ACE
Engineering Academy
Head Office : Sree Sindhi Guru Sangat Sabha Association, # 4-1-1236/1/A, King Koti, Abids, Hyderabad – 500001.
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ESE- 2019 (Prelims) - Offline Test Series Test-7

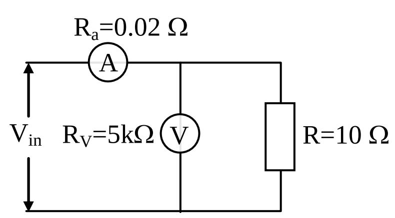
ELECTRICAL ENGINEERING

SUBJECT: ELECTRICAL & ELECTRONIC MEASUREMENTS AND POWER SYSTEMS

Solutions

01. Ans: (c)

Sol: In both given connection methods, error caused by unknown resistance side meter i.e., in connection (a) ammeter and in connection (b) voltmeter.



If unknown resistance, R = $\sqrt{R_a \times R_V}$, the error caused in both methods are equal

Given: R_a = 0.02 Ω

R_V = 5 kΩ

R = $\sqrt{0.02 \times 5k}$ = 10 Ω

R = 10 Ω (given)

Therefore, any of the above two connection, as both of them give equal accuracy.

02. Ans: (b)

Sol: $$K = \frac{\text{rev}}{\text{kWh}}$$

$$600 = \frac{\text{rev}}{\frac{600}{1000} \times \frac{1}{60}}$$

$$\Rightarrow \frac{\text{rev}}{\text{min}} = \frac{600 \times 600}{1000 \times 60} = 6 \text{ rpm}$$

03. Ans: (a)

Sol: In reed type frequency meter, the frequency at which the reeds resonates is twice the input frequency, i.e. if a reed is resonating at 50Hz, then the natural frequency of resonance for the reed is 100Hz. The above explanation holds good only for pure a.c currents. But if the input current has a d.c offset along with a.c component then the reeds resonates at frequency equal to input frequency.

So in the given question it is said that the reed type frequency meter range is 47–53Hz. So the reeds are designed to resonate for frequency range of

(47 × 2 – 53 × 2) = 94 – 106Hz. In the second case when dc bias is provided then the reed type frequency meter responds to input frequency range of 94 – 106Hz.

04. Ans: (c)

Sol: Dynamometer instrument is used as transfer instrument between ac and dc

Thermocouple based instrument is a true rms meter Ramp generator (or) saw tooth generator) is the time base generator in CRO.

Weston standard cell is standard of emf.

05. Ans: (a)

Sol: In 1-ϕ electrodynamometer type pf meter, the values of R and L are so adjusted that the two moving coils carry same magnitude of current R = ωL.

Hence 1-ϕ electrodynamometer type meter indications are dependent on both frequency and shape of wave form (since any waveform other than sinusoidal contains harmonics) and will give rise to serious errors.

But in 3-ϕ electrodynamometer type pf meter, both the moving coils are connected through resistors. Hence in 3-ϕ electrodynamometer type pf meters, the indications are independent of waveform and frequency of supply.

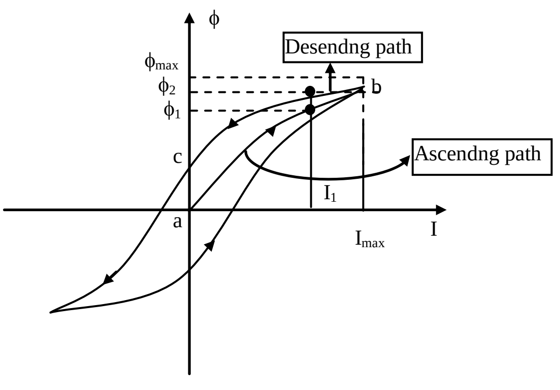
06. Ans: (b)

Sol: Dead zone is defined as the change in the physical variable to which the instrument doesn't respond.

Lag (minimum) is the time required by the instrument to begin to respond to a large in the measurement.

07. Ans: (c)

Sol: In moving Iron type instruments, flux produced due to the current flowing through the instrument don't follow a linear relationship in practical case because of hysteresis.



In ideal case we assume that $I \propto \phi \Rightarrow I = k\phi$

But when hysteresis is taken in account then $I = k\phi$ does not hold true.

In the above figure, when current is increased from 0 to I_{max}, ϕ increases from 0 to ϕ_{max}. But when current is decreasing from I_{max}, ϕ follows a different path along bc. Hence if we look closely, for the same current I_1, flux produced is greater in descending path [$\phi_2 > \phi_1$] and hence it will indicate higher reading.

08. Ans: (c)

Sol: Thermocouple that can measure temperature in the range 1300° C to 1400° C is R type of thermocouple which has range of –50° C to 1768° C. Its composition is 87% platinum, 13% (platinum + Rhodium).

09. Ans: (a)

Sol: (i) Given $T_d = KI$

$T_C = K_1\theta$ for spring control

$T_C = K_2\text{Sin}\theta$ for gravity control

At balance position

For spring:

$T_d = T_C$

$\Rightarrow K_1\theta = KI$

$$\Rightarrow \theta = \left(\frac{K}{K_1}\right)I \Rightarrow \text{linear scale}$$

For gravity:

$T_d = T_C$

$$\Rightarrow K_s\sin\theta = KI \Rightarrow \sin\theta = \frac{KI}{K_2}$$

$$\Rightarrow \theta = \text{Sin}^{-1}\left(\frac{KI}{K_2}\right) \Rightarrow \text{non linear}$$

(ii) Gravity control can be used only in vertically mounted systems.

10. Ans: (b)

Sol: Damping torque $T_D = \dfrac{B^2R^2dbt\omega}{K\rho}$

B = flux density of damping magnets

R = Radius of disc

ω = speed of rotation of the disc

ρ = resistivity of the disc

t = thickness of the disc

11. Ans: (c)

Sol: $r_{sh} = 0.02$ (fixed)

For R = 1000 Ω, full scale deflection (fsd) is obtained for a current of 25 A

$\therefore$ Voltage across the shunt is $V_s = 250\times0.02$
$= 0.5$ V

$\therefore$ Current through the meter for full scale deflection (i) $= \dfrac{V_s}{R} = \dfrac{0.5}{1000} = 0.5$ mA

$\therefore$ i = 0.5 mA

Now it is given that for I = 100 A deflection is 40%

For fsd $I = \frac{100}{40/100} = 250\text{ A}$

$\therefore V_{sh} = I \times R_{sh}$

$= 250 \times 0.02$

$= 5\text{ V}$

$i = 0.5\text{ mA}$

$\Rightarrow R = \frac{V_{sh}}{i} = \frac{5}{0.5\times10^{-3}} = 10^4\ \Omega$

$\Rightarrow R = 10{,}000\ \Omega$

12. Ans: (b)

Sol: A ideal PMMC voltmeter will read average voltage,

for 1-ϕ, half wave voltage controller, output voltage,

$V_0 = \frac{V_m}{2\pi}[\cos\alpha - 1]$

$= \frac{V_m}{2\pi}[-1-1] = \frac{-V_m}{\pi}$

13. Ans: (b)

Sol: Uncertainty distribution is used for analysis of single sample data.

14. Ans: (b)

Sol: The disc should be conducting such that it provided path for eddy currents and at the same time it should be non-magnetic as it should not produce any magnetic field which can affect the working field.

15. Ans: (c)

Sol: $\tan\phi = \sqrt{3}\left[\frac{W_1 - W_2}{W_1 + W_2}\right]$

Reactive power consumed per phase,

$Q = \frac{W_1 - W_2}{\sqrt{3}}$

$Q = \tan\phi\ \frac{W_1 + W_2}{3}$

$= \frac{1}{\sqrt{3}} \times \frac{519}{3} = 100\text{ VAR}$

16. Ans: (c)

Sol: Rayleigh's current balance:

This instrument works on the principle that if a current carrying coil placed with its parallel to that of another current carrying coil with their axes coincident, there will be a force exerted between the coils. This force is proportional to the product of currents in the two coils and if the coils carry same current, the force is proportional to the square of the current. This force can be measured if one of the coils is movable and is suspended.

17. Ans: (c)

Sol: A swamping resistance of manganin having a resistance 20 to 30 time the coil resistance is connected in series with the coil and a shunt of manganin is connected across this combination. Since copper forms a small fraction of the series combination, the proportion in which the currents would divide between the meter and the shunt would not change appreciably with change in temperature.

18. Ans: (c)

Sol: Clamp on meters are used to measure current flowing in a line with out braking the circuit.

19. Ans: (c)

Sol: Phase angle error in current transformer is given by

$$\phi = \frac{I_m \text{Cos}\delta - I_e \text{Sin}\delta}{nI_s} \text{ rad.}$$

For inductive burdens δ is positive.

$\Rightarrow$ ϕ is positive for small values of δ and

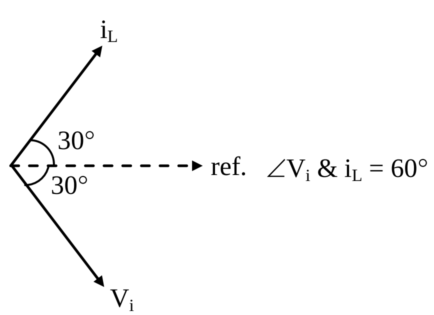
ϕ is negative for large values of δ

For capacitive burdens δ is negative.

$\Rightarrow$ ϕ is positive irrespective of magnitude of δ.

20. Ans: (c)

Sol:



Wattmeter reading,

$W = V_{rms} \times I_{rms} \times \cos\phi$

$= \frac{10}{\sqrt{2}} \times \frac{10}{\sqrt{2}} \times \frac{1}{2}$

$= 25$ W

21. Ans: (d)

Sol: Linear Variable Differential Transformer has one primary and two secondary coils connected in phase opposition i.e., 180° out of phase.

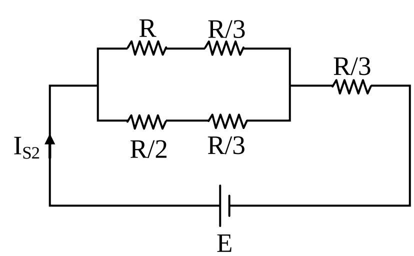
22. Ans: (c)

Sol: At bridge is balanced

$R_{eq} = 2R // \left[R + \left(R // 2R\right)\right] = \frac{10R}{11}$

$I_{S1} = \frac{E}{R_{eq}} = \frac{11E}{10R}$ ……….. (1)

At balanced detector is short circuited



$R_{eq} = \frac{11R}{13}$; $I_{S2} = \frac{13E}{11R}$ ……..…(2)

$\therefore \frac{I_{S1}}{I_{S2}} = \frac{11E}{10} \times \frac{11}{13E}$

$= \frac{121}{130}$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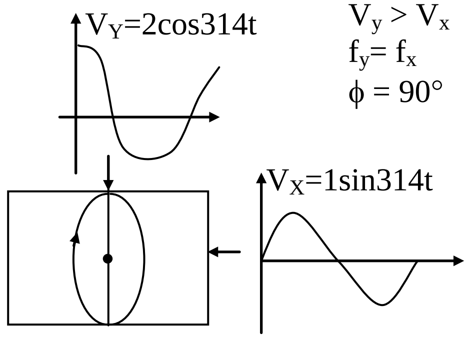
23. Ans: (d)

Sol: The least suitable transducer for static pressure measurement is piezoelectric transducer

24. Ans: (b)

Sol:



Vertical Ellipse

$V_y > V_x$

$f_y = f_x$

$\phi = 90°$

25. Ans:(c)

Sol: $R_{eff} = NR_i = 20 \times 1M\Omega = 20M\Omega$

26. Ans: (b)

Sol: A dual trace oscilloscope usually offers two modes-chop and alternate. Alternate mode is usually used for displaying high frequency wave forms while chop mode is used for displaying low frequency wave forms.

27. Ans: (d)

Sol: $r = \dfrac{200V}{2\times10^4 \text{steps}}$

$= 000.01V$

$= 10 \text{ mV}$

28. Ans: (c)

Sol: We know $T_1 = nTs$............. for noise rejection

$$\Rightarrow 1000\times = \frac{1}{f_{clk}} = n\times\frac{1}{50Hz}$$

$$\Rightarrow f_{lck} = \frac{1000\times50Hz}{n}$$

$$\Rightarrow f_{clk\,max} = \frac{50kHz}{n_{min}}$$

$$\Rightarrow f_{clk\,max} = \frac{50kHz}{1} = 50kHz$$

29. Ans:(a)

Sol: Electronic DC voltmeter (like FET input voltmeter) offers very high resistance and high sensitivity than electronic AC voltmeter (like rectifier AC voltmeter).

30. Ans: (d)

Sol: In full wave rectifier type voltmeter, deflection (θ) $\propto$ Average voltage

$\theta_1 \propto 12$ V

If an ac voltage of 15 V rms voltage is applied, then average voltage is

$$V_{avg} = \frac{1}{\pi}\int_0^{\pi} V_m \sin\theta d\delta$$

$$= \frac{V_m}{\pi}\int_0^{\pi}\sin\theta d\theta = \frac{V_m}{\pi}[-\cos\theta]_0^{\pi}$$

$$= \frac{15\sqrt{2}}{\pi}[2] = \frac{30\sqrt{2}}{\pi}$$

$= 13.5 = 0.9 \times 15$

Usually

$V_{dc} = 0.9\, V_{ac}$ (for a full wave rectifier)

$V_{dc} = 0.9 \times 15$

$V_{dc} = 13.5$ V

$$\frac{\theta_1}{\theta_2} = \frac{12}{13.5}$$

$$\frac{80}{\theta_2} = \frac{12}{13.5}$$

$$\Rightarrow \theta_2 = \frac{13.5 \times 80}{12}$$

$\Rightarrow \theta_2 = 90°$

31. Ans: (b)

Sol: For successive approximation ADC conversion time is same

$\therefore$ Conversion time for 5.1V input = 40μs

32. Ans: (c)

Sol: $\because V_s = AV_R + B\, I_R$

$I_s = CV_r + D\, I_R$

But at no load, $I_R = 0$

$$\Rightarrow V_R = \frac{V_s}{A} = \frac{220}{0.9} = 244.4\,\text{kV}$$

33. Ans: (b)

Sol: $$L_a = \frac{\mu_0\mu_r}{8\pi} + \frac{\mu_0\mu_r}{2\pi}\ln\left(\frac{1}{r}\right) - \frac{\mu_0\mu_r}{2\pi}\ln\left(\frac{1}{d}\right)$$

$L_{self} = L_{self}$ due to $\psi_{int} + L_{self}$ dut to ψ_{ext}

$$= \frac{\mu_0\mu_r}{8\pi} + \frac{\mu_0\mu_0}{2\pi}\ln\left(\frac{1}{r}\right)$$

$$L_{mutual} = L_{\text{mutual due to ext}} = \frac{\mu_0\mu_r}{2\pi}\ln\left(\frac{1}{d}\right)$$

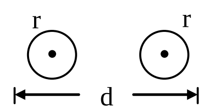
Ans: kH/m

($\because$ 1^{st} term is independent of diameter)

34. Ans: (c)

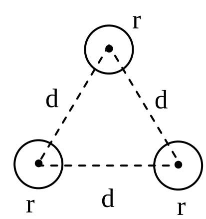
Sol: $D_s = \sqrt[4]{(r'd)(r'd)}$

$= \sqrt{(r'd)}$ ……….. (1)



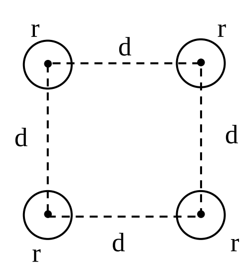
$D_s = \sqrt[9]{(r'dd)(r'dd)(r'dd)}$

$= \sqrt[3]{(r'd^2)}$ ------(2)



$D_s = \sqrt[16]{(r'dd\sqrt{2}d)^4}$

$= \mathbf{10.91}\sqrt[4]{r'd^3}$ -----(3)



35. Ans: (d)

Sol: For DC, insulator capacitances are ineffective and voltage across each unit is same.

36. Ans: (b)

Sol: Surge impedance for a given transmission line is constant and is independent of length of the transmission line and frequency of surge. It depends only on magnitude of inductance/km and capacitance/km.

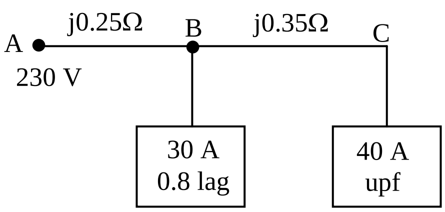
$$\left[\because Z_0 = \sqrt{\frac{\text{Inductance/km}}{\text{capacitance/km}}}\right]$$

37. Ans: (a)

Sol: Corona losses are significantly lower in case of HVDC transmission.

38. Ans: (a)

Sol:



By taking C as reference and neglecting voltage drop in BC

$I_{BC} = 40[1 + j0]$ A

$I_{BC} = 40$ A

$I_{AB} = I_{BC} + 30[0.8 - 0.6]$ A

$= 40 + 24 - j18$

$= (64 - j18)$ A

Voltage drop @ AC is

$V_{AC} = \bar{I}_{AB}\bar{Z}_{AB} + \bar{I}_{BC}\bar{Z}_{BC}$

$= (64 - j18)j0.25 + (j0.35)(40)$

$= 16j + 4.5 + 14j$

$\therefore V_{AC} = 4.5 + 30j$ V

39. Ans: (a)

Sol: By providing series compensation to the line stability gets improved. By providing shunt compensation to the line Ferranti effect can be reduced. By providing shunt compensation line current can be controlled, power loss can be reduced and efficiency can be improved.

40. Ans: (d)

Sol: Capacitance per phase = $3C_C + C_S$

Where C_C = capacitance between any two conductors

C_S = capacitance between any conductor and sheath (neglected)

$C_{ph} = 3C$.

41. Ans: (b)

Sol: Voltage of the bus is controlled by reactive power of the bus. If at a bus

Reactive power supply > Reactive power demand ⇒ voltage↑

Reactive power supply < reactive power demand ⇒ voltage↓

Moreover frequency of a bus is a function of the active power at the bus.

42. Ans: (c)

Sol: In LLG fault,

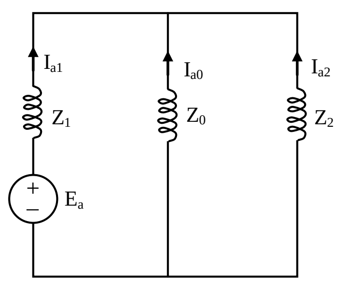
$$I_{a_1} = \frac{E_a}{Z_1 + Z_0 \parallel Z_2}$$

Since Z_0, Z_1 and Z_2 are in pu , $E_a = 1$

$$\therefore I_{a1} = \frac{1}{Z_1 + \dfrac{Z_0 Z_2}{Z_0 + Z_2}}$$

$$I_{a1} = \frac{(Z_0 + Z_2)}{Z_0 Z_2 + Z_1(Z_0 + Z_2)} \quad \text{.......... (1)}$$

Connection of sequence networks in LLG fault is given by:



From the circuit,

$$I_{a0} = -I_{a1}\left[\frac{Z_2}{Z_0 + Z_2}\right]$$

$$I_{a0} = -\left[\frac{Z_2}{Z_0 Z_2 + Z_1(Z_0 + Z_2)}\right] \text{[from(1)]}$$

Fault current in LLG fault is given by

$I_f = I_b + I_c$

$I_f = 3I_{a0}$

$$\therefore I_f = \frac{3Z_2}{Z_0 Z_2 + Z_1(Z_0 + Z_2)}$$

43. Ans: (b)

Sol: In impedance relay, the relay operates when impedance seen by it is less than a set value $Z < Z_C$. By universal torque equation,

$$K_1 I^2 > K_2 V^2 \quad \text{.......... (1)}$$

$$\frac{I^2}{V^2} > \frac{K_2}{K_1}$$

$$\frac{V^2}{I^2} < \frac{K_2}{K_1}$$

$$Z^2 < \frac{K_1}{K_1}$$

$Z < Z_C$

$\therefore$ From (1) operating torque is produced by current; restraining torque is produced by voltages.

44. Ans: (d)

Sol: Since $I_a + I_b + I_c = 3Ia_0$, a single earth relay is enough to detect earth faults[since all earth faults contain zero sequence currents] but to protect the entire 3-phase line against phase faults at least two phase relays are required.

45. Ans: (a)

Sol: 1. Insulation resistance of a cable is given by $R = \frac{\rho}{2\pi l}\ln\frac{R}{r}\,\Omega$. So insulation resistance is inversely proportional to length of cable.

2. Gradient of cable is $g = \dfrac{V}{x \ln \frac{R}{r}}$.

So, dielectric stress is maximum at the conductor surface and minimum at the inner radius of sheath.

3. Grading of cable is meant to distribute the dielectric material such that the difference between the maximum gradient and the minimum gradient is reduced.

4. Capacitance per phase is given by $C_{ph} = 3C_C + C_S$.

46. Ans: (c)

Sol: $Y_{12} = \dfrac{1}{j0.5}$

$\Rightarrow Y_{12} = -j2$

$Y_{13} = \dfrac{1}{j\,0.2}$

$\Rightarrow Y_{13} = -5j$

$Y_{23} = \dfrac{1}{j\,0.25}$

$\Rightarrow Y_{23} = -4j$

$Y_{11} = Y_{12}+Y_{13} = -7j$

$Y_{22} = Y_{23} + Y_{12} = -6j$

$Y_{33} = Y_{13} + Y_{23} = -9j$

47. Ans: (c)

Sol: Bus type Parameters specified

Load	P, Q
Generator	P, V
Slack	V, δ

48. Ans: (d)

Sol: When an unloaded transformer is switched on, it draws a large initial magnetizing current which may be several times the rated current of the transformer. This initial magnetizing current is called the magnetizing inrush current in which second harmonic is more predominant. To avoid unnecessary tripping of the transformer due to magnetizing inrush current second harmonic restraining coil should be used in conjunction with differential protection to distinguish between fault current and magnetic inrush current.

49. Ans: (c)

Sol: An interconnected power system:

1. Frequency will be same at all buses in the system.
2. Voltages can be different at different buses.

50. Ans: (d)

Sol: $I_f = 2000A$

I_f @ secondary of CT = $\dfrac{5}{400} \times 2000$

$$I_{f_2} = 25\,A$$

Relay setting (I_s) = $\frac{50}{100} \times 5 = 2.5\,A$

$$PSM = \frac{I_{f_2}}{I_s} = \frac{\text{fault current}}{\text{current setting}}$$

$$= \frac{25}{2.5} = 10$$

51. Ans: (b)

Sol: For a definite time static over current relay to work as an inverse time over current relay an integrator circuit is added such that the charging RC circuit takes place through a source of variable voltage magnitude depending upon the severity of fault and capacitor gets charged in difference times.

52. Ans: (c)

Sol: SF_6 gas has excellent insulating strength because of its affinity for electrons and has excellent heat transfer properties because of its high molecular weight which makes it suitable for use in circuit breakers.

53. Ans: (d)

Sol: Reactance of each alternator (X_S) = 0.2 pu

∴ Short circuit fault MVA flowing in each alternator is $S_A = \frac{1}{0.2} \times 5\,\text{MVA}$

= 25 MVA

∴ Short circuit fault MVA @ bus bar

Number of alternators × Fault MVA of each alternator

= 4 × 25

= 100 MVA

54. Ans: (a)

Sol: Total load, P_{load} = 500 MW

$$P_{G_1} + P_{G_2} = 500 \quad \text{……….. (1)}$$

Cost curves $C_1 = P_{G_1} + 0.01P_{G_1}^2$

$$C_2 = 5P_{G_2} + 0.02P_{G_2}^2$$

Most economical load scheduling

$$\frac{dc_1}{dP_{G_1}} = \frac{dc_2}{dP_{G_2}}$$

$$1 + 0.02\,P_{G_1} = 5 + 0.04P_{G_2}$$

$$0.02\,P_{G_1} - 0.04P_{G_2} = 4$$

$$2P_{G_1} - 4P_{G_2} = 400$$

$$P_{G_1} - 2P_{G_2} = 200 \quad \text{……….. (2)}$$

Equation (1) and (2)

$$P_{G_1} + P_{G_2} = 500$$

$$P_{G_1} - 2P_{G_2} = 200$$

$$3P_{G_2} = 300$$

$$P_{G_2} = 100$$

$$P_{G_1} = 400\,MW$$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55. Ans: (c)

Sol: $\lambda = \dfrac{dF_n}{dP_n} \times \dfrac{1}{1 - \dfrac{\partial P_L}{\partial P_n}}$.

For economic load dispatch the generation with highest positive incremental transmission loss will operate at the lowest incremental cost of production.

56. Ans: (b)

Sol: Steady state stability $P_{max} = \dfrac{EV}{X}$

By using Bundle conductors or double circuit lines, the reactance is reduced than single circuit line. Hence steady state stability limit increases

57. Ans: (b)

Sol: Cost of received power $= \left(\left. \dfrac{dF_1}{dP_1} \right|_{P_1 = 10\,MW} \right) \times L_1$

Where, L_1 is the penalty factor.

Also, $L_1 = \dfrac{1}{1 - \dfrac{\partial P_L}{\partial P_1}}$

$$= \frac{1}{1 - \frac{2}{10}} = \frac{1}{\frac{8}{10}} = \frac{10}{8}$$

$$\Rightarrow C = (0.1 \times (10) + 3) \times \frac{10}{8}$$

$$= 4 \times \frac{10}{8} = 5\,\text{Rs / MWhr}$$

58. Ans: (a)

Sol: **Flat frequency regulation:**

Let S_1 and S_2 (stations) connected through a tie line.

If the change in load is either at S_1 or at S_2, but only the generation of S_1 is regulated to take care the load change, then it is called flat frequency regulation.

Eg: S_2 operating at base load, i.e., S_2 would maintain a constant output.

Advantage: S_2 can be operated with maximum output with more efficiency.

Disadvantage: Tie-line is subjected to absorb the load changes at S_2.

Parallel frequency regulation:

If the change in the load is shared by both the stations to maintain a constant frequency.

Flat Tie-line control:

Load change in a particular area is taken care by the generators of that area only.

In this case Tie-line loading remains constant.

59. Ans: (a)

Sol: Given data,

Rated normal current = 1500 A

S = 2000 MVA, V = 33kV

Then, Breaking current $= \dfrac{2000}{\sqrt{3} \times 33}$

= 34.99 kA

Now, Making current $= 2.55 \times 34.99$

$= 89.22\text{kA}$

60. Ans: (b)

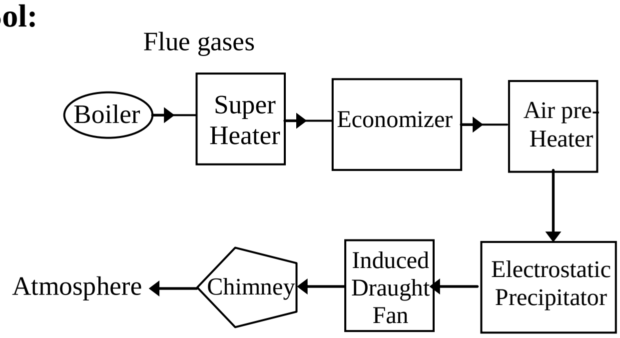
Sol: Kaplan turbine is best suitable for low head-high flow conditions.

61. Ans: (b)

Sol: Moderator in nuclear reactor is used to slow down the neutrons, by absorbing some of the kinetic energy of the neutrons by direct collision, thereby increasing the chances of fission.

62. Ans: (b)

Sol:



63. Ans: (b)

Sol: In multi machine interconnected system, transient stability can be studied by knowing the solution of swing equation where as Equal area criteria is used study the transient stability of two machine inter connected system but not for multi machine system.

64. Ans: (a)

Sol: Given data: $f_1 = 50\text{Hz}$, $f_2 = 60\text{Hz}$, $\delta_2 = 0.9\delta_1$

$$\because \; P_{loss} \propto \frac{(f+25)}{\delta}$$

$$\text{Then, } \frac{P_{loss_2}}{P_{loss_1}} = \frac{(f_2+25)}{(f_1+25)} \times \frac{\delta_1}{\delta_2}$$

$$\Rightarrow \frac{P_{loss_2}}{P_{loss_1}} = \frac{85}{75} \times \frac{1}{0.9} = 1.26$$

65. Ans: (c)

Sol: Both equivalent – T and π circuits given same result but from practical point of view, equivalent-π is preferred because no need to create a new bus.

The nature of reactive power compensation changes as the load changes.

Ferranti effect means receiving end voltage is greater than sending end voltage. This phenomenon occurs in medium and long transmission lines which are at lightly loaded or no-load condition

66. Ans: (a)

Sol: An overexcited synchronous motor operated under no-load condition called Synchronous condenser which is used to deliver the reactive power only such that power factor can be corrected, for this purpose diameter of shaft need not be large.

67. Ans: (c)

Sol: For large power systems, NR method is found to be more efficient and practical from the view point of computational time and convergence characteristics. The convergence characteristics of NR method are not affected by the selection of a slack bus when compared to GS method, and In case of NR method, the number of iterations is more or less independent of the size of the system and vary between 3 to 5 iterations

68. Ans: (a)

Sol: Lighting arresters are connected between the line and ground at the substation to divert or discharge the surge to the ground and always act in shunt with the equipment to be protected. Shunt capacitors are used in conjunction with lighting arresters for the protection of equipment to be protected against surges. These shunt capacitors will absorb some part of the over voltages. (i.e. reduce the crest of the surges).

69. Ans: (d)

Sol: Given maximum demand = 500 MW

$$\text{Load factor} = \frac{\text{Average demand}}{\text{Maximum demand}}$$

$$\frac{50}{100} = \frac{\text{Average demand}}{500}$$

$\Rightarrow$ Average demand = 250 MW

$$\text{Capacity factor} = \frac{\text{Actual energy that is generated}}{\text{Total energy that could've been generated}}$$

$$\Rightarrow \frac{40}{100} = \frac{\text{Average demand} \times t}{\text{Plant capacity} \times t}$$

$$\Rightarrow \text{Plant capacity} = \frac{5}{2} \times 250$$

Plant capacity = 625 MW

Reserve capacity

= Plant capacity – Maximum demand

= 625 – 500

Reserve capacity = 125 MW

70. Ans: (a)

Sol: Both statement (I) and statement (II) are individually true and statement (II) is the correct explanation of statement (I)

71. Ans: (d)

Sol: Air cored electrodynamometer type instruments are protected against external magnetic fields by enclosing them in a casing of **high** permeability alloy.

72. Ans: (a)

Sol: Shunts used with measuring instruments should have the following properties:

(i) The resistance temperature coefficient of shunt should be low and as nearly as possible to that of the instrument.

(ii) Resistance of shunts should be time invariant

(iii) They should have low thermal emfs with copper.

(iv) They should carry current without excessive temperature rise.

Manganin has a low temperature coefficient of resistance which is 40×10^{-6} 1°C. Hence it is a preferred shunt material in DC instruments.

Constantan's thermal emf with copper, even though high, is unidirectional and hence it is used as a shunt in AC instruments.

73. Ans: (a)

Sol: Both statement (I) and statement (II) are individually true and statement (II) is the correct explanation of statement (I)

74. Ans: (d)

Sol: The rotating disc is aluminium disc and it is not a magnetic material.

75. Ans: (d)

Sol: Statement (I) is false, but statement (II) is true.