A full-vector semi-analytical numerical technique for the analysis of frequency selective surfaces made out of graphene will be presented. The method is based on the periodic method of moment for the analysis of general frequency selective surfaces. The required modifications to consider the anisotropic conductivity model of the graphene as well as the spatial dispersion appearing in the low infra-red frequency range are described. Various computational aspects of the method, such as effect of basis functions type and combination with transmission line model for studying periodically inhomogeneous substrates, will be investigated through some examples. Owing to the graphene properties, the structure performance changes with the variation of electrostatic and magnetostatic bias fields. Some examples will be outlined to examine the effect of this phenomenon on the designed surfaces.