

1M/PHY-100 (Th) Syllabus-2023

2 0 2 5

(Nov-Dec)

FYUP : 1st Semester Examination

MAJOR

PHYSICS

**(Mathematical Physics, Properties of Matter
and Waves)**

PHY-100

Marks : 56

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

Answer any **eight** questions

1. (a) State Stokes' theorem and explain its significance. 3
(b) Solve the differential equation : 4

$$\frac{d^2y}{dx^2} + 3\frac{dy}{dx} + 2y = x^3 + x$$

2. (a) If $\vec{V} = x\cos z\hat{i} + y\log x\hat{j} - z^2\hat{k}$, then
evaluate $\vec{\nabla} \cdot \vec{V}$. 2

(2)

- (b) What do you mean by curl of a vector field? Explain its significance. 1+1=2

- (c) Solve the initial value problem

$$\frac{d^2y}{dx^2} + 4y = 2 \sin x$$

Given, $y_{(0)} = 1$ and $\frac{dy}{dx}(0) = 0$. 3

3. State and explain the Newton's laws of motion with examples. Show that Newton's first law of motion is simply a special case of second law. 5+2=7

4. (a) What are inertial and non-inertial frames of references? Give one example of each. 2

- (b) Derive the moment of inertia of a solid cylinder about an axis passing through its centre and perpendicular to its own axis of symmetry. 5

5. (a) Derive Stokes' formula for the velocity of a small sphere falling through a viscous liquid using dimensional analysis. Mention one application of Stokes' law. 3+1=4

(3)

- (b) Two drops of water of the same size are falling through air with terminal velocity 1 m/s. If the two drops combine to form a single drop, calculate the new terminal velocity. 3

6. State and prove Bernoulli's theorem. Give two applications of the theorem. 5+2=7

7. (a) State Hooke's law. Deduce the relation

$$\frac{9}{Y} = \frac{3}{\eta} + \frac{1}{K}$$

where the symbols have their usual meaning. 1+3=4

- (b) The breaking stress of steel is $8 \times 10^9 \text{ N/m}^2$. Find the maximum length of steel wire that can be hung vertically without breaking. Density of steel is 10^4 kg/m^3 . 3

8. (a) What is SHM? Show that the sum of kinetic energy and potential energy of a particle executing simple harmonic motion is constant. 1+3=4

- (b) A mass of 1 kg is suspended from a spring of stiffness constant 25 Nm^{-1} . If the undamped frequency is $2\sqrt{3}$ times the damped frequency, calculate the damping factor. 3

(4)

9. Obtain the equation of motion of a damped simple harmonic motion and solve it for critical damping. 3+4=7
10. Explain forced vibration. Obtain differential equation of motion of forced oscillator. Distinguish between transient and steady state in a forced oscillator. 2+2+3=7
11. Obtain the classical wave equation of a plane progressive wave and find its general solution. 3+4=7
12. (a) What are Lissajous figures? Mention any two of its uses. 1+2=3
- (b) Obtain the resultant of two simple harmonic motions acting on a particle at right angle to each other having same amplitude, same phase difference and frequencies are in the ratio 1:2. 4
