9. (a) Explain the operation of swept TRF spectrum analyzer.

   (b) How an electronic voltmeter is used as electronic ohmmeter?

6 + 6 = 12

ELECTRONICS INSTRUMENTATION AND MEASUREMENT
(AEIE 3202)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

   (i) Chopper stabilized dc amplifier type EVM overcomes the effect of
   (a) amplifier CMRR (b) amplifier drift
   (c) amplifier sensitivity (d) electromagnetic interference.

   (ii) True r.m.s responding voltmeters use
   (a) thermistors (b) RTDs
   (c) LVDTs (d) thermocouples.

   (iii) The capture range of a PLL depends on
   (a) phase detector (b) cut off frequency of LPF
   (c) amplifier gain (d) none of these.

   (iv) For a digital voltmeter having 3-1/2 digit display, the input voltage of 0.2563 V on 10 V range will be displayed as
   (a) 0.256 V (b) 0.2563 V (c) 0.25 V (d) 0.2 V.

   (v) A charge amplifier is used in
   (a) VCO (b) Hall effect transducer
   (c) Piezoelectric transducer (d) Ramp type DVM.

   (vi) An OPAmp based non-inverting amplifier has biasing voltages +12V & -12V and gain 10. For the input of 2 volt the output voltage will be
   (a) +20 V (b) $+V_{sat}$ (c) +8 V (d) $-V_{sat}$.

   (vii) When the phase shift between two same frequency signals applied to both vertical & horizontal plates is 90°, then the Lissajous figure will be
   (a) straight line (b) circle
   (c) ellipse (d) hyperbola.

(viii) For the measurement of self capacitance of a coil, at 3 MHz supply frequency, the tuning capacitor is set to 350 pF and at 6 MHz frequency the capacitor is tuned to 70 pF to achieve resonance. The self capacitance of the coil is
(a) 40.3 pF (b) 23.3 pF (c) 60.3 pF (d) 10.3 pF.

(ix) A FET input stage is used in electronic voltmeters because
(a) it provides high input impedance
(b) it provides low input impedance
(c) it is cheap
(d) none of these.

(x) A true r.m.s thermocouple ammeter is used to measure a 10 MHz sine wave and it indicates a current of 2 A. The peak current in this waveform is
(a) 2 A (b) 2.83 A
(c) 0.2 A (d) 20 A.

Group – B

2. (a) Explain the working principle of voltage controlled oscillator with neat diagram. Explain how PLL is used as FM demodulator.

(b) What is the advantage of true r.m.s voltmeter over rectifier type ac electronic voltmeter? Describe the operation of thermocouple type true r.m.s voltmeter.

(c) What are the uses of voltage to frequency and frequency to voltage converters?

(3 + 2) + (1 + 4) + 2 = 12

3. (a) With a neat diagram briefly explain the operation of current mirror. What is its use in electronic circuits?

(b) Briefly explain the use of charge amplifier as signal conditioning circuit in piezoelectric transducer. What is the advantage of programmable gain amplifier over conventional amplifier?

(4 + 1) + (5 + 2) = 12

Group – C

4. (a) Draw the block diagram of an automatic time base of CRO. If the input to the vertical deflection amplifier is a sine wave then draw the outputs at each stages of the time base.

(b) Why blanking circuit is required? How can it be possible to measure the phase difference between two input sine wave signals by CRO?

6 + (4 + 2) = 12

5. (a) Draw and explain the circuit of a sweep generator in the CRO.

(b) A 1 V signal (V_s) with a source resistance of R_s = 600 Ω is connected to an oscilloscope which has an input impedance of R_i = 1 MΩ in parallel with C_i = 30 pF. The coaxial cable has a capacitance of C_{cc} = 100 pF. Calculate the oscilloscope terminal voltage (V_i) when the signal frequency is 100 Hz. Also determine the frequency at which V_i is 3 dB below V_s.

7 + (2 + 3) = 12

Group – D

6. (a) With a neat diagram describe the measurement of the frequency of an ac signal by digital frequency meter.

(b) A digital frequency meter has a time base derived from a 1 MHz crystal oscillator having 5 decade counters as frequency divider. Determine the measured frequency when a 2.625 KHz sine wave is applied.

(c) What are common cathode and common anode seven segment display?

6 + 3 + 3 = 12

7. (a) Briefly explain the operation of ramp type digital voltmeter.

(b) How an analog voltage of 4.7 V is measured by 3 bit successive approximation type digital voltmeter?

(c) What is the use of timebase in electronic measurement system? What is the role of divider in timebase generator?

5 + 5 + (1 + 1) = 12

Group – E

8. (a) Describe the series connection method of Q meter to find impure capacitance and inductance and Q factor.

(b) What is self capacitance of a coil? Compute the value of self capacitance of a coil when the following measurements are made:
At 2 MHz frequency the tuning capacitor is set to 450 pF and at 5 MHz frequency the capacitor is tuned to 60 pF to achieve resonance.

7 + (2 + 3) = 12