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2B6M19285 (Pages : 2) Reg. No:.............................

Name: ....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Sixth Semester B.Sc Mathematics Degree Examination, March /April 2019

MAT6B09 - Real Analysis

(2016 Admission onwards)

Time: 3 hours

Max. Marks: 120

Section A

Answer all questions.

Each question carries 1 mark.

1. Give an example of an unbounded function f : (0 , 1) → R.
2. Find the absolute minimum of the function f : (– 1 , 1) → R defined by f (x) = x^2.
3. Give an example of a function which is nowhere continuous.
4. Define : Partition of an interval.
5. State true or false : A bounded function on [a , b] is always Riemann integrable.
6. Give an example of a step function on [0 , 3]
7. Define : Beta function.
8. Give an example of an improper integral and specify its type (kind).
9. Find the value of β (1 , n).
10. Write the Cauchy criterion for convergence of a sequence of functions.
11. Find the limit of (f_n (x)) = $\left(\frac{1}{x+n}\right)$, x ε [0 , 1]
12. State Weierstrass M test.

(12 x 1 = 12 marks)

Section B

Answer any ten questions.

Each question carries 4 marks.

13. State and prove Boundedness theorem.
14. Let f : [0 . 1] → R be defined by f (x) = x e^x – 2. Is there a real number c in (0 . 1) , such that f (c) = 0. Justify your answer.
15. Let f : (a , b) → R be a continuous function. Is it true that { f(x) : x ε (a , b) } is always open ? Justify your answer.
16. Define : Continuity and uniform continuity of a function defined on [a , b].
17. Define : Norm of a partition. Find the norm of P = (0 , 1 , 1.5 , 2 , 3.8 , 4)
18. Show that f : [a , b] → R defined by f (x) = c is Riemann integrable.
19. If f : [a , b] → R takes on only a finite number of distinct values. is f a step function ? Justify your answer.

20. Define : Gamma function. Write the recurrence formula for Gamma function.

21. Show that $\beta(m, n) = \beta(n, m)$

22. Test for convergence : $\int_0^\infty \cos x \, dx$

23. Examine the convergence of $\int_1^5 \frac{dx}{\sqrt{x^2-1}}$.

24. Show that $\Gamma\left(\frac{1}{2}\right) = \sqrt{\pi}$

25. Find the radius of convergence of the power series $\sum_{n=0}^{\infty} \left(\frac{n!}{n^n} x^n\right)$

26. Examine the convergence of the series of functions $\sum_{n=0}^{\infty} \frac{\sin n x}{n!}$, $x \geq 0$

(10 x 4 = 40 marks)

Section C

Answer any six questions.
Each question carries 7 marks.

27. State and prove location of roots theorem.

28. Let I be a closed and bounded interval and $f : I \to R$ be continuous.
Show that $\{ f(x) : x \in I \}$ is a closed and bounded interval.

29. Let $f : [0, 3] \to R$ be defined by $f(x) = 2$, for $0 \leq x \leq 1$, and $f(x) = 3$, for $1 < x \leq 3$.
Using the definition of Riemann integration, evaluate $\int_0^3 f(x) \, dx$.

30. Show that a continuous function on [a , b] is Riemann integrable.

31. State and prove the product theorem on Riemann integration.

32. Examine the convergence of $\int_{-5}^{5} \frac{dx}{(x-1)^3}$ in (i) Usual sense (ii) Cauchy Principal value sense.

33. Examine the convergence of $\int_0^\infty \frac{dx}{\sqrt{x+x^2}}$

34. Test for convergence : $(f_n(x)) = \left(\frac{nx}{1+n^2x^2}\right)$, $x \geq 0$.

35. Show that $\beta(m, n) = 2 \int_0^{\frac{\pi}{2}} \sin^{2m-1} x \cos^{2n-1} x \, dx$

(6 x 7 = 42 marks)

Section D

Answer any two questions.
Each question carries 13 marks.

36. (i) State and prove uniform continuity theorem.
(ii) Define : Lipschitz function.
(iii) Show that a Lipschitz function is uniformly continuous.

37. (i) Define : Monotone function on an interval [a , b].
(ii) Show that a monotone function on [a , b] is Riemann integrable.

38. (i) Define : Absolute and conditional convergence of an improper integral of first kind
(ii) Show that $\int_0^\infty \frac{\sin x}{x} dx$ is conditionally convergent.

(2 x 13 = 26 marks)

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2B6M19286 (Pages : 3) Reg. No:..............................

Name:..............................

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Sixth Semester B.Sc Mathematics Degree Examination, March /April 2019

MAT6B10 - Complex Analysis

(2016 Admission onwards)

Time: 3 hours Max. Marks: 120

Section A

Answer all the twelve questions.
Each question carries 1 mark.

1. Find $|e^{iz}|$ where $z = 2 + 3i$.
2. If $z = x + iy$ then find imaginary part of $\cos z$.
3. What is the period of the function $f(z) = \sinh z$.
4. Express the function $\log z$ in the form $u(x, y) + iv(x, y)$.
5. Evaluate $\int_0^{\frac{\pi}{4}} e^{it}\,dt$.
6. Write the Laplace's equation.
7. The Maclaurian Series representation of $\frac{1}{z+1}$ is........
8. If $z(t) = x(t) + iy(t), a \le t \le b$ is a differentiable arc, then the length of the curve is.
9. Give an example of a function which is analytic everywhere.
10. Find the residue of $f(z) = \frac{4z+3}{1-z}$ at $z = 1$.
11. Find the value of $\int_{|z|=2} \frac{z^2+2}{z-1}\,dz$
12. Which type of isolated singularity of the function $f(z) = e^{\frac{1}{z}}$ is at $z = 0$.

$(12 \times 1 = 12\ Marks)$

Section B

Answer any ten out of fourteen questions.
Each question carries 4 marks.

13. Define harmonic function with example.
14. Find all zeroes of $\cos z$.
15. Prove that $|\cos z| \ge |\cos x|$.
16. Find the principal value of $(1 + i)^{4i}$.
17. Show that $f(z)$ is continuous at z_0 and $f(z) \neq 0$ throughout some neighborhood of that point z_0.

18. State Cauchy Goursat Theorem.

19. What you mean by principle of deformation of paths?

20. Prove that $\sum_{n=0}^{\infty} \frac{(3-4i)^n}{n!}$ converges.

21. Show that if a sequence converges its limit is unique.

22. Find the radius of convergence of the series $\sum_{n=0}^{\infty} \left(1+\frac{1}{n}\right)^{n^2} z^n$.

23. Use multiplication of the series to show that

$\frac{e^z}{1+z} = 1 + \frac{1}{2}z^2 - \frac{1}{3}z^3 + \cdots \ldots\ldots \quad (|z| < 1)$.

24. Find out zeroes and order of zeroes of $f(z) = \frac{(9+z^2)^2}{(1-z^2)^3}$.

25. Find the Residue of the function $f(z) = \frac{4z-3}{z(z-1)(z-2)}$ at each of its singular points.

26. Evaluate $\int_C \frac{e^z}{z^2(z^2-4)} dz$ where C is the unit circle (counter clock wise) using residue.

$(10 \times 4 = 40\ Marks)$

Section C

Answer any six out of nine questions.
Each question carries 7 marks.

27. Show that $f(z) = \bar{z}$ is nowhere differentiable.

28. If $f(z)$ is a regular function of z prove that $\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}\right)|f(z)|^2 = 4|f'(z)|^2$.

29. Show that $u = x^3 - 3xy^2 + 3x^2 - 3y^2 + 1$ satisfies Laplaces equation and determine corresponding analytic function $f(z) = u + iv$.

30. Find all roots of $\sinh z = i$.

31. Let f(z) be defined by the equation $f(z) = \begin{cases} 1 \text{ when } y < 0 \\ 4y \text{ when } y \geq 0 \end{cases}$ and C is the arc from $z = -1 - i$ to $z = 1 + i$ along the curve $y = x^3$. Evaluate $\int_C f(z)dz$.

32. Evaluate $\int_C \frac{z^2 - \frac{1}{3}}{z^3 - z} dz$ where C is the circle $\left|z - \frac{1}{2}\right| = 1$ oriented in the counter clockwise direction.

33. Expand $f(z) = \frac{z^2-1}{(z+1)(z+3)}$ in a Laurent series valid in the annulus $1 < |z| < 3$.

34. Prove that a power series $\sum_{n=0}^{\infty} a_n (z - z_0)^n$ represents a continuous function S(z) at each point inside its circle of convergence $|z - z_0| = R$.

35. Show that $\int_0^{2\pi} \frac{d\theta}{a + b\cos\theta} = \frac{2\pi}{\sqrt{a^2 - b^2}} \qquad (a > b > 0)$

$(6 \times 7 = 42\ Marks)$

Section D

Answer any two out of three questions.
Each question carries 13 marks.

36. Derive the polar form of Cauchy Riemann and using this show that $f(z) = \sqrt[n]{z}$ is differentiable everywhere.

37. If f(z) is analytic in a domain D and z_0 is a point in D then prove $f^n(z_0) = \frac{n!}{2\pi i}\int_C \frac{f(z)}{(z-z_0)^{n+1}}dz$ where $n = 1, 2, 3, ...$ and C is any simple closed curve contained in D which encloses z_0 and oriented in the counter clockwise direction.

38. Prove that $\int_0^{\infty} \frac{x^3 \sin x}{x^2+a^2}dx = -\frac{\pi}{4}(a-2)e^{-a} \quad a > 2.$

$(2 \times 13 = 26\ Marks)$

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M6M19287 (Pages : 3) Reg. No:..............................

Name: ....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Sixth Semester B.Sc Mathematics Degree Examination, March /April 2019

MAT6B11– Numerical Methods

(2016 Admission onwards)

me: 3 hours

Max. Marks : 120

Section A

Answer all the twelve questions.

Each question carries 1 mark.

1. By Newton-Raphson method find the first approximation to a root of $x - \cos x = 0$, when $x_0 = \pi/2$.
2. State True or False: In bisection method if roots of the equation $f(x) = 0$ lies between a and b then $f(a)f(b) < 0$
3. What is the condition for the convergence of iteration method for solving $x = \phi(x)$.
4. Forward difference $\Delta y_n =$ ....
5. Define averaging operator μ.
6. Define the characteristic polynomial of a square matrix A.
7. Write Gauss forward formula.
8. What is the order of error in Trapezoidal rule.
9. The value of $(\Delta^2/E)e^x =$...........
10. Given

x	1	2	3
$f(x)$	3	8	15

find $\Delta^2 f(1)$.

11. The $n \times n$ matrix $A = (a_{ij})$ such that $a_{ij} = 0$ if $|i - j| > 1$ is called ....
12. Write simpson's $\frac{3}{8}$ rule.

Section B

Answer any the ten out of fourteen questions.
Each question carries 4 marks.

13. Deduce secant formula from Newton-Raphson formula, for finding a root of $f(x) = 0$

14. Find an iteration formula to find a positive value of $N^{1/k}$ by Newton-Raphson method.

15. Evaluate $\Delta^n e^x$, interval of differencing being unity.

16. Show that $\delta = E^{1/2} - E^{-1/2}$.

17. Show that $\mu = \sqrt{1 + \frac{1}{4}\delta^2}$.

18. What is inverse interpolation. Reduce the formula for $L_n(y)$.

19. Find the missing term in the following table.

$x:$	0	1	2	3	4
$y:$	1	3	9	...	81

20. Find $\frac{d^2y}{dx^2}$ for non-tabular value of x, from Newton's forward interpolation formula.

21. Evaluate $\int_0^1 \frac{dx}{1+x}$ using Trapezoidal rule by taking $h = 0.5$.

22. What is Partial pivoting and Complete pivoting in the solution of linear simultaneous equation?

23. Decompose the matrix $A = \begin{bmatrix} -4 & 9 \\ 6 & -5 \end{bmatrix}$ into the form LU, where L is the lower triangular matrix and U is an upper triangular matrix.

24. Given $\frac{dy}{dx} = 1 + y^2$ where $y(0) = 0$. Find $y(0.2)$ correct to four decimal places by Runge-Kutta second order formula.

25. Using Picard's method obtain a solution up to the fourth approximation to the equation $\frac{dy}{dx} = y + x$ such that $y(0) = 1$.

26. Show that $e^x(u_0 + x\Delta u_0 + \frac{x^2}{2!}\Delta^2 u_0 + \cdots\cdots) = (1 + xE + \frac{x^2E^2}{2!} + \cdots\cdots)u_0$

Section C

Answer any the ***six*** *out of nine questions.*
Each question carries 7 marks.

27. By using Newton's forward difference interpolation formula find the cubic polynomial which takes the following values: $y(1) = 24$, $y(3) = 120$, $y(5) = 336$, $y(7) = 720$.

28. Find a positive root of $xe^x = 1$ in $(0, 1)$ correct to 3 decimal places, by bisection method.

29. Using the method of separation of symbols, show that
$\Delta^n u_{x-n} = u_x - nu_{x-1} + \frac{n(n-1)}{2}u_{x-2} + \cdots\cdots + (-1)^n u_{x-n}$.

30. Using Newton's general interpolation formula with the divided differences find $f(x)$ as a polynomial in x . Given

x :	-1	0	3	6	7
$f(x)$:	3	-6	39	822	1611

31. From the following values of x and y, find $\frac{dy}{dx}$ when $x = 6$

x :	4.5	5	5.5	6	6.5	7	7.5
y :	9.69	12.90	16.71	21.18	26.37	32.34	39.15

32. Apply Milne's method, to find a solution of the differential equation $\frac{dy}{dx} = x - y^2$ in the range $0 \leq x \leq 1$ for the boundary condition $y(0) = 0$.

33. Find the inverse of $A = \begin{bmatrix} 2 & 4 & 3 \\ 0 & 1 & 1 \\ 2 & 2 & -1 \end{bmatrix}$ by Gauss modified method.

34. Determine the largest eigenvalue and the corresponding eigenvector of the matrix $A = \begin{bmatrix} 5 & 3 & 1 \\ 3 & 8 & 0 \\ 1 & 0 & 10 \end{bmatrix}$

35. Establish the general formula to find y_{n+1} by Euler's modified method.

Section D

*Answer any the **two** out of three questions.*
Each question carries 13 marks.

36. Find the smallest root of the equation
$$1 - x + \frac{x^2}{(2!)^2} - \frac{x^3}{(3!)^2} + \frac{x^4}{(4!)^2} - \cdots\cdots = 0$$

37. Solve by Jacobi's method
$$\begin{aligned} 10x - 2y - z - w &= 3 \\ -2x + 10y - z - w &= 15 \\ -x - y + 10z - 2w &= 27 \\ -x - y - 2z + 10w &= -9 \end{aligned}$$

38. Explain Taylor's method of successive approximation of the differential equation $y' = f(x, y)$, $y(x_0) = y_0$ and using Taylor method find an approximate value of $y(0.1)$, if $y'' - xy' - y = 0$, $y(0) = 1$, $y'(0) = 0$.

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(Pages :3)

Reg. No:.............................

Name: ....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Sixth Semester B.Sc. Mathematics Degree Examination, March/April 2019

MAT6B12 - Number Theory & Linear Algebra

(2016 Admission onwards)

Time: 3 hours

Max. Marks: 120

PART A

Answer *all twelve* questions.

Each question carries 1 mark.

1. Show that square of any integer is either of the form $4k$ or $4k + 1$.
2. If $a|b$ and $c|d$, then show that $ac|bd$, where a, b, c, d are any integers.
3. Find gcd(273, 385).
4. Does there exist a solution for the Diophantine equation $143\,x + 227\,y = 370$?
5. If p is a prime and $p|ab$, then prove that $p|a$ or $p|b$, where a, b are any integers.
6. Find all prime numbers that divide 100!
7. If $a \equiv b\ (mod\ n)$ and $b \equiv c\ (mod\ n)$, then prove that $a \equiv c\ (mod\ n)$, where a, b, c, n are any integers with $n > 1$.
8. Find the remainder when 16! Is divided by 17.
9. Give an example of multiplicative number theoretic function.
10. Is $\mathbb{R}$ a vector space over $\mathbb{Q}$?
11. Is union of a set of subspaces of a vector space V a subspace of V, why?
12. If the mapping $f : V \to W$ is linear then show that $f(0_V) = 0_W$, where V and W are any two vector spaces over the same field F.

(12 × 1 = 12 marks)

PART B

Answer *any ten* questions from among the questions 13 to 26.

Each question carries 4 marks.

13. Prove that $3a^2 - 1$ is never a perfect square.
14. For integers a, b, c, if $a|b$ and $a|c$, then show that $a|(bx + cy)$, for arbitrary integers x and y.
15. If $gcd(a, b) = d$ then show that $gcd(\frac{a}{d}, \frac{b}{d}) = 1$.
16. Use the Euclidean algorithm to obtain integers x and y satisfying $\gcd(143,227) = 143\,x + 227\,y$.

17. Determine all solutions in the integers of the Diophantine equation $18x + 5y = 48$.

18. Prove that the number $\sqrt{2}$ is irrational.

19. Determine whether the integer 701 is prime by testing all primes $p \leq \sqrt{701}$ as possible divisors.

20. For arbitrary integers a and b, $a \equiv b \ (mod\ n)$ if and only if a and b leave the same nonnegative remainder when divided by n.

21. Show that $41 | 2^{20} - 1$.

22. Solve the linear congruence $17\,x \equiv 3\ (mod\ 210)$ by solving the system

$$17\,x \equiv 3\ (mod\ 2);\ 17\,x \equiv 3\ (mod\ 3);\ 17\,x \equiv 3\ (mod\ 5);\ 17\,x \equiv 3\ (mod\ 7).$$

23. Show that the mapping $f : \mathbb{R}^2 \to \mathbb{R}^3$ given by $f(a,b) = (a + b, a - b, b)$ is linear.

24. Let $f : V \to W$ be linear. If X is a subspace of V then prove that $f^{\to}(X)$ is a subspace of W.

25. If V and W are vector spaces of the same dimension n over F, then prove that V and W are isomorphic.

26. Let S_1 and S_2 be non-empty subsets of a vector space such that $S_1 \subseteq S_2$. Prove that if S_2 is linearly independent then so is S_1

($10 \times 4 = 40$ marks)

PART C

Answer *any six* questions from among the questions 27 to 35.
Each question carries 7 marks.

27. Given integers a and b, not both of which are zero, prove that there exist integers x and y such that $\gcd(a,b) = ax + by$.

28. If a cock is worth 5 coins, a hen 3 coins, and three chicks together 1 coin, how many cocks, hens, and chicks, totaling 100, can be bought for 100 coins?

29. If p_n is the n^{th} prime number, then prove that $p_n \leq 2^{2^{n-1}}$.

30. State and prove Wilson's theorem.

31. Let V and W be vector spaces of finite dimension over a field F. If $f : V \to W$ is linear, then show that $dim\ V = dim\ Im\ f + dim\ Ker\ f$.

32. Determine whether or not the following subsets of $\mathbb{R}^4$ are subspaces.

    a) $\{(x + 2y, 0, 2, x) : x, y \in \mathbb{R}\}$

    b) $\{(x + 2y, x, y, x - y) : x, y \in \mathbb{R}\}$

33. Prove that the linear mapping $f: \mathbb{R}^3 \to \mathbb{R}^3$ given by

$f(x, y, z) = (x + z, x + y + 2z, 2x + y + 3z)$ is neither surjective nor injective.

34. Consider the basis $\{(1, 1, 1);\ (1, 2, 3);\ (1, 1, 2)\}$ of $\mathbb{R}^3$. If $f : \mathbb{R}^3 \to \mathbb{R}^3$ is linear and such that

$f(1, 1, 1) = (1,1,1)$; $f(1, 2, 3) = (-1, -2, -3)$; $f(1,1,2) = (2,2,4)$, then determine f completely.

35. Let S_1 and S_2 be non-empty subsets of a vector space such that $S_1 \subseteq S_2$.

Prove that

a. if S_2 is linearly independent then so is S_1;

b. if S_1 is linearly dependent then so is S_2.

($6 \times 7 = 42$marks)

PART D

Answer *any two* questions from among the questions 36 to 38.
Each question carries 13 marks.

36. Solve

a. the linear Diophantine equation 172x + 20y = 1000;

b. the system of linear congruences $x \equiv 3 \pmod 7$; $x \equiv 7 \pmod{12}$; $x \equiv 4 \pmod{17}$.

37. If $n = p_1^{k_1} p_2^{k_2} \dots p_r^{k_r}$ is the prime factorization of $n > 1$, then show that

a) $\tau(n) = (k_1 + 1)(k_2 + 1) \dots (k_r + 1)$ and

b) $\sigma(n) = \frac{p_1^{k_1+1}-1}{p_1-1} \frac{p_2^{k_2+1}-1}{p_2-1} \dots \frac{p_r^{k_r+1}-1}{p_r-1}$.

c) Find $\tau(143)$ and $\sigma(227)$.

38. Let V and W be vector spaces each of dimension n over a field F. If $f : V \to W$ is linear then prove that the following statements are equivalent:

(1) f is injective;

(2) f is surjective;

(3) f is bijective;

(4) f carries bases to bases, in the sense that if $\{v_1, v_2, \dots, v_n\}$ is a basis of V then $\{f(v_1), f(v_2), \dots, f(v_n)\}$ is a basis of W.

($2 \times 13 = 26$marks)

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M6M19289

(Pages : 3)

Reg. No:..............................

Name: ....

FAROOK COLLEGE (AUTONOMOUS), KOZHIKODE

Sixth Semester B.Sc Mathematics Degree Examination, March /April 2019

MAT6B14(E02) – Linear Programming

(2016 Admission onwards)

me: 3 hours

Max. Marks : 80

Section A

Answer all the 12 questions.

Each question carries 1 marks

1. Define convex polyhedron.
2. Find the convex hull of $\{(0,1),(1,-1)\}$.
3. a simplex in two dimension is......
4. Show that the following set is convex

$$A = \{(x_1, x_2) : 0 \leq x_1 \leq 1, x_2 = 0\}.$$

5. Verify Minimax theorem for the function f(x)=2x+1,where x=1,2,3,4.
6. dual of the dual is.......... .
7. If the constraints are not satisfied simultaneously,then the set of feasible solution is.........
8. In a linear programming problem the basic feasible solution is unbounded if...........
9. Write the number of basic variables of the general transportation problem at any stage of feasible solutions.
10. The allocated cells in the transportation table are called...............
11. The necessary and sufficient condition for the existence of a feasible solution to the transportation problem is ....
12. What is an unbalanced assignment problem?.

Section B

Answer any nine out of twelve questions.
Each question carries 2 marks

13. Verify whether the set $A = \{(x, y) : x^2 + y^2 = 1\}$ is a convex set.

14. For a linear programming problem define,

    (a) Objective function

    (b) Feasible solution.

15. Explain the general linear programming problem.

16. Prove that the set of all feasible solution of an LPP is a convex set.

17. Write the dual of the following linear programming problem

    Minimize $z = 5x_1 + 3x_2$, subject to:

$$
\begin{aligned}
3x_1 + 5x_2 &\leq 15 \\
5x_1 + 2x_2 &\leq 10 \\
-x_1 + x_2 &\geq -2 \\
x_1 \geq 0, &\quad x_2 \text{ is unrestricted}
\end{aligned}
$$

18. Define slack and surplus variables in LPP.

19. Explain the iterative procedure for the Charne's Big-M method

20. Write the matrix form of the transportation problem.

21. How the degeneracy arises in a transportation problem? How does we overcome it?

22. Find the initial b.f.s of a transportation problem by using the North-West corner rule

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

23. In an assignment problem , show that if we add a constant to every element of a row of the cost matrix, then an assignment plan which minimizes the total cost for the new matrix ,also minimizes the total cost for the original matrix.

Write the mathematical formulation of an assignment problem.

Section C

Answer any six out of nine questions.
Each question carries 5 marks

25. Formulate the following LPP:

    A company sells two different products A and B . The company makes a profit of Rs.40 and Rs.30 per unit on products A and B respectively. The two products are produced in a common production process and are sold in two different markets . the production process has a capacity of 30,000 man hours . It takes two hours to produce one unit of A and one hour to produce one unit of B .The market has been surveyed and the company officials feel that the maximum number of units of A can be sold is 8,000 and maximum of B is 12,000 units. Subject to these limitations the product can be sold in any convex combinations.

26. Use graphical method to solve the LPP Minimize $z = 8x_1 + 6x_2$ subject to: $4x_1 + 2x_2 \leq 60, 2x_1 + 4x_2 \leq 48, x_1, x_2 \geq 0$

27. Let S be a convex subset of the plane bounded by lines in the plane. Then a linear function $z = c_1x_1 + c_2x_2$, where c_1, c_2 are scalars,attains its extreme values at the vertices of S only.

28. Explain different steps involved in simplex algorithm.

29. Prove that if the k^{th} constraint of a primal problem is an equality then the k^{th} dual variable will be unrestricted in sign. .

30. Use simplex method to solve the LPP
    Minimize $z = 6x_1 + 4x_2$, subject to :

$$\begin{aligned} -2x_1 + x_2 &\leq 2 \\ x_1 - x_2 &\leq 2 \\ 3x_1 + 2X_2 &\leq 9 \\ x_1, x_2, x_3 &\geq 0 \end{aligned}$$

31. Prove that all basis of a transportation problem are triangular

32. Find the initial solution of the transportation problem by Vogel's approximation method.

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