

2025

PHYSICS — HONOURS

Paper : DSCC-9

(Electronics - I)

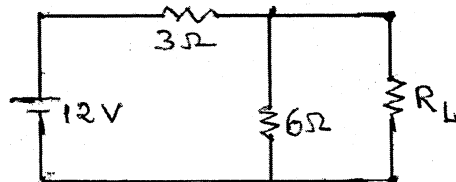
Full Marks : 75

*The figures in the margin indicate full marks.**Candidates are required to give their answers in their own words as far as practicable.*Answer **question no. 1** and **any five** questions from the rest.1. Answer **any five** questions :

- (a) What is reverse saturation current in a $p-n$ junction diode? How does it depend on temperature? 2+1
- (b) Why do Si or Ge diodes not emit light but GaAs diodes do? 3
- (c) Draw the output characteristics of BJT in CE configuration. Plot load line and show Q-point on it. 1+1+1
- (d) State at least three advantages of FET over BJT. 3
- (e) Suppose you have a 4.7 V, 400 mW Zener diode. What is the maximum allowable current through that Zener diode? 3
- (f) What are the advantages of negative feedback in amplifier? 3
- (g) Suppose the voltage gain of an OP AMP is 10^5 , then why the output voltage does not become 10^5 volt for an input voltage of 1 V? 3
- (h) Explain Barkhausen's criterion for self sustained oscillations. 3

2. (a) State and explain Norton's theorem.

- (b) For the electrical network shown below, find the value of load resistance (R_L) for which source will supply maximum power to the load. Find also the maximum power.

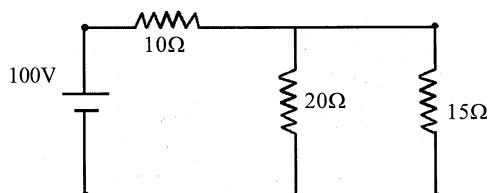


- (c) What is a clipper circuit and why it is useful?

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- (d) Using Thevenin's theorem, find the current through the 15Ω resistance.



(2+1)+(3+1)+2+3

3. (a) Draw the circuit of a bridge rectifier using $p-n$ junction diodes.
 (b) Establish the relation $I_C = \beta I_B + (1 + \beta) I_{CBO}$ for CE transistor in active region, where I_C , I_B , I_{CBO} and β have their usual meaning.
 (c) Draw the circuit diagram of a common-emitter $n-p-n$ transistor with the following parameters : $V_{BB} = 5V$, $R_B = 100\text{ K}\Omega$, $V_{CC} = 10V$, $V_{BE} = 0.7V$, $I_{CO} \approx 0$ and $h_{FE} = 100$. Find I_B and I_C . Is the transistor operating in the saturation region? 3+3+(1+4+1)
4. (a) What are the factors that affect the bias stability of a transistor?
 (b) Draw a circuit and explain how an $n-p-n$ transistor can be self-biased.
 (c) Draw the circuit for static characteristic curve of an n -channel JFET. Sketch and explain the nature of the curves. Define transconductance (g_m) of a JFET. 3+(2+1)+(2+1+2+1)
5. (a) Draw the circuit diagram of a series voltage regulator using two transistors and a Zener diode. Explain its operation. Draw the variation of load voltage with load current for a fixed input voltage.
 (b) Draw the circuit diagram of a CE amplifier and find an expression for its gain in mid-frequency range. Comment on the improvement of the bandwidth of the amplifier. (2+3+1)+(2+3+1)
6. (a) An open loop amplifier changes its gain by a factor of 25% due to some reason. How this change can be brought to 1% only? Given, the closed loop gain = 50.
 (b) What is the CMRR of an OP AMP?
 (c) Derive the expression for the voltage gain of a non-inverting amplifier using an OP AMP in terms of circuit parameters. What is the phase difference between the input and output voltage?
 (d) Write down the characteristics of an ideal OP AMP. 3+2+(3+1)+3
7. (a) Draw a circuit diagram of an active differentiator using an OP AMP. Why is the circuit called a differentiator? What will be the nature of the waveform at the output of the differentiator if a triangular wave is applied at its input?
 (b) Draw a circuit using one or more OP AMP whose output V_o is given as $V_o = 4V_1 + 6V_2$, where V_1 and V_2 are two input signals.
 (c) What is the importance of knowing slew rate? (2+2+2)+4+2

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8. (a) Draw circuit of a relaxation oscillator using OP AMP.
(b) Draw the circuit diagram of Wien bridge oscillator and explain how it works.
(c) Explain with diagrams, how a LC tank circuit generates oscillations. In what frequency range does a LC oscillator work? 2+(2+3)+(4+1)
9. (a) Explain how a transistor can be used as a switch.
(b) What is a multivibrator? Draw the circuit diagram of an astable multivibrator and explain its working principle. Write the expression for the frequency of oscillation. 3+(2+2+3+2)
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