Ex/ME(M2)/PE/H/T/416F/2024

B.E.. MECHANICAL ENGINEERING FOURTH YEAR 1ST SEMESTER

EXAMINATION 2024

Subject : ATMOSPHERIC FLUID DYNAMICS

Time: Three Hours Full Marks :100

*ANSWER ANY **FIVE** QUESTIONS*

1. a) Define atmosphere and what is the extent of atmosphere ?

What are the elements of atmosphere ?

b) Discuss about the different layers of atmosphere in brief.

10 + 10

2. a) What are the factors influencing air temperature and air pressure ? How is atmosphere heated ?

b) Describe how the different factors affect Air Temperature

10 +10

3. 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 30^0 N latitude is divided into two equal halves and are moved to 60^0 and 0^0 N respectively. Find out the difference ineffective weights of aforesaid two halves of air. Take radius of earth as 6.37×10^6metres. **15 +5**

[Turn over

4.a) Derive an expression for adiabatic lapse rate of temperature of atmosphere starting from static force balance.

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**

5. a)Apply Buckinham'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

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

b) Explain what is stability of atmosphere. Discuss about the cases related to stability. **10 +10**

7. a) Explain the phenomenon of temperature inversion.

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

c) what is isobar ?

7+ 8 + 5

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

a) Meteorology, b) Cyclone, c) Local winds, d) thunderstorms

e) tornadoes .f)components of atmosphere, g) turbulent Ekman layer..

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