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Your Roll No. : ....

Sl. No. of Q. Paper : **8599** **J**

Unique Paper Code : 32221101

Name of the Course : **B.Sc. (Hons.) Physics**

Name of the Paper : Mathematical Physics-I

Semester : I

Time : 3 Hours ***Maximum Marks : 75***

Instructions for Candidates :

(a) Write your Roll No. on the top immediately on receipt of this question paper.

(b) Question **NO.1** is compulsory.

(c) Attempt **four** more questions out of the rest.

(d) Non-programmable calculators are allowed.

1. Do any **five** of the following : 5×3=15

(a) Determine the linear independence/linear dependence of e^x, xe^x, x^2e^x.

(b) Determine the order, degree and linearity of the following differential equation.

$$\frac{d^3y}{dx^3} + x^2\left(\frac{d^2y}{dx^2}\right)^2 = 0$$

(c) Find the are of the triangle having vertices at P (1,3,2), Q (2,-1,1) and (-1,2,3).

(d) Let $\vec{A}$ be a constant vector. Prove that

$$\vec{\nabla}\left(\vec{r}.\vec{A}\right) = \vec{A}$$

P.T.O.

(e) Find the acute angle between the surfaces $xy^2z-3x-z^2=0$ and $3x^2-y^2+2z=1$ at the point $(1,-2,1)$

(f) A random variable X has probability density function

$$f(x) = \frac{1}{\sqrt{2\pi}} e^{-(x-5)^2/2}$$

$-\infty < x < \infty$

Find the mean

(a) Solve the simultaneous differential equations given below.

$$\frac{dy}{dt} = y, \qquad \frac{dx}{dt} = 2y + x$$

(b) Two independent random variables X and Y have probability density functions $f(x) = e^{-x}$ and $g(y)=2e^{-2y}$ respectively. What is the probability that X and Y lie in the intervals $1<x\leq 2$ and $0 < y \leq 1$

The time rate of change of the temperature of a body at an instant t is proportional to the temperature difference between the body and its surrounding medium at that instant.

c) Box A contains 8 items out of which 3 are defective. Box B contains 5 items out of which 2 are defective. An item is drawn randomly from each box.

5+5+5

) What is the probability that both the items are non-defective ?

i) What is the probability that only one item is defective ?

ii) What is the probability that the defective item came from box A ?

olve the following differential equations.

ı) $y'' + y = \sec x$ 8

) $(z + ye^{xy})dx + (xe^{xy} - 2y)dy = 0$ 7

) Solve the initial value problem. 8

(i) $y'' + 4y' + 8y = \sin x$

(ii) $y(0) = 1$, $y'(0) = 0$

) A metal bar at a temperature 100^0 F is placed in a room at a constant temperature of 0^0F. After 20 minutes the temperature of the bar is 50^0 F. Find : 7

(i) The time it will take the bar to reach a temperature of 25^0 F

(ii) Temperature of the bar after 10 minutes

a) If v denotes the region inside the semicircular cylinder

$$0 \leq x \leq \sqrt{a^2 - y^2} \quad 0 \leq z \leq 2a$$

Evaluate $\iiint_v x\,dv$ 7

b) 17 8

6. (a) Find the directional derivative of $\varphi = 4$ $3x^2y^2z$ at $(2,-1,2)$ in the direction $2\hat{i} - 3\hat{j}$

(b) Find the value of $\nabla^2(\ln r)$

(c) Prove that :

$$\iiint \frac{dv}{r^2} = \oiint_S \frac{\bar{r}.\hat{n}}{r^2}\, ds$$

Where v is the volume of region enclose surface

7. (a) Suppose $\vec{A} = (2y + 3)\hat{i} + xz\hat{j} + (yz - x)\hat{k}$

Evaluate $\int_c \vec{A}.d\vec{r}$ along the following pat

(i) $x = 2t^2$, $y = t$, $z = t^3$ from $t = 0$ to $t = 1$

(ii) The straight line from $(0,0,0)$ to $(0,$ then to $(0,1,1)$ and then to $(2,1,1)$

(iii) The straight line joining $(0,0,0)$ $(2,1,1)$

(b) Evaluate $\iint \vec{A}.\hat{n}\, dS$

where $\vec{A} = z\hat{i} + x\hat{j} - 3y^2z\hat{k}$ and S is the Surface of the cylinder $x^2+y^2=16$ inclu in the first octant between $z = 0$ to $z = 5$

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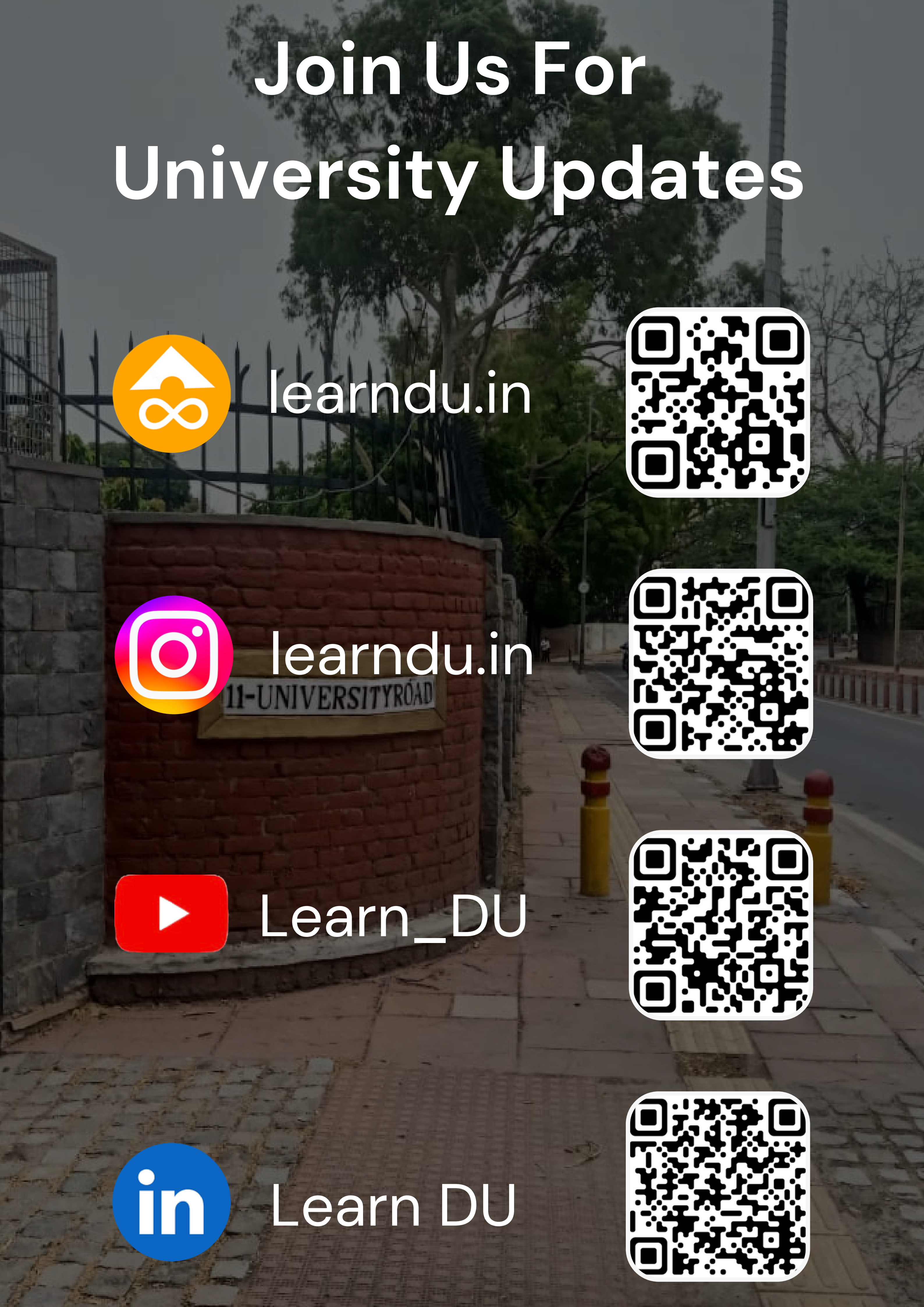
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