CHAPTER-6
EXTENSION OF INSTRUMENT RANGES

01. Ans: (b)

Sol: $I_m = 1mA = 1\times10^{-3}A$, $R_m = 100\ \Omega$
$I = 5A$ $R_{sh} = ?$

$$R_{sh} = \frac{R_m}{m-1} \qquad \text{Where } m = \frac{I}{I_m}$$

$$= \frac{100}{\frac{5}{10^{-3}}-1} = \frac{100}{5000-1} = \frac{100}{4999} = \frac{1}{49.99}\Omega$$

02. Ans: (a)

Sol: $I_m = 1mA = 1\times10^{-3}A$, $R_m = 100\Omega$, $V = 100V$

$V_m = I_m R_m = 1\times10^{-3}\times100 = 0.1V$

$$R_{se} = R_m\,(m-1) = 100\left(\frac{V}{V_m}-1\right) = 100\left(\frac{100}{0.1}-1\right)$$

$= 100\ (1000-1) = 99900$
$= 99.9K\Omega$

03. Ans: (a)

Sol: The shunt Resistance is used for a milli-Ammeter to extend the range & to reduce the resistance of the instrument

04. Ans: (d)

Sol: The Internal resistance of a practical Ammeter in the range of "Hundreds of ohms"

05. Ans: (a)

Sol: Similarly for an milli ammeter the range is in ohms

06. Ans: (b)

Sol: Similarly for an micro Ammeter the range is in kilo ohms
Note: The Internal resistance of
(1) Ideal Ammeter ----------Zero
(2) Ideal voltmeter ---------- infinity
(3) Ideal Current source ---------- infinity
(4) Ideal voltage Source ---------- Zero.

07. Ans: (a)

Sol: $I = 50\ \mu A$

$$\text{Sensitivity} = \frac{1}{I} = \frac{1}{50\times10^{-6}} = \frac{10^6}{50} = \frac{10^4}{50}$$

$= 20\ K\Omega/V$

08. Ans: (c)
Sol: To reduce the Temperature error the resistance is made up of manganin.

09. Ans: (d)
Sol: A Ayrton shunt or universal shunt is used to make the D'Arsonal galvanometer into multi range Ammeter.

10. Ans: (a)
Sol: $Rm_1 = 100\Omega$, $P_1 = 0.1m\omega$
$Rm_2 = 200\Omega$ $P_2 = ?$
$P_1 = I_1^2 R_{m1}$

$$I_1 = \sqrt{\frac{0.1\times10^{-3}}{100}} = \frac{0.01}{10} = 1mA$$

$$P = I_1^2 R_{m2} = \left(1\times10^{-3}\right)\times 200 = 0.2mW$$

11. Ans: (b)
Sol: $I_m = 1mA$, $R_m = 100\Omega$ $I = 1A$

$$R_{sh} = \frac{R_m}{m-1} = \frac{100}{\frac{1}{10^{-3}}-1} = \frac{100}{999} = 0.1001\Omega$$

12. Ans: (c)
Sol: $I_m = 1\times10^{-3}A$ $R_m = 100\Omega$ $V=10V$
$$R_{se} = R_m(m-1) = 100\left(\frac{10}{10^{-3}\times100}-1\right) = 9900\Omega$$

13. Ans: (b)
Sol: $I_m = 1mA$ $R_m = 100\Omega$ $I = 100mA$

$$R_{sh} = \frac{R_m}{m-1} = \frac{100}{\frac{100\times10^{-3}}{10^{-3}}-1} = \frac{100}{99} = 1.01\Omega$$

14. Ans: (b)
Sol: $R_m = 1000\Omega$ $m = 50$
$$R_{sh} = \frac{R_m}{m-1} = \frac{1000}{50-1} = 20.408\Omega$$

15. Ans:(a)
Sol: The most widely used material for resistors to get precision are
(i) Manganin (ii) Constantan (iii) Nickel Chromium Alloys

17. Ans: (d)

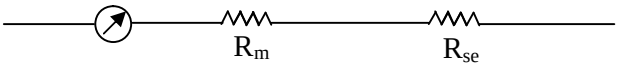
Sol: Shunts are used to extend the range of Ammeter or galvanometer upto 100Amps only & to measure high currents C.T'S are used.
Multipliers are used to extend the range of the voltmeter upto 1KV & to measure high voltages P.T's are used

18. Ans:(a)

Sol: The Purpose of Shunt in an Ammeter is to by pass the current

19. Ans:(a)

Sol: The multiplier & meter coil are connected in series to a voltmeter



20. Ans: (c)

Sol: The loading effect is across a 2mΩ resistor only since $I \propto 1/R$

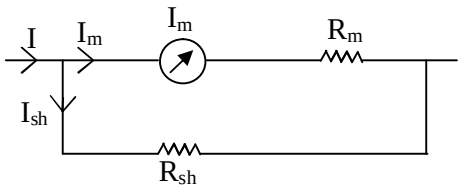
21. Ans: (a)

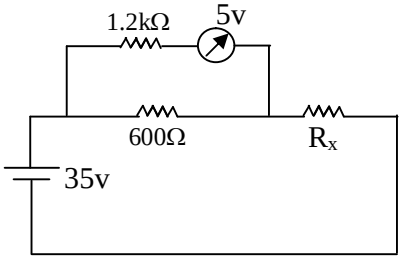
Sol: $R_m = 1000\Omega$ $I_m = 1mA$ $I = 3I_m$

$$R_{sh} = \frac{R_m}{m-1} = \frac{1000}{\frac{3I_m}{I_m}-1} = 500\Omega$$

22. Ans: (b)

Sol:





$R_{sh} = 0.02\Omega$ $R_m = 100\Omega$ $V_m = 500mV$
Voltage across parallel paths will be same
$I_m R_m = I_{sh} R_{sh}$
$500\times10^{-3} = I_{sh}(0.02)$

$$I_{sh} = \frac{500\times10^{-3}}{0.02} = 25A$$

23. Ans: (d)

Sol: By KVL
Voltage across $R_x\Omega = 35-5 = 30V$
1.2 KΩ & 600Ω are in parallel

$$R_{eq} = \frac{1.2\times10^3\times600}{1.2\times10^3+600} = 400\Omega$$

So voltage across 400Ω is 5V
By voltage division

$$30 = 35.\frac{R_x}{R_x + 400}$$

$R_x = 2400\Omega = 2.4K\Omega$

25. Ans: (d)

Sol: Swamping resistance is connected in series with the meter because to reduce the temperature error in shunt resistance.

27. Ans: (a)

Sol: $K = 0.14\times10^{-6}\,N.m/rad,\ \theta = \frac{\pi}{2}\ rad,$ $l \times d = 15mm \times 12mm$

$B = 1.8\times10^{-3}\,wb/m^2$ $I = 5mA$

$K\theta = BINA$

$$N = \frac{K\theta}{BIA} = \frac{0.14\times10^{-6}\times3.14/2}{1.8\times10^{-3}\times5\times10^{-3}\times15\times12\times10^{-6}}$$

$N = 135.67 \cong 136$

28. Ans: (a)

Sol: $I_m = 10mA$ $V_m = 100mV$ $I = 100A$

$$R_{sh} = \frac{R_m}{m-1} = \frac{100\times10^{-3}/10\times10^{-3}}{\frac{100}{10\times10^{-3}}-1} = \frac{10}{9999}$$

$R_{sh} = 0.001\Omega$

29. Ans: (a)

Sol: $R_{se} = R_m(m-1) = \frac{100\times10^{-3}}{10\times10^{-3}}\left(\frac{1000}{100\times10^{-3}}-1\right) = 10(9999)$

$99.99K\Omega \cong 100K\Omega$

Previous IES Questions

01. Ans: (d)

Sol: $25A \pm 1\% \rightarrow 25\times\frac{1}{100} = 0.25A \rightarrow G.A.E$

$$5A\times\frac{x\%}{100} = 0.25 \Rightarrow \%x = \frac{0.25\times100}{5} = 5\%$$

02. Ans: (c)

Sol: $S_v = 20000\Omega/V$ (0–100V) ($V_m = 100V$) $V = 1000V$

$R_m = 20000\times100 = 2\times10^6\Omega = 2M\Omega$

$R_{se} = R_m(m-1)$

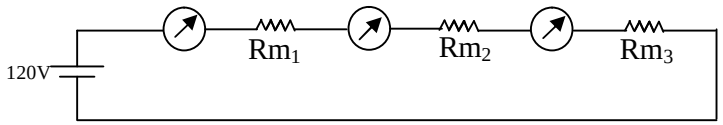
$$2\times10^{6}\left(\frac{1000}{100}-1\right) = 18M\Omega$$

03. Ans: (a)

Sol: $Rm_1=\frac{V_m}{I_m}=\frac{100}{5\times10^{-3}}=20K\Omega$

$Sv_2 = 250\Omega/V$ $Rm_2 = 250\times100 = 25K\Omega$

$Rm_3 = 15K\Omega$



By voltage division

$$Vm_1 = 120\times\frac{20K\Omega}{20K+25K+15K} = 120\times\frac{20K}{60K}\ 40V$$

$$Vm_2 = 120\times\frac{25K\Omega}{60K\Omega}=50V$$

$$Vm_3 = 120\times\frac{15K\Omega}{60K\Omega} = 30V$$

Previous Gate Questions

01. Ans: (c)

Sol: $I_m = 100\mu A$ $R_m = 100\Omega$ $I = 500\mu A$

$$R_{sh}=\frac{R_m}{m-1}=\frac{100}{\frac{500\times10^{-6}}{100\times10^{-6}}-1} = \frac{100}{4}=25\Omega$$

02. Ans: (d)

Sol: $R_m = 50\Omega$ $I_m = 50\mu A$ $I = 1mA$

$$R_{sh} = \frac{R_m}{m-1} = \frac{50}{\frac{1\times10^{-3}}{50\times10^{-6}}-1} = \frac{50}{19} = 2.63\Omega$$

03. Ans: (c)

Sol: $R_m = 0.1\Omega$ $I_m = 100A$ $I = 500A$

$$R_{sh} = \frac{R_m}{m-1} = \frac{0.1}{\frac{500}{100}-1} = \frac{0.1}{4} = 0.025\Omega$$