*Total number of printed pages–7*

**3 (Sem–4/CBCS) PHY HC 3**

**2023**

# PHYSICS

( Honours Core )

Paper : PHY–HC–4036

***( Analog Systems and Applications )***

*Full Marks : 60*

Time : Three hours

***The figures in the margin indicate full marks for the questions.***

**Answer** the following questions as directed : 1×7=7

*(i)* The random motion of holes and free electrons due to thermal agitation is called _____. *(Fill in the blank)*

*(ii)* A photodiode is normally

*(a)* forward biased

*(b)* reverse biased

*(c)* emitting light

*(d)* neither forward nor reverse biased

*(Choose the correct option)*

*Contd.*

(iii) The voltage gain of a transi
connected in _____ arrangement
highest.

(a) common base

(b) common collector

(c) common emitter

(d) None of the above

*(Choose the correct op*

(iv) Which of the following amplifiers
the highest linearity and low
distortion ?

(a) Class A

(b) Class B

(c) Class C

(d) Class AB

*(Choose the correct op*

(v) In an RC phase-shift oscillator,
frequency determining elements
_____. *(Fill in the bla*

(vi) Negative feedback in an OP-A
increases the input impedance a
bandwidth. *(Write True* **or** *Fa*



(vii) A voltage follower has a voltage gain of _____. *(Fill in the blank)*

Give short answers of the following questions : 2×4=8

(i) How are potential barrier and depletion region formed in a *p-n* junction ?

(ii) Draw a capacitor filter circuit. How the value of capacitor is choosen in a shunt capacitor filter ?

(iii) In a CB transistor amplifier, if the collector current $I_C = 2\,mA$ and the base current $I_B = 0.04\,mA$, calculate the current amplification factors $\alpha$ and $\beta$ respectively.

(iv) What are d.c and a.c load lines ? What do they specify ?

Answer the following questions : ***(any three)*** 5×3=15

(i) Draw a fixed biased circuit. Derive the expression for its stability factor. Mention the disadvantage of this circuit. 2+2+1=5

(ii) State Barkhausen criterion fo
sustained oscillations. Expla
conditions that must be satisfie
sinusoidal oscillators to produce
oscillations.

(iii) Write *two* advantages of neg
feedback. The gain of an amplifi
150. When negative feedback is ap
the voltage gain is reduced to
(a) Determine the percentage
feedback. (b) If the gain of the amp
with feedback is 80, calculate the
of the amplifier without feedback.
2+1½+1

(iv) Write down the characteristics of
ideal Op-Amp. With the help of a cir
diagram, describe the non-inver
Op-Amp with feedback. 2+

(v) Write short notes on : **(any one)**

(a) Fullwave bridge rectifier

(b) Class AB amplifier



Answer the following questions : **(any three)** 10×3=30

(i) What are intrinsic and extrinsic semiconductors ? Define mobility of a charge carrier and mention its unit. Derive an expression for the conductivity of an extrinsic semiconductor in terms of the concentration $n$ and $P$ and the mobilities $\mu_n$ and $\mu_P$. 2+2+6=10

(ii) Draw the circuit diagram of a fullwave rectifier and calculate its ripple factor and efficiency.

A halfwave rectifier uses an internal resistance $r_f = 20\,\Omega$. If the applied voltage is $V = 40 \sin \omega t$ and load resistance is 780 $\Omega$, then find —

(i) $I_m$, $I_{dc}$ and $I_{rms}$ ;

(ii) ac power input and dc power input. (1+2+2)+(3+2)=10

(iii) State and explain the characteris
CE transistor amplifier. What is
by the leakage current in transis
Show that $I_C = \beta I_B + I_{CBO}$, w
$I_C$, $I_B$ and $I_{CBO}$ are collector cur
base current and collector to
leakage current respectively.
(1+2)+1+6

(iv) Draw a neat diagram of two stage
coupled transistor CE amplifier. D
the expression for the voltage gai
RC coupled amplifier for high freque
range by drawing its ac equiva
circuit. What is half-power frequen
Why it is called 3 *db* frequency ?
2+6+2

(v) Explain how an OP-Amp can be
as (a) a summing amplifier,
(b) logarithmic amplifier.
A non-inverting amplifier
$R_1 = 20\,k\Omega$ and $R_f = 100\,k\Omega$. W
would be the output voltage for an i
voltage of 1 *V* if the power su
voltage is $\pm 12\,V$ ?
(4+4)+2



(vi) Write short notes on : ***(any two)***
5×2=10

(a) Colpitt's oscillator

(b) Analog to digital converter

(c) Wien bridge oscillator

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