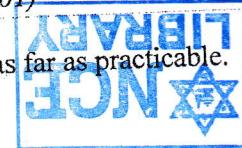


TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2080 Baishakh

Exam. Level	BE	Back	
Programme	All(Except BAR)	Full Marks	80
Year / Part	II / I	Pass Marks	32



Subject: - Engineering Mathematics (SH 501)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- * ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Use properties of Determinant to show $\begin{vmatrix} a-b-c & 2a & 2a \\ 2b & b-c-a & 2b \\ 2c & 2c & c-a-b \end{vmatrix} = (a+b+c)^3$. [5]

2. Show that for every complex square matrix, it can be uniquely express as the sum of a Hermitian matrix and a skew-Hermitian matrix. [5]
3. Test the consistency of the system of equations:

$$x+2y-z=0, 2x+3y+z=10, 3x-y-7z=1.$$

and solve completely if found consistent. [5]

4. Find the eigen-values of the matrix $A = \begin{bmatrix} 2 & -2 & 2 \\ 1 & 1 & 1 \\ 1 & 3 & -1 \end{bmatrix}$. [3+1+1]

Hence use them to compute:

a) $|A|$

b) Eigenvalues of A^{-1}

5. Evaluate $\int_C \vec{F} \cdot d\vec{r}$ where $\vec{F} = (\sin y) \vec{i} + x(1+\cos y) \vec{j}$ and the curve is circular path given by $x^2 + y^2 = a^2, z=0$. [5]

6. Evaluate $\iint_S \vec{F} \cdot \vec{n} ds$ where $\vec{F} = y^2 z^2 \vec{i} + z^2 x^2 \vec{j} + x^2 y^2 \vec{k}$ and S is the surface of the sphere $x^2 + y^2 + z^2 = 1$ above the xy-plane. [5]

7. State Green's theorem in plane. Apply it to find the area of the curve $x^{2/3} + y^{2/3} = a^{2/3}$. [1+4]

8. Apply Gauss' divergence theorem to evaluate $\iint_S \vec{F} \cdot \hat{n} ds$ where

$\vec{F} = (2xy + z) \vec{i} + y^2 \vec{j} - (x + 3y) \vec{k}$ and V is the region bounded by the surface of the planes $2x + 2y + z = 6$, $x = 0$, $y = 0$, $z = 0$. [5]

9. Obtain a Fourier series to represent $x + x^2$ for $-\pi \leq x \leq \pi$ and

Deduce that $\frac{\pi^2}{6} = \frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} \dots$ [5]

10. Define periodic function. Find the Fourier series of the function

[2+3]

$$f(x) = 2x - x^2 \text{ in the interval } (0,2)$$

11. State existence condition for Laplace transform. Obtain the Laplace transform of

[1+2+2]

a) $\frac{1}{\sqrt{t}}$

b) $\frac{1 - \cos 2t}{t}$

12. Obtain a Fourier series to represent $x + x^2$ for $-\pi \leq x \leq \pi$ and

Deduce that $\frac{\pi^2}{6} = \frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} \dots$ [5]

13. Solve the initial value problem by Laplace transform method:

$$y'' - 3y' + 2y = 4x + e^{3x}; \quad y(0) = 1, \quad y'(0) = -1.$$

[5]

14. Solve the following Linear programming problem by using simplex method
Max p = $15x_1 + 10x_2$, subject to $2x_1 + x_2 \leq 10$, $x_1 + 3x_2 \leq 10$ and $x_1, x_2 \geq 0$.

[7]

15. Solve the Linear Programming Problem by Big M method:

[8]

$$\text{Maximize: } P = 2x_1 + x_2 + 3x_3$$

$$\text{Subject to: } x_1 + x_2 + 2x_3 \leq 5$$

$$2x_1 + 3x_2 + 4x_3 = 12$$

$$\text{and } x_1, x_2, x_3 \geq 0.$$

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Bhadra

Exam. Level	BE	Regular	
Programme	All (Except BAR)	Full Marks	80
Year / Part	II / I	Pass Marks	32
		Time	3 hrs.

Subject: - Engineering Mathematics III (SH 501)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.



1. Prove that $\begin{vmatrix} a^3 & 3a^2 & 3a & 1 \\ a^2 & a^2 + 2a & 2a + 1 & 1 \\ a & 2a + 1 & a + 2 & 1 \\ 1 & 3 & 3 & 1 \end{vmatrix} = (a - 1)^6$ by using properties of determinate. [5]
2. Define transpose of a matrix. Prove that the transpose of the product of two matrices is the product of their transpose taken in reverse order. [1+4]
3. Find the rank of the matrix $\begin{bmatrix} 1 & 0 & -5 & 6 \\ 3 & -2 & 1 & 2 \\ 3 & -2 & -9 & 14 \\ 4 & -2 & -4 & 8 \end{bmatrix}$ by reducing it into normal form. [5]
4. State Cayley-Hamilton Theorem. Use it to find the inverse of the matrix: [1+4]
- $$\begin{bmatrix} 1 & 1 & 3 \\ 1 & 3 & -3 \\ 2 & -4 & -4 \end{bmatrix}$$
5. Prove that the line integral $\int_C \vec{F} \cdot d\vec{r}$ of a continuous vector function \vec{F} defined in a region R is independent of the path C joining any two points in R if and only if there exists a single valued scalar function ϕ , having first order partial derivatives such that $\vec{F} = \nabla\phi$. [5]
6. Evaluate $\iint_S \vec{F} \cdot \vec{n} ds$ where $\vec{F} = y^2 z^2 \vec{i} + z^2 x^2 \vec{j} + x^2 y^2 \vec{k}$ and S is the surface of the sphere $x^2 + y^2 + z^2 = 1$ above the xy-plane. [5]
7. Apply Green's theorem in plane to evaluate, $\int_C \vec{F} \cdot d\vec{r}$ where $\vec{F} = (x^2 - xy^3) \vec{i} + (y^2 - 2xy) \vec{j}$ and C is a square with vertices $(0, 0), (2, 0), (2, 2), (0, 2)$. [5]
8. Verify the stroke's theorem for $\vec{F} = (x^2 + y^2) \vec{i} - 2xy \vec{j}$ taken round the rectangle bounded by the lines $x = \pm a, y = 0, y = b$. [5]

9. Define Laplace transform of function $f(t)$. Find the Laplace transform of [1+2+2]

a) $te^{-4t} \sin 3t$ b) $\frac{1-e^t}{t}$

10. Find the inverse Laplace transform of: [2+3]

a) $\frac{s^2}{(s+2)^3}$ b) $\tan^{-1} \frac{2}{s}$

11. Solve the following initial value problem by using Laplace transform

$$y'' + 2y' - 3y = \sin t, y(0) = y'(0) = 0. \quad [5]$$

12. Find the Fourier series of the function $f(x) = \frac{(\pi-x)^2}{4}$ in the interval $0 \leq x \leq 2\pi$. [5]

13. Obtain the half-range Fourier cosine series of $\sin x$ in the interval $0 \leq x \leq \pi$. [5]

14. Solve the linear programming problem maximize by simplex method [7]

Maximize: $Z = 10x_1 + x_2 + 2x_3$,

Subject to: $x_1 + x_2 - 2x_3 \leq 10$

$$4x_1 + x_2 + x_3 \leq 20$$

and $x_1, x_2, x_3 \geq 0$.

15. Solve the linear programming problem by simplex method using two phase method: [8]

Maximize $Z = 3x_1 - x_2$

Subject to $2x_1 + x_2 \geq 2$

$$x_1 + 3x_2 \leq 2$$

$$x_2 \leq 4; x_1, x_2 \geq 0.$$

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	All (Except BAR)	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Engineering Mathematics III (SH 501)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Use the Properties of determinant to show that:

$$\begin{vmatrix} (a+b)^2 & ca & bc \\ ca & (b+c)^2 & ab \\ bc & ab & (c+a)^2 \end{vmatrix} = 2abc(a+b+c)^3$$

[5]

2. Define Hermitian and Skew-Hermitian of a square complex matrix. If A is any square matrix, prove that $A + A^*$ is Hermitian and $A - A^*$ is Skew-Hermitian matrix.

[5]

3. Test the consistency of the system by matrix rank method and solve it completely if consistent:

[5]

$$x + 2y - z = 0, 2x + 3y + z = 10, 3x - y - 7z = 1$$

4. Find the eigenvalues of the matrix $A = \begin{bmatrix} 1 & 0 & -1 \\ 1 & 2 & 1 \\ 2 & 2 & 3 \end{bmatrix}$ and use them to compute

- (i) eigenvalues of A^{-1}
(ii) determinant of A
(iii) eigenvalues of $\text{adj } A$

[2+1+1+1]

5. Evaluate $\int_C \vec{F} \cdot d\vec{r}$ where $\vec{F} = S \sin y \hat{i} + x(1+\cos y) \hat{j}$ and C is the circular path given by $x^2 + y^2 = a^2, z = 0$.

[5]

6. Evaluate $\iint_S \vec{F} \cdot \vec{n} \, ds$ where $\vec{F} = yz \hat{i} + zx \hat{j} + xy \hat{k}$ where S is the surface of the sphere $x^2 + y^2 + z^2 = 1$ in the first octant.

[5]

7. Apply Green's Theorem in plane to compute the area of the curve $\left(\frac{x}{a}\right)^{\frac{2}{3}} + \left(\frac{y}{b}\right)^{\frac{2}{3}} = 1$.

[5]

8. State Gauss divergence theorem in vector calculus. Apply it to evaluate $\iint_S [(x^3 - yz)\hat{i} - 2x^2y\hat{j} + 2k]\cdot \vec{n} \, ds$ where S denote the surface of the cube bounded by the planes $x = 0, x = a, y = 0, y = a, z = 0, z = a$.

[1+4]

9. State the condition for existence property of Laplace transform. Find the Laplace transform of: (a) $\frac{1}{\sqrt{t}}$ (b) $\frac{1-\cos 2t}{t}$

[1+2+2]

10. State the convolution theorem for inverse Laplace transform and use it to find the inverse Laplace transform of $\frac{s}{(s^2 + 1)(s^2 + 4)}$.

[5]

11. Solve the initial value problem by applying Laplace transform:

[5]

$$y'' - 10y' + 9y = 5t, y(0) = -1, y'(0) = 2.$$

12. Obtain the Fourier series of $f(x) = x + x^2$ in $-\pi \leq x \leq \pi$.

[5]

13. Express $f(x) = x^2$ as a half-range sine series in $0 < x < 3$.

[5]

14. Solve following LPP by the Simplex method:

[7]

Maximize, $P = x_1 + x_2$

Subject to : $2x_1 + x_2 \leq 16$

$$x_1 \leq 6$$

$$x_2 \leq 10$$

$$x_1 \geq 0, x_2 \geq 0$$

15. Solve following LPP by the Dual Method:

[8]

Minimize, $C = 21x_1 + 50x_2$

Subject to : $2x_1 + 5x_2 \geq 12$

$$3x_1 + 7x_2 \geq 17$$

$$x_1 \geq 0, x_2 \geq 0$$

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Kartik

Exam.		Back	
Level	BE	Full Marks	80
Programme	All (Except BAR)	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Engineering Mathematics III (SH 501)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.



1. If $\begin{vmatrix} a & a^2 & a^3 - 1 \\ b & b^2 & b^3 - 1 \\ c & c^2 & c^3 - 1 \end{vmatrix} = 0$; where $a \neq b \neq c$, apply the properties of determinants to show $abc = 1$. [5]
2. Define an orthogonal matrix. Prove that the product of two orthogonal matrices of the same order is also orthogonal. [5]
3. For the matrix $= \begin{bmatrix} 5 & 4 \\ 1 & 2 \end{bmatrix}$, find the modal matrix and the corresponding diagonal matrix. [5]
4. State Cayley-Hamilton theorem and verify the theorem for the square matrix $A = \begin{bmatrix} 1 & 3 & 7 \\ 4 & 2 & 3 \\ 1 & 2 & 1 \end{bmatrix}$. [5]
5. Prove that "for any simple closed curve C, the line integral $\int_A^B \vec{F} \cdot d\vec{r}$ is independent of the path joining the points A and B in the region if and only if $\int_C \vec{F} \cdot d\vec{r} = 0$ ". [5]
6. State Green's theorem in the plane. Using Green's theorem find the area of the hypocycloid $\left(\frac{x}{a}\right)^{2/3} + \left(\frac{y}{b}\right)^{2/3} = 1$. [5]
7. Evaluate $\iint_S \vec{F} \cdot \vec{n} ds$ by Gauss' divergence theorem, where $\vec{F} = x \vec{i} - y \vec{j} + (z^2 - 1) \vec{k}$ and S is the cylinder formed by the surfaces $x^2 + y^2 = 4$, $z = 0$, $z = 1$. [5]
8. Verify Stoke's theorem for $\vec{F} = (x^2 - y^2)\vec{i} + 2xy\vec{j}$ taken over the rectangular bounded by the lines $x = 0$, $x = a$, $y = 0$, $y = b$. [5]
9. Define Laplace transform of f(t). Find the Laplace transform of:
 - $t e^{-t} \cosh t$
 - $\frac{\sin t \sin 5t}{t}$[1+1.5+2.5]
10. Find the inverse Laplace transform of:
 - $\log \frac{s}{s+1}$
 - $\frac{1}{(s-2)(s^2+1)}$[2.5+2.5]
11. Solve the initial value problem $y'' + 4y' + 3y = 0$, $y(0) = 3$, $y'(0) = 1$ by using Laplace transform. [5]
12. Find the Fourier series of $f(x) = 2x - x^2$ in $(0, 2)$. [5]
13. Obtain the half range sine series for $f(x) = e^x$ in $0 < x < 1$. [5]
14. Use Simplex method to solve following LPP:

Maximize, $P = 50x_1 + 80x_2$
 Subject to : $x_1 + 2x_2 \leq 32$
 $3x_1 + 4x_2 \leq 84$
 $x_1, x_2 \geq 0$

[7]
15. Solve the following LPP by using big M method:

Maximize, $P = 2x + y$
 Subject to: $x + y \leq 10$
 $-x + y \geq 2$
 $x, y \geq 0$

[8]

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	All (Except BAR)	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Engineering Mathematics III (SH 501)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.



1. Prove that $\begin{vmatrix} 1+a^2-b^2 & 2ab & -2b \\ 2ab & 1-a^2+b^2 & 2a \\ 2b & -2a & 1-a^2-b^2 \end{vmatrix} = (1+a^2+b^2)^3$ by using the properties of determinants. [5]

2. Prove that every square complex matrix can uniquely be expressed as a sum of a Hermitian and a skew-Hermitian matrix. [5]

3. Reduce the matrix $\begin{bmatrix} 1 & 0 & -5 & 6 \\ 3 & -2 & 1 & 2 \\ 5 & -2 & -9 & 14 \\ 4 & -2 & -4 & 8 \end{bmatrix}$ into normal form and hence find its rank. [5]

4. Find the eigen values and eigen vectors of the matrix $\begin{bmatrix} 2 & 0 & 1 \\ 0 & 2 & -1 \\ 0 & 0 & 2 \end{bmatrix}$ and also find its modal matrix. [5]

5. If $\vec{F} = 3x^2yz^2\vec{i} + x^3z^2\vec{j} + 2x^3yz\vec{k}$, show that $\int_C \vec{F} \cdot d\vec{r}$ is independent of the path of integration. Hence evaluate the integral on any path C from (0, 0, 0) to (1, 2, 3). [5]

6. Verify Green's Theorem in plane for $\int_C [(x-y)dx + (x+y)dy]$ where c is the boundary of the region enclosed by $y^2 = x$ and $x^2 = y$. [5]

7. Evaluate $\iint_S \vec{F} \cdot \vec{n} ds$ where $\vec{F} = 4x\vec{i} - 2y^2\vec{j} + z^2\vec{k}$ taken over the region bounded by the cylinder $x^2 + y^2 = 4$ and the planes $z = 0, z = 3$. [5]

8. Evaluate $\int_C \vec{F} \cdot d\vec{r}$, where c is the rectangle bounded by the lines $x = \pm a, y = 0, y = n$ and $\vec{F} = (x^2 + y^2)\vec{i} - 2xy\vec{j}$. [5]

9. State the condition for existence of Laplace transform. Obtain the Laplace transform of:

a) $\cos^3 2t$ (b) $\frac{\cos at - \cos bt}{t}$ [1+1.5+2.5]

10. Find the inverse Laplace transform of:

$$a) \frac{s+3}{(s^2 + 6s + 13)^2}$$

$$b) \frac{e^{-2s}}{(s+1)(s^2 + 2s + 2)}$$

[2+3]

11. Solve the differential equation $y'' + 2y' - 3y = \sin t$ under the conditions $y(0) = y'(0) = 0$ by using Laplace transform.

[5]

12. Obtain the Fourier series to represent the function $f(x) = e^x$ for $-\pi \leq x \leq \pi$.

[5]

13. Obtain the half range cosine series for the function $f(x) = xsinx$ in the interval $(0, \pi)$.

[5]

14. Use Simplex method to solve following LPP:

$$\text{Maximize, } P = 30x_1 + x_2$$

$$\text{Subject to : } 2x_1 + x_2 \leq 10$$

$$x_1 + 3x_2 \leq 10$$

$$x_1, x_2 \geq 0$$

[7]

15. Use Big M method to solve following LPP:

$$\text{Minimize, } Z = 4x_1 + 2x_2$$

$$\text{Subject to : } 3x_1 + x_2 \geq 27$$

$$-x_1 - x_2 \leq -21$$

$$x_1 + 2x_2 \geq 30$$

$$x_1, x_2 \geq 0$$

[8]

TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
 Examination Control Division
 2076 Ashwin

Exam.	Back		
Level	BE	Full Marks	80
Programme	All except BAR	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Engineering Mathematics III (SH 501)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Prove that:
$$\begin{vmatrix} (b+c)^2 & c^2 & b^2 \\ c^2 & (c+a)^2 & a^2 \\ b^2 & a^2 & (a+b)^2 \end{vmatrix} = 2(ab + bc + ca)^2$$
 [5]

2. Prove that the necessary and sufficient condition for a square matrix A to possess an inverse is that $|A| \neq 0$. [5]

3. Find the rank of the matrix
$$\begin{bmatrix} 2 & -2 & 0 & 6 \\ 4 & 2 & 0 & 2 \\ 1 & -1 & 0 & 3 \\ 1 & -2 & 1 & 2 \end{bmatrix}$$
 by reducing it to normal form. [5]

4. State any two properties of eigen values of a matrix. Obtain eigen values and eigen

vectors of the matrix
$$\begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$$
 [1+4]

5. Prove that the line integral $\int_A^B \vec{F} \cdot d\vec{r}$ is independent of path joining any two points A and B

in the region if and only if $\int_C \vec{F} \cdot d\vec{r} = 0$ for any simple closed curve C in the region. [5]

6. State Green's Theorem and use it to find the area of the curve $\left(\frac{x}{a}\right)^{2/3} + \left(\frac{y}{b}\right)^{2/3} = 1$. [1+4]

7. Use Gauss' divergence theorem to evaluate $\iint_S \vec{F} \cdot \vec{n} ds$ where

$\vec{F} = (2xy + z)\vec{i} + y^2\vec{j} - (x + 3y)\vec{k}$ and S is the surface bounded by the plane $2x + 3y + z = 6$, $x=0, y=0, z=0$. [5]

8. Verify Stoke's Theorem for the vector field $\vec{F} = (2x - y)\vec{i} - yz^2\vec{j} - y^2z\vec{k}$ over the upper half of the sphere $x^2 + y^2 + z^2 = 1$ bounded by its projection on xy-plane. [5]

9. Find the Laplace transform of: [2+3]

i) $t^2 \cos at$

ii) $\frac{1 - \cosh(at)}{t}$

10. Find the inverse Laplace transform of : [2+3]
- $\frac{e^{-\pi s}(s+1)}{s^2 + 2s + 2}$
 - $\tan^{-1} \frac{2}{s}$
11. Solve the differential equation $y''+3y'+2y=e^{-t}$, $y(0)=y'(0)=0$ by applying Laplace transform. [5]
12. Find the Fourier Series of the function $f(x)=|\sin x|$ for $-\pi \leq x \leq \pi$. [5]
13. If $f(x) = |x-x^2|$ in $(0,1)$, show that the half range sine series for $f(x)$ is $\frac{8I^2}{\pi^3} \sum_{n=0}^{\infty} \frac{1}{(2n+1)^3} \sin(2n+1) \frac{\pi x}{1}$. [5]
14. Find the maximum and minimum values of the function $z=20x+10y$ subject to: $x+2y \leq 40$, $3x+y \geq 30$, $4x+3y \geq 60$, $x,y \geq 0$ by graphical method. [5]
15. Solve the following linear programming problem using big M method:
- Maximize $P = 2x_1 + 5x_2$
 subject to : $x_1 + 2x_2 \leq 18$
 $2x_1 + x_2 \geq 21$
 $x_1, x_2 \geq 0$.
- [10]

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Chaitra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	All except BAR	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Engineering Math III (SH 501)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.



1. If $\begin{vmatrix} a & a^2 & a^3 - 1 \\ b & b^2 & b^3 - 1 \\ c & c^2 & c^3 - 1 \end{vmatrix} = 0$, where $a \neq b \neq c$ show that $abc=1$. [5]
2. If A is a square matrix of order n, prove that $A(\text{adj. } A) = (\text{adj. } A)A = |A|I_n$, where I_n is a unit matrix having same order as A. [5]
3. Test the consistency of the system by matrix rank method and solve completely if found consistent: $x+2y-z=3$, $2x+3y+z=10$, $3x-y-7z=1$ [5]
4. State Cayley-Hemilton Theorem and verify it for the matrix $A = \begin{bmatrix} 1 & 0 & -1 \\ 1 & 2 & 1 \\ 2 & 2 & 3 \end{bmatrix}$ [1+4]
5. A vector field is given by $\vec{F} = \sin y \vec{i} + x(1 + \cos y) \vec{j}$. Evaluate the line integral $\int \vec{F} \cdot d\vec{r}$ over the circular path c given by $x^2 + y^2 = a^2$, $z=0$. [5]
6. State and prove Green's Theorem in plane. [1+4]
7. Evaluate $\iint_S \vec{F} \cdot \vec{n} ds$ for $\vec{F} = yz\vec{i} + zx\vec{j} + xy\vec{k}$ where S is the surface of the sphere $x^2 + y^2 + z^2 = 1$ in the first octant. [5]
8. State Stoke's theorem. Evaluate $\oint_C (xydx + xy^2dy)$ by Stoke's theorem taking c to be a square in the xy-plane with vertices $(1,0), (-1,0), (0,1)$ and $(0,-1)$. [1+4]
9. Find the Laplace transform of :
 - $te^{-t}\sin t$
 - $\frac{\cos 2t - \cos 3t}{t}$
10. Find the inverse Laplace transform of :
 - $\frac{s+2}{(s+1)^4}$
 - $\cot^{-1}(s+1)$
11. Solve the differential equation $y'' + y = \sin 3t$, $y(0) = y'(0) = 0$ by using Laplace transform. [5]
12. Define Fourier Series for a function f(x). Obtain Fourier series for $f(x) = x^3$; $-\pi \leq x \leq \pi$. [5]
13. Express $f(x) = e^x$ as the half range Fourier Sine series in $0 < x < 1$. [5]
14. Find the maximum and minimum values of the function $z = 50x_1 + 80x_2$ subject to: $x_1 + 2x_2 \leq 32$, $3x_1 + 4x_2 \leq 84$, $x_1, x_2 \geq 0$; by graphical method. [5]
15. Solve the following Linear Programming problem using big M method:
Maximize $P = 2x_1 + x_2$
Subject to : $x_1 + x_2 \leq 10$
 $-x_1 + x_2 \geq 2$
 $x_1, x_2 \geq 0$ [10]

Exam.	Back	Full Marks	80
Level	BE	Pass Marks	32
Programme	All (Except B.Arch.)	Time	3 hrs.
Year / Part	II / I		

Subject: - Engineering Mathematics III (SH501)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Define the determinant as a function and using its properties. Show that

$$\begin{vmatrix} b+c & c+a & a+b \\ q+r & r+p & p+q \\ y+z & z+x & x+y \end{vmatrix} = 2 \begin{vmatrix} a & p & x \\ b & q & y \\ c & r & z \end{vmatrix} \quad [5]$$

2. If A and B are orthogonal matrices of same order, prove that the product AB is also orthogonal. [5]

3. Test the consistency of the system $x - 2y + 2z = 4$, $3x + y + 4z = 6$ and $x + y + z = 1$ and solve completely if found consistent. [5]

4. For a matrix $A = \begin{pmatrix} 5 & 4 \\ 1 & 2 \end{pmatrix}$, find the modal matrix and the corresponding diagonal matrix. [5]

5. Prove that line integral $\int_A^B \vec{F} \cdot d\vec{r}$ is independent of path joining any two points A and B in the region if and only if $\int_C \vec{F} \cdot d\vec{r} = 0$ for any simple closed curve C in the region. [5]

6. Verify Green's theorem in the plane for $\int_C [(3x^2 - 8y^2)dx + (4y - 6xy)dy]$ where C is region bounded by $y = x^2$ and $x = y^2$. [5]

7. Evaluate $\iint_S \vec{F} \cdot \vec{n} ds$ where $\vec{F} = 6z \vec{i} - 4 \vec{j} + y \vec{k}$ and S is the region of the plane $2x + 3y + 6z = 12$ bounded in the first octant. [5]

8. Evaluate using Gauss divergence theorem, $\iint_S \vec{F} \cdot \vec{n} ds$ where $\vec{F} = x^2y \vec{i} + xy^2 \vec{j} + 2xyz \vec{k}$ and S is the surface bounded by the planes $x = 0$, $y = 0$, $z = 0$, $x + 2y + z = 2$. [5]

9. Obtain the Fourier Series to represent $f(x) = x - x^2$ from $x = -\pi$ to $x = \pi$ and deduce that

$$\frac{\pi^2}{12} = \frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \dots \quad [5]$$

10. Obtain the half range Fourier Sine Series for $f(x) = \pi - x$ in the range $0 < x < \pi$. [5]

11. State the conditions for existence of Laplace transform. Obtain the Laplace transform of:

(i) $e^{2t} \cos^3 2t$ (ii) $\frac{\cos 2t - \cos 3t}{t}$ [1+2+2]

12. Find the inverse Laplace transform of:

(i) $\frac{1}{(S-2)(S^2+1)}$

(ii) $\cot^{-1}(S+1)$

[2.5+2.5]

13. Solve the following intial value problem by using Laplace transform:

$y'' + 4y' + 3y = e^t$, $y(0) = 0$; $y'(0) = 2$

[5]

14. Graphically maximize $Z = 7x_1 + 10x_2$

Subject to constraints:

$$3x_1 + x_2 \leq 9$$

$$x_1 + 2x_2 \leq 8$$

$$x_1, x_2 \geq 0.$$

[5]

15. Solve the following linear Programming Problem by simple method:

Maximize: $Z = 3x_1 + 5x_2$

Subject to:

$$3x_1 + 2x_2 \leq 18$$

$$x_1 \leq 4, x_2 \leq 6$$

$$x_1, x_2 \geq 0.$$

[10]

Exam.		Regular	
Level	BE	Full Marks	80
Programme	All (Except B.Arch.)	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Engineering Mathematics III (SH501)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. If $\begin{vmatrix} a & a^2 & a^3 - 1 \\ b & b^2 & b^3 - 1 \\ c & c^2 & c^3 - 1 \end{vmatrix} = 0$ where $a \neq b \neq c$; apply properties of determinant to show $abc = 1$. [5]
2. If A be an $n \times n$ matrix, prove that $\text{Adj}(A) \cdot A = A \cdot (\text{Adj}A) = |A|I$ where I is an $n \times n$ unit matrix. [5]
3. Find the rank of the following matrix by reducing it into normal form:

$$\begin{pmatrix} 3 & 1 & 4 \\ 0 & 5 & 8 \\ -3 & 4 & 4 \\ 1 & 2 & 4 \end{pmatrix}$$
 [5]
4. Find the modal matrix for the matrix

$$A = \begin{pmatrix} 2 & 1 & 1 \\ -2 & 1 & 3 \\ 2 & 1 & -1 \end{pmatrix}$$
 [5]
5. State and prove Green's theorem in plane. [5]
6. Find the total work done in moving the particle in a force field given by $\vec{F} = \sin y \vec{i} + x(1+\cos y) \vec{j}$ over the circular path $x^2 + y^2 = a^2$, $z=0$. [5]
7. Evaluate $\iint_S \vec{F} \cdot d\vec{s}$ where $\vec{F} = x \vec{i} - y \vec{j} + z \vec{k}$ and S is the surface of the cylinder $x^2 + y^2 = a^2$, $0 < z < b$. [5]
8. Verify Stoke's theorem for $\vec{F} = (x^2 + y^2) \vec{i} - 2xy \vec{j}$ taken round the rectangle bounded by the lines $x = \pm a$, $y = 0$, $y = b$. [5]
9. Obtain Fourier series for $f(x) = x^3$ in the interval $-\pi \leq x \leq \pi$. [5]
10. Express $f(x) = e^x$ as a half range Fourier Cosine Series in $0 < x < 1$. [5]
11. State existence theorem for Laplace Transform. Obtain the Laplace transform of

a) $te^{-t} \sin t$

b)
$$\frac{e^{-at} - e^{-bt}}{t}$$

1+2+2]

12. Find the inverse Laplace transform of:

a) $\frac{1}{s^2 - 5s + 6}$

b) $\tan^{-1} \frac{2}{s}$

[2+5.+2.5]

13. By using Laplace transform, solve the initial value problem:

$y'' + 2y = r(t)$, $y(0) = y'(0) = 0$

Where $r(t) = 1$, $0 < t < 1$

= 0, otherwise

[5]

14. Graphically maximize $Z = 5x_1 + 3x_2$ Subject to constraints

$x_1 + 2x_2 \leq 50$

$2x_1 + x_2 \leq 40$.

$x_1, x_2 \geq 0$

[5]

15. Solve the following Linear Programming Problem by simple method:

Maximize : $Z = 4x + 3y$

Subject to : $2x + 3y \leq 6$

$-x + 2y \leq 3$

$2y \leq 5$

$2x + y \leq 4$

$x, y \geq 0$.

[10]

Exam.	Back		
Level	BE	Full Marks	80
Programme	ALL (Except B. Arch)	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Engineering Mathematics III (SH501)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Use properties of determinant to show [5]
- $$\begin{vmatrix} x^2 & x^2 - (y-z)^2 & yz \\ y^2 & y^2 - (z-x)^2 & zx \\ z^2 & z^2 - (x-y)^2 & xy \end{vmatrix} = (x-y)(y-z)(z-x)(x+y+z)(x^2 + y^2 + z^2)$$
2. Prove that every square matrix can be uniquely expressed as the sum of symmetric and a skew symmetric matrix. [5]
3. Define eigen values and eigen vectors in terms of linear transformation with matrices as operator. Find eigen values of the matrix. [2+3]
- $$\begin{pmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{pmatrix}$$
4. Test the consistency of the system $x+y+z=3$, $x+2y+3z=4$, $2x+3y+4z=7$ by using rank of matrix method and solve if consistent. [5]
5. If \vec{F} is the gradient of some scalar point functions ϕ i.e. $\vec{F} = \nabla\phi$, prove that the line integral is independent of the path joining any two points in the region and conversely. [5]
6. Evaluate $\iint_S \vec{F} \cdot \vec{n} \, ds$, where $\vec{F} = xy\vec{i} - x^2\vec{j} + (x+z)\vec{k}$ and S is the region of the plane $2x+2y+z=6$ bounded in the first quadrant. [5]
7. State and prove Green's theorem in plane. [5]
8. Apply Gauss' divergence theorem to evaluate $\iint_S [(x^3 - yz)\vec{i} - 2x^2y\vec{j} + 2\vec{k}] \cdot \vec{n} \, ds$, where S is the surface of the cube bounded by the planes $x=0$, $x=a$, $y=0$, $y=a$, $z=0$, $z=a$. [5]
9. Expand $f(x) = x \sin x$ as a Fourier series in $-\pi \leq x \leq \pi$. [5]
10. Obtain half range cosine series for $f(x) = x$ in the interval $0 \leq x \leq \pi$. [5]
11. Find the Laplace transform of: [3+2]
- $t^2 \cos at$
 - $\frac{\sin t}{t}$

12. State convolution theorem for inverse Laplace transform and use it to find the inverse Laplace transform of $\frac{S}{(S^2 + 4)(S^2 + 9)}$ [1+4]

13. Solve the following initial value problem by using Laplace transform: [5]

$$y'' + 2y' - 3y = \sin t, y(0) = y'(0) = 0$$

14. Graphically maximize [5]

$$Z = 7x_1 + 10x_2$$

Subject to constraints,

$$3x_1 + x_2 \leq 9$$

$$x_1 + 2x_2 \leq 8$$

$$x_1, x_2 \geq 0$$

15. Solve the following LPP by simplex method using duality of: [10]

Minimize $Z = 20x + 50y$

Subject to:

$$2x + 5y \geq 12$$

$$3x + 7y \geq 17$$

$$x, y \geq 0$$

Examination Control Division
2073 Shrawan

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	ALL (Except B. Arch)	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Engineering Mathematics II (SH501)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Use properties of determinants to prove: $\begin{vmatrix} a^2 & bc & ac + c^2 \\ a^2 + ab & b^2 & ac \\ ab & b^2 + bc & c^2 \end{vmatrix} = 4a^2b^2c^2$ [5]

2. Prove that the necessary and sufficient condition for a square matrix A to posses an inverse is that the matrix A should be non singular. [5]

3. Find the rank of the matrix $\begin{pmatrix} 1 & 3 & -2 & 1 \\ 1 & 1 & 1 & 1 \\ 2 & 0 & -3 & 2 \\ 3 & 3 & -3 & 3 \end{pmatrix}$ [5]

by reducing it into normal form.

4. Find the eigenvalues and eigenvectors of the matrix $\begin{pmatrix} 2 & 1 & 1 \\ 1 & 2 & 1 \\ 0 & 0 & 1 \end{pmatrix}$ [4+1]

Give an example showing importance of eigenvectors.

5. Show that $\vec{F} = (2x + z^2) \vec{i} + Z \vec{j} + (y + 2xz) \vec{k}$ is irrotational and find its scalar potential. [5]

6. State and prove Green's Theorem in plane. [5]

7. Evaluate $\iint_S \vec{F} \cdot \vec{n} \, ds$, where $\vec{F} = yz \vec{i} + zx \vec{j} + xy \vec{k}$ and S is the surface of the sphere $x^2 + y^2 + z^2 = 1$ in the first octant. [5]

8. Evaluate $\int_C xy \, dx + xy^2 \, dy$ by applying stokes theorem where C is the square in xy-plane with vertices (1,0), (-1,0), (0,1), (0,-1) [5]

9. Find the Laplace transform of : [2+3]

i) $te^{2t} \sin 3t$
ii) $\frac{e^{-t} \sin t}{t}$

10. Find the inverse Laplace transform of : [2+3]

i) $\frac{s+2}{s^2 - 4s + 13}$

ii) $\log\left(\frac{s+a}{s-a}\right)$

11. Solve the following initial value problem using Laplace transform: [5]

$$x'' + 4x' + 4x = 6e^{-t}, \quad x(0) = -2, \quad x'(0) = -8$$

12. Find the Fourier series representation of $f(x) = |x|$ in $[-\pi, \pi]$ [5]

13. Obtain the half range Fourier Sine Series for the function $f(x) = x^2$ in the interval $(0, 3)$. [5]

14. Apply Graphical method to maximize, [5]

$$Z = 5x_1 + 3x_2$$

Subject to the constraints:

$$x_1 + 2x_2 \leq 50$$

$$2x_1 + x_2 \leq 40$$

$$x_1 \geq 0, x_2 \geq 0$$

15. Solve the following Linear Programming Problem by Simplex method: [10]

Maximize: $Z = 15x_1 + 10x_2$

Subject to: $x_1 + 3x_2 \leq 10$

$$2x_1 + x_2 \leq 10$$

$$x_1 \geq 0, x_2 \geq 0$$

Exam.		Regular	
Level	BE	Full Marks	80
Programme	All (Except B. Arch)	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Engineering Mathematics III (SH501)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Use properties of determinants to prove:

[5]

$$\begin{vmatrix} a^2 + 1 & ba & ca & da \\ ab & b^2 + 1 & cb & db \\ ac & bc & c^2 + 1 & dc \\ ad & bd & cd & d^2 + 1 \end{vmatrix} = 1 + a^2 + b^2 + c^2 + d^2$$

2. Show that every square matrix can be uniquely expressed as the sum of symmetric and Skew-Symmetric matrices.

[5]

3. Test the consistency of the system $x+y+z=3$, $x+2y+3z=4$ and $2x+3y+4z=7$ and solve completely if found consistent.

[5]

4. State Cayley-Hamilton theorem and verify it for the matrix; $A = \begin{pmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{pmatrix}$

[1+4]

5. Prove that " The line integral $\int_C \vec{F} \cdot d\vec{r}$ of a continuous function \vec{F} defined in a region R is independent of path C joining any two points in R if and only if there exists a single valued scalar function ϕ having first order partial derivatives such that $\vec{F} = \nabla\phi$ ".

[5]

6. State Green's theorem and use it to find the area of astroid $x^{2/3} + y^{2/3} = a^{2/3}$.

[5]

7. Evaluate $\iint_S \vec{F} \cdot \vec{n} ds$, where $\vec{F} = x^2 \vec{i} + y^2 \vec{j} + z^2 \vec{k}$ and 's' is the surface of the plane $x + y + z = 1$ between the co-ordinate planes.

[5]

8. Apply Gauss' divergence theorem to evaluate $\iint_S \vec{F} \cdot \vec{n} ds$ where

$\vec{F} = (x^3 - yz) \vec{i} - 2x^2y \vec{j} + 2z \vec{k}$ and 's' is the surface the cube bounded by the planes $x = 0, x = a, y = 0, y = a, z = 0, z = a$.

[5]

9. Find the Laplace transform of:

[2+3]

i) $t \sin^2 3t$

ii) $\frac{\sin 2t}{t}$

10. Find the inverse Laplace transform of:

[2+3]

i) $\frac{1}{s^2 - 3s + 2}$

ii) $\frac{1}{s(s+1)^3}$

11. Apply Laplace transform to solve the differential equation:

[5]

$$y'' + 2y' + 5y = e^{-t} \sin t, \quad x(0) = 0, x'(0) = 1$$

12. Find a Fourier series to represent $f(x) = x - x^2$ from $x = -\pi$ to $x = \pi$. Hence show that

[5]

$$\frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \dots = \frac{\pi^2}{12}$$

13. Develop $f(x) = \sin\left(\frac{\pi x}{l}\right)$ in half range Cosine Series in the range $0 < x < l$.

[5]

14. Graphically maximize,

[5]

$$Z = 7x_1 + 10x_2$$

Subject to constraints,

$$3x_1 + x_2 \leq 9$$

$$x_1 + 2x_2 \leq 8$$

$$x_1 \geq 0, x_2 \geq 0$$

15. Solve the following LPP using simplex method.

[10]

$$\text{Maximize: } P = 50x_1 + 80x_2$$

$$\text{Subject to: } x_1 + 2x_2 \leq 32$$

$$3x_1 + 4x_2 \leq 84$$

$$x_1 \geq 0, x_2 \geq 0$$

01 TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2071 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	All (Except B.Arch.)	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Engineering Mathematics III (SH501)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Using the properties, evaluate the determinant:

[5]

$$\begin{vmatrix} 1 & a & a^2 & a^3 + bcd \\ 1 & b & b^2 & b^3 + cda \\ 1 & c & c^2 & c^3 + abd \\ 1 & d & d^2 & d^3 + abc \end{vmatrix}$$

2. Prove that every square matrix can uniquely be expressed as the sum of a symmetric and a skew symmetric matrix. [5]

3. Test the consistency of the system: [5]

$$x - 6y - z = 10, \quad 2x - 2y + 3z = 10, \quad 3x - 8y + 2z = 20$$

And solve completely, if found consistent.

4. Find the eigen values and eigenvectors of the matrix $\begin{pmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{pmatrix}$. [5]

5. Using the line integral, compute the workdone by the force [5]

$$\vec{F} = (2x - y + 2z) \vec{i} + (x + y - z) \vec{j} + (3x - 2y - 5z) \vec{k}$$

when it moves once around a circle $x^2 + y^2 = 4; z = 0$

6. State and prove Green's Theorem in plane. [5]

7. Verify Stoke's theorem for $\vec{F} = (x^2 + y^2) \vec{i} - 2xy \vec{j}$ taken around the rectangle bounded by the lines $x = \pm a, y = 0, y = b$. [5]

8. Evaluate $\iint_S \vec{F} \cdot \vec{n} \, ds$ where $\vec{F} = (2xy + z) \vec{i} + y^2 \vec{j} - (x + 3y) \vec{k}$ by Gauss divergence theorem; where S is surface of the plane $2x + 2y + z = 6$ in the first octant bounding the volume V. [5]

9. Find the Laplace transform of the following: [2.5×2]

a) $te^{-2t} \cos t$

b) $\sin ht \cos t$

10. Find the inverse Laplace transform of :

[2.5×2]

a) $\frac{1}{S(S+1)}$

b) $\frac{S^2}{(S^2 + b^2)^2}$

11. Solve the differential equation $y''+2y'+5y=e^{-t} \sin t$, $y(0)=0$, $y'(0)=1$, by using Laplace transform.

[5]

12. Expand the function $f(x)=x \sin x$ as a Fourier series in the interval $-\pi \leq x \leq \pi$.

[5]

13. Obtain half range sine series for the function $f(x)=x-x^2$ for $0 < x < 1$.

[5]

14. Graphically maximize and minimize

[5]

$z = 9x + 40y$ subjected to the constraints

$y - x \geq 1$, $y - x \leq 3$, $2 \leq x \leq 5$

15. Solve the following Linear Programming Problem by Simplex method:

[10]

Maximize, $P = 20x_2 - 5x_1$

Subjected to, $10x_2 - 2x_1 \leq 5$

$2x_1 + 5x_2 \leq 10$ and $x_1, x_2 \geq 0$

01 TRIBHUVAN UNIVERSITY
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Examination Control Division
 2070 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	All (Except B.Arch)	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Mathematics III (SH501)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Using the properties of determinant prove

[5]

$$\begin{vmatrix} (b+c)^2 & a^2 & a^2 \\ b^2 & (c+a)^2 & b^2 \\ c^2 & c^2 & (a+b)^2 \end{vmatrix} = 2abc(a+b+c)^3$$

2. Prove that $(AB)^T = B^T A^T$ where A is the matrix of size $m \times p$ and B is the matrix of size $p \times n$

[5]

3. Find the rank of the following matrix by reducing normal form.

[5]

$$\begin{bmatrix} 1 & 3 & -2 & 1 \\ 1 & 1 & 1 & 1 \\ 2 & 0 & -3 & 2 \\ 3 & 3 & -3 & 3 \end{bmatrix}$$

4. Find the eigen values and eigen vectors of the following matrix.

[5]

$$\begin{bmatrix} 2 & 0 & 1 \\ 0 & 2 & -1 \\ 0 & 0 & 2 \end{bmatrix}$$

5. Prove that the line integral $\int_A^B \vec{F} \cdot d\vec{r}$ is independent of the path joining any two points A and B in a region if $\int_C \vec{F} \cdot d\vec{r} = 0$ for any simple closed curve C in the region.

[5]

6. Evaluate $\iint_S \vec{F} \cdot \hat{n} ds$ where $\vec{F} = x^2 \vec{i} + y^2 \vec{j} + z^2 \vec{k}$ and S is the finite plane $x + y + z = 1$ between the coordinate planes.

[5]

OR

Evaluate $\iint_S \vec{F} \cdot \hat{n} ds$ for $\vec{F} = yz \vec{i} + zx \vec{j} + xy \vec{k}$ where S is the surface of sphere $x^2 + y^2 + z^2 = 1$ in the first octant.

7. Evaluate, $\iint_S \vec{F} \cdot \hat{n} ds$ for $\vec{F} = x \vec{i} - y \vec{j} + (z^2 - 1) \vec{k}$ where S is the surface bounded by the cylinder $x^2 + y^2 = 4$ and the planes $z = 0$ and $z = 1$

[5]

8. Verify the stoke's theorem for $\vec{F} = (2x - y) \vec{i} - yz^2 \vec{j} - y^2 z \vec{k}$ where S is the upper part of the sphere $x^2 + y^2 + z^2 = a^2$ C is its boundary. [5]
9. Find the Laplace transform of (a) $t^2 \sin zt$ and (b) $\frac{1-e^t}{t}$ [2.5×2]
10. Find the inverse Laplace transform of (a) $\frac{2s+3}{s^2+5s-6}$ (b) $\frac{s^3}{s^4-a^4}$ [2.5×2]
11. Solve the following differential equation by using Laplace transform [5]
 $y'' + y' - 2y = x, y(0) = 1, y'(0) = 0$
12. Obtain the Fourier series for $f(x) = x^2$ in the interval $-\pi < x < \pi$ and hence prove that
- $$\sum \frac{1}{x^2} = \frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} \dots = \frac{\pi^2}{6} \quad [5]$$
13. Obtain half range sine series for $f(x) = \pi x - x^2$ in $(0, \pi)$ [5]
14. Graphically minimize $z = 4x_1 + 3x_2 + x_3$ [5]
- Subject to $x_1 + 2x_2 + 4x_3 \geq 12$
 $3x_1 + 2x_2 + x_3 \geq 8$ and $x_1, x_2, x_3 \geq 0$
15. Minimize $z = 8x_1 + 9x_2$ [10]
- Subject to $x_1 + 3x_2 \geq 4$
 $2x_1 + x_2 \geq 5$ with $x_1, x_2 \geq 0$

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INSTITUTE OF ENGINEERING
Examination Control Division.
2069 Ashad

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	All (Except B. Arch.)	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Engineering Mathematics III (SH 501)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Find the value of the determinant: [5]

$$\begin{vmatrix} 1 & a & a^2 & a^3 + bcd \\ 1 & b & b^2 & b^3 + cda \\ 1 & c & c^2 & c^3 + dab \\ 1 & d & d^2 & d^3 + abc \end{vmatrix}$$

2. Prove that every square matrix can be uniquely expressed as the sum of a symmetric and a skew-symmetric matrices. [5]

3. Find the rank of matrix: $\begin{bmatrix} 1 & 3 & -2 & 1 \\ 1 & 1 & 1 & 1 \\ 2 & 0 & -3 & 2 \\ 3 & 3 & -3 & 3 \end{bmatrix}$ reducing to echelon form. [5]

4. Verify Cayley-Flamilton theorem for the matrix: $\begin{bmatrix} 1 & 3 & 7 \\ 4 & 2 & 3 \\ 1 & 2 & 1 \end{bmatrix}$. [5]

5. Find the Laplace transforms of: (a) $te^{-t}\sin t$ (b) $\frac{e^{at} - \cos bt}{t}$ [5]

6. If $L[f(t)] = F(s)$, then prove that $L[f'(t)] = SF(s) - f(0)$. [5]

7. Use Laplace transform to solve: $x'' + 2x' + 5x = e^{-t} \sin t$ given $x(0) = 0$; $x'(0) = 1$. [5]

8. Obtain the Fourier series for $f(x) = x^3$ in the interval $-\pi \leq x \leq \pi$. [5]

9. Obtain half-range sine series for e^x in $(0, 1)$. [5]

10. Maximize $z = 2x_1 + 3x_2$ subject to constraints $x_1 - x_2 \leq 2$, $x_1 + x_2 \geq 4$ and $x_1, x_2 \geq 0$ graphically. [5]

11. Solve the linear programming problems by simplex method constructing the duality [10]

Minimize $Z = 3x_1 + 2x_2$

Subject to $2x_1 + 4x_2 \geq 10$

$4x_1 + 2x_2 \geq 10$

$x_2 \geq 4$ and $x_1, x_2 \geq 0$

12. Prove that $\vec{F} = (2xz^3 + 6y)\vec{i} + (6x - 2yz)\vec{j} + (3x^2z^2 - y^2)\vec{k}$ is conservative vector field and find its scalar potential function. [5]

13. Evaluate $\iint_S \vec{F} \cdot \hat{n} ds$ where $\vec{F} = x^2\vec{i} + y^2\vec{j} + z^2\vec{k}$ and S is the finite plane $x+y+z=1$ between the co-ordinate planes. [5]

14. Using Green's theorem, find the area of the hypocycloid $\frac{x^{2/3}}{a^{2/3}} + \frac{y^{2/3}}{b^{2/3}} = 1$. [5]

15. Evaluate $\iint_S \vec{F} \cdot \hat{n} ds$ where $\vec{F} = 2x\vec{i} + 3y\vec{j} + 4z\vec{k}$ and S is the surface of sphere $x^2+y^2+z^2=1$ by Gauss divergence theorem. [5]

OR

Verify Stoke's theorem for $\vec{F} = 2y\vec{i} + 3x\vec{j} - z^2\vec{k}$ where S is the upper half of the sphere $x^2+y^2+z^2=9$ and 'C' is its boundary. [5]

Exam.	Regular		
Level	BE	Full Marks	80
Programme	All (Except B.Arch)	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Engineering Mathematics III (SH501)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Find the value of the determinant $\begin{vmatrix} a^2 & a^2 - (b-c)^2 & bc \\ b^2 & b^2 - (c-a)^2 & ca \\ c^2 & c^2 - (a-b)^2 & ab \end{vmatrix}$ [5]
2. Show that the matrix $B^T AB$ is Hermitian or skew-Hermitian according as A is Hermitian and skew- Hermitian. [5]
3. Find the rank of the matrix $\begin{bmatrix} 6 & 1 & 3 & 8 \\ 4 & 2 & 6 & -1 \\ 10 & 3 & 9 & 7 \\ 16 & 4 & 12 & 15 \end{bmatrix}$ reducing this into the triangular form. [5]
4. Obtain the characteristic equation of the matrix $A = \begin{bmatrix} 1 & 0 & 2 \\ 0 & 2 & 1 \\ 2 & 0 & 3 \end{bmatrix}$ and verify that it is satisfied by A. [5]
5. Evaluate $\int_C \vec{F} \cdot d\vec{r}$, where $\vec{F} = (x-y) \vec{i} + (x+y) \vec{j}$ along the closed curve C bounded by $y^2 = x$ and $x^2 = y$ [5]
6. Find the value of the normal surface integral $\iint_S \vec{F} \cdot \vec{n} ds$ for $\vec{F} = x \vec{i} - y \vec{j} + (z^2 - 1) \vec{k}$, where S is the surface bounded by the cylinder $x^2 + y^2 = 4$ between the planes $Z = 0$ and $Z = 1$. [5]
7. Using Green's theorem, find the area of the astroid $x^{\frac{2}{3}} + y^{\frac{2}{3}} = a^{\frac{2}{3}}$ [5]
8. Verify stoke's theorem for $\vec{F} = 2y \vec{i} + 3x \vec{j} - z^2 \vec{k}$ where S is the upper half of the sphere $x^2 + y^2 + z^2 = 9$ and C is its boundary. [5]

OR

Evaluate the volume intergral $\iiint_V \vec{F} dv$, where V is the region bounded by the surface $x = 0, y = 0, y = 6, z = x^2, z = 4$ and $\vec{F} = 2xz \vec{i} - x \vec{j} + y^2 \vec{k}$

9. Find the Laplace transforms of the following functions [2.5×2]
 - $t e^{-4t} \sin 3t$
 - $\frac{\cos at - \cos bt}{t}$

10. State and prove the second shifting theorem of the Laplace transform. [5]

11. Solve the following differential equation using Laplace transform. [5]

$$\frac{d^2y}{dx^2} + \frac{dy}{dx} - 2y = x \text{ given } y(0) = 1, y'(0) = 0$$

12. Obtain the Fourier series for $f(x) = x^2$ in the interval $-\pi < x < \pi$ and hence show that

$$\sum \frac{1}{n^2} = \frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \dots = \frac{\pi^2}{6} \quad [5]$$

13. Express $f(x) = x$ as a half-range sine series in $0 < x < 2$ [5]

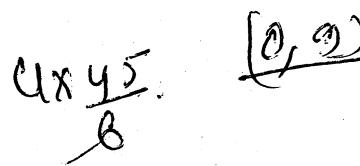
14. Maximize $Z = 4x_1 + 5x_2$ subject to constraints [5]

$$2x_1 + 5x_2 \leq 25$$

$$6x_1 + 5x_2 \leq 45$$

$$x_1 \geq 0 \text{ and } x_2 \geq 0$$

graphically



15. Solve the following linear programming problem using the simplex method. [10]

$$\text{Maximize } P = 50x_1 + 80x_2$$

$$\text{Subject to } x_1 + 2x_2 \leq 32$$

$$3x_1 + 4x_2 \leq 84$$

$$x_1, x_2 \geq 0$$

02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division

2068 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE, BEL, BEX, BCT, BME, BIE, B. AGRI.	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Engineering Mathematics III (SH 501)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Prove that: $\begin{vmatrix} a & b & c^2 \\ b & c & a \\ c & a & b \end{vmatrix} = \begin{vmatrix} 2bc - a^2 & c^2 & b^2 \\ c^2 & 2ac - b^2 & a^2 \\ b^2 & a^2 & 2ab - c^2 \end{vmatrix} = (a^3 + b^3 + c^3 - 3abc)^2$. [5]
2. Define Hermitian and Skew Hermitian matrix. Show that every square matrix can be uniquely expressed as the sum of a Hermitian and a skew Hermitian. [5]
3. For what value of λ the equation $x + y + z = 1$, $x + 4y + 10z = \lambda^2$ and $x + 2y + 4z = \lambda$ have a solution? Solve them completely in each case. [5]
4. Find the eigen values and eigen vectors of $A = \begin{vmatrix} 3 & -4 & 4 \\ 1 & -2 & 4 \\ 1 & -1 & 3 \end{vmatrix}$. [5]
5. Evaluate $\int_C \vec{F} \cdot d\vec{r}$, Where $C: x^2 = y$ and $y^2 = x$ and $\vec{F} = (x-y) \vec{i} + (x+y) \vec{j}$. [5]
6. State and prove Green theorem in a plane. [5]
7. Verify Gauss divergence theorem for $\vec{F} = x^2 \vec{i} + 3 \vec{j} + yz \vec{k}$. Taken over the cube bounded by $x = 0, x = 1, y = 0, y = 1, z = 0, z = 1$. [5]
8. Find the Laplace transform of the given function (i) $t^2 \sin t$ (ii) $\cos at \sin bt$. [5]
9. Evaluate $\iint_s \vec{F} \cdot d\vec{s}$ where $\vec{F} = 3 \vec{i} + x \vec{j} - yz \vec{k}$ and s is the surface of the cylinder $x^2 + y^2 = 9$ included in the first octant between the plane $z = 0, z = 4$. [5]
10. Find the inverse Laplace transform: (a) $\frac{1}{(S-2)(S+4)}$ (b) $\log\left(\frac{s^2 + a^2}{s^2}\right)$ [5]
11. Solve the equation using Laplace transform $y'' + 4y' + 3y = t$, $t > 0$ $y(0) = 0$, $y'(0) = 1$. [5]

12. Obtain a Fourier series to represent the function $f(x) = |x|$ for $-\pi \leq x \leq \pi$ and hence.

$$\text{deduce } \frac{\pi^2}{8} = \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \dots \quad [5]$$

13. Obtain the half Range Sine Series $f(x) = ex$ in $0 < x < 1$. [5]

OR

Obtain the Fourier series for $f(x) = x - x^2$ where $-1 < x < 1$ as a Fourier series of period 2.

14. Solve the following by using the simplex method: [7.5]

Maximize $P = 15x_1 + 10x_2$,

Subject to

$$2x_1 + x_2 \leq 10,$$

$$x_1 + 3x_2 \leq 10,$$

$$x_1, x_2 \geq 0.$$

15. Solve by using the dual method: [7.5]

Minimize $C = 21x_1 + 50x_2$,

Subject to $2x_1 + 5x_2 \leq 12$,

$$3x_1 + 7x_2 \leq 17,$$

$$x_1, x_2 \geq 0.$$

OR

Solve the following LPP by using the big M-method:

Maximize $P = 2x_1 + x_2$,

Subject to

$$x_1 + x_2 \leq 10,$$

$$-x_1 + x_2 \geq 2,$$

$$x_1, x_2 \geq 0.$$

02 TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2068 Baishakh

Exam.	Regular / Back.		
Level	BE	Full Marks	80
Programme	All (Except B.Arch.)	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Engineering Mathematics III

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Using the properties of determinant prove that:

[5]

$$\begin{vmatrix} x & 1 & y & 1 \\ 1 & y & 1 & x \\ 1 & x & 1 & y \\ y & 1 & x & 1 \end{vmatrix} = (x+y+2)(x-y)^2(x+y-2)$$

2. If A and B are two non singular matrices of the same order, prove that $(AB)^{-1} = B^{-1} \cdot A^{-1}$.

[5]

3. Find the rank of the following matrix reducing to normal form

$$\begin{bmatrix} 1 & 2 & 1 & 2 \\ 1 & 3 & 2 & 2 \\ 2 & 4 & 3 & 4 \\ 3 & 7 & 4 & 6 \end{bmatrix}$$

[5]

4. Find the eigen values and eigen vectors of the matrix

$$\begin{bmatrix} 2 & -2 & 2 \\ 1 & 1 & 1 \\ 1 & 3 & -1 \end{bmatrix}$$

[5]

5. Find the Laplace transform of the following functions:

[5]

a) $te^{-3t} \cos 2t$

b) $\frac{e^{at} - \cos 6t}{t}$

6. Find the inverse Laplace transform of the following functions:

[5]

a) $\frac{1}{(s-2)(s+2)^2}$

b) $\frac{1}{s^2(s+2)}$

7. Solve using Laplace transform $(D^2 + 4D + 3)x = e^{-t}$, where $x(0) = x'(0) = 1$.

[5]

8. Obtain a Fourier series for $f(x) = x^3$ in the interval $-\pi \leq x \leq \pi$.

[5]

9. Find the half range sine series for the function $f(x) = x - x^2$ in the interval $0 < x < 1$.

[5]

10. Maximize $Z = x_1 + 1.5 x_2$ subject to constraints

[5]

$2x_1 + 2x_2 \leq 160$

$x_1 + 2x_2 \leq 120$

$4x_1 + 2x_2 \leq 280$

$x_1 \geq 0$ and $x_2 \geq 0$ graphically.

11. Solve the following linear programming problems by simplex method [10]

Maximize $Z = 15x_1 + 10x_2$

Subject to $2x_1 + 2x_2 \leq 10$

$x_1 + 3x_2 \leq 10$ and $x_1, x_2 \geq 0$

12. Show that the vector field $\vec{F} = (x^2 - yz)\hat{i} + (y^2 - zx)\hat{j} + (z^2 - xy)\hat{k}$ is irrotational. Find the scalar function $\phi(x, y, z)$ such that $\vec{F} = \nabla\phi$. [5]

13. If S be the part of the surface $Z = 9 - x^2 - y^2$ with $Z \geq 0$ and $\vec{F} = 3x\hat{i} + 3y\hat{j} + Z\hat{k}$, find the flux of F through S. [5]

14. State and prove that Green's theorem in the plane. [5]

15. Evaluate by Stoke's theorem: [5]

$$\int_C (e^x dx + 2y dy - dz)$$

Where C is the curve: $x^2 + y^2 = 4$, $z = 2$.

OR

Verify Gauss divergence theorem for the vector function $\vec{F} = x^2\hat{i} + z\hat{j} + yz\hat{k}$, taken over the unit cube bounded by the planes: $x = 0, x = 1, y = 0, y = 1, z = 0, z = 1$.

05 TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2067 Ashadh

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	All (Except B.Arch.)	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Mathematics III

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. Using the properties of determinant prove:

$$\begin{vmatrix} a^2 + 1 & ba & ca & da \\ ab & b^2 + 1 & cb & db \\ ac & bc & c^2 + 1 & dc \\ ad & bd & cd & d^2 + 1 \end{vmatrix} = a^2 + b^2 + c^2 + d^2 + 1$$

2. Show that every square matrix can be uniquely expressed as the sum of hermitian and a skew-hermitian matrix.

3. Reduce to normal form and find the rank of the matrix:

$$\begin{bmatrix} 2 & -2 & 0 & 6 \\ 4 & 2 & 0 & 2 \\ 1 & -1 & 0 & 3 \\ 1 & -2 & 1 & 2 \end{bmatrix}$$

4. Find the eigen values and eigenvectors of the matrix

$$\begin{bmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{bmatrix}$$

5. Find the Laplace transform of:

a) cosh at sin at

b) $\frac{\cos 2t - \cos 3t}{t}$

6. Find the inverse Laplace transform of:

a) $\frac{1}{s^2(s^2 + a^2)}$

b) $\log \frac{s+1}{s-1}$

7. State and prove the integral theorem of the Laplace transform.

8. Solve the following differential equation using the Laplace transform.

$y''' + 2y'' - y' - 2y = 0$ where $y(0) = y'(0) = 0$ and $y''(0) = 6$

9. Find a Fourier series to represent $x - x^2$ for $-\pi < x < \pi$. Hence show that

$$\frac{\pi^2}{12} = \frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \dots$$

10. Express $f(x) = x$ as a cosine half range series in $0 < x < 2$.

11. The acceleration of a moving particle at any time t is given by

$\frac{d^2 \vec{r}}{dt^2} = 12 \cos 2t \hat{i} - 8 \sin 2t \hat{j} + 16t \hat{k}$. Find the velocity \vec{v} and displacement \vec{r} at anytime t if

$$t = 0, \vec{v} = 0 \text{ and } \vec{r} = 0.$$

12. Find the angle between the normals to the surface $xy = z^2$ at the points $(1,4,2)$ and $(-3,-3,3)$

13. Find the work done in moving a particle once round the circle $x^2 + y^2 = 9, z = 0$ under the force field \vec{F} given by $\vec{F} = (2x - y + z) \hat{i} + (x + y - z^2) \hat{j} + (3x - 2y + 4z) \hat{k}$.

14. Evaluate $\iint_S \vec{F} \cdot \vec{n} ds$ where s is the upper side of triangle with vertices $(1,0,0), (0,1,0), (0,0,1)$ where $\vec{F} = (x - 2z) \hat{i} + (x + 3y + z) \hat{j} + (5x + y) \hat{k}$.

15. State Green's theorem in a plane. Using Green's theorem find the area of $x^{2/3} + y^{2/3} = a^{2/3}$.

16. Verify Stoke's theorem for $\vec{F} = (2x - y) \hat{i} - yz^2 \hat{j} - y^2 z \hat{k}$ where s is the upper part of the sphere $x^2 + y^2 + z^2 = a^2$ and c is its boundary.

OR

Verify Gauss theorem for $\vec{F} = y \hat{i} + x \hat{j} + z^2 \hat{k}$ over the region bounded by $x^2 + y^2 = a^2, z = 0$ and $z = h$.

04 TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2067 Magh

Exam.	Back		
Level	BE	Full Marks	80
Programme	All (Except B.Arch.)	Pass Marks	32
Year / Part	II / I	Time	3 hrs.

Subject: - Mathematics III

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. Show that $\begin{vmatrix} a & b & b & b \\ a & b & a & a \\ a & a & b & a \\ b & b & b & a \end{vmatrix} = -(b-a)^4$.

2. If P and Q are two orthogonal matrices of the same order, prove that their product is also orthogonal.

3. Reducing to normal form, find the rank of matrix $\begin{vmatrix} 1 & -1 & 2 & -3 \\ 4 & 1 & 0 & 2 \\ 0 & 3 & 0 & 4 \\ 0 & 1 & 0 & 2 \end{vmatrix}$.

4. Find the eigen values and eigen vectors of the matrix $\begin{vmatrix} 2 & -2 & 2 \\ 1 & 1 & 1 \\ 1 & 3 & -1 \end{vmatrix}$.

5. Find a Fourier series for $f(x) = x^3$, $-\pi < x < \pi$.
6. Find the half range sine series for the function $f(x) = e^x$ for $0 < x < \pi$.

7. Find the Laplace transform of

a) $t^2 \cos at$
 b) $t^3 e^{-3t}$

8. Find the Inverse Laplace transform of

a) $\frac{s}{(s-3)(s^2+4)}$

b) $\log \frac{s(s+1)}{(s^2+4)}$

9. If $L\{f(t)\} = F(s)$, then prove $L\{e^{at} f(t)\} = F(s-a)$.

10. Use the Laplace transform to solve $\frac{d^2y}{dt^2} + 4\frac{dy}{dt} + 3y = e^{-t}$, $y(0) = y'(0) = 1$.

11. The position vector of a moving particle at any time t is given by $\vec{r} = (t^2 + 1)\vec{i} + (4t - 3)\vec{j} + (2t^2 - 6)\vec{k}$. Find the velocity and acceleration at $t = 1$. Also find their magnitudes.

12. Define divergence and curl of \vec{V} . Prove that $\text{div}(\text{curl } \vec{V}) = 0$.

13. Evaluate $\int_C \vec{F} \cdot d\vec{r}$ where $\vec{F} = Z\vec{i} + x\vec{j} + y\vec{k}$ and C is the arc of curve, $x = t^2 + 1$, $y = 2t^2$, $z = t^3$ from $t = 1$ to $t = 2$.

14. Evaluate $\iint_S \vec{F} \cdot \vec{n} ds$ where $\vec{F} = x\vec{i} + y\vec{j} + z\vec{k}$ and S is the outside of the lateral surface of circular cylinder, $x^2 + y^2 = a^2$ between planes $z = 0$ and $z = 4$.

15. Use Green's theorem to find the area of ellipse, $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$.

16. Verify Stoke's theorem for $\vec{F} = x\vec{i} + z^2\vec{j} + y^2\vec{k}$ over the plane surface $x + y + z = 1$ lying in first octant.

OR

Verify Gauss's theorem for $\vec{F} = 4x\vec{i} - 2y^2\vec{j} + z^2\vec{k}$ taken over the region bounded by $x^2 + y^2 = 4$, $z = 0$ and $z = 3$.
