

ME/5/T/413A/2017 (OLD)(S)

B. MECHANICAL ( EVENING ) 4<sup>TH</sup> YEAR 1<sup>ST</sup> SEMESTER SUPPLE  
EXAM.2017 (OLD)

Subject : Elective I ( ELEMENTS OF ATMOSPHERIC FLUID DYNAMICS) (OLD)

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) Explain the phenomenon of temperature inversion.
- b) What is atmospheric pressure and how does it change ?
- c) What is isobar ? 7+ 8 + 5
3. a) Discuss about vertical convection and Gravity-induced convection.
- b) Express potential temperature  $\Theta$  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
4. a) Apply Buckingham's  $\pi$  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  $\theta$  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  $1.2 \text{ kg/m}^3$ , 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
5. 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
6. 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  $30^\circ$  N latitude is divided into two equal halves and are moved to  $60^\circ$  and  $0^\circ$  N respectively. Find out the difference ineffective weights of aforesaid two halves of air. Take radius of earth as  $6.37 \times 10^6$  metres. 15 +5

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..

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