

Roll No.

Total Printed Pages -09

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**M.Sc. (Fourth Semester)
EXAMINATION, May - June, 2022
PHYSICS
Paper Fourth (A)
(Astronomy and Astrophysics-II)**

Time : Three Hours]

[Maximum Marks:80

Note: Attempt all sections as directed.

**Section-A
Objective/Multiple Choice Questions
(1 mark each)**

Note: Attempt all question:

1. Elliptical galaxies are populated by-
 - (A) hot stars
 - (B) old stars
 - (C) O-B stars
 - (D) young stars

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2. The rotational velocity curve of disk galaxies remains fairly constant because of the presence of
 - (A) dark energy
 - (B) super massive Black Hole at the center
 - (C) Stellar mass Black Hole at the Center
 - (D) dark matter
3. AGNs produce energy through
 - (A) fusion
 - (B) fission
 - (C) accretion
 - (D) all of these
4. Seyfert galaxies are
 - (A) spiral galaxies
 - (B) active galaxies
 - (C) luminous galaxies
 - (D) all of these
5. An elliptical galaxy is represented by E_n , this means
 - (A) a/b increases with n
 - (B) a/b decreases with n
 - (C) a/b remains unchanged
 - (D) initially increases, then decreases

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6. Which galaxy has properties similar to the globular clusters?
- (A) S
 - (B) SB
 - (C) E
 - (D) Irr
7. For an E_6 galaxy
- (A) b is 60% to a
 - (B) b is 6% to a
 - (C) b is 4% to a
 - (D) a is 2.5 times b
8. Which telescope will be suitable for the rotation curve measurement towards the edges of galaxies?
- (A) X-ray Telescope
 - (B) UV telescope
 - (C) Optical telescope
 - (D) Radio Telescope
9. Galactic orbital radius of the Sun is-
- (A) 8.5 Kpc
 - (B) 8.5 Mpc
 - (C) 8.5 light years
 - (D) 8.5 AU

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10. Lyman-alpha ($\lambda_0 = 1216 \text{ \AA}$) UV line is emitted from a quasar at a redshift of $z=3$. This will appear to us as-
- (A) Yellow line due to Sun light
 - (B) we can not see because it is Ultra-Violet
 - (C) Microwave due to CMBR
 - (D) It will be blue in colour
11. Which telescope will be suitable to observe this line from quasar in Q. 10?
- (A) Ultra Violet telescope
 - (B) Microwave telescope
 - (C) Optical telescope
 - (D) We can not see this UV line, need to use space telescope.
12. Dark energy causes
- (A) Attraction in the Universe
 - (B) repulsion in the Universe
 - (C) neither attraction nor repulsion
 - (D) attraction in local but repulsion in distant Universe

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13. The early 'Universe after its creation expanded exponentially.' This is called
- (A) Big Bang
 - (B) Big Crunch
 - (C) Inflation
 - (D) Hubble's expansion
14. Neutrinos got spread in the early Universe. What should be its present temperature?
- (A) 3 K
 - (B) 1.5 K
 - (C) 6500 K
 - (D) 273 K
15. In the early Universe
- (A) $T \propto 1/S^4$
 - (B) $T \propto S$
 - (C) $T \propto 1/S^3$
 - (D) $T \propto 1/S$
16. In the primordial nucleosynthesis, Helium was synthesized in percentage of
- (A) ~25%
 - (B) ~50%
 - (C) ~75%
 - (D) ~35%

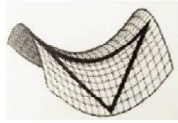
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17. Some of the angles in a triangle are less than 180 degrees. This indicates that
- (A) $\Omega < 1$
 - (B) $\Omega = 1$
 - (C) $\Omega > 1$
 - (D) It is not possible
18. Inflation was proposed by-
- (A) Alexander Friedmann
 - (B) W. de Sitter
 - (C) Alan Guth
 - (D) Albert Einstein
19. The universe will keep on expanding for a given geometry-
- (a)




Positive Curvature

(b)




Negative Curvature

(c)



Flat Curvature

(d)



No Curvature
- (A) Positive Curvature
 - (B) Negative Curvature
 - (C) Flat Curvature
 - (D) No Curvature

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20. The universe will keep on expanding if

- (A) $q < \frac{1}{2}$
- (B) $q = \frac{1}{2}$
- (C) $q > \frac{1}{2}$
- (D) $q = 0$

Section-B

Very Short Answer Type Questions

(2 mark each)

Note: Attempt all question:

1. Which profile does fit reasonably well with the elliptical galaxies? Discuss briefly.
2. What are the changes seen in the galaxy sequece of $Sa \rightarrow Sb \rightarrow Sc$.
3. What is the Einstein ring? How is this produced? Explain.
4. Why did the early Universe suddenly start expanding exponentially?
5. What is the temperature of the present universe? How has it been estimated?
6. Is it possible that all the angles of a triangle $A=B=C=90$ degrees. Justify your answer.
7. Why could nuclei like C, O, etc., not be formed in the early Universe?

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8. Why does the formation of deuteron require a low-density environment? What will happen in the high density?

Section-C

Short Answer Type Questions

(3 mark each)

Note: Attempt all question:

1. How is the 21cm line produced? Why is this line so important?
2. Find the size of the visible Universe. Compare the size of the Milky-way with the visible Universe.
3. Discuss Oort's theory of galactic rotation briefly.
4. Ca H&K lines ($\lambda_0 = 3969 \text{ and } 3934 \text{ \AA}$) are emitted from a quasar at $z=2$. What will happen when these lines' light reaches to the Earth?
5. Why did radiation get decoupled from matter? Why is this radiation seen today as microwave?
6. Rest mass of an electron is 0.511 MeV. Then at what temperature pair annihilation did take place? Why not at a higher temperature? (Note: $1\text{eV} = 10,000\text{K}$).
7. How can the age of the Universe be calculated theoretically (mention, do not calculate)? How can the age be estimated observationally (mention the method briefly).
8. Mention and explain briefly and phenomenon that does not favour steady-state theory.

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Section-D
Long Answer Type Questions

(5 marks each)

Note: Attempt all question:

1. Discuss the different classes of galaxies.

OR

Write a note on the Milky Way galaxy.

2. Prove that there exists a supermassive black hole at the center of an AGN. How much matter will this black hole accrete per year?

OR

Write a note on anyone of the AGNs.

3. Discuss the Friedmann model in detail.

OR

Write a note on General relativity.

4. Explain how can the theoretical models be tested observationally. Give an example of any such observational test.

OR

Discuss some evolutionary stages of the early Universe.