BITS PILANI K K BIRLA GOA CAMPUS

MIDSEMESTER EXAM, IST SEM 2019-20
INTR. TO ASTRON. & ASTROPHY. (PHY F215), MM:60

$G = 6.7 \times 10^{-11}\ m^3\ kg^{-1}\ s^{-2}$, M (Sun) = 2×10^{30} kg

Q1: Consider two bodies in circular orbits about each other, with masses m_1 and m_2 and separated by a distance, **a**. The distance between the center of mass and m_1 is a_1 and between the center of mass and m_2 is a_2. **[25]**

a) The forces acting on the mass are the gravitational force and centripetal acceleration from its orbital motion. Derive Kepler's third law, to determine the total mass of the system as a function of average separation **a,** and orbital period **P**. **[6]**

b) For a distant binary system, it is be difficult to determine the separation of the two stars in the binary system. However, using spectroscopy, it might be possible to find the velocity of both of the stars (say v_1 and v_2) in the system. Using their respective velocities and orbital period **P**, derive the expression to determine the total mass of the system. **[6]**

c) Consider that the star is in orbit with a black hole and assume that the orbital plane is inclined at an angle θ with respect to the observer. Modify the equation in terms of velocity v_1 **only.** **[6]**

d) Consider the diagram here. The stars have a measured period of **4/3 years** and a separation distance of **4 A.U.** Use the observed velocities in the figure below to find the individual masses of the stars. What is their respective separation about the center of mass. **[3 + 4 = 7]**

Q2: A main sequence star **A** with radius **R = 7 X 10^8 m** and luminosity **L = 4 X 10^{26} W** is observed. **[7 + 3 + 5 = 15]**

a) Using the Stefan-Boltzman law, estimate the average surface temperature of the Star. (Stefans constant σ **= 5 X 10^{-8} W m^{-2} K^{-4}**)

b) Calculate the wavelength at which the star's spectra will peak, if approximated as a black body spectrum (**in A^0 unit**).

c) Another star **B** is twice as luminous as star **A** and radius twice of that of **A**. Estimate the temperature of star **B**.

Q3: Many of the solar activites are related to effect of magnetic field and the plasma. **[8 + 8 + 4 = 20]**

a) Derive the basic equation for solar magnetohydrodynamics to explain the concept of frozen magnetic field for the sun.

b) Define magnetic Reynold's number and its relevance to the sun.