VIVEKANANDA COLLEGE, TIRUVEDAKAM WEST
College with Potential for Excellence
Residential & Autonomous – A Gurukula Institute of Life-Training
Re-accredited (3rd Cycle) with 'A' Grade (CGPA 3.59 out of 4.00) by NAAC
[Affiliated to Madurai Kamaraj University]

B.Sc. Physics/Chemistry Degree (Semester) Examinations, November 2022
Part – III: Ability Enhancement Course: Third Semester: Paper – I
MATHEMATICS – I
Under CBCS and LOCF – Credit 4

Time: **3** Hours Max. Marks: **75**

SECTION – A

Answer ALL Questions **(10 × 1 = 10)**

1. The derivative of logx is_____

a) –x b) – 1 / x c) 1/x d) None

2. The value of $\cosh^2 x + \sinh^2 x$ is _____

a) 0 b) cosh2x c) 1 d) None

3. If g is the inverse function of function f then $g^1(f(x))$ is _____

a) f(x) b) $f^1(x)$ c) $1/f^1(x)$ d) None

4. The derivative of $\text{sech}^{-1}x$ is_____

a) $\frac{-1}{x\sqrt{x^2-1}}$ b) $\frac{1}{x\sqrt{x^2-1}}$ c) $\frac{1}{x\sqrt{1-x^2}}$ d) None

5. The value of $\int e^x dx$ _____is

a) $-e^x$ b) e^x c) e^{-x} d) None

6. The value of $\int \sinh x dx$ is

a) – coshx b) coshx c) cosech x d) None

7. The vectors $\vec{a}$ & $\vec{b}$ are parallel if $\vec{a} \times \vec{b} =$ _____

a) 0 b) 1 c) non zero d) None

8. The value of grad $(\phi \pm \psi)$ is

a) grad $(\phi) \mp$ grad (ψ) b) grad $(\phi) \times$ grad (ψ)

c) grad $(\phi) \pm$ grad (ψ) d) None

9. The value of sin (ix) = _____.

a) isinhx b) - isinhx c) sinhx d) None

10. The value of $1+ \tan^2\theta$ = _____.

a) $\cot^2\theta$ b) - $\sec^2\theta$ c) $\sec^2\theta$ d) None

SECTION – B

Answer any FIVE Questions **(5 × 2 = 10)**

11. Find $\lim_{x \to 0} \frac{2t}{x} \frac{x - \sin x}{x^3}$.

12. Prove that $\cos h^2 x - \sin h^2 x = 1$.

13. If $y = a\cos 2x + b\sin 3x$ then find $\frac{d^2y}{dx^2}$.

14. Evaluate $\int_0^{\frac{\pi}{2}} Cos^8 x\, dx$

15. If $\vec{A}$ and $\vec{B}$ are irrotational, then prove that $\vec{A} \times \vec{B}$ is solenoidal.

16. If v is the volume enclosed by a closed surface S and $\vec{F} = x\vec{i} + 2y\vec{j} + 3z\vec{k}$. Then show that $\int_s \vec{F}.\hat{n}\, ds = 6v$

17. Evaluate $\int_C \bar{A}\ x\ \bar{r}\ d\ \bar{r}$.

SECTION – C

Answer ALL Questions **(5 × 5 = 25)**

18. a) Express $\cos 8\theta$ in terms of $\sin\theta$.

[OR]

b) Express $\cos b^{-1}x$ in terms of logarithmic function.

19. a) If $y = ae^{mx} + be^{-mx}$, then show that $\frac{d^2y}{dx^2} - m^2 = 0$

[OR]

b) If $y = \frac{x+1}{x+2}$ then find $\frac{d^2y}{dx^2}$

20. a) Evaluate $\int_0^{2a} \int_0^{\sqrt{2ax - x^2}} xy\, dy\, dx$

[OR]

b) Evaluate $\int_0^1 \int_{y^2}^1 \int_0^{1-x} x\, dz\, dx\, dy$.

21. a) Find the directional derivative of $f = xyz$ at (1,1,1) in the direction of $\vec{i} + \vec{j} + \vec{k}$.

[OR]

b) If $\vec{F} = xz^3\vec{i} - 2x^2yz\vec{j} + 2yz^4\vec{k}$, then find curl $\vec{F}$ at (1, -1, 1)

22. a) If $\vec{F} = yz\vec{i} + zx\vec{j} + xy\vec{k}$ then find $\int_C \vec{F}.\vec{dr}$ where C is given by

$x = t, y = t^2, z = t^3$ from $P(0,0,0,)toQ(2,4,8)$.

[OR]

b) Evaluate by stoke's theorem $\int_C \left(e^x dx + 2ydy - dz\right)$.

SECTION – D

Answer any THREE Questions **(3 × 10 = 30)**

23. If $\cosh u = \sec\theta$, show that $u = \log\tan(\frac{\pi}{4} + \frac{\theta}{2})$.

24. If $x = a(\cos\theta + \theta\sin\theta)$ and $y = a(\sin\theta - \theta\cos\theta)$ then find $\frac{d^2y}{dx^2}$.

25. Evaluate $\int \cos^7 x\, dx$ using reduction formula.

26. Find the directional derivative of $\phi = x^2yz + 4xz^2$ at (1, 1, 1) in the direction of $\vec{i} + \vec{j} + \vec{k}$.

27. Evaluate by Green's theorem $\int_C e^{-x}(\sin y\, dx + \cos y\, dy)$ where C is the rectangle with vertices $(0,0),(\pi,0),(\pi,\frac{\pi}{2}),(0,\frac{\pi}{2})$.

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B.Sc. Mathematics Degree (Semester) Examinations, November 2022
Part – III: Ability Enhancement Course: Third Semester: Paper – I

PROGRAMMING IN PYTHON

Under CBCS and LOCF – Credit 4

Time: **3** Hours Max. Marks: **75**

SECTION – A

Answer ALL Questions **(10 × 1 = 10)**

1. All keywords in Python are in _____

   a) Capitalized b) lower case

   c) UPPER CASE d) None of the mentioned

2. What does pip stand for python?

   a) Preferred Instruction Program b) Private Institution Program

   c) Preferred Installer Program d) Private Induction Program

3. Which of the following statements is used to create an empty set in Python?

   a) set| | b) set[ ] c) set{ } d) set()

4. What is output of print(math.pow(3, 2))?

   a) 9.0 b) 8.0 c) 9 d) 8

5. Which of the following keyword is used to define the function testpython(): ?

   a) define b) pass c) def d) while

6. Defining strings within triple quotes allows creating:

a) Single line Strings b) Multiline Strings

c) Double line Strings d) Multiple Strings

7. If List=[10,20,30,40,50] then List[2]=35 will result

a) [35,10,20,30,40,50] b) [10,20,30,40,50,35]

c) [10, 20, 35, 40, 50] d) [10,35,30,40,50]

8. Which statement is generally used as a placeholder?

a) continue b) break c) pass d) goto

9. What will be the output of the following Python code?

1. >>>t=(1,2,4,3) 2. >>>t[1:-1]

a) (1, 2) b) (1, 2, 4) c) (2, 4) d) (2, 4, 3)

10. How many edges does a leaf cluster contain?

a) 0 b) 1 c) 2 d) 3

SECTION – B

Answer any FIVE Questions **(5 × 2 = 10)**

11. Define program.

12. State any two rules for naming variables.

13. List any four math functions.

14. Define encapsulation.

15. Elucidate len function with example.

16. What is Zip?

17. Illustrate the work of the operators + and * in List operation.

SECTION – C

Answer ALL Questions **(5 × 5 = 25)**

18. a) Summarize on Arithmetic operators.

[OR]

b) Illustrate the order of operations with example.

19. a) Recall about stack diagram.

[OR]

b) Explicate Boolean functions.

20. a) Describe multiple assignment.

[OR]

b) Discuss on two-dimensional table.

21. a) How will you compare strings?

[OR]

b) Explain Map, Filter and Reduce.

22. a) Describe about tree traversal.

[OR]

b) Recapitulate Mutability and tuples.

SECTION – D

Answer any THREE Questions **(3 × 10 = 30)**

23. Differentiate between formal and natural languages.

24. Critically analyse how to add new functions and its flow of execution.

25. Illustrate the working of while statement with example.

26. How to traverse elements and delete elements in a list?

27. Summarize on Tuple assignment and tuple as return values.

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B.Sc. Mathematics Degree (Semester) Examinations, November 2022
Part – III: Core Course: First Semester: Paper – I
ALGEBRA AND TRIGONOMETRY
Under CBCS and LOCF – Credit 4

Time: **3** Hours Max. Marks: **75**

SECTION – A

Answer ALL Questions **(10 × 1 = 10)**

1. If $x^3+4x+2=0$ has roots as α,β&γ then $\sum\alpha =$ _____

a) zero b) 1 c) 2 d) None

2. In an equation $x^n + 1 = 0$ has no real roots if n is _____

a) zero b) odd c) even d) None

3. _____ = $\left(\sum\alpha\right)^2 \sum\alpha\beta - \sum\alpha^2\beta\gamma$

a) $\sum\alpha\beta^2$ b) $\sum\alpha^3\beta$ c) $\sum\alpha\beta\gamma$ d) None

4. $\sum\alpha^3 = \left(\sum\alpha\right)^3 - 9$_____

a) $\sum\alpha\beta^2$ b) $\sum\alpha^2\beta$ c) $\left(\sum\alpha\right)^2$ d) None

5. In a reciprocal equation, the grouping of terms x + 1/x replaced by _____

a) z b) – z c) 1/ z d) None

6. An equation f(x) = 0 cannot have more _____ roots than there are changes of sign in f(x).

a) two b) – ve c) + ve d) None

7. The value of sinh(iπ/2) is _____

a) 1 b) 0 c) i d) None

8. The real part of cosh(α+iβ) is _____

a) cosh α cos β b) cosh α + cos β c) cosh α - cos β d) None

9. The expansion of sinh2x = _____

a) sinhxcoshx b) 2 sinhxcoshx c) - 2 sinhxcoshx d) None

10. The value of $\log\left(\frac{2+3i}{2-3i}\right)$ is _____

a) real number b) complex number c) rational number d) None

SECTION – B

Answer any FIVE Questions **(5 × 2 = 10)**

11. State Remainder Theorem.

12. How many roots for an equation f(x) = 0 of the n^{th} degree.

13. Find the quotient and remainder when $3x^3+8x^2+8x+12$ is divided by $x-4$.

14. Write Rolle's Theorem.

15. Write the formula for $\tan n\theta$ is power of $\tan\theta$.

16. Prove that $\cosh^2 x-\sinh^2 x=1$ using exponential functions.

17. Write the formula for $\log_e(x+iy)$.

SECTION – C

Answer ALL Questions **(5 × 5 = 25)**

18. a) Form a rational cubic equation which shall have the roots $1, 3-\sqrt{-2}$.

[OR]

b) Change the equation $2x^4-3x^3+3x^2-x+2=0$ into another the coefficient of whose highest term will be unity.

19. a) Diminish the roots of $x^4-5x^3+7x^2-4x+5=0$ by 2.

[OR]

b) Find the equation whose roots are squares of the roots of $x^4+x^3+2x^2+x+1=0$.

20. a) Determine completely the nature of the roots of the equation $x^5-6x^2-4x+5=0$.

[OR]

b) Find the multiple roots of the equation $x^4-9x^2+4x+1z=0$.

21. a) Expand $\frac{\sin 6\theta}{\sin\theta}$ in terms of $\cos\theta$.

[OR]

b) If $\cosh u=\sec\theta$, Show that $u=\log\tan(\frac{\pi}{4}+\frac{\theta}{2})$.

22. a) Find $Log(1-i)$

[OR]

b) Prove that $\pi=2\sqrt{3}\left\{1-\frac{1}{3^2}+\frac{1}{5}-\frac{1}{3^2}-\frac{1}{7}-\frac{1}{3^3}+....\right\}$

SECTION – D

Answer any THREE Questions **(3 × 10 = 30)**

23. Find the condition that the roots of the equation $ax^3+3bx^2+3cx+d=0$ may be in geometric progression solve the equation $27x^3+42x^2-28x-8=0$ whose roots are in geometric progression.

24. Solve the equation $6x^5-x^4-43x^3+43x^2+x-6=0$.

25. Calculate the root to three places of decimals, the equation $x^3-3x+1=0$ has a root between 1 and 2.

26. Show that $\cos\frac{\pi}{9}.\cos\frac{2\pi}{9}.\cos\frac{4\pi}{9}=\frac{1}{8}$.

27. Sum to infinity the series $\cos\alpha+\frac{1}{2}\cos(\alpha+\beta)+\frac{1.3}{2.4}\cos(\alpha+2\beta)+....$

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B.Sc. Mathematics Degree (Semester) Examinations, November 2022
Part – III: Core Course: First Semester: Paper – II

DIFFERENTIAL CALCULUS

Under CBCS and LOCF – Credit 4

Time: **3** Hours Max. Marks: **75**

SECTION – A

Answer ALL Questions **(10 × 1 = 10)**

1. The derivative of cosecx is_____

a) –cosecx cotx b) cot x

c) – cot x d) None

2. The derivative of sinhx is_____

a) – coshx b) coshx c) cosechx d) None

3. The derivative of $\tan^{-1}x$ is_____

a) $\frac{1}{\sqrt{1-x^2}}$ b) $\frac{-1}{\sqrt{1-x^2}}$

c) $\frac{1}{1+x^2}$ d) None

4. If x = tanθ, then $\frac{2x}{1+x^2}$ is

a) sin2θ b) cos2θ c) tan2θ d) None

5. The value of $D^n(e^{ax})$ is_____

a) n e^{ax} b) a^n e^{ax}

c) e^{ax-1} d) None

6. The radius of curvature of the curve in parametric form x= f(θ) and y=g(θ) is_____

a) $\frac{\left(x'^2+y'^2\right)^{\frac{3}{2}}}{x'y''-x''y'}$ b) $\frac{\left(x'y''-y'x''\right)^{\frac{3}{2}}}{\left(x'^2+y'^2\right)^{3/2}}$

c) $\frac{\left(x'y''+y'x''\right)^{\frac{3}{2}}}{\left(x'^2+y'^2\right)^{3/2}}$ d) None

7. The evolute of the cycloid $x=a(\theta-\sin\theta)$ and $y=a(1-\cos\theta)$ is_____

a) a circle b) a straight c) another cycloid d) catenary

8. If z = f(u), where u = g(x,y) then $\frac{\partial z}{\partial y}$ is_____

a) $\frac{dz}{du}.\frac{\partial u}{\partial y}$ b) $\frac{\partial z}{\partial u}.\frac{\partial u}{\partial x}$ c) $\frac{\partial z}{\partial y}.\frac{\partial y}{\partial u}$ d) None

9. The expression for tan hx is

a) $\frac{e^x+e^{-x}}{e^x-e^{-x}}$ b) $\frac{e^x-e^{-x}}{e^x+e^{-x}}$ c) $\frac{e^{ix}-e^{-ix}}{i(e^{ix}+e^{-ix})}$ d) None

10. Under usual notations, which one is correct?

a) φ = ψ + θ b) θ = ψ + φ c) ψ = φ + θ d) None

SECTION – B

Answer any FIVE Questions **(5 × 2 = 10)**

11. Find $\frac{d}{dx}\left(e^x\sin x\right)$.

12. Prove that $\cosh^2 x-\sinh^2 x=1$.

13. Find y_n if y = e^{ax} .

14. Prove that the sub-tangent to the curve y = a^x is of constant length.

15. What is the cartesian formula for radius of curvature?

16. Write the formula for Pedal equation of a curve.

17. If xy = c^2, find $\frac{dy}{dx}$.

SECTION – C

Answer ALL Questions **(5 × 5 = 25)**

18. a) If y = $(2x^2+4)^3$, find $\frac{dy}{dx}$.

[OR]

b) Show that $y=\log\left(x+\sqrt{x^2+1}\right)$ when $y=\sinh^{-1}x$

19. a) Find y_n where $y=\frac{3}{(x+1)(2x-1)}$.

[OR]

b) If $xy=ae^x+be^{-x}$ prove that $x\frac{d^2y}{dx^2}+2\frac{dy}{dx}-xy=0$.

20. a) Show that in the curve $r=ae^{\theta\cot\alpha}$

i) the polar sub-tangent = $r\tan\alpha$ ii) the polar subnormal = $r\cot\alpha$

[OR]

b) Find the envelope of the family of circles $\left(x-a^2\right)+y^2=2a$, where a is the parameter.

21. a) What is the radius of curvature of the curve $x^4 + y^4 = 2$ at the point (1 ,1)?

[OR]

b) Prove that the p-r equation of the cardioid $r = a(1-\cos\theta)$ is $p^2 = \frac{r^3}{2a}$

22. a) If $u = \log\left(x^3 + y^3 + z^3 - 3xyz\right)$, show that $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = \frac{3}{x+y+z}$

[OR]

b) Verify Euler's theorem when $u = x^3 + y^3 + z^3 + 3xyz$.

SECTION – D

Answer any THREE Questions **(3 × 10 = 30)**

23. If $x(1+y)^{\frac{1}{2}} + y(1+x)^{\frac{1}{2}} = 0$, prove that $\frac{dy}{dx} = -\frac{1}{1+x^2}$.

24. Find the n^{th} differential co-efficient of $\sin^2 x \cos^3 x$.

25. Find $\frac{ds}{d\theta}$ and $\frac{ds}{dr}$ for the cardioids $r = a(1+\cos\theta)$.

26. Show that the evolutes of the cycloid $x = a(\theta - \sin\theta)$; $y = a(1 - \cos\theta)$ is another cycloid.

27. If $u = \tan^{-1}\frac{x^3 + y^3}{x - y}$, prove that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = \sin 2u$.

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B.Sc. Mathematics Degree (Semester) Examinations, November 2022

Part – III: Core Course: Third Semester: Paper – I

DIFFERENTIAL EQUATIONS

Under CBCS and LOCF – Credit 4

Time: **3** Hours Max. Marks: **75**

SECTION – A

Answer ALL Questions **(10 × 1 = 10)**

1. The general form of Bernoulli's equation is _____

a) $\frac{dy}{dx} + Qy = Py^n$ b) $\frac{dy}{dx} + Py = Qy^n$

c) $\frac{dy}{dx} = Qy^n$ d) $\frac{dy}{dx} = Py^n$.

2. The integrating factor of the differential equation $y(xy + 2x^2y^2)dx + x(xy - x^2y^2)dy = 0$ is_____

a) $\frac{1}{3x^2y^2}$ b) $\frac{1}{3x^3y^2}$ c) $\frac{1}{3x^2y^3}$ d) $\frac{1}{3x^3y^3}$

3. The Particular integral of $(D^2 - 9)y = \cos x$ is _____

a) $\frac{\cos x}{10}$ b) $-\frac{\cos x}{10}$ c) $\frac{\cos x}{8}$ d) $-\frac{\cos x}{8}$

4. The Particular integral of the differential equation $(D^2 - 4)y = 0$ is ____

a) 1 b) 2 c) 3 d) 0

5. The general solution of the simultaneous differential equation $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$ is _____, if $u = c$ and$v = c_1$ are the solutions of this equation

a) $\phi(u, v) = 0$ b) $\phi(-u, v) = 0$

c) $\phi(u, -v) = 0$ d) $\phi(-u, -v) = 0$

6. The value of $L(cos\ at) =$

a) $\frac{s}{s^2+a^2}$ b) $\frac{a}{s^2+a^2}$ c) $\frac{s}{s^2-a^2}$ d) $\frac{a}{s^2-a^2}$

7. The value of $L\left\{\frac{f(t)}{t}\right\} =$

a) $\int_s^\infty F(s)dt$ b) $\int_s^\infty F(s)ds$ c) $\int_0^\infty F(s)dt$ d) $\int_0^\infty F(s)ds$

8. The value of $L^{-1}\left(\frac{4}{(s-3)^2-16}\right) =$

a) $e^{-3t}\ sinh\ 4t$ b) $e^{-3t}\ sin\ 4t$

c) $e^{3t}\ sin\ 4t$ d) $e^{3t}\ sinh\ 4t$

9. In a partial differential equation, t denotes

a) $\frac{\partial^2 z}{\partial x^2}$ b) $\frac{\partial^2 z}{\partial y^2}$ c) $\frac{\partial^2 z}{\partial x \partial y}$ d) $-\frac{\partial^2 z}{\partial x^2}$

10. In an equation $z = (x+a)^2 + (y+b)^2,\ s =$

a) 2 b) -2 c) -1 d) 0

SECTION – B

Answer any FIVE Questions **(5 × 2 = 10)**

11. Eliminate c from y = c x + c – c^3.

12. Solve $(D^2 + 5D + 4)\ y = 0$.

13. Find the particular integral of $(D^2 + 5D + 6)\ y = e^x$.

14. Solve the equation $\frac{dx}{yz} = \frac{dy}{zx} = \frac{dz}{xy}$.

15. Find L ($t\ e^{-at}$).

16. Write the formula for $L^{-1}\left[\frac{s}{s^2+a^2}\right]$.

17. Eliminate a and b from z = (x+a) (y+b).

SECTION – C

Answer ALL Questions **(5 × 5 = 25)**

18. a) Solve $y^2 + x^2\frac{dy}{dx} = xy\frac{dy}{dx}$.

[OR]

b) Solve $\frac{dy}{dx} + y\cos x = \frac{1}{2}\sin 2x$.

19. a) Solve $(D^2 + 16)\ y = \cos 4x$.

[OR]

b) Solve $(D^2 + D + 1)\ y = x^2$.

20. a) Solve the equations $2\frac{dx}{dt} + x + \frac{dy}{dt} = \cos t; \frac{dx}{dt} + 2\frac{dy}{dt} + y = 0$.

[OR]

b) Solve yz (ax + y + z) dx + zx (x + ay + z) dy + xy (x + y + az) dz = 0.

21. a) Find L($t\ e^{-t} \sin t$).

[OR]

b) Find $L^{-1}\left[\frac{s}{\left(s^2-1\right)^2}\right]$.

22. a) Solve p = 2qx.

[OR]

b) Solve p + q = x + y.

SECTION – D

Answer any THREE Questions **(3 × 10 = 30)**

23. Solve $\frac{dy}{dx} - y\tan x = \frac{\sin x \cos^2 x}{y^2}$.

24. Solve $3x^2 \frac{d^2y}{dx^2} + x\frac{dy}{dx} + y = x$.

25. Solve $\frac{d^2y}{dx^2} + y = \sec x$.

26. Solve the equation $\frac{d^2y}{dx^2} + 2\frac{dy}{dx} - 3y = \sin t$ given that $y = \frac{dy}{dt} = 0$

when t = 0.

27. Solve $x^2 \frac{\partial z}{\partial x} + y^2 \frac{\partial z}{\partial y} = (x + y)z$.

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B.Sc. Mathematics Degree (Semester) Examinations, November 2022
Part – III: Core Course: Third Semester: Paper – II

NUMERICAL METHODS

Under CBCS and LOCF – Credit 4

Time: **3** Hours Max. Marks: **75**

SECTION – A

Answer ALL Questions **(10 × 1 = 10)**

1. An iteration method the condition for the convergence of the sequence to the root is

a) $\varphi(x)=c$ b) $|\varphi'(x)|=1$ c) $|\varphi'(x)|<1$ d) $|\varphi'(x)|>1$

2. One root of $3x-1-\cos x=0$ lies is the interval _____.

a) $\left(\pi/2,\pi\right)$ b) $\left(0,\pi/2\right)$ c) $\left(-\pi/2,0\right)$ d) None

3. Newton Raphson's iteration formula is _____.

a) $x_n=x_0-\dfrac{f(x_n)}{f'(x_n)}$ b) $x_{n+1}=x_n-\dfrac{f(x_n)}{f'(x_n)}$

c) $x_n=x_{n-1}-\dfrac{f'(x_n)}{f(x_n)}$ d) None

4. If the interval of differencing is unity, then $\nabla^2 x^2$ is _____.

a) $2x-1$ b) $2x+1$ c) 2 d) None

5. $\dfrac{E^{1/2}+E^{-1/2}}{2}=$ _____.

a) μ b) δ c) D d) None

6. Gauss forward interpolation formula is used to interpolate the values of y for _____.

a) $0 < p < 1$ b) $-1 < p < 0$ c) $-\frac{1}{2} < p < \frac{1}{2}$ d) None

7. First divided difference $[x_1, x_2] =$ _____.

a) $\frac{y_1 - y_0}{x_1 - x_0}$ b) $\frac{y_2 - y_1}{x_2 - x_1}$ c) $\frac{x_2 - x_1}{y_2 - y_1}$ d) None

8. Angular acceleration = _____.

a) $\frac{d^2\theta}{dt^2}$ b) $\frac{d\theta}{dt}$ c) $\frac{d^2s}{dt^2}$ d) None

9. The error is Simpson's $\frac{1}{3}$ rule is of order _____.

a) $\hbar^2$ b) $\hbar^3$ c) h^4 d) None

10. Euler's method is less efficient is practical problems, since it required _____ to be small.

a) x b) $\hbar$ c) p d) None

SECTION – B

Answer any FIVE Questions **(5 × 2 = 10)**

11. What is the order of convergence of Newton's Raphson formula.

12. Write Newton - Raphson formula to obtain the cube root of N.

13. Write the Newton's backward interpolation formula.

14. Write Stirling's formula.

15. What is the error in Simpson's one third rule?

16. Write Newton-cote's quadrature formula.

17. Write the second order Runge-kutta formula.

SECTION – C

Answer ALL Questions **(5 × 5 = 25)**

18. a) Find by Newton-Raphson method correct to 4 decimal places the root between 0 and 1 of the equation $3x - \cos x - 1 = 0$.

[OR]

b) Solve the equations x+y=2 and 2x+3y=5 by Gauss-elimination method.

19. a) Find the n^{th} difference of $e^{x.}$

[OR]

b) Construct Newton's forward interpolation polynomial for the following data.

x	4	6	8	10
y	1	3	8	10

Use it to find the value of y for x=5.

20. a) Find $y'(x)$ given

x	0	1	2	3	4
y(x)	1	1	15	40	$\overline{85}$

Hence find $y'(x)\, at\, x = 0.5$

[OR]

b) From the following data obtain the first derivative of $y = \log e^x\, at\, x = 500.$

x	500	510	520	530	540	550
$y = \log e^x$	6.2146	6.2344	6.2538	6.2729	6.2916	6.3099

21. a) Evaluate $\int_0^5 \frac{dx}{4x+5}$ by Trapezoidal rule using 11 coordinates.

[OR]

b) Calculate $\int_{0.5}^{0.7} e^{-x} x^{1/2} dx$ using Simpson's $\frac{1}{3}$ rule by taking 5 ordinates.

22. a) Solve $\frac{dy}{dx} = 1 - y, y(0) = 0$ using Euler's method. Find y at x=0.1 and x=0.2

[OR]

b) Write the formula for third order and fourth order Runge-Kutta method.

SECTION – D

Answer any THREE Questions **(3 × 10 = 30)**

23. Find the inverse of the matrix $A = \begin{pmatrix} 2 & 1 & 1 \\ 3 & 2 & 3 \\ 1 & 4 & 9 \end{pmatrix}$ using Gaussian method.

24. The following data given the melting point of zinc and lead, ϑ is the temperature and x are the percentage of lead. using Newton's interpolation formula find i) ϑ when x=48 ii) ϑ when x=84.

x	40	50	60	70	80	90
ϑ	184	204	226	250	276	304

25. The following are the number of deaths in four successive ten-year age groups. Calculate the number deaths at 45 - 50.

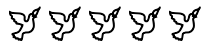
Age Group	25-35	35-45	45-55	55-65
No. of details	13229	18139	24225	31496

26. Evaluate $\int_0^1 \frac{dx}{1+x}$ using i) Trapezoidal rule

ii) Simpson's one third rule iii) Simpson's three eight rule

iv) Weddle's rule v) Find the error in each method by comparing with the actual integration up to 4 places od decimals. Take $h = \frac{1}{6}$ for all cases.

27. Using Runge-kutta method of fourth order find y(0.1), y(0.2) and y(0.3), given that $\frac{dy}{dx} = 1 + xy, y(0) = 2.$



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B.Sc. Mathematics Degree (Semester) Examinations, November 2022
Part – III: Core Course: Fifth Semester: Paper – I
STATISTICS
Under CBCS and LOCF – Credit 5

Time: **3** Hours Max. Marks: **75**

SECTION – A

Answer ALL Questions **(10 × 1 = 10)**

1. If $\gamma = 0$, then the lines of regression are _____.

a) Parallel b) equal c) perpendicular d) None

2. If the two variables deviate in the same direction, the correlation is said to be

a) direct b) inverse c) perfect d) None

3. Any sub set A of a sample space S is called

a) Event b) Possible event c) Sure event d) None

4. The distribution function F(x) = _____

a) $P(X \geq x)$ b) $P(X \leq x)$ c) $P(X = x)$ d) None

5. If X_1& X_2 are independent R.V then $\phi_{(X_1+X_2)}(t)$ = _____.

a) $\phi_{X_1}(t)\ \phi_{X_2}(t)$ b) $\phi_{X_1}(t)+\phi_{X_2}(t)$ c) $\phi_{X_1}(t)/\phi_{X_2}(t)$ d)None

6. The M.G.F of a binomial distribution about the origin

a) $\left(p+qe^{t}\right)^{n}$ b) $\left(q+pe^{-t}\right)^{n}$ c) $\left(q+pe^{t}\right)^{n}$ d) None

7. Which relation is correct

a) $\gamma_1 = \sqrt{\beta_1}$ b) $\gamma_2 = \beta_2 - 3$ c) $\beta_2 = \frac{\mu_4}{\mu_2^2}$ d) all

8. If Z follows N(0,1), then p.d.f is

a) $\phi(z) = \frac{1}{\sqrt{2\pi}} e^{\frac{z^2}{2}}$ b) $\phi(z) = e^{-\frac{z^2}{2}}$

c) $\phi(z) = \frac{1}{\sqrt{2\pi}} e^{-\frac{z^2}{2}}$ d) None

9. _____ confidence limits for μ are $\left(\bar{x} - \frac{s.t_{.05}}{\sqrt{n-1}}, \bar{x} + \frac{s.t_{.05}}{\sqrt{n-1}}\right)$

a) 94% b) 95% c) 96% d) None

10. In χ^2 test, the population variance is _____.

a) S^2 b) N^2 c) σ^2 d) None

SECTION – B

Answer any FIVE Questions **(5 × 2 = 10)**

11. Find the variance of the first *n* natural numbers.

12. Prove that arithmetic mean of the regression coefficients is greater than or equal to the correlation coefficient.

13. The chance of X solving a particular problem is $^2/_3$ and that of Y solving the problem is ¾. What is the probability that the problem is solved if they try independently?

14. Let X have the p.d.f. $f(x) = \begin{cases} \frac{x+2}{18} & if -2 < x < 4 \\ 0 & otherwise \end{cases}$. Compute $E[(X+2)^2]$.

15. A discrete random variable X has the mean 6 and variance 2. If it is assumed that the distribution is binomial, determine the probability that $5 \leq X \leq 7$.

16. Define null hypothesis and an alternative hypothesis. Also list the error which may arise in testing a hypothesis.

17. Test the hypothesis that σ = 8 given that s = 10 for a random sample of size 51.

SECTION – C

Answer ALL Questions **(5 × 5 = 25)**

18. a) From the following data of marks obtained by 10 students in Physics and Chemistry, calculate the rank correlation coefficient.

Physics(P)	35	56	50	65	44	38	44	50	15	26
Chemistry(C)	50	35	70	25	35	58	75	60	55	35

[OR]

b) The two variables *x* and *y* have the regression lines *3x+2y –26 = 0* and *6x+y –31 = 0*.

Estimate: i) the mean values of *x* and *y*. ii) the correlation coefficient between *x* and *y*. and *iii*) the variance of *y* if the variance of *x* is 25.

19. a) The contents of three urns are

Urn I : 1 white 3 red 2 black balls

Urn II : 3 white 1 red 1 black balls

Urn III : 3 white 3 red 3 black balls

Two balls are chosen from a randomly selected urn. If the balls are 1 white and 1 red ball, compute the probability that they come from Urn II.

[OR]

b) A random variable X has the probability function $(x) = \frac{1}{2^x}$, $x = 1, 2, 3, \ldots$. Find its

i) Moment generating function ii) mean iii) variance.

20. a) Derive a recurrence formula for the moments of a binomial distribution.

[OR]

b) Find the mean, median and mode for a normal distribution N (μ, σ^2).

21. a) A group of 10 rats fed on a diet A and another group of 8 rats fed on a different diet B recorded the following increase in weight in grams:

Diet A	5	6	8	1	12	4	3	9	6	10
Diet B	2	3	6	8	1	10	2	8	-	-

Test whether Diet A is superior to Diet B.

[OR]

b) In one sample of 8 observations the sum of the squares of deviations of the sample values from the sample mean was 84.4 and in another sample of 10 observations it was 102.6. Test whether the difference in variances is significant at 5% level using F – test.

22. a) In an experiment of pea, a scientist got the following frequencies of seeds. Round yellow: 315; wrinkled yellow : 101; round and green : 108; wrinkled green: 32; total : 556. Theory predicts that the frequencies should be in the proportion 9 : 3 : 3 : 1. Examine the correspondence between theory and experiment.

[OR]

b) The following table gives the classification of 100 workers according to their gender and nature of work.

Nature of Work / Gender	**Skilled**	**Unskilled**	**Total**
Male	40	20	60
Female	10	30	40
Total	50	50	100

SECTION – D

Answer any THREE Questions **(3 × 10 = 30)**

23. Find β_1 and β_2 for the following data and hence discuss the nature of the distribution.

x	0	1	2	3	4	5	6
f	5	15	17	25	19	14	5

24. A random variable X has the following probability function:

x	-2	-1	0	1	2	3
$p(x)$	0.1	k	0.2	$2k$	0.3	k

Evaluate: (i) the value of k (ii) mean (iii) variance (iv) $P(X \geq 2)$

(v) $P(-1 < X < 3)$.

25. i) A set of examination marks is approximately distributed with a mean 75 and S.D. 5. If the top 5% of students get Grade A and the bottom 25% get Grade B, what mark is the lowest A and what mark is the highest B?
ii) Assuming that one in 80 births is a case of twins, calculate the probability of 2 or more births of twin on a day when 30 births occur using binomial distribution and Poisson distribution.

26. Two random samples give the following results:

Sample	**Size**	**Sample Mean**	**Sum of squares of deviation from mean**
I	10	15	90
II	12	14	108

Test whether the samples could have come from the same normal population.

27. Fit a Poisson distribution for the following data and test the goodness of fit:

x	0	1	2	3	4	5	6
f	273	70	30	7	7	2	1

SECTION – D

Answer any THREE Questions **(3 × 10 = 30)**

23. Find β_1 and β_2 for the following data and hence discuss the nature of the distribution.

x	0	1	2	3	4	5	6
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Test whether the samples could have come from the same normal population.

27. Fit a Poisson distribution for the following data and test the goodness of fit:

x	0	1	2	3	4	5	6
f	273	70	30	7	7	2	1

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B.Sc. Mathematics Degree (Semester) Examinations, November 2022
Part – III: Core Course: Fifth Semester: Paper – II

MODERN ALGEBRA

Under CBCS and LOCF – Credit 4

Time: **3** Hours Max. Marks: **75**

SECTION – A

Answer ALL Questions **(10 × 1 = 10)**

1. Let S be a finite set with n elements. The number of elements in the largest equivalence relation on S is_____
   a) n b) n^2 c) 2n d) 3n
2. The range of the function f : R→ R given by $f(x) = 1$ is_____
   a) 1 b) R c){1} d) ϕ
3. Let f :A→B and g:B→C be two functions such that (g$o$$f$) :A→C is onto then g is_____
   a) 1-1 b) onto
   c) 1-1 and onto d) neither one-one nor onto
4. Let H, K be subgroups of a group G. Then_____
   a) H$\cup$K is a subgroup of G b) H$\cap$K is a subgroup of G
   c) H$\times$K is a subgroup of G d) HK is a subgroup of G
5. In the group $(Q^*, .)$the inverse of 1 is_____
   a) -1 b) 0 c) 1 d) none
6. The group S_n has …. elements
   a) n b) n! c) $\frac{n!}{2}$ d) n_{c2}
7. The kernel of homomorphism f: G→ G' is_____
   a) a subgroup of G' b) a normal subgroup of G'
   c) a normal subgroup of G d) {e}

8. The kernel of homomorphism f:(R*,.)→ $(R^+,.)$ define by f(x)= $|x|$ is___

a) {1} b) $\{-1\}$ c) {0} d) {1.-1}

9. The algebraic structure which is not a ring is_____

a) (Z, +, .) b) (Q,+,.) c) (R, +, .) d) (R,.,+)

10. Any ordered integral domain is of characteristic_____

a) 1 b) 0 c) infinite d) prime

SECTION – B

Answer any FIVE Questions **(5 × 2 = 10)**

11. Define equivalence relation on a set.
12. When we say two elements are comparable in a set?
13. Define symmetric group.
14. State Fermat's theorem
15. Give any two examples for normal group.
16. Show that $R^*/\{1,-1\} \cong R^+$
17. When do we say ana ideal is principal ideal?

SECTION – C

Answer ALL Questions **(5 × 5 = 25)**

18. a) Show that the union of two equivalence relations need not be an equivalence relation.

[OR]

b) Prove that "Any partition of a set S determines an equivalence relation ℓ such that the members of the partition are precisely the equivalence classes defined by ℓ"

19. a) Let G be a group and $a,b \varepsilon G.$ Then prove that the equations ax=b and y a=b has unique solutions for x and y in G.

[OR]

b) Let G be a finite set with an associative binary operation defined on G in which both cancellation laws hold good. Then Prove that G is a group.

20. a) Let G be a group and a be on element of order n in G. Then Prove that $a^m = c iff$ n divides M.

[OR]

b) State and Prove Euler's theorem.

21. a) Prove that "Isomorphism preserves the order of each element in a Group"

[OR]

b) State and Prove "Fundamental theorem of homeomorphism in Groups".

22. a) Prove that "A ring R has no Zero-divisors iff cancellation law is valid in R".

[OR]

b) Let R be a commutative ring with identity. Then Prove that R is a field iff R has no Zero proper ideals.

SECTION – D

Answer any THREE Questions **(3 × 10 = 30)**

23. If $f: A \to B and\ g: B \to C$ are bijections then Prove that $^{-}(gof)^{-1} = f^{-1}og^{-1}.$

24. Prove that "The union of two subgroups of a group G is a subgroup iff one is contained in the other".

25. Prove that "A subgroup N of G is normal iff the product of two right cosets of N is again a right coset of N".

26. Prove that "Isomorphism is an equivalence relation among groups".

27. Let R be a commutative ring with identity. Then Prove that an ideal M of R is maximal iff R/M is a field.

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B.Sc. Mathematics Degree (Semester) Examinations, November 2022
Part – III: Core Course: Fifth Semester: Paper – III
REAL ANALYSIS
Under CBCS and LOCF – Credit 4

Time: **3** Hours Max. Marks: **75**

SECTION – A

Answer ALL Questions **(10 × 1 = 10)**

1. Two sets A and B are equivalent if there exists a _____ from A to B.

a) injection b) bijection

c) surjection d) homomorphism

2. In **R** with usual metric choose the incorrect statement from the following statements where d denotes the diameter of the subset of **R** concerned _____

a) d (**N**) = ∞ b) d (**Q**) = ∞

c) d ({1,3,5,7,9}) = 5 d) d ([-3,5]) = 8

3. Let (M,d) be a metric space. Let A and B be subsets of M. The incorrect statement is _____

a) A is open $\Leftrightarrow$ A = Int A b) $A \subseteq B \Rightarrow Int\ A \subseteq Int\ B$

c) Int (A U B) = Int A U Int B d) Int (A $\cap$ B) = Int A $\cap$ Int B

4. If $\overline{A}$ denotes the closure of A in a metric (M,d) the incorrect statement is _____

a) $\Phi = \overline{\phi}$ b) $\left(\overline{\overline{A}}\right) = \overline{A}$ c) M = $\overline{M}$ d) None

5. In C with usual metric, let A = {z / |z|<1}. Then the derived set D(A) is given by _____

a) {z / |z|>1} b) {z / |z|≤1} c) A d) {z / |z|≥1}

6. In R^2 with usual Euclidean metric, an open ball is _____

a) an open interval

b) an open square with sides parallel to the coordinate axes

c) an open circular disc d) an open rectangle

7. In R with usual metric Int ($\overline{Q}$) is_____

a) Φ b) **Q** c) $\mathbf{Q^c}$ d) **R**

8. A connected subset of **R** containing more than one point is _____

a) bounded b) finite c) uncountable d) countable

9. In a discrete metric space, the only connected subsets are _____

a) Finite sets b) the whole set

c) singleton sets d) all proper subsets

10. Choose the correct statement _____

a) **Q** is connected b) **R** is connected

c) A subspace of a connected space is connected

d) If A and B are connected subsets of a metric space M then AUB is connected

SECTION – B

Answer any FIVE Questions **(5 × 2 = 10)**

11. If d is a metric on M, prove that $\sqrt{d}$ is a metric on M.

12. In R with usual metric prove that $(0, 1)$ is an open set.

13. In R with usual metric prove that $[1, 3]$ is a closed set.

14. Prove that A is closed iff $A = \bar{A}$

15. Prove that in R with usual metric any finite subset A is nowhere dense.

16. Prove that any discrete metric space M with more than one point is disconnected.

17. Prove that any compact metric space is totally bounded.

SECTION – C

Answer ALL Questions **(5 × 5 = 25)**

18. a) Let M be the set of all sequences in R. Let $x, y \in M$ and let $x = (x_n)$ and $y = (y_n)$. Define $d(x, y) = \sum_{n=1}^{\infty} \frac{|x_n - y_n|}{2^n(1+|x_n - y_n|)}$. Prove that d is a metric on M.

[OR]

b) Define open ball in a metric space and prove that in any metric space (M, d) each open ball is an open set.

19. a) Let (M, d) be a metric space. Let $A, B \subseteq M$. Prove the following:

i) $A \subseteq B \Rightarrow \bar{A} \subseteq \bar{B}$ ii) $\overline{A \cup B} = \bar{A} \cup \bar{B}$ iii) $\overline{A \cap B} \subseteq \bar{A} \cap \bar{B}$

[OR]

b) Let M be any metric space and $A \subseteq M$. Prove that $\bar{A} = A \cup D(A)$.

20. a) Prove that a subset A of a complete metric space M is complete iff A is closed.

[OR]

b) Prove that any complete metric space is of second category.

21. a) Let M be a metric space. Let A be a connected subset of M. If B is a subset of M such that $A \subseteq B \subseteq \overline{A}$ prove that B is connected.

[OR]

b) i) Prove that any continuous image of a connected set is connected.

ii) Let f be a real valued continuous function defined on an interval I. Prove that f takes every value between any two values it assumes.

22. a) Prove that any compact subset A of a metric space (M, d) is closed.

[OR]

b) Prove that any continuous mapping f defined on a compact metric space (M_1, d_1) into any other metric space (M_2, d_2) is uniformly continuous on M_1.

SECTION – D

Answer any THREE Questions **(3 × 10 = 30)**

23. State and prove the Holder's inequality.

24. Let M be a metric space and M_1 a subspace of M. Let $A_1 \subseteq M_1$. Prove that A_1 is open in M_1 iff there exists an open set A in M such that $A_1 = A \cap M_1$.

25. Let M be a metric space. Prove that M is complete iff for every sequence (F_n) of non empty closed subsets of M such that $F_1 \supseteq F_2 \supseteq \cdots \supseteq F_n \supseteq \cdots$ and $\big(d(F_n)\big) \to 0$, $\bigcap_{n=1}^{\infty} F_n$ is non empty.

26. Prove that a subspace of R is connected iff it is an interval.

27. Prove that a metric space M is compact iff any family of closed sets with finite intersection property has non empty intersection.

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B.Sc. Mathematics Degree (Semester) Examinations, November 2022
Part – III: Core Course: Fifth Semester: Paper – IV

STATICS

Under CBCS and LOCF – Credit 4

Time: **3** Hours Max. Marks: **75**

SECTION – A

Answer ALL Questions **(10 × 1 = 10)**

1. When the body tend to separate out the force is _____
   a) Attraction b) repulsion c) contraction d) None
2. The converse of the _____ of forces is not true.
   a) Triangle b) Polygon c) Parallelogram d) None
3. Moment of a force about a point is _____ if the force is zero.
   a) Constant b) Zero c) vector d) None
4. Two equals unlike parallel forces not acting at the same point is said to constitute a _____
   a) Force b) couple c) moment d) None
5. If three coplanar forces acting on a rigid body keep it in equilibrium, they must be _____ or be parallel.
   a) Two of them parallel b) concurrent
   c) non concurrent d) None
6. If the resultant of $\overline{OA}$, $\overline{OB}$ is $2\overline{OC}$ then C is _____.
   a) Centroid of ΔOAB b) orthocenter of ΔOAB
   c) midpoint of AB d) None
7. When one body in contact with another is in equilibrium, the friction exerted is just sufficient to maintain equilibrium and is called _____.
   a) Dynamical b) statical c) limiting d) None
8. Semi vertical angle in the cone of friction is _____.
   a) Any angle b) angle of friction c) 90^0 d) None

9. Intrinsic equation of the catenary _____.

a) $c = s \tan \psi$ b) $s = c \tan \psi$ c) $\tan \psi = sc$ d) None

10. Each interior angle of a regular hexagon

a) 100^0 b) 120^0 c) 180^0 d) None

SECTION – B

Answer any FIVE Questions **(5 × 2 = 10)**

11. ABCD and A'B'C'D' are parallelograms. Prove that forces $\overline{AA'}, \overline{B'B}, \overline{CC'}, \overline{D'D}$ acting at a point will keep it at rest.

12. State and prove the triangle of forces.

13. Prove that a couple and a single force acting on a body are equivalent to the single force acting at some other point parallel to its original direction.

14. Find the resultant of two like parallel forces acting on a rigid body.

15. Write the procedure to be followed in solving any statistical problem.

16. State the laws of friction.

17. The span of a suspension bridge is 100 metre and the sag at the middle of the chain is 10 metres. If the total load on each chain is 750 quintals, find the greatest tension in each chain and tension at the lowest point.

SECTION – C

Answer ALL Questions **(5 × 5 = 25)**

18. a) State and prove the Lami's theorem.

[OR]

b) The resultant of two forces P, Q acting at a certain angle is X and that of P, R acting at the same angle is also X. The resultant of Q, R acting again at the same angle is Y. Prove that $P = (X^2 + QR)^{\frac{1}{2}} = \frac{QR(Q+R)}{Q^2+R^2-Y^2}$.

19. a) ABC is an equilateral triangle of side a. D, E, F divide the sides BC, CA, AB respectively in the ratio 2:1. Three forces each equal to P act at D, E, F perpendicularly to the sides and outward from the triangle. Prove that they are equivalent to a couple of moment $\frac{1}{2}Pa$.

[OR]

b) Two men carry a load of 224 kg. wt. which hangs from a light pole of length 8 m. each end of which rests on a shoulder of one of the men. The point from which the load is hung is 2 metres nearer to one man than the other. What is the pressure on each shoulder?

20. a) If D is any point on the base BC of triangle ABC such that $\frac{BD}{DC} = \frac{m}{n}$ and $\angle ADC = \theta$, $\angle BAD = \alpha$ and $\angle DAC = \beta$, then prove that $(m + n) \cot \theta = m \cot\alpha - n \cot\beta$ and $(m + n) \cot \theta = n \cot B - m \cot C$.

[OR]

b) Forces 3, 2, 4, 5 kg wt. act respectively along the sides AB, BC, CD and DA of a square. Find the magnitude of their resultant and the points where its line of action meets AB and AD.

21. a) A body is at rest on a rough plane inclined to the horizon at an angle greater than the angle of friction and is acted upon by a force, parallel to the plane and along the line of greatest slope. Find the limits between which the force must lie.

[OR]

b) A uniform ladder is in equilibrium with one end resting on the ground and the other against a vertical wall. If the ground and wall be both rough, the coefficients of friction being μ and μ' respectively, and if the ladder be on the point of slipping at both ends, show that the inclination θ of the ladder to the horizon is given by $\tan\theta = \frac{1-\mu\mu'}{2\mu}$.

22. a) A string hangs under gravity and is so loaded that the weight on each element of it is proportional to the horizontal projection of that element. Show that it will hang in the form of a parabola.

[OR]

b) A uniform chain of length l is to be suspended from two points in the same horizontal line so that either terminal tension is n times that at the lowest point. Show that the span must be $\frac{l}{\sqrt{n^2-1}}\log(n + \sqrt{n^2-1})$.

SECTION – D

Answer any THREE Questions **(3 × 10 = 30)**

23. ABC is a given triangle. Forces P, Q, R acting along the lines OA, OB, OC are in equilibrium Prove:

i) $P : Q : R = a^2(b^2 + c^2 - a^2) : b^2(c^2 + a^2 - b^2) : c^2(a^2 + b^2 - c^2)$ if O is the circumcentre of the triangle.

ii) $P : Q : R = \cos\frac{A}{2} : \cos\frac{B}{2} : \cos\frac{C}{2}$ if O is the incentre of the triangle.

24. State and prove Varigon's theorem of moments.

25. A uniform rod of length *a* hang against a smooth vertical wall being supported by means of a string, of length *l*, tied to one end of the rod, the other end of the string being attached to a point in the wall. Show that the rod can rest inclined to the wall at an angle θ given by $cos^2\theta = \frac{l^2 - a^2}{3a^2}$.

26. A ladder 20 metre long with its centre of gravity 8 metre up from the bottom, weighs 60 kg and rests at an angle of θ to the ground against a smooth vertical wall. The coefficient of friction between the ladder and the ground is ½. Find the least value of θ which will enable a man weighing 140 kg to reach the top without the ladder slipping.

27. A telegraph wire stretched between two poles at a distance *a* feet apart, sags *n* feet in the middle. Prove that the tension at the ends is approximately $w\left(\frac{a^2}{8n} + \frac{7n}{6}\right)$ where *w* is the weight of unit length of the wire.

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B.Sc. Mathematics Degree (Semester) Examinations, November 2022
Part – III: Elective Course: Fifth Semester: Paper – I

LINEAR PROGRAMMING

Under CBCS and LOCF – Credit 5

Time: **3** Hours Max. Marks: **75**

SECTION – A

Answer ALL Questions **(10 × 1 = 10)**

1. Which of the following is not correct about LPP?

a) All constraints must be linear relationships.

b) Objective function must be linear

c) All the constraints and decision variable must be of either $'\leq'$ or $'\geq'$ tybe

d) All decision variable must be non-negative.

2. Which of the following is not correct?

a) Feasible solution of an LPP is independent of the objective function.

b) The feasible region of an LPP must be a convex set.

c) The feasible region for a constraint is restricted if its$\geq$ or $\leq$sign is replaced by a $=$ sign.

d) It is not possible to obtain feasible solution of an LPP by graphical method.

3. A necessary and sufficient condition for a basic feasible solution to a minimization LPP to be an optimum is that (for all j):

a) $z_j - c_j \geq 0$ b) $z_j - c_j \leq 0$

c) $z_j - c_j = 0$ d) $z_j - c_j > 0$ or$z_j - c_j < 0$

4. Which of the following is not correct?

a) An LPP may have no optimum solution, a unique and optimum solution, multiple optimum solution or an unbounded solution

b) In the optimum solution to an LPP if a basic variable is zero, then multiple optimum solutions are indicated

c) Multiple optimum solutions to an LPP would all have the same objective function values and would consume the same amount of the resources

d) The inverse of a square matrix can be obtained by using *Simplex method*

5. The right-hand side constant of a constraint in a primal problem appears in the corresponding dual is

a) a coefficient in the objective function

b) a right-hand side constant of a constraint in a dual problem

c) an input-output coefficient d) none of the above

6. The number of primal constraints is equal to the number of _____

a) dual variables b) dual constraints

c) both a and b d) none of them

7. While solving the T.P the occurrence of degeneracy means that

a) Total supply equals total demand

b) The solution so obtained is not feasible

c) The few allocations become negative

d) None of the above

8. In a T.P, existence of a feasible solution if and only if _____

a) total supply = total demand b) total supply< total demand

c) total supply> total demand

d) total supply not equal to total demand

9. In an assignment problem, origin is called

a) resources b) activity c) destination d) basis

10. In making assignments, which of the following should be preferred

a) Only that row which have single zero

b) Only that column which have single zero

c) Only a row/column that have single zero

d) Only column having more than zero

SECTION – B

Answer any FIVE Questions **(5 × 2 = 10)**

11. Define decision variable.

12. What do you mean Basic Feasible solution?

13. State Basic duality theorem in Liner Programming.

14. When do we say a set containing a loop?

15. What is two-person zero-sum games?

16. Define objective function of the general L.P.P.

17. What do you mean Assignment Problem?

SECTION – C

Answer ALL Questions **(5 × 5 = 25)**

18. a) What are the steps involved in mathematical formulation of a linear Programming Problem?

[OR]

b) Use the graphical method to solve the following L.P.P.

Maximize; $Z = 2x_1 + 3x_2$; Subject to the Constraints;

$x_1 + x_2 \le 30,\ x_1 - x_2 \ge 0,\ x_2 \ge 3$

$0 \le x_1 \le 20$ *and* $0 \le x_2 \le 12$

19. a) Let $x_1 = 2, x_2 = 2$ *and* $x_3 = 1$ be a feasible solution to the system of equations $2x_1 - x_2 + 2x_3 = 2$ $x_1 + 4x_2 = 18$. Reduce the given feasible solution to a basic feasible solution.

[OR]

b) Use two-phase simpler method to maximize $Z = 5x_1 + 3x_2$

Subject to the constraints: $2x_1 + x_2 \le 1$, $x_1 + 4x_2 \ge 6$ *and* $x_1, x_2 \ge 0$

20. a) Write the dual of the L.P.P Minimize $Z = 4x_1 + 6x_2 + 18x_3$

Subject to the constraints: $x_1 + 3x_2 \ge 3$, $x_2 + 2x_3 \ge 5$ *and* $x_1, x_2, x_3 \ge 0$

[OR]

b) Prove that the dual of the dual is the Primal.

21. a) Obtain an initial basic feasible solution to the following transportation problem using the north-west corner rule.

	D	E	F	G	Available
A	11	13	17	14	250
B	16	18	14	10	300
C	21	24	13	10	400
Requirements	200	225	275	250	

[OR]

b) Obtain an initial basic feasible solution to the following T.P using the matrix minima method:

	D1	D2	D3	D4	Capacity
O1	1	2	3	4	6
O2	4	3	2	0	8
O3	0	2	2	1	10
Demand	4	6	8	6	

Where Oi and Dj denote i^{th} origin and j^{th} destination respectively.

22. a) A department head has four subordinates and four tasks to be performed. The subordinates differ in efficiency, and the tasks differ in their intrinsic difficulty. His estimate, of the time each man would take to perform each task, is given in the matrix below:

Tasks	Men			
	E	F	G	H
A	18	26	17	11
B	13	28	14	26
C	38	19	18	15
D	19	26	24	10

How should the tasks be allocated, one to a man, so as to minimize the total man-hours?

[OR]

b) Determine the range of value of P and Q that will make the payoff element q22, a saddle point for the game whose payoff matrix (aii) is given below:

$$\begin{array}{c} \\ \textit{Player A} \end{array} \begin{array}{c} \textit{Player B} \\ \begin{bmatrix} 2 & 4 & 5 \\ 10 & 7 & q \\ 4 & p & 8 \end{bmatrix} \end{array}$$

SECTION – D

Answer any THREE Questions **(3 × 10 = 30)**

23. A company makes two kinds of leather belts. Belt A is a high-quality belt, and belt B is of lower quality. the respective profits are ₹ 4.00and ₹ 3.00 per belt. Each belt of type A requires twice as much time as a belt of type B, and if all belts were of type B, the company could make 1000 belt per day. The supply of leather is sufficient for only 800 belts per day (Both A and B combined). Belt A requires a fancy buckle and only 400 buckles per day are available. There are only 700 buckles a day available for belt B. Determine the optimal product mix.

24. Use penalty (or Big M) method to

Maximize $Z = 6x_1 + 4x_2$ Subject to the Constraints:

$2x_1 + 3x_2 \le 30, 3x_1 + 2x_2 \le 24, x_1 + x_2 \ge 3$ $x_1 \ge 0$ *and* $x_2 \ge 0$. Is the solution unique? If not, give two different solutions

25. Obtain the dual problem of the following Primal Problem:

Minimize $Z = x_1 - 3x_2 - 2x_3$ Subject to the Constraints:

$3x_1 - x_2 + 2x_3 \le 7, 2x_1 - 4x_2 \ge 12, -4x_1 + 3x_2 + 8x_3 = 10$

$x_1, x_2 \ge 0$ *and* x_3. is unrestricted.

26. Use Vogel's Approximation Method to obtain an initial basic feasible solution of the transportation problem:

	D	E	F	G	Available
	11	13	17	14	250
	16	18	14	10	300
	21	24	13	10	400
Demand	200	225	275	250	

27. A company wishes to assign 3 jobs to 3 machines in such a way that each job is assigned to some machine and no machine works on more than one job. The cost of assigning job i to machine j is given by the matrix below (ij^{th} entry):

Cost matrix $\begin{bmatrix} 8 & 7 & 6 \\ 5 & 7 & 8 \\ 6 & 8 & 7 \end{bmatrix}$

Draw the associated network. Formulate the network LPP and find minimum cost of making the assignment.

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B.A. & B.Sc. Degree (Semester) Examinations, November 2022
Part – IV: Generic Elective Course: First Semester: Paper – I
FUNDAMENTALS OF MATHEMATICS
Under CBCS and LOCF – Credit 2

Time: **2** Hours Max. Marks: **75**

SECTION – A

Answer ALL Questions **(10 × 1 = 10)**

1. $5^4/5^2$ is equal to _____

a) 5^4 b) 4^5 c) 5^2 d) 125^2

2. The decimal value of the ratio 4:20 is _____

a) 0.1 b) 0.2 c) 0.3 d) 0.4

3. The slope of the straight-line $ax+by+c=0$ is

a) c / a b) 1 / 3 c) 1 / 4 d) – a / b

4. The distance between (0, 0) and (6,8) points is _____

a) 5 b) 10 c) 20 d) 30

5. The fifth term of GP 3, 6, 12,… is

a) 28 b) 25 c) 82 d) 48

6. The ratio between any terms to the previous term of GP is _____

a) Common difference b) Ratio

c) Common ratio d) Terms

7. A matrix with equal number of rows and columns is called _____

a) Square Matrix b) Rectangular Matrix

c) Index d) Row Matrix

8. Find the Identity matrix

a) $\begin{pmatrix} 0 & 0 & 1 \\ 0 & 0 & 1 \\ 0 & 1 & 1 \end{pmatrix}$ b) $\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$ c) $\begin{pmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{pmatrix}$ d) $\begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}$

9. The Equation of the second degree is called_____

a) Cubic equation b) Simultaneous equation

c) Linear equation d) Quadratic equation

10. The equation with highest index for the variable as 2 is called_____

a) Quadratic equation b) Cubic equation

c) Simultaneous equation d) Linear Equation

SECTION – B

Answer any FIVE Questions **(5 × 2 = 10)**

11. Evaluate $(5a^2)^3$?

12. Find the **compound ratio** for 3:2 and 4:5?

13. Calculate the **distance** between the points (3, 7) and (4, 8)?

14. Find the **slope** of the joining the two points (-3, 2) and (6, 7)?

15. If A = $\begin{pmatrix} 1 & 4 \\ 2 & 3 \end{pmatrix}$ and B = $\begin{pmatrix} 2 & 3 \\ 1 & 5 \end{pmatrix}$, find 2A – 3B?

16. Find the **15^{th} term** in the A.P series 2, 8, 14, 20, …?

17. Find the **third** proportion to 15 and 75?

SECTION – C

Answer ALL Questions **(3 × 9= 27)**

18. a) Monthly income of **A** and **B** are in the ratio of **5:6** and their expenses in the ratio **4:5**. If each save Rs 200 per month, find their incomes?

[OR]

b) Simplify: $\frac{2^5 X 8^2 X 4^3}{2X64^2}$

19. a) Find the value of x when (x+2) : (x-3) = (x+8) : (x-1)

[OR]

b) Check the parallelogram A (8, 0), B (4, 0), C (5, 1) and D (9, 1).

20. a) Solve $2x^2+9x+10=0$.

[OR]

b) Find the sum of series 51+52+53+--------- +100.

SECTION – D

Answer any TWO Questions **(2 × 14 = 28)**

21. A and B can do piece of work in 10 days, B and C in 15 days and A and C in 20 days. All of them work at it for 2 days and then A leaves. After 4 days of work, B leaves. In how many days will C complete the reaming work?

22. If A=$\begin{pmatrix} 1 & 0 \\ 2 & 1 \end{pmatrix}$, B=$\begin{pmatrix} 1 & 2 \\ -1 & 3 \end{pmatrix}$, C=$\begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix}$ then find $A^2+B^2+2AB+2C$?

23. Show that the points (8,-10), (7,-3) and (0,-4) are the vertices of a right angled triangle?

24. If A= $\begin{pmatrix} 1 & 5 & 2 \\ 3 & -2 & 4 \\ 6 & 2 & 1 \end{pmatrix}$ then find A^{-1}?

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B.Sc. Mathematics Degree (Semester) Examinations, November 2022
Part – IV: Skill Enhancement Course: Third Semester: Paper – I
COMPETITIVE MATHEMATICS
Under CBCS and LOCF – Credit 2

Time: **2** Hours Max. Marks: **75**

SECTION – A

Answer ALL Questions **(10 × 1 = 10)**

1. The highest common factor of 36 and 84 is_____

a) 4 b) 6 c)12 d)18

2. The value of $\sqrt{6561}$

a)77 b) 81 c)87 d) 91

3. The value of x is $\sqrt[3]{x+\sqrt[3]{5+\sqrt[3]{27}}}$ =3 _____

a) 25 b)27 c)8 d)64

4. The ages of Samina and Suhana are in the ratio 7:3 respectively. After 6 years, the ratio of their ages will be 5:3. What is the difference in their ages?

a) 6 b)8 c)10 d)12

5. Formula for Loss_____

a) SP-CP b) CP-SP c) SP+CP d) CP-Loss

6. Which of the following is a pair of co-prime?

a) (16,62) b) (18,25) c) (21, 35) d) (23,92)

7. The cube root of 0.000216 is _____

a) 0.6 b) 0.06 c) 0.006 d) None of these

8. Sohan started a business with a capital of ₹ 80000. After 6 months Mohan joined as a partner by investing ₹ 65000. After one year they earned total profit ₹ 20000. What is share of Sohan in the profit?

a) ₹ 5222.2 b) ₹ 14222.2 c) ₹ 6222.2 d) ₹ 6777.7

9. The income is divided between four person P, Q, R and S in the ratio 6:10:16:18 respectively. The share of S is 3744 more than the share of P. Find the total income of Q & R together?

a) 8112 b) 4165 c) 8056 d) 7065

10. A: B: C is in the ratio of 3: 2: 5. How much money will C get out of ₹ 1260?

a) 252 b)125 c) 503 d) None of these

SECTION – B

Answer any FIVE Questions **(5 × 2 = 10)**

11. Reduce $\frac{391}{667}$ to lowest terms.

12. Evaluate $\sqrt{248+\sqrt{51+\sqrt{169}}}$.

13. Find the cube root of 2744.

14. Find HCF of 2923 and 3239.

15. The ratio of the ages of Tina and Rakesh is 9:10 respectively. Ten years ago, the ratio of their ages 4:5 respectively. What is the present age of Rakesh?

16. If 10% of x is equal to 20% of y then find $x:y$?

17. A, B and C are partners. They have invested ₹ 35000, ₹ 25000 and ₹ 10,000 respectively for the same period. If the total profit is ₹ 18000, find the share of A.

SECTION – C

Answer ALL Questions **(3 × 9= 27)**

18. a) Find HCF and LCM of $\frac{9}{10}, \frac{12}{25}, \frac{18}{35}$ and $\frac{21}{40}$.

[OR]

b) i) The traffic lights at three different road crossing change after every 48 sec, 72 sec and 108 sec, respectively. If they all change simultaneously at 8:20:00 hours, then at what time will they again change simultaneously?

ii) Find the HCF and LCM of 84,100, 120.

19. a) Evaluate: i) $\sqrt{175.2976}$ ii) $\sqrt{1000}$.

[OR]

b) i) The age of a man 10 years ago was thrice the age of his son. 10 years hence, the man age will be twice the age of his son. What is the ratio of present age?

ii) The product the ages of Arun and Karun is 240. If twice the age of Arun is more than Karun age by 4 years, then find Arun and Karun ages and also find their ages ratio?

20. a) Write the formula for gain and loss percentage and find SP, when

i) CP=₹ 56.25, Gain=20% ii) CP=₹ 80.40, loss=15%.

[OR]

b) A, B and C enter into partnership with capitals of ₹ 25000, ₹ 30000 and ₹ 15000 respectively. A is the working partner and he gets 30% of the profit for managing the business. The balance profit is distributed in proportion to the capital investment. At the year end, a get ₹ 200 more than B and C together. Find the total profit and the share of each.

SECTION – D

Answer any TWO Questions **(2 × 14 = 28)**

21. i) Evaluate $\sqrt{6084}$ by factorization method.

ii) Find the value of $\sqrt{4}$ up to three places of decimal.

22. i) Discovery the HCF of 513, 1134 and 1215 using division algorithm.

ii) Find the LCM of 16, 24,36 and 54.

23. i) Sobha's father was 38 years of age when she was born while her mother was 36 years old when her brother four years younger to her was born. What is the difference between the ages of Shoba's parents?

ii) A television manufacturing earns 20% profit by selling each TV, set for ₹14400. If the production cost is increased by 15%, what should be the new selling price of a set so as to a) gain 15% b) loss 27%.

24. i) A person covers the different distances by train, bus, and car in the ratio of 4: 3: 2. The ratio of the fair is 1: 2: 4 per km. The total expenditure as a fair is ₹720. Find the total expenditure as fare on the train.

ii) Ramesh and Suresh enter into a partnership with capitals in the ratio of 10:12. At the end of 8 months, Ramesh withdraws. If they receive profits in the ratio of 10:18. Find how long Suresh's capital was used.

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B.A., B.Sc., B.Com. & B.Com.(CA) Degree (Semester) Examinations, November 2022

QUANTITATIVE APTITUDE

Time: **2** Hours **CERTIFICATE COURSES** Max. Marks: **50**

SECTION – A

Answer ALL Questions **(10 × 1 = 10)**

1. Write any two logarithms formula.
2. A and B together can complete a piece of works in 15 days and B alone in 20 days. In how many days can A alone complete the work?
3. A train travel 82.6 km/hr. How many meters will travel it in 15 minutes?
4. If $\log_{\sqrt{8}} x = 3\frac{1}{3}$, find the value of x.
5. If January 1, 1996, was Monday, what day of the week was January 1, 1997?
6. What is the compound interest on ₹ 2500 for 2 years at rate of interest 4% per annum?
7. A train moving at speed of 90 km/hrs. crosses a pole in 7 seconds. Find the length of the train.
8. Write the formula for speed and distance.
9. Write the formula for simple interest.
10. Convert: i) 10 km in m ii) 5 hours in seconds.

SECTION – B

Answer ALL Questions **(4 × 5 = 20)**

11. a) A and B can do a piece of work in 9 days; B and C can do it 12 days; A and C can do it in 18 days. In how many days will A, B and C finish it, working together and separately?

[OR]

b) Vikas and Mohan working together can complete a work in 6 days. If Vikas alone complete the same work in 10 days, in how many days Mohan alone can complete the same work?

12. a) A dog takes 4 leaps for every 5 leaps of hare but 3 leaps of a dog are equal to 4 leaps of the hare. Compare their speeds?

[OR]

b) A clock is set at 4am. It loses 16 minutes in 24 hours. What will be the correct time when the clock indicates 9pm on the 4th day?

13. a) i) It was Saturday on January 1, 2005. Find the day of the week on January 1, 2010.
ii) If it was Wednesday on March 1, 2006, which day was it on March 1, 2002?

[OR]

b) Ramesh borrowed ₹ 3600 at a certain rate of interest C.I. and the sum grows to ₹ 4624 in 2 years. What is the rate of interest?

14.a) A train of length 100 meters is moving at a speed of 70 km/hr. In what time it will cross a man who is walking at 10 km/hrs. in the same direction?

[OR]

b) A man buys ₹ 20 shares paying 9% dividend. The man wants to have an interest of 12% on his money. Find the market value of each share.

SECTION – C

Answer any TWO Questions **(2 × 10 = 20)**

15.i) A can do a work in 4 days, B in 5 days and c in 10 days. Find the time taken by A, B and C to do the same work together.

ii) A farmer travelled from his village to city to buy seeds. He went by bicycle at a speed of 20 km/hrs. and came back at a speed of 5 km/hr. If the farmer took 5 hours and 40 minutes to complete his journey, find the distance between village and city?

16.i) A watch which gains uniformly is 5 minutes slow at 6am on Monday and is 5 minutes 48 seconds fast at 6pm on the following Monday. When was it correct?

ii) The simple interest on a certain sum of money at rate of interest 5% per annum for 2 years is ₹ 500. What is the compound interest on the same sum for the same period and at the same rate of interest?

17.i) A man sitting in a train which is running at a speed of 100 km/hrs. saw a goods train which is running in opposite direction towards him. The goods train crosses the man in 8 seconds. If the length of goods train is 300 meters, find its speed.

ii) Sakshi invests a part of ₹ 12,000 in 12% stock at ₹ 120 and the remainder in 15% stock at ₹ 125. If his total dividend per annum is ₹ 1360, how much does he invest in 12% stock at ₹ 120?

₹₹₹₹₹