B.Sc. Semester-IV Examination, 2022-23
PHYSICS [Honours]

Course ID : 42413   Course Code : SH/PHS/403/C-10(T10)

Course Title : Analog Systems and Applications

Time : 1 Hour 15 Minutes   Full Marks : 25

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

SECTION–I

1.   Answer any **five** questions: $1\times5=5$

   a)   Why do Si or Ge diodes not emit light but GaAs diode does?

   b)   In an n-p-n transistor, 95% of emitted electrons reach to collector. If the collector current is $19\,\mu A$, then determine the value of base current.

   c)   Draw the output characteristics curves of an n-p-n transistor in CE mode. Indicate the active, cut-off and saturation regions on the output curves.

   d)   A p-n junction Ge diode has the reverse saturation current of $1.5\,\mu A$ at 300 K. Obtain the dynamic resistance of the diode at that temperature for an applied forward voltage of 0.3 V.

   e)   Why a transistor cannot be made by joining two diodes back to back?

   f)   An n-channel JFET has $I_{DSS} = 12$ mA. If the pinch off voltage $V_P = -4V$, find the drain current for $V_{GS} = -2V$.

   g)   Why filters are used at the output of a rectifier system?

   h)   What is fundamental principle inherent for the action of a Photodiode?

SECTION–II

2.   Answer any **two** questions: $5\times2=10$

   a)   Draw a neat circuit diagram for a full wave rectifier and explain its operation. Calculate the efficiency of rectification of the full wave rectifier.
$$1+2+2$$

   b)   Discuss the operation and working of a Zener diode and a real example of its use. Draw the energy level diagram for unbiased p-n junction.
$$(1+2+1)+1$$

   c)   i)   What is early effect? What is punch through in a transistor?

   ii)   Find the transistor currents and V_{CE} in the following circuit with silicon transistor of β value 100 and negligible I_{co}. $1+1+3$

$V_{cc} = 10\ Volt$

$R_B = 250\ k\Omega$ $R_C = 2\ k\Omega$

$\beta = 100$

$R_E = 1\ k\Omega$
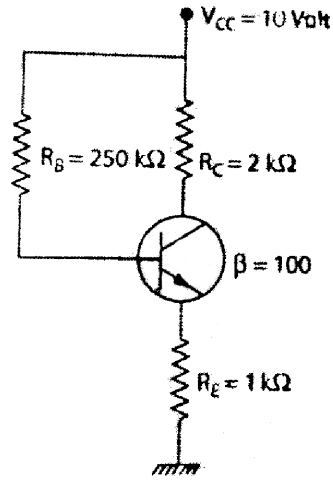
d) What do you mean by feedback in amplifier? What do you mean by positive and negative feedback? Find the relation between the open loop gain and closed loop gain of a negative feedback amplifier.

1+(1+1)+2

SECTION–III

3. Answer any **one** question: 10×1=10

a) i) Draw the h-parameter equivalent circuit of two stage RC coupled amplifier and find its mid frequency gain.

ii) The mid frequency gain of a RC coupled amplifier is 120. At frequency 100 Hz and 100 kHz, the gain falls to 60. Determine the lower and upper cut-off frequencies.

iii) Define frequency distortion in an amplifier.

iv) The output voltage of an amplifier is 10 V at 5 kHz and 70.07 V at 25 kHz. What is the decibel change in the output power level?

5+3+1+1

b) Why OP-AMP is so called? What is common mode rejection ratio of an OP-AMP? How do the characteristics of a practical OP-AMP differ from that of an ideal OP-AMP? Explain how an OP-AMP may be used as (i) differentiator (ii) integrator. 1+1+2+3+3

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