Name: **Enrolment No:**	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2019

Course: Mathematical Physics II | **Semester: III**
Program: B.Sc. Physics (H) | **Time 03 hrs.**
Course Code: PHYS 2001 | **Max. Marks: 100**

Instructions: 1. The question paper has three sections: Section A, B and C. All sections are compulsory.
2. Section B and C have internal choices.

	SECTION A		
S. No.		**Marks**	**CO**
Q 1	Define Parseval's Formula for half-range sine series and cosine series.	**4**	**CO1**
Q 2	Outline the steps to solve second order linear differential equation when $x = 0$ is an ordinary point.	**4**	**CO2**
Q 3	Describe how the generating function of Legendre's polynomial emerged from Physics based potential estimation concept.	**4**	**CO4**
Q 4	Evaluate the following integral using gamma function $$\int_0^\infty \sqrt[4]{x}\, e^{-\sqrt{x}} dx$$	**4**	**CO1**
Q 5	Convert the following Hermite polynomial into an ordinary polynomial $$P(x) = 2H_4(x) + 3H_3(x) - H_2(x) + 5H_1(x) + 6H_0$$	**4**	**CO2**
	SECTION B		
Q 6	If $u = \frac{5x^3y^4}{z^5}$ and errors in each x, y, z be 0.001 then compute the relative maximum error in it when $x = 1, y = 1, z = 1$.	**10**	**CO1**
Q 7	Using the Rodrigue's formula for Legendre function, prove that $$\int_{-1}^{+1} x^m\, P_n(x)\, dx = 0,$$ where m, n are positive integers and $m < n$.	**10**	**CO2**

Q 8	Show that Bessel's function $J_n(x)$ is an even function when n is even and is odd function when n is odd.	**10**	**CO1**
Q 9	Approximate the following function using Fourier series $$f(x) = \begin{cases} -\pi & -\pi < x < 0 \\ x & 0 < x < \pi \end{cases}$$ and deduce that $$\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \cdots \ldots\ldots\ldots\ldots\ldots\ldots\ldots. = \frac{\pi^2}{8}$$ **OR** Using half-range sine series prove that for $0 < x < \pi$ $$x(\pi - x) = \frac{8}{\pi}\left[\frac{\sin x}{1^2} + \frac{\sin 3x}{3^2} + \frac{\sin 5x}{5^2} + \cdots \ldots\ldots\ldots\ldots\ldots.\right]$$	**10**	**CO2**
SECTION-C			
Q 10	A tightly stretched string with fixed end points $x = 0$ and $x = \pi$ is initially at rest in its equilibrium position. If it is set vibrating by giving to each of its points an initial velocity $$\left(\frac{\partial y}{\partial t}\right)_{t=0} = 0.03\ \sin x - 0.04\ \sin 3x$$ then determine the displacement $y(x, t)$ at any point of string at any time t.	**20**	**CO3**
Q 11	Solve the following partial differential equation $$\frac{\partial^2 f}{\partial x^2} - 2\frac{\partial f}{\partial x} + \frac{\partial f}{\partial y} = 0$$ by the method of separation of variables. **OR** Solve the Laplace equation $$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$$ on a rectangle in the xy −plane with the following boundary conditions $u(x, 0) = 0$, $u(x, b) = 0$, $u(0, y)$ and $u(a, y) = f(y)$, parallel to y-axis.	**20**	**CO4**