S'11 : 4 AN : AN 208 (1408)

ELECTRONICS AND 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.

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Group A

1. (*a*) Distinguish between majority and minority carriers in a semiconductor. Also, define and explain mobility of charge carriers. 8

(*b*) The intrinsic resistivity at 27°C is $2{\cdot}8 \times 10^3\ \Omega$ - m. The electron and hole mobilities are $0{\cdot}38\ m^2/V\text{-}s$ and $0{\cdot}18\ m^2/V\text{-}s$, respectively. Obtain intrinsic carrier density at the given temperature. 6

(*c*) What is Zener breakdown ? How is it different for Avalanche breakdown ? Explain. 6

(Turn Over)

2. (*a*) Explain thermal runaway of BJT. 6

(*b*) Distinguish between a.c. and d.c load lines. Obtain the load line equation of BJT in CE configuration. 8

(*c*) Explain the emitter follower with a suitable circuit diagram. 6

3. (*a*) Define *h*-parameters. What are advantages of adopting *h*-parameters in design of amplifier — elaborate. Derive expression for (*i*) voltage gain, (*ii*) current gain, (*iii*) input resistance, and (*iv*) output resistance of common emitter amplifiers using *h*-parameters. 4 x 3

(*b*) What is meant by depletion region in JFET ? Explain, with a suitable diagram, the basic difference between BJT and JFET. 8

4. (*a*) What are the requirements of an ideal operational amplifier ? Explain the terms : CMRR, slew rate, input off set and output offset voltage in an operational amplifier. 8

(*b*) A differential amplifier has inputs $V_{s1} = 10\,\text{mV}$ and $V_{s2} = 9\,\text{mV}$. It has a differential mode gain of 60 db and CMRR of 80 db. Obtain the percentage error in output voltage and the error voltage. 6

(*c*) 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

Group B

5. (*a*) What are essential requirements in an indicating instruments ? Why are controlling and damping essential ? Also, discuss methods used for producing controlling torque and damping torque in above instruments. 8

(*b*) Describe the construction and working of an attractive-type moving iron instrument. 6

(*c*) A moving iron voltmeter has resistance of 1000 ohms and inductance of 0·10 Henry between its terminals. The meter indicates correct voltage at 50 Hz-frequency. If it is used at 100 Hz, obtain the percentage correction required to be applied to get correct voltages. 6

6. (*a*) Give a block diagram representation of CRO and describe functioning of its major blocks. 8

(*b*) Calculate for the velocity of electrons that have been accelerated through a potential of 2500 V. Derive the relation used. 6

(*c*) How are the following measured using a CRO ? (*i*) Frequency of a waveform (*ii*) Phase angle of the waveform, and (*iii*) Delay measurement. 3 x 2

7. (*a*) Give technical specifications of a digital voltmeter including all essential and optional features. Also, suggest classification of these meters. 8

(*b*) Discuss functioning of any type of digital voltmeter with the help of a block diagram. 6

(*c*) Why are digital display devices used in an instrumentation system ? Discuss the basic system of a digital display device. 6

8. Write technical notes on the following : 8 + 6 + 6

(*i*) Analog and digital data acquisition system

(*ii*) *Q*-meter and its applications

(*iii*) LVDT transducer for displacement measurement.

Group C

9. Answer the following in brief : 10 x 2

(*i*) Give *three* applications of A/D converters.

(*ii*) Differentiate between 'resolution' and 'accuracy' with reference to an A/D converter.

(*iii*) Name types of MOSFETs in which they are available. Show characteristics of enhancement-type MOSFET.

(*iv*) Briefly describe accuracy and conversion type of a D/A converter.

(*v*) Define slew rate (SR) of an op-amp. Obtain maximum closed loop voltage gain that can be used when the input signal varies by 0·5 V in 10 μs. Assume SR of op-amp as 2 V/μs.

(*vi*) Show a functional block diagram of a CRO.

(*vii*) Define a transducer and distinguish between a sensor and a transducer.

(*viii*) Give diagrams showing basic construction and characteristics of the TRIAC.

(*ix*) Enumerate *three* applications/areas of data acquisition system (DAS).

(*x*) List important elements of a digital data acquisition system.

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Group A

1. (*a*) Draw and explain the circuit of a bridge rectifier. Derive expressions for average and rms output currents for a 10 ohm load. 10

(*b*) Differentiate between intrinsic and extrinsic semiconductors and find relation between dopants concentrations. 4

(*c*) Draw and explain *v-i* characteristics of Zener diode. 6

2. (*a*) 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. 14

(*b*) What is meant by self-bias CE circuit of BJT transistor ? How does it differ from negative feedback ? 3

(*c*) What are the advantages of FET over BJT ? Give reasons in support of your answer. 3

3. (*a*) Draw and explain operating point and characteristics of *n-p-n* transistor. 10

(*b*) An *n*-channel JFET has $V_{GS} = -4$ V, $I_{DS} = 0{\cdot}45$ mA. If V_{GS} is changed to -3V, I_{DS} becomes 1·8 mA. Find I_{DSS} and pinch-off voltage. 6

(*c*) Explain the term 'negative feedback' and state its advantages. 4

4. (*a*) Draw and explain two transistor model of thyristor. How do the parameters of two transistors jointly affect the performance. 8

(*b*) Draw an op-amp circuit to obtain

$$v_0 = 3v_1 - 4v_2$$

where v_1 and v_2 are the input voltages and v_0, the output voltage. Give typical values of resistance used in the circuit. 8

(*c*) What is the necessity of analog-to-digital conversion ? Describe its function with the help of a diagram. 4

Group B

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

(*b*) Write the advantages and disadvantages of moving iron instruments. 5

(*c*) Compare induction and dynamometer-type wattmeters. 5

6. (*a*) Explain the working of peak reading electronic voltmeter. 6

(*b*) How can a signal be displayed on the CRO screen ? 6

(*c*) What are the different settings of a time base of cathode ray tube ? Explain their working. 8

7. (*a*) Explain the principle of resistance thermometer. 6

(*b*) Draw a simple diagram of potentiometric position transducer and explain its working. 8

(*c*) Explain the working of phase shift oscillator. 6

8. Write short notes on the following : 7 + 6 + 7

(*a*) Spectrum analyser

(*b*) *Q*-meter

(*c*) Measurement of energy.

Group C

9. Give reasons for the following in brief : 10 × 2

(*i*) *p-n-p* and *n-p-n* transistors are known as bipolar junction transistors.

(*ii*) In a transistor, the collector and emitter currents are nearly equal where the CE current gain is very high.

(*iii*) Bridge rectifier is not suitable for low voltage circuits as compared to other full wave rectifier.

(*iv*) CE amplifier is a commonly used circuit.

(*v*) Op amp has very high input impedance circuits.

(*vi*) Wheatstone bridge cannot be used to measure low resistances.

(*vii*) A moving iron instrument has non-linear scale.

(*viii*) A true rms voltmeter can be formed by using thermocouples.

(*ix*) Time base generator in a CRO needs five adjustments for stable pattern.

(*x*) Some transducers are classified as active transducers.

S'12:6AN:AN 208 (1408)

ELECTRONICS AND INSTRUMENTATION

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

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Group A

1. (*a*) Describe the operation of successive approximation A/D converter. 10

(*b*) Calculate the conversion time of 8-bit successive approximation A/D converter having clock frequency 640 kHz. 4

(*c*) Explain the operation of weighted resistance D/A converter. Indicate the limitations. 6

2. (*a*) Give the design of one CE mode transistor amplifier with a self-bias. 6

(*b*) A silicon n-p-n transistor is with $V_{cc} = 22{\cdot}5$ V; $R_C = 5{\cdot}6$ kΩ ; $R_e = 1$ kΩ, $R_2 = 10$ kΩ, $R_1 = 90$ kΩ.

(Turn Over)

$\beta = 55$ (Fig. 1). Find the operating point of the transistor. 6

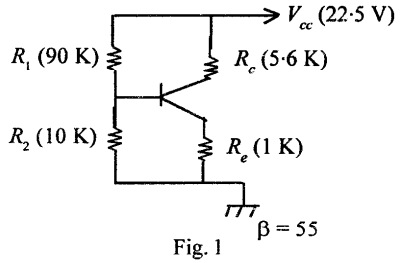

Fig. 1

(*c*) Define bias stabilization factors. How does it depend upon operating point ? 3

(*d*) Describe full wave rectifiers with capacitive filters. How do you find its ripple factor ? 5

3. (*a*) Describe static V-I characteristics of a thyristor for different gate currents. Explain reverse blocking and forward blocking conditions in it. 2 + 6

(*b*) Explain gate triggering of thyristor. Describe R and RC firing methods. 6

(*c*) Using op-amp, draw and explain operation for (*i*) differentiator, and (*ii*) non-inverting integrator. 3 + 3

4. Write short notes on *any two* of the following : 10 + 10

(*i*) C-MOSFET switch

(*ii*) Feedback gain of –ve and +ve feedback systems and condition for oscillation

(*iii*) Fermi levels in intrinsic and extrinsic semiconductors

(*iv*) Input and output impedances of amplifier.

Group B

5. (*a*) Describe the working principle of permanent magnet moving coil (PMMC) meter. 5

(*b*) A PMMC having 100 turns, 20 mm width, 30 mm depth placed in the gap with 0·1 Wb/m^2 flux density carries a current of 10 mA. Calculate the deflecting torque and the deflection of the coil, its spring constant being 2×10^{-6} Nm/degree. 5

(*c*) Describe electrodynamometer-type voltmeter and ammeter. Mention advantage and disadvantage of this type of meter. 8 + 2

6. (*a*) Describe rectifier, peak responding and rms-type voltmeter. 12

(*b*) Describe the principle of *Q*-meter working by susceptance method. 8

7. (*a*) Describe swept frequency spectrum analyzer using a block diagram. 6

(*b*) Describe harmonic distortion analyzer using bridged T network. 4

(*c*) Describe integrating-type digital voltmeter. 10

8. Write short notes on *any two* of the following : 10 + 10

(*a*) Wheatstone bridge
(*b*) Seven segment display
(*c*) RC phase shift oscillators
(*d*) Bellow and Bourdon-type pressure gauges.

Group C

9. Answer the following in brief : 10 × 2

(*i*) What is latching current of thyristor ?

(*ii*) How can the resolution of A/D converter be increased ?

(*iii*) What is cut in voltage of semiconductor diode ?

(*iv*) What is the offset voltage of an op-amp and why does it occur ?

(*v*) What is the common case of Zener diode, and in what mode of biasing this is used ?

(*vi*) What is the resolution of a three-and-half digit display DVM ?

(*vii*) What is the basic functional difference between CRO and spectrum analyser ?

(*viii*) What are the advantage and disadvantage of thyristor-based temperature sensor ?

(*ix*) What is the rise time for a rectangular pulse ?

(*x*) What is CMRR and how does it affect amplifier quality ?

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Group A

1. (*a*) Give the simple circuit diagram for half wave and full wave rectifiers using semiconductor diode. Find the expressions for efficiency of these rectifiers. 4 + 6

(*b*) What are the values of ripple factors for these rectifiers. Comment on the improvement of ripple factor on the type of rectification. Describe the operation of capacitive filter in this context on further improvement of ripple factor. 2 + 2 + 6

2. (*a*) Give two transistor models of thyristor. Mention ways of increasing anode current for thyristor turn on. Describe the simple circuit for protection against high rate of change of current. 2 + 3 + 3

(*b*) Describe (*i*) phase control thyristor, (*ii*) fast switching thyristor, and (*iii*) gate turn off (GTO) thyristor.

(Turn Over)

Mention advantages of GTO in low power application. Describe V-I characteristic of thyristor for different gate currents. 2 + 2 + 2 + 2 + 4

3. (*a*) Explain the operations of A/D converter of (*i*) successive approximation-type, and (*ii*) dual slope-type. 6 + 6

(*b*) Draw and explain basic sample and hold (S/H) circuit. Mention the necessity of S/H circuit and criterion of sampling rate in the context of A/D converter. 4 + 2 + 2

4. Write short notes on *any two* of the following : 10 + 10

(*i*) Op amp application for (*a*) low pass and high pass filters, adder and subtractor, attenuator.

(*ii*) Comparative study of BJT, FET and MOSFET.

(*iii*) Feedback amplifier, regenerative feedback and condition of oscillation.

(*iv*) Diode breakdown and Zener diode.

Group B

5. (*a*) Draw and explain, with a block diagram, one general purpose cathode ray oscilloscope (CRO). Explain the function of delay line in deflection system. 8 + 2

(*b*) Explain, with a block diagram, the dual trace arrangement of CRO. Mention the difference between dual trace and dual beam CRO. 4 + 2

(*c*) Describe the use of CRO for measurement of frequency, period, phase, amplitude of a signal. 4

6. (*a*) Using a circuit diagram, explain the operation of single-phase wattmeter. Describe compensated wattmeter. 8 + 2

(*b*) For a series L-C-R circuit operated by an a.c. source, mention the Q-value. Describe one practical Q-meter circuit. 3 + 7

7. (*a*) Describe measurement of temperature using variation in resistance with positive and negative temperature coefficients. Mention superiority in sensitivity in temperature measurement with concerned type of resistance. 4 + 4 + 2

(*b*) Explain and describe working of the strain gauge for force measurement. Mention the principle of piezo sensor in this context and compare the measurements in these types. 6 + 2 + 2

8. Write short notes on *any two* of the following : 10 + 10

(*a*) LVDT and its use for pressure measurement.

(*b*) Data acquisition system and its application.

(*c*) Audio and RF signal generators

(*d*) Distortion meter.

Group C

9. Explain the following in brief : 10 × 2

(*i*) Using op amp in inverting mode, give the circuit arrangement of one basic low-pass filter. Mention distinctly *i/p*, *o/p*, inverting and non-inverting points in the circuit.

(*ii*) Using op amp in inverting node, give the circuit arrangement of one basic differentiator. Mention distinctly *i/p*, *o/p*, inverting and non-inverting points in circuit.

(*iii*) Give, with justification, the efficiency of full wave rectifier for zero forward resistance of diode.

(*iv*) State, with justification, the type of d.c. power supply filter– low pass, high pass, band pass, band rejection.

(*v*) What is the power supply needed for TTL (digital) IC devices ? Name some such IC devices.

(*vi*) What are the advantages and disadvantages of TTL, MOS devices in terms of power handling and noise immunity ?

(*vii*) What is the type of ADC suitable for higher accuracy ?

(*viii*) What is the principle of operation of platinum resistance thermometer ?

(*ix*) What is the specific advantage of using differential transformer in LVDT ?

(*x*) What is the working principle of *Q*-meter ?

S'13 : 6 AN : AN 208(1408)

ELECTRONICS AND INSTRUMENTATION

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Group A

1. (*a*) Explain clearly the differences in the band structure of a conductor, an insulator, and a semiconductor. 4

(*b*) Explain the operation of a bridge rectifier circuit with a neat sketch. Calculate its efficiency. 4 + 4

(*c*) How Zener breakdown differs from avalanche breakdown ? Also, explain, with a circuit, that how a Zener diode can work as a reference voltage source. 4 + 4

2. (*a*) An n-p-n transistor is used as a CE amplifier and has the collector to base bias arrangement with $\beta = 99$, $V_{BE} = 0.7$ V, $V_{CC} = 12$ V, $R_L = 2\ k\Omega$, $R_B = 100\ k\Omega$. Find the Q-point analytically and the stability factors s, s' and s'' .

(*b*) Prove that the efficiency of a 'class A' power amplifier is 25%. 6

(*c*) Explain the operation of an n-channel enhancement-type MOSFET and make a comparison between a MOSFET and a JFET. 4 + 2

3. (*a*) A transistor amplifier in CE configuration couples a source of internal resistance 1 kΩ to a load of 20 kΩ. Find the input and output resistances, if h_{ie} = 1 kΩ, $h_{re} = 2.5 \times 10^{-4}$, h_{fe} = 150 and $1/h_{oe}$ = 40 kΩ. 6

(*b*) Explain how a negative feedback to an amplifier increases the stability and input resistance of an amplifier. 3 + 3

(*c*) With two transistor analogy, explain the operation of an SCR. Also, explain different methods for turn-off an SCR. 4 + 4

4. (*a*) Draw the equivalent circuit of an op-amp and write the characteristics of an ideal op-amp. 2 + 3

(*b*) Find an expression for feedback gain of an op-amp when operating in non-inverting mode. How is this concept used to design an adder circuit which can add three voltages 3V, 5 V and 7 V. 4 + 4

(*c*) Explain the operation of a weighted resistor-type D/A converter with a neat circuit. Write drawbacks of this circuit. 5 + 2

Group B

5. (*a*) Draw the block diagram of a general purpose CRO and indicate the basic components. Why is delay line used in the vertical deflection system of a CRO ? Whether current can be measured by using a CRO ? If yes, then how ? 6 + 2 + 2

(*b*) Explain the operation of a three-phase wattmeter with a neat circuit. 6

(*c*) What is integrating meter ? 4

6. (*a*) With a neat circuit, explain the operation of a Q-meter. 6

(*b*) Draw a.c. voltmeter section of a multimeter and explain its operation. How an analog voltmeter can be converted to a digital voltmeter ? 4 + 4

(*c*) Write a technical note on different types of digital displays. 6

7. (*a*) What is a transducer ? How a transducer differs from a sensor ? Also, write the differences between an active and a passive transducer. Write the characteristics of a transducer. 1 + 2 + 2 + 3

(*b*) Explain, with schematics, how can the level of water in a tank of a multistoried building be measure using an LVDT ? 6

(*c*) How is platinum resistance thermometer used to measure very high temperature. Mention some of its advantages and disadvantages. 6

8. Write short notes on *any two* of the following : 2 × 10

(*a*) Spectrum analyzer

(*b*) Digital data aquisition and transmission system

(*c*) Strain gauge

(*d*) Dual shape-type A/D converter.

Group C

9. Choose the *correct* answer for the following : 10 × 2

(*i*) In a p-n junction diode, with the increase of reverse bias, the reverse saturation current

(*a*) increases.

(*b*) decreases.

(*c*) remains constant.

(*d*) may increase or decrease.

(*ii*) Ripple factor of a full wave rectifier is

(*a*) 0.24

(*b*) 0.48

(*c*) 0.96

(*d*) 1.21

(*iii*) For a transistor, β is related to α as

(*a*) $\beta=\alpha/(1+\alpha)$

(*b*) $\beta=\alpha/(1-\alpha)$

(*c*) $\beta=(1+\alpha)/\alpha$

(*d*) $\beta=(1-\alpha)/\alpha$

(*iv*) One of the following is not the characteristic of an ideal op-amp :

(*a*) CMRR is α

(*b*) Slew rate is α.

(*c*) Offset voltage is α.

(*d*) Bandwidth is α.

(*v*) One of the following is not the feature of a FET :

(*a*) Very high input impedance

(*b*) Less temperature-sensitive

(*c*) Low noise

(*d*) Very high gain as an amplifier.

(*vi*) A measure of the reproducibility of measurement is known as

(*a*) resolution.

(*b*) fidelity.

(*c*) precision.

(*d*) accuracy.

(*vii*) Strain gauge is used to

(*a*) convert sound energy into electrical energy.

(*b*) sense temperature.

(*c*) convert electrical current into a mechanical transducer.

(*d*) convert mechanical displacement into a change in resistance.

(*viii*) Which one of the following methods is used for measurement of high resistances :

(*a*) Loss of charge method

(*b*) Wheatstone bridge

(*c*) Potentiometer method

(*d*) Kelvin bridge method

(*ix*) Megger is an instrument for

(*a*) measuring current.

(*b*) measuring voltage.

(*c*) testing insulation.

(*d*) measuring power.

(*x*) A galvanometer cannot be used for

(*a*) determining the equality of two currents.

(*b*) measuring currents and voltages of small magnitudes.

(*c*) measuring the voltage impulse.

(*d*) measuring the quantity of electricity or current impulse.

W'13 : 6 AN : AN 208 (1408)

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Group A

1. (*a*) Explain, with a simple circuit diagram and output waveform, the working of one half wave rectifier for one sinusoidal input. 5

(*b*) For half wave rectifier, find expression for (*i*) efficiency, and (*ii*) ripple factor. Define PIV and state its significance. Mention the value of PIV for half wave rectifier. 5 + 3 + 2

(*c*) What is capacitive filter and how does it work ? 2 + 3

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

(*b*) Find the transistor current for circuit shown in Fig.1 for

transistor with $\beta = 100$, $I_{CO} = 20$ nA. Consider the silicon transistor. 7

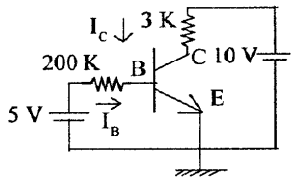

Fig. 1

(*c*) Repeat part *b*, if a 2 K emitter resistor is added to the circuit of Fig. 1 7

3. (*a*) Find an expression for the closed loop gain of one regenerative feedback system. Hence, find the condition of oscillation in terms of open loop gain and feedback gain. 5 + 2

(*b*) With V-I characteristics, describe the operation of thyristor for different gate currents. How can triac be realized using thyristor? 5 + 2

(*c*) For op amp, define and explain (*i*) offset voltage, (*ii*) CMRR, and (*iii*) slew rate. 3 × 2

4. Write short notes on *any two* of the following : 10 + 10

(*i*) Use of op amp as (*a*) phase inverter, (*b*) attenuator, (*c*) differentiator, (*d*) integrator, and (*e*) adder. All in inverting mode.

(*ii*) Successive approximation A/D converter

(*iii*) Enhancement mode *vs.* depletion mode MOSFET.

(*iv*) Intrinsic and extrinsic semiconductors

Group B

5. (*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. 6 + 4 + 4

(*b*) Describe dynamometer-type power meter. 6

6. (*a*) Define sensitivity of voltmeter. Explain loading of a voltmeter and its significance in sensitivity. 3 + 5

(*b*) It is desired to measure the voltage across the 50 kΩ resistor in the circuit of Fig. 2. Two voltmeters are available for this measurement (Fig. 2) : Voltmeter 1 with sensitivity of 1000 Ω/V, and voltmeter 2 with sensitivity of 20,000 Ω/V. Both meters are used on their 50 V range. Calculate the (*i*) reading of each meter, and (*ii*) error in each reading expressed as a percentage of true value. Comment on the sensitivity effect in the reading. 8 + 4

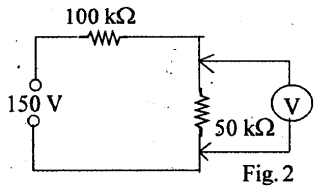

Fig. 2

7. (*a*) Describe rectifier-type PMMC meter for measurement of rms voltage. 6

(*b*) Give the measure of total harmonic distortion. Explain, with a neat circuit diagram, the operation of tuned

circuit harmonic analyser. Name the instrument for measurement of spectral parity of a signal and explain. 3 + 8 + 3

8. Write short notes on *any two* of the following : 10 + 10

(*a*) Q meter and its application

(*b*) Digital voltmeter

(*c*) Strain gauge

(*d*) RF signal generator

Group C

9. Answer the following in brief : 10 × 2

(*i*) What is Fermi level ?

(*ii*) What is varicap ?

(*iii*) What is the speciality of Zener diode and how is it biased ?

(*iv*) What are advantages and disadvantages of TTL and MOS devices in terms of power handling capacity and noise immunity ?

(*v*) What is the type of ADC suitable for higher accuracy ?

(*vi*) What is the working principle of Q meter ?

(*vii*) What is the principle of thermocouple-type temperature sensor ?

(*viii*) What is the ideal value of CMRR of op amp ?

(*ix*) What is the ideal value of offset voltage of op amp and why it differs from practical value ?

(*x*) What is the main difference between CRO and spectrum analyser in terms of domain of operation ?

S'14 : 6 AN : AN 208 (1408)

ELECTRONICS AND INSTRUMENTATION

Time : Three hours

Maximum Marks : 100

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Group A

1. (*a*) Explain how, for one time varying signal, ADC yields digital output. 4

(*b*) Describe the operation of one ramp-type ADC. 10

(*c*) Explain the operation of weighted resistance DAC. 6

2. (*a*) What is thyristor ? What are the gates available for control of anode-to-cathode break over voltage ? Describe thyristor characteristics for different gate currents. 2 + 2 + 6

(*b*) Describe half-wave power control circuit using thyristor. Also, describe full wave rectification power control using thyristor. In each case, show the output waveform for one sinusoidal input. 6 + 4

3. (*a*) Describe op amp used for non-inverting mode amplifier. Using op amp, describe comparator. What is virtual ground of op amp ? For op amp, what are the ideal values of (*i*) input resistance, (*ii*) output resistance, (*iii*) voltage gain (open loop), (*iv*) band-width, (*v*) balance in output for same voltages at differential inputs and (*vi*) drift of output with temperature. 3 + 4 + 2 + 3

(*b*) Describe operation and application of Zener diode. Explain its use as reference voltage using the circuit diagram. 8

4. (*a*) Describe basic structure of FET. Explain its V-I characteristics with different gate voltages. In reference to bipolar transistor, compare the input and output impedances of FET and MOSFET. 3 × 4

(*b*) For FET with small signal, establish the relation $\mu = g_m r_d$, where μ = amplification factor, g_m = transconductance and r_d = drain resistance. 4

(*c*) Following readings were obtained experimentally for a FET :

V_{GS} :	0 V	0 V	0.2 V
V_{DS} :	7 V	15 V	15 V
I_D :	10 mA	10.25 mA	9.65 mA

Determine the values of μ, g_m and r_d. 4

Group B

5. (*a*) For CRO, describe the focussing and deflection systems with graded potential using a neat diagram. 8

(*b*) Describe, with blocks, the circuit arrangement for horizontal and vertical deflection systems. 4

(*c*) Distinguish between dual trace and dual beam CRO. Give and explain the circuit for dual trace CRO. 2 + 6

6. (*a*) What is meant by spectral purity of a signal ? What is the function of spectrum analyser ? Describe, with blocks, the operation of spectrum analyser. 2 + 2 + 10

(*b*) Explain various applications of spectrum analyser. 6

7. (*a*) Explain, with a neat diagram, the operation of true RMS meter. 5

(*b*) Describe the operation of electrodynamometer with a neat diagram. 5

(*c*) Explain the operation of moving iron instrument. 5

(*d*) What is voltmeter sensitivity ? What is loading effect ? Explain the importance of sensitivity in connection with loading effect. 5

8. Write short notes on *any two* of the following : 10 + 10

(*a*) Audio oscillator

(*b*) Digital voltmeter and digital display

(*c*) Digital data acquisition and transmission system

(*d*) Thermistor and platinum resistance thermometers, their construction, range, linearity and measurement

Group C

9. Answer the following in brief : 10 × 2

(*i*) What is the drawback of successive approximation-type DVM and how can this be improved ?

(*ii*) What is the unit of mobility of charge carrier ?

(*iii*) What are the active region and saturation region of transistor ?

(*iv*) What are the types of feedback in amplifier and oscillator ?

(*v*) What are the signals used to horizontal and vertical deflection plates of CRO ?

(*vi*) How can temperature compensation be done for strain gauge ?

(*vii*) What are the advantages and disadvantages of thermistor-type temperature sensor ?

(*viii*) What is the advantage of LVDT ?

(*ix*) What is slew rate of op amp ?

(*x*) What are the values of d.c. load current for half-wave and full-wave rectifiers ?

W'14: 6 AN: AN 208 (1408)

ELECTRONICS AND 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 term 'fermi level'. Discuss why it lies closer to conduction band in n-type semiconductor. 6

(*b*) Bring out the role of valence electrons in determining electrical properties of solids. 6

(*c*) Discuss the operation of a p-n diode in forward bias and reverse bias conditions. 8

2. (*a*) Why is a filter needed in a rectifier circuit ? How does a simple capacitor serve this purpose in such a case ? 6

(*b*) A bridge rectifier circuit has an output d.c. current of 20 mA and filter capacitance of 470 μF. Find peak-to-peak ripple voltage for 50 Hz input signal and 50 ohm load. 6

(*c*) Discuss the biasings of n-p-n and p-n-p BJTs as a switch. 8

3. (*a*) What are the diffusion and drift currents in a transistor ? Define emitter efficiency, transport factor and transistor α. 10

(*b*) Draw a self-bias circuit and discuss why it is needed. How does it differ from negative feedback circuit ? 6

(*c*) How is MOSFET different from a JFET ? 4

4. (*a*) Explain the working of thyristor. How does it resemble with interconnected p-n-p and n-p-n BJTs ? How do the $\propto$'s of p-n-p and n-p-n play the role in control of thyristor ? 6

(*b*) What is an 'op amp' ? Discuss its use as a non-inverting integrator. 6

(*c*) What is a feedback amplifier ? Where is it used ? What are the advantages of negative feedback given to an emplifier ? 8

Group B

5. (*a*) Discuss the construction, working advantages and disadvantages of a Cathode Ray Oscilloscope (CRO) instrument. 10

(*b*) What is a pressure sensing instrument ? Show the connections of a sensor-to-digital acquisition system. 10

6. (*a*) Draw the circuit of a.c. rms electronic voltmeter. Discuss its working. 8

(*b*) What is a sweep signal ? Where is it generated ? 8

(*c*) How can phase angle be measured using CRO ? 4

7. (*a*) What should be the output impedance of RF signal generator ? Where is RF signal generator used ? 4

(*b*) What is a counter in digital instruments ? Draw its circuit and describe its operation. 6

(*c*) What is a distortion meter ? Show its construction. 4

(*d*) For what purposes is temperature sensor used and how ? 6

8. Write short notes on the following : 7 + 7 + 6

(*a*) Regulated power supply

(*b*) Q-meter

(*c*) Telemetry

Group C

9. Answer the following in brief : 10 × 2

(*i*) How are transducers classified ?

(*ii*) What is a piezoelectric material ?

(*iii*) What is Lissajous figure ?

(*iv*) What is a volt ratio box ?

(*v*) What are accuracy classes of indicating instruments as per BIS ?

(*vi*) Why should op amp has high input resistance ?

(*vii*) What is a GTO ?

(*viii*) What is a constant current source ?

(*ix*) What is ripple factor ?

(*x*) What is impedance matching ?

S'15: 6 AN: AN 208(1408)

ELECTRONICS AND 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.

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

Group A

1. (*a*) With the help of energy-band diagram, explain the difference between semiconductor, conductor and insulator. State and prove the law of mass action for semiconductors. 4 + 2

   (*b*) How a zener breakdown differs from an avalanche breakdown ? Mention difference of some junction properties of zener diode as compared to that of tunnel diode. 3 + 1

   (*c*) With a neat circuit, explain the operation of a bridge rectifier and calculate its efficiency. Compare with the efficiency of two-diode full rectifier. 4 + 6

2. (*a*) A Ge-transistor with $\beta = 49$ is in self-biasing arrangement, where $V_{CC} = 10$ V, $R_L = 1\text{k}\Omega$, $V_{CE} = 5$ V, $I_C = 4.9$ mA and $V_{BE} = 0.2$ V. The

stability factor, s, is derived to be 10. Obtain the value of R_1, R_2 and R_e, where R_1 and R_2 are for base bias and R_e is for emitter grounding. 8

(*b*) With a neat circuit, explain the operation of a class-B push-pull amplifier. Mention some of its drawback. Calculate the efficiency of class-B push-pull amplifier. How does the requirement served by power amplifier not get served by small signal amplifier? 4 + 2 + 6

3. (*a*) Draw the structure of enhancement mode MOSFET and explain its biasing and operation. Also, explain how does it differ from a depletion mode of MOSFET ? Why is input impedance of a MOSFET higher than that of a JFET in general ? 2 + 2 + 2 + 2

(*b*) A CE amplifier uses a transistor with $h_e = 1\text{k}\Omega$, $h_{fe} = 100$, and $h_{oe} = 25\times10^{-6}\Omega^{-1}$. The load resistance is 5 kΩ. Find the current amplification, overall voltage and power gains for a source resistance of 1 kΩ. 6

(*c*) Explain how negative feedback to an amplifier reduces the gain and improves its stability. With the help of a circuit, describe a transistor amplifier with negative feedback. 6

4. (*a*) Design a circuit, using op-amp, which can make an average of three voltages 2 V, 4 V and 6 V in phase with the input. 4

(*b*) With a neat schematic, explain the operation of 'successive approximation register'-type A/D converter. Mention its advantage over that of ramp-type one. 6 + 2

(*c*) Explain, with a neat circuit, the operation of an R-2R ladder type D/A converter. How is it better than a binary weighted register type D/A converter ? How do you ensure that a load of 1/2 watt can get connected to its output ? 8

Group B

5. (*a*) How a moving coil-type galvanometer differs from a moving iron-type ? Write their relative merits and demerits. 3 + 2

(*b*) With a neat schematic, explain the operation of electrodynamometer-type single-phase power meter. 5

(*c*) Explain the operation of a shunt-type ohmmeter. How does it differ from a series-type ohmmeter ? 4 + 1

(*d*) Explain the operation of an average reading electronic voltmeters. 5

6. (*a*) What is a transducer ? Write the characteristics of a transducer for temperature sensing. Explain, with a neat schematic, the operation of a Linear Variable Differential Transducer (LVDT). Suggest a mechanism by which the level of a fluid can be measured by using LVDT. 1 + 1 + 2 + 4 + 4

(*b*) What do you mean by a Bourden tube ? Describe its operation in brief. 4

(*c*) Explain the operation of a 'capacitive pressure transducer'. 4

7. (*a*) Describe working of phase shift oscillator. 2 + 8

(*b*) With a neat schematic, explain the role of time base synchronization operation of a dual trace CRO. What do you mean by 'ALT' and 'CHOP' mode of operation ? How can current be measured by using a CRO ? How can the same display be used for varying ranges of voltages to measure. 4 + 4 + 2

8. Write short notes on any *two* of the following : 2 ×10

(*a*) Digital data acquisition system

(*b*) Distortion meter

(*c*) Voltage-to-frequency converter

Group C

9. Choose the *correct* answer for the following : 10 × 2

(*i*) The ripple factor in a half wave rectifier is

(*a*) 40.6 (*b*) 81.2 (*c*) 1.21 (*d*) 0.48

(*ii*) One of the following is not a characteristics of an ideal op amp :

(*a*) Infinite voltage gain (*b*) Infinite slew rate

(*c*) Infinite offset voltage (*d*) Infinite CMRR

(*iii*) If $\beta = 99$ for a transistor, then the value of α for that transistor is

(*a*) 0.99 (*b*) 0.98 (*c*) 0.97 (*d*) 0.96

(*iv*) One of the following characteristics of the amplifier is not due to negative feedback :

(*a*) Reduction of non-linear distortion.

(*b*) Reduction of bandwidth of the amplifier.

(*c*) Reduction of efficiency of the amplifier.

(*d*) Reduction of noise present in the amplifier.

(*v*) The following method of biasing is the most stable method for a transistor :

(*a*) Base resistor method

(*b*) Collector-to-base feedback method

(*c*) Voltage divider method or self-bias

(*d*) All of the above.

(*vi*) Gauge factor (k) of a strain gauge relates with Poisson's ratio (μ) as

(*a*) $k = 2\mu$ (*b*) $k = 1 + 2\mu$

(*c*) $k = 1/(1+\mu)$ (*d*) $k = \mu$

(*vii*) Barkhausen criteria for sinusoidal oscillation is

(*a*) $-A\beta = 1$ (*b*) $A\beta = 0$

(*c*) $A\beta = 1$ (*d*) $A = 1/\sqrt{\beta}$

(*viii*) Emitter resistance without capacitor bypass is a negative feedback amplifier using

(*a*) voltage series feedback.

(*b*) current series feedback.

(*c*) current shunt feedback.

(*d*) voltage shunt feedback.

(*ix*) An ideal op-amp is an ideal

(*a*) voltage-controlled current source.

(*b*) voltage-controlled voltage source.

(*c*) current-controlled current source.

(*d*) current-controlled voltage source.

(*x*) Class B push-pull amplifier suffers from

(*a*) cross-over distortion.

(*b*) intermodulation distortion.

(*c*) excessive harmonic distortion.

(*d*) phase distortion.

S'16: 6 AN: AN 208 (1408)

ELECTRONICS AND 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.**

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

Group A

1. (*a*) What is a Zener diode. Explain Zener equivalent circuit with its reverse VI characteristics. Also, list important applications of this diode. 6

   (*b*) Explain operational features of full-wave centre-tap rectifier circuit and derive an expression for its rectification efficiency. 6

   (*c*) Determine the germanium p-n junction diode current for the forward bias value of 0.22 V at room temperature 25 °C with reverse saturation current equal to 1 mA. Given the value of (η,) a constant equal to one for the germanium diode. 8

2. (*a*) What are different ways of biasing a BJT (bipolar junction transistor) in general. Explain with the help of respective circuit diagram. 6

(Turn Over)

(*b*) Describe output characteristics of a transistor (BJT) in common-base configuration with the help of a proper circuit arrangement. 4

(*c*) A germanium transistor used in a complementry symmetry amplifier has a collector cut-off current $I_{CBO} = 10\ \mu A$ at a temperature of 27 °C and value of $\beta = 50$. (*i*) Find collector current, when base current is 0.25 mA and (*ii*) if the value of β does not increase with temperature, what would be the value of new collector current, if the temperature of this transistor rises to 50 °C. 10

3. (*a*) Explain the working of a thyristor with the help of its two transistor (analogy) equivalent circuit. 8

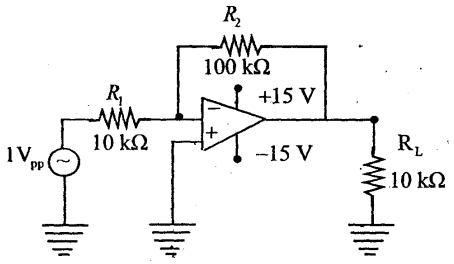
(*b*) Discuss forward and reverse characteristics of a silicon-controlled rectifier (SCR). Support your answer with the help of neat characteristic plots. 6

(*c*) Explain the working of a TRIAC with the help of its V-I characteristics. Elaborate the difference between SCR and TRIAC. 6

4. (*a*) Draw the pin diagram of an IC 741 used as an operational amplifier. Explain the function of different pin connections. 4

(*b*) Explain the following terms in connection with an operational amplifier: (*i*) Common-mode rejection ratio (CMRR), (*ii*) slew rate, (*iii*) virtual ground, (*iv*) input resistance and (*v*) output resistance. 5×2

(*c*) For the operational amplifier circuit shown in Fig. 1, find the closed-loop gain, input impedance, common-mode rejection ratio and maximum operating frequency. 6



Op amp parameters are : Common-mode gain = 0.001, differential gain = 180,000, input impedance = 1 MΩ ; output impedances = 80 Ω and slew rate = 0.5 V/μs.

Group B

5. (*a*) Describe the constructional details and operational principle of an electrodynamometer-type instrument. Also, develop torque equation of the electrodynamic type instrument. 8

(*b*) Explain why electrodynamometer-type of instrument can be used both on a.c. and d.c. 4

(*c*) The inductance of 25 A electrodynamic-type of ammeter changes uniformly at the rate of 0.0035 μH/ degree. The spring constant is 10^{-6} N-m/degree. Find the angular deflection at full scale. 8

6. (*a*) Describe the constructional details and operational features of an electrostatic instruments. Derive force and torque equations for electrostatic instrument for a linear motion. 6

(*b*) Why cannot electrostatic instruments be used for measurement of low voltages while electromagnetic instruments can be used ? 6

(*c*) An electrostatic voltmeter reading 2000 V, maximum is controlled by a spring with a torsion constant of 5×10^{-6} N-m/rad, has a full-scale deflection of 90°. The value of capacitance at zero voltage is 15 picofarad. Calculate the value of the capacitance at 2000 V pointer deflection. 8

7. (*a*) Describe the circuit details and working principle of a Q meter. Also, describe its applications. 7

(*b*) Discuss how Q factor of a coil can be measured using a bridge T network. Derive the corresponding expression for Q. 7

(*c*) How the following parameters may be measured using Q meter : (*i*) Q factor and (*ii*) bandwidth. 3 + 3

8. (*a*) Describe the construction and working principle of thermocouples. What are various specifications used for thermocouples ? 6

(*b*) Discuss various types of compensation used and also the methods of measurement of output voltage of the thermocouples. 6

(*c*) Calculate the thermoelectric sensitivity of a bridge using bismuth and tellurium as two dissimilar metals. Estimate the maximum output voltage for a 100 °C temperature difference at room temperature using one junction. The sensitivity of bismuth is (–)72 μV/°C and the sensitivity of tellurium is 500 μV/°C. 8

Group C

9. Answer the following in brief : 10 × 2

(*i*) An intrinsic semiconductor at absolute zero temperature behaves like an insulator – why ?

(*ii*) Justify that energy gap in a semiconductor decreases with temperature.

(*iii*) Why is the depletion within a p-n junction reduced when the junction is forward-biased ?

(*iv*) Why an Zener diode does have a sharp breakdown at low reverse voltage ?

(*v*) Justify that in a p-n-p transistor the electrons flow within the transistor at collector and base leads.

(*vi*) Why is a transistor, in general, said to be in saturation region when both collector and emitter junctions are forward-biased.

(*vii*) For the operation of depletion-type MOSFET, the gate voltage has to be 'high negative' – why ?

(*viii*) After triggering a thyristor, the gate current I_G is removed. The current in the thyristor rises immediately a little and afterwards it falls down – justify.

(*ix*) Why high torque-to-weight ratio in an analog indicating instrument indicates low frictional loss ?

(*x*) Justify that in a semiconductor strain gages when tensile strain is applied, the resistance increases in p-type materials.

W'16 : 6 AN : AN 208 (1408)

ELECTRONICS AND 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.**

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

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Group A

1. (*a*) Define doping. Why doping is done ? Write down different material used for doping. Explain the process of doping. 10

   (*b*) With suitable diagram explain the operation of p-n junction diode. Draw the characteristics curve. 10

2. (*a*) Compare between Avalenche breakdown and Zener breakdown. 10

   (*b*) Explain how Zener diode is used as a voltage regulator. 5

   (*c*) With suitable diagram explain the operation of common-emitter amplifier. 5

(Turn Over)

3. (*a*) Write down the advantages and limitations of negative feedback. 5

(*b*) Draw the hybrid parameter equivalent circuits for common emitter configuration. Derive all the hybrid parameters. 10

(*c*) Define regenerative feedback. Write down the condition of oscillation. 5

4. (*a*) Draw a differential amplifier using Operational Amplifier (OPAMP). Find out its output. 10

(*b*) Explain the operation of successive approximation type ADC and compare it with flash type ADC. 10

Group B

5. (*a*) Differentiate between permanent magnet moving coil and moving iron meter. Draw proper diagram to support your answer. 10

(*b*) Explain the construction and working of integrating meters. 10

6. (*a*) Describe the operation of rms reading type voltmeter and compare it with average reading type voltmeter. 10

(*b*) With suitable diagram explain the operation of Cathode Ray Oscilloscope (CRO). 10

7. (*a*) Explain how the liquid level can be measured using (*i*) resistive transducer, (*ii*) capacitive transducer. Give suitable diagram. 10

(*b*) Draw the basic block diagram of a Data Acquisition System and explain each block. 10

8. Write short notes on :

(*a*) Spectrum Analyser 5

(*b*) Digital Voltmeter 5

(*c*) Digital Display Devices 5

(*d*) Q-Meter 5

Group C

9. Choose the *correct* answer for the following :

(*i*) Which of the following diode is designed to operate in the breakdown region ?

(*a*) Signal diode

(*b*) Zener diode

(*c*) Power diode

(*d*) All of the three above.

(*ii*) A semi-conductor that is electrically neutral :

(*a*) has no majority carriers

(*b*) has no minority carriers

(*c*) has no free charge carriers

(*d*) has equal amount of positive and negative charges

(*iii*) In a transistor α is related to β by the relation :

(*a*) $\beta = \dfrac{\alpha + 1}{\alpha}$

(*b*) $\beta = \frac{\alpha - 1}{\alpha}$

(*c*) $\beta = -\frac{\alpha}{\alpha - 1}$

(*d*) $\beta = \frac{\alpha}{\alpha + 1}$

(*iv*) The ripple factor for a half-wave rectifier is :

(*a*) 2 (*b*) 1.21 (*c*) 0.7 (*d*) 0.45

(*v*) An ideal voltage simplifier should have :

(*a*) $R_i = 0, R_0 = 0$

(*b*) $R_i = \infty, R_0 = 0$

(*c*) $R_i = 0, R_0 = \infty$

(*d*) $R_i = \infty, R_0 = \infty$

(*vi*) A phase shift oscillator consists of a number of :

(*a*) RC circuits

(*b*) RL circuits

(*c*) LC circuits

(*d*) RLC circuits

(*vii*) Which of the following ADC is the fastest ADC ?

(*a*) Dual slope type

(*b*) Ramp type

(*c*) SAR type

(*d*) Flash type

(*viii*) Differentiate between accuracy and precision.

(*ix*) The gauge factor is defined as :

(*a*) $\frac{\Delta L/L}{\Delta R/R}$

(*b*) $\frac{\Delta R/R}{\Delta L/L}$

(*c*) $\frac{\Delta R/R}{\Delta D/D}$

(*d*) $\frac{\Delta R/R}{\Delta \rho/\rho}$

Where L, D, ρ and R are length, diameter, resistivity and resistance of strain gauge.

(*x*) In a CRT the focusing anode is located :

(*a*) between pre-accelerating and accelerating anode

(*b*) alter accelerating anode

(*c*) between preaccelerating anode

(*d*) None of the three above.