ST. JOSEPH'S COLLEGE (AUTONOMOUS), BANGALORE-27
SEMESTER EXAMINATION - APRIL 2018
B.Sc. PHYSICS: VI SEMESTER
PH 6215: ASTRONOMY, ASTROPHYSICS AND NUCLEAR PHYSICS

TIME: $2\frac{1}{2}$HOURS MAX.MARKS: 70

Note: This question paper has 3 parts and 2 printed pages.

PART A

Answer any **FOUR**. Each question carries 10 marks. $[4 \times 10 = 40]$

1. (a) i) Mention any two astronomical sources that emit radiation predominantly in x-ray and in radio waves. What are the wavelength ranges of these windows? ii) Explain why γ ray observations of an astronomical source has to be carried out using a satellite. [4+1]
   (b) What do you understand by apparent, absolute, bolometric magnitudes and by *bolometric correction*? [5]
2. (a) Write a note on virial theorem. [4]
   (b) Obtain an expression connecting the luminosity and mass of a main sequence star. [6]
3. (a) With the help of a neat diagram, explain the importance of H-R diagram. [6]
   (b) What are white dwarfs? What do you understand by Chandrashekar mass limit of white dwarfs? [4]
4. (a) Derive an expression for the hydrostatic equilibrium of a sun like star. [5]
   (b) How was cosmic micro-wave back ground radiation detected? What is it's importance in cosmology? [5]
5. (a) Explain the important features of beta ray spectrum and how it lead to Pauli's neutrino hypothesis. [6]
   (b) What are the conservation laws that nuclear reactions should satisfy? [4]
6. With the help of a neat diagram, explain the working principle of a cyclotron. What are it's limitations? [10]

PART B

Answer any **FOUR**. Each question carries 5 marks. $[4 \times 5 = 20]$

[Given:- Planck's constant=6.626×10^{-34} J.s,G=6.674×10^{-11} m^3 kg^{-1} s^{-2}, 1 atomic mass unit(u) =1.6605×10^{-27} kg, mass of electron=9.11×10^{-31} kg, mass of proton=1.6726×10^{-27} kg, mass of neutron=1.6749×10^{-27} kg, Avogadro number$= 6.023\times10^{23}$ particles/mol, Boltzmann constant=1.38×10^{-23} J.K^{-1}, 1 curie=3.7×10^{10} disintegrations/second, Mass of sun (M$_\odot$)=2×10^{30} kg, Radius of sun(R$_\odot$)=7×10^8 m, L$_\odot$=3.828×10^{26} W, 1 parsec= 3.08×10^{16} m, 1 AU = 1.5×10^{11} m, Hubble's constant=72 km/s/Mpc]

7. Using Rayleigh criterion, estimate the theoretical diffraction limit for the angular resolution of a typical 20 cm amateur telescope at 550 nm. Express your answer in arcseconds. If the mean distance between the Earth and the Moon is 384.4×10^3 km, estimate the minimum size of a crater on the moon that can be resolved by this telescope. What will be the light gathering power of such a telescope compared to human eye having an aperture of 7 mm?

8. If the parallax of a star is 0.01 arcseconds, calculate it's distance modulus. If the apparent magnitude of this star is +3.14, what will be its absolute magnitude?

9. Estimate the life expectancy of sun, if the energy is generated by gravitational contraction. What will be the life expectancy of sun if the energy production is due to nuclear fusion reactions where 0.7% mass of two hydrogen atoms is converted into energy?

10. The redshift to a galaxy is 0.3. What will be the velocity at which this galaxy will be moving away from us? What will be the distance to this galaxy? At what wavelength will one observe the 21 cm atomic hydrogen line from this galaxy?

11. A container has 0.56 gm of ^{90}Sr having a half life of 28.8 years. Calculate the activity of the sample in curies.

12. Calculate the Q-value of the reaction $_7N^{14}(\alpha,p)_8O^{17}$ and hence determine its threshold energy. Given:- mass of $_7N^{14}$=14.00753u, mass of α= 4.00385 u,mass of $_8O^{17}$=17.0045 u

PART C

Answer any **FIVE** by giving the **correct reason** or **explanation**. Each question carries 2 marks. $[5 \times 2 = 10]$

13. (a) What effect will the introduction of the secondary mirror have on the image in the case of a Newtonian or Cassegrain telescope in comparison to the image formed at the prime focus of the telescope?
    (b) Even though the sunspots have a typical temperature of about 3500 K, which is close to the melting temperature of Tungsten, they appear dark on the solar surface. Why?
    (c) How do you know that solar corona has very high temperature in comparison to the photosphere of the sun?
    (d) Can we have the Hubble's tuning fork diagram of galaxies if observations are carried out in x-rays?
    (e) Element A has a half life period of 3 days while element B has a half life period of 3 years. If both these elements are alpha emitters, the alpha rays generated by which will have longer range?
    (f) Can the reaction $p^+ + p^+ \rightarrow p^+ + p^+ + n^0$ happen in nature?