S–3107

Sub. Code
23MPH1C1

M.Sc. DEGREE EXAMINATION, APRIL 2024

First Semester

Physics

MATHEMATICAL PHYSICS

(CBCS – 2023 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A $(10 \times 2 = 20)$

Answer **all** questions.

1. Define vector space.
2. State linear independence.
3. What is meant by singular points?
4. What are Riemannian conditions?
5. Define rank of matrix.
6. Find the eigen values of the matrix $\begin{pmatrix} 1 & 1 \\ 1 & 1 \end{pmatrix}$
7. Define Laplace transform of a function $f(x)$.
8. State Dirac delta function.
9. Can you expand $f(x) = \tan x$ in a Fourier series.
10. State Fourier transform and its inverse.

Part B (5 × 5 = 25)

Answer **all** questions, choosing either (a) or (b).

11. (a) Elaborately discuss isomorphism of vector space.

Or

(b) Explain about ket and bra notation.

12. (a) State and prove Cauchy integral formula.

Or

(b) Briefly explain about de Moivre's theorem.

13. (a) Verify Cayley Hamilton's theorem for the matrix $A = \begin{pmatrix} 1 & 2 \\ 2 & -1 \end{pmatrix}$.

Or

(b) Explain the terms trace of a matrix, rank of matrix. Illustrate with one example in each case.

14. (a) Find the Sine and Cosine transforms of $e^{-ax} (a > 0)$.

Or

(b) Solve the following equation by the Laplace transform method $y'' + 2y' + 2y = 5 \sin x$ given $y(0) = y'(0) = 0$.

15. (a) State and prove the Liouville differential equation.

Or

(b) Solve the following differential equations $\frac{d^2y}{dx^2} + 5\frac{dy}{dx} + 6y = 0$.

Part C (3 × 10 = 30)

Answer any **three** questions.

16. Briefly explain about linear operator and change of basis.

17. State and prove the Laurent's expansion.

18. Find the Eigen values and Eigen vectors of $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$.

    Is this matrix unitary?

19. State and prove the convolution theorem.

20. Using the following recurrence relation satisfied by $J_n(x)$.

    (a) $J_{n-1}(x) + J_{n+1}(x) = \frac{2n}{x} J_n(x)$.

    (b) $J_{n-1}(x) - J_{n+1}(x) = 2\frac{d}{dx} J_n(x)$.

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S–3108

Sub. Code
23MPH1C2

M.Sc. DEGREE EXAMINATION, APRIL 2024.

First Semester

Physics

CLASSICAL MECHANICS AND RELATIVITY

(CBCS – 2023 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A $(10 \times 2 = 20)$

Answer **all** the questions.

1. Define holonomic constraints.

2. State principle of virtual work.

3. What is conservative system?

4. Define projectile motion.

5. Define phase space.

6. State conjugate momentum.

7. What are normal coordinates?

8. Define normal modes.

9. What are non-inertial frames of reference?

10. Define length contraction.

Part B (5 × 5 = 25)

Answer **all** questions, choosing either (a) or (b).

11. (a) Explain holonomic and non-holonomic constraints.

Or

(b) Define generalized coordinate and obtain the expression for generalized momentum.

12. (a) Obtain Lagrange's equation for a simple pendulum.

Or

(b) Derive Lagrange's equation of notion for projectile motion.

13. (a) Discuss the cyclic coordinates and conservation theorems.

Or

(b) Obtain the Hamilton's canonical equations of motion.

14. (a) Briefly explain the normal coordinates.

Or

(b) Discuss the vibrations of a linear triatomic molecules.

15. (a) Explain the relativistic addition of velocities.

Or

(b) Describe the Minkowski space.

Part C

$(3 \times 10 = 30)$

Answer any **three** questions.

16. Explain in details of transformation equations.

17. Deduce Lagrange's equation of motion from D Alembert's principle for non conservation system.

18. Derive the canonical equation of motion of particle in a central force field.

19. Outline the theory of small oscillations for a system of two coupled oscillators in the neighborhood of stable equilibrium.

20. Obtain the Einstein mass – energy relation.

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S–3109	Sub. Code
	23MPH1E1

M.Sc. DEGREE EXAMINATION, APRIL 2024.

First Semester

Physics

Elective – LINEAR AND DIGITAL ICs AND APPLICATIONS

(CBCS – 2023 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A $(10 \times 2 = 20)$

Answer **all** questions.

1. Mention the advantages of integrated circuit.

2. Point out features of 741 op — amp.

3. What are the limitations of log amplifier?

4. What is an instrumentation amplifier?

5. Why active filters are preferred?

6. What is meant by cut off frequency of a high pass filter?

7. List the classification of ADCs.

8. Write the specification of DAC.

9. Design CMOS transistor circuit for 2 inputs AND gate.

10. How to drive CMOS gate to TTL gate?

Part B (5 × 5 = 25)

Answer **all** questions, choosing either (a) or (b).

11. (a) Draw the basic block diagram of op – amp and explain the operation of each block.

Or

(b) Explain the circuit diagram and operation of ideal op – amp.

12. (a) Explain the working of a Schmitt trigger with neat circuit diagram.

Or

(b) How op – amp is used for comparator? Explain its working.

13. (a) Explain the working of an astable multivibrator using IC555 with circuit diagram.

Or

(b) Draw and explain the principles and description of individual blocks of PLL in detail.

14. (a) With a neat diagram explain the working principle of R – 2R ladder type DAC.

Or

(b) Briefly explain the working of parallel comparator type ADC with neat diagram.

15. (a) Design a comparator circuit using IC7485 and explain its operation.

Or

(b) Explain the working of 4 bit parallel adder circuit using IC7483.

Part C

$(3 \times 10 = 30)$

Answer any **three** questions.

16. Draw the internal circuit diagram of TC 741 operation amplifier and explain the function of each stage.

17. Explain the working of instrumentation amplifier with suitable diagram.

18. Explain how 555 timer acts as monostable multivibrator.

19. Explain the working of dual slop ADC with neat circuit diagram.

20. Design an asynchronous binary counter using 74XXICs and explain its working with neat timing wave forms.

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S–3110	Sub. Code
	23MPH1E2

M.Sc. DEGREE EXAMINATION, APRIL 2024.

First Semester

Physics

Elective – ENERGY PHYSICS

(CBCS – 2023 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. What is meant by conventional energy sources?

2. Give some examples of non renewable energy sources.

3. Define principle of tidal power.

4. State ocean thermal energy.

5. Write any two advantages of wind energy.

6. Give the applications of wind energy.

7. Define Aerobic digestion.

8. What is biogas?

9. What is photosynthesis?

10. Write any two causes of greenhouse effect.

Part B (5 × 5 = 25)

Answer **all** questions, choosing either (a) or (b).

11. (a) Write any five differences between renewable and nonrenewable sources.

Or

(b) Explain in details about non conventional energy resources.

12. (a) Write a note on principle of tidal power.

Or

(b) Briefly explain the energy from the oceans.

13. (a) Describe how to energy storage in wind energy.

Or

(b) Explain the components of wind energy and its conversion system.

14. (a) Write the advantages of anaerobic digestion.

Or

(b) Write a note on properties of bio gas.

15. (a) How will you measure solar radiation using pyranometer?

Or

(b) Explain the solar cell parameter.

Part C

$(3 \times 10 = 30)$

Answer any **three** questions.

16. Explain the nuclear energy and its advantages.

17. Explain the principle of ocean thermal energy conversion system.

18. Describe the major applications of wind energy.

19. Explain the conversion of biomass into other form of energy.

20. Explain the construction and working of solar distillation.

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S–3111

Sub. Code
23MPH2C1

M.Sc. DEGREE EXAMINATION, APRIL 2024

Second Semester

Physics

STATISTICAL MECHANICS

(CBCS – 2023 onwards)

Time : 3 Hours Maximum : 75 Marks

Section A (10 × 2 = 20)

Answer **all** questions.

1. What is Critical Indices?
2. List out the Characteristics of Dimensional Analysis.
3. Define the term “entropy”.
4. What are Macro and Micro States.
5. Write a note on density fluctuations.
6. Give any three Trajectories of ensembles.
7. State – Plant radiation formula.
8. What are Fermions? Give it’s examples.
9. Define – Brownian Motion.
10. What are meant by Correlation.

Section B (5 × 5 = 25)

Answer **all** questions, choosing either (a) or (b).

11. (a) Explain the limitations of Statistical methods.

Or

(b) State and Explain the Third Law of thermodynamics.

12. (a) Write short note on Micro Canonical ensemble and What are it's Consequences.

Or

(b) Write any five connections between statistical and Thermodynamics.

13. (a) State and Prove – Liouville's theorem.

Or

(b) Explain – Energy fluctuations.

14. (a) Distinguish between classical and quantum statistics.

Or

(b) Obtain an expression for the Maxwell–Boltzmann distribution Law.

15. (a) Give an account of Langevin's theory.

Or

(b) Write about thermodynamical properties of a Real gas.

Section C

$(3 \times 10 = 30)$

Answer any **three** questions.

16. State and prove the Landau's theory of phase transition.

17. Explain – Gibb's Paradox.

18. Discuss any five relation between Partition function and Thermodynamical quantities.

19. Give a brief introduction of Bose–Einstein and Fermi dirac statistics in comparison to MB Statistics.

20. Explain the Concepts of Ising model and Show that this three dimensions of mean–field theories.

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S–3112

Sub. Code
23MPH2C2

M.Sc. DEGREE EXAMINATION, APRIL 2024

Second Semester

Physics

QUANTUM MECHANICS – I

(CBCS – 2023 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A $(10 \times 2 = 20)$

Answer **all** questions.

1. State Born's interpretation of wave function.
2. Define Normalisation.
3. Define Zeropoint energy.
4. Show that $p_x = i\hbar . \frac{d}{dx}$ is a hermitian operator.
5. Outline the Dirac's Bra and Ket notation.
6. Define Parity.
7. What are spherical harmonics? Are they mutually orthogonal?
8. Mention the four properties of density matrix.
9. Define Pauli's exculsion principle.
10. Give the communication relation b/w J_+ and J_- mutually.

Part B (5 × 5 = 25)

Answer **all** questions choosing either (a) or (b).

11. (a) Obtain timedepent Schrodinger wave equation.

Or

(b) Discuss the various admissibility conditions on the wave functions of a system?

12. (a) Show that the operator for momentum in the momentum space (p) it self?

Or

(b) Explain Linear harmonic oscillator in operator method.

13. (a) Explain equation of motions.

Or

(b) Some note on symmetries and conservation laws.

14. (a) Explain WKB approximation theory.

Or

(b) Outline the connection formulas.

15. (a) Explain Eigen values of J^2 and J_z.

Or

(b) Briefly evaluate the Clebsh – Gordan Coefficients for $j_1 = 1$ and $j_2 = 1$

Part C

$(3 \times 10 = 30)$

Answer any **three** questions.

16. Discuss the eigen value problem for a particle moving in one dimensional squarwell potential.

17. Explain (a) Linear operator (b) Hermitian operator.

18. Explain the equation of motion in Heisenberg representation.

19. Discuss ground state energy discussed by the examples of Helium atom.

20. Explain about addition of angular momenta with CG coefficients.

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S–3113	Sub. Code
	23MPH2E1

M.Sc. DEGREE EXAMINATION, APRIL 2024

Second Semester

Physics

Elective – BIO PHYSICS

(CBCS – 2023 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. How are ions transported across all membranes?
2. What is the significance of cellular osmosis?
3. What is molecular biophysics?
4. How do molecular motors operate within cells?
5. Write down Nerst equation.
6. What is meant by electrochemical potential?
7. Define X-ray and its importance.
8. What is meant by UV radiation?
9. Define Thin Layer chromatography (TLC).
10. What is meant by Electron spin resonance (ESR)?

Part B (5 × 5 = 25)

Answer **all** questions choosing either (a) or (b).

11. (a) Explain the process of cellular osmosis and volume regulation.

Or

(b) Describe the techniques and methodologies used in biophysics research.

12. (a) Discuss the future directions and challenges in molecular biophysics.

Or

(b) What are the advances molecular biophysics?

13. (a) Explain Electrochemical potential.

Or

(b) Write down Gadman equations.

14. (a) What are the radiation hazards?

Or

(b) Write down application radiation in Cancer.

15. (a) Explain differential centrifugation.

Or

(b) Write down density gradient centrifugation.

Part C

$(3 \times 10 = 30)$

Answer any **three** questions.

16. Explain briefly Electrical activities of cardiac and neuronal cells.

17. Explain briefly RNA and DNA structure.

18. Explain briefly different types of nervous system.

19. Explain UV radiation affect in bio macro molecular and proteins.

20. Explain briefly ESR and TLC.

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S–3114

Sub. Code
23MPH2E2

M.Sc. DEGREE EXAMINATION, APRIL 2024.

Second Semester

Physics

Elective – ADVANCED OPTICS

(CBCS – 2023 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. Define the term double refraction.

2. What is optical activity?

3. State any four applications of LASER in communications.

4. What is a Solid state laser?

5. What is an optical fiber?

6. What is coherent bundle?

7. What you mean by a non-linear medium?

8. What is phase matching condition?

9. What is Faraday effect?

10. What is meant by electric double refraction?

Part B (5 × 5 = 25)

Answer **all** questions choosing either (a) or (b).

11. (a) What are polaroids? State their uses.

Or

(b) What are uniaxial crystals? Explain the phenomenon of double refraction in a calcite crystal.

12. (a) What are the essential components of a laser? Explain their functions briefly.

Or

(b) Explain the working of Nd-YAG laser.

13. (a) What do you meant by numerical aperture? Obtain a relation between numerical aperture fractional difference in refractive indices.

Or

(b) With neat diagram, Explain the propagation of light through step index and graded index fibers.

14. (a) Draw an indicatrix diagram for uniaxial crystal and explain briefly about phase matching condition.

Or

(b) Explain the parametric generation of light.

15. (a) Explain the stark effect and Inverse stark effect.

Or

(b) What do you meant by verdet constant? Describe an experiment to demonstrate it for a transparent medium.

Part C

$(3 \times 10 = 30)$

Answer any **three** questions.

16. Describe the theory of production and detection of circularly and elliptically polarized light.

17. With the help of energy band diagram discuss the working of a semi conductor laser.

18. Discuss the different types of attenuation mechanisms occurs in optical fibers.

19. Discuss the theory of harmonic generation to get

    (a) second and third harmonic generations and

    (b) optical mixing.

20. What is Kerr effect? What is kerr constant? Describe a kerr cell and explain how it can be used as an electro-optic shutter.

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S–3115

Sub. Code
23MPH2E3

M.Sc. DEGREE EXAMINATION, APRIL 2024

Second Semester

Physics

Elective – MICROPROCESSOR 8085 AND MICROCONTROLLER 8051

(CBCS – 2023 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. What is an address map?

2. Define - mode O.

3. Give any two electrical quantities of 8085 interfacing.

4. List the features of 8051 microcontroller.

5. What is the use of internal RAM?

6. What is the size of internal data memory in an 8051?

7. State the stack pointer.

8. Write different types of JUMP instructions in 8051.

9. What do you understand serial communication interrupts?

10. Write an interrupt vector table.

Part B (5 × 5 = 25)

Answer **all** questions, choosing either (a) or (b).

11. (a) Explain data transfer operation with its examples.

Or

(b) Differentiate between the instructions INRL, INR H and INX H.

12. (a) Explain - A/D converter interface to microprocessor 8085.

Or

(b) Give any one physical quantities of 8085 interfacing system.

13. (a) Explain the IN and Out put pins.

Or

(b) List the various Register set of 8051 and give some examples.

14. (a) Write a note an subroutines.

Or

(b) What happens when the CALL instruction is executed? what are the use of CALL instruction?

15. (a) Distinguish between Enabling and Disabling an interrupt.

Or

(b) What are the action taken by the microcontroller in response to an interrupt request.

Part C

$(3 \times 10 = 30)$

Answer any **three** questions.

16. Explain - Direct memory Access (DMA).

17. Explain with necessary block diagram. how a temperature monitoring system can be designed using a 8085.

18. Explain in brief classifications of 8051 microcontroller.

19. Discuss the different logic instructions in the instruction set of 8051 with its examples.

20. Describe how four 7-segment displays can be interfaced to 8051.

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S–3116

Sub. Code
23MPH2E4

M.Sc. DEGREE EXAMINATION, APRIL 2024

Second Semester

Physics

Elective — CHARACTERIZATION OF MATERIALS

(CBCS – 2023 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. Define loss of weight.
2. What is meant by heat capacity?
3. Draw the neat diagram of optical microscopy.
4. What is meant interference?
5. Define AFM.
6. Write the principle of SEM.
7. What is meant by impurity?
8. Define Luminescence.
9. Write the basic principle of XRD.
10. What do you understand Rman intensity?

Part B (5 × 5 = 25)

Answer **all** questions, choosing either (a) or (b).

11. (a) Determine the decomposition of the product.

Or

(b) Explain in detail the differential thermo analysis.

12. (a) Discuss briefly confocal microscopy principle and working.

Or

(b) Write a short notes on digital holographic microscopy.

13. (a) Write the basic principle and working of STEM.

Or

(b) Discuss working and principle of TEM.

14. (a) Describe the Two Probe method.

Or

(b) Explain the impurity concentration electro chemical C-V profiting method.

15. (a) Explain in detail ESR.

Or

(b) Explain working of NQR.

Part C

$(3 \times 10 = 30)$

Answer any **three** questions.

16. Discuss in detail about the TGA.

17. Explain the some optical microscopy.

18. Explain the principle of EDAX and how it's working.

19. What is meant by interaction and explain in detail about the light matter interaction?

20. Discuss in detail for principle and working of SIMS.

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S–3117

Sub. Code
23MPH2S1

M.Sc. DEGREE EXAMINATION, APRIL 2024

Second Semester

Physics

SOLAR ENERGY UTILIZATION

(CBCS – 2023 onwards)

Time : 3 Hours Maximum : 75 Marks

Part A (10 × 2 = 20)

Answer **all** questions.

1. Define Radiation.
2. What is heat transfer?
3. Define conversion of solar radiation.
4. What is optical loss?
5. Type of solar water heater.
6. Some note on collectors.
7. What is solar energy conversion?
8. Define thermoelectric conversion.
9. What is fuel cell?
10. Define ceramics.

Part B (5 × 5 = 25)

Answer **all** questions, choosing either (a) or (b).

11. (a) Explain conduction, convention and radiation.

Or

(b) Some note on solar energy measuring instruments.

12. (a) Explain general characteristics of solar collectors.

Or

(b) Briefly note on thermal performance evaluation of optical loss.

13. (a) Explain solar heating system.

Or

(b) Explain solar cooling system.

14. (a) Write a note on matallization.

Or

(b) Briefly note on process flow of silicon solar cells.

15. (a) Uses of nanotechnology in hydrogen production and storage.

Or

(b) Explain

(i) Catalysis

(ii) Electrolytes

Part C

$(3 \times 10 = 30)$

Answer any **three** questions.

16. Explain solar energy measuring instruments.

17. How to works solar collectors and physical principles of conversion of solar radiation into heat flat plat collectors?

18. Explain different approaches on the process of

    (a) Diffusion

    (b) Antireflection coatings

19. Application of ceramic catalysts and nanotechnology.

20. Explain collectors, storage tanks and solar ponds.

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