ASL310 (Fundamentals of Atmosphere and Ocean) **Minor I**

Marks 20 **Time 60 min**

Instructions: *You can consult only your own lecture notes and photocopies/print-outs of slides and materials from any textbook. Exchange of lecture notes is strictly prohibited. Read the questions carefully. State all assumptions clearly. All abbreviations carry usual meanings.*

[$\sigma = 5.67 \times 10^{-8}$ W m^{-2} K^{-4}; Wien's constant = 2897.9 K μm; $h = 6.626 \times 10^{-34}$ J s; $H = 8$ km]

1. In a hypothetical spherical planet, atmosphere is composed of only greenhouse gases. Transmittance at SW and LW are 1 and 0.2. Solar constant of the planet is 3000 W m^{-2} and planetary albedo is 0.5. Assume uniform atmospheric emission in both upward and downward directions. [*No need to derive equation*] **(Marks 2 + 2 + 2 + 2 = 8)**

   (a) Ignoring any energy transfer via sensible and latent heat, calculate the atmospheric temperature of the planet at radiative equilibrium.

   (b) In presence of what kind of atmosphere, surface temperature of the planet will rise above 360 K?

   (c) If clouds form in the planet and as a result SW transmittance changes to 0.7, calculate the TOA SW cloud radiative forcing. Cloud SW absorptance is zero.

   (d) If the clouds emit 155 W m^{-2}, calculate the peak wavelength of cloud emission. Assume $\varepsilon_{cloud} = 0.7$.

2. Answer the following questions based on radiosonde data shown below and meteorological observations. 50% of the sky is covered by cloud. Southerly wind is blowing at a speed 9.5 km/hr at the surface. There is no change in surface pressure for the last 3 hours. **(Marks 4 + 2 + 2 = 8)**

Altitude (km)	T (K)	RH (%)	Pressure (hPa)
0	288	70	*Not measured*
1	277	80	886.91
2	266	90	782.69
3	255	100	690.72

   (a) Draw the weather station model for the site for meteorological conditions at surface.

   (b) Is the condition suitable for dispersion of pollutants? Briefly explain your answer.

   (c) If the site is located at the east coast (coastline oriented in north-south), do you expect upelling or downwelling in the coastal ocean and why?

3. Write 'True' or 'False' with reason. *Answer any two.* **(Marks 2 + 2 = 4)**

   (a) In another ~11,500 years, India will experience cooler climate in July than in January.

   (b) One needs to know global vegetation pattern to estimate water-vapour climate feedback.

   (c) δ_{18O} is known as 'paleo-thermometer' of the Earth.