

EX/PG/ME/T/113B/2018

M.E. MECHANICAL ENGINEERING 1ST YEAR 1ST SEMESTER EXAM.2018

Subject : ATMOSPHERIC FLUID DYNAMICS

Time: Three Hours

Full Marks :100

ANSWER ANY FIVE QUESTIONS

1.a) Discuss about different layers of Atmosphere.

b) Derive an expression for adiabatic lapse rate of temperature of atmosphere starting from static force balance. 10 +10

2. a) Discuss about vertical convection and Gravity-induced convection.

b)) Express potential temperature Θ in terms of temperature T and pressure P , then derive an expression for $d\theta/dz$ in terms of T and C_p . 10 +10

3.. a) Apply Buckingham's π Theorem to carry out dimensional analysis in case of a flow past bluff structures neglecting thermal variations .Identify the dimensionless terms.

b) The pressure at the centre θ far away from the centre of hurricane are 0.2 bar and 1.5 bar respectively. The radius of maximum pressure gradient is 100 km, the density of air is 1.2 kg/m^3 , and the radius of the hurricane is 450 km. Find out the cyclostropic wind velocity of a tornado of radius 150 metres and having pressure gradient at radius 1000 times the pressure gradient at radius of the aforesaid hurricane. 15 + 5

4. . a) Explain the phenomenon of temperature inversion.

b) What is atmospheric pressure and how does it change ?

c) What is isobar ?

7+ 8 + 5

5. a) Show that for Froude number similitude, $[\lambda_v^2 / \lambda_l \lambda_g] = 1$, where $\lambda_v, \lambda_l, \lambda_g$ are scales of velocity, length and gravity respectively.

b) A packet of air mass of 1 kg moving with the the surface of the earth at 30° N latitude is divided into two equal halves and are moved to 60° and 0° N respectively. Find out the difference ineffective weights of aforesaid two halves of air. Take radius of earth as 6.37×10^6 metres. 15 +5

6. a) Discuss about the circulation in the atmosphere ; in this respect explain vertical convection, gravity -induced convection.

b) What is stability of the atmosphere ? Explain the three cases related to the stability 10 +10

7. Write short notes on any four of the followings : 4X5

- a) Meteorology, b) Adiabatic lapse rate c) Cyclone, d) Local winds, e) Thunderstorms f) Tornadoes
g) Components of atmosphere, h) Turbulent Ekman layer..
