1. (15 %) Describe the following terms. (a) Schottky barrier diode, (b) Tunneling current, (c) phototransistor.

2. (20 %) Design a base-bias amplifier with four resistors (R_1, R_2, R_C, and R_E), a npn transistor (Q_1), and a 12 V d.c. voltage source. Draw your circuit. Determine the I_c and V_{CE} for your circuit if the transistor has β_F.

3. (15 %) Draw an OP-Amp version of phase-shift oscillator. Determine the oscillation frequency.

4. (15 %) Pleas draw a circuit of an inverting half-wave perfect rectifier using OP-Amp, resistors, and diodes. Plot the input-output characteristics for the circuit output.

5. (20 %) For the security of a supermarket, please design a digital system to count the number of customers entering and leaving a single gate. (Hint: You may use the photodiode, standard logic circuit, or microprocessor, etc.)

6. (15 %) The isolation amplifier is a very important component in medical device. Please describe the general principles of isolation amplifier. Sketch two general approaches to achieve an isolation amplifier.

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