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DUMKAL COLLEGE

P.O- Basantapur, P.S- Dumkal, Dist.- Murshidabad, West Bengal, Pin- 742406

(Govt. Aided, Affiliated to the: University of Kalyani Included under section 2(f) & 12 (B) of UGC Act.)

Date: 10.12.2025

NOTICE

(Department of Physics)

For submission of assignments:

All the student of Semester-I (Major Course) are hereby instructed to submit their assignments according to the following topics. The hard copy of assignments must be submitted to the Department of Physics on 16.12.2025 and 17.12.2025 at 12:00 pm. No assignments will be accepted after that day.

1st Semester Major

PHY-M-T-01 (Mathematical Physics - 1)

1. **Linear Algebra**: Find the **Eigenvalues and Eigenvectors** of a given 3×3 Matrix.
2. **Plotting**:
   - i) Plot the curve: $y = |x^2 - a^2|$.
   - ii) Plot the curve: $y = x^2 e^{-x}$ for $x \geq 0$.
3. **(a)** Define a **Surface Integral** of a vector field $\mathbf{F}$. **(b)** Evaluate the surface integral $\iint_S \mathbf{A} \cdot \mathbf{n} dS$ (the flux) where $\mathbf{A} = 18z\mathbf{i} - 12\mathbf{j} + 3y\mathbf{k}$, and S is the part of the plane $2x + 3y + 6z = 12$ that lies in the first octant. **(c)** If $\mathbf{A}$ is a vector function of a scalar variable u, prove that $\frac{d}{du}(\mathbf{A} \cdot \mathbf{A}) = 2\mathbf{A} \cdot \frac{d\mathbf{A}}{du}$.

SEC

PHY-SEC-T-01 (Electrical Circuit and Network Skills)

1. Discuss the application of a **diode as a rectifier** with **L, C, and L-C filter arrangements**.
2. Write down the difference between an **Analog Voltmeter** and a **Digital Voltmeter**. Explain the **principle of the transformer** as a **step-up** and **step-down** transformer.

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1st Semester Minor

PHY-MI-T-01 (Mathematical Physics - 1)

1. **Linear Algebra**: Find the **Eigenvalues and Eigenvectors** of a given 3×3 Matrix.
2. **Plotting**:
   - i) Plot the curve: $y = |x^2 - a^2|$.
   - ii) Plot the curve: $y = x^2 e^{-x}$ for $x \geq 0$.
3. **(a)** Define a **Surface Integral** of a vector field $\mathbf{F}$. **(b)** Evaluate the surface integral $\iint_S \mathbf{A} \cdot \mathbf{n} dS$ (the flux) where $\mathbf{A} = 18z\mathbf{i} - 12\mathbf{j} + 3y\mathbf{k}$, and S is the part of the plane $2x + 3y + 6z = 12$ that lies in the first octant. **(c)** If $\mathbf{A}$ is a vector function of a scalar variable u, prove that $\frac{d}{du}(\mathbf{A} \cdot \mathbf{A}) = 2\mathbf{A} \cdot \frac{d\mathbf{A}}{du}$.

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3rd Semester Major

PHY-M-T-03 (Electricity and Magnetism)

1. **Maxwell's Equations**: Show that $\nabla \times B = \mu_0 J$ (or the full Ampère-Maxwell equation $\nabla \times B = \mu_0 J + \mu_0 \epsilon_0 \frac{\partial E}{\partial t}$) and $\nabla \cdot B = 0$.
2. **Clausius-Mossotti Equation**: Derive the expression for the **Clausius-Mossotti Equation**.
3. **Electrostatics**: Show that the **Electric field is Conservative**. Find the Electric field at the **Axial point of a uniformly charged disc**.

3rd Semester (SEC)

PHY-SEC-T-03 (Renewable Energy and Energy Harvesting)

1. Briefly discuss any two methods of **piezoelectric energy harvesting**.
2. Write a Short note on **OTEC (Ocean Thermal Energy Conversion)**.

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3rd Semester Minor

PHY-MI-T-03 (Electricity and Magnetism)

1. **Maxwell's Equations**: Show that $\nabla \times B = \mu_0 J$ (or the full Ampère-Maxwell equation) and $\nabla \cdot B = 0$.
2. **Clausius-Mossotti Equation**: Find the expression for the **Clausius-Mossotti Equation**.
3. **Electrostatics**: Show that the **Electric field is Conservative**. Find the Electric field at the **Axial point of a uniformly charged disc**.

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5th Semester Major

PHY-M-T-06 (Classical and Statistical Mechanics)

1. Derive **Lagrange's equation of motion** from **Hamilton's Variational Principle**.
2. **Distribution Function**: What is meant by a distribution function? Derive the **Fermi-Dirac (F-D) distribution function**.
3. **Particle Distribution**: If 4 balls are to be distributed in 3 different energy states, find the number of ways of distribution (probability of ways) if they are:
   - i) Bosons (using **Bose-Einstein statistics**)
   - ii) Fermions (using **Fermi-Dirac statistics**)
   - iii) Classical particles (using **Maxwell-Boltzmann statistics**)

PHY-M-T-07 (Quantum Mechanics)

1. Discuss the application of the **Time-Independent Schrödinger Equation (TISE)** to a one-dimensional **Square Well Potential of finite depth**.
2. Provide a description of a particle using **wave packets**. Discuss the spread of the **Gaussian wave packets** for a free particle in one dimension.
3. Find the **Uncertainty Product** for the **One-Dimensional Linear Harmonic Oscillator (1D LHO)** in its **Ground State**.

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5th Semester Minor

PHY-MI-T-05 (Classical and Statistical Mechanics)

1. Discuss the **Laws of Thermodynamics** (Zeroth, First, Second, and Third).
   - Explain the working of a **Heat Engine** and a **Heat Pump/Refrigerator**.
   - Derive the **Efficiency of a Carnot Cycle** and state **Carnot's Theorem**.
2. Find the relation for the difference in specific heat capacities, $C_p - C_v$, for both an **Ideal Gas** and a **Real Gas**.

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