FD-301

M.Sc. 1st Semester
Examination, Dec.-Jan., 2021-22

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*) Explain linear independence, bases with suitable examples. 4

(*b*) Define inner product and dimensionality 4

(*c*) What are orthogonal and unitary matrices ? Explain with examples. 4

(*d*) Discuss complete orthonormal sets of function 4

OR

(*a*) If a matrix A satisfies a relation $A^2 + A - I = 0$, then prove that A^{-1} exists and $A^{-1} = I + A$ being an identity matrix. 4

(*b*) Show that diagonalizing matrix of a Hermitian matrix is unitary. 4

(*c*) Find the inverse of the following matrix : 8

$$\begin{bmatrix} 1 & 3 & 3 \\ 1 & 4 & 3 \\ 1 & 3 & 4 \end{bmatrix}$$

Unit-II

2. (*a*) What is an analytic function ? Deduce Cauchy-Riemann conditions for function to be analytic. 12

(*b*) Find the residue of 4

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

at $z = 1$

OR

(*a*) Derive Cauchy integral formula, using this formula calculate 12

$\int_C \frac{zdz}{\left(9 - z^2\right)(z+i)}$, where C is the circle $|z| = 2$.

(*b*) Explain contour integraion with examples. 4

Unit-III

3. (*a*) Determine the solution of linear differential equation with variable coefficients. 10

(*b*) Solve the differential equation 6

$$y'' + 3y' + 2y = x^3 + x$$

OR

(*a*) What are non-homogeneous differential equations ? Deduce its solution by the method of Green's function. 10

(*b*) Solve the differential equation using power series method 6

$$xy'' + y' + x^2 y = 0$$

Unit-IV

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

$$x^2 \frac{d^2y}{dx^2} + x\frac{dy}{dx} + \left(x^2 - n^2\right)y = 0$$

(*b*) Derive recurrence relation of Legendre polynomial (any four). 6

OR

(*a*) Deduce orthogonality of Legendre's polynomials. 6

(*b*) Derive generating function for Hermite differential equation and Lagurre's polynomial. 10

Unit-V

5. (*a*) Define Laplace's transform, with examples. Write its different properties. 10

(*b*) Derive convolution theorem. 6

OR

(*a*) Explain Fourier series with its properties and applications. 10

(*b*) Find the inverse Laplace transform of 6

(*i*) $\frac{2s-5}{9s^2-25}$

(*ii*) $\frac{s^2+s+2}{s^{3/2}}$

(*iii*) $\frac{s-2}{6s^2+20}$

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FD-302

M.Sc. 1st Semester
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PHYSICS

Paper - II

Classical Mechanics

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

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

Unit-I

1. (*a*) What is meant by constraints ? Give their classification.

(*b*) Set up Lagrangian function for simple pendulum.

OR

State Hamilton's principle. Derive Lagrange's equation from Hamilton's principle.

Unit-II

2. (*a*) Deduce Hamilton's equation of motion with the help of Legendre transformation.

(*b*) Obtain the principle of Least action.

OR

State and prove Hamilton's equation from Hamilton's principle.

Unit-III

3. (*a*) Explain the Poisson's Brackets.

(*b*) Discuss action and angle variables.

OR

Discuss Hamilton-Jacobi's equation for Hamilton's characteristic function.

Unit-IV

4. Discuss two-body central force problem and reduce it to the equivalent one-body problem.

OR

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

Unit-V

5. Define the Euler angles. Explain the Euler's equation of motion of rigid body.

OR

What do you understand by stable and unstable equilibria ? Obtain the Lagrange's equation of motion for small oscillations of a system in the neighbourhood of stable equilibrium.

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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. Discuss Lorentz gauge, Coulomb gauge and obtain Green function for the wave equation.

OR

Explain the following :

(*a*) Matrix representation of Lorentz transformation

(*b*) Scalar and vector potentials

Unit-II

2. Discuss Larmor's formula and its relativistic generalization, also obtain angular distribution of radiation emitted by an accelerated charge.

OR

Write notes on the following :

(*a*) Lienard-Wiechert potential

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

Unit-III

3. Write notes on the following :

(*a*) Bremsstrahlung emission

(*b*) Cherenkov radiation

OR

Explain the following :

(*a*) Spectral index for power law electron distribution

(*b*) Synchrotron radiation

Unit-IV

4. Explain Debye shielding phenomenon and criteria for plasma. Discuss the motion of charged particles in the electromagnetic field.

OR

Write notes on the following :

(*a*) Magnetic mirror effect

(*b*) Adiabatic invariance of flux

Unit-V

5. Discuss the plasma kinetic theory and obtain Boltzmann equation along with the plasma oscillation.

OR

Explain the following :

(*a*) Plasma confinement schemes

(*b*) Magnetosonic and Alfven waves

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PHYSICS

Paper - IV

Electronics

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

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

Unit-I

1. (*a*) Draw schematic block diagram of the basic Op-amp with inverting and non-inverting inputs. Sketch their equivalent circuits. Also write its characteristics.

(*b*) Discuss the use of Op-amp comparators.

OR

(*a*) Describe the function of an Op-amp as an integrator.

(*b*) Discuss the use of Op-amp as analog computation.

Unit-II

2. (*a*) Explain with the help of truth table, the working of AND, OR NOT and NOR gate.

(*b*) Draw two input TTL NAND gate, explaining active pull-up and phase splitter

OR

(*a*) Write about unipolar logic families. Explain any one unipolar logic family.

(*b*) What are NOR and NAND gates ? What are their characteristics ? Why these are called as universal building block ?

Unit-III

3. (*a*) Describe the working of RS flip-flop. How it differs from D flip-flop ?

(*b*) Define converters. State the various methods used for A/ID conversion and discuss one of them in detail.

OR

(*a*) How will you realise a Master-Slave JK flip-flop using NOR gates and NAND gates ?

(*b*) What do you understand by a register ? What is buffer register ? Explain it in detail.

Unit-IV

4. (*a*) Draw a block diagram of 8085 microprocessor and explain the following functions in brief :

(*i*) Arithmetic Logic Unit (ALU)

(*ii*) Timing and control logic

(*b*) Interface memory chips 2k EPROM and 2k RAM to 8085 microprocessor. The EPROM address should start at location 0000H and RAM at location 4000H.

OR

(*a*) What is stack ? Explain how it works with the help of stack pointer, PUSH and POP instruction.

(*b*) Solve the following :

(*i*) $(2142.53)_{10} = (\ )_8$

(*ii*) $(1101.11)_2 = (\ )_{10}$

(*ii*) $(6ABC.2A)_{16} = (\ )_2$

(*ii*) $(7324.456)_8 = (\ )_{16}$

Unit-V

5. (*a*) Explain the data transfer and arithmetic instruction set of 8085 microprocessor ?

(*b*) Sixteen blocks of data are stored in memory location from C550H to C55FH. Write an assembly language program to transfer entire block of data to new memory location starting at C570H in reverse order.

OR

(*a*) Explain the following instructions of 8085 microprocessor with memory location required, addressing modes used and functions :

(*i*) CALL 5000H

(*ii*) DAA

(*b*) Write an assembly language program to subtract two 8-bit hexadecimal number.

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