

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]
