ED-301

M.Sc. 1st Semester
Examination, March-April 2021

PHYSICS

Paper - I

Mathematical Physics

Time : Three Hours]   [*Maximum Marks* : 80

Note : Answer **all** questions. The figures in the right-hand margin indicate marks.

Unit-I

1. (*a*) Define inner product of vector space and explain its properties.   4

   (*b*) Find the inverse of a matrix   12

$$A = \begin{bmatrix} 3 & -1 & 1 \\ -15 & -6 & -5 \\ 6 & -2 & 2 \end{bmatrix}$$

OR

(*a*) What do you mean by linear dependence or independence of vectors ?   4

(*b*) Examine the linear dependence or independence of the following set of vectors :   12

$[2, 1, -4]$; $[0\ 1\ 2]$

$[6, -1, 14]$, $[4\ 0\ 12]$

(2)

Unit-II

2. (*a*) Deduce Cauchy residue theorem. 12

 (*b*) Explain Contour integration. 4

OR

 (*a*) Explain Cauchy integral formula with one example. 12

 (*b*) Find the residue of 4

$$\frac{z^4}{(z-1)^4(z-2)(z-3)}$$

 at $z = 1$

Unit-III

3. (*a*) Deduce the formula for second order differential equation with variable co-efficients. 10

 (*b*) Solve the differential equation 6

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

OR

 (*a*) Solve the differential equation 12

$$x(1-2x)\frac{d^2y}{dx^2} - (6x+1)\frac{dy}{dx} - 2y = 0$$

 (*b*) Explain the method of Green's function. 4

DRG_41_(3) *(Continued)*

(3)

Unit-IV

4. (*a*) Find the solution of Lagurre's differential equation. 10

$$x \frac{d^2 y}{dx^2} + (1 - x)\frac{dy}{dx} + \lambda y = 0$$

(*b*) Show that 6

(*i*) $\frac{d}{dx}\left[x^{-n} J_n(x) \right] = -x^{-n} J_{n+1}(x)$

(*ii*) $J_0'(x) = -J_1(x)$

OR

(*a*) Establish orthogonality of Bessel's function. 8

(*b*) Derive generating function for $H_n(x)$. 8

Unit-V

5. (*a*) Define inverse Laplace's transform and explain its properties. 10

(*b*) Explain any one theorem on Fourier transform. 6

OR

(*a*) Explain Fourier integral and Fourier transform in detail. 10

(*b*) Discuss the properties of Fourier series. 6

ED-302

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PHYSICS

Paper - II

Classical Mechanics

Time : Three Hours]   [*Maximum Marks* : 80

Note : Answer **all** questions. The figures in the right-hand margin indicate marks.

Unit-I

1. (*a*) What are constraints ? Classify the constraints with some examples.   6

(*b*) Obtain Lagrange's equation and show that these can be written as   10

$$\frac{d}{dt}\left(\frac{\partial T}{\partial \dot{q}_j}\right) - \frac{\partial T}{\partial q_j} = Q_j$$

OR

What is D'Alembert's principle? Derive Lagrange's equation of motion from it for conservation system. How will result be modified for non-conservative system?　　16

Unit-II

2. Derive Hamiltonian function and equation of motion for a compound pendulum. Also explain why Hamiltonian method preferred over the Lagrangian formulation.　　16

OR

(a) Explain cyclic co-ordinates and their physical significance.　　8

(b) Discuss the principle of least action.　　8

Unit-III

3. Explain Hamilton-Jacobi theory and apply it to solve the problem of one dimensional harmonic oscillator.　　16

OR

(a) Discuss the physical significance of:　　8

　　(i) Hamilton's principle function

　　(ii) Hamilton's characteristics function

(b) Use action-angle variable to determine the frequency of one dimensional harmonic oscillator.　　8

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(3)

Unit-IV

4. (*a*) How will you reduce the two-body problem into one body problem ? Hence explain the concept of reduced mass. Give its two examples.   10

   (*b*) Calculate reduced mass of the Hydrogen atom and Positronium.   6

OR

Derive the differential equation of orbit in polar coordinates under central force. Investigate the motion of particle under attractive inverse square law.   16

Unit-V

5. Answer any **two** of the following :   16

   (*a*) Eulerian angles

   (*b*) Angular momentum and kinetic energy of the rigid body

   (*c*) Formulation of the problem of small oscillations

   (*d*) The Coriolis force

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ED-303

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PHYSICS

Paper - III

Electrodynamics and Plasma Physics

Time : Three Hours]   [*Maximum Marks* : 80

Note : Answer **all** questions. All questions carry equal marks.

Unit-I

1. What are inertial and non-inertial frame of references ? Derive Lorentz's transformation equaiton.

OR

Write notes on the following :

(*a*) Scalar and vector potentials

(*b*) Green's function for the wave equation

(2)

Unit-II

2. What are Lienard-Wiechart potentials ? Derive formula for Lienard-Wiechart potentials for a print charge.

OR

Write notes on the following :

(*a*) Radiation emitted by a charge in arbitrary extremely relativistic motion

(*b*) Larmor's formula

Unit-III

3. Explain the following :

(*a*) Synchrotron Radiation

(*b*) Cherenkov Radiation

OR

Write notes on the following :

(*a*) Spectrum of synchrotron radiation

(*b*) Transition of cyclotron to synchrotron emission

Unit-IV

4. What is Plasma ? Explain Debye shielding phenomenon and criteria for plasma.

OR

Explain the following :

(*a*) Motion of charge particle in transverse magnetic field

(*b*) Magnetic mirror effect

Unit-V

5. State, explain and prove the Boltzmann equation.

OR

Write notes on the following :

(*a*) Hydrodynamic waves

(*b*) Magnetosonic and Alfven waves

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Paper - IV

Electronics

Time : Three Hours]   [*Maximum Marks* : 80

Note : Answer **all** questions. All questions carry equal marks.

Unit-I

1. (*a*) Explain the working of differential amplifier in dual input and balanced output mode.

(*b*) Explain Op-amp based Schmitt trigger circuit.

OR

(*a*) Compare the parameters of IC 741 Op-amp and ideal Op-amp.

(*b*) What is Op-amp ? Explain any one application of Op-amp.

Unit-II

2. (*a*) Describe the circuit and working of one logic gate family in which unsaturated voltage level is used.

(*b*) Represent a digital circuit using NOR gate for the given function

$$f(a, b, c) = \Sigma\, m\,(0, 2, 4, 6)$$

OR

(*a*) What are the different laws of Boolean algebra ? How De Morgan's law help in changing the logic gates in any digital circuit ?

(*b*) Explain the working of DCTL logic family as gate.

Unit-III

3. (*a*) What is the difference between dynamic memory and static memory ?

(*b*) Define flip-flop. Explain the race around condition of level triggered JK flip-flop. Also give the solution to remove race around condition.

OR

(*a*) Explain 4-bit asynchronous ripple counter using JK flip-flop.

(*b*) Draw the internal circuit diagram of 16×1 multiplexer circuit using gates.

(3)

Unit-IV

4. (*a*) Describe architecture of 8085 microprocessor.

   (*b*) How many interrupt pins are there in 8085 microprocessor ? Explain its working with one example.

OR

   (*a*) Describe pin diagram of 8085 microprocessor.

   (*b*) Write short notes on the following :

   (*i*) General purpose register

   (*ii*) Flag register

Unit-V

5. (*a*) How many instructions are there in 8085 microprocessor ?

   (*b*) Write an assembly language programme for adding two 8-bit numbers.

OR

   (*a*) Write an assembly language programme for multiplying two 8-bit numbers.

   (*b*) Explain addressing mode of 8085 microprocessor.

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