

Q.1) Attempt the following [50M]

1) The minimum number of vectors of equal magnitude required to produce zero resultant is _____.

a) two b) three c) four d) more than four

2) The vector sum of two forces is perpendicular to the vector difference. In that case the forces are _____.

a) equal to each other b) equal to each other in magnitude c) not equal to each other in magnitude d) none of the above

3) If the sum of two vectors is a unit vector then the magnitude of their difference is _____.

a) $\sqrt{2}$ b) $\sqrt{3}$ c) $\sqrt{5}$ d) $\sqrt{6}$

4) A ship is traveling due east at 10 km per hour. A ship heading 30 degrees east of north is always due north from the first ship. The speed of the second ship in kilometers per hour is _____.

a) $20\sqrt{2}$ b) $20\sqrt{3}/2$ c) 20 d) $20/\sqrt{2}$

5) A man moves on a cycle with a velocity of 4 km per hour. The rain appears to fall to him with a velocity 3 km per hour vertically. The actual velocity of rain is _____.

a) 7 kilometer per hour b) $4/3$ kilometer per hour c) $3/4$ kilometer per hour d) 5 kilometer per hour

6) The divergence of a vector field is _____.

a) a vector b) a scalar c) either a scalar or a vector d) none of the above

7) The operator Del is known as _____.

a) delta b) lambda c) nabla d) none of the above

8) If a vector field can be expressed as the gradient of a scalar then the vector field is called _____.

a) solenoid b) gradient c) divergence d) Irrotational

9) The degree & order of the differential equation $\frac{dy}{dx} = \cos x$.

a) Order=1 & degree =1 b) Order=1 & degree =2
c) Order=2 & degree =1 d) Order=2 & degree =2

10) An equation involving only partial derivatives of one or more functions of two or more independent variables is called a _____.

a) Ordinary differential equation b) Partial differential equation
c) linear differential equation d) non-linear differential equation

11) Which of the following equations is non-linear?

a) $\frac{dy}{dx} + \frac{y}{x} = \log x$ b) $y \frac{dy}{dx} + 4x = 0$ c) $dx + dy = 0$ d) $\frac{dy}{dx} = e^x$

- 12) The non-homogeneous differential equation $\frac{d^2y}{dx^2} + P(x)\frac{dy}{dx} + q(x) = Q(x)$ can be reduced to homogeneous equation by putting _____.
- a) $P(x)=0$ b) $Q(x)=0$ c) $q(x)=0$ d) $P(x)$ & $q(x)$ both equal to zero
- 13) CR has dimension of _____.
- a) s b) $1/s$ c) H/s d) S/H
- 14) In LR -series circuit, the current through an inductor follows (when circuit is closed) with _____.
- a) a linear growth b) a linear decay c) an exponential growth d) an exponential decay
- 15) In a LCR series circuit if $\frac{R^2}{4L^2} = \frac{1}{LC}$ then the circuit is _____.
- a) Oscillatory b) dead beat c) critical damped d) none of these
- 16) In CR -circuit, for the case of decay of current, the magnitude of current can be calculated by using formula _____.
- a) $i = -i_0 e^{-\frac{t}{\tau}}$ b) $i = i_0 e^{-\frac{t}{\tau}}$ c) $i = -i_0 e^{\frac{t}{\tau}}$ d) $i = i_0 e^{\frac{t}{\tau}}$
- 17) If two SHM's of the same amplitude, time period and phase act at right angles to each other, then the resultant vibration is _____.
- a) Elliptical b) Circular c) Straight line d) Parabolic
- 18) The general solution of the differential equation of simple harmonic motion is given by _____.
- a) $X = A \sin \omega t$ b) $X = A \cos \omega t$ c) $X = A \cos \square$ d) $X = A \sin (\omega t + \square)$
- 19) For particle executing SHM's, the phase difference between displacement and velocity is _____.
- a) π b) 0 c) $\pi/2$ d) $-\pi/2$
- 20) Which of the following is not essential for simple harmonic motions?
- a) Inertia b) Gravity c) Restoring force d) Elasticity
- 21) The speed of wave in a stretched string depends upon _____.
- a) The tension in the string b) The amplitude of the wave
c) The wavelength of the wave d) The acceleration due to gravity
- 22) The sound waves are _____.
- a) Transverse wave b) The longitudinal wave c) Mixed wave d) Sometime transverse and sometime longitudinal wave
- 23) Of the following properties of the wave, the one that is independent of the others is its _____.
- a) Amplitude b) Speed c) Wavelength d) Frequency
- 24) Wave transmits _____ from one place to another
- a) Mass b) Amplitude c) Wavelength d) Energy
- 25) The initial phase of the particle in the wave equation is called _____.
- a) Phase b) Amplitude c) Epoch d) Time

Q.2) Attempt any 3 of the following [15M]

- Two vectors having a equal magnitudes A makes an angle θ with each other find the magnitude and direction of resultant vector..
- Find the area of a triangle having vertices $A(1,3,2)$, $B(2,-1,1)$, and $C(-1,2,3)$.
- Find the unit normal to the surface $y^2 + z^2 = x^2$ at a point $(1,2,3)$.
- Define vectors and its types.
- Define curl of vector field and state its properties.

Q.3) Attempt any 3 of the following [15M]

- A body starts from rest and falls under Gravity in a resistive medium if we assume that the resistive force is proportional to the velocity, its equation of motion is $dv/dt + bv = g$ Solve the equation for v .
- Discuss the decay of current in an L-R circuit through which a current i_m is flowing initially. The differential equation describing the process is $L di/dt + iR = 0$.
- A series combination of capacitor and resistance is connected across a source of constant EMF, an expression for the charge on the capacitor and current through the circuit during charging.

- 4) In an L-R Series DC circuit, $L = 50 \text{ mH}$, $R = 5 \text{ Ohm}$, and $E = 6 \text{ volt}$. Calculate the time constant of the circuit and the current in the circuit after 5 ms when the circuit is switched on.
- 5) Solve the equation: $dy/dx = y + 2 / x + 3$.

Q.4) Attempt any 3 of the following [15M]

- 1) Write down the equation of motion of simple harmonic motion. Obtain its solution and the expression for angular frequency. Why SHM is called sinusoidal motion?
- 2) Discuss the composition of two parallel simple harmonic motions of slightly different period. Hence, define the beats.
- 3) Give mathematical description of the travelling wave. Hence, find the expression for particle velocity and particle acceleration.
- 4) Show that difference between two consecutive nodes or antinodes is $\lambda/2$.
- 5) A 500 gram mass is hung from the lower end of a coiled spring and causes the spring to elongate by 5 cm . if the mass is now set bobbing up and down, how many complete oscillations will it make in one minute?

Q.5) Attempt any one of the following [5M]

- 1) Write a note on normal modes of vibration on string fixed at both ends.
- 2) What is time constant of a C-R series circuit? Derive an expression for it by considering discharging in a C-R circuit.
- 3) Explain the physical interpretation of divergence of a field.

-X-X-X-X-X-