TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

Examination Control Division

2081 Baishakh

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

Subject: - Engineering Mathematics I (*SH 401*)

✓ 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.*

NCE LIBRARY

1. State Leibnitz's theorem on higher order derivatives. If $y = e^{a\tan^{-1}x}$, prove that $(1+x^2)\,y_{n+2} + (2nx+2x-a)\,y_{n+1} + n(n+1)\,y_n = 0$.
2. State and prove lagrange's mean value theorem.
3. Evaluate: $\lim\limits_{x\to 0}\left(\dfrac{\tan x}{x}\right)^{\frac{1}{x^2}}$
4. Find the asymptote of $x^3 - 2x^2y + xy^2 + x^2 - xy + 2 = 0$.
5. Define curvature and radius of curvature to a curve. Prove that radius of curvature to a curve $\sqrt{x} + \sqrt{y} = \sqrt{a}$ at the point where $y = x$ line cuts it is $a/\sqrt{2}$.
6. Prove that $\int_0^{\frac{\pi}{2}} \log(\sin x)\,dx = \frac{\pi}{2}\log\frac{1}{2}$
7. Apply the method of differentiation under the integral sign to prove $$\int_0^{\frac{\pi}{2}} \frac{dx}{(a^2\sin^2 x + b^2\cos^2 x)^2} = \frac{\pi(a^2+b^2)}{4a^3b^3}.$$
8. If $I_n = \int_0^{\frac{\pi}{4}} \tan^n x\,dx$, show that $I_n + I_{n-2} = \dfrac{1}{n-1}$ and hence deduce the value of I_5.
9. Obtain the area of a loop of the curve $y^2(a^2 + x^2) = x^2(a^2 - x^2)$.

   OR

   Find the volume of the solid generated by the revolution of the cardoid $r = a(1 - \cos\theta)$ about the initial line.
10. Solve: $(1+y^2)\,dx = (\tan^{-1} y - x)\,dy$.
11. Find the general solution of $y = px + x^4p^2$ where the symbols have their usual meaning.
12. Solve: $\dfrac{d^2y}{dx^2} - 4\dfrac{dy}{dx} + 4y = x^3e^{2x}$.
13. Solve: $x\dfrac{d^2y}{dx^2} + \dfrac{dy}{dx} = \dfrac{12\log x}{x}$.
14. What does the equation of the lines $7x^2 + 4xy + 4y^2 = 0$ become when the axes are the bisectors of angle between them.
15. Derive the equation of ellipse in standard form.
16. Describe and sketch the graph of the conic $r = \dfrac{10}{3+2\cos\theta}$.

    OR

    Find the center, foci and eccentricity of the conic: $x^2 + 4xy + y^2 - 2x + 2y - 6 = 0$.

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2080 Bhadra

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

Subject: - Engineering Mathematics I (*SH 401*)

NCE LIBRARY

- ✓ 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. State Leibnitz's theorem on higher order derivative. If $y^{\frac{1}{m}} + y^{-\frac{1}{m}} = 2x$, then show that [5]
   a) $(x^2 - 1)\, y_2 + xy_1 - m^2 y = 0$
   b) $(x^2 - 1)\, y_{n+2} + (2n + 1)\, xy_{n+1} + (n^2 - m^2)\, y_n = 0.$

2. State Rolle,s Mean Value theorem. Interpret it geometrically. Is this theorem applicable for the function $f(x) = \frac{1}{x^2}, x \in [-1, 1]$? Justify your answer. [1+2+2]

3. Define indeterminate form of function. [1+4]

   Evaluate: $\lim\limits_{x \to 0} \left(\frac{1}{x^2} - \frac{1}{\sin^2 x} \right)$

4. What do you mean by the asymptote of a curve? Fine the asymptotes of the curve $(x - y)^2 (x - 2y) + 2(x - y)^2 - x - 9y + 2 = 0$ [1+4]

5. Show that for the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, the radius of curvature at any one extremity of major axis is equal to the half of the length of latus rectum. [5]

6. What do you mean by fundamental theorem of integral calculus? [5]

   Evaluate: $\int_0^a \frac{\sqrt{x}}{\sqrt{x} + \sqrt{a - x}}\, dx$

7. Using the method of differentiation under integral sign, find the value of $\int_0^\infty \frac{e^{-ax} \sin x}{x}\, dx$ also deduce that $\int_0^\infty \frac{\sin x}{x}\, dx = \frac{\pi}{2}$ [4+1]

8. Define Beta and Gamma function. Use it to evaluate: $\int_0^1 x^6 \sqrt{1 - x^2}\, dx$ [1+4]

9. Find the area of the surface of the solid generated by the revolution of the cardioid $r = a\,(a + \cos\theta)$ about the initial line [5]

10. Define Bernoulli's differential equation with example. Find the solution of the equation $\frac{dy}{dx} + \frac{1}{x} \tan y = \frac{1}{x^2} \tan y \sin y$ [1+4]

11. Find the general solution of the differential equation: $y = 2px + p^3 y^2$ [5]

12. Solve the differential equation: $\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 4y = e^{2x} + \sin 2x$ [5]

13. Solve the differential equation $(2x + 3)^2 \frac{d^2y}{dx^2} + 2(2x + 3)\frac{dy}{dx} - 4y = 8x$ [5]

14. Transform the equation $x^2 - 2xy + y^2 + x - 3y = 0$ to axes through the point (-1,0) parallel to the lines bisecting the angles between original axes. [5]

15. Show that the line $x + y = \sqrt{a^2 + b^2}$ is a tangent to the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$. Also find the point of contact. [4+1]

16. Identify the conic $x^2 + 4xy + y^2 - 2x + 2y - 6 = 0$. Find its centre and length of axes. [1+2+2]

OR

What does the conic $r = \frac{12}{3 - 2\cos\theta}$ represent. Sketch its graph and describe it.

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2080 Baishakh

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

Subject: - Engineering Mathematics I (*SH 401*)

- ✓ 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.*

NCE LIBRARY

1. If $y = \log(x + \sqrt{a^2 + x^2})$, then show that [5]
   i) $(a^2+x^2)\, y_2 + xy_1 = 0$
   ii) $(a^2+x^2)\, y_{n+2} + (2n+1)\, xy_{n+1} + n^2 y_n = 0$.
2. Assuming the validity of expansion prove that the series by using Maclaurin's series: [5]
   $$\frac{x}{e^x - 1} = 1 - \frac{x}{2} + \frac{x^2}{12} - \frac{x^4}{720} + \dots\dots\dots\dots$$
3. Evaluate: $\lim_{x \to 0} \left(\frac{\sin x}{x}\right)^{\frac{1}{x^2}}$ [5]
4. Define an asymptotes to a curve. File all the asymptotes of the cubic [5]
   $x^3 - 2y^3 + xy\,(2x-y) + y\,(x-y) + 1 = 0$.
5. Find the pedal equation of the curve: $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$. [5]
6. Show that $\int_0^a \frac{\sqrt{\cot x}}{1+\sqrt{\cot x}}\,dx = \frac{\pi}{4}$. [5]
7. Evaluate: $\int_0^\pi \frac{\log(1 + a\cos x)}{\cos x}\,dx$, using the rule of differentiation under the sign of integration. [5]
8. Define Beta and Gamma function. Using Beta and Gamma function evaluate: [1+4]
   $$\int_0^{\frac{\pi}{4}} \cos^2\theta \sin^4\theta \, d\theta.$$
9. Find the volume of the solid formed by revolution of cardioid $r = a\,(1-\cos\theta)$ about the initial line. [5]
10. Solve $\frac{dy}{dx} = 2y\tan x + y^2 \tan^2 x$. [5]
11. Solve the differential equation: $y = yp^2 + 2px$ [5]
12. Solve the differential equation: $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = xe^x \sin x$. [5]
13. Solve the differential equation: $x^2\frac{d^2y}{dx^2} + 4x\frac{dy}{dx} + 2y = e^x$. [5]

    OR

    The current in a circuit containing resistance R and inductance L in a series with voltage source E. Find the current in the circuit as the function of time. [5]

14. Derive the standard equation of ellipse. [5]

15. Find the angle through which the axes may be turned so that the equation $x+2y+5=0$ may be reduced to $x = c$ and also determine the value of c. [5]

16. Show that the conic $3x^2 + 10xy + 3y^2 - 26x - 22y + 43 = 0$ is a hyperbola. Also find the eccentricity. [1+4]

OR

Describe and sketch the conic

$$r = \frac{4\sec\theta}{2\sec\theta - 1}$$ [5]

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TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Baishakh

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

Subject: - Engineering Mathematics I *(SH 401)*

NCE LIBRARY

- ✓ 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. State Leibnitz's theorem. If $y = \log(x + \sqrt{a^2 + x^2})$ then using the theorem show that $(a^2 + x^2)y_2 + xy_1 = 0$ and hence show that $(a^2 + x^2)y_{n+2} + (2n + 1)xy_{n+1} + n^2y_n = 0$. [1+4]
2. Assuming the validity of expansion, find the expansion of: log(secx) by using Maclaurin's theorem. [5]
3. What do you mean by indeterminate form? State various forms of indeterminacy. Evaluate $\lim_{x \to 0}\left(\frac{\sin x}{x}\right)^{\frac{1}{x^2}}$. [5]
4. Define asymptotes and its types. Find the asymptotes of the curve $x^3 + 4x^2y + 5xy^2 + 2y^3 + 2x^2 + 4xy + 2y^2 - x - 9y + 1 = 0$. [1+4]
5. Find the pedal equation of the curve of $r^m = a^m\cos m\theta$. [5]
6. Show that $\int_0^{\pi/2} \frac{x}{\sin x + \cos x}dx = \frac{\pi}{2\sqrt{2}}\log(\sqrt{2} + 1)$. [5]
7. Evaluate, by using the rule of differentiation under the sign of integration: $\int_0^{\pi} \frac{\log(1 + a\cos x)}{\cos x}dx$. [5]
8. Define Beta and Gamma function and use these to evaluate $\int_0^1 \frac{dx}{(1 - x^6)^{1/6}}$. [5]
9. Find the area included between an arc of cycloid $x = a(\theta - \sin\theta)$, $y = a(1 - \cos\theta)$ and its base.

   OR

   Find the volume of the solid formed by revolution of the cardoid $r = a(1 + \cos\theta)$ about the initial base. [5]
10. Solve the differential equation $\frac{dy}{dx} + \frac{x}{1 - x^2}y = x\sqrt{y}$. [5]
11. State Clairatut's equation, find the general and singular solution of $y = px + p - p^2$. [5]
12. Find the particular integral and hence solve the differential equation $y'' - 2y' + 5y = e^{2x}\sin x$. [5]
13. Solve the differential equation $x^2\frac{d^2y}{dx^2} - x\frac{dy}{dx} + 2y = x\log x$. [5]
14. Through what angle should the axes be rotated to reduce the equation $3x^2 + 2xy + 3y^2 - \sqrt{2}x = 0$ into one with the xy term missing? Also obtain the transformed equation. [2+3]
15. Deduce the standard equation of the hyperbola. [5]
16. Describe and sketch the graph of the equation $r = \frac{10}{2 - 3\sin\theta}$

    OR

    Find the centre, length of axes and eccentricity of the conic $3x^2 + 8xy - 3y^2 - 40x - 20y + 50 = 0$. [5]

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TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

Examination Control Division

2079 Bhadra

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

Subject: - Engineering Mathematics I (*SH 401*)

- ✓ 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.*

NCE LIBRARY

1. State Leibnitz's theorem. If $y = a\cos(\log x) + b\sin(\log x)$ then show that $x^2 y_{n+2} + (2n+1) x y_{n+1} x + (n^2+1) y_n = 0$.
2. Apply Maclaurin's series to find the expansion of $e^x \sec x$ as far as the term in x^3.
3. State L'Hopital's rule. Using it evaluate $\lim\limits_{x \to 0} \left(\frac{\sin x}{x}\right)^{\frac{1}{x^2}}$
4. Find the asymptotes of the curve
   $(x+y)^2 (x+2y+2) = x + 9y - 2$
5. Show that for the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, the radius of curvature at the extremity of the major axis is equal to half of the Latus rectum.
6. Integrate: $\int_0^{\frac{\pi}{2}} \frac{\cos x\,dx}{(1+\sin x)(2+\sin x)}$
7. Apply the rule of differentiation under integral sign to evaluate: $\int_0^{\infty} \frac{e^{-ax}\sin x}{x}dx$ and hence deduce that $\int_0^{\infty} \frac{\sin x}{x}dx = \frac{\pi}{2}$
8. Define Beta and Gamma functions. Evaluate: $\int_0^a x^4\sqrt{a^2 - x^2}\,dx$
9. Show that the area of the astroid $x^{2/3}-y^{2/3}=a^{2/3}$ is $\frac{3\pi a^2}{8}$

   OR

   Find the volume of the solid of revolution of the cardoid $r = a(1+\cos\theta)$ about the initial line.
10. Solve: $x\frac{dy}{dx}+2y = x^2\log x$
11. Solve: $y = yp^2 + 2px$ where $p = \frac{dy}{dx}$
12. Solve: $\frac{d^2y}{dx^2} + 3\frac{dy}{dx} + 2y = e^{2x}\sin x$
13. Solve: $x\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + 2\frac{y}{x} = \frac{1}{x^2}$
14. Derive the standard equation of an ellipse.
15. Through what angle should the axes be rotated to reduce the equation $3x^2 + 2xy + 3y^2 - \sqrt{2}\,x = 0$ in to one with the xy term missing?
16. Find the center, length of the axes and eccentricity of the conic
    $9x^2 + 4xy + 6y^2 - 22x - 16y + 9 = 0$

    OR

    Describe and sketch the graph of the equation $r = \frac{10}{3+2\cos\theta}$

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TRIBHUVAN UNIVERSITY	Exam.	Regular		
INSTITUTE OF ENGINEERING	Level	BE	Full Marks	80
Examination Control Division	Programme	All except BAR	Pass Marks	32
2078 Bhadra	Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Mathematics I *(SH 401)*

- ✓ 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 $y=(x^2-1)^n$, then prove that: $(x^2-1)y_{n+2}+2xy_{n+1}-n(n+1)y_n=0$ [5]
2. Assuming the validity of expansion, expand log(1+x) by using Maclaurin's theorem. [5]
3. Give an example of indeterminate from. Evaluate: $\lim_{x\to 0}(\cot x)^{\frac{1}{\log x}}$ [5]
4. Find the asymptote of the curve: $(x^2-y^2)^2-2(x^2+y^2)+x-1=0$ [5]
5. Find the radius of curvature for the curve $r^m=a^m\cos m\theta$. [5]

   OR

   Find the pedal equation of the following curves $y^2=4a(x+a)$. [5]
6. Evaluate: $\int_0^1 \frac{\log(1+x)}{(1+x^2)}dx$ [5]
7. Evaluate by using the rule of differentiation under the sign of integration: $\int_0^\infty \frac{\log(1+a^2x^2)}{1+b^2x^2}dx$ [5]
8. Define Gamma function. Use it to prove: $\int_0^{\pi/8}\cos^3 4x\,dx=\frac{1}{6}$ [5]
9. Find the area of a loop of the curve : $a^2y^2=a^2x^2-x^4$ [5]

   OR

   Prove that the volume and surface area of a sphere of radius 'a' is $\frac{4}{3}\pi a^3$ and $4\pi a^2$ respectively. [5]
10. Solve: $\frac{dy}{dx}+\frac{y}{x}\log y=\frac{y}{x^2}(\log y)^2$ [5]
11. Find the general solution of the differential equation $y=(1+p)x+ap^2$. [5]
12. Solve: $(D^2+3D+2)y=e^{2x}\sin x$ [5]
13. Solve: $(x^2D^2-2)y=x^2+\frac{1}{x}$

    OR

    A certain culture of bacteria grows at rate proportional to its size. If the size doubles in 4 days, find the time required for the culture to increase to 10 times to its original size. [5]
14. Through what angle must the axes be rotated to remove the term containing xy in $11x^2+4xy+14y^2=5$. [5]
15. Prove that: $2x^2+3y^2-4x-12y+13=0$ represents equation of ellipse. Find its center, length of axes, eccentricity, and direct ices of ellipse. [5]
16. Show that the line $x\cos\alpha+y\sin\alpha=p$ will be a tangent to the hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$ if $a^2\cos^2\alpha-b^2\sin^2\alpha=p^2$. [5]

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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	I / I	Time	3 hrs.

Subject: - Engineering Mathematics I *(SH 401)*

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

1. State Leibnitz's theorem. If $y^{1/m} + y^{-1/m} = 2x$, prove that $(x^2 - 1)y_2 + xy_1 - m^2 y = 0$, and hence show that $(x^2 - 1)y_{n+2} + (2n+1)xy_{n+1} + (n^2 - m^2)y_n = 0$.

2. Apply Maclaurin's series to find the expansion of $\frac{e^x}{1+e^x}$ as far as the term in x^3 and hence find the expansion of $\log(1+e^x)$.

NCE LIBRARY

3. State L-Hospital's rule. Evaluate $\lim_{x \to 0} \left(\frac{\sin x}{x}\right)^{1/x^2}$

4. Find the asymptotes of the curve of $x^2(x-y)^2 - a^2(x^2 + y^2) = 0$.

5. Define the radius of curvature, obtain the radius of curvature for the curve at the origin $x^3+y^3=3axy$.

6. Prove that: $\int_0^{\pi} \frac{x \tan x}{\sec x + \tan x} dx = \frac{\pi}{2}(\pi - 2)$

7. Apply the method of differentiation under integral sign to prove.

$$\int_0^{\pi} \frac{dx}{(a + b\cos x)^2} = \frac{\pi a}{(a^2 - b^2)^{3/2}}$$

8. State Beta and Gamma function. Use them to evaluate: $\int_0^1 x^6 \sqrt{1-x^2}\, dx$

9. Define the term quadrature. Find the area bounded by the curve $r = a(1 - \cos\theta)$.

   OR

   Find the volume of the solid formed by the revolution of cycloid $x = a(\theta + \sin\theta)$, $y = a(1 + \cos\theta)$ about x-axis.

10. Solve the differential equations: $(x + y + 1)dx + (y - x)dy = 0$

11. Find the general solution of the differential equation: $e^y - p^3 - p = 0$ where $p = \frac{dy}{dx}$.

12. Solve the different equation: $(D^2 + 2D + 1)y = e^x + x^2$

13. Solve: $(x^2 D^2 + xD - 1)y = x^2$

OR

A radioactive material has an initial mass 100mg. After 2 years, it is left to 80mg. Find the amount of material at any time t.

14. Through what angle the axes be rotated to remove the term containing xy in $11x^2 + 4xy + 14y^2 - 5 = 0$.

15. Define hyperbola as a locus of a point and deduce the equation of hyperbola in standard form.

16. Find the center, length of axes, and eccentricity of the following conic:

$$3x^2 + 8xy - 3y^2 - 20y - 40x + 50 = 0$$

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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	I / I	Time	3 hrs.

Subject: - Engineering mathematics I *(SH 401)*

- ✓ 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.*

ACE LIBRARY

1. If y=acos(log x) + b sin(logx) prove that:

   (i) $x^2y_2+xy_1+y=0$

   (ii) $x^2y_{n+2}+(2n+1)xy_{n+1}+(n^2+1)y_n=0$

2. State and prove Lagrange's mean value theorem.

3. State L' Hospital's Rule and hence evaluate $\lim_{x\to 0}(\cot x)^{\sin 2x}$

4. Find the asymptote of $(x+y)^2(x+2y+2) = x+9y-2$

5. Find the radius of curvature of the curve $r = a(1 - \cos\theta)$.

   Or,

   Find the pedal equation of $y^2=4a(x+a)$

6. Evaluate $\int_0^{\pi/2} \frac{x\sin x\cos x}{\cos^4 x+\sin^4 x}dx$

7. Using the rule of differentiation under the integral sign, evaluate $\int_0^{\infty}\frac{\log(1+a^2x^2)}{1+b^2x^2}dx$

8. Obtain the reduction formula for $\int_0^{\pi/2}\cos^n x dx$ and hence evaluate $\int_0^{\pi/2}\cos^{10} x dx$.

9. Obtain the area of a loop of the curve $y^2(a^2+x^2)=x^2(a^2-x^2)$

   Or,

   Find the volume of the solid formed by the revolution of the cycloid $x=a(\theta+\sin\theta)$

10. Solve the differential equation: $\frac{dy}{dx}=\frac{y}{x}+\tan\frac{y}{x}$

11. Find the general solution of $y=Px+x^4p^2$

12. Solve $(D^2-2D+5)y = e^{2x}\sin x$

13. Solve $x^2\frac{d^2y}{dx^2}-2x\frac{dy}{dx}-4y=x^4$

    Or,

    A radio active material has an initial mass 100mg. After two years, it is left to 75mg. Find the amount of the material at any time t.

14. What does the equation $3x^2+3y^2+2xy=2$ become when the axes are turned through an angle 45° with the original axes.

15. Obtain the equation of hyperbola in standard form.

16. Find the center for the conic $3x^2+8xy-3y^2-40x-20y+50=0$.

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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	I / I	Time	3 hrs.

Subject: - Engineering Mathematics I *(SH 401)*

- ✓ 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 $y=\sin(m\sin^{-1}x)$, show that $(1-x^2)y_{n+2}-(2n+1)xy_{n+1}+(m^2-n^2)y_n=0$, where suffices of y denote the respective order of derivatives of y. [5]
2. State Lagrange's mean value theorem. Verify it for the function $y=\sin x$ on $\left[-\frac{\pi}{2},\frac{\pi}{2}\right]$. Is this theorem valid for the function $y=\tan x$ on $[0, \pi]$? [1+3+1]
3. Evaluate $\lim_{x\to 0}\left(\frac{\tan x}{x}\right)^{1/x}$ [5]
4. Find the asymptotes of the curve $(x+y)^2(x+2y+2)=x+9y-2$. [5]
5. Find the pedal equation of the curve $y^2=4a(x+a)$. [5]
6. Evaluate, if possible $\int_0^e \ln x\,dx$. [5]
7. Apply differentiation under integral sign to evaluate $\int_0^\infty \frac{e^{-ax}\sin x}{x}dx$ and then show that $\int_0^\infty \frac{\sin x}{x}dx=\frac{\pi}{2}$. [4+1]
8. Define Beta and Gamma function and use it to show that, $\int_0^{\pi/6}\cos^4 3\theta\sin^2 6\theta\,d\theta=\frac{5\pi}{192}$. [5]
9. Find the volume of the solid formed by the revolution of the cardioid r = a(1 + cos θ) about the initial line. [5]
10. Solve the differential equation $\frac{dy}{dx}+y\cot x=2\cos x$. [5]
11. If p stands for $\frac{dy}{dx}$, then solve the differential equation $y-2px+ayp^2=0$. [5]
12. Solve the differential equation $(D^2-2D+5)y=e^{2x}\sin x$. [5]
13. Solve the differential equation $(x^2D^2+xD+1)y=\sin(\log x^2)$ [5]
14. Define ellipse and obtain the equation of ellipse in standard form. [5]
15. Prove that the locus of a point which moves in such a way that the difference of its distances from the point (5, 0) and (-5, 0) is 2 is a hyperbola. [5]
16. Describe and sketch the graph of the conic $r=\frac{10}{3+2\sin\theta}$ [5]

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IOE LIBRARY

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Chaitra

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

Subject: - Engineering Mathematics I *(SH 401)*

- ✓ 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. If $y = e^{a\sin^{-1}x}$, then prove that $(1-x^2)y_{n+2} - (2n+1)xy_{n+1} - (n^2+a^2)y_n = 0$
2. Assuming the validity of expansion, find the expansion of $\log(1+e^x)$ by using Machlaurin's Theorem.
3. Evaluate: $\lim_{x\to 0}\left(\frac{\sin x}{x}\right)^{1/x}$
4. Find the asymptotes of the curve:
$$y^2 = \frac{(a-x)^2}{a^2+x^2}x^2$$
5. Show that for the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$, the radius of curvature at the extremity of major axis is equal to half of the latus rectum.
6. Show that $\int_0^1 \cot^{-1}(1-x+x^2)dx = \frac{\pi}{2} - \log 2$.
7. Evaluate by using the rule of differentiation under the sign of integration
$$\int_0^{\pi} \frac{\log(1+a\cos x)}{\cos x}dx$$
8. Prove that: $\int_0^{\infty}\sqrt{y}e^{-y^2}dy \times \int_0^{\infty}\frac{e^{-y^2}}{\sqrt{y}}dy = \frac{\Pi}{2\sqrt{2}}$
9. Find the surface area of solid generated by revolution of cycloid. $x = a(\theta+\sin\theta), y = a(1+\cos\theta)$ about its axis.
10. Solve the differential equation:
$$\frac{dy}{dx}+\frac{1}{x}\sin 2y = x^3\cos^2 y$$
11. If p denotes $\frac{dy}{dx}$, then solve $p^3 - 4xyp + 8y^2 = 0$.
12. Solve: $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = x^2e^{3x}$
13. Solve: $x^2\frac{d^2y}{dx^2} - x\frac{dy}{dx} + y = \log x$
14. Derive the standard equation of an ellipse.
15. Find the condition that the line xcosα + ysinα = p to touch hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$ and also find point of contact.
16. Find the centre, length of axes and eccentricity of conic $9x^2+4xy+6y^2-22x-16y+9=0$.

OR

Describe and sketch the graph of polar equation: $r = \frac{4}{1-3\cos\theta}$

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NCE LIBRARY

02 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Ashwin

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

Subject: - Engineering Mathematics I *(SH401)*

- ✓ 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. State Leibnitz's theorem. If $y^{\frac{1}{m}} + y^{\frac{-1}{m}} = 2x$, show that $(x^2-1)y_2 + xy_1 - m^2y = 0$ and hence prove that $(x^2-1)y_{n+2} + (2n+1)xy_{n+1} + (n^2-m^2)y_n = 0$. [2+3]

2. State Roller's theorem. Does the theorem hold when the function is not continuous at the end points? Justify your answer. Verify the theorem for $f(x) = x^2 - 4x + 3$ on [1,3]. [5]

3. State L-Hospital's theorem and evaluate $\lim_{x \to 0}\left(\frac{\sin x}{x}\right)^{\frac{1}{x^2}}$ [5]

4. Find the asymptotes of curve $4x^3 - 3xy^2 - y^3 + 2x^2 - xy - y^2 - 1 = 0$ [5]

5. Find the pedal equation of the curve $y^2 = 4c(x+c)$ [5]

6. Show that $\int_0^{\frac{\pi}{2}} \frac{\sin^2 x}{\sin x + \cos x} dx = \frac{1}{\sqrt{2}} \log(\sqrt{2}+1)$ [5]

7. Evaluate, by using differentiation under the sign of integration [5]

   $$\int_0^{\infty} \frac{\log(1+a^2x^2)}{1+b^2x^2} dx$$

8. Define Beta-Gamma function and use it to evaluate $\int_0^{\frac{\pi}{6}} \cos^4 3\theta . \sin^2 6\theta . d\theta$ [5]

9. Find the surface area of the solid generated by the revolution of the cardioids $r = a(1+\cos\theta)$ about the initial line. [5]

10. Transform the equation $12x^2 - 10xy + 2y^2 + 11x - 5y + 2 = 0$ by translating the axes into an equation with linear term missing. [5]

11. Derive the standard equation of hyperbola. [5]

12. Find the centre, Length of axes and eccentricity of the conic [5]

    $$9x^2 + 4xy + 6y^2 - 22x - 16y + 9 = 0$$

    OR

    Describe and sketch the graph of the equation $r = \frac{12\sec\theta}{2+3\sec\theta}$.

13. Solve $\frac{dy}{dx} + \frac{\sin 2y}{x} = x^3 \cos^2 y$ [5]

14. Solve the differential equation of $xp^2 - 2yp + ax = 0$ [5]

15. Solve $(D^2 - 1)y = \sinh(x)$ [5]

16. $(x^2D^2 + xD + 1)y = \sin(\log x^2)$ [5]

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01 TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

Examination Control Division

2074 Ashwin

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

Subject: - Engineering Mathematics I *(SH401)*

- ✓ 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. State Leibnitz's theorem on heigher order derivative. If $y = e^{a\tan^{-1}x}$, prove that $(1+x^2)y_{n+2} + (2nx + 2x - a)y_{n+1} + n(n+1)y_n = 0$
2. State difference between Roll's Theorem and Lagrange's Mean value theorem. Verify Lagrange's mean value theorem for f(x) = x(x-1)(x-2) when $x \in \left[0, \frac{1}{2}\right]$.
3. Define inderminate form of a function. Evaluate

   $$\lim_{x \to 0}\left(\frac{\tan x}{x}\right)^{1/x^2}$$
4. Define asymptote to a curve. Find the asymptotes of curve $y^3 + 2xy^2 + x^2y - y + 1 = 0$.
5. Find radius of curvature of the curve $x^3 + y^3 = 3axy$ at origin.

   OR

   Find the pedal equation of the polar curve $r^m = a^m \cos m\theta$.
6. Integrate : $\int_0^{\pi/2} \frac{\cos x\, dx}{(1+\sin x)(2+\sin x)}$
7. Apply differentiation under integral sign to evaluate $\int_0^{\infty} \frac{e^{-ax}\sin x}{x} dx$.
8. Define Beta and Gamma function. Use them to evaluate $\int_0^{2a} x^5\sqrt{2ax - x^2}\,dx$.
9. Show that the area of the curve $x^{2/3} + y^{2/3} = a^{2/3}$ is $\frac{3}{8}\pi a^2$.

   OR

   Find the volume of the solid formed by the revolution of the cardoid $r = a(1+\cos\theta)$ about the initial line.
10. Solve: $(1+y^2)dx = (\tan^{-1}y - x)dy$
11. Solve: $y = px - \sqrt{m^2 + p^2}$ where $p = \frac{dy}{dx}$.

12. Solve: $(D^2+2D+1)y=e^x+x^2$.

13. Solve: Solve: $x^2\frac{d^2y}{dx^2}-2x\frac{dy}{dx}-4y=x^4$.

OR

A resistance of 100 ohms, an inductance of 0.5 Henry are connected in series with a battery of 20 volts. Find the current in the circuit as a function of time.

14. What does the equation of lines $7x^2+4xy+4y^2=0$ become when the axes are the bisectors of the angles between them?

15. Derive the equation of hyperbola in standard form.

16. Find the foci and eccentricity of the conic $x^2+4xy+y^2-2x+2y-6=0$.

OR

Describe and sketch the graph of the conic $r=\frac{12}{6+2\sin\theta}$.

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022 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Chaitra

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

Subject: - Engineering Mathematics I *(SH401)*

- ✓ 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. State Leibnitz theorem. If $\log y = \tan^{-1} x$, then show that
$(1+x^2)y_{n+2} + (2nx + 2x - 1)y_{n+1} + (n^2 + n)y_n = 0$ [1+4]
2. State Rolle's theorem. Is the theorem true when the function is not continuous at the end points? Justify your answer. Verify Rolle's theorem for $f(x) = x^2 5x + 6$ on [2,3]. [1+2+2]
3. State L-Hospital's rule. Evaluate $\lim_{x \to 1}(2-x)^{\tan\left(\frac{\pi x}{2}\right)}$ [1+4]
4. Find the asymptotes of the curve $(x+y)^2(x+2y+2) = x + 9y - 2$ [5]
5. Find the pedal equation of the ellipse $\frac{x^2}{b^2} + \frac{y^2}{a^2} = 1$. [5]
6. Evaluate the integral $\int_{-1}^{1} \frac{1}{x^2} dx$ [5]
7. Apply the rule of differentiation under integral sign to evaluate $\int_0^\infty \frac{e^{-ax} \sin x}{x} dx$ and hence deduce that $\int_0^\infty \frac{\sin x}{x} dx = \frac{\pi}{2}$ [5]
8. Define Beta function. Apply Beta and Gamma function to evaluate $\int_0^{2a} x^5 \sqrt{2ax - x^2} dx$ [5]
9. Find the area common to the circle $r = a$ and the cordioid $r = a(1+\cos\theta)$ [5]
10. Through what angle should the axes be rotated to reduce the equation
$3x^2 + 2xy + 3y^2 - \sqrt{2x} = 0$ into one with the xy term missing? Also obtain the transformed equation. [2+3]
11. Derive the equation of an ellipse in standard form. [5]
12. Find the product of semi-axis of the conic $x^2 - 4xy + 5y^2 = 2$ [5]

OR

Describe and sketch the graph of conic $r = \frac{12}{3 + 2\cos\theta}$

13. Solve the differentiate equation of $(x^2 - y^2)dx + 2xydy = 0$ [5]
14. Solve: $y = yp^2 + 2px$ where $p = \frac{dy}{dx}$ [5]
15. Solve $(D^2 - 6D + 9)y = x^2 e^{2x}$ [5]

01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
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	I / I	Time	3 hrs.

Subject: - Engineering Mathematics I *(SH401)*

- ✓ 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. State Leibnitz's theorem. If $y=(\sin^{-1}x)^2$, show that
   $(1-x^2)y_{n+2}-(2n+1)xy_{n+1}-n^2y_n=0$
2. Verify Rolle's Theorem for $f(x)=\log\dfrac{x^2+ab}{(a+b)x}$; $x\varepsilon\,[a,b]$. How does Rolle's Theorem differ from Lagrange's mean value theorem.
3. Evaluate $\lim\limits_{x\to 0^+}\left(\dfrac{\sin x}{x}\right)^{\frac{1}{x}}$
4. Find the asymptotes to the curve $y^3+2xy^2+x^2y-y+1=0$
5. Find the radius of curvature at origin for the curve $x^3+y^3=3axy$.
6. Show that $\int_0^{\pi} x\log(\sin x)dx=\dfrac{\pi^2}{2}\log\dfrac{1}{2}$
7. Apply the rule of differentiation under integral sign to evaluate $\int_0^{\infty}\dfrac{e^{-ax}\sin x}{x}dx$ and hence deduce that $\int_0^{\infty}\dfrac{\sin x}{x}dx=\dfrac{\pi}{2}$
8. Define Beta function. Apply Beta and Gamma function to evaluate $\int_0^{2a}x^5\sqrt{2ax-x^2}\,dx$
9. Find the volume generated by revolution of astroid $x^{2/3}+y^{2/3}=a^{2/3}$ about x-axis.
10. What does the equation $3x^2+3y^2+2xy=2$ becomes when the axes are turned through an angle of 45° to the original axes?
11. Find center, length of axes, eccentricity and directrices of the conic
    $3x^2+8xy-3y^2-40x-20y+50=0$

    OR

    Describe and sketch the conic $r=\dfrac{12}{2-6\cos\theta}$
12. Deduce standard equation of ellipse.
13. Solve the differential equation: $(1+y^2)+(x-e^{\tan^{-1}y})\dfrac{dy}{dx}=0$
14. Solve: $xp^2-2yp+ax=0$ where $p=\dfrac{dy}{dx}$
15. Solve: $\dfrac{d^2y}{dx^2}+3\dfrac{dy}{dx}+2y=e^{2x}.\sin x$
16. Resistance of 100 ohms, an inductance of 0.5 Henry are connected in series with battery

01 TRIBHUVAN UNIVERSITY	Exam.	Regular		
INSTITUTE OF ENGINEERING	Level	BE	Full Marks	80
Examination Control Division	Programme	All (Except B.Arch.)	Pass Marks	32
2073 Chaitra	Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Mathematics I *(SH401)*

- ✓ 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. State Leibnitz theorem. If $y = e^{x^2}$, then show that $y_{n+1} - 2xy_n - 2ny_{n-1} = 0$.
2. Expand $e^x \log_e(1+x)$ in ascending powers of x upto the term containing x^4 in Maclaurin's series.
3. State L-hospital's rule. Evaluate,

$$\lim_{x \to 0}\left(\frac{1}{x^2}\right)^{\tan x}$$

4. State the types of asymptotes to a curve. Find the asymptotes of the curve $(x^2 - y^2)(x + 2y + 1) + x + y + 1 = 0$.
5. Find the chord of curvature through the pole for the curve $r = a(1+\cos\theta)$.
6. Show that $\int_0^{\infty} \frac{\log(1+x^2)}{1+x^2}dx = \pi \log 2$
7. Apply the method of differentiation under integral sign to prove

$$\int_0^{\pi/2} \frac{dx}{(a^2\sin^2 x + b^2\cos^2 x)^2} = \frac{\pi(a^2+b^2)}{4a^3b^3}$$

8. Using Beta -Gamma Function, show that

$$\int_0^{\pi/4} \sin^4 x.\cos^2 x\, dx = \frac{3\pi - 4}{192}$$

9. Find the area included between an arc of cycloid $x = a(\theta - \sin\theta)$, $y = a(1 - \cos\theta)$ and its base.

OR

Find the volume of the solid formed by the revolution of the cardoid $r = a(1+\cos\theta)$ about the initial base.

10. What does the equation $x^2 + 2\sqrt{3}xy - y^2 = 2a^2$ become when the axes are turned through an angle 30° to the original axes?
11. Derive the equation of an ellipse in the standard form.

12. Find the eccentricity of the conic,

$$x^2 + 4xy + y^2 - 2x + 2y - 6 = 0$$

OR

Describe and sketch the conic

$$r = \frac{10 \operatorname{cosec}\theta}{2 \operatorname{cosec}\theta + 3}$$

13. Solve: $\frac{dy}{dx} = \frac{x + 2y - 3}{2x + y - 3}$

14. Solve: $\frac{dy}{dx} + y \tan x = \sec x$

15. Solve: $y = 2px + p^3 y^2$; where $p = \frac{dy}{dx}$

16. Solve: $x^2 \frac{d^2y}{dx^2} - 2x\frac{dy}{dx} + 2y = \frac{1}{x}$

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01 TRIBHUVAN UNIVERSITY INSTITUTE OF ENGINEERING **Examination Control Division** **2072 Kartik**				
	Exam.	**New Back (2066 & Later Batch)**		
	Level	BE	**Full Marks**	80
	Programme	All (Except B.Arch)	**Pass Marks**	32
	Year / Part	I / I	**Time**	3 hrs.

Subject: - Engineering Mathematics I *(SH401)*

- ✓ 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. If $y = (\sin^{-1} x)^2$, then show that:

   i) $(1-x^2)y_2 - xy_1 - 2 = 0$

   ii) $(1-x^2)y_{n+2} - (2n+1)xy_{n+1} - n^2 y_n = 0$

2. State Rolle's Theorem and verify the theorem for $f(x) = \frac{x(x+3)}{e^{x/2}}; x \in [-3,0]$

3. Evaluate: $\lim_{x \to 0} \left(\frac{\tan x}{x}\right)^{1/x}$

4. Find the asymptotes of the curve: $(a+x)^2(b^2+x^2) = x^2.y^2$

5. Find the pedal equation of the curve $r^2 = a^2 \cos 2\theta$

6. Evaluate $\int_0^{\pi/4} \frac{(\sin x + \cos x)}{(9+16\sin 2x)} dx$

7. Use Beta Gamma function to evaluate $\int_0^{2a} x^5.\sqrt{2ax - x^2}.dx$

8. Evaluate by using the rule of differentiation under the sign of integration.

   $\int_0^{\infty} \frac{e^{-x} \sin bx}{x}.dx$

9. Find the area of one loop of the curve $r = a \sin 3\theta$

   OR

   Find the volume of the solid formed by the revolution of the cardioid $r = a(1+\cos\theta)$ about the initial line.

   Find center and eccentricity of conic $x^2 + 4xy + y^2 - 2x + 2y - 6 = 0$

   OR

   Describe and sketch the graph of the equation $r = \frac{10}{3+2\cos\theta}$

10. Find the condition that the line $lx + my + n = 0$ may be a normal to the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$

11. Show that the pair of tangents drawn from the center of a hyperbola are its asymptotes.

12. Solve the differential equation: $\frac{dy}{dx}=\frac{y}{x}+\tan\frac{y}{x}$

13. Solve: $y-2px+ayp^2=0$ where $p=\frac{dy}{dx}$

14. Solve the differential equation: $x\frac{dy}{dx}+y\log y=xye^x$

15. Solve the differential equation: $x^2\frac{d^2y}{dx^2}+x\frac{dy}{dx}-4y=x^2$

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2072 Chaitra

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

Subject: - Engineering Mathematics I *(SH401)*

- ✓ 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. State Leibnitz's theorem. If $y=(x^2-1)^n$, then prove that
$(x^2-1)y_{n+2}+2xy_{n+1}-n(n-1)y_n=0$
2. Assuming the validity of expansion, expand $\log(1+\sin x)$ by Maclaurin's therom.
3. Evaluate $\lim_{x\to 0}\frac{(1+x)^{1/x}-e}{x}$
4. Find the asymptotes of the curve: $x(x-y)^2-3(x^2-y^2)+8y=0$
5. Find the radius of curvature at any point (r,θ) for the curve $a^2=r^2\cos 2\theta$
6. Show that: $\int_0^{\pi}\frac{x\sin x}{1+\cos^2 x}dx=\frac{\pi^2}{4}$
7. Apply differentiation under integral sign to evaluate $\int_0^{\pi/2}\log\frac{a+b\sin x}{a-b\sin x}\frac{dx}{\sin x}$
8. Define Gamma function. Apply Beta and Gamma function to evaluate:
$\int_0^{\pi/6}\cos^2 6\theta.\sin^4 3\theta=\frac{7\pi}{192}$
9. Find the area inclosed by $y^2(a-x)=x^3$ and its asymptotes.
10. If the axes be turned through and angle of $\tan^{-1}2$, what does the equation $4xy-3x^2-a^2=0$ become?
11. Find the center, length of axes, eccentricity and directrices of the conic.
$2x^2+3y^2-4x-12y+13=0$

OR

Describe and sketch the graph of the conic $r=\frac{10}{3+2\cos\theta}$.
12. Deduce standard equation of hyperbola.
13. Solve the differential equation: $x\log x\frac{dy}{dx}+y=2\log x$
14. Solve: $(x-a)p^2+(x-y)p-y=0$: where $p=\frac{dy}{dx}$
15. Solve: $(D^2-D-2)y=e^x+\sin 2x$
16. Find a current i(t) in the RLC circuit assuming zero initial current and charge q, if R = 80 ohms, L = 20 Henry, C = 0.01 Fardays and E = 100 volts.

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01 TRIBHUVAN UNIVERSITY	Exam.	New Back (2066 & Later Batch)	
INSTITUTE OF ENGINEERING	Level	BE	Full Marks	80
Examination Control Division	**Programme**	All (Except B.Arch)	**Pass Marks**	32
2071 Shawan	**Year / Part**	I / I	**Time**	3 hrs.

Subject: - Engineering Mathematics I *(SH401)*

- ✓ 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 $y = \log\left(x + \sqrt{a^2 + x^2}\right)$, then show that $\left(a^2 + x^2\right)y_{n+2} + (2n+1)xy_{n+1} + n^2 y_n = 0$ [5]

2. State and prove Lograng e's Mean Value theorem. [5]

3. Evaluate: $\lim_{x \to \Pi} (\sin x)^{\tan x}$ [5]

4. Find the asymption of the curve $a^2y^2 + x^2y^2 - a^2x^2 + 2ax^3 - x^4 = 0$ [5]

5. Find the radius of curvature at the origin for the curve $x^3 + y^3 = 3axy$

6. Evaluate $\int_0^a \frac{\sqrt{x}}{\sqrt{x} + \sqrt{a-x}} dx$ [5]

7. Apply differentiation under integral sign to evaluate $\int_0^\infty \frac{e^{-ax} - e^{-bx}}{x} dx$ [5]

8. Using Gamma function show that $\int_0^{\frac{\pi}{4}} \sin^4 x \cos^2 x \, dx = \frac{3\pi - 4}{192}$ [5]

9. Find the area bounded by the curve $x^2 = 4y$ and the line $x = 4y - 2$

   OR

   Find the volume of the solid generated by the revolution of the cardioid r = a (1-cosθ) about the initial line.

10. Solve: $\text{Sin}x \frac{dy}{dx} + y\cos x = x\sin x$ [5]

11. Solve: $xp^2 - 2yp + ax = 0$ where $p = \frac{dy}{dx}$ [5]

12. Solve: $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = x^2e^{3x}$ [5]

13. Solve: $x^2\frac{d^2y}{dx^2} - x\frac{dy}{dx} + y = \log x$ [5]

14. Transform the equation $x^2 - 2xy + y^2 + x - 3y = 0$ to axes through the point (-1,0) parallel to the lines bisecting the angles between the original axes. [5]

15. Find the center, length of axes and the eccentricity of the ellipse $2x^2 + 3y^2 - 4x - 12y + 13 = 0$ [5]

16. Find the length of axes and ecentricity of the conic [5]

   $$14x^2 - 4xy + 11y^2 - 44x - 58y + 71 = 0$$

   OR

   Describe and sketch the conic $r = \frac{12}{}$

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	I / I	Time	3 hrs.

Subject: - Engineering Mathematics I *(SH401)*

- ✓ 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. State Leibnity's theorem on Leigher derivatives:
   If $y = \sin(m \sin^{-1} x)$ then show that
   $(1-x^2)\, y_{n+2} - (2n+1)\, xy_{n+1} + (m^2-n^2)y_n = 0$

2. Assuming the validity of expansion, find the expansion of the function $\frac{e^x}{1+e^x}$ by Maclaurin's theorem.

3. Evaluate $\lim_{x\to 0} \frac{xe^x - (1+x)\log(1+x)}{x^2}$

4. Find the asymptotes of the curve $y^3 + 2xy^2 + x^2y - y + 1 = 0$

5. Find the radius of curvature of the curve $y = x^2(x-3)$ at the points where the tangent is parallel to x-axis

   OR

   Find the pedal equation of the curve $r^2 = a^2 \cos 2\theta$

6. Show that $\int_0^a \frac{dx}{x+\sqrt{a^2-x^2}} = \frac{\Pi}{4}$

7. Apply differentiation under integral sign to evaluate $\int_0^{\Pi/2} \frac{dx}{(a^2\sin^2 x + b^2\cos^2 x)^2}$

8. Use gamma function to prove that $\int_0^1 \frac{dx}{(1-x^6)^{1/6}} = \Pi/3$

9. Find the volume or surface area of solid generated by revolving the cycloid $x = a(\theta+\sin\theta)$, $y = a(1+\cos\theta)$ about its base.

10. If the line lx+my+n=0 is normal to the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ then show that $\frac{a^2}{l^2}+\frac{b^2}{m^2}=\frac{(a^2-b^2)^2}{n^2}$

11. Solve the locus of a point which moves in such a way that the difference of its distance from two fixed points is constant is Hyperbola.

12. Solve the differential equation $x\frac{d^2y}{dx^2}+2\frac{dy}{dx}=6x$

13. Solve $(x^2D^2+xD+1)y=\sin(\log x^2)$

14. Solve $y=yp^2+2px$ where $p=\frac{dy}{dx}$

15. Solve: $\frac{d^2y}{dx^2}+3\frac{dy}{dx}+2y=e^{2x}\sin x$

16. Describe and sketch the graph of the equation $r=\frac{10}{2-3\sin\theta}$

OR

Show that the conic section represented by the equation

$14x^2-4xy+11y^2-44x-58y+71=0$ is an ellipse. Also find its center, eccentricity, latus rectuns and foci

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2070 Ashad

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

Subject: - Mathematics I *(SH401)*

- ✓ 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. State Leibnitz's Theorem on higher derivatives. If $y = \sin(m \sin^{-1}x)$ then show that $(1-x^2)\, y_{n+2} - (2n+1)\, xy_{n+1} + (m^2-n^2)y_n = 0$

2. State Rolle's Theorem and verify it for the function $f(x) = \dfrac{x(x+3)}{e^{\frac{x}{2}}}$, $x \varepsilon [-3,0]$

3. Evaluate: $\underset{x \to 0}{\mathrm{Lt}} \left(\dfrac{\tan x}{x}\right)^{\frac{1}{x^2}}$

4. Find the asymptotes of the curve $(x^2 - y^2)^2 - 2(x^2 + y^2) + x - 1 = 0$

5. Show that the radius of curvature at any point (r,θ) of the curve $r^m = a^m \cos m\theta$ is $\dfrac{a^m}{(m+1)r^{m+1}}$

6. Show that $\int_0^1 \dfrac{\log(1+x)}{1+x^2}\, dx = \dfrac{\pi}{8}\log 2$

7. Evaluate by using the rule of differentiation under the sign of integration $\int_0^\infty \dfrac{e^{-x}\sin bx}{x}\, dx$

8. Use Gamma function to prove $\int_0^{\frac{\pi}{6}} \cos^4 3\theta .\ \sin^2 6\theta = \dfrac{5\pi}{192}$

9. Find the area bounded by the curve $x^2y = a^2(a-y)$ and $X-$axis

OR

Show that the volume of the solid formed by revolving the ellipse $\dfrac{x^2}{a^2} + \dfrac{y^2}{b^2} = 1$ about the line $x = 2a$ is $4\pi^2a^2b$ cubic units.

10. Solve the differential equation $(1+y^2)\ dy = (\tan^{-1} y - x)\ dx$

11. Solve the differential equation $y = yp^2 + 2px$ where $p = \dfrac{dy}{dx}$

12. Solve the differential equation $(D^2 - 2D + 5)y = e^{2x}.\sin x$

13. Solve the differential equation $x^2 \frac{d^2y}{dx^2} - x\frac{dy}{dx} + 2y = x \log x$

OR

Newton's law of cooling states that the temperature of an object changes at the rate proportional to the difference of temperature between the object and its surroundings. Supposing water at 100°C cools to 80°C in 10 minutes in a room temperature of 30°C find the time when the temperature of water will become 40°C?

14. If the axes be turned through an angle $\tan\theta = 2$ what does the equation $4xy - 3x^2 - a^2 = 0$ becomes.

15. Find the condition that the straight line $x \cos \alpha + y \sin \alpha = p$ touches the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

16. Find the centre, length of axes and eccentricity of the conic $9x^2 + 4xy + 6y^2 - 22x - 16y + 9 = 0$

OR

Describe and sketch the graph of the equation $r = \frac{12}{3 + 2\cos\theta}$

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01 TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

Examination Control Division

2070 Chaitra

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

Subject: - Engineering Mathematics I *(SH401)*

- ✓ 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. If $Y = \text{Sin}(m \sin^{-1}x)$, then show that $(1-x^2)y_{n+2} - (2n+1)xy_{n+1} + (m^2 - n^2)y_n = 0$

2. Apply Maclaurin's series to find the expansion of $\frac{e^x}{1+e^x}$ as far as the term in x^3

3. Evaluate: $\lim_{x \to a} \left(2 - \frac{x}{a}\right)^{\text{Tan}\frac{\pi x}{2a}}$

4. Find the asymptotes of the curve $x(x-y)^2 - 3(x^2 - y^2) + 8y = 0$

5. Find the pedal equation of the curve $x^{\frac{2}{3}} + y^{\frac{2}{3}} = a^{\frac{2}{3}}$

6. Apply the method of differentiation under integral sign to evaluate $\int_0^\infty \frac{\log(1+a^2x^2)}{1+b^2x^2} dx$

7. Show that $\int_0^\infty \frac{\log(1+x^2)}{1+x^2} dx = \pi \log 2$

8. Use Gamma function to prove that $\int_0^1 \frac{dx}{(1-x^6)^{\frac{1}{6}}} = \frac{\pi}{3}$

9. Find the area of two loops of the curve $a^2y^2 = a^2y^2 - x^4$

   OR

   Find the volume of the solid formed by the revolution of the cycloid $x = a\,(\theta + \sin\theta)$, $y = a\,(1 - \cos\theta)$ about the tangent at the vertex.

10. Solve the differential equation $(1+y^2) + (x - e^{\tan^{-1}y})\frac{dy}{dx} = 0$

11. Solve: $y - 3px + ayp^2 = 0$

12. Solve: $(D^2 - 2D + 5)y = e^{2x}.\sin x$

13. A resistance of 100 Ohms, an inductance of 0.5 Henry are connected in series with a battery 20 volts. Find the current in the circuit as a function of time.

14. What does the equation $3x^2 + 3y^2 + 2xy = 2$ becomes when the axes are turned through an angle 45° to the original axes.

15. Show that the locus of a point which moves in such a way that the differences of its distance from two fixed points is constant is a hyperbola.

16. Find the center, length of the axes and eccentricity of the conic $2x^2 + 3y^2 - 4x - 12y + 13 = 0$

    OR

    Describe and sketch the graph of the polar equation of conic $r = \frac{10\text{cosec}\theta}{\ldots}$

INSTITUTE OF ENGINEERING	Level	BE	Full Marks	80
Examination Control Division	Programme	All (Except B. Arch.)	Pass Marks	32
2069 Ashad	Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Mathematics *(SH 401)*

- ✓ 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. If $y = (x^2-1)^n$, prove that $(x^2-1)y_{n+2}+2xy_{n+1}-n(n+1)y_n = 0$.
2. State and prove Lagrange's mean value theorem and verify $f(x) = \log x$, $x \in [i,e]$.
3. Evaluate $\lim_{x \to 0}\left(\frac{1}{x^2} - \frac{1}{\sin^2 x}\right)$.
4. Find the asymptotes of the curve $x(x-y)^2-3(x^2-y^2)+8y = 0$.
5. Find the tangent at (a, b) to the curve $\left(\frac{x}{a}\right)^3 + \left(\frac{y}{b}\right)^3 = 2$.
6. Evaluate $\int_{\infty}^{\alpha} \frac{dx}{x^3}$.
7. Use Gamma function to prove $\int_0^{\pi} \sin^6\frac{x}{2}\cos^6\frac{x}{2}\,dx = \frac{5\pi}{2^{11}}$
8. Use method of differentiation under integral sign, evaluate $\int_0^{\alpha} \frac{\operatorname{Tan}^{-1}(ax)}{x(1+x^2)}dx$.
9. Find the area between the curve and its asymptotes $y^2(a-x) = x^3$.

   OR

   Find the volume of the ellipscoid formed by the revolution of an ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$.
10. Transform the equation $3x^2-2xy+4y^2+8x-10y+8=0$ by translating the axis into an equation with linear term missing.
11. Find the equation of ellipse whose centre is origin and whose axis are the axis of coordinates and passes through the pair of curves (1,6) and (2,3).
12. Prove that the product of the semi axis of conic $5x^2+6xy+5y^2+12x+4y-4=0$ is 3.
13. Solve the differential equation $xdy-ydx = \sqrt{x^2+y^2}\,dx$.
14. Find the general solution of the differential equation $xy^2(p^2+2)=2py^3+x^3$
15. Find the general solution of the differential equation $(x^2D^2+4xD+2)y=e^x$.
16. A tank contains 1000 liters of fresh water. Salt water which contains 150gms of salt per liter, runs into it at the rate of 5 liter per minute and well-stirred mixture runs out of it at the same rate. When will the tank contain 5000gms of salt?

    OR

    Solve $\frac{d^2y}{dx^2} - y = x^2\cos x$.

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01 TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

Examination Control Division

2069 Chaitra

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

Subject: - Engineering Mathematics I *(SH401)*

- ✓ 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. If $y = \log\left(x + \sqrt{(a^2 + x^2)}\right)$ show that $(a^2+x^2)y_{n+2} + (2n+1)xy_{n+1} + n^2y_n = 0$

2. State and prove Lagrange's Mean Value theorem.

3. If $\lim_{x \to 0} \dfrac{a \sin x - \sin 2x}{\tan^3 x}$ is finite, find the value of a and the limit.

4. Find asymptotes of $(x^2-y^2)^2 - 2(x^2+y^2) + x - 1 = 0$

5. Find the radius of curvature at any point (x,y) for the curve $x^{2/3}+y^{2/3}=a^{2/3}$

6. Prove that $\int_0^{\infty} \dfrac{\sin bx}{x} dx = \dfrac{\pi}{2} (b > 0)$

7. Use Beta and Gamma function to evaluate $\int_0^{2a} x^5 \sqrt{2ax - x^2}\, dx$

8. Evaluate $\int_0^{\infty} \dfrac{e^{-x} \sin bx}{x} dx$ by using the rule of differentiation under the sign of integration.

9. Find the volume of the solid formed by the revolution of the cardiod $r = a\,(1+\cos\theta)$ about initial line.

OR

Find the area bounded by the curve $x^2y = a^2\,(a-y)$ and the x-axies

10. Solve the differential equation $\dfrac{dy}{dx} = \dfrac{y}{x} + \tan\dfrac{y}{x}$

11. Solve the differential equation $x\dfrac{dy}{dx} + y \log y = xye^x$

12. Solve the differential equation $\dfrac{d^2y}{dx^2} + 2\dfrac{dy}{dx} = e^x + e^{-x}$

13. Solve $y = px - \sqrt{m^2 + p^2}$ where $p = \dfrac{dy}{dx}$

OR

A resistance of 100 ohms, an inductance of 0.5 henry are connected in series with a battery of 20 volts. Find the current in the circuit as a function of time.

14. Solve that locus of a point which moves in such a way that the differences of it distance from two fixed point is constant is Hyperbola.

15. Find the equation of ellipse of the form $\dfrac{x^2}{a^2} + \dfrac{y^2}{b^2} = 1$ where a>b

16. Describe and sketch the graph of the equation $r = \dfrac{4 \sec\theta}{2 \sec\theta - 1}$

Subject :- Engineering Mathematics I

2068 - Shrawan

1. If $y = \log(x + \sqrt{a^2 + x^2})$, show that $(a^2 + x^2)y_{n+2} + (2n + 1)xy_{n+1} + n^2y_n = 0$.
2. State and prove Lagrange's mean value theorem.
3. Evaluate: $\lim_{x \to 0} \left(\frac{\tan x}{x}\right)^{1/x}$
4. Find the asymptotes of the curve $(x^2 - y^2)(x + 2y + 1) + x + y + 1 = 0$.
5. Show that for the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, the radius of curvature at the extremity of the major axis is equal to half of the latus rectum.
6. Evaluate: $\int_0^{\pi/2} \frac{dx}{1 + \sqrt{\tan x}}$.
7. Use Gamma function to prove that $\int_0^1 \frac{dx}{(1 - x^6)^{1/6}} = \frac{\pi}{2}$.
8. Using method of differentiation under integral sign, evaluate: $\int_0^\infty \frac{e^{-x} \sin bx}{x} dx$.
9. Find the angle through which the axes must be turned so that the equation $ax^2 + 2hxy + by^2 = 0$ may become an equation having no term involving xy.

11. Obtain the equation of an ellipse in the standard form.
12. Find the Center of Conic $3x^2+8xy-3y^2-40x-20y+50=0$
13. Solve the differential equation $(x + y + 1)\frac{dy}{dx} = 1$.
14. Find the general Solution of the differential equation: $P^3-4xyp+8y^2=0$
15. Find the general solution of the differential equation: $(D^2 + 2D + 1)y = e^x\cos x$.
16. Newton's Law of cooling states that " The temperature of an object changes at a rate proportional to the differences of tempretures between the object and it's surrounding". Supposing water at a tempreture 100°C. cools to 80°c in 10minutes., in a room maintained at 30°c. Find when the tempreture of water will becomes 40°c.

OR

Solve: $x^2\frac{d^2y}{dx^2} - 4x\frac{dy}{dx} + 6y = x$

01 TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

Examination Control Division

2068 Chaitra

Exam.		Regular	
Level	BE	Full Marks	80
Programme	ALL	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Mathmatics I *(SH 401)*

- ✓ 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. If $y^{1/m} + y^{-1/m} = 2x$ Show that:
   a) $(x^2-1)y_2+xy_1-m^2y=0$
   b) $(x^2-1)y_{n+2}+(2n+1)xy_{n+1}+(n^2-m^2)\,y_n=0$.
2. State the Rolle's theorem and use it to prove Lagrange's mean value theorem.
3. Evaluate: $\lim\limits_{x\to 0}\left(\dfrac{1}{x^2}-\dfrac{1}{\sin^2 x}\right)$
4. Find the asymptotes of the curve $a^2b^2 + 2ab^2x + b^2x^2 + a^2x^2 + 2ax^3 + x^4 - x^2y^2 = 0$.
5. Find the pedal equation of the curve $r^m = a^m\cos m\theta$.
6. Show that $\displaystyle\int_0^{\frac{\pi}{2}}\frac{x}{(\sin x+\cos x)}dx=\frac{\pi}{2\sqrt{2}}\log(\sqrt{2}+1)$
7. Apply differentiation under integral sign to evaluate $\displaystyle\int_0^{\infty}\frac{e^{-x}\sin bx}{x}dx$
8. Use Gamma function to evaluate $\displaystyle\int_0^1 x^6\sqrt{1-x^2}\,dx$
9. Find the area of curve $y^2(2a-x)=x^3$ and its asymptotes.

   OR

   Find the volume of solid formed by the revolution of the cardiode $r = a(1+\cos\theta)$ about the initial line.
10. Solve the differential equation $\dfrac{dy}{dx}-2y\tan x=y^2\tan x$
11. Solve the differential equation $xp^2 - 2yp + ax = 0$ where $p = dy/dx$.
12. Solve $(D^2 - 2D + 5)y = 10\sin x$
13. Solve the differential equation $x^2\dfrac{d^2y}{dx^2}+4x\dfrac{dy}{dx}+2y=e^x$
14. Derive the equation of an ellipse in standard form.
15. Prove that the normal at a point t of the rectangular Hyperbola $xy = c^2$ meets the curve again at a point t_1 such that $t^3t_1 = -1$.
16. Find the equation of axes and length of axes of conic $x^2 - 4xy - 2y^2 + 10x + 4y = 0$

    OR

    Describe and sketch the polar conic $r = \dfrac{12}{\text{[illegible]}}$.

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2067 Ashadh

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

Subject: - Engineering Mathematics I

- ✓ 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 $y = e^{a\tan^{-1}x}$, prove that $(1+x^2)y_{n+2} + (2nx+2x-a)y_{n+1} + n(n+1)y_n = 0$.
2. State and prove Lagrange's mean value theorem.
3. Evaluate $\lim\limits_{x\to 0}\left(\frac{\sin x}{x}\right)^{\frac{1}{x}}$
4. Find the asymptotes of the curve $(x+y)^2(x+2y+z) = x+9y-2$.
5. Find the radius of curvature of the curve $r = a(1-\cos\theta)$.
6. Apply the method of differentiation under integral sign to evaluate $\int_0^\infty \frac{\tan^{-1}(ax)}{x(1+x^2)}dx$.
7. Prove that $\int_0^{\pi/2} \frac{\sin^2 x dx}{\sin x + \cos x} = \frac{1}{\sqrt{2}}\log(\sqrt{2}+1)$.
8. Use Gamma function to prove $\int_0^{\pi/6} \cos^4 3\theta . \sin^2 6\theta = \frac{5\pi}{192}$.
9. Find, by method of integration, the area of the loop of the curve $ay^2 = x^2(a-x)$.
10. Solve the differential equation $(1+x^2)\frac{dy}{dx} + y = e^{\tan^{-1}x}$.
11. Solve $y = yp^2 + 2px$, where $p = dy/dx$
12. Solve $(D^2 - 3D + 2)y = x^2 + x$
13. Newton's law of cooling states that the temperature of an object changes at a rate proportional to the difference of temperature between the object and its surroundings. Supposing water at 100°C cools to 80°C in 10 minutes, in a room temperature of 30°C, find when the temperature of water will become 40°C?

    OR

    Solve the differential equation $x^2\frac{d^2y}{dx^2} - x\frac{dy}{dx} + y = \log x$.
14. Find the condition that the line $\ell x + my + n = 0$ may be the tangent to the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$.
15. Derive the equation of a hyperbola in standard form.
16. Find the centre, length of axes and eccentricity of the conic $2x^2 + 3y^2 - 4x - 12y + 13 = 0$.

    OR

    Identify and sketch the conic $r = \frac{10}{3+2\cos\theta}$.

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01 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2067 Ashwin

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

Subject: - Engineering Mathematics I

- ✓ 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. If $y = \sin(m \sin^{-1}x)$, Prove that
   a) $(1-x^2)y_2 - xy_1 + m^2y = 0$
   b) $(1-x^2)y_{n+2} - (2n+1)xy_{n+1} + (m^2-n^2)\,y_n = 0$
2. Obtain the series expansion of $e^{\sin x}$ by Machaurin's theorem as far as the term x^4.
3. Evaluate $\lim\limits_{x \to 0}\left(\frac{\tan x}{x}\right)^{\frac{1}{x}}$.
4. Find the asymptotes of the curve $(x + y)^2 (x + 2y) + 2(x + y)^2 - x - 9y + 2 = 0$.
5. Show that the radius of curvature for the curve $r^m = a^m \cos m\theta$ is $\frac{a^m}{(m+1)r^{m+1}}$.
6. Show that $\int_0^{\pi/2} \frac{x \sin x \cos x}{\cos^4 x + \sin^4 x}\,dx = \frac{\pi^2}{16}$.

   OR

   Evaluate $\int_1^{\infty} \frac{x\,dx}{(1+x^2)^2}$.
7. Apply differentiation under integral sign to evaluate $\int_0^{\infty} \frac{\log(1+a^2x^2)}{(1+b^2x^2)}$.
8. Prove that $\int_0^1 \frac{dx}{(1-x^6)^{1/6}} = \frac{\pi}{3}$. (Using Gamma function)
9. Find the area of astroid, $x^{2/3} + y^{2/3} = a^{2/3}$.

   OR

   Find the surface area of solid generated by the revolution of cardioid $r = a(1+\cos\theta)$.
10. Through what angle should the axes be rotated so that the equation $9x^2 - 2\sqrt{3}xy + 7y^2 = 10$ may be changed to $3x^2 + 5y^2 = 5$.