BPHET-143

ASSIGNMENT BOOKLET

BACHELOR'S DEGREE PROGRAMME
(BSCG)

DIGITAL AND ANALOG CIRCUITS AND INSTRUMENTATION

Valid from 1st January, 2026 to 31st December, 2026

School of Sciences
Indira Gandhi National Open University
Maidan Garhi, New Delhi-110068
(2026)

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: ……
……
……

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, 2026 to 31st December, 2026**. If you have failed in this assignment or fail to submit it by 31st December, 2026, then you need to get the assignment for the year 2027, 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/2026
Max. Marks: 100

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

PART A

1. a) Draw the graph of current density versus electrical field in an intrinsic semiconductor and describe the mechanisms governing the three regions of this plot. (5)

   b) Describe the construction of a photodiode with appropriate diagram. What is the minimum frequency (in Hertz) of the photons detectable by a photodiode made of a semiconductor with 2.5 eV bandgap? (3+2)

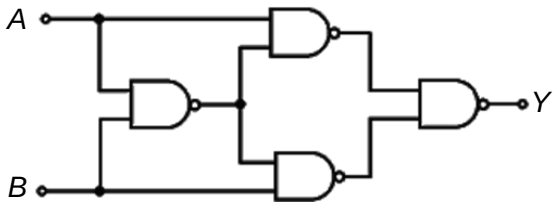
2. a) Draw the structure of an *n*-channel JFET with appropriate voltage bias and explain the process of pinch-off. Explain the various regions on the drain characteristic of this JFET for $V_{DS} > 0$ and $V_{GS} = 0$V. (3+3)

   b) Obtain the *Q*- point of a bipolar junction transistor in *CE* configuration with $V_{CC} = 20$ V, $I_B = 10$ μA, $\beta = 75$ and $R_L = 10$ kΩ. (4)

   c) *h*-parameters of a single stage CE amplifier are given as $h_i = 1$ kΩ , $h_r = 1 \times 10^{-4}$, $h_f = 120$ and $h_o = 25$ μAV^{-1}. Calculate A_i, A_v, Z_{in} and Z_{out} with $r_L = 5$ kΩ and $r_S = 150$ Ω. (5)

3. a) Convert 3960_{10} (decimal) into its hexadecimal equivalent and then divide it by hexadecimal number 08_{16}. Express the result in octal equivalent. (5)

   b) Obtain the expression for the output of the following logic circuit. Write its truth table. Which gate is represented by this circuit? (5)



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) Using the Boolean laws and theorems prove the following identities: (5)

   i. $\overline{(A + \overline{A})} = 0$

   ii. $\overline{(\overline{A} + \overline{A})} = A$

   iii. $A + (A\overline{B}C\overline{D}) = A$

iv. $\overline{A} \bullet \overline{(ABCD)} = \overline{A}$

v. $(A+B) \bullet (B+C) = AC + B$

c) Draw the circuit of 2's complement binary adder-subtractor and using it explain the addition of binary equivalent of decimal number 9 and binary equivalent of decimal number 4 . (5)

PART B

5. a) In the universal biasing of a transistor, which resistor acts as a feedback element? How does it provide stability to the circuit? (1+4)

b) How class *B* amplifier is more efficient than class *A* amplifier? What will be the effect on the output of a push-pull amplifier if unmatched transistors are used? (2+1)

c) What are the advantages of resistance-capacitance (*RC*) coupling between the two stages of a cascade amplifier? (2)

6. a) Why *LC* oscillators are preferred over *RC* oscillators to generate high frequencies? Why 2-stage amplifier is required in Wien bridge oscillator in contrast to a single stage amplifier in the phase shift oscillator? (2+1)

b) Draw the circuit of a Colpitts oscillator. Calculate its frequency of oscillation if value of both the capacitors is 5 nF and inductor is 5 mH. (4)

c) The turns ratio of a transformer used in half wave rectifier is 30:1. The primary is connected to the power mains: 220 V, 50 Hz. If the diode resistance in forward bias is 10 Ω and the load resistance, R_L is 1 kΩ, determine

i) the peak value, the dc value and the rms value of current;

ii) the ripple factor (4)

d) Design and draw shunt voltage regulator using a zener diode to provide 7 V output with maximum load current of 50 mA. Assume that the input unregulated dc voltage is 10 V and the minimum zener current is 10 mA. (4)

7. a) You want to amplify a triangular wave signal of $\pm$ 10V amplitude and 10 MHz frequency. Which characteristic of op-amp will be significant in this case? What is its minimum value? (5)

b) Design and draw a circuit using an op-amp to get + 9 V at output for input less than +5 V and $-$9 V at output for input greater than +5 V. (5)

c) Design a 2-channel op-amp based circuit to give following output relation:

$$V_O = 7V_1 + 5\frac{dV_2}{dt}$$ (5)

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 deflection plates (*L*) is 3 cm and the distance between screen and centre of the deflection plates (*R*) is 12 cm. Accelerating

voltage applied to the anode is 1200 V and applied deflection voltage is 80 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 an astable multivibrator using IC 555 to generate the square wave of 20 kHz frequency. (5)

****