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**UNIVERSITY OF PETROLEUM AND ENERGY STUDIES**  
**Examination, July 2020**

**Programme:** B.Sc. Physics(H)

**Semester** : IV

**Course Name:** Analog System and Application

**Max. Marks** : 100

**Course Code:** PHYS 2006

**Attempt Duration** : 3 Hrs.

**No. of page/s:**

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**Note:**

1. Read the instruction carefully before attempting.
2. This question paper has two section, Section A and Section B.
3. There are total of five questions in this question paper. **One** in **Section A** and **four** in **Section B**
4. **Section A** consist of multiple choice based questions and has the total weightage of 60%.
5. **Section A** will be conducted online on BB Collaborate platform
6. **Section B** consist of long answer based questions and has the total weightage of 40%. The questions for section B shall also appear in BB Collaborate
7. **Section B** is to be submitted within 24 hrs from the scheduled time i.e. if the examination starts at 10:00 AM, the long answers must be submitted by 09:59:59 AM next day. Similarly, if the examination starts at 2:00 PM it must be submitted by 01:59:59 PM next day. (*Exceptional provision due extraordinary circumstance due to COVID-19 and due to internet connectivity issues in the far-flung areas*).
8. No submission of **Section B** shall be entertained after 24 Hrs.
9. **Section B** should be attempted after **Section A**
10. **Section B** should be attempted on blank white sheets (hand written) with all the details like programme, semester, course name, course code, name of the student, Sap id at the top (as in the format) and signature at the bottom (right hand side bottom corner)
11. Both section A & B should have questions from entire syllabus.
12. The COs mapping, internal choices within a section is same as earlier

**Section – A (Attempt all the questions)**  
**(60 marks. There are 28 questions, 10 questions are of 1 marks each, 6 questions are of 2 marks each, 10 questions are of 3 marks each, while 2 questions are of 4 marks each. Marks are individually mentioned against each question.)**

QUESTION 1

1 Marks

CO1

An increase in the temperature of a metal results in \_\_\_\_\_ in the mobility and \_\_\_\_\_ in conductivity.

- a) Increase; decrease
- b) Increase; increase
- c) Decrease; decrease
- d) Decrease; increase

QUESTION 2

2 Marks

CO1

In a forward biased p-n junction semiconductor diode,

- a) The electrons cross the junction from the n-type to the p-type, and the holes cross the junction from the p-type to the n-type
- b) "The electrons cross the junction from the p-type to the n-type, and the holes cross the junction from the n-type to the p-type"
- c) "Both the electrons and holes cross the junction from the p-type to the n-type"
- d) "Both the electrons and holes cross the junction from the n-type to the p-type"

QUESTION 3

1 Marks

CO3

A transistor amplifier has high output impedance because

- a) Emitter is heavily doped
- b) Collector has reverse bias
- c) Collector is wider than emitter or base
- d) Base emitter is reversed biased

QUESTION 4

3 Marks

CO4

If  $ADM = 3500$  and  $ACM = 0.35$ , the CMRR is

- a) 1225
- b) 10000
- c) 80 dB
- d) answer (ii) and (iii)

QUESTION 5

2 Marks

CO1

When a p-n junction is biased in the reverse direction, it results in the reverse saturation current to flow across the junction. This reverse saturation current will \_\_\_\_\_ with increasing temperature, and hence the back resistance of the semiconductor diode \_\_\_\_\_ with increasing temperature.

- a) Increase; increases
- b) Increase; decreases
- c) Decrease; increases
- d) Decrease; decreases

QUESTION 6

3 Marks

CO1

Statement I: If intrinsic semiconductor material is doped with n-type impurities, the number of electrons increases.

Statement II: If intrinsic semiconductor material is doped with n-type impurities, the number of holes decreases below that which would be available in the intrinsic semiconductor material

- a) Statement I is correct; Statement II is incorrect.
- b) Statement I is incorrect; Statement II is correct.
- c) Both statements are correct
- d) Both statements are incorrect.

QUESTION 7

3 Marks

CO3

In a fixed-bias CE circuit, for Beta = 100,

- a) IB increases 100 times as fast as ICO.
- b) IB increases 101 times as fast as ICO.
- c) IC increases 100 times as fast as ICO.
- d) IC increases 101 times as fast as ICO.

QUESTION 8

4 Marks

CO4

Three input signals 1 V, 2 V, and 3 V are applied to the inverting terminal of the closed-loop inverting amplifier configuration through 3 k $\Omega$  resistor each. If R<sub>f</sub> = 1 k $\Omega$ , then the output voltage will be:

- a) -2 Volt
- b) -6 Volt
- c) 6 Volt
- d) 2 Volt

QUESTION 9

3 Marks

CO4

The common mode gain is

- a) Very high
- b) Very low
- c) Always 1
- d) Unpredictable

QUESTION 10

1 Marks

CO3

The purpose of RC or transformer coupling is

- a) Block A.C.

- b) Separate bias of one stage from another
- c) Increase thermal stability
- d) Block D.C.

QUESTION 11

2 Marks

CO4

In an ideal operational amplifier,

- a) "Input resistance,  $R_i = \text{Infinite}$ ; Output resistance  $R_o = 0$ ; Bandwidth = 0"
- b) "Input resistance,  $R_i = 0$ ; Output resistance  $R_o = \text{infinite}$ ; Bandwidth = infinite"
- c) "Input resistance,  $R_i = \text{infinite}$ ; Output resistance  $R_o = 0$ ; Bandwidth = infinite"
- d) "Input resistance,  $R_i = \text{infinite}$ ; Output resistance  $R_o = \text{infinite}$ ; Bandwidth = infinite"

QUESTION 12

3 Marks

CO1

Statement I: "The ripple factor is the ratio of rms value of the ac components of the current to the average value of the current in the output waveform of the rectifier circuit".

Statement II: "The ripple factor is the ratio of rms value of the ac components of the voltage to the average value of the voltage in the output waveform of the rectifier circuit".

- a) Statement I only is correct.
- b) Statement II only is correct.
- c) Both Statements are correct.
- d) Both Statements are incorrect.

QUESTION 13

1 Marks

CO1

Silicon has a total of \_\_\_\_\_ electrons in its atomic structure.

- a) 32
- b) 14
- c) 8
- d) 5

QUESTION 14

1 Marks

CO2

A transistor acts as a closed switch when it operates in:

- a) Saturation region.
- b) cutoff region.
- c) Active region.
- d) Either cutoff region or active region.

QUESTION 15

2 Marks

CO4

Which statement is correct?

- a) Slew rate signifies how rapidly the output of an op-amp can change in response to changes in the frequency of input signal.
- b) Slew rate does not change with change in voltage gain.
- c) Slew rate should be smaller for high speed op-amp applications.
- d) The Slew rate of an op-amp is not fixed.

QUESTION 16

1 Marks

CO1

The ripple factor for the full-wave rectifier circuit is:

- a) 0.482
- b) 1.11
- c) 1.21
- d) 1.57

QUESTION 17

3 Marks

CO2

In the \_\_\_\_\_ region, the \_\_\_\_\_ junction is reverse-biased and the \_\_\_\_\_ junction is forward-biased.

- a) Active; emitter; collector
- b) Active; collector; emitter
- c) Saturation; emitter; collector
- d) Cutoff; collector; emitter

QUESTION 18

4 Marks

CO2

A transistor uses voltage divider bias method, with  $R_1 = 50\text{ K}\Omega$ ,  $R_2 = 10\text{ K}\Omega$  and  $R_E = 1\text{ K}\Omega$ , If  $V_{CC} = 12\text{ V}$  and  $V_{BE} = 0.1\text{ V}$ , what is the value of  $I_C$

- a) 1.9 mA
- b) 1.7 mA
- c) 1.9  $\mu\text{A}$
- d) 1.7  $\mu\text{A}$

QUESTION 19

1 Marks

CO2

"In the saturation region, the \_\_\_\_\_ junction is forward-biased and the collector-base junction is \_\_\_\_\_."

- a) Emitter-base; forward-biased.
- b) Emitter-base; reverse-biased.
- c) Emitter-base; unbiased.
- d) Emitter-base; either forward or reverse biased.

QUESTION 20

1 Marks

CO1

"In an n-type semiconductor material, the free-electron concentration is \_\_\_\_\_ the density of donor atoms."

- a) Greater than
- b) Less than
- c) Approximately equal to
- d) Not related with

QUESTION 21

1 Marks

CO4

A common mode signal is applied to

- a) Noninverting input
- b) Inverting input
- c) Both inputs
- d) Top of tail resistor

QUESTION 22

3 Marks

CO1

"When acceptor, or p-type, impurities are added to the intrinsic semiconductor, they produce an allowable discrete energy level which is just:"

- a) Above the valence band
- b) Below the valence band.
- c) Above the conduction band.
- d) Below the conduction band.

QUESTION 23

3 Marks

CO3

In common-emitter transistor configuration, there is reverse collector saturation current  $I_{CBO}$  even when the emitter current is zero. The factor(s) that contribute to make  $I_{CBO} > I_{CO}$ ;

Statement I: There exists a leakage current which flows around the junction and across the surfaces.

Statement II: New carriers may be generated by collision in the collector-junction transition region, leading to avalanche multiplication of current and eventual breakdown.

- a) Statement I only is correct.
- b) Statement II only is correct.
- c) Both Statements are correct.
- d) Both Statements are incorrect.

QUESTION 24

1 Marks

CO1

"At 0°K, the most important practical semiconductor material silicon has typical value of an energy gap (a forbidden band) between conduction band and valence band as."

- a) 0.72 eV
- b) 0.7 eV
- c) 1.21 eV
- d) 1.1 eV

QUESTION 25

3 Marks

CO2

The input characteristics of the transistor represent simply the forward characteristics of the emitter-to-base diode for various collector voltages. There exists a threshold voltage below which the emitter current is very small. In general, this voltage is

approximately \_\_\_\_\_ for germanium transistors and \_\_\_\_\_ for silicon transistors.

- a) 0.3V; 0.7V
- b) 0.2V; 0.6V
- c) 0.1V; 0.5V
- d) 0.1V; 0.7V

QUESTION 26

2 Marks

CO3

Which one of the following statements justify the negative feedback?

- a) "When the feedback voltage is applied so as to increase the input signal level, and the feedback is in-phase with the input signal."
- b) "When the feedback voltage is applied so as to decrease the input signal level, and the feedback is in-phase with the input signal."
- c) "When the feedback voltage is applied so as to increase the input signal level, and the feedback is out-of-phase with the input signal."
- d) "When the feedback voltage is applied so as to decrease the input signal level, and the feedback is out-of-phase with the input signal."

QUESTION 27

3 Marks

CO2

Statement I: The emitter efficiency of a BJT is the ratio of total emitter current to current of injected carriers at emitter-junction.



Statement II: The large-signal current gain of a common-base transistor is the ratio of the collector current increment to the emitter-current change from zero to  $I_E$ .

- a) Statement I only is correct
- b) Statement II only is correct.
- c) Both Statements are correct.
- d) Both Statements are incorrect.

QUESTION 28

3 Marks

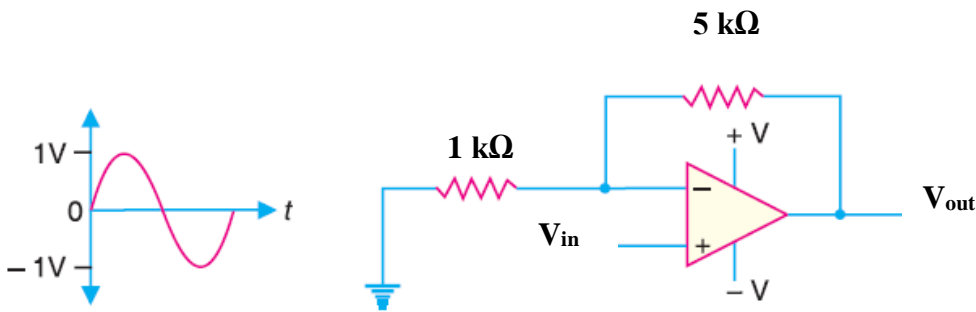
CO4

The output of a particular OP-AMP increase 8 V in 12 micro sec. The slew rate is

- a) 90 V/ $\mu$ s
- b) .67 V/ $\mu$ s
- c) 1.5 V/ $\mu$ s
- d) none of these

**Section – B (Attempt all the questions, all questions carry equal marks)  
(40 marks)**

Q1 (a) Find peak-to-peak output voltage for the operational amplifier circuit shown in the figure below: CO4



(b) Explain the terms ‘CMRR’ and ‘Slew Rate’ in contest to an operational amplifier. CO4

Q2. With the help of circuit diagrams, explain the working of OP-AMP as  
(1) Inverting amplifier, (2) Non-inverting amplifier, (3) Differentiator and (4) Integrator. CO4

Q3. Discuss Base Resistor method of transistor biasing through circuit diagram. Also, calculate its stability factor. CO3

Q4. When negative voltage feedback is applied to an amplifier of gain 100, the overall gain falls to 50.

- (i) Calculate the fraction of the output voltage feedback.
- (ii) If this fraction is maintained, calculate the value of the amplifier gain required if the overall gain is to be 75. CO3