Answer on Question # 73804, Physics -Electric Circuits:

Question: The radius of the wire in a coaxial cable is 0.65 mm and the inner radius of the coaxial conducting cylinder is 1.45 mm. Assuming that there is vacuum between the wire and the cylinder, calculate the capacitance of a 1.5 m length of the cable.

Solution: We know the capacitance per unit length of a cable is given by,

$$C = \frac{2\pi\varepsilon}{\ln(\frac{b}{a})} \quad \text{.....(1)}$$

Where, $\mathcal{E}$ = permittivity (here permittivity of vacuum $\varepsilon = \varepsilon_0 = 8.85 \times 10^{-12}$ Farad/meter)

b = inner radius of the coaxial conducting cylinder = 1.45 mm = 0.00145 m.

a = radius of wire in a coaxial cable = 0.65 mm = 0.00065 m.

Put these value in equation (1), we get,

$$C = \frac{2\times\pi\times 8.85\times 10^{-12}}{\ln(\frac{0.00145}{0.00065})} = \frac{55.578}{0.80235} \times 10^{-12} = 69.27 \times 10^{-12} \text{ Farad/meter.}$$

So, total capacitance of the cable is $69.27 \times 1.5 \times 10^{-12} = 103.9 \times 10^{-12}$ Farad = 103.9 Pico farad .

Answer : Capacitance of a 1.5 m length of the cable is 103.9 pico-farad.

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