Q1- What is the maximum current in a 2.20-micro-farade capacitor when it is connected across
(a) A North American electrical outlet having V_{rms} = 120v, f = 60.0 Hz,
(b) A European electrical outlet having v_{rms} = 240 V, f = 50.0 Hz?

(a) The capacitive reactance of the capacitor is given by

$$X_C = \frac{1}{C\omega} = \frac{1}{C*2\pi f} = \frac{1}{2.20*10^{-6}*2*3.1416*60} = 1205.72\Omega$$

Hence the rms value of the current in the circuit is given by

$$I_{rms} = \frac{V_{rms}}{X_C} = \frac{120}{1205.72} = 0.0995A = 99.5mA$$

Now as we know that the rms current is related to the maximum current as

$$I_{rms} = \frac{I_{\max}}{\sqrt{2}}$$

Hence the maximum current in the circuit will be

$$I_{\max} = \sqrt{2}I_{rms} = 1.414*99.5 = 140.7mA$$

Hence the maximum current in the capacitor will be 140.7 mA.

b) A European electrical outlet having vrms = 240v, f = 50.0 Hz?

The capacitive reactance of the capacitor for this frequency is given by

$$X_C = \frac{1}{C\omega} = \frac{1}{C*2\pi f} = \frac{1}{2.20*10^{-6}*2*3.1416*50} = 1446.86\Omega$$

Hence the rms value of the current in the circuit is given by

$$I_{rms} = \frac{V_{rms}}{X_C} = \frac{240}{1446.86} = 0.166A = 166mA$$

Now as we know that the rms current is related to the maximum current as

$$I_{rms} = \frac{I_{\max}}{\sqrt{2}}$$

Hence the maximum current in the circuit will be

$$I_{\max} = \sqrt{2}I_{rms} = 1.414*166 = 234.55mA$$

Hence the maximum current in the capacitor will be 234.55 mA.