Example 3.2. A wattmeter reads 25.34 watts. The absolute error in the measurement is – 0.11 watt. Determine the true value of power.

Solution: Measured value, A_m = 25.34 watts

Absolute error, δA = – 0.11 watt

True value, A = Measured value – absolute error

= $A_m - \delta A$ = 25.34 – (– 0.11) = 25.45 watts **Ans.**

Example 3.3. The measured value of a capacitor is 205.3 μF, whereas its true value is 201.4 μF. Determine the relative error.

[B.P. Univ. of Technology Orissa Electronics Measurements and Measuring Instruments, 2007]

Solution: Measured value, $A_m = 205.3 \times 10^{-6}$ F

True value, $A = 201.4 \times 10^{-6}$ F

Absolute error, $\varepsilon_0 = A_m - A = 205.3 \times 10^{-6} - 201.4 \times 10^{-6} = 3.9 \times 10^{-6}$ F

Relative error, $\varepsilon_r = \dfrac{\varepsilon_0}{A} = \dfrac{3.9 \times 10^{-6}}{201.4 \times 10^{-6}} = 0.0194$ or 1.94% **Ans.**

Example 3.4. The expected value of the voltage across a resistor is 80 V. However, the measurement gives a value of 79 V. Calculate:

(i) absolute error (ii) % error (iii) relative accuracy (iv) % of accuracy.

[M.D. Univ. Electrical Measurement and Measuring Instruments, December-2010]

Solution: Measured value of voltage, A_m = 79 V

Expected value of voltage, A = 80 V

(*i*) Absolute error, $\varepsilon_o = A_m - A = 79 - 80 = -1$ V **Ans.**

(*ii*) % error = $\dfrac{A_m - A}{A} \times 100 = \dfrac{79 - 80}{80} \times 100 = -1.25\%$ **Ans.**

(*iii*) Relative accuracy = $1 - \left|\dfrac{\varepsilon_o}{A}\right| = 1 - \dfrac{1}{80} = 0.9875$ **Ans.**

(*iv*) % of accuracy = 100 × relative accuracy = 100 × 0.9875 = 98.75% **Ans.**

Example 3.5. A resistor of value 4.7 kΩ is read as 4.65 kΩ in a measurement. Calculate (i) absolute error, (ii) % error and (iii) accuracy.

[U.P.S.C. I.E.S. Electronics and Telecommunication Engineering-I, 2009]

Solution: Measured value of voltage, A_m = 4.65 kΩ

True value of resistor, A = 4.7 kΩ

(*i*) Absolute error, $\varepsilon_o = A_m - A = 4.65 - 4.7 = -0.05$ kΩ or – 50 Ω **Ans.**

(*ii*) % error = $\dfrac{A_m - A}{A} \times 100 = \dfrac{4.65 - 4.7}{4.7} \times 100 = -1.064\%$ **Ans.**

(*iii*) Accuracy = 100 – |% error|% = 100 – 1.064 = 98.936% **Ans.**

Example 3.6. Define limiting errors.

A 0–10 A ammeter has a guaranteed accuracy of 1.5 per cent of full-scale reading. The current measured by the instrument is 2.5 A. Calculate the limiting values of current and the percentage limiting error. *[U.P. Technical Univ. Elec. Measurements and Measuring Instruments 2005-06]*

Solution: The magnitude of limiting error of the instrument,

$$\delta A = \varepsilon_r \times A = \frac{1.5}{100} \times 10 = 0.15 \text{ A}$$

Scanned with CamScanner