ELECTRONICS & INSTRUMENTATION

***Time**: Three Hours*

***Maximum Marks**: 100*

Answer five questions, taking ANY TWO from Group A, any two from Group B and all from Group C.

All parts of a question (a, b, etc.) should be answered at one place.

Answer should be brief and to-the-point and be supplemented with neat sketches.

Unnecessary long answer may result in loss of marks.

Any missing or wrong data may be assumed suitably giving proper justification.

Figures on the right-hand side margin indicate full marks.

Group A

1. (a) Explain the difference in conduction among insulators, semiconductors and conductors, showing the energy band diagrams. 6

   (b) Make a comparative study between an avalanche p - n junction diode and a Zener diode. 6

   (c) State the important features of the CB, CE and CC modes of operation of a transistor. 8

2. (a) Explain active region, saturation region and cut-off region of transistor operation 6

   (b) With an appropriate circuit diagram for CE mode operation, explain fixed bias and emitter bias of transistor. With a suitable circuit parameters, find the expressions for stability of collector current with respect to I_{CO} (reverse saturation current), V_{BE} (base-emitter voltage), and beta. 8

   (c) Make a comparative study between a “Bipolar Junction Transistor (BJT)” and a “Junction Field Effect Transistor(JFET) or FET”. 6

3. (a) Draw a schematic of the physical structure of an n-channel JFET. Explain the current conduction mechanism and I-V characteristics of n-channel JFET. 6

(b) Draw the circuit of a CE amplifier. Also, draw its small signal equivalent circuit. Derive expressions for input impedance, output impedance, voltage gain, and current gain. 8

(c) Discuss in detail the reasons (advantages) for opting negative feedback in transistor amplifiers. 6

4. (a) What are the differences between a transistor and a thyristor? Discuss operation of a thyristor with help of its characteristics. Also, mention at least three applications of thyristors. 6

(b) How op-amp can be used as a (i) Summer (ii) Differentiator (iii) Integrator? Derive the output voltage equation for both the cases. 6

(c) With a neat schematic, explain the operation of a 'successive approximation register' type analog to digital converter circuit using op-amp. Mention its advantages and disadvantages with respect to other methods of A/D converters. 8

Group B

5. (a) Describe, with a neat sketch, the constructional feature and working principle of a dynamometer type wattmeter. Deduce the expression for torque produced. 10

(b) Draw a neat diagram of a permanent magnet moving coil instrument and explain its working. 10

6. (a) Explain the operation of PMMC-type voltmeter. Establish the working formula. A moving coil instrument has the following data: Number of turns = 100, width of coil = 20 mm, depth of coil = 30 mm, flux density in the gap = 0.1 Wb/m^2. Calculate the deflecting torque when carrying a current of 10 mA. Also, calculate the deflection, if the control string constant is 2×10^{-6} Nm /degree. Ignore friction involved. 10

(b) With a neat schematic, explain the operation of a Q- meter. 10

7. (a) What are the differences in the following electronic voltmeters: (i) peak reading type, (ii) rms reading type, and (iii) average reading type. Explain briefly using schematic diagrams. 10

(b) Write short notes on any two of the following : (i) Spectrum analyzer (ii) RF signal generator (iii) Distortion meters. 10

8. (a) What is a strain gauge? With a neat schematic diagram, explain its operation. Prove that for a strain gauge, the gauge factor is given by $K = 1 + 2\mu$ where μ is the Poisson's ratio. 10

(b) With a neat schematic, explain how the level of water in a tank of a multistoried building can measure without moving at the roof top. 10

Group C

9. Select the right choice. 20

(i) The controlling torque in a spring controlled indicating instrument is proportional to

(a) θ

(b) θ^2

(c) $1/\theta$

(d) $1/\theta^2$

(ii) In the measurement of three-phase power by two wattmeter method, if two wattmeter readings are equal, the power factor of the circuit is

(a) 0

(b) 0.8 lagging

(c) 0.8 leading

(d) unity.

(iii) Which of the following meter is integrating type ?

(a) Moving iron voltmeter

(b) Rectifier type ammeter

(c) Induction type energy meter .

(d) Dynamometer type wattmeter.

(iv) The principle of operation of LVDT is based on variation of

(a) self-inductance

(b) mutual inductance

(c) reluctance

(d) performance.

(v) Transistor, as a digital device, operates in

(a) active region only

(b) cut-off condition only

(c) salutation condition only

(d) bath cutoff and saturation conditions

(vi) The common emitter amplifier provides phase shift of

(a) 360°

(b) 270^0

(c) 180^0

(d) 90^0

(vii) A transistor is operating in active region. Under this condition,

(a) both the junctions are forward biased

(b) both the junctions are reverse biased

(c) emitter-base junction is reverse biased, collector-base junction is forward biased

(d) emitter-base junction is forward biased, collector-base junction is reverse biased.

(viii) In a p-n junction biased in the forward direction, the holes

(a) cross the junction from n-type into p-type region

(b) remain stationary in the p-type region

(c) cross the junction from p-type into n type region

(d) remain stationary in the n-type region.

(ix) The amplifier is said to have negative feedback when:

(a) any decrease in the output signal results in a feedback signal into (he input in such a way as to cause a decrease in the output signal

(b) any decrease in the input signal results in a feedback signal into the output in such a way as to cause an increase in the output signal

(c) any increase in the input signal results in a feedback signal into the input in such a way as to cause a decrease in the output signal

(d) any increase in the output signal results in a feedback signal into the input in such a way as to cause a decrease in the output signal.

(x) The p-channel MOSFET consists of

(a) a lightly doped n-type substrate into which two highly doped p^+ regions are diffused

(b) a lightly doped n type substrate into which two highly doped n^+ regions are diffused

(c) a highly doped n-type substrate into which one highly doped p^+ region is diffused

(d) a highly doped p-type substrate into which two highly doped p^+ regions are diffused.

(Refer our course material for answers)