1. Describe and compare the generation lifetime and recombination lifetime.(10%)

2. (1) Write the general continuity equation for minority carriers in an n-type semiconductor.(5%)

   (2) If an n-type semiconductor is uniformly illuminated with generation rate of G_L without applying electric field, as shown in Fig.1. What is the minority carrier density in bulk with surface recombination at left side of the semiconductor. Assume that the surface recombination velocity is S, and the minority carrier density at thermal equlibrium is p_{no}. The minority carrier lifetime is τ_p.(5%)

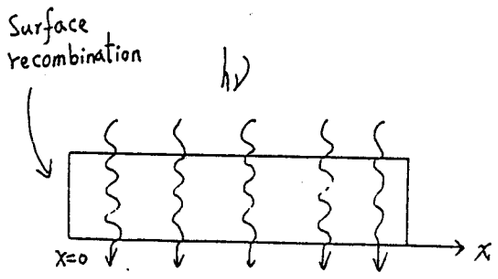

Fig.1

3. Describe the operation principle of a tunnel diode by using energy band diagrams.(10%)

4. For a p-n-p-n thyristor, use the two-transistor mode to derive and describe that under what condition the forward breakover occurs. Assume that the common-emmiter(common-base) current gain for transistir 1 and transistor 2 are $\beta_1(\alpha_1)$ and $\beta_2(\alpha_2)$, respectively.(10%)

5. (1) Compare the difference between negative resistance and negative differential resistance.(4%)

   (2) How a semiconductor material with negative differential resistance generates microwave power.(6%)

6. Write the four Maxwell equations and Explain in detail their applications. (10%)

7. The total charge on one of the three concentric spheres S_1 is Q. There is no charge on S_2, and S_3 is grounded, as shown in Fig.2. Try to find the electric field intensity E and the potential V in the following regions: (1) $r<r_1$, (2) $r_1<r<r_2$, (3) $r_2<r<r_3$, and (4) $r>r_3$.

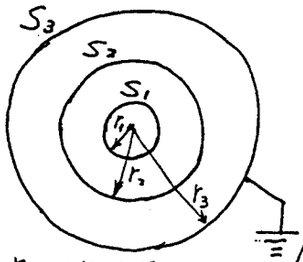

Fig.2

Now, in case a conducting wire has been made connecting the two spheres S_1 and S_2 for a long time, then the wire is taken away. Find E and V in the above regions. (8%)

8. An alternating voltage $V\sin\omega t$ is applied to the two plates of a cylindrical capacitor with radius R and height h as shown in Fig.3. The conductivity and permittivity of the dielectric between the two plates are σ and ϵ respectively. Find the current I. (10%)

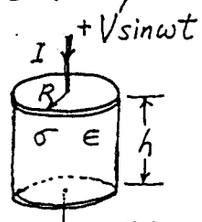

Fig.3

9. How is an electromagnetic standing wave produced? Give the explanation mathematically in detail. (10%)

10. Try to explain Poynting theorem by taking Fig.3 as an example. The permeability of the dielectric between the two plates is μ. (12%)