Name-   Entry No-   Group No-

ENERGY, ECOLOGY, ENVIRONMENT (ESL 330)

Major Test   **4th May *2007***

PART (B)

2. Demonstrate graphically/through schematic diagrams.   **(3 x 6 marks)**

    (i)   Formation of photochemical smog.
    (ii)   Pattern of variation of major pollutants in a gasoline (Spark Ignition) engine.
    (iii)   Radiative forcing of the major greenhouse gases with respect to concentration.
    (iii)   Energy flow pyramids.
    (iv)   Flow of energy to and from the earth.
    (v)   World CFC production indicating the landmark of Montreal protocol.

3. It is believed that doubling the atmospheric concentration of CO_2 causes a radiative forcing of 4.35 W/m^2. If the earth's albedo does not change, estimate the climate sensitivity factor λ and use it to estimate the eventual change in the surface temperature of earth needed to balance incoming and outgoing radiation. Assume suitable data wherever necessary.   **(2 marks)**

4. Typical coal burned in power plants has an energy content of approximately 24 kJ/g and an average carbon content of about 62 percent. For almost all new coal plants, Clean Air Act emission standards limit sulfur emissions to 260 g of sulfur dioxide (SO_2) per million kJ of heat input to the plant (130 g of elemental sulfur per 10^6 kJ). They also restrict particulate emissions to 13 g/10^6 kJ. Suppose the average plant burns fuel with 2 percent sulfur content and 10 percent unburnable minerals called **ash**. About 70% of the ash is released as **fly ash** and about 30 percent settles out of the firing chamber and is collected as **bottom ash**. Assume this is a typical coal plant with 3 units of heat energy required to deliver 1 unit of electrical energy.

a) Per kilowatt-hour of electrical energy produced, find the emissions of SO_2, particulates, and carbon (assume all of the carbon in the coal is released to the atmosphere).

b) How efficient must the sulfur emission control system be to meet the sulfur emission limitations?

c) How efficient must the particulate control system be to meet the particulate emission limits?   **(6 marks)**