

Anjuman Islam Janjira Degree College of Science
Murud-Janjira, Raigad-402401
Affiliated to University of Mumbai

Class: -S.Y.B.Sc	Subject: - Physics - III
Semester:- III	Course code: -USPH303
Exam Event:- Winter 2023 (SH)	Marks: -75
Date:- 25/10/2023	Duration:- 2.30 Hours

- N.B: 1. All questions are compulsory.
 2. Figures to the right indicate full marks.
 3. Use of log-table/nonprogrammable calculator is allowed.
 4. Answer for the same question as far as possible should be written together.

Q1. Attempt any Four of the following. (20)

- 1) Solve the following differential equation $y'' + y' - 2y = 0$
- 2) Provide the general solution of $\frac{d^2y}{dx^2} - 8\frac{dy}{dx} + 15y = 0$
- 3) What is second order differential equation? how to solve it if the roots are real and unequal?
- 4) Determine the following equation is exact or not $(5x^4 + 3x^2y^2 - 2xy^3) dx + (2x^3y - 3x^2y^2 - 5y^4) dy = 0$
- 5) Solve the following differential equation of radioactive decay of nuclei

$$\frac{dN(t)}{dt} = -\lambda N(t) \text{ at } N(t=0) = N_0$$

- 6) Solve the following differential equation $\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 9y = 0$

Q 2. Attempt any Four of the following. (20)

- 1) Solve the following differential equation $y'' - 2y' + y = 2\cos x$
- 2) Write important partial differential equation in physics.
- 3) Solve the following differential equation using method of separation of variable

$$3\frac{\partial u}{\partial x} + 2\frac{\partial u}{\partial y} = 0 \quad u(x, 0) = 4e^{-x}$$

- 4) Explain the method of separation of variable.
- 5) Solve the following Second-Order Non-Homogeneous Equations with Constant Coefficients

$$y'' - 4y' + 4y = 2e^{2x}$$

- 6) Solve $\frac{dy}{dx} = x^2y$ using method of separation of variable.

Q 3. Attempt any Four of the following. (20)

- 1) Illustrate the block diagram of electronic communication system.
- 2) Write a note on analog and digital communication with advantage and disadvantage.
- 3) Define Noise, for a non-ideal amplifier, determine S/N ratio in terms of decibel where signal power is $2 \times 10^{-10}W$ and noise power is $2 \times 10^{-18}W$.
- 4) Explain reverberation, reverberation time and Sabine's formula.
- 5) Define FM? Write the comparison between AM and FM.
- 6) Calculate the height of Antenna for signal of Frequency 20Hz and 20,000 Hz.

Q4. A) Select correct answer. (Solve any 8 out of 12) (08)

1) What is a differential equation?

- | | |
|---|------------------------------------|
| a) An equation that includes only derivatives | b) An equation with no solutions |
| c) An equation with variables and constants | d) An equation with only variables |

2) Which of the following is a first-order homogeneous differential equation?

- | | | | |
|-------------------|--------------------|------------------|--------------|
| a) $y' + 2xy = 3$ | b) $y' + xy = x^2$ | c) $xy' = y - x$ | d) $y' = 2x$ |
|-------------------|--------------------|------------------|--------------|

3) The variable separable method is used to solve which type of differential equations?

- | | |
|----------------------------------|---------------------------------------|
| a) Linear differential equations | b) Non-linear differential equations |
| c) Exact differential equations | d) Homogeneous differential equations |

4) What is the general form of a first-order linear differential equation?

- | | | | |
|-------------------|------------------------|------------------|-----------------|
| a) $y' = f(x, y)$ | b) $y' + p(x)y = q(x)$ | c) $y'' = p(x)y$ | d) $y' = p(x)y$ |
|-------------------|------------------------|------------------|-----------------|

5) Which method is commonly used to solve partial differential equations with separable variables?

- a) Laplace Transform method
- b) Separation of Variables method
- c) Matrix method
- d) Substitution method

6) What physical phenomenon does the wave equation model?

- a) Electrical circuits
- b) Heat conduction in solids
- c) Wave propagation in strings and fluids
- d) Particle motion in a vacuum

7) In a non-homogeneous second-order linear differential equation, the non-homogeneous part represents:

- a) A term involving only the unknown function.
- b) A term involving both the unknown function and its derivatives.
- c) A constant term.
- d) A term independent of the unknown function.

8) Which of the following represents a second-order non-homogeneous differential equation with constant coefficients?

- a) $y'' - 2y' + y = e^x$
- b) $y'' + 3y' + 2y = \sin(x)$
- c) $y'' + 4y = 10 \cos(x)$
- d) $y'' - y = x^2$

9) What does the term "reverberation" refer to in acoustics?

- a) Sound absorption by materials
- b) Persistence of sound in a room after the sound source stops
- c) Speed of sound in a medium
- d) Frequency of sound waves

10) Which type of communication system allows data transmission in both directions but not simultaneously?

- a) Simplex
- b) Half-Duplex
- c) Full-Duplex
- d) Duplex

11) Signal-to-Noise Ratio (SNR) is a measure of:

- a) Signal strength
- b) Noise strength
- c) Signal clarity in the presence of noise
- d) Transmission speed

12) In the context of room acoustics, which of the following materials typically has a high absorption coefficient?

- a) Concrete
- b) Glass
- c) Carpet
- d) Metal

Q4. B) Answer in one sentence (Solve any three out of five) (03)

- 1) Define differential equation.
- 2) What is order of differential equation.
- 3) What is partial differential equation?
- 4) What is reverberation in acoustics?
- 5) What is simplex communication?

Q4. C) Fill in the Blanks (Solve any four out of six) (04)

- 1) In physical systems like LC circuits, second-order homogeneous differential equations often model _____ phenomena.
- 2) _____ method is used to convert partial differential equation into ordinary differential equation
- 3) The _____ method is commonly used to solve partial differential equations by assuming a solution in the form of a product of functions.
- 4) The partial differential equation that describes the distribution of temperature in a two-dimensional space over time is known as the _____ equation.
- 5) In _____ communication, signals are transmitted in their original form without modulation.
- 6) The _____ of a material indicates how much sound it absorbs, with higher values signifying better sound absorption properties.