BPHET-143

ASSIGNMENT BOOKLET

BACHELOR'S DEGREE PROGRAMME
(BSCG)

DIGITAL AND ANALOG CIRCUITS AND INSTRUMENTATION

Valid from 1st January, 2024 to 31st December, 2024

School of Sciences
Indira Gandhi National Open University
Maidan Garhi, New Delhi-110068
(2024)

Dear Student,

Please read the section on assignments in the Programme Guide for B.Sc. that we sent you after your enrolment. A weightage of 30 per cent, as you are aware, has been earmarked for continuous evaluation, **which would consist of one tutor-marked assignment** for this course. The assignment is in this booklet, and it consists of two parts: Part A and Part B. The total marks of both parts are 100, of which at least 35% are needed to pass.

Instructions for Formatting Your Assignments

Before attempting the assignment please read the following instructions carefully:

1) On top of the first page of your answer sheet, please write the details exactly in the following format:

ROLL NO.: ……………………………………………
NAME: ……………………………………………
ADDRESS: ……………………………………………
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COURSE CODE:…………………………
COURSE TITLE: …………………………
ASSIGNMENT CODE: …………………..
STUDY CENTRE: ……………………….. **DATE:** ……………………………………...

PLEASE FOLLOW THE ABOVE FORMAT STRICTLY TO FACILITATE EVALUATION AND TO AVOID DELAY.

2) Use only foolscap size writing paper (but not of very thin variety) for writing your answers.
3) Leave 4 cm margin on the left, top and bottom of your answer sheet.
4) Your answers should be precise.
5) Solve Part A and Part B of this assignment, and **submit the complete assignment answer sheets containing Parts A and B within the due date.**
6) The assignment answer sheets are to be submitted to your Study Centre as per the schedule. **Answer sheets received after the due date shall not be accepted.**

   We strongly suggest that you retain a copy of your answer sheets.
7) This assignment is **valid from 1st January, 2024 to 31st December, 2024**. If you have failed in this assignment or fail to submit it by 31st December, 2024, then you need to get the assignment for the year 2025, and submit it as per the instructions given in the Programme Guide.
8) **You cannot fill the examination form for this course** until you have submitted this assignment. For any queries, please contact: sgokhale@ignou.ac.in. Please note that, we do not provide answers to Assignment questions.

We wish you good luck.

Tutor Marked Assignment

DIGITAL AND ANALOG CIRCUITS AND INSTRUMENTATION

Course Code: BPHET-143
Assignment Code: BPHET-143/TMA/2024
Max. Marks: 100

Note: Attempt all questions. The marks for each question are indicated against it.

PART A

1. a) Write the three processes responsible for charge carrier transport in a semiconductor. Calculate the resistivity of an intrinsic semiconductor sample of area 4 cm^2 , thickness 0.5 cm and carrier concentration of 5×10^{16} m^{-3}. It is given that the electron and hole motilities are 0.35 $m^2 V^{-1} s^{-1}$ and 0.2 $m^2 V^{-1} s^{-1}$ respectively. (1+4)

   b) What is the difference between a zener diode and a conventional *p-n* junction diode? Explain the breakdown processes observed in case of zener diode. (2+3)

2. a) Draw the structure of an *n*-channel JFET and explain the process of pinch-off when appropriate voltage bias is applied. Why is the depletion layer wider near the drain terminal? (4+1)

   b) Design a universal bias for a CE-amplifier (Fig. 4.11 of your study material) using *n-p-n* transistor for the following parameter values: V_{CC} = 20 V, V_B = 4 V, I_C = 10 mA, V_{BE} = 0.6V, V_{CE} = 10 V and β = 100. Obtain the values of R_C, R_E, R_1 and R_2. Explain how the *Q*-point remains stable in this biasing scheme. (8+2)

3. a) Convert 732.52_{10} into its octal equivalent. (5)

   b) Draw a circuit to realize a 2-input AND gate using two diodes and explain its working with the help of its truth table. (5)

   c) Write the Sum of Products (Boolean expression) for the following truth table, simplify it and draw its logic circuit using minimum number of gates. (5)

A	*B*	*C*	*Y*
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	0

4 a) Write the truth table of a full adder and obtain the expressions of its Sum and Carry using the SOP method. (5)

b) Draw the circuit of 2's complement binary adder-subtractor and using it explain the addition of binary equivalent of decimal number 7 and binary equivalent of decimal number 6. (5)

PART B

5. a) Draw the circuit and explain the working of a class B push-pull amplifier. What are its advantages over a class A power amplifier? (4+1)

b) Explain the effect of negative feedback on the performance of an amplifier. Calculate the gain of negative feedback amplifier with internal gain $A = 500$ and feedback factor $\beta = 0.02$. (3+2)

6. a) Explain the working of Wien bridge oscillator. Calculate the value of resistors in the Wien bridge oscillator with frequency $f = 5$ kHz if 100 pF capacitors are used. (3+2)

b) State the criteria for obtaining sustained oscillations from an oscillator circuit. Draw the circuit of Hartley Oscillator. A Hartley oscillator oscillates with 500 kHz frequency. Determine the total inductance, L forming the tank circuit with 10 pF capacitor. (2+1+2)

c) Design a shunt voltage regulator using a zener diode to give regulated 10 V dc output with maximum load current of 100 mA. Consider that input unregulated dc supply is 15 V and $I_z = 1$ mA. Write down the voltage and power ratings of the zener diode and power rating of series resistor R_S in your circuit. (5)

7. a) A triangular wave of $\pm$ 12 V amplitude and 10 MHz frequency is generated at the output of an op-amp. Calculate the minimum slew rate of this op-amp. (5)

b) Design a 3-channel op-amp based circuit to give following output relation:

$$V_o = 7V_1 - 5V_2 + 10\frac{dV_3}{dt}$$ (10)

8. a) Refer to Fig. 15.4 in your study material showing the geometry of the electron beam deflection in a CRT. In this CRT, the length of the deflections plates (L) is 4 cm and the distance between the screen and the centre of the deflection plates (R) is 10 cm. Accelerating voltage applied to the anode is 1000 V and applied deflection voltage is 75 V. If the deflection suffered by the electron beam at the edge of the deflection plate (h) is 1 mm, calculate the plate separation (s). Determine the deflection observed on the CRT screen (y) and calculate the deflection sensitivity. (5)

b) Design and draw the circuit of a monostable multivibrator using IC 555 timer to generate a pulse of 5.5 s duration when a trigger pulse is applied. (5)

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