WEST BENGAL STATE UNIVERSITY

B.Sc. Honours Part-III Examination, 2020

PHYSICS

PAPER-PHSA-VII-A

Time Allotted: 2 Hours | Full Marks: 50

The figures in the margin indicate full marks.
Candidates should answer in their own words and adhere to the word limit as practicable.
All symbols are of usual significance.

Answer Question No. 1 and any *four* questions from the rest

1. Answer any ***five*** questions from the following: 2×5 = 10

   (a) Explain why FET is a voltage controlled device whereas BJT is a current controlled device.

   (b) What do you mean by class AB type amplifier?

   (c) What are the advantages of negative feedback in amplifiers?

   (d) What are the differences between a voltage amplifier and a power amplifier?

   (e) What are the essential requirements for steady oscillations at a fixed frequency of an oscillator?

   (f) What is the utility of calculating CMRR of an OPAMP?

   (g) What are the advantages of FM over AM?

   (h) Draw Circuit diagram of a 4:1 Multiplexer and write down its logic equation.

2. (a) How does the transconductance vary with drain current of an *n*-channel JFET? 2

   (b) Establish the relation $\mu = r_d \times g_m$ for JFET, where symbol have their usual meaning. 2

   (c) What is CMOS? Describe its use as a logic inverter. 1+2

   (d) A Common source FET amplifier has a load resistance $R_L = 500$ kΩ. If the a.c. drain resistance (r_d) and amplification factor (μ) of the FET are 100 kΩ and 24 respectively, calculate the voltage gain of the amplifier. 3

3. (a) Classify oscillators in terms of their constructional features. 2

   (b) Draw a neat circuit diagram of Wien Bridge Oscillator. Find an expression for the frequency of oscillation. Show that the voltage gain of the amplifier used in this oscillator must be greater than 3. 1+3+1

(c) The electrical equivalent circuit of a crystal consists of a series, $L = 137\,\text{H}$, $C = 0.0235\,\text{pF}$, $R = 15\ \text{k}\Omega$ connected in parallel with a capacitor $C = 3.5\,\text{pF}$. Find the resonant frequencies. 3

4. (a) What is a power amplifier? Draw a neat circuit diagram of a series - fed class A power amplifier. Find expressions for its maximum output power and efficiency. 1+2+2

(b) Draw a typical frequency response characteristic of an RC coupled amplifier indicating therein the three frequency ranges and the bandwidth. 2

(c) The mid-band gain of an RC coupled amplifier is 150. The lower cutoff and upper cutoff frequencies of the amplifier are 20 Hz and 4000 kHz. Find the gain of the amplifier at the following frequencies, 3

(i) 10 Hz (ii) 600 kHz (iii) 800 kHz

5. (a) Draw the circuit diagram of an OPAMP Schmitt trigger and explain its operation. Name an application of it. 3

(b) Explain the operation of a summing amplifier using OPAMP in non-inverting mode. 3

(c) Draw an analog computer circuit using OPAMP to solve the following simultaneous equations: 4

(i) $5x + 2y = 12$; (ii) $2x + 3y = 6$

6. (a) What is a flip-flop? What is its importance in a digital system? Draw the logic circuit of an RS flip-flop using NOR gates. 1+1+2

(b) Show how an RS flip-flop can be converted into a JK flip-flop. 2

(c) What is a D/A converter? Give the circuit diagram of a 4-bit R-2R ladder D/A converter that uses one OP-Amp. Write down the expression for the output voltage. 1+2+1

7. (a) Show that an AM wave consists of a carrier and two sideband components for each modulation frequency. Find the expressions for power of the carrier and two side bands. 3+2

(b) The peak to peak value of an amplitude modulated wave has maximum value of 8 volt and minimum value of 2 volt. What is percentage modulation and amplitude of carrier wave? 2+1

(c) Show that amount of frequency deviation is independent of modulating signal frequency in case of FM. 2

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