

(4)

6. (a) Describe the construction and working of a thyristor with schematic diagram.
- (b) What is latching current?
- (c) What is pulse transformer and why is pulse transformer used to 'trigger ON' a thyristor? [4+3+3]

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Ex/SC/INSC/PG/CORE/TH/MI 102/2024

M. Sc. INSTRUMENTATION SCIENCE EXAMINATION, 2024

(1st Year, 1st Semester)

ANALOG, DIGITAL AND POWER ELECTRONICS

PAPER : PG/CORE/TH/MI 102

Time : 4 Hours

Full Marks : 80

PART—I

Use separate answer scripts for each Part;

Answer *any* **four** questions

1. Give two reasons why an open loop OP-AMP is unsuitable for linear applications. Calculate the input resistance (R_{iF}) or voltage gain (A_F) for an OP-AMP connected with voltage series feedback. The 741 OP-AMP having the following parameters: ($A=200000$, $R_i = 2\text{ M}\Omega$, $R_o=75\ \Omega$, $R_1=5\text{ Hz}$, supply voltage = $\pm 15\text{ V}$) connected as inverting amplifier with $R_1 = 470\ \Omega$ and $R_F = 4.7\text{ k}\Omega$. Calculate the values of A_F , R_{iF} and R_{oF} .
1+4.5+4.5
2. Write the diode equation and give the meanings of various symbols used. What is tunnel diode? How does the Zener breakdown differ from the Avalanche breakdown? A p-n junction germanium diode ($\eta = 1$) is given a forward bias of 0.7 V. Determine the static and dynamic resistance of the diode at 300 K, if the reverse saturation current is $1\ \mu\text{A}$.

2+2+3+3

(2)

3. Describe the structure and operation of n channel FET. Draw the drain and transfer characteristics of n-channel FET. A common source FET amplifier has a load resistance of $150\text{ k}\Omega$. The ac drain resistance and transconductance of FET are $100\text{ k}\Omega$ and 0.1 mA/V respectively. Calculate the voltage gain of the amplifier. 4+2+4
4. What are self-bias and fixed bias (explain with circuit diagram) configuration? Explain the role of bypass capacitor in self-bias circuit. 7+3
5. Find the expression of depletion width of a p-n junction diode. How it varies with doping concentration? Draw the band structure of a p-n junction diode in equilibrium, and forward and reverse bias condition. 5+2+3
6. What are the characteristics of an ideal OP-AMP? What is slew rate? List the cause of slew rate. Define a filter. How filters are classified? What are the advantages of active filters over passive ones? 3+2+3+2

PART—II

(Use separate sheet for each Part)

Answer **any four** questions :

1. (a) Prove the following :
$$AB + A\bar{B}C + B\bar{C} = AC + B\bar{C}$$
- (b) Convert S-R flip-flop into J-K flip-flop.
- (c) Briefly describe the operation of a full adder using circuit and truth table. [3+3+4]

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[Continued]

(3)

2. (a) What are the differences between combinational and sequential logic systems?
- (b) Design a 4:1 Multiplexer using 2:1 Multiplexers.
- (c) Explain the working of a 4-bit ripple counter. [2+3+5]
3. (a) Briefly explain the operation of 4-bit parallel-in-parallel-out shift register using circuit diagram.
- (b) A 5-bit DAC has a current output. For a digital input of 10100_2 , an output current of 10 mA is produced. What will I_{OUT} be for a digital input of 11101 ?
- (c) Draw the circuit diagram of Flash type ADC. [4+3+3]
4. For an $11\text{ kV}/433\text{ V}$ -3-phase-100 kVA transformer with Delta/Star connection, calculate —
- (a) line and phase current in the 11 kV (delta connected) side;
- (b) phase voltage and line current in the 433 V (star connected) side. [5+5]
5. In an electric circuit a load consisting of inductance of 30 mH in series with a resistance of 20 Ohm is connected to an AC source of 240 volts 50 Hz .
- (a) Calculate the current and power factor of the circuit.
- (b) What will be the capacitance value of capacitor to be connected in parallel to the existing load to make the power factor of the circuit unity? [6+4]

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[Turn Over]