AP RCET 2019
SYLLABUS

SUBJECT : Electronics and Instrumentation **Code No. :45**

PART-B will cover 90 Objective Type Questions (Multiple Choice, Matching type, True/False, Assertion – Reasoning type) carrying 90 marks of 90 minutes duration. Each question carries 1 mark.

Unit 1. Fundamentals of Instrumentation

Typical applications of instrument systems. Functional elements of instrumentation and measuring systems. Input elements (Transducers and Electrodes), Intermediate elements (signal conditioning) and output elements (data display and storage), Order of Instruments: Zero, First, Second and nth order Instruments. (b) Null & Deflection, Manual & Automatic, Self-generating & Power operated. Proximity & Non proximity types. (c) Analogue and Digital Types. Introduction to errors and uncertainties in the measurement. Performance parameters of instruments. Propagation of uncertainties in measurement. Accuracy, Precision, Resolution, Threshold, Sensitivity, Linearity, Hysterises, Dead bad. Backlash, Drift, Span. Impedance loading and Matching. Specifications of an Instrument.

Unit 2. Control Systems

Basic components of a control system, Open-loop and closed-loop control system and their differences. Classifications of control systems. Linear & non-linear time –invariant & time varying continuous & sampled data and digital. Effects of feedback on overall gain, stability, sensitivity, bandwidth and noise. Differential equation approach to the electrical circuits and components. Transfer function approach to physical systems. Block diagram algebra. Signal flow-graphs. Standard test signals. Time response of first and second order systems Transient and steady state response. Time domain specifications. Steady state errors and error coefficients. Concept of stability. Necessary condition for stability. Hurwitz stability criterion. Routh stability criterion. Relative stability analysis. Frequency domain specifications. Bode diagrams. Phase margin and gain margins. Polar plots Nyquist plot. Applications of Nyquist criterion to find the stability.

Unit 3. Linear IC Applications

Introduction to Semiconductors. General Semiconductor Devices – Diode, - Zener Diode, Transistor, Field Effect Transistor (FET) MOSFET UJT, SCR, Diac, Triac. Introduction to Operational Amplifiers. Circuit details of Thevenin type of Op Amp ?A. Characteristics of Ideal and Real Operational Amplifiers. Op Amp. Configurations – Inverting, Non-Inverting, Current and Voltage Followers, Differential Amplifier and Comparator. Virtual ground and Miller effect. Mathematical Operations:-

Addition, Subtraction, Scale Changing (Multiplication & Division) Integration and Differentiation. Operational amplifier frequency response.

Unit 4. Operational Amplifier Applications

Oscillators –win bridge oscillators, phase shift oscillators, colpittoscillators, Hartley oscillators, crystal oscillators. Multivibrators: Astable, mono stable, bi-stable, Schmidt trigger and ZCD Operational amplifier for construction of active filters (low pass, high pass, band pass and band reflect). Instrumentation amplifier and its applications. D.C. Voltage Regulation – Zener and electronic regulation. IC 723 regulator. 3 pin regulators and switch mode Regulated power supplies (SMPS). Constant current regulation. IC 8038 function generator and its applications. Voltage to frequency converts and its applications LM338 IC555 Timer and its Applications. Phase locked loop IC 565

Unit 5. Digital Design

Binary numbers. Representation of negative numbers. One's and Two's complement addition and subtraction, binary codes, logic signals and gates, logic families, basic theorems and properties, Boolean functions. The map method, four-variable map, product of sums simplifications. Don't-care conditions. NAND and NOR implementation, other Two-level implementations. Exclusive OR function. Switching algebra. Combinational circuit analysis. Combinational circuit design binary adder-subtractor, decimal adder, binary multiplier, magnitude. Comparator, decoders, encoders, multiplexers. Sequential circuits, latches. Flip flops. Analysis of clocked sequential circuits and their state machine analysis. Block diagram of an asynchronous sequential circuit Analysis procedure. SR latch circuit and its analysis. Registers, shift registers, ripple counters, synchronous counters and other counters. Random Access, Memory (RAM) Memory decoding. Error detection and Read only memory (ROM), Programmable Logic Array (PLA), Programmable Array Logic (PAL)

Unit 6. Programming in 'C'

Overview of computers: Overview of computer system, people procedures, data, information, hardware- operations of computing, hardware categories, software application software and system software. Developments in computer technology, types of programming languages, algorithms, flow charts. Overview of C: History of C, importance of C, basic structure of C programs, programming style. Constants, Variables and Data Types: Character set, C tokens, key words and identifiers, constants, variables, data types, declaration of variables, declaration storage classes, assigning values to variables, defining symbolic constants, declaring a variable as Constant and volatile, Overflow and
under flow of data. Introduction to operators, arithmetic operators, relational operators, logical operators, assignment operators, increment and decrement operators, conditional operators, bit wise operators, special operators, arithmetic expressions, reading and writing a character, formatted input and output. IF and Else IF statements, SWITCH statements, WHILE, DO-WHILE and FOR statements. C programs covering all the above aspects.

Arrays and Strings: Introduction to arrays, initialization of One dimensional array and two dimensional arrays, declaring and initializing string variables, reading and writing strings, string handling functions. User Defined Functions: need for user-defined functions, definition of functions, return values and their types, function calls and declarations, arguments but no return values, no arguments no return values, nesting of functions, passing arrays to functions, passing strings to

functions. Structures and Pointers: Defining a structure, declaring structure variables, structure initialization, copying and comparing structure variables, arrays of structures, understanding pointers,
declaring pointer variables, initialization of pointer variables, pointer expressions. File Management and Linked Lists: Defining and opening a file, closing a file input/output operations on files, concepts of Single Linked Lists.

Unit 7. Microcontrollers and Interfacing

Intel 8051 Microcontroller – Architecture – Block diagram and description of functional units.8051 Addressing modes. Classification of instructions. Detailed Instruction set assembly language Programming. Software development tools for programming – Assembler – Complier – imulator. Interfacing of buffers, latches, EPROMs, RAMs. Interfacing of I/O devices – Programmable peripheral interfaces – 8255, 8253 and 8155. Interfacing of hex matrix key board and LCD odules. Interfacing 8-bit D/A and A/D converters. Data transfer schemes – Serial and parallel. Serial bus standards – 12C bus, SPI bus operation. Serial communication standards – Rs232, RS422, RS485, USB and CAN. Measurement of voltage, current, resistance. Measurement of pH and conductivity. Temperature controller. Stepper motor control. DC motor speed control.

Unit 8. Sensors and Signal Conditioning

Definition of a transducers\sensor. Role of transducers. Characteristics of transducers. Significant parameters of a transducer. Selection of a transducer. Classification of transducers. Linearization of transducers. Photoelectric effect. Photoemissive tube and photomultiplier tubes. Photoconductive and photovoltaic cells. Photo diodes and photo transistor. Light Dependent Resistors. Mechanical Temperature sensors. Resistance type temperature sensors. Platinum resistance thermometer. Thermocouples. Solid state sensors. Radiation type sensors – optical pyrometers. Calibration of thermometers. Flow characteristics. Obstruction meters-Venturi meter and orifice meters. Turbine flow measuring devices. Diaphragm level sensor. Differential pressure level sensor. Laser level sensor. Level gauges.

Displacement transducers-Variable resistance, inductance and capacitance. Linear Voltage Differential Transformer (LVDT). Strain-definition. Principle of working of strain gauges. Gauge factor. Types of strain gauges. Materials for strain gauges. Temperature compensation. Applications. Manometers. Elastic transducers - Diaphragms, Bellows, Bourdon or helical tubes. Electrical pressure transducers – variable resistance, inductance and capacitance. Piezoelectric pressure transducer. Pressure calibration. What are MEMS? Fabrication methods of MEMS. Physical microsensors – Classification of physical sensors – thermal, electrical, mechanical, optic and magnetic sensors. Chemical and Biomedical sensors. Microactuators - microvalves, micropumps and micromotors. Elements of Process Instrumentation – Switches, Valves, Gauges, Converters, transmitters, actuators, relays. Introduction to Interlocks, Programmable Logic Controllers and Distributed Control systems. Process instrumentation diagrams – Familiarization.

Unit 9. Scientific/Analytical Instrumentation

Colorimeter – Principle and working with a block diagram. Salient features of individual blocks. Specifications of a colorimeter. Applications of colorimeters to analytical and biomedical purposes. Spectrophotometer – Principle and working with a block diagram. Salient features of individual blocks. Specifications and operation of spectrophotometer. Types of Spectrophotometers -

Ultraviolet, Visible and Infrared. Applications of spectrophotometers. Atomic absorption spectrometer – Principle and working with a block diagram. Salient features of individual blocks. Applications. Raman Spectrometer – Principle and working with a block diagram. Salient features of individual blocks. Applications of Raman spectrometer.

Conductivity bridge – Principle and working of a conductivity bridge with a block diagram. Salient features of individual blocks. Applications of conductivity bridges. pH Meters – Principle and working with a block diagram. Salient features of individual blocks. Types of pH meters. Applications of pH meters in chemical and industrial fields. Polarograph – Principle and working with a block diagram. Salient features of individual blocks. Characteristics of dropping mercury electrode. Polarogram. Pulse polarograph. Application of Polographs in chemical and Industrial fields. Thermo gravimetric and Differential Thermal analyzers – Principle and working with schematic diagram. Description of individual blocks. Applications.

Unit 10. Bio-Medical Instrumentation

Introduction to Bio-electricity – Characteristics of ECG, EEG, EMG signal – Basics of Medical Instrumentation and Measurement, Design Criteria. Bio-medical transducer: Electrodes – thermal sensors – LVDT – Strain gauge – semiconductor sensor – Optical fiber sensors –MEMS. Bio medical signal conditioning & Recorders: Instrumentation amplifier – Active filters DC-to DC regulators – Power management techniques – Electrical Hazards and safety. Different types of Recorder (X-Y, T-Y RECORDERS, optical recorders, computerized recording principles). ECG-EMG-EEG- Spyg monometer – Respirometer – Gas analyzers – Imaging techniques: X-ray, Image intensifier – Computer tomography – Magnetic resonance Imaging –ultrasound scanner – 2D, 3D echo imaging – PET scan Imaging-Thermal imaging. Pace maker – defibrillator – heart-lung instrument- ventilators –nebulizers – surgical diathermy – Electrotherapy- Haemodialysis machine.