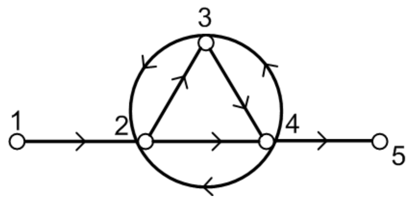
# APSPDCL-2014 Solutions:

**(1)** **A**




Forward paths are :1-2-4-5&1-2-3-4-5, loops are :3-2-3, 2-4-2, 3-4-3, 2-3-4-2, 4-3-2-4.

**(2)** **A**

**(3)** **B**

$V_1=h_{11}I_1+h_{12}V_2$

$I_2=h_{21}I_1+h_{22}V_2$

$h_{11}=\frac{V_1}{I_1}/v_2=0$; $h_{12}=\frac{V_1}{V_2}/I_1=0$;

$h_{21}=\frac{I_2}{I1}/v_2=0$; $h_{22}=\frac{I_2}{V_2}/I_1=0$. ∴Hence $h_{12}$ and $h_{21}$ are dimensionless quantities.

**(4)** **D**

$Y_{11}=I_1/V_1$ at $V_2=0$, when $V_2=0$ no current flows through 10Ω.$Y_{11}$ does not exists.

**(5)** **C**

No.of nodes = 4

No.of branches = 6

The order of incidence matrix = $n \times b$

$=7 \times 6$. The order of reduced of incidence matrix = $(n-1)\times b = 3 \times 6$.

**(6)** **C**

If f(-t) = -f(t) it is not even function.

**(7)** **C**

Flash or parallel ADC is the fastest.

**(8)** **A**

EX - OR and EX - NOR gates are considered as 1 bit comparators.

**(9)** **A**

The characteristic equation of T-flip flop is $T\overline{Q}_n+\overline{T}\,Q_n$.

**(10)** **B**

The given IC 555 timer is operating in astable mode.

$$f = \frac{1.44}{(R_A+2R_B)C}$$

$$= \frac{1.44}{(7.2K+2\times3.6K)0.1\times10^{-6}}$$

$$= 1000Hz.$$

**(11)** **C**

Given $N_1$=200rpm,$N_2$ = 500rpm
For t = 0-0.06sec,
Induced emf = $500\times\frac{0.09}{0.06}$ =75V.
For 0.06 < t < 0.1, change in flux = 0 and hence induced emf will be zero.
For 0.1 < t < 0.12, Induced emf = $500\times(\frac{-0.09}{0.12-0.1})$= -225V.

**(12)** **C**
In V/f control, $T_{max}$ is constant.

**(13)** **B**
Given $V = 15KV$ $V_{th}$ =1800V, $\eta$ =10
Derating factor = 1-$\eta$
= 1- $\frac{15000}{10\times1800}$ = 15.5%.

**(14)** **D**
Given $f_c$= 15 KHz, f = 50
No.of pulses per half cycle =
$\frac{f_c}{2f} = \frac{15\times10^3}{2\times500}$ =15.

**(15)** **B**
Given δ = 0.2 and R = 10 Ω
$R_{eff} = \frac{R}{\delta} = \frac{10}{0.2} = 50\ \Omega$.

**(16)** **D**

**(17)** **B**

**(18)** **A**
Load bus: Known quantities - P and Q, unknown quantities - V and δ

Generator bus: Known quantities - P and V, unknown quantities - Q and δ

Slack or reference bus: Known quantities - V and δ, unknown quantities - P and Q

**(19)** **C**
Z-bus is a full matrix,
Y-bus is a sparse matrix.

**(20)** **D**

**(21)** **A**
In nuclear reactor, chain reaction is controlled by using boron or cadmium rods.

**(22)** **B**

**(23)** **D**
Given, Z = (5-j5) Ω at lower half power frequency. At resonant frequency $X_L$ and $X_C$ cancel out each other. Therefore impedance will be 5 Ω.

**(24)** **A**

Given R = 2 Ω, L = 1 H, V = 10 V

The current at 10s may vary be taken as steady state condition. So under steady state condition L acts as a short circuit.

∴I = 10/2 = 5 A.

**(25)** **C**

The remaining quantities will represent time.

**(26)** **D**

**(27)** **A**

$$V_2(s) = V_1(S) \times \frac{\frac{1}{Cs}}{1+\frac{1}{Cs}} = \frac{1}{s+1}$$

**(28)** **A**

$$A_d = \frac{h_{fe}R_c}{R_s+h_{ic}} = \frac{100\times4.7\times10^3}{100+2.8\times10^3} = 162.$$

**(29)** **B**

Slew rate, $S = \frac{3V}{\mu s} = \frac{dV_0}{dt}$

change in input signal, $\frac{dV_0}{dt} = \frac{0.4}{12} v/\mu s$,

Closed loop voltage gain, $A_{CL} = \frac{\frac{dV_0}{dt}}{\frac{dV_i}{dt}}$.

$$= \frac{3}{\frac{0.4}{12}} = 90.$$

**(30)** **D**

| | $\overline{Y}_1$ | $Y_1$ |
|---|---|---|
| $\overline{X}_1$ | 1 | 0 |
| $X_1$ | 0 | 0 |

The truth table for the given logic circuit is

$f = \overline{x}_1.\overline{x}_2 = \overline{x_1+x_2}$ .This is a NOR gate.

**(31)** **C**

From the given truth table, the SOP terms are: $f = \overline{x}_1\overline{x}_2 + \overline{x}_1x_2 + x_1x_2$

$= \overline{x}_1(\overline{x}_2 + x_2) + x_1x_2$

$= \overline{x}_1 + x_1x_2$.

**(32)** **D**

To get heating in the windings, the ratio of $R_{eq\ auto}$ to $R_{eq\ two}$ is

$$\frac{v_1}{v_2} = \frac{(a-1)^2}{a^2} = \frac{(\frac{3}{2}-1)^2}{(\frac{3}{2})^2} = \frac{\frac{1}{4}}{\frac{9}{4}} = 1/9.$$

**(33)** **A**

Compoles – DC machine
Damper bars - Synchronous machine
Slip rings - 3-ϕ Induction machine
Shaped rings - 1-ϕ induction motor.

**(34)** **B**

**(35)** **C**

**(36)** **D**

Given that armature resistance drop = %, change in applied voltage =1%.

**(37)** **A**

It is a variable armature voltage method.

**(38)** **B**

**(39)** **C**

Voltage across surge arrestor = $\frac{132\ KV}{1.1}$ = 120KV

The no of blocks required = $\frac{120KV}{4KV}$ = 30.

**(40)** **C**

**(41)** **B**

**(42)** **C**

$Z_{pu\ new} = Z_{pu\ old} \times (\frac{KV_{old}}{KV_{new}})^2 \times \frac{MAV_{new}}{MAV_{old}}$

$= 0.2 \times (11/22)^2 \times (150/50) = 0.05$p.u.

**(43)** **B**

Zero sequence component of current present when the fault involves ground.

**(44)** **A**

$a^3 = 1$ then $a^{729} = (a^{243})^3 = (1)^3 = 1$.

**(45)** **C**

**(46)** **B**

**(47)** **B**

V=200 cos 1000t ⇒ $\omega$ =1000 ⇒f = $\frac{500}{\pi}$

$X_L = 2\pi \times \frac{500}{\pi} \times 0.01 = 10\Omega$

$X_C = \frac{1}{2\pi \times \frac{500}{\pi} \times 10 \times 10^{-6}} = 100\Omega.$

Since $X_c > X_L$ the circuit behaves like a capacitive circuit. So, current in the circuit leads the applied voltage.

**(48)** **D**

$R_{a\text{-}b} = \frac{(10+20)(80+40)}{10+20+40+80} = 24\Omega$

**(49)** **B**

For a saw tooth wave,
average value = maximum value/2,
R.M.S value = maximum value/$\sqrt{3}$.

**(50)** **C**

Under steady state conditions inductor acts as like a short circuit to dc the voltage across a capacitor cannot change abruptly.

**(51)** **C**

**(52)** **A**

**(53)** **C**

In two wattmeter method of power measurement, the readings of two wattmeters are given by
$W_1 = VI\cos(30\text{-}\phi)$-High reading
$W_2 = VI\cos(30+\phi)$-Low reading
When $\phi = 60^o$, $W_2 = 0$. If $\phi = 90^o$, $W_2$ reading becomes negative .
Hence for $60^o < \phi < 90^o$, the reading of $W_2$ will be negative which means
$0.5 > p.f > 0$.

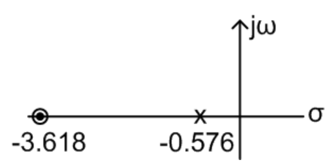
**(54)** **B**

With the increase in temperature, the resistance of thermistor decreases.

**(55)** **D**

Watt- hour meter or energy meter is an integrating type instruments.

**(56)** **B**




Given $G(s) = \frac{K(S+3.618)}{(S+0.576)}$

The pole zero diagram is shown in figure.A lag compensator has dominant pole.

**(57)** **C**

Developed by **Institute of Electrical & Electronics Engineering (ieee)**, S.R.Nagar, Hyderbad.

**(58)** **C**

The gain margin is determined from the gain at the phase cross over frequency. The phase margin is determined from the phase at the gain cross over frequency.

**(59)** **A**

The characteristics of repulsion motor resembles the characteristics of DC series motor.

**(60)** **C**

**(61)** **B**

**(62)** **B**

Given $P_i$ = 10KW, S = 0.05, stator copper loss =1 KW, mechanical loss = 550 W,
Input to rotor = $P_i$ - stator copper loss = 10-1 = 9 KW.
Rotor copper loss = 9 × 0.05 = 0.45 KW = 450W.
Total loss = stator copper loss + rotor copper loss + mechanical loss =1+450+550 =2KW
Output power = 10-2 = 8 KW
Efficiency, $\eta = \frac{8 \text{ KW}}{10 \text{ KW}} \times 100 = 80\%$.

**(63)** **C**

**(64)** **A**

Given V = 440V, f = 50 Hz, Δ/Y, stator to rotor turns ratio = 5

$R_5 = \frac{440}{8.8} = 50\ \Omega$

$R_r = \frac{R_S}{K^2} = 50/25 = 2\ \Omega$.

**(65)** **B**

**(66)** **C**

**(67)** **C**

Maximum demand = 30MW, Load factor = 0.6, Plant capacity factor = 0.5,
Average demand = 0.6 × 30 = 18MW
Plant capacity = 18/0.5 = 36MW.
Reserve capacity = Plant capacity – Maximum demand = 36-30 = 6MW.

**(68)** **A**

Reserve generating capacity which is in operation but not in service is called hot reserve.
Reserve generating capacity which is not in operation but not in service is called cold reserve.

**(69)** **D**

**(70)** **C**

Insulation resistance of a cable $\propto \frac{1}{\text{Length of cable}} = \frac{R_1}{R_2} = \frac{l_1}{l_2} \Rightarrow 1 \times \frac{10}{20} = 0.2\ \text{M}\Omega$.

**(71)** **A**

String efficiency, $\eta = \frac{\text{Voltage across the string}}{\text{no of insulator discs} \times \text{voltage across lowest disc}} = \frac{38 \times 10^3}{4 \times 12 \times 10^3}$ = 79.16%.

**(72)** **B**

**(73)** **A**

$$\text{Sag, } S = \frac{\frac{700 \times 220}{1000} \times 220}{8 \times 1400} = 3.02\text{m}.$$

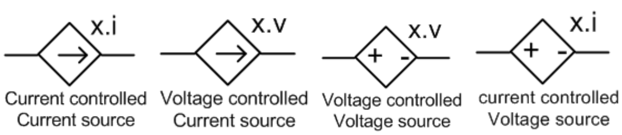
**(74)** **C**

**(75)** **C**

Energy stored in a capacitor,

$E = 1/2CV^2 = 1/2\ Q \times V$. If the total is doubled, then energy stored is also doubled.

**(76)** **A**




**(77)** **C**

In the given circuit,conductances in siemens are given

$R_{eq}$ =1/2+1/4 = 3/4Ω.

**(78)** **D**

$i_o = \frac{36-5i_o}{4} \Rightarrow 36\text{-}5i_o = 4i_0 \Rightarrow i_o = 4\text{A}$.

**(79)** **A**

No. of independent loops,l=b-n+1

No. of no nodes n=b-l+1

n =12-8+1=5.

**(80)** **B**

KVL states that the algebraic sum of voltages around a closed loop is zero. Voltage is the difference between potentials of two points and potential is a form of energy. So KVL is based on the principle of conservation of energy.

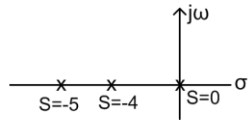
KCL states that the algebraic sum of currents meetings at a point or junction is zero. Current is nothing but the flow of charge carriers. Hence KCL is based on the principle of conservation of charge.

**(81)** **A**

Given transfer function is a 2nd order system. In low frequency portion i.e from $\omega = 0.1$ to $\omega = 1$, its slope varies from -20dB to -40dB. In high frequency portion i.e. $\omega = 1$ to $\omega = 10$, the slope will be zero.

**(82)** **D**

$G(S) = \frac{K}{S(S+4)(S+5)}$




Break away point lies on the portion of negative real axis for which the sum of poles and zeros to the right side is odd.

**(83)** **B**

In f-i analogy, mass is analogous to capacitance.

**(84)** **B**

Characteristic Equation is S(S+1) +K = 0.⇒$S^2$+2S+K = 0.

Comparing it with standard second order system $\omega_n = \sqrt{k} = \sqrt{1} = 1$, $\xi = 1$- critically damped.

**(85)** **C**

Given system is type-1 system.The steady state error to a unit ramp input for type-1 is given by

$e_{SS} = \frac{1}{K_V}$ where $K_V = \lim_{S\to 0} SG(S) = \lim_{S\to 0} SG(S) = \lim_{S\to 0} S\frac{20}{S(S+2)(s^2+2S+2)} = 5$

$e_{SS} = 1/5 = 0.2$.

**(86)** **D**

Impulse→Integrating→Step→Integrating→Ramp→ Integrating→Parabolic.

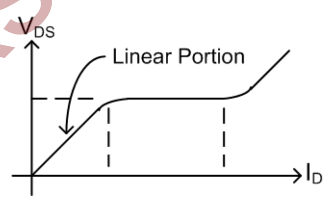
Parabolic→Diffrenciating→Ramp→Diffrenciating→Step→Differentiating→Impulse

**(87)** **C**

In connection I, when compared to connection II, the flux produced will be more and hence torque developed is high.

**(88)** **D**

**(89)** **B**




**(90)** **D**

When synchronous generator is operating at full load ZPF leading, the field current required to produce rated voltage is minimum.

**(91)** **A**

$I_{pu} = \frac{V\angle 0 - E\angle 0}{SX_S} = \frac{1\angle 0 - 0.5\angle 0}{1\angle 90} = \frac{0.5\angle 0}{1\angle 90} = 0.5\angle{-90^0} = 0 + j0.5$

**(92)** **B**

**(93)** **C**

**(94) B**

**(95) D**

Given l = 10 Km, d =1.5m, D =1cm,
r = 0.5cm

$L = \frac{lm}{\pi}[1/4+\ln(d/a)] = \frac{10X10^{3}4\pi X10^{-7}}{\pi}[1/4+\ln(\frac{150}{0.5})]$

$=4\times10^{3}[0.25+\ln(300)]$

$=4\times10^{-3}[0.25+5.7]$

=23.8mH.

**(96) D**

A&B both are having similar acceleration and retardation characteristics with different maximum speeds.In this case $SEC_A = SEC_B$.

**(97) A**

**(98) D**

$P_0$ in H.P = (74.6 × 36000)/3.6 = 1000
H.P (1 HP = 746 W).

**(99) C**

Assume waste light factor = 1.2, maintenance factor = 0.75
Beam factor = 0.6
Lumens required = 20/0.25
= 100 lumens/$m^2$.

$= \frac{E \times A \times WLF}{M.F} = \frac{600 \times 100 \times 1.2}{0.75}$

=96000lumens/$m^2$

Lumen provided by one lamp = output lumen of each lamp × beam factor = 8000×0.6 = 4800 lumens.

No.of lamps required = 9600/4800 = 20.

**(100) B**