MANIPAL
ACADEMY of HIGHER EDUCATION
(Deemed to be University under Section 3 of the UGC Act, 1956)

Reg. No.										

DEPARTMENT OF SCIENCES, III SEMESTER M.Sc
END SEMESTER EXAMINATIONS: 2020-21
PHY5051: FUNDAMENTALS OF ASTRONOMY AND ASTROPHYSICS (OPEN ELECTIVE)
(REVISED CREDIT SYSTEM)

Time: 3 Hours MAX. MARKS: 50

Note:

(i) Answer all the questions

(ii) Any missing data may be suitably assumed

(iii) Show all necessary steps, substitutions and calculations. Draw neat diagrams wherever necessary

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Useful data:

- 1 Light year = 9.461×10^{12} km
- 1 AU = 1.496×10^{8} km = 1.581×10^{-5} ly
- 1 parsec = 2.06×10^{5} AU = 3.26 light years
- Stephan-Boltzmann constant = 5.67×10^{-8} $Wm^{-2}K^{-4}$
- Wien's constant = 2.9×10^{6} nmK
- Radius of Sun = 696000 km
- Mass of Sun = 2×10^{30} kg
- The average density of Sun = 1410 kgm^{-3}
- Luminosity of Sun = 3.846×10^{26} W
- G = 6.674×10^{-11} Nm^2/kg^2
- k = 1.381×10^{-23} J/K
- Mass of Hydrogen atom = 1.67×10^{-27} kg
- Mass of Electron = 9.11×10^{-31} kg
- Planck's constant = 6.626×10^{-34} Js

1(a) The radius of a star is 1.5 times that of Sun. If its surface temperature is 9500 K, absolute and apparent magnitudes are +1.4 and -1.5 respectively, find (a) its distance from Earth in light years, (b) its luminosity and (c) stellar parallax produced by the star in arc seconds — 3 Marks

1(b) Explain how the radial velocity of a star can be determined from stellar spectra. — 2 Marks

1(c) Describe the internal structure of Sun with a neat diagram. Explain the granulation of the photosphere — 5 Marks

2(a) Explain how the energy is produced in stars through p-p chain, CNO cycle and triple alpha process — 5 Marks

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2(b) A neutron star has 1.8 times the solar mass and a radius of about 13 km. If the angular speed of the neutron star is about 2×10^9 times than of Sun, what is the angular momentum of the neutron star in terms of solar angular momentum? 2 Marks

2(c) In p-p chain, 0.71% of the original mass of hydrogen is lost. Assuming that the entire mass of Sun was made up of hydrogen at the time of its birth, calculate how long Sun can produce energy at the current rate through p-p chain. 3 Marks

3(a) Explain the production of electron degeneracy pressure in a white dwarf. Obtain an expression for electron degeneracy pressure (Neglect relativistic effects) 5 Marks

3(b) A giant spherical cloud, composed mainly of hydrogen atoms, has a density of $1.7 \times 10^{-16} kgm^{-3}$. If the temperature of the cloud is 45 K then, (a) what should be the minimum radius of the cloud so that it can be gravitationally bound? (b) what is the gravitational potential energy of the cloud with this minimum radius? 3 Marks

3(c) Why a typical white dwarf has very low opacity to radiation? Explain 2 Marks

4(a) Describe the formation of type I and type II supernovae 4 Marks

4(b) A PULSAR has a mass of 3.52×10^{30} kg and a time period of 0.1 s. If the kinetic energy of the PULSAR is $4 \times 10^{41} J$, what is its radius? If the period of the PULSAR is increasing at a rate of $2.5 \times 10^{-6} s/year$, find its lifetime. 3 Marks

4(c) Show that the fractional change in the period of a neutron star is equal to twice the fractional change in its radius 3 Marks

5(a) Describe the design and operation of Newtonian, Cassegrain and Coude type of telescopes with neat diagrams 5 Marks

5(b) Explain the cosmological principle. 2 Marks

5(c) Explain the classification of elliptical and spiral galaxies 3 Marks

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