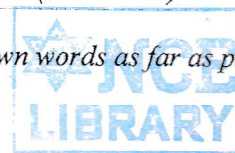


TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2082 Chaitra

Exam.	Regular (New Course)		
Level	BE	Full Marks	60
Programme	All (Except BAR)	Pass Marks	24
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Mathematics I (ENSH 101)

- ✓ 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. a) Expand $f(x) = \sinh x$ in powers of x up to three non-zero terms in the expansion. [2]
- b) Evaluate $\lim_{x \rightarrow 0} \left(\frac{\sin x}{x} \right)^{\frac{1}{x}}$ using L'Hospital's rule. [2]
- c) Find the pedal equation of the polar curve $r^2 = a^2 \cos 2\theta$. [2]
2. a) Does the integral $\int_0^1 \ln x \, dx$ converge or diverge? Why? [2]
- b) Evaluate $\int_0^1 \frac{x^6}{\sqrt{1-x^2}} dx$ using properties of Beta and Gamma function. [2]
- c) Make a rough sketch of $y^2 = 4x$, shade the area between $x = 0$ and $x = 2$ above the x -axis. Now using integration evaluate the Volume of revolution of the shaded area by revolving it with respect to the x -axis. [2]
3. a) Reduce the differential equation $(1 + x^2) \frac{dy}{dx} = x^2 \ln x - 2xy$ in to Linear Form. Find its integrating factor. [2]
- b) Define Clairaut's equation. Find the general solution of the differential equations.
 $y = px + p^n$ where $p = \frac{dy}{dx}$ [2]
- c) Find the particular integral (P.I.) of the differential equation
 $y'' + 9y = \sec 3x$ [2]
4. 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? [2]
5. a) Find of the point of intersection the line $\frac{x+1}{1} = \frac{y+3}{3} = \frac{z-2}{-2}$ and the plane $3x+4y+5z = 5$. [2]
- b) Find the equation of the sphere through the circle $x^2 + y^2 = 4, z = 0$ and the point $(0, -2, 3)$. [2]
6. Find the asymptotes of $x^3 + y^3 - xy^2 - x^2y + x^2 - y^2 - 1 = 0$ [4]
7. Find the radius of curvature of $2x^2 - y^2 = 25$ at the point where it intersects the line $y = x$ where $x > 0, y > 0$ [4]
8. Apply the method of differentiation under integral sign to evaluate [4]

$$\int_0^\infty e^{-ax} \sin bx \, dx; \text{ for } a > 0, b > 0, \text{ and evaluate } \int_0^\infty \frac{\sin x}{x} dx$$

OR

$$\text{Find the total area of the curve } y^2(x^2 + a^2) = x^2(a^2 - x^2)$$

9. Calculate the moment of inertia about x-axis and y-axis for a plane lamina bounded by curves $y = x^2$ between ordinates $x = 0, x = 2$, x-axis with uniform density $\rho = 1 \text{ gm/cm}^2$. [4]
10. Identify, sketch and describe the polar curve $r = \frac{12 \operatorname{cosec} \theta}{3 \operatorname{cosec} \theta - 2}$ [4]
11. Find the length, the equation of shortest distance and its points between the lines $\frac{x-6}{3} = \frac{y-7}{-1} = \frac{z-4}{1}$ and $\frac{x}{-3} = \frac{y+9}{2} = \frac{z-2}{4}$. [4]
12. Find the equation of right circular cone with vertex $(1,1,1)$ and axis of the line $\frac{x-1}{-1} = \frac{y-1}{2} = \frac{z-1}{3}$ and semi vertical angle 30° . [4]

OR

Find the equation of a right circular cylinder whose guiding curve is $x^2 + y^2 + z^2 = 9$, $x - y + z = 3$.

13. Solve the differential equation $\frac{d^2 y}{dx^2} + 3 \frac{dy}{dx} + 2y = e^{2x} \sin x$. [4]
14. A mass of 1 kg is attached at one end of a spring on a frictionless horizontal surface fixed at one end. The force of 6N applied to the spring stretches 1.5m from its natural length. If the mass is initially released from rest from 1m to the right of its equilibrium position, determine the position of mass as a function of time t. [4]

TRIBHUVAN UNIVERSITY
 INSTITUTE OF ENGINEERING
Examination Control Division
 2082 Kartik

Exam.	Back (New Course)		
Level	BE	Full Marks	60
Programme	All Except BAR	Pass Marks	24
Year / Part	I / I	Time	3 hrs

Subject: - Engineering Mathematics I (ENSH 101)

- ✓ 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. a) Expand $y = \tan x$ in powers of x up to three non-zero terms. [2]
- b) State L'Hospital's rule and hence evaluate the limit $\lim_{x \rightarrow 0} \frac{\log_e x}{\cot x}$. [2]
- c) Find the pedal equation of the polar curve $r^2 = a^2 \cos 2\theta$. [2]
2. a) Does the integral $\int_1^\infty \frac{1}{1+x^2} dx$ converge or diverge? Justify [2]
- b) Using Gamma function, evaluate $\int_0^\infty e^{-x^2} \sqrt{x} dx$. [2]
- c) Sketch the region bounded by $y = \sin x, y = 0$ in between $x = 0$ and $x = \frac{\pi}{2}$.
Using integration evaluate the area of the shaded region. [2]
3. a) Solve the differential equation $\frac{dy}{dx} + 2y = xe^{-x}$ [2]
- b) Solve $y - 2px + ay^2 = 0$. [2]
- c) Solve $(D^2 - 5D + 6)y = e^{-x}$ [2]
4. What will be the form of equation $x^2 + y^2 + 2xy = 2$, when the axes are turned through 60° about the origin. [2]
5. a) State the condition for the two lines in space are perpendicular to each other. Find the value of the constant k so that the lines $\frac{x+7}{2} = \frac{y-2}{-3k} = \frac{z-31}{10}$ and $\frac{x-1}{2k} = \frac{y+12}{2} = \frac{z-1}{1}$ are perpendicular to each other. [2]
- b) Prove that the line $\frac{x+1}{-2} = \frac{y+2}{3} = \frac{z+5}{4}$ lies in the plane $x + 2y - z = 0$. [2]
6. Find the asymptotes of the curve $x^3 + 2x^2y - xy^2 - 2y^3 + x^2 - y^2 + x + y + 1 = 0$. [4]
7. Find the radius of curvature at origin of the curve $x^3 + y^3 = 3axy$. [4]
8. Using differentiation under integral sign, evaluate $\int_0^\infty \frac{\tan^{-1}(ax)}{x(1+x^2)} dx$. [4]
9. Find the centroid of the region R bounded by $y = 4 - x^2$ and $y = 0$. [4]
10. Show that the lines $\frac{x+5}{3} = \frac{y+4}{1} = \frac{z-7}{-2}$ and $3x + 2y + z - 2 = 0, x - 3y + 2z - 13 = 0$ are coplanar, and find the equation of a plane in which they lie. [4]
11. Find the center and radius of the circle $x^2 + y^2 + z^2 + 12x - 12y - 16z + 111, 2x + 2y + z = 17$. [4]

12. Find the equation of right circular cone whose vertex at origin and semi-vertical angle α and having axis as z-axis. [4]

OR.

Find the equation of cylinder whose generator are parallel to the line

$\frac{x}{1} = \frac{y}{-2} = \frac{z}{3}$ and whose guiding curve is $x^2 + 2y^2 = 1, z = 3$

13. Solve $(x^2 D^2 + xD - 1)y = x^2$ [4]

14. A spring of mass 2 kg has natural length 0.5 m. A force of 25.6 N is required to maintain it stretched to a length of 0.7 m. If the spring is stretched to a length of 0.7 m and then released with initial velocity zero, find the position of mass at any point. [4]

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2081 Baishakh

Exam.	Regular (New Course - 2080 Batch)		
Level	BE	Full Marks	60
Programme	All except BAR	Pass Marks	24
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Mathematics I (SH 101)

- ✓ 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. a) Assuming the validity of the expansion, show that $e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \dots$ [2]
 b) Find the pedal equation of the polar curve $r = a\theta$. [2]
 c) Evaluate the limit $\lim_{x \rightarrow \infty} \frac{e^{px}}{x^{100}}$; $p > 0$ and interpret the limit. [2]
2. a) Evaluate the integral $\int_1^{\infty} \frac{1}{1+x^2} dx$. [2]
 b) Use gamma function to evaluate $\int_0^{\frac{\pi}{2}} \sin^3 x \cos^5 x dx$. [2]
 c) Find the arc length of semi-cubical parabola $ay^2 = x^3$ from $x = 0$ to $x = a$. [2]
3. a) Solve the differential equation $\frac{dy}{dx} + \frac{y}{x} = x^2$. [2]
 b) Define Clairaut's differential equations and find the general solution of the differential equations $\sin(y - px) = p$ where $p = \frac{dy}{dx}$. [2]
 c) Solve $x''(t) + \mu x(t) = 0$, $\mu > 0$ given that $x = a$ and $x' = 0$ when $t = \frac{\pi}{2\sqrt{\mu}}$. [2]
4. Transform the equation $2x^2 + 4xy + 5y^2 - 4x - 22y + 7 = 0$ to parallel axes through $(-2, 3)$. [2]
5. a) Show that the lines $\frac{x+3}{2} = \frac{y+5}{3} = \frac{z-7}{-3}$ and $\frac{x+1}{4} = \frac{y+1}{5} = \frac{z+1}{-1}$ are coplanar. [2]
 b) Find the equation of the sphere through the circle $x^2 + y^2 + z^2 = 9$, $x + 3y + 4z = 2$ and the origin. [2]
6. Find the asymptotes of the curve $y^3 - xy^2 - x^2y + x^3 + x^2 - y^2 = 1$. [4]
7. Find the radius of curvature of the curve $y = x^2(x - 3)$ at the point where the tangent is parallel to x-axis. [4]
8. Evaluate $\int_0^{\infty} \frac{\tan^{-1}(ax)}{x(1+x^2)} dx$ using the differentiation under the integral sign. [4]

OR

Find the volume of the ellipsoid obtained by the rotation of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$.

9. Find the centroid of the region R bounded by $y = \cos x$, $y = 0$, $x = 0$ and $x = \pi/2$. [4]
10. Identify the conic $9x^2 + 4xy + 6y^2 - 22x - 16y + 9 = 0$. Find the center and length of axes. [4]
11. Find the length and the equation of shortest distance between the lines $\frac{x-3}{3} = \frac{y-8}{-1} = \frac{z-3}{1}$ and $2x - 3y + 27 = 0$, $2y - z + 20 = 0$. [4]

12. Find the equation of a right circular cylinder of radius 2 units, whose axis passes through the point (1, 2, 3) and has direction ratios 2, -3, 6. [4]

OR

Find the equation of right circular cone with vertex (1,1,1) and axis of the line

$\frac{x-1}{-1} = \frac{y-1}{2} = \frac{z-1}{3}$ and semi vertical angle 30° .

13. Solve $\frac{dy}{dx} + xy \log y = xy (\log y)^2$. [4]
14. A mass of 1 kg is attached at one end of a spring on a frictionless horizontal surface fixed at one end. The force of 6 N applied to the string stretches 1.5 m from its natural length. If the mass is initially released from rest from 1 m to the right of its equilibrium position, determine the position of mass as a function of time t. [4]

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2081 Kartik

Exam.	Back (New Course-2080 Batch)		
Level	BE	Full Marks	60
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Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Mathematics I (SH 101)

- ✓ 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. a) Expand $y = \cosh x$ in powers of x up to three non-zero terms in the expansion. [2]
 b) Find the pedal equation of the polar curve $r = a(1 + \cos \theta)$. [2]
 c) Evaluate $\lim_{x \rightarrow 0} x^x$. [2]
 2. a) Evaluate $\int_0^a \frac{x^4}{\sqrt{a^2 - x^2}} dx$ using beta and gamma function. [2]
 b) Find the position of centroid of semi-circular plate of radius a . [2]
 c) Find the area of surface of revolution of the curve $y = x^3, 0 \leq x \leq 2$, about x -axis. [2]
 3. a) Find the integrating factor (I.F.) of $x \frac{dy}{dx} = x^2 \ln x - 2y$. [2]
 b) Solve the differential equation $p^2 + p - 6 = 0$ where $p = \frac{dy}{dx}$. [2]
 c) Solve $(D^2 - 5D + 6)y = e^x$ [2]
 4. Identify the conic $9x^2 + 4xy + 6y^2 - 22x - 16y + 9 = 0$. [2]
 5. a) Find the angle between the line $\frac{x+1}{2} = \frac{y}{3} = \frac{z-1}{6}$ and the plane $3x + y + z = 7$. [2]
 b) Find the equation of right circular cone whose vertex is origin and the axis is the line $\frac{x}{1} = \frac{y}{2} = \frac{z}{3}$ with semi vertical angle 30° . [2]
 6. Find the asymptotes of the curve, $(x^2 - y^2)(x + 2y + 1) + x + y + 1 = 0$ [4]
 7. Find the radius of the curvature of the curve $\sqrt{x} + \sqrt{y} = \sqrt{a}$ at the point where it cuts the line $y = x$. [4]
 8. Evaluate by using the rule of differentiation under the sign of integration, $\int_0^\infty \frac{\log(1+a^2x^2)}{1+b^2x^2} dx$ [4]
- OR
- Find the surface area of the solid formed by revolving the astroid $x^{\frac{2}{3}} + y^{\frac{2}{3}} = a^{\frac{2}{3}}$ about x -axis.
9. Find the centroid of the region between the curves $y = x^2, y = x + 2$. [4]
 10. Transform the equation $x^2 - y^2 = a^2$ into $xy = c^2$ by the suitable angle of rotation of the axes. [4]
 11. Find the center and radius of the circle $x^2 + y^2 + z^2 - 8x + 4y + 8z - 45 = 0$,
 $x - 2y + 2z = 3$. [4]

12. Show that the lines $\frac{x+1}{-3} = \frac{y-3}{2} = \frac{z+2}{1}$ and $\frac{x}{1} = \frac{y-7}{-3} = \frac{z+7}{2}$ are coplanar. Also find its point of intersection and the common plane. [4]

OR

Find the length and equation of the shortest distance between the lines

$$\frac{x+3}{-4} = \frac{y-6}{6} = \frac{z}{2} \text{ and } \frac{x+2}{-4} = \frac{y}{1} = \frac{z-7}{1}.$$

13. Solve $\frac{dy}{dx} + x \sin 2y = x^3 \cos^2 y$. [4]

14. In a series R L C circuit with resistor with $R = 20 \Omega$, inductor with $L = 1 H$, capacitor with $C = .002 F$ with 12 v battery. Initially the both charge and current are zero, then find the charge and current at any time t in the circuit. [4]

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Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Mathematics I (ENSH 101)

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

1. a) List the indeterminate forms for which L'Hospitals rule can be applied. Evaluate $\lim_{x \rightarrow 0} x^{\tan x}$ using L'Hospitals rule. [2]
- b) Assuming the validity of the expansion, find the expansion of $\cosh x$ by using Maclaurian's series. [2]
- c) Find the radius of curvature of $xy = c^2$ at (c, c) . [2]
2. a) Evaluate the improper integral $\int_0^1 \log_e x \, dx$. [2]
- b) Evaluate $\int_0^1 x^6 \sqrt{1-x^2} \, dx$ using properties of Beta and Gamma functions. [2]
- c) The area bounded by the parabola $y^2 = 4px$ and the line $x = a$ revolves about the x -axis. Find the volume generated. [2]
3. a) Solve the differential equation $\frac{dy}{dx} + \frac{1}{x}y = e^{-x}$. [2]
- b) Define Clairaut's equation. Find the general solution of $y = px + p - p^2$, where $p = \frac{dy}{dx}$. [2]
- c) Find the solution of the differential equation $y'' - 3y' + 2y = e^{-3x}$. [2]
4. Transform the equation $x^2 + y^2 - 6x + 4y - 4 = 0$ to a parallel axes system with origin $(3, -2)$. [2]
5. a) Prove that the lines $x = ay + b$, $z = cy + d$ and $x = a'y + b'$, $z = c'y + d'$ are perpendicular if $aa' + cc' + 1 = 0$. [2]
- b) If the tangent plane to the sphere $x^2 + y^2 + z^2 = r^2$ makes intercepts a, b, c on coordinate axes, then prove that $\frac{1}{a^2} + \frac{1}{b^2} + \frac{1}{c^2} = \frac{1}{r^2}$. [2]
6. Find the asymptotes of $x^3 + y^3 - xy^2 - x^2y + x^2 - y^2 - 1 = 0$. [4]
7. Find the radius of curvature of the curve $\sqrt{x} + \sqrt{y} = \sqrt{a}$ at the point where it cuts the line $y = x$. [4]
8. Apply the method of differentiation under integral sign to evaluate $\int_0^\infty \frac{e^{-ax} - e^{-bx}}{x} \, dx$. [4]
9. Find the centroid of the region R bounded by $y = \cos x$, $y = 0$, $x = 0$ and $x = \frac{\pi}{2}$. [4]
10. Identify, sketch and describe the graph of conic $r = \frac{4 \sec \theta}{2 \sec \theta - 1}$. [4]
11. Show that the lines $\frac{x+1}{-3} = \frac{y-3}{2} = \frac{z+2}{1}$ and $\frac{x}{1} = \frac{y-7}{-3} = \frac{z+7}{2}$ are coplanar. Also find its point of intersection and the common plane. [4]

12. Find the equation of right circular cone with vertex at (2, -3, 5) axis makes equal angle with co-ordinate axes and semi-vertical angle is 30° .

[4]

OR

Find the equation of right circular cylinder of radius 2 and whose axis is the line

$$\frac{x-1}{-2} = \frac{y-2}{1} = \frac{z-3}{2}$$

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

[4]

14. Find current i in the RLC circuit assuming zero initial current and charge q if $R = 80 \Omega$, $L = 20$ Henrys, $C = 0.01$ Farads and $E = 100$ volts.

[4]
