

Paper I — RESEARCH METHODOLOGY

Time : Three hours

Maximum : 100 marks

PART A — (5 × 5 = 25 marks)

Answer ALL the questions.

1. Discuss the important aspects of publishing a research papers.
2. What are instrumental errors? Explain.
3. Find root of the equation $xe^x = \cos x$ using the secant method correct to four decimal places.
4. Explain the symmetry operations with suitable diagrams.
5. What is recursion? Explain the same with an example program.

PART B — (5 × 15 = 75 marks)

Answer ALL the questions.

6. (a) Explain the steps involved in the Scientific Research method.

Or

- (b) Explain in detail the art of writing the thesis.

7. (a) Explain the two types of statistical treatment of data in detail.

Or

- (b) Explain linear regression and polynomial regression and their need in research studies.

8. (a) If $y(10) = 35.3$, $y(15) = 32.4$, $y(20) = 29.2$, $y(25) = 26.1$, $y(30) = 23.2$ and $y(35) = 2.05$, find $y(12)$ using (i) Newton's forward interpolation formula and (ii) Newton's backward interpolation formula.

Or

- (b) Evaluate $\int_{-3}^3 x^4 dx$ by using (i) Trapezoidal rule (ii) Simpson's rule. Verify your results by actual integration.

9. (a) (i) Explain the role of character table in molecular vibrations. Construct C_{2v} and C_{3v} point group character tables.

(ii) Prove $|G| = |A^t| \cdot |G| \cdot |A|$.

Or

- (b) Explain in detail the molecular vibrations and their classification.

10. (a) Explain the various control statements of C++ with examples.

Or

- (b) Discuss the character handling in C++ with examples.
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COURSE WORK I

Time : Three hours

Maximum : 100 marks

PART A — (5 × 5 = 25 marks)

Answer ALL questions.

1. Discuss briefly the Pauli spin matrices and their properties.
2. Show that $N_k(N_k-1) = 0$ for fermions.
3. Derive the modified Thomson's equation for melt.
4. Write a short note on Q-factor.
5. What is relative concentration error? Explain its implications.

PART B — (5 × 15 = 75 marks)

Answer ALL questions.

6. (a) What is spin? Explain its importance. Discuss the spin function for two electrons system.

Or

- (b) Explain the Hartree-Fock method for the determination of ground state energy.

7. (a) Deduce the classical Lagrangian and Hamiltonian equation.

Or

- (b) Discuss electromagnetic field in vacuum. Hence obtain \vec{E} and \vec{B} in the second quantization form.

8. (a) Explain in detail the phase diagram and phase rule.

Or

- (b) Discuss in detail the methods of melt growth and vapour growth.

9. (a) Discuss the principle of the laser system. Derive the condition for light amplification in laser system.

Or

- (b) What is mode-locking? Explain the theory of mode-locking. Also explain the methods for mode-locking.

10. (a) Bring out the significance of computer averaging. Discuss the laws of photometry.

Or

- (b) Describe the Fourier transform spectroscopic technique in detail.

Paper III — COURSE WORK II

Time : Three hours

Maximum : 100 marks

PART A — (5 × 5 = 25 marks)

Answer ALL questions.

1. What do you mean by electronic configuration of molecules? Explain the same based on molecular orbital concept.
2. Discuss in detail phase matching.
3. Write a note on thickness measurements in thin films.
4. Explain systematic absences.
5. Explain flame emission spectrometry.

PART B — (5 × 15 = 75 marks)

Answer ALL questions.

6. (a) Explain the molecular orbital method to solve hydrogen molecule. Discuss the results.

Or