[This question paper contains 4 printed pages.]

Sr. No. of Question Paper : 2389 F–4 Your Roll No.....

Unique Paper Code : 2221403

Name of the Course : **B.Sc. (Hons) Physics**

Name of the Paper : Analog System and Applications

Semester : IV

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **five** questions in all.
3. Question No. **1** is compulsory.
4. Non programmable calculators are allowed.

1. Attempt any **five** of the following

(a) Draw the output characteristics of a solar cell and label important parameters.

(b) Define accuracy and resolution for an D/A converter

(c) What is the difference between differential and common mode inputs for an op-amp.

(d) The energy gap of the semiconducting material of an LED is 1.37eV. What is the wavelength of the emitted light?

(e) Show that $I_c = \beta I_B + (1 + \beta) I_{CBO}$

(f) Distinguish between Class A and Class B amplifiers with the help of load line and Q point.

(g) Define PIV, ripple factor and rectification efficiency of a rectifier.

(3×5=15)

P.T.O.

2. (a) Obtain an expression for the barrier width of a p-n junction diode, assuming a step junction.

(b) In a Ge sample a donor type impurity is added to the extent of 1 atom per 10^8 Ge atoms. Find the concentration of electrons and holes in the sample. Given $N_i = 2.5 \times 10^{13}$ electrons / cm^3 and number of Ge atoms is 4.41×10^{22} per cm^3. (12,3)

3. (a) Explain the working of a center-tap full wave rectifier using suitable diagrams and obtain the expressions for

(i) ripple factor and

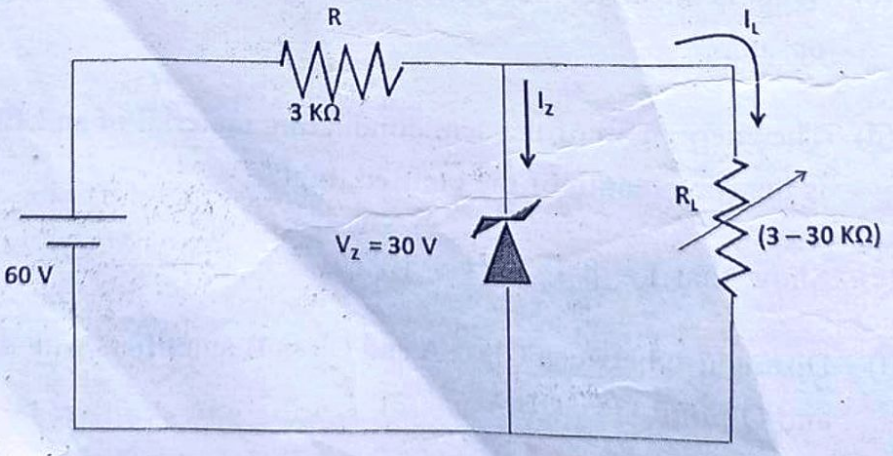
(ii) rectification efficiency.

(b) Find the current through the zener diode in the following circuit when load resistance R_L is :

(i) 30kΩ,

(ii) 5kΩ

(iii) 3kΩ



(11,4)

4. (a) Describe "load line" and "Q-point" of a transistor in CE configuration with appropriate diagram.

(b) Draw a diagram for the voltage divider bias circuit of an n-p-n transistor in CE configuration. Derive an expression for the stability factor (S) using Thevenin's equivalent circuit.

(c) Find the Q - point of the fixed bias circuit with $R_C = 4k\Omega$, $R_B = 1.2\ M\Omega$, $V_{CC} = 9.0\ V$, $V_{BE} = 0.2\ V$ and $\beta = 80$. (4,4,7)

5. (a) Using 'h' parameters, obtain expressions for current gain, voltage gain, input impedance and output impedance for transistor in CE configuration.

(b) For a 4-bit binary R-2R ladder D/A converter the input levels are 0=0V and 1=+10V. Find the output voltage caused by

(i) 0011,

(ii) 1001 and

(iii) 1111. (12,3)

6. (a) Describe the conditions for sustained oscillations in an oscillator? Derive an expression for the frequency of a Colpitt's oscillator.

(b) A phase shift oscillator has three identical RC sections R_L=R=10kΩ and C=0.01μF. Determine the frequency of oscillation. (12,3)

7. (a) Explain with the help of an appropriate circuit diagram the working of a logarithmic amplifier using an op-amp.

(b) What would be the output of an op-amp in the inverting mode if input resistance is 1 kΩ and feedback resistance is

(i) 2 kΩ and

P.T.O.

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(ii) 20kΩ for a dc input signal of 1.5 V? ($V_{sat} = \pm 14$ V).

(c) Draw the circuit of an Op-amp as an integrator and find an expression for its output. Draw the output waveform when the input to the integrator is a square wave. (6,3,6)

This question paper contains 4+1 printed pages]

Roll No. | | | | | | | | | | |

S. No. of Question Paper : **2822**

Unique Paper Code : **32221403** **GC-4**

Name of the Paper : **Analog Systems and Applications**

Name of the Course : **B.Sc. (Hons) Physics**

Semester : **IV**

Duration : **3 Hours** Maximum Marks : **75**

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt *five* questions in all.

Question No. **1** is compulsory.

Non-programmable calculators are allowed.

Attempt any *five* of the following :

(*a*) Draw the energy band diagram of an unbiased p-n junction diode with appropriate labels.

(*b*) Differentiate between Zener breakdown and Avalanche breakdown in a p-n junction diode.

P.T.O.

(*c*) The energy gap of the semiconducting material of an LED is 1.37 eV. What is the wavelength of the emitted light ?

(*d*) Draw the output characteristics of a transistor in CE mode and identify the active, cut-off and saturation regions.

(*e*) Distinguish between Class A and Class B amplifiers with the hep of load line and Q point.

(*f*) Explain the Barkhausen's criterion for sustained oscillation.

(*g*) What is the difference between differential and common mode inputs for an Op-amp ?

(*h*) For a 4-bit binary R-2R ladder D/A converter the input levels are 0 = 0V and 1 = + 10V.

Find the output voltage caused by :

(*i*) 0011

(*ii*) 1001 and

(*iii*) 1111.

5×3=15

2. (*a*) Obtain an expression for the barrier width of a p-n junction diode, assuming a step junction.

(*b*) In a Ge sample a donor type impurity is added to the extent of 1 atom per 10^8 Ge atoms. Find the concentration of electrons and holes in the sample. Given $N_i = 2.5 \times 10^{13}$ electrons/cm^3 and number of Ge atoms is 4.41×10^{22} per cm^3.

3. (*a*) Explain the working of a center-tap full wave rectifier using suitable diagram and obtain the expressions for :

(*i*) ripple factor and

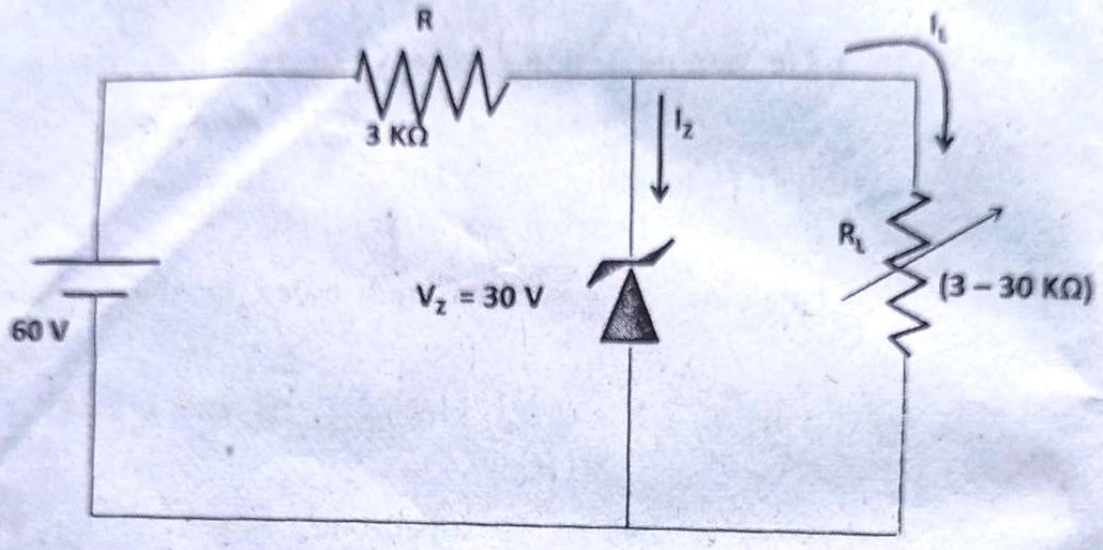
(*ii*) rectification efficiency.

(*b*) Find the current through the Zener diode in the following circuit when load resistance R_L is :

(*i*) 30 kΩ

(*ii*) 5 kΩ and

(*iii*) 3 kΩ. 9,6



4. (*a*) What are the factors that affect the bias stability of a transistor ? Compare the "voltage divider bias circuit" with the "fixed bias circuit" with respect to their stability. Explain how the self-biasing resistor improves the stability.

(*b*) Obtain the general expression for stability factor S of a common-emitter configuration. 10,5

5. Explain the working of RC coupled amplifier and give its frequency response. How does the gain change at low, mid and high frequencies ? Derive the expressions for the gain in the mid and high frequency regions. 15

(*a*) Draw the circuit diagram of an RC phase shift oscillator using transistor and state the conditions for sustained oscillations. Derive an expression for its frequency.

(*b*) In a Colpitt's oscillator $C_1 = 0.1\ \mu F$, $C_2 = 0.01\ \mu F$ and $L = 50$ mH, find the frequency of oscillation. 10,5

(*a*) Draw the circuit of an op-amp as an integrator and find an expression for its output. Draw the output waveform when the input to the integrator is a square wave.

(*b*) What would be the output of an op-amp in the inverting mode if input resistance is 1 kΩ and feedback resistance is (*i*) 2 kΩ and (*ii*) 20 kΩ for a dc input signal of 1.5 V ? ($V_{sat} = \pm 14$ V). 10,5

This question paper contains 4 printed pages.

Your Roll No. .....

S. No. of Paper	: 6684	HC
Unique Paper Code	: 32221403	
Name of the Paper	: **Analog Systems and Applications**	
Name of the Course	: **B.Sc. (Hons.) Physics**	
Semester	: **IV**	
Duration	: **3 hours**	
Maximum Marks	: 75	

(Write your Roll No. on the top immediately on receipt of this question paper.)

*Attempt **five** questions in all.*
Question No. 1 is compulsory.

Non-programmable calculators are allowed.

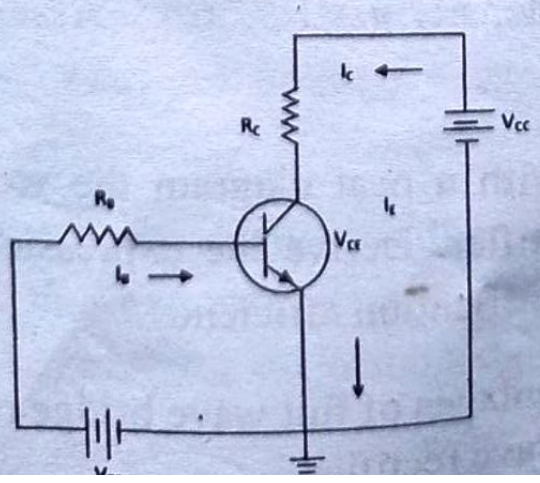
1. Attempt any **five** of the following:

(a) Define drift and diffusion currents in doped semiconductors.

(b) Explain with a circuit diagram, how Zener Diode is used in voltage regulation under varying load conditions.

(c) Draw the IV characteristics of a Solar cell for different intensities of light.

(d) Calculate the value of I_B, I_C and V_{CE} for the following circuit, given that R_B=470 kΩ; R_C = 2.2 kΩ; V_{BB}= V_{CC}= 18 V; β=100.



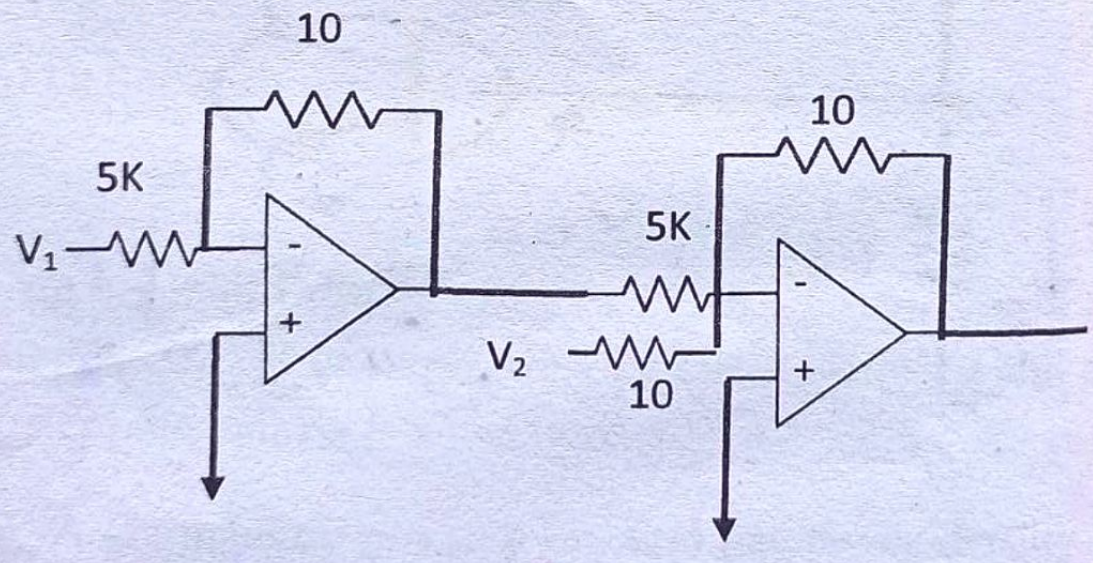
P. T. O.

(b) In a phase shift oscillator, R= R_L =10 kΩ and C= 0.0 μF, calculate the time period of oscillation and h_{fe} of the transistor. 10, 5

7. (a) Draw the circuit of an Op-amp as a Differentiator and explain its operation.

(b) An op-amp integrator has R=1 MΩ and C=0.5 μF. With input signal 2 sin 100πt determine the output voltage as a function of time assuming that initial voltage across capacitor is zero. Sketch the output in relation to the input.

(c) In the following circuit calculate output voltage if V_1 =5 V and V_2 =2 V. 5,5,5



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Your Roll No. : .....

Sl. No. of Q. Paper : **2266** **IC**

Unique Paper Code : 32221403

Name of the Course : **B.Sc. (Hons.) Physics**

Name of the Paper : Analog Systems and Applications

Semester : IV

Time : 3 Hours ***Maximum Marks : 75***

Instructions for Candidates :

(a) Write your Roll No. on the top immediately on receipt of this question paper.

(b) Attempt any **five** questions in all.

(c) Question **NO.1** is compulsory.

(d) **All** parts of a question should preferable by attempted together.

1. Attempt any **five** of the following : 3×5=15

(a) Draw the output characteristics of a photodiode and label important parameters.

P.T.O.

(b) Mention some advantages of Schottky barrier diode over the p-n junction diode.

(c) Describe briefly CMRR and Slew rate for an op-amp.

(d) Draw the circuit and describe the working of a log amplifier.

(e) Draw the energy band diagram for insulator, conductor and semiconductor. How does doping affect the Fermi energy level of a semiconductor ?

(f) For a pnp transistor, the current amplification factor (β) is 100. What is the value of α? If I_{CBO} = 10 μA, what is the collector current (I_C) for an emitter current (I_E) of 2 mA ?

(g) An RC coupled amplifier has a voltage gain of 150 in the frequency range of 500 Hz to 50 kHz. On either side of these frequencies, the gain falls such that it is reduced by 3dB at 100 Hz and 100 kHz. Calculate gain in dB at cut of frequencies and also draw a plot of frequency response.

2. (a) Show that the depletion width for a step junction pn diode in equilibrium condition is given as :

$$W=\sqrt{2\varepsilon \frac{V_o}{q} \frac{(N_a+N_d)}{N_a N_d}}$$

where symbols have their usual meaning.

10

P.T.O.

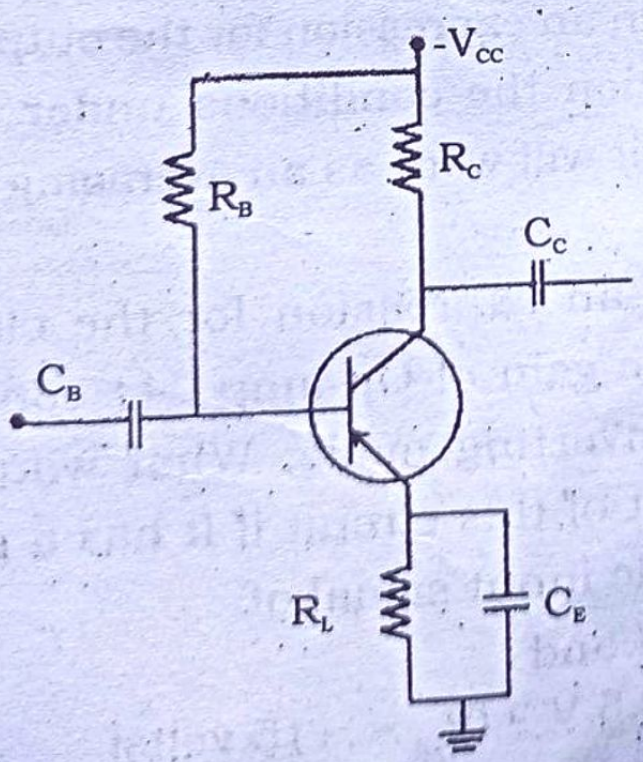
(b) The reverse saturation current at 300K of a pn junction Ge diode is 5 μA. Find the voltage to be applied across the junction to obtain a forward current of 50 mA. Given that the ideality factor for the Ge diode is 1, value of Boltzmann constant is 1.38×10^{-23} J/K and q is 1.6×10^{-19} C. 5

3. (a) Explain the working of a full wave bridge rectifier using suitable diagrams and obtain the expressions for (i) ripple factor and (ii) rectification efficiency. How this rectifier circuit is advantageous over the centre tap full wave rectifier ? 10

(b) In a Zener diode voltage regulator circuit, the source series resistance, $R_s = 20\,\Omega$ Zener voltage $V_z = 18V$ and load resistance $R_L = 200\,\Omega$. How load current is related to the values of current flowing through zener diode ? If source voltage V_s is varied from 20V to 30V, find the maximum and minimum current flowing through the zener diode. 5

4. (a) Draw the circuit for a transistor amplifier in CE configuration using voltage divider bias circuit and derive the expressions for I_c and V_{CE}. Explain the origin of phase difference between the input and output voltages in a transistor amplifier in CE configuration. 10

(b) A pnp transistor having a DC current gain of 100 in CE configuration is to be biased at I_c = 5mA and V_{CE} = 3.8 V. The collector load has a resistance of 500 Ω. If V_{cc} = – 10V and V_{BE} = – 0.3 V. Calculate the values of R_B and R_E for the figure given below 5



P.T.O.

5. (a) Using the h-parameter equivalent circuit for a transistor amplifier in CE configuration, derive the expressions for voltage gain and input impedance. 10

(b) Explain negative and positive feedback using block diagrams ? Discuss the effect of negative feedback on the input impedance of the amplifier. 5

6. (a) Draw the circuit of an Op-amp as a non inverting summing amplifier for three voltage input signals (V_1, V_2 and V_3) and obtain an expression for the output voltage. Mention the conditions under which the circuit will work as an averaging amplifier. 10

(b) Write an expression for the closed loop voltage gain of Op-amp 741 configured in non-inverting mode. What would be the output of this circuit if it has a gain of 10 for a dc input signal of

(i) +1V and

(ii) + 2.5 V ? (V_{cc} = ±15 volts). 5

7. (a) Explain the working of a Hartley oscillator and write the expression for its frequency of oscillation. Determine the value of involved capacitor for obtaining f_o = 100 kHz using inductors of equal inductance of 10 mH.

10

(b) In a R-2R binary ladder based D/A convertor input reference voltage of + 10 V is applied. Find the equivalent analog output voltage for the following digital input states (i) 1001 and (ii) 1011. What should be the value of full scale analog output voltage for the 8-bit D/A converter ?

5