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)*

✓ 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
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 $(x^2-1)y_2 + xy_1 - m^2y = 0$, 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 $\dfrac{e^x}{1+e^x}$ as far as the term in x^3 and hence find the expansion of $\log(1+e^x)$.

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

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: $\displaystyle\int_0^{\pi} \frac{x\tan x}{\sec x + \tan x}dx = \frac{\pi}{2}(\pi - 2)$

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: $\displaystyle\int_0^1 x^6\sqrt{1-x^2}\,dx$

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 $p = \dfrac{dy}{dx}$.

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

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

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
2078 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.*
- ✓ *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]

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.*

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 $\lim\limits_{x \to 0}(\cot x)^{\sin 2x}$
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 $\int_0^{\pi/2} \cos^n xdx$ and hence evaluate $\int_0^{\pi/2} \cos^{10} xdx$.
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 $\int_0^e \ell n\, x dx$. [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 $r = a(1 + \cos\theta)$ 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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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 $x\cos\alpha + y\sin\alpha = p$ 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: $r = \frac{4}{1+3\cos\theta}$

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

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: $\left(D^2+2D+1\right)y=e^x+x^2$.

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

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 $r=\dfrac{12}{6+2\sin\theta}$.

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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

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 $\lim_{x\to 0}\dfrac{(1+x)^{1/x}-e}{x}$
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: $\int_0^{\pi}\dfrac{x\sin x}{1+\cos^2 x}dx=\dfrac{\pi^2}{4}$
7. Apply differentiation under integral sign to evaluate $\int_0^{\pi/2}\log\dfrac{a+b\sin x}{a-b\sin x}\dfrac{dx}{\sin x}$
8. Define Gamma function. Apply Beta and Gamma function to evaluate:
$\int_0^{\pi/6}\cos^2 6\theta.\sin^4 3\theta=\dfrac{7\pi}{192}$
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 $r=\dfrac{10}{3+2\cos\theta}$
12. Deduce standard equation of hyperbola.
13. Solve the differential equation: $x\log x\dfrac{dy}{dx}+y=2\log x$
14. Solve: $(x-a)p^2+(x-y)p-y=0$: where $p=\dfrac{dy}{dx}$
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
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 $f(x) = \dfrac{x(x+3)}{e^{x/2}}; x \in [-3,0]$

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

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

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

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

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

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 $r = \dfrac{10}{3+2\cos\theta}$

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

2071 Shawan

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.*
- ✓ *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 $\left(a^2 + x^2\right)y_{n+2} + (2n+1)xy_{n+1} + n^2y_n = 0$ [5]
2. State and prove Lagrange's Mean Value theorem. [5]
3. Evaluate: $\lim\limits_{x \to \Pi} (\sin x)^{\tan x}$ [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 $r = a\ (1-\cos\theta)$ about the initial line.
10. Solve: $\mathrm{Sin}x \frac{dy}{dx} + y\cos x = x\sin x$ [5]
11. Solve: $xp^2 - 2yp + ax = 0$ where $p = \frac{dy}{dx}$ [5]
12. ~~Solve:~~ $\cancel{\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = x^2e^{3x}}$ ~~[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 $r = \frac{12}{2 - 6\cos\theta}$

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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
2071 Shawan

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.*
- ✓ *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 Lagrange'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 $r = a\,(1-\cos\theta)$ 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 $r = \frac{12}{2 - 6\cos\theta}$

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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 $a^2y^2 = a^2x^2 - x^4$

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

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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 $r = \dfrac{4 \sec\theta}{2 \sec\theta - 1}$

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01 TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

Examination Control Division

2068 Shrawan

Exam.	New Back (2066 Batch & Later)		
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 $y = \log(x + \sqrt{a^2 + x^2})$, 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 $\int_0^1 \frac{dx}{(1 - x^6)^{1/6}} = \frac{\pi}{3}$.

8. Using method of differentiation under integral sign, evaluate: $\int_0^\infty \frac{e^{-x} \sin bx}{x} dx$.

9. Find the area bounded by the cardioid, $r = a(1 + \cos\theta)$.

   OR

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

10. 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 centre of the 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 difference of temperatures between the object and its surroundings". Supposing water at a temperature 100°C cools to 80°C in 10 minutes, in a room maintained at 30°C, find when the temperature of water will become 40°C.

    OR

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

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01 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	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 $y = a\cos(\log x) + b\sin(\log x)$. Prove that $x^2.y_{n+2} + (2n+1)x.y_{n+1} + (n^2+1)y_n = 0$.
2. State and prove Rolle's theorem.
3. Determine the values of a, b, c, so that $\underset{x\to 0}{\mathrm{Lt}} \dfrac{(a + b\cos x)x - c.\sin x}{x^5} = 1$.
4. Find the asymptotes of the curve $(x + y)^2 (x + 2y + 2) = x + 9y - 2$.
5. If e_1 and e_2 be the radii of curvature at the ends of a focal chord of the parabola $y^2 = 4ax$, prove that $e_1^{-2/3} + e_2^{-2/3} = (2a)^{-2/3}$.
6. Prove that $\displaystyle\int_0^{\pi} \frac{x\tan x}{\sec x + \cos x}dx = \frac{\pi^2}{4}$.
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. Use Gamma function to prove that $\displaystyle\int_0^{1} \frac{dx}{(1-x^6)^{1/6}} = \frac{\pi}{3}$.
9. Find the area bounded by the curve $x^2y = a^2(a-y)$ and the x axis.

OR

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

10. Solve the differential equation: $(1 + y^2) + (x - e^{\tan^{-1}y})\dfrac{dy}{dx} = 0$.
11. Solve: $xy^2(p^2 + 2) = 2py^3 + x^3$
12. solve : $(D^2 - 2D + 5)y = e^{2x}.\sin x$
13. Solve the differential equation: $x^2\dfrac{d^2y}{dx^2} + 4x\dfrac{dy}{dx} + 2y = e^x$
14. What does the equation $3x^2 + 3y^2 + 2xy = 2$ becomes when the axes are turned through an angle 45° to the original axis.

OR

Describe and Sketch the graph of the conic $r = \dfrac{10\operatorname{cosec}\theta}{2\operatorname{cosec}\theta + 3}$.

15. Derive the equation of Ellipse in the standard form.
16. Find the equation of tangents to the hyperbola $3x^2 - 4y^2 = 12$ which are perpendicular to the line $x - y + 2 = 0$. Also find the point of contact.

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01 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	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 $(1 + x^2)y_{n+2} + (2nx + 2x - a)y_{n+1} + n(n+1)y_n = 0$. 5
2. State and prove Lagrange's mean value theorem.
3. Evaluate $\lim_{x \to 0} \left(\frac{\sin x}{x}\right)^{\frac{1}{x}}$
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 $\int_0^{\pi/6} \cos^4 3\theta . \sin^2 6\theta = \frac{5\pi}{192}$. 5
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 $(1+x^2)\frac{dy}{dx} + y = e^{\tan^{-1}x}$. 5
11. Solve $y = yp^2 + 2px$, where $p = dy/dx$ 5
12. Solve $(D^2 - 3D + 2)y = x^2 + x$ 5
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 $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$. 5
15. Derive the equation of a hyperbola in standard form. 5
16. Find the centre, length of axes and eccentricity of the conic $2x^2 + 3y^2 - 4x - 12y + 13 = 0$.

    OR 5

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

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03 TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

Examination Control Division

2066 Shrawan

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

Subject: - 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. Find the angle of intersection of the pair of curves $r^n = a^n \cos n\theta$ and $r^n = a^n \sin n\theta$. [5]

OR

If $y = a\cos(\log x) + b\sin(\log x)$. Prove that $x^2 y_{n+2} + (2n+1)x.y_{n+1} + (x^2+1)y_n = 0$

2. State Rolle's theorem and verify it for the function $f(x) = x.(x+3).e^{-(x/2)}$, $x \in [-3, 0]$ [5]

3. Evaluate: $\underset{x \to 0}{\text{Lt}} \dfrac{(1+x)^{1/x} - e}{x}$ [1+4]

4. A cone is circumscribed to a sphere of radius r. Show that when the volume of the cone is least its altitude is 4r and its semivertical angle is $\sin^{-1}(1/3)$. [5]

5. Find the asymptotes of the curve $(x+y)^2.(x+2y+2) = x+9y-2$. [5]

OR

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

6. Integrate any three [10]

a) $\displaystyle\int \frac{x.e^x}{(1+x)^2}.dx$

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

c) $\displaystyle\int_{-\infty}^{\infty} \frac{e^x}{1+e^{2x}}.dx$

d) $\displaystyle\int_0^{\pi/2} \frac{\sqrt{\cot x}}{1+\sqrt{\cot x}}.dx$

7. Evaluate $\displaystyle\int_1^4 x^3 dx$ by the method of summation. [5]

8. Obtain reduction formula for $\int \cot^n x\, dx$ and hence integrate $\int \cot^7 x\, dx$. [5]

OR

Using Gamma function show that $\displaystyle\int_0^{\infty} e^{-x^4}.x^2 dx \times \int_0^{\infty} e^{-x^4}.dx = \frac{\pi}{8\sqrt{2}}$

9. Find the area bounded by the cardioid $r = a(1 + \cos\theta)$ [5]

OR

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

10. Solve any three of the following differential equations. [15]

a) $x\,dy - y\,dx = \sqrt{x^2 + y^2}\,.dx$

b) $x\dfrac{dy}{dx} + y.\log y = xy.e^x$

c) $y - 2px + ap^2.y = 0$

d) $(D^2 - 3D + 2)y = e^x$

11. If the axes be turned through an angle $\tan\theta = 2$. What does the equation $4xy - 3x^2 = a^2$ becomes? [5]

12. Find the equation of an ellipse in the standard form. [5]

13. If e_1 and e_2 are the eccentricities of the hyperbola, and it conjugate respectively. Then prove that $\dfrac{1}{e_1^2} + \dfrac{1}{e_2^2} = 1$. [5]

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1. Find the angle between the curves $r = a \sin 2\theta$, $r = a \cos 2\theta$. [5]

OR

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. [5]

3. Evaluate: $\lim\limits_{x \to 0} (\cot x)^{\frac{1}{\log x}}$ [5]

4. Find the surface of the right circular cylinder of greatest surface which can be inscribed in a sphere of radius r. [5]

5. Find the asymptotes of the curve $(x^2 - y^2)(x + 2y + 1) + x + y + 1 = 0$. [5]

OR

Show that the radius of curvature for the curve $r^m = a^m \cos m\theta$ is $\dfrac{a^m}{(m+1)r^{m-1}}$.

6. Integrate any three: [10]

a) $\displaystyle\int \frac{\cos x dx}{(1+\sin x)(2+\sin x)}$ b) $\displaystyle\int_0^{\pi/4} \frac{\sin 2\theta d\theta}{\sin^4\theta + \cos^4\theta}$

c) $\displaystyle\int_0^{\pi/2} \frac{\sqrt{\cot x}dx}{1+\sqrt{\cot x}}$ d) $\displaystyle\int_{-1}^{2} \frac{dx}{x^3}$

7. Evaluate $\int_0^1 \sqrt{x}dx$ by the method of summation. [5]

8. Obtain a reduction formula for $\int \sec^n x \, dx$ and hence find $\int \sec^6 x \, dx$. [5]

OR

Evaluate $\displaystyle\int_0^1 \frac{dx}{(1-x^6)^{1/6}}$

9. Find the area of a loop of the curve $a^2y^2 = a^2x^2 - x^4$. [5]

OR

Find the volume of the solid generated by revolving the astroid $x^{\frac{2}{3}} + y^{\frac{2}{3}} = a^{\frac{2}{3}}$ about the axis of x.

10. Solve any three of the following differential equations. [15]

a) $(3y - 7x + 7)dx + (7y - 3x + 3)dy = 0$
b) $\cos x \, dy = y(\sin x - y)dx$
c) $p^2 - py + x = 0$; where $p = \dfrac{dy}{dx}$
d) $(D^2 - 3D + 2)y = x^2 + x$

11. Find the changed form of the equation $3x^2 + 3y^2 + 2xy = 2$ when the axes are turned through 45° the origin remaining fixed. [5]

12. The line $x + y = 0$ is a directrix of an ellipse, the point (2,2) is the corresponding focus. If the eccentricity be 1/3, find the equation of the other directrix. [5]

13. Find the equation of the hyperbola in the standard form [5]

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