2015

ELECTRONICS

[Honours]

PAPER – III (Theory)

Full Marks : 100

Time : 4 hours

The figures in the right hand margin indicate marks

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

Illustrate the answers wherever necessary

GROUP – A

Answer any **two** questions : 15×2

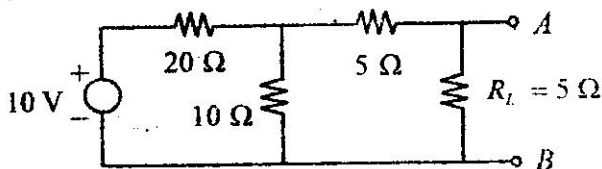1. (a) Determine the current through the load R_L of the following circuit using Kirchhoff's current Law.

Fig. 1

(b) What do you mean by the 'node' and branch of a Network ?

(c) Derive the expression of loop current $i(t)$ of the following circuit for $t > 0$. The 'K' switch closes the circuit at $t = 0$.
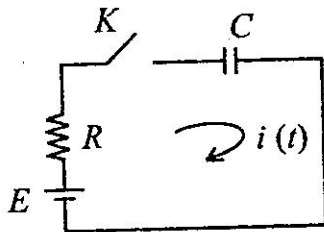

Fig. 2

Also determine the steady state value of $i(t)$.

(d) Write down the principle of operation of a Wien bridge. $5 + 2 + (4 + 1) + 3$

2. (a) Discuss the terms of depletion capacitance and diffusion capacitance in connection with a P-N junction diode.

(Continued)

(b) Explain with a neat circuit diagram how a Zener diode can be used as a voltage regulator.

(c) A transistor amplifier in CE configuration couples a source of internal resistance $1\,K\Omega$ to a load of $20\,K\Omega$. Find the input and the output resistances if $h_{ie} = 1\,K\Omega$, $h_{re} = 2 \cdot 5 \times 10^{-4}$, $h_{fe} = 150$ and $1/h_{oe} = 40\,K\Omega$.

(d) Explain the principle of operation of a CMOS inverter with suitable circuit diagram. $2 + 4 + 5 + 4$

3. (a) What are the fundamental differences among the class A, class B and class C amplifiers ?

(b) Draw the circuit diagram of a two-stage RC coupled CE transistor amplifiers. Show how the magnitude and phase angle of its voltage gain vary with frequency. Qualitatively explain these variations. Define half power frequencies.

(c) Explain with a circuit diagram the operation of a single tuned amplifier. Draw its ac equivalent circuit and find an expression for the voltage gain and bandwidth.

$$3 + (2 + 2 + 2) + (2 + 4)$$

GROUP — B

Answer any **five** questions : 8×5

4. (a) The arm impedance of a π network are $Z_A = 20\ \Omega$, $Z_B = j\,30\ \Omega$ and $Z_C = 40\ \Omega$. Calculate the arm impedance of an equivalent T network.

(b) With a neat sketch discuss the principle of operation of a transformer. $5 + 3$

5. (a) What is the difference between an enhancement type and a depletion type MOSFET ?

(b) Deduce the relationship $\mu = r_d \cdot g_m$ for a field effect transistor.

(c) Derive the expression of pinch-off voltage of a field effect transistor. $2 + 3 + 3$

6. (a) Compute the output voltage V_0 of the following circuit when input is $V_{in} = 0.5 \sin 100\,\pi t$:
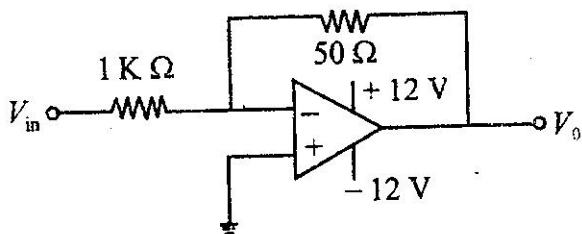
(b) Discuss how an OPAMP can be used as a differentiator ? 5 + 3

7. (a) What is an emitter follower ? Discuss the principle of operation of a Darlington Amplifier.

(b) Using h-parameter model of a transistor derive the expressions of input resistance and current gain. (2 + 2) + (2 + 2)

8. (a) State and prove the maximum power transfer theorem.

(b) Indicate some application of thermocouples. 6 + 2

9. (a) With a neat circuit diagram discuss the principle of operation of a CMOS NAND gate.

(b) Why MOS logic is preferred in IC fabrication in comparison with TTL logic ?   6 + 2

10. (a) Draw the energy band diagram of a photo-diode and explain its operation. What is P-i-N photodiode ?

(b) Discuss how avalanche photodiode works ?
                                                    (3 + 2) + 3

11. (a) Discuss the working principle of a push-pull amplifier.

(b) Discuss how negative resistance is achieved in a GUNN diode ?   5 + 3

GROUP – C

Answer any **five** questions :   4 × 5

12. Derive an expression of small-signal voltage gain of a common source FET amplifier.   4

13. Write a short note on Unijunction transistor.   4

14. What is a light emitting diode ? Why silicon is not preferred for LED material ? 2 + 2

15. Discuss the working principle of a phase-shift oscillator. 4

16. For a metal semiconductor contant prove that

$$q\phi_{bn} + q\phi_{bp} = E_g.$$ 4

17. What do you mean by switched mode power supply ? Indicate some of its uses. 2 + 2

18. Explain the working principle of a Schmitt trigger using an OP AMP. 4

19. Explain the terms % regulation and ripple factors of a rectifier circuits. 2 + 2

[*Internal Assessment* : 10 Marks]

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