PLANETARY ATMOSPHERES ***HOMEWORK-1***
Instructor: Z. KaymaZ ***Given :20/02/2024***
Faculty: ITU, UUBF ***Due* :28/02/2024 17:30***

(10p) Q.1. CONCEPTS: Search and Answer the questions below with your own words in your understanding and **using only one or two sentences**. **Give a definition** for the quantities below and **Indicate the differences** between them. Try to understand the physical differences between these quantities. Give their units. (Do not write long definitions out of the internet. Note that giving definition is not equivalent to giving the differences. Give differences in a list.)

a- Kinetic temperature, Brightness temperature, Color temperature? First give definition then give comparison as a list.

b- Radiative equilibrium and Hydrostatic equilibrium? First give definition then give comparison as a list.

(6p) Q.2. LUMINOSITY CONCEPT

Aşağıdaki sorulara cevaplarınızı Güneş'in büyüklükleri cinsinden veriniz.

a. What is the luminosity of a star that is twice as big as the Sun but has the same surface temperature?

b. What is the luminosity of a star that is half as big as the Sun and twice as hot?

c. Estimate the size of a star that has the same surface temperature as the Sun but produces 100 times as much energy?

(20 p) Q.3. STAR FORMATION-I: give brief answers.

(4p) a. What stops the collapse of the gas cloud in a nebula?

(4p) b. What is a proto-star? What distinguishes it from a main sequence star?

(4p) c. What does conservation of angular momentum imply about the collapse of a rotating object?

(4p) d. What is the meaning of the Jeans Mass? What is it used for?

(4p) e. Consider three molecular clouds: clouds A and B have the same density, but cloud A is twice as hot; clouds B and C have the same temperature, but cloud C is twice as dense. Which clouds have the lowest and highest Jeans mass? Which would you choose to observe if you were hunting for regions of star formation? Explain.

(20p) Q.4. STAR FORMATION-II

a- A key step in star formation of a molecular cloud when the cloud mass exceeds the Jean's mass, $M_{cloud} > M_J$. In the class, we have seen that $M_J \propto T^{3/2}\rho^{(-1/2)}$. Apply the Jeans theorem (PE+2KE=0) for a spherical, homogenous cloud and **derive the full expression for the Jeans mass, M_J**. Make use the relation between the mass, density and volume of a spherical cloud. Show all your derivation steps.

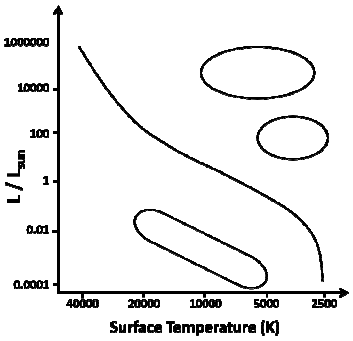
b- A Giant Mass Cloud (GMC) at a distance r=200 parsec (pc) has typically a temperature of T=10^{o}K and a density of about $\rho=3x10^{-16}$ kg/m^3. Assume the cloud is spherical. What is the Jean's radius of the cloud? First you need to derive the Jean's radius equation to solve this question. Make use the relation between the mass, density and volume of a spherical cloud.

c- What is the Jean's mass of the cloud in part-b?

d- Assuming that clouds with masses 1-100M_{sun} can form a proto-star, can this cloud in part-b collapse and form a proto-star?

e- Assume that a supernova explodes in the vicinity of nebula and emits a pressure wave which passes through the nebular cloud. If an external pressure is pushing the cloud inwards, discuss if this would increase or decrease the minimum mass required for collapse?

(4p) Q.5. HR-DIAGRAM



Letter	Temperature	Luminosity	Color	Type of Star
A	6,000 k	10^{-1}		
B	20,000 k	10^{6}		
C	20,000 k	10^{-2}		
D	2,500k	10^{6}		
E	4000 k	10^{2}		

Plot the stars (A – E) on the HR diagram on the left. After plotting, determine their color and type and fill them in the table.

Q.6. Search Topic/Brain Storm: (10 points)

a. What is the story of Milky Way in Greek and Latin culture?

b. What is the story of "Samanyolu" in our culture? Why do we call it as "Samanyolu"? Give the story behind it.

c. Find out the mythological character of your birth day in Roman and Greek mythology and give the story of your character.

d. What is your planet corresponding to your birthday?

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* *Note:*

1. *Homework returned after due date will not be accepted.*
2. *Do not send scanned homework.*
3. *Do not use computer printer outputs for your homework. Use your handwriting.*
4. *Return your homework to the assistant at Room: Rotham ArGör Odası, No: 6. Class assistant is M. Barış Kelebek. kelebek15@itu.edu.tr*