2019

PHYSICS

(Major)

Paper : 5.4

(Electronics)

Full Marks : 60

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Answer the following questions briefly : 1×7=7

(a) In what respect an LED is different from photodiode?

(b) Which of the three transistor amplifier CB, CE and CC configurations is regarded as most stable one, in terms of stability factor?

(c) Name the diode, manufactured in such a way that its capacitance varies inversely with applied voltage.

(d) State why input and output terminals of RC coupled CE transistor amplifiers are connected with coupling capacitors (C_c).

(e) What is the full form of CRO?

(f) State what you understand by sequential circuits.

(g) State the number of power supplies required at least for operation of an OP-AMP.

2. Give very short answers to any *four* of the following : 2×4=8

(a) In a half-wave rectifier, the input voltage is $20\sin 314t$ and the load resistance is 500 ohms. Considering negligible diode resistance, find peak and r.m.s. value of current.

(b) With reference to 8085 miroprocessor, state any two functions of its ALU.

(c) What is the value of lower cutoff frequency of an OP-AMP? Find the value of bandwidth if upper cutoff frequency of the OP-AMP is 10 MHz.

(d) In a CE transistor amplifier, $h_{fe} = 200$. What will be the maximum value of current gain it could achieve theoretically?

(e) Draw the circuit diagram of an astable multivibrator.

(f) Define critical frequency of an ionospheric layer.

3. Draw the circuit diagram of a *p-n* junction diode full-wave rectifier. Derive the expression for its efficiency and ripple factor. 1+2+2=5

Or

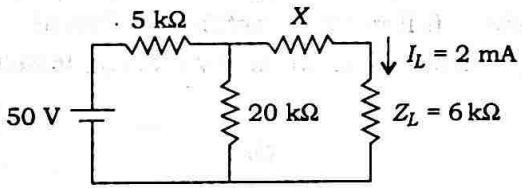
Derive the expressions for current gain, voltage gain and input impedance of a CE amplifier using hybrid equivalent circuit. 2+2+1=5

4. Draw the circuit diagram of a transistor phase shift oscillator. Draw the equivalent circuit of the oscillator and find expression for the frequency of oscillation. 1+1+3=5

Or

A feedback amplifier having normal voltage gain 1000, input resistance 10 kΩ and output resistance 2 kΩ is subjected to negative voltage series feedback. If feedback ratio is 0·001, then find the modified values of *(a)* input resistance, *(b)* output resistance and *(c)* closed-loop voltage gain after the feedback. 2+2+1=5

5. Convert the following circuit into Thevenin's equivalent and calculate Thevenin's equivalent voltage and unknown impedance X if current flowing through the load is 2 mA : 1+2+2=5



6. Answer any *two* questions from the following : 5×2=10

(a) Draw the circuit diagram of an RC coupled CE amplifier. Derive the expression for voltage gain in the mid-frequency range from the equivalent circuit. Give reasons for elements neglected in the equivalent circuit. 1+3+1=5

(b) What is the need of stabilization of Q-point for operation of transistor? Write the expression for total collector current in terms of I_B, I_{CO} and β. Define stability factor. 2+2+1=5

(c) What are the major constituents of ionosphere? Name the different layers of ionosphere. What are the factors which determine the path of a radio wave in the ionosphere? 1+1+3=5

(d) What are the characteristics of an ideal OP-AMP? Derive an expression for output voltage of a differential amplifier in terms of difference mode voltage gain (A_d) and common mode voltage gain (A_c). 2+3=5

7. Answer any *two* questions from the following : 5×2=10

(a) (i) Define 'nible' and 'byte'.

(ii) Add the binary numbers 1101·11 and 1001·01, and also find their difference using 2's complement method.

(iii) Convert the decimal numbers 75·875 and 25·25 into binary equivalent. 1+3+1=5

(b) State De Morgan's theorem. How can you realize NAND and NOR gates using diode, resistance and transistor? Write truth tables. 5

(c) The AM wave given by the equation

$$v_{AM} = 50(1 + 0{\cdot}8\cos 6280t + 0{\cdot}6\cos 12560t)\cos(628 \times 10^4)t$$

Calculate—

(i) the radio frequency components each USB & LSB and their amplitude;

(ii) the power of each sidebands if load resistance is 100 Ω;

(iii) the composite modulation index. 2+2+1=5

(d) State the fundamental differences in the operation of class–A, class–B and class–C power amplifiers. Show graphically the portion of the input cycle for which the collector current flows through the active device. Write which class of above amplifiers exhibits maximum theoretical efficiency. 2+2+1=5

8. Answer any *two* questions from the following : 5×2=10

(a) An FM wave is represented by the equation

$$v_{FM} = 141\sin(6{\cdot}28 \times 10^5 t + 2\sin 12560t)$$

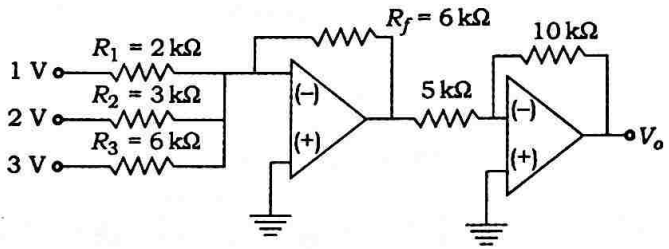
Calculate—

(i) the carrier and modulating frequencies;

(ii) the modulation index and maximum frequency deviation of the FM wave;

(iii) the power dissipated in a 1 kΩ resistance. 2+2+1=5

(b) Find the value of output voltage of the OP-AMP (V_o) from the following circuit : 5



(c) Show the working of *S-R* flip-flop with a suitable diagram. Give the truth table of the flip-flop constructed with NOR gates. Write the characteristic equation of SRFF. 2+2+1=5

(d) Write a short note on any *one* of the following : 5

(i) Maximum power transfer theorem

(ii) SSB transmission

(iii) Wien bridge oscillator

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