1. Discuss analytically (with proper equations) what could be the effect of increase in temperature on the junction potential of a P-N junction. (5)

2. Suppose the impact ionization coefficient $\alpha$ is given by, $\alpha = k \times E^n$, where $k$ is a constant and $E$ is the electric field. Also, suppose we have a quadratically graded junction i.e. doping density across the P-N junction is given by, $Q(x) = \pm qGx^2$, where $q$ is the electronic charge, and $G$ is the grading constant. Derive the analytical relationship between the breakdown voltage and grading constant. (10)

3. Electric fields in a one-dimensional P-N junction are generally triangular. Suppose, by some design methodology, the electric field is made *trapezoidal* instead of triangular. What is the fundamental advantage of this modification from the breakdown voltage point of view? Explain analytically (with proper equation). (5)

HINT: Electric field is derivative of electric potential.