May 2025
M.Sc.
Fourth Semester
CORE – 12
PHYSICS
Course Code: MPHC 4.21
(Experimental Methods)

Total Mark: 70   *Pass Mark: 28*
Time: 3 hours

Answer <u>five</u> *questions, taking* <u>one</u> *from each unit.*

UNIT–I

1. (a) Why is precision not always an indicator of accuracy?   2
    (b) What is an aperiodic signal? How does it differ from a periodic signal?   2
    (c) Explain the origin and characteristics of $1/f$ noise. Why is it significant in low-frequency measurements?   4
    (d) Explain the method of curve fitting. Describe the least squares method for fitting a straight-line graph $y = mx + c$ to experimental data.   6

2. (a) What is the average deviation? How is it calculated?   2
    (b) Define thermal noise. What is its main source?   2
    (c) Explain frequency response of a system. How can it be used to analyse the behaviour of a second-order system?   4
    (d) Discuss error and uncertainty analysis in experimental data. How do significant figures and precision play a role in reporting uncertainties?   6

UNIT–II

3. (a) Define electrostatic shielding.   2
    (b) Explain the meaning of energy coupling in instrumentation systems.   2
    (c) What is calibration? Why is it important in measurement systems?   4

(d) Compare zero-order, first-order, and second-order systems based on their step responses and performance characteristics. Give practical examples of each. 6

4. (a) Define sensitivity and linearity in context of static characteristics. 2
   (b) What is a zero-order system? Give one example. 2
   (c) State two differences between first-order and second-order systems with examples. 4
   (d) Describe the working principles, efficiency, and applications of any two industrial transducers. 6

UNIT–III

5. (a) List any two characteristics of a good transducer. 2
   (b) Mention two types of semiconductor temperature sensors. 2
   (c) Compare RTD and thermocouple based on accuracy and range. 4
   (d) Describe the construction, working, and applications of LVDT. 6

6. (a) Name any two signal conditioning techniques. 2
   (b) What is the role of a semiconductor temperature sensor? 2
   (c) Explain the working principle of a capacitance change transducer. 4
   (d) Describe the working of LM35 and compare it with AD590 in terms of output, accuracy, and application. 6

UNIT–IV

7. (a) Give two practical uses of a digital LCR bridge. 2
   (b) What are the quantities measured by a digital multimeter? 2
   (c) Describe the working principle of a Q-meter. 4
   (d) Draw and explain the working of an RLC bridge used for component testing. 6

8. (a) List two advantages of digital instruments over analog instruments. 2
   (b) State the principle of measurement of resistance using a multimeter. 2
   (c) Explain how inductance is measured using an RLC bridge. 4

(d) Explain how a CRO can be used for both qualitative and quantitative signal analysis. 6

UNIT–V

9. (a) What is the function of a vacuum chamber? 2
   (b) Why is vacuum required in electron microscopy? 2
   (c) Explain how a turbo molecular pump works with the help of molecular momentum transfer. 4
   (d) Describe in detail the working and applications of a diffusion pump. Compare it with mechanical pumps. 6

10. (a) Name two types of pressure gauges used in vacuum measurement. 2
    (b) What is the typical unit used to express vacuum pressure? 2
    (c) Describe the working principle of a Penning gauge. 4
    (d) Explain the concept of pumping speed. How does it affect the performance of a vacuum system? 6

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