

KAMARAJ COLLEGE (Autonomous)

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(Affiliated to Manonmaniam Sundaranar University, Tirunelveli)

(3 Pages)

Reg. No:.....

Question Code: 26E00207

Course Code : 24UMMA41

UG Degree - End Semester Examinations, April 2026

Fourth Semester

B.Sc., MATHEMATICS

Sequence and Series

(For those who joined in July 2024 onwards)

Time : 3Hours

Maximum: 75 Marks

PART - A (10 × 1 = 10 Marks)

Answer ALL Questions

Choose the correct answer :

CO:1 1. The range of the sequence $0, 1, -1, 2, -2, \dots, n, -n$ is _____

- K:1
- (a) \mathbb{Z} (b) \mathbb{N}
(c) \mathbb{R} (d) \mathbb{Q}

CO:1 2. $\lim_{n \rightarrow \infty} \frac{n+1}{n} =$ _____

- K:2
- (a) 0 (b) 1
(c) n (d) ∞

CO:2 3. The sequence $(\frac{1}{n})$ is a _____

- K:1
- (a) Divergent sequence (b) Oscillating sequence
(c) Cauchy sequence (d) Bounded but not convergent sequence

CO:2 4. Any convergent sequence is _____

- K:1
- (a) Bounded (b) Unbounded
(c) Oscillating (d) Divergent

CO:3 5. The series $\sum (\frac{1}{2^n})$ converges to the sum _____

- K:2
- (a) e (b) 2
(c) 1 (d) 0

CO:3 6. The harmonic series $\sum \frac{1}{n^p}$ converges if _____

- K:1
- (a) $p > 1$ (b) $p < 1$
(c) $p = 1$ (d) $p > 0$

- CO:4 7. The series $\sum \frac{n^n}{n!}$ is _____
K:2
- (a) Divergent (b) Convergent
(c) Bounded (d) Oscillating
- CO:4 8. If $a_n = \frac{x^n}{n}$, then $\lim_{n \rightarrow \infty} \frac{a_n}{a_{n+1}} =$ _____
K:2
- (a) x (b) $\frac{1}{x}$
(c) x^2 (d) $\frac{n}{x}$
- CO:5 9. A series whose terms alternatively positive and negative is _____
K:1
- (a) Alternating (b) Increasing
(c) Decreasing (d) Convergent
- CO:5 10. The series $\sum \frac{(-1)^n}{n^2}$ is _____
K:2
- (a) Convergent (b) Absolutely convergent
(c) Divergent (d) Conditionally convergent

PART - B (5 X 5 = 25 Marks)

Answer ALL Questions choosing either (a) or (b).

Answer should not exceed 250 words.

- CO:1 11. (a) Prove that any convergent sequence is a bounded sequence.
K:4

(OR)

(b) Show that $\lim_{n \rightarrow \infty} \frac{3n^2 + 2n + 5}{6n^2 + 4n + 7} = \frac{1}{2}$.

- CO:2 12. (a) Show that if $r < 1$ then $(nr^n) \rightarrow 0$.
K:4

(OR)

(b) Prove that any convergent sequence is a Cauchy sequence.

- CO:3 13. (a) Let $\sum a_n$ converge to a , $\sum b_n$ converge to b . Then prove that
K:3 $\sum (a_n \pm b_n)$ converges to $a \pm b$ and $\sum ka_n$ converges to ka .

(OR)

(b) Discuss the convergence of the series

$$1 + \frac{1}{2^2} + \frac{2^2}{3^3} + \frac{3^3}{4^4} + \dots$$

- CO:4 14. (a) Test the convergence of the series $\frac{1}{3} + \frac{1.2}{3.5} + \frac{1.2.3}{3.5.7} + \dots$
K:3

(OR)

(b) Test the convergence of the series $\sum \frac{1}{n(\log n)^p}$.

CO:5 15. (a) Show that the series $\sum \frac{(-1)^{n+1}}{\log(n+1)}$ converges.

K:4

(OR)

(b) State and prove Abel's test.

PART - C (5 X 8 = 40 Marks)

Answer ALL Questions choosing either (a) or (b).

Answer should not exceed 500 words.

CO:1 16. (a) Prove that if $(a_n) \rightarrow a$ and $(b_n) \rightarrow b$ then

(a) $(a_n + b_n) \rightarrow (a + b)$.

K:4

(OR)

(b) Show that $\lim_{n \rightarrow \infty} \left(a^{\frac{1}{n}}\right) = 1$, where $a > 0$ is any real number.

CO:2 17. (a) State and prove Cauchy's first limit theorem.

K:4

(OR)

(b) Show that $\lim_{n \rightarrow \infty} \left(1 + \frac{1}{n}\right)^n = \lim_{n \rightarrow \infty} \left(1 + \frac{1}{1!} + \dots + \frac{1}{n!}\right) = e$.

CO:3 18. (a) Applying Cauchy's general principle of convergence, prove

(a) that $1 - \frac{1}{2} + \frac{1}{3} - \dots + (-1)^{n+1} \frac{1}{n} + \dots$ is convergent.

K:4

(OR)

(b) State and prove Comparison test.

CO:4 19. (a) State and prove Cauchy's root test.

K:4

(OR)

(b) Test the convergence of the series $\frac{1}{3}x + \frac{1.2}{3.5}x^2 + \frac{1.2.3}{3.5.7}x^3 + \dots$

CO:5 20. (a) State and prove Leibnitz's test.

K:4

(OR)

(b) Show that the series $\sum \frac{\sin n\theta}{n}$ converges for all values of θ .