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

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2020

Course: Mathematical Physics II — **Semester: III**
Program: B.Sc. Physics (H) — **Time 180 Minutes**
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 C has internal choice.

SECTION A

S. No.		Marks	COs
Q 1	Identify Dirichlet's conditions: any function $f(x)$ can be developed as a Fourier series provided that (a)_____, (b)_____, (c)_____ .	**5**	**CO1**
Q 2	Approximate the function $f(x) = xsinx$ in $(-\pi,\ \pi)$ to estimate the value of b_n using Fourier series _____ .	**5**	**CO1**
Q 3	Compute the regular singular points of the differential equation $x^2(x-2)^2\,y'' + 2(x-2)\,y' + (x+3)\,y = 0$ are _____ .	**5**	**CO2**
Q 4	Evaluate $\int_0^1 x^4\,(1-\sqrt{x})^5\,dx$ using Beta function and fill in the blank _____ .	**5**	**CO3**
Q 5	Choose the correct option as using Gamma function $\int_0^\infty \frac{x^a}{a^x}\,dx$ can be evaluated in the form of $\frac{1}{(\log a)^{a+1}}(a!)$. [Note: "!" indicates factorial sign].	**5**	**CO3**
Q 6	Choose the correct option that the equation of a vibrating string is equivalent to the equation of a wave. (a) True or (b) False.	**5**	**CO4**

SECTION B

Q 7	Determine Fourier series expansion for a periodic function of period 4 which is defined as $f(x) = \|x\|, \quad -2 < x < 2.$	**10**	**CO1**
Q 8	Deduce that $$\frac{\pi^2}{8} = 1 + \frac{1}{3^2} + \frac{1}{5^2} + \frac{1}{7^2} + \cdots$$ by using the sine series for $f(x) = 1 \ in \ 0 < x < 1.$	**10**	**CO1**
Q 9	Solve the Bessel's equation $$x^2 \frac{d^2y}{dx^2} + x\frac{dy}{dx} + (x^2 - n^2)y = 0.$$	**10**	**CO2**
Q 10	Ascertain that Legendre polynomial $P_n(x)$ is the coefficient of z^n in the expansion of $(1 - 2\,xz + z^2)^{-1/2}$ in ascending powers of z.	**10**	**CO2**
Q 11	Evaluate $$\int_0^1 \frac{x^{m-1} + x^{n-1}}{(1+x)^{m+n}}\, dx$$ using the transformation property of beta function as $$\beta(m,n) = \int_0^\infty \frac{x^{m-1}}{(1+x)^{m+n}}\, dx$$	**10**	**CO3**
SECTION-C			
Q 12	Create one dimensional (1D) wave equation for a stretched string with schematic diagram and apply the method of separation of variables to solve it. OR Create two dimensional (2D) wave equation for a rectangular membrane with schematic diagram and apply the method of separation of variables to solve it.	**20**	**CO4**