controlled by the field excitation in controlled by universal voltage controller. Universal voltage controller controls the field current to maintain the set output voltage of the alternator. To control the output voltage...
IGBT is provided in field circuit as switching device. The gate of the IGBT is controlled with micro controller which is programmed with all data as per the requirement of the specification. The micro controller gets the power and information through the A/D converter multiplexer and isolation transformer.

**Current sensing circuit:** Out put current of alternator is controlled by field excitation. When ever the output current exceeds preset value the micro-controller gives signal to gate of GBT provided in the field circuit. IGBT is fast switching device controls field excitation thereby output current maintained within set limits. Hall Effect sensor is used in this circuit to sense the current flowing in the alternator. This hall sensor is a transformer operating with a balanced magnetic flux principle to measure DC-AC-pulsating current with galvanic insulation between primary and secondary circuits. The primary current produces a magnetic field, which is detected by a Hall Effect device and via an electronic amplifier, is immediately balanced by injecting an current into the secondary winding. The secondary current thus injected in the exact replica of the primary current times the turns ratio. This closed loop current sensing is fed into the main circuit to limit the output current and protect the equipment from over current. Battery current limit is same as above.

**Over Voltage Protection Circuit:** Static Over voltage protection circuit is provided to stop the generation in case of any fault of the components and cause over voltage. As the voltage goes beyond 142 volts for more than 3 seconds the OVP circuit immediately reduces the field current and latches the output voltage at less than 90 Volts. This latching remains even without battery. The OVP users a sensing circuit for sensing the output voltage. The senses voltage is fed to a comparator, electronic relay and a delay circuit. When the voltage exceeds the set value, the delay circuit switches on and the comparator gives a pulse to an electronic relay connected in series with the field circuit. The opening of electronic relay prevents the output voltage of regulator from rising, above the set value of 142V. After a pre-set delay time, the signal is latched and the field current is not allowed beyond a level to generate only the latched voltage of 80 to 90 Volts. As and when the fault is removed from the circuit the OVP automatically isolates itself or the latching can be removed through a reset switch provided in the circuit. Micro controller gets power supply from SMPS.

8) **How do you conduct temperature rise test on alternators with ERRU?**

**Ans:**

The temperature rise test shall be conducted with the same capacity alternator and rectifier cum regulator with universal voltage controller, with forced air cooling of 6m/sec. for regulator. The temperature rise test shall be conducted on ERRU in conjunction with alternator of different capacities at MFO and at 2500 rpm speed at rated capacity until the body temperature of alternator gets stabilized as evident from three consecutive readings of frame temperature at half an hour interval. The air velocity at location where the alternator and ERRU are to be located for tests shall be adjusted as mentioned above. For 25 KW after each temperature the test in MFO and 2500rpm speed, one hour over load test shall be conducted at 222 Amps. While conducting acceptance test, in case of 24 KW ERRU, only at 2500 rpm at rated output and one hour overload test at 222A shall be conducted whereas temperature rise test in case of 4.5 KW only at 2500rpm at rated condition shall be conducted.
<table>
<thead>
<tr>
<th>Capacity KW</th>
<th>Maximum speed rpm</th>
<th>Minimum speed rpm</th>
<th>Rated voltage in volts</th>
<th>Rated Current Amps</th>
<th>One Amps</th>
<th>O/L Amps</th>
</tr>
</thead>
<tbody>
<tr>
<td>25KW</td>
<td>2500</td>
<td>MFO</td>
<td>130</td>
<td>193</td>
<td></td>
<td>222</td>
</tr>
<tr>
<td>18KW</td>
<td>2500</td>
<td>MFO</td>
<td>130</td>
<td>138.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.5 KW</td>
<td>2500</td>
<td>MFO</td>
<td>120</td>
<td>37.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Alternator frame temperature, terminal /board(T.B) side and non terminal board (N.T.B) side bearing temperature shall be recorded for every one hour upto four hours and thereafter for every half an hour readings shall recorded. Three consecutive half an hour readings indicate stabilization of the body temperature. Bearing temperature shall not be exceed 100 deg.C

The temperature rise of the stator and field winding shall not exceed the RDSO approved value for the respective capacity alternator.

In regard to ERRU equipment, the temperature rise of main diodes Hall Sensors, HRC fuses, bleeder resisters, current transformers, bus bars, etc. shall be less then designed temperature limits of each component under worst operating conditions. The tem. Rise of electronic devices being used in UVC ie., IGBT, Auxiliary diode, Auxiliary power supply module etc. shall not increase more than 30 deg. C above the ambient of 55 degree C. Inside ambient of the UVC Box shall also be recorded and it shall not be exceeding 30.

The temperature rise of power diodes, ISO-Packs, Hall Sensors, Excitation Transformer, (if used), bus-bars, etc. shall not be more than 50 deg. C above the ambient of 55 deg. C. The tem. Rise of fuse, terminal posts of ERRU shall not be abnormally high. There shall be consistency in the quality during ot production of the equipment where by achieving consistency bin various test parameters such as regulation, tem. rise, etc.

9) How do you conduct OVP and surge protection test on alternators with ERRU?
Ans:
There shall not be any nuisance tripping under “NO LOAD” due to no load voltage. OVP circuit shall not trip at OA load at 800, 1800, 2500rpm. The voltage and status of OVP shall be recorded for these conditions. OVP circuit shall also net trip at the surge voltages. The surge test shall be conducted with and without battery with “FULL LOAD” at 800, 1800, 2500 rpm.

The test shall be carried out with MCCB connected in DC output circuit to have consistency in tripping time while blowing on/off the load during the above conditions.

The test shall be conducted as under:

The full load current shall be thrown off to OA at the above mentioned speeds.
The full load current shall be thrown off retaining base load, at the above mentioned speeds. Output voltage of the alternator shall not rise beyond 400V at base load and shall drop to normal value in less than 5 sec.
Full load shall be put on ERRU at the above mentioned speeds.
The output terminal surge voltage rise and dip voltage along with respective transient times shall be recorded using digital storage oscilloscope having suitable interface with printer/PC for downloading the voltage and current waveforms and its measurements. OVP circuit shall protect the ERRU when the control circuit is opened/defective leading to generation of excessive DC output voltage.

OVP circuit shall latch before the DC output voltage reaches s145 volts.

The circuit may be provided with certain time delay in its operation time in such a way to avoid nuisance tripping during surge voltages but also ensuring safe and reliable working of the ERRU without getting damaged.

The control circuit shall be opened with base load, half load and full load at 800, 1600 & 2500 rpm.

During the test, the status of OVP circuit (latched or not latched) shall be recorded.

The output terminal surge voltage rise and dip voltage along with respective transient times shall be recorded using digital storage oscilloscope having suitable interface with printer/PC for downloading the voltage and current waveforms and its measurements.

10) Explain the following:
   a) Over current (Short circuit) protection test on alternators with ERRU.
   Ans: Short the DC+ DC- and BCC terminals at the Rectifier Regulator output. Run the alternator at.

11) Explain the following:
   a) What do you know about coding (grading) system of V belt?
   Ans: If the actual pitch length of the belts is equal to nominal pitch length + 1.00 mm, the belts shall be given the coding number as 50. One unit shall represent a deviation of 2.0 mm in length and the coding number will increase or decrease as the length is more or less. If the coding number is printed on belt is 50 means the actual length of the belt is equal to pitch length + 1mm. Actual pitch length of V belts C122 is in the range of 3154 mm to 3156 mm then the coding number is 50. If actual pitch length of VB belt c122 is in the range of 3156 and 3158 mm, then the coding number will be 51. If actual length of V belt C122 is in the range of 3158 mm to 3160 mm, then the coding number will be given 52. If actual pitch length of ‘V’ belt C3156 is in the range of 3154 mm to 3152 mm then the coding number is 49. If actual pitch length of V belt C122 is in the range of 3152 and 3150 mm then coding number will be 48.

Ans:

- Tensioning gear consists of tensioning rod, ‘U’ clamp, nut and check nut of ‘U’ Clamp side, spring
- Tighten collar spring tension indicator free ends side nut check nut and split pin.
- Tensioning rod play a vital rod for tightening or loosening of ‘V’ belts.
- If the rod moves towards the alternator from the bracket, alternator moves away from the axle pulley and belts are tightening. If the tension rod moves towards the bracket from the alternator the belt is loosened.
- Moving of the tension rod is due to tightening or loosening of spring collar nut, if the spring is tightened the tension rod moves away from the bracket.
- While tightening ‘V’ belt if the spring tightening collar nut is loosened, the tensioning rod moves towards the bracket from the alternator and ‘V’ belt are loosened.
- Free end side nut should not be used for tightening or loosening the ‘V’ belts.

13) What are the “Dos and DON’T’s for V Belt for AC/Non-AC coaches?

ANS:

A. Dos.
   (1) Use belts of the same length (i.e. grade) for a set.
   (2) Belts should be stacked in lots as per date of receipt and the principle of first in first out should be adopted. The belts should be stored in a well ventilated room free from direct sunlight and moisture.
   (3) Ensure correct belt tension (for 18 KW alternators – 330Kg, and for 4.5 KW alternators 105 Kg.). The tolerance in tension is +5 Kg, in both cases.
(4) Re-tension newly fitted belts after first trip or 300 kms. Run whichever is convenient.

(5) Maintain a gap of about 75 mm and 55 mm between supporting plate and fixing nut on the free end of tension rod or up to the split pin for AC coaches and non-AC coaches respectively.

(6) Maintain proper alignment between axle pulley and alternator pulley.

(7) Replace pulleys with worn-out grooves i.e., 0.8 mm depression on sides and bottom of groove is uniformly shining surface.

(8) Form grades of the belts, received from the supplier after checking on belt measurement gadget. The grading of belts fitted should be between 48 to 52 only.

B. Don’ts

(1) Do not allow loose belts.

(2) Do not disturb the nut and check nut on free end of tension rod if proper gap is available between supporting plate & fixing nut.

(3) Do not use repaired pulleys.

(4) Do not use old and new mixed belts.

(5) Belts should not have any oil or grease traces. If persists, clean it by soap & water.

(6) The matched set should have belts of one manufacturer only. Do not use belts of same grade of different manufacturer in a set.

(7) Do not try to cut tension rod of V belts drive, when it is in full tension.

(8) Do not try to remove or replace tensioning device or V belts with out pit.

14) How do you carry out initial charging of TL cells?

Ans:

(a) As per the SMI No.RDSO/TL/SMI/14, dt.16.02.1993.

INSTRUCTIONS

a. Remove the filling plugs and fill the cells with previously prepared and cooled electrolyte to the specific gravity recommended by maker for each make and type of cells till the lower marking on the float guide is visible. It is usually 1.200

b. Allow the cells to rest for a period of 12-16 hours.

c. During the rest period if there is fall in electrolyte level, restore it with some more electrolyte now the cells are ready for 1st initial charge.

d. Select the recommended initial charge current recommended by maker it is usually 1/30th of capacity.

e. Now select a DC source to obtain initial charging current and charge the cells for a period of 80 hours. Care shall be taken that the temperature exceeds 50 degree C.

f. While charging, there will be some fall in the level of electrolyte due to gassing. Restore the level by required quantity of distilled water.

g. After the initial charging, Keep the battery on rest for a period of 12 hours.

h. After the rest period. Connect cells/battery to a load and adjust the discharge current to 1.10th of the capacity. Continue the discharging till the cell and battery voltage is
1.8V/cell, the product of time of discharge and rate of discharge shall not be less than 85% of the battery capacity at 10 hours rate.

i. Again connect the battery to DC source and charge the battery at normal rate i.e. 1/10th of the capacity for 10 hours.

j. After 10 hours of charge, the cell attains a voltage of 2.4 V reduce the charging rate to 1/20th of the capacity and continue charging for the period such that the total charging period becomes 15 hours. During this period adjust the specific gravity of electrolytic to the final specific gravity of electrolytic to the final specific gravity value recommended by the maker. It is usually 1210 to 1220.

k. After the above period the battery will be fully charged which will be indicated by

   (a) Gas is freely evolved in every cell.
   
   (b) The Voltage and specific gravity of electrolyte will remain will be indicated by readings.

l. The cells/battery is now ready for installation on Railway Coach.

(Ans) (b) As per the SMI No.RDSO/TL/SMI/14, dt.16.02.1993.

INSTRUCTIONS

l. Remove the filling plugs and fill the cells with previously prepared and cooled electrolyte to the specific gravity recommended by maker for each make and type of cells till the lower marking on the float guide is visible. IT is usually 1.200

m. Allow the cells to rest for a period of 12-16 hours.

n. During the rest period if there is fall in electrolyte level, restore it with some more electrolyte now the cells are ready for 1st initial charge.

o. Select the recommended initial charge current recommended by maker it is usually 1/30th of capacity.

p. Now select a DC source to obtain initial charging current and charge the cells for a period of 80 hours. Care shall be taken that the temperature exceeds 50 degree C.

q. While charging, there will be some fall in the level of electrolyte due to gassing. Restore the level by required quantity of distilled water.

r. After the initial charging, Keep the battery on rest for a period of 12 hours.

s. After the rest period. Connect cells/battery to a load and adjust the discharge current to 1.10th of the capacity. Continue the discharging till the cell and battery voltage is 1.8V/cell, the product of time of discharge and rate of discharge shall not be less than 85% of the battery capacity at 10 hours rate.

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of the capacity and continue charging for the period such that the total charging period becomes 15 hours. During this period adjust the specific gravity of electrolytic to the final specific gravity of electrolytic to the final specific gravity value recommended by the maker. It is usually 1210 to 1220.

v. After the above period the battery will be fully charged which will be indicated by
    (c) Gas is freely evolved in every cell.
    (d) The Voltage and specific gravity of electrolyte will remain will be indicated by readings.

II. The cells/battery is now ready for installation on Railway Coach.

15) Explain the following:
   a) normal charge
   (Ans) Normal charge is used to recharge the cells after discharge.
   Normal charge is, charge the batteries with a current equal to the 1/10\textsuperscript{th} of the rated capacity of cell. When the voltage reaches 2.4 volts/cell, reduce charging current 1/20\textsuperscript{th} of the rated capacity until the cells are fully charged and its voltage and SPGR remain constant for 3 hours.
   
   EX: - Normal charge of 120 AH battery is equal to 120 divided by 10 =12 amps.
   
   b) boost charge
   Under certain conditions the battery may be required to be given a quick charge. In that event charging at high rate of current for a short time may be restored to. However when cell voltage reaches 2.4 volts the current must be brought down to the finishing rate. Such a charging is known as boosting. Temperature is very important in this high rate of charging. Normally boost charge will be 2 times normal charging of 1/5\textsuperscript{th} of capacity. Finishing rate will be 1/20\textsuperscript{th} of the battery capacity
   
   c) trickle charge
   Trickle charge is a continuous charge at low rate sufficient to compensate for the internal losses of the battery, there by maintaining the battery in fully charged condition

16) What are the general precautions to be taken while using lead acid batteries?
   Ans:
   (a) The lead acid battery should not be discharged below 1.8 volts.
   (b) The battery should never be left in a discharge condition.
   (c) The density of the electrolyte should not fall below 1:10 otherwise the lead will tend to hydrate and loose capacity.
   (d) Great care should be taken that the acid used as electrolyte should not contain any Substantial impurity.
   (e) The electrodes should remain completely immersed in electrolyte.
   (f) The cell should be charged at normal rate and temperature below 49\degree C.
   (g) Sparks, fumes must be kept away from the vent of the cell so that the hydrogen and oxygen produced in the cell do not get ignited.
   (h) When not in use, the battery should be fully charged and stored in a cool and dry place.
   (i) The room where the cells are charged should be well ventilated.
   (j) The loss of water due to gassing etc. should be made up with distilled water only.

17) What are the points to be checked on batteries during trip schedule?
To know the condition of cells during Trip Examination some cells in a battery are treated as pilot cells. On arrival of train in the maintenance line, disconnect all inter vehicle connections. Record the specific gravity of pilot cells in each battery. Different cells should be identified as pilot cells every month. The idea of identifying different cells as pilot cells every month is to ensure that true condition of the battery is reflected.

In case of conventional coaches working on 110 V DC system there are two crates with 9 mono block batteries in each battery box. Marking of these cells to indicate pilot cells shall be done as follows.

a. Check the floats of each cell and check for correct electrolyte level and indicated in the float stem, Replace missing/defective floats. In case of low level replenish with distill water. If any cell needs too much water for replenishing, watch for crack in the cells and also checks the voltage on load which should the same make and lug date as close to the one already in the coach.

b. Coaches with discharged batteries which shows less than 100 V on load should be put on charge at double the normal rate of charge and the charging reduced to half the rate of charge as soon as the gassing starts and continued in the specific gravity rises to the fully charged value which should be between 1210 and 1220. Use the battery charging terminals provided in coaches for charging purpose check up correct polarity and connect the charge cables. Use a clip on DC ammeter of 0-25 A range to check up the battery charging current. Note down the rate of charging and the number of hours of charge.

c. Check specific gravity of pilot cells and the total voltage of battery on load at the end of charge and record.

d. Keep micro porous vent plug tight. Ensure that washer is available in micro porous vent plugs.

e. Check all the battery box members for any cracks in the fabricated battery box/cradle and take corrective action.

f. Check for proper fitment of mono block in the battery box ensuring wooden packing pieces.

g. The person in charge of battery maintenance should record all the readings mentioned above in his diary and this information should be transferred to the registered maintained for various trains.

h. Check anti-theft rods and provision of nuts both inside and outside the battery box on either side provide if found missing. See the battery box cover finally after all works are completed.

i. Ensure the cells are properly cleaned.

j. Ensure the water level in all the cells/Mono block is up to the mark and top up the cells with distilled water wherever required.

k. Ensure all micro porous vent plugs and sealed floats guide are properly closed.

l. Check the sp. gravity of cells if it is less than 1200, the battery shall be connected on charge.

m. Measure the load voltage of the cells/mono block if it less than 100 V, identity the low voltage cell and replace if needed.

n. Check the terminations in the fuse and the condition of the fuse.

Check the termination of cable in the under frame link box, for proper condition and attend if needed.

18) Compare between Conventional, LMLA & VRLA batteries.

Ans: Comparison between conventional batteries, LMLA batteries, VRLA Batteries.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Description</th>
<th>Conventional batteries</th>
<th>LMLA batteries</th>
<th>VRLA Batteries</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Container lid made</td>
<td>Hard rubber.</td>
<td>PPCP</td>
<td>PPCP</td>
</tr>
<tr>
<td>02</td>
<td>Positive plate</td>
<td>Lead peroxide</td>
<td>Lead peroxide</td>
<td>Lead calcium tin</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>03.</td>
<td>Negative plate</td>
<td>Spongy lead</td>
<td>Spongy lead</td>
<td>Lead calcium alloy</td>
</tr>
<tr>
<td>04.</td>
<td>Vent plug</td>
<td>Open vent plug</td>
<td>Ceramic vent plug</td>
<td>Not available.</td>
</tr>
<tr>
<td>05.</td>
<td>Float guide</td>
<td>Open float guide</td>
<td>Closed float guide</td>
<td>Not necessary since it is sealed.</td>
</tr>
<tr>
<td>06.</td>
<td>Water topping up</td>
<td>Once in two months</td>
<td>Once in 06 Months</td>
<td>Not necessary since it is sealed.</td>
</tr>
<tr>
<td>07.</td>
<td>Space for storage of electrolyte</td>
<td>Less</td>
<td>More</td>
<td>Quantity of electrolyte requires very less.</td>
</tr>
<tr>
<td>08.</td>
<td>Antimony content</td>
<td>More.(At about 3.5%)</td>
<td>Less (0.8 to2.5%)</td>
<td>Not applicable</td>
</tr>
<tr>
<td>09.</td>
<td>Space from top of</td>
<td>Less (25mm)</td>
<td>More (70mm)</td>
<td>Not applicable</td>
</tr>
<tr>
<td>10.</td>
<td>Codal life</td>
<td>04 years</td>
<td>04 years</td>
<td>04 years</td>
</tr>
<tr>
<td>11.</td>
<td>Electrolyte</td>
<td>Dilute H₂SO₄</td>
<td>Dilute H₂SO₄</td>
<td>Dilute H₂SO₄</td>
</tr>
<tr>
<td>13.</td>
<td>Evolution of gas</td>
<td>More</td>
<td>more</td>
<td>Less</td>
</tr>
<tr>
<td>14.</td>
<td>Evolution of oxygen at</td>
<td>Positive plate</td>
<td>Positive plate</td>
<td>Positive plate</td>
</tr>
<tr>
<td>15.</td>
<td>Evolution of hydrogen</td>
<td>Negative plate</td>
<td>Negative plate</td>
<td>At Negative plate reacts with oxygen and becomes water.</td>
</tr>
<tr>
<td>17.</td>
<td>Sealing of Container and cover</td>
<td>Bitimus compound</td>
<td>Hermetically sealed</td>
<td>Hermetically sealed</td>
</tr>
<tr>
<td>18.</td>
<td>Cost</td>
<td>Less</td>
<td>Less</td>
<td>More</td>
</tr>
<tr>
<td>19.</td>
<td>Charging</td>
<td>Robust for charging</td>
<td>Robust for Charging</td>
<td>Sensitive for charging.</td>
</tr>
<tr>
<td>20.</td>
<td>Float charging voltage</td>
<td>2.30V/cell</td>
<td>2.30V/Cell</td>
<td>2.25/Cell</td>
</tr>
<tr>
<td>21.</td>
<td>Terminal or boost charging</td>
<td>2.35V/Cell</td>
<td>2.35V/Cell</td>
<td>2.3V/Cell</td>
</tr>
</tbody>
</table>
19) What are the features effecting the shelf life of a lead acid battery?
Ans:
Batteries will slowly discharge during storage must be so located that they can conveniently reached for recharging without moving newer batteries away. Besides, the grid framework of plats is cast from an alloy of antimony and lead, containing upto 4-6% antimony ( the antimony content of the grid is generally less in the present day batteries). During charging of a battery, some antimony dissolves from the positive plate and deposits on the sponge lead of the negative plates, where it sets up a local electromechanical action with the sponge lead. This slowly discharges the negative plate by the creation of local action, promoting self discharge and contributes thus to poor wet battery shelf life. The rate of this self-discharge increase with increases in the antimony content of the positive grids and owing also to other factors. The presence of small quantities of other impurities may affect either the positive plates or the negative plates or both. The shelf life of the battery is also affected by the temperature of the ambient and the condition of the state of charge of the battery.

20) How do you identify weak cell in a VRLA battery?
Ans: SMI No RDSO/PE/TL/0002-98(Rev.O)

**IDENTIFICATION OF WEAK CELL:**
Identification of the cells shall be carried out in two stages i.e., stage-I and Stage-II. These are as under:

2.1 **Stage-I**
(1) Charge the battery set at the following rates:
(a) 120 Ah at 2.3 VPC with current limit of 24 AMPS for 12 hrs duration.
(b) 1100 Ah at 2.3 VPC with current limit of 220 AMPS. 12 hrs duration.
(2) Keep the batteries set in open circuit condition for a period from 2 to 3 hours and average voltage.
Per cell 0.1 volts, such a cell shall be deemed as a weak cell.

2.2 **Stage-II**
Discharge the battery with full load i.e. both AC plants working along with light and fan load “ON” (and lights and fan load in case of TL Coaches) for 10 minutes.
Measure individual cell voltage. Calculate average cell voltage.
Theory Maintenance and operation manual on TL & AC Equipment
While calculating average cell voltage. Consider only those cells which have its terminal voltage more than or equal to 1.75 volt. The cells having voltage less than 1.75 V and also identified as week cells. During discharge the cells which are found to be having voltages 1.5V or less are called weak cells.

21) Why vent plug / safety valve is required for cell?
Ans:
All lead acid batteries generate gases during operation. To allow for escape of the gases generated, batteries are normally provided with an opening called as vent. The vent port is provided with plugs specially designed to suit the varied requirements of specific application. The primary requirement of the vent plug to allow for free passage of gases generated without any build up of pressure inside the cell/battery. The requirement of the vent plug (safety valve) in a MF-VRLA battery is different from that of a conventional battery. In a MF-VRLA battery, the gasses evolved are not to be allowed to escape freely into the atmosphere but should facilitate for recombination. At the same time, gases should not be allowed to increase the cell pressure beyond a certain level. This requirement is basically to prevent water loss and also to improve the recombination efficiently of MF-VRLA cell/ batteries. For the above reasons vent plug/safety valve is required for cell.

22) How raw water is demineralised in the deminiseralised plant?
Raw water enter into the activated carbon filter removes organic tastes, adours, chlorine and organic matter in the water. Then filtered water enters into the caution exchanger column. it contains caution exchange material which exchanges cautions such as calcium, magnesium and sodium for hydrogen ions to forms the corresponding acids. For example, calcium sulphate in the raw water is converted to sulphur acid and calcium carbonate to carbonic acid or a solution of carbon dioxide in water. This acid water enter Theory Maintenance and operation manual TL & AC Equipment. Into anion exchanger column which contains anion exchange material which acts as an acid absorber, removing the acid formed by the caution exchanger material and producing water which is sensibly free from dissolved solids. For best quality of DM water this water again. Sent to mixed bed which contains caution and anion exchange material. In this bed the water is once again demineralised for best quality of water whose conductivity is less than one micro slemens/CM. Mixed bed is polishing unit. The other way of explanation that, the filtered water id first treated in hydrogen caution exchange column in which the main mass of cations and others are removed (retained) and replaced by the cation hydrogen. After this, water mainly contains anions, and it is directed to anion exchanger column in which the column built up of anion exchange material that retains all anions of strong acids and release hydroxyl ions. The Displaced hydrogen and hydroxyl ions combine to form water.

23) What is the precaution to be taken while back washing the DM plant?
1. IT should be remembered that anion exchanger and cation exchanger columns should not backed with raw water. For anion exchanger column, cation
exchanger outlet water should be used for back washing. For cation exchanger column, filter outlet water to be used.

2. The back washing of mixed bed unit must be done when mixed bed unit required regeneration.

3. During back washing care should be taken to see that the filling materials are not washed out of the column.

4. Back washing for bed separation must be carried out when the cation and anion exchange resins are in exhaust condition. If they are in exhausted, it must be necessary to exhaust the resins by passing filtered water for few hours.

24) Why the conductivity test is important for treated water of DM plant?
The specific conductance of water is a measure of the ability of water to conduct an electric current. The conductivity test is important as a direct measure of the total ionisable solids in the water. If the water contains ion, the water becomes a better conductor of electricity and conductivity increases. Conductivity increases. Conductivity is a measure of total ionic concentration. It therefore gives an indication of quality of de-mineralized water, conductivity test is an exceedingly sensitive test and is accurate don to the level of approximately 0.5 -1.0PPm, ionisable solids. The electrical conductivity which is conventionally expressed in micro siemens/ cm or micro ohms/cm.

25) Explain how to test Stone India Limited (SIL) make OVP in 4.5kw regulator. Indicate equipments used with a diagram.

Following points for testing of OVP in 4.5kw regulator of make M/s. Stone India Limited (SIL):

- Connect DC(+) ve & DC(-) ve output terminals of the test unit to the DC(+) ve & DC(-) ve terminals to OVP.
- Connect DC(+) ve output terminals of the test unit to the U terminals of OVP.
- Connect F(+) ve & F(-) ve of the test unit to the F(+) ve & F(-) ve terminals of OVP.
- Switch ‘ON’ the test unit.
- Rotate slowly the Regulator knob clockwise in test unit until the voltmeter reads 116/119 volt AC and wait for a short time until OVP trips and Buzzer sounds. This shows that OVP is healthy.
- Test voltage for OVP: Relay interlock- SHUNT, Test voltage – 116/119V AC.
VII. HINDI OBJECTIVE QUESTIONS:

Multiple choice questions:-

1. Electricity
(a) बिजली (b) टिकाक्ष (c) प्रकाश (d) कमाई

2. Alternate Current
(a) बिजली कर्ण (b) वैकल्पिक कर्ण (c) सीधा कर्ण (d) वर्तमान कर्ण

3. Direct Current
(a) वैकल्पिक कर्ण (b) बिजली कर्ण (c) सीधा कर्ण (d) वर्तमान कर्ण

4. Temperature
(a) तापमान (b) ऊपर (c) तार (d) सामान

5. Accidents
(a) अघित (b) घटना (c) अपसामान्य (d) दुर्घटना

6. Stores
(a) भंडार (b) सीधा (c) अनाज (d) पोटली

7. Danger
(a) क्रोध (b) खलनायक (c) खतरा (d) भय

8. Fire
(a) धुआं (b) अग्नि (c) शान्त (d) ऊष्मा

9. Heat
(a) आग (b) शीतल (c) ठंडी (d) गरमी

10. Work
(a) कामगार (b) कार्यालय (c) कानून (d) काम

Choose the correct answer:-

1. मात्री
(a) Passenger (b) Traffic (c) Transport (d) Train
2. बिजली
   (a) Sunlight
   (b) Electricity
   (c) Current
   (d) Heat

3. गाड़ी
   (a) Coach
   (b) Depot
   (c) Rake
   (d) Train

4. कार्यालय
   (a) Office
   (b) Department
   (c) Chamber
   (d) Rest Room

5. पंखा
   (a) Tube light
   (b) Cable
   (c) Fan
   (d) Cooler

6. दुर्घटना
   (a) Party
   (b) Accident
   (c) Meeting
   (d) Inspection

7. अनुरक्षण
   (a) Cleaning
   (b) Working
   (c) Washing
   (d) Maintenance

8. गाड़ी प्रकाश
   (a) Air-Condition
   (b) Safety
   (c) Comfortable
   (d) Train Lighting

9. तापमान
   (a) Temperature
   (b) Telegram
   (c) Heat
   (d) Weather

10. कर्मचारी
    (a) Staff
    (b) Farmer
    (c) Teacher
    (d) Officer

V (iii) Abbreviations:-

1. GM जी.एम.
   - महाप्रबंधक
2. DRM संग्रही
   - मंडल रेल प्रबंधक
3. Sr.DPO चर्माकारी
   - वरिष्ठ मंडल कार्यकारी अधिकारी
4. Sr.DEE चर्मविचारी
   - वरिष्ठ मंडल विद्युत इंजीनियर
5. JE कांडी
   - कनिष्ठ इंजीनियर
(iv) Meanings:

<table>
<thead>
<tr>
<th>No.</th>
<th>English</th>
<th>Hindi</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gazette</td>
<td>राजपत्रित</td>
</tr>
<tr>
<td>2</td>
<td>Technician</td>
<td>यंत्रविद्</td>
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<tr>
<td>3</td>
<td>Complaint</td>
<td>आरोप</td>
</tr>
<tr>
<td>4</td>
<td>Inconvenience</td>
<td>असुविधा</td>
</tr>
<tr>
<td>5</td>
<td>Smoke</td>
<td>धुआं</td>
</tr>
<tr>
<td>6</td>
<td>Festival</td>
<td>त्योहार</td>
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<td>7</td>
<td>Holiday</td>
<td>छुट्टी</td>
</tr>
<tr>
<td>8</td>
<td>Absent</td>
<td>गैरहाजिर</td>
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<tr>
<td>9</td>
<td>Danger</td>
<td>खतरा</td>
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<td>10</td>
<td>Master</td>
<td>प्रधान</td>
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<td>11</td>
<td>Responsible</td>
<td>जिम्मेदार</td>
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<td>राष्ट्र</td>
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<td>Accounts</td>
<td>लेखा</td>
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<td>14</td>
<td>Department</td>
<td>विभाग</td>
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<tr>
<td>15</td>
<td>Personnel</td>
<td>कार्यकर्म</td>
</tr>
</tbody>
</table>

(v) Short Answer Questions:

1) When an employee is deemed to possess proficiency in Hindi?
   Ans: The employee is deemed to be proficiency in Hindi
   a) if he has passed Metric or equivalent or higher examination with Hindi as medium
   b) if he took Hindi as an elective subject in a Degree or Equivalent or higher examination
   c) If he declares that he possess proficiency in Hindi

2) When an employee is deemed to have acquired working knowledge of Hindi?
   Ans: An employee is deemed to have acquired working knowledge of Hindi
   a) if he has passed Metric or equivalent or higher examination with Hindi as subject
   b) If he has passed Pragya examination under government’s Hindi teaching scheme
   c) Other examinations specified by the government
   d) if he declares that he has acquired a working knowledge of Hindi

3) What incentives are given for passing various Hindi examinations?
   Ans: Passing of Prabodh --- Rs.250/-
   Praveen --- Rs.250/-
<table>
<thead>
<tr>
<th>Course</th>
<th>Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pragya</td>
<td>Rs.300/-</td>
</tr>
<tr>
<td>Hindi Typewriting</td>
<td>Rs.150/-</td>
</tr>
<tr>
<td>Hindi Stenography</td>
<td>Rs.300/-</td>
</tr>
<tr>
<td>Other Hindi examinations</td>
<td>Rs.300/-</td>
</tr>
<tr>
<td>Conducted by voluntary</td>
<td></td>
</tr>
<tr>
<td>bodies</td>
<td></td>
</tr>
</tbody>
</table>

Those passed with 60% or above will be given an increment. Special casual leave may be granted for appearing to such examinations.

4) **What is the importance of Hindi Divas?**

   Ans: 14<sup>th</sup> September is celebrated as Hindi Day because the constitution Assembly of India had adopted in Devanagari script as the official language of the union on that day.

5) **Which is the official language of government of India and what is its scripts & minerals prescribed?**

   Ans: As per Article 343 of constitution of India, Hindi in Devanagari script is the official language of India & the international form of Indian numerals are prescribed for Official language.

6) **What are states come under Region “A”, Region “B” & Region “C”?**


   Region-B: Gujarat, Maharashtra & Punjab, Union territories of Chandigarh.

   Region-C: All states & Union territories other than region “A” & “B”.


# Industrial Electrical Symbols

<table>
<thead>
<tr>
<th>DISCONNECT</th>
<th>CIRCUIT INTERRUPTER</th>
<th>CIRCUIT BREAKER WITH THERMAL OL</th>
<th>CIRCUIT BREAKER WITH MAGNETIC OL</th>
<th>CIRCUIT BREAKER WITH THERMAL AND MAGNETIC OL</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Symbol" /></td>
<td><img src="image2" alt="Symbol" /></td>
<td><img src="image3" alt="Symbol" /></td>
<td><img src="image4" alt="Symbol" /></td>
<td><img src="image5" alt="Symbol" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LIMIT SWITCHES</th>
<th>FOOT SWITCHES</th>
<th>PRESSURE AND VACUUM SWITCHES</th>
<th>LIQUID LEVEL SWITCH</th>
<th>TEMPERATURE-ACTUATED SWITCH</th>
<th>FLOW SWITCH (AIR, WATER, ETC.)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image6" alt="Symbol" /></td>
<td>NO</td>
<td><img src="image7" alt="Symbol" /></td>
<td><img src="image8" alt="Symbol" /></td>
<td><img src="image9" alt="Symbol" /></td>
<td><img src="image10" alt="Symbol" /></td>
</tr>
<tr>
<td>HELD CLOSED</td>
<td>NC</td>
<td>NC</td>
<td>NC</td>
<td>NC</td>
<td>NC</td>
</tr>
</tbody>
</table>

### Speed (Plugging) and Anti-Plug

**Symbols for Static Switching Control Devices**

Static switching control is a method of switching electrical circuits without use of contacts, primarily by solid-state devices. Use symbols shown in Table and enclose them in a diamond.

- **Input Coil**: ![Symbol](image11)
- **Output NO**: ![Symbol](image12)
- **Limit Switch NO**: ![Symbol](image13)
- **Limit Switch NC**: ![Symbol](image14)

### Selector

#### Two-Position

<table>
<thead>
<tr>
<th>J</th>
<th>A1</th>
<th>A2</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image15" alt="Symbol" /></td>
<td><img src="image16" alt="Symbol" /></td>
<td><img src="image17" alt="Symbol" /></td>
</tr>
</tbody>
</table>

X-contact closed

#### Three-Position

<table>
<thead>
<tr>
<th>J</th>
<th>K</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image18" alt="Symbol" /></td>
<td><img src="image19" alt="Symbol" /></td>
<td><img src="image20" alt="Symbol" /></td>
</tr>
</tbody>
</table>

X-contact closed

#### Two-Position Selector Pushbutton

<table>
<thead>
<tr>
<th>CONTACTS</th>
<th>SELECTION POSITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>FREE</td>
<td>BUTTON</td>
</tr>
<tr>
<td>X</td>
<td>DEPRESSED</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1-2</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-4</td>
<td>X</td>
</tr>
</tbody>
</table>

X-contact closed

### Pushbuttons

#### Momentary Contact

<table>
<thead>
<tr>
<th>SINGLE CIRCUIT</th>
<th>DOUBLE CIRCUIT</th>
<th>MUSHROOM HEAD</th>
<th>WOBBLE STICK</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image21" alt="Symbol" /></td>
<td><img src="image22" alt="Symbol" /></td>
<td><img src="image23" alt="Symbol" /></td>
<td><img src="image24" alt="Symbol" /></td>
</tr>
</tbody>
</table>

NO and NC

<table>
<thead>
<tr>
<th>MAINTAINED CONTACT</th>
</tr>
</thead>
<tbody>
<tr>
<td>TWO SINGLE CIRCUIT</td>
</tr>
<tr>
<td>ONE DOUBLE CIRCUIT</td>
</tr>
</tbody>
</table>

#### Illuminated

<table>
<thead>
<tr>
<th>ILLUMINATED</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image25" alt="Symbol" /></td>
</tr>
</tbody>
</table>

NO and NC
### Industrial Electrical Symbols

#### Contacts

<table>
<thead>
<tr>
<th>Instant Operating</th>
<th>Timed Contacts - Contact Action Retarded After Coil Is:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>With Blowout</strong></td>
<td><strong>Without Blowout</strong></td>
</tr>
<tr>
<td>NO</td>
<td>NC</td>
</tr>
<tr>
<td>ENERGIZED</td>
<td>DE-ENERGIZED</td>
</tr>
</tbody>
</table>

#### Overload Relays

<table>
<thead>
<tr>
<th>Thermal</th>
<th>Magnetic</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="diagram.png" alt="Diagram of Overload Relays" /></td>
<td></td>
</tr>
</tbody>
</table>

#### Supplementary Contact Symbols

<table>
<thead>
<tr>
<th>SPST NO</th>
<th>SPST NC</th>
<th>SPDT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Break</td>
<td>Double Break</td>
<td>Single Break</td>
</tr>
<tr>
<td><img src="diagram.png" alt="Diagram of SPST NO" /></td>
<td><img src="diagram.png" alt="Diagram of SPST NC" /></td>
<td><img src="diagram.png" alt="Diagram of SPDT" /></td>
</tr>
</tbody>
</table>

#### Meter (Instrument)

<table>
<thead>
<tr>
<th>Indicate Type by Letter</th>
<th>To Indicate Function of Meter or Instrument, Place Specified Letter or Letters Within Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM or A</td>
<td>AMMETER</td>
</tr>
<tr>
<td>AH</td>
<td>AMPERE HOUR</td>
</tr>
<tr>
<td>μA</td>
<td>MICROAMMETER</td>
</tr>
<tr>
<td>mA</td>
<td>MILLIAMMETER</td>
</tr>
<tr>
<td>PF</td>
<td>POWER FACTOR</td>
</tr>
<tr>
<td>V</td>
<td>VOLTMETER</td>
</tr>
</tbody>
</table>

#### Pilot Lights

<table>
<thead>
<tr>
<th>Non Push-to-Test</th>
<th>Push-to-Test</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="diagram.png" alt="Diagram of Pilot Lights" /></td>
<td><img src="diagram.png" alt="Diagram of Pilot Lights" /></td>
</tr>
</tbody>
</table>

#### Inductors

<table>
<thead>
<tr>
<th>Iron Core</th>
<th>Air Core</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="diagram.png" alt="Diagram of Iron Core" /></td>
<td><img src="diagram.png" alt="Diagram of Air Core" /></td>
</tr>
</tbody>
</table>

#### Coils

<table>
<thead>
<tr>
<th>Dual-Voltage Magnet Coils</th>
<th>Blowout Coil</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="diagram.png" alt="Diagram of High-Voltage Coils" /></td>
<td><img src="diagram.png" alt="Diagram of Low-Voltage Coils" /></td>
</tr>
</tbody>
</table>
### INDUSTRIAL ELECTRICAL SYMBOLS

#### TRANSFORMERS

<table>
<thead>
<tr>
<th>AUTO</th>
<th>AIR CORE</th>
<th>CURRENT</th>
<th>CONTROL TRANSFORMER</th>
<th>AUTOTRANSFORMER FOR REDUCED-VOLTAGE STARTING</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="transformer-diagrams.png" alt="Transformer Diagrams" /></td>
<td><img src="transformer-diagrams.png" alt="Transformer Diagrams" /></td>
<td><img src="transformer-diagrams.png" alt="Transformer Diagrams" /></td>
<td><img src="transformer-diagrams.png" alt="Transformer Diagrams" /></td>
<td><img src="transformer-diagrams.png" alt="Transformer Diagrams" /></td>
</tr>
</tbody>
</table>

#### AC MOTORS

<table>
<thead>
<tr>
<th>SINGLE-PHASE</th>
<th>SEPARATE PHASE, TWO-SPEED</th>
<th>THREE-PHASE</th>
<th>SEPARATE WINDING, TWO-SPEED</th>
<th>CONSTANT-TORQUE, TWO-SPEED</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="ac-motor-diagrams.png" alt="AC Motor Diagrams" /></td>
<td><img src="ac-motor-diagrams.png" alt="AC Motor Diagrams" /></td>
<td><img src="ac-motor-diagrams.png" alt="AC Motor Diagrams" /></td>
<td><img src="ac-motor-diagrams.png" alt="AC Motor Diagrams" /></td>
<td><img src="ac-motor-diagrams.png" alt="AC Motor Diagrams" /></td>
</tr>
</tbody>
</table>

#### DC MOTORS

<table>
<thead>
<tr>
<th>ARMATURE</th>
<th>SHUNT FIELD</th>
<th>SERIES FIELD</th>
<th>COMM OR COMPENS FIELD</th>
<th>NOT CONNECTED</th>
<th>POWER</th>
<th>Wiring Terminal</th>
<th>Connections</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="dc-motor-diagrams.png" alt="DC Motor Diagrams" /></td>
<td><img src="dc-motor-diagrams.png" alt="DC Motor Diagrams" /></td>
<td><img src="dc-motor-diagrams.png" alt="DC Motor Diagrams" /></td>
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<td><img src="dc-motor-diagrams.png" alt="DC Motor Diagrams" /></td>
<td><img src="dc-motor-diagrams.png" alt="DC Motor Diagrams" /></td>
</tr>
</tbody>
</table>

#### CONTROL AND POWER CONNECTIONS - 600 V OR LESS ACROSS THE LINE STARTERS

<table>
<thead>
<tr>
<th>1φ</th>
<th>2φ, 4-WIRE</th>
<th>3φ</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LINE MARKINGS</strong></td>
<td>L1, L2</td>
<td>L1, L3 PHASE 1, L2, L4 PHASE 2</td>
</tr>
<tr>
<td><strong>GROUND WHEN USED</strong></td>
<td>L1 IS ALWAYS UNGROUNDED</td>
<td>-</td>
</tr>
<tr>
<td><strong>MOTOR RUNNING OVERCURRENT UNITS IN</strong></td>
<td>1 ELEMENT</td>
<td>L1</td>
</tr>
<tr>
<td></td>
<td>2 ELEMENT</td>
<td>L1, L4</td>
</tr>
<tr>
<td></td>
<td>3 ELEMENT</td>
<td>-</td>
</tr>
<tr>
<td><strong>CONTROL CIRCUIT CONNECTED TO</strong></td>
<td>L1, L2</td>
<td>L1, L3</td>
</tr>
<tr>
<td><strong>FOR REVERSING INTERCHANGE LINES</strong></td>
<td>-</td>
<td>L1, L3</td>
</tr>
</tbody>
</table>
## Industrial Electrical Symbols

<table>
<thead>
<tr>
<th>Resistors</th>
<th>Capacitors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fixed</strong></td>
<td><strong>Fixed</strong></td>
</tr>
<tr>
<td><strong>Adjustable by Fixed Taps</strong></td>
<td><strong>Adjustable</strong></td>
</tr>
<tr>
<td><strong>Rheostat, Pot, or Adjustable Tap</strong></td>
<td><strong>Polarized</strong></td>
</tr>
<tr>
<td><img src="image1" alt="Resistor" /></td>
<td><img src="image2" alt="Capacitor" /></td>
</tr>
<tr>
<td><strong>Heating Element</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fuse</th>
<th>Bell</th>
<th>Buzzer</th>
<th>Horn, Siren, etc.</th>
<th>Half-Wave Rectifier</th>
<th>Full-Wave Rectifier</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3" alt="Fuse" /></td>
<td><img src="image4" alt="Bell" /></td>
<td><img src="image5" alt="Buzzer" /></td>
<td><img src="image6" alt="Horn" /></td>
<td><img src="image7" alt="Half-Wave Rectifier" /></td>
<td><img src="image8" alt="Full-Wave Rectifier" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Battery</th>
<th>Thermocouple</th>
<th>Ignitron Tube</th>
<th>Semiconductors...</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image9" alt="Battery" /></td>
<td><img src="image10" alt="Thermocouple" /></td>
<td><img src="image11" alt="Ignitron Tube" /></td>
<td><img src="image12" alt="Diode" /> <img src="image13" alt="Tunnel Diode" /> <img src="image14" alt="Unidirectional Breakdown (Zener) Diode" /></td>
</tr>
</tbody>
</table>

### Semiconductors...

<table>
<thead>
<tr>
<th>Bidirectional Breakdown Diode</th>
<th>Photosensitive Cell</th>
<th>Triac (Bidirectional Triode Thyristor)</th>
<th>Silicon Controlled Rectifier</th>
<th>Programmable Unit - Junction Transistor (PUT)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image15" alt="Diode" /></td>
<td><img src="image16" alt="Cell" /></td>
<td><img src="image17" alt="Triac" /></td>
<td><img src="image18" alt="Silicon Controlled Rectifier" /></td>
<td><img src="image19" alt="Programmable Unit - Junction Transistor (PUT)" /></td>
</tr>
</tbody>
</table>

### Semiconductors

<table>
<thead>
<tr>
<th>Transistor</th>
<th>Unijunction Transistor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PNP Base</strong></td>
<td><strong>NPN Base</strong></td>
</tr>
<tr>
<td><img src="image20" alt="PNP Base" /></td>
<td><img src="image21" alt="NPN Base" /></td>
</tr>
<tr>
<td><strong>P Base</strong></td>
<td><strong>N Base</strong></td>
</tr>
<tr>
<td><img src="image22" alt="P Base" /></td>
<td><img src="image23" alt="N Base" /></td>
</tr>
</tbody>
</table>