

task_kyt15w11e3sempb2_with_calculation

Student Group

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resistivity, power, exam ee1 SS2023

**Exercise E1 Equivalent linear Source
(written test, approx. 7 % of a 60-minute written test, SS2023)**

The conductivity of a dielectric material is given by $\rho_{PP}(T) = 10^{17} \cdot e^{\alpha T + \beta T^2}$ $\Omega^{-1}m^{-1}$ for $20 \leq T \leq 55$ $^{\circ}C$.
 A dielectric material with a thickness of $d = 100 \mu m$ is used as a capacitor. The capacitance of the capacitor is $C = 100 pF$.
 The voltage across the capacitor is $U = 100 V$.
 Calculate the resistance of the dielectric material for $T = 20$ $^{\circ}C$.

Solution
 The resistivity of the dielectric material is $\rho_{PP}(20 \text{ } ^{\circ}C) = 10^{17} \cdot e^{\alpha T + \beta T^2}$ Ωm .
 For the given material the temperature coefficients in the range of $20 \text{ } ^{\circ}C$ and $55 \text{ } ^{\circ}C$ are given as $\alpha = -0.048 \text{ } 1/K$ and $\beta = +0.00057 \text{ } 1/K^2$.

$$R(55 \text{ } ^{\circ}C) = R(20 \text{ } ^{\circ}C) \cdot (1 + \alpha \Delta T + \beta \Delta T^2 + \dots)$$

$$R(55 \text{ } ^{\circ}C) = 80 \text{ } G\Omega \cdot (1 - 0.048 \text{ } 1/K \cdot (35 \text{ } K) + 0.00057 \text{ } 1/K^2 \cdot (35 \text{ } K)^2)$$

Calculate the resistance for the dielectric material for $20 \text{ } ^{\circ}C$.

Solution

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\begin{align*} R(20 \sim \text{°C}) &= \rho \cdot \left\{ \frac{d}{A} \right\} \cdot 10^{17} \sim \Omega \\ \text{m} &\cdot \left\{ \frac{0.8 \cdot 10^{-6} \sim \text{m}}{1 \sim \text{m}^2} \right\} \end{align*}
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