TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

Examination Control Division

(Sample Question)

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

Subject: - Engineering Mathematics II (SH 151)

- ✓ 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) $\log\left(x^3+y^3-x^2y-xy^2\right)$, then show that $\left(\frac{\partial}{\partial x}+\frac{\partial}{\partial y}\right)^2 u = -\frac{4}{(x+y)^2}$ [2]

(b) If $u=\sin^{-1}\left(\frac{x+y}{\sqrt{x}+\sqrt{y}}\right)$, then show that $x\frac{\partial u}{\partial x}+y\frac{\partial u}{\partial y}=\frac{1}{2}\tan u$ [2]

2 (a) Evaluate $\int_0^{\pi}\int_0^{x}\sin y\ dx\, dy$ [2]

(b) Evaluate $\iiint_y^x xyz\, dx\, dy\, dz$ over the sphere $x^2+y^2+z^2=a^2$ in first octant [2]

3 (a) A particle moves along the curve $x=4\cos t,\ y=4\sin t,\ z=6t$, then find the velocity and acceleration at time $t=\frac{\pi}{2}$ [2]

(b) Find the unit normal vector to the surface $xy^3z^2=4$, at the point $(-1,-1,2)$ [2]

(c) If $\phi=x^3+y^3+z^3-3xyz$, then show that $curl\ (grad\ \phi)=0$ [2]

4 (a) Find the Laplace Transform of the function: $\frac{\sin^2 t}{t}$ [2]

(b) Find the inverse Laplace transform of $\frac{s^2+s-2}{s(s+3)(s-2)}$ [2]

5 (a) Find the rank of the following matrix: [2]

$$\begin{bmatrix} 1 & 2 & 0 & -1 \\ 3 & 4 & 1 & 2 \\ -2 & 3 & 2 & 5 \end{bmatrix}$$

(b) Test whether the vectors (1,2,-1),(1,2,4) and (3,0,1) are linearly independent or dependent. [2]

6 Solve y ² + y=0, by power series method. [2]

7 Find the minimum value using Lagrange multiplier method of $x^2+y^2+z^2$ subject to the condition $ax+by+cz=p$. [4]

8 Change the order of integration and evaluate $\int_0^1\int_x^{\sqrt{2x-x^2}}\frac{x}{\sqrt{(x^2+y^2)}}dxdy$ [4]

9	Prove that "A line integral $\int_C \vec{F}\cdot d\vec{r}$ is independent of path C joining any two points A and B if and only if $\vec{F} = \nabla\phi$ for some scalar function ϕ"	[4]
10	Using Green's theorem, evaluate the line integral $\int_C (3x^2 - 8y^2)dx + (4y - 6xy)dy$ where C is the boundary of the region $y = \sqrt{x}$ and $y = x^2$	[4]
11	Using Gauss divergence theorem to evaluate the surface integral $\int\int_s \vec{F}.\vec{n}\, ds$ for $\vec{F} = xy\,\vec{i} - xz^2\vec{j} + yz\vec{k}$ where S is the surfaces $x + y + z = 1, x = 0, y = 0, z = 0$	[4]
12	Using the Laplace transform technique, solve the initial value problem: $$y''(t) + 4y'(t) + 3y(t) = e^{-t},\ \ y(0) = 0, y'(0) = 1$$	[4]
13	Find the eigen values and eigen vectors of the Matrix $\begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$	[4]
14	Reduce the quadratic form $Q(x) = 2x_1^2 + x_2^2 + 2x_3^2 + 2x_1x_2 + 2x_2x_3 + 2\,x_1x_3$ into canonical form.	[4]
15	Show that $J_{-\frac{1}{2}}(x) = \sqrt{\frac{2}{\pi x}}\cos x$, where $J_{-\frac{1}{2}}(x)$ is Bessel's function.	[4]
	OR	
	Show that $n\,P_n(x) = x\,P_n'(x) - n\,P_{n-1}'(x)$, where $P_n(x)$ is Legendre's polynomial.	[4]