

# Devi Ahilya University, Indore

## Syllabus for Ph.D. Entrance Exam (DET)

Faculty: Sciences, Subject: Instrumentation

### PART B

#### Unit 1: Measurements:

Static and dynamic characteristics of measurement systems. Standards and calibration, Error and uncertainty analysis, Statistical analysis of data and curve fitting. Linear and angular measurements; S/N & SINAD ratio. Sensitivity of d.c bridge, measurement of low and high resistances, d.c. potentiometer, principles of a.c. bridges for measurement of L and C; Instrument specifications and error analysis; Extension of Instrument range: CT and PT. D-Arsonval Galvanometer, moving coil meters,

Measurement of straightness, flatness, roundness and roughness. Measurement of R, L and C; Bridges and potentiometers, Measurements of Voltage, current, power, power factor and energy. Instrument transformers, Q-meter, Waveform analyzers, Digital Voltmeters and Multimeters, Time, Phase and Frequency measurements, Oscilloscope, noise and interference instrumentation. Cathode Ray Oscilloscope, Digital Storage Oscilloscope. Sample and Hold circuits, Data Acquisition Systems

#### Unit 2: Sensors and Transducers:

Transducer fundamentals: Transducer terminology, Classification, Performance characteristics, Criterion for selection. Measurements of displacement, Velocity (linear and rotational), acceleration, shock vibration, force, torque, power, strain, stress, pressure, flow, temperature, humidity, viscosity, and density. Introduction to Vacuum Gauges. Actuators: Mechanical, electrical, hydraulic, pneumatic. Advances in sensors: Use of fiber in temperature, image, displacement, pressure, flow liquid level sensors.

#### Unit 3 Control Systems

Introduction, open and closed loop control systems, differential equations of physical systems, transfer functions, block diagram, reduction techniques, signal flow graphs, feedback characteristics of control systems. Basic control component, transient and steady state response analysis. Stability of linear systems. Routh-Hurwitz criterion, relative stability, root-loci technique, root-contours, frequency response analysis, correlation between time and frequency response, polar plots, Bode plots, stability in frequency domain, Nyquist stability criterion, compensation techniques.

#### Unit : 4 Analog and Digital Electronics

Characteristics of diodes, BJTS, JFETS and MOSFETS, Diode circuits, Amplifiers, Single and multistage feedback, frequency response, Operational Amplifier- Design, Characteristics, linear and non-linear applications, difference amplifiers, Instrumentation amplifiers, Precision Rectifiers, I to V converters, Active filters, Oscillators, Comparators, Signal generators, Wave

shaping circuits. Combinational logic circuits, minimization of Boolean functions, IC families (TTL, MOS CMOS) arithmetic circuits, multiplexers and decoders, sequential circuits: flip-flops, counters, registers, semiconductor memories: Types of RAM & ROM. Schmitt triggers, timers and multivibrators. Analog switches, multiplexers, sample and hold circuits, analog to digital and digital to analog converters: types of ADC and DAC.

### **Unit 5 Microprocessor and Interfacing**

Microprocessors and assembly language, Microprocessor architecture and microcomputer systems. 8085 types of instructions, addressing modes, delay programmes, stack and subroutines. BCD arithmetic 16 bit data operations. Interfacing memory and I/O devices, I/O mapped, I/O and memory mapped I/O. Interfacing ADC and DAC to processor. Interrupts, priorities of interrupts, interrupt circuits. DMA. Interfacing devices: 8155/8156, 8255, 8253, and 8259. Data transfer scheme- Programmed data transfer, synchronous and asynchronous data transfer, serial and parallel interface.

### **Unit 6 Analytical Instrumentation**

Different physical characterization of materials, Electrical characteristics. Hall mobility. Differential thermal analysis. Thermo gravimetric analysis. Bulk characterization. Spectrophotometers, Polarimeters. Online analyzers: Sampling systems for gas and liquids, fluid density monitors, consistency and viscosity analyzers, thermal conductivity gas analyzers, paramagnetic gas analyzers. Introduction to X-ray spectroscopy, X-ray diffraction, Extended X-ray absorption spectroscopy, X-ray photoelectron spectroscopy.

### **Unit 7 Programming in C++**

Introduction to flowcharts and problem solving. Types of programming languages, Programming with C++:- C++ Data Types. Variables and Constants, Operators, Arithmetic and Logical Expressions, Assignment Statements and Type Casting. Control structures- Iteration statements, Jump Statements and Selective statements. Common C++ Header files, Generation of Random numbers in C++.

**Functions:** Call by Value, Call by Reference, recursion, Arrays. Structures: Structure elements, Nested Structures, Array of Structures, Array within structures and passing structures to functions. **Pointers:-** Dynamic Memory allocation/deallocation, Pointers and Arrays:-Array of Pointers, Pointer to an array, Function returning a pointer, Reference variables and use of alias.

Basic Concepts of OOP - Benefits of OOP. Class and object fundamentals and various visibility modes in class, Object as function arguments pass by value and pass by reference. Constructor. Function Overloading, Destructor, Operator overloading, Inheritance. Types of exceptions - Exception Handling Mechanism - Throwing and Catching

### **Unit 8 Engineering Mathematics**

Matrices and Matrix algebra, transpose, Rank, Inverse of Matrix, Cramer's rule, eigen value problem. Ordinary differential equations. Partial differential and its applications, Vector calculus: Gradient, divergence and curl. Fourier series, Laplace transforms, Fourier Transform, Numerical methods to solve algebraic and Transcendental equations. Numerical solutions to ordinary differential equations.

**Recommended Books:**

1. Electronic Measurements and Instrumentation, Oliver and Cage
2. Electronic Instrumentation & Measuring Techniques, W. Cooper
3. Higher Engineering Mathematics, B. S. Grewal
4. Advanced Engineering Mathematics, M. D. Greenberg
5. Op-amps and Linear Integrated Circuits, R. A. Gayakwad,
6. Integrated Electronics, Millman and Halkias, 3. Electronic Principles, A. P. Malvino
7. Electrical and Electronics Measurement and Instrumentation, A. K. Sawhney
8. Electronic Instrumentation & Measuring Techniques, W. Cooper
9. Control Systems Engineering, Gopal and Nagrath
10. Modern Control Engineering, Ogata
11. Automatic Control Systems, B.C. Kuo
12. Digital Computer Electronics, A. P. Malvino
13. Digital Systems: Principles and Applications, R. J. Tocci
14. Digital Logic and Computer design, M. Moris Mano
15. Microprocessor Architecture, Programming and Applications R. S. Gaonkar,
16. Digital Computer Electronics A. P. Malvino
17. Introduction to Microprocessor, L. A. Lventhal
18. Introduction to Chemical Instrumentation, B. K. Sharma
19. Handbook of Analytical Instrumentation, B. S. Khandpurkar
20. Instrument Technology Vol. 2, B. E. Noltongk
21. Object Oriented Programming with C++- E.Balagurusamy