This question paper contains **4** printed pages]

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

S. No. of Question Paper : **6218**

Unique Paper Code : **222504** **D**

Name of the Paper : **Electronic Devices (PHHT-518)**

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

Semester : **V**

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. *All* questions carry equal marks.

Question No. **1** is compulsory. Use of Scientific Calculator is allowed.

All symbols have their usual meaning.

($h = 6.63 \times 10^{-34}$ Js, $k_B = 1.38 \times 10^{-23}$ J/K, $q = 1.6 \times 10^{-19}$ C, $c = 3 \times 10^8$ m/s.)

5×3=15

1. Answer the following questions (any *five*) :

(*a*) Calculate I_C and I_E for a transistor that has $\alpha = 0.98$ and $I_B = 100\ \mu A$.

(*b*) The wavelength of light emitted by a certain LED is 60 nm. Find the energy gap in eV.

(*c*) Determine peak point emitter voltage for a UJT transistor if $V_{BB} = 20$ V and $\eta = 0.6$.

P.T.O.

P.T.O.

(*d*) What is the position of the Fermi level in an intrinsic semiconductor ? How does its position change when :

(*i*) donors and

(*ii*) acceptors

are added to the semiconductor ?

(*e*) Show that negative feedback helps in reduction of noise in amplifiers.

(*f*) Give a short note on photodiode.

(*g*) Differentiate between amplifier and oscillator. State Barkhausen Criterion for self-sustained oscillations.

2. (*a*) Explain the concept of potential energy barrier.

(*b*) Derive the Volt-Ampere (V-I) equation for a *p-n* junction diode.

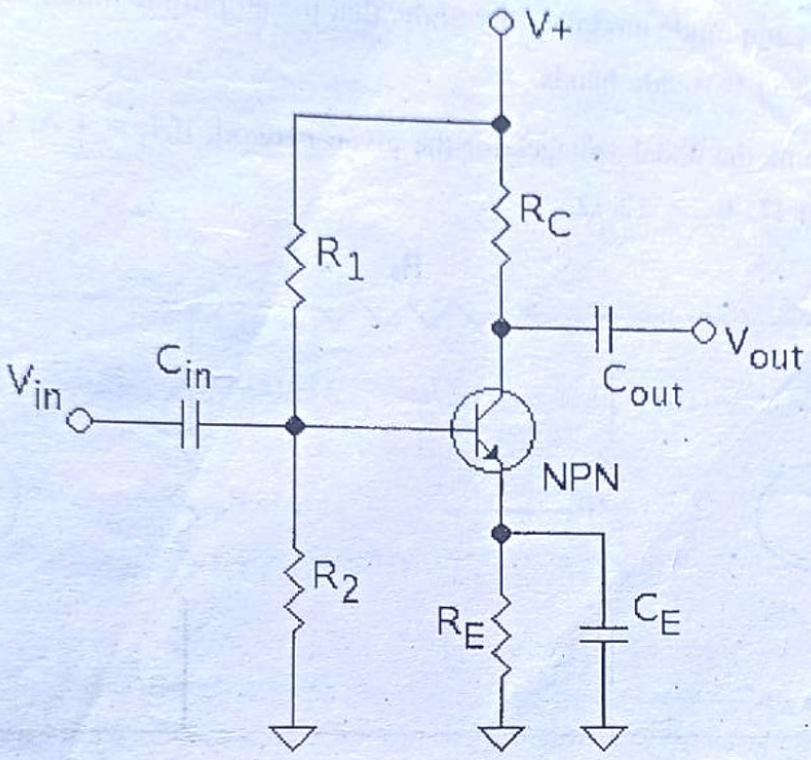
(*c*) For an abrupt Ge *p-n* junction doped with donor and acceptor concentrations of $N_d = 10^{23}$ m^{-3} and $N_a = 10^{22}$ m^{-3}, calculate the potential barrier if intrinsic carrier density $n_i = 10^{13}$ cm^{-3}. Assume $KT/q = 0.026$ V. 2,10,3

3. (*a*) Draw circuit diagram of a Full Wave rectifier. Calculate I_{dc}, I_{rms}, ripple factor, efficiency of rectification.

(*b*) With the help of energy band diagram, explain current *Vs.* voltage characteristics of a Tunnel diode in forward and reverse biasing conditions. 8,7

4. (*a*) Why the voltage divider bias circuit is preferred to Fixed bias circuit for a BJT ? Calculate stability factors S of voltage divider bias circuit.

(*b*) Determine the dc bias voltage and the current I_c for the voltage-divider configuration if V = 22 V, R_1 = 39 kΩ, R_2 = 3.9 kΩ, R_c = 10 kΩ, R_E = 1.5 kΩ, C_{in} = C_{out} = 10 μF, C_E = 50 μF and β = 140. 8,7



5. (*a*) Draw the circuit diagram of RC coupled amplifier. Give its ac equivalent circuit in different frequency ranges. Derive its voltage gain in low frequency region.

(*b*) Calculate hybrid parameters of a CE single stage transistor amplifier :

(*i*) with a.c. output shorted having I_b = 20 μA, I_c = 1 mA, V_{be} = 22 mV and V_{ce} = 0 V

(*ii*) with a.c. input open circuited having I_b = 0 μA, I_c = 30 μA, V_{be} = 0.25 mV and V_{ce} = 1 V. 8,7

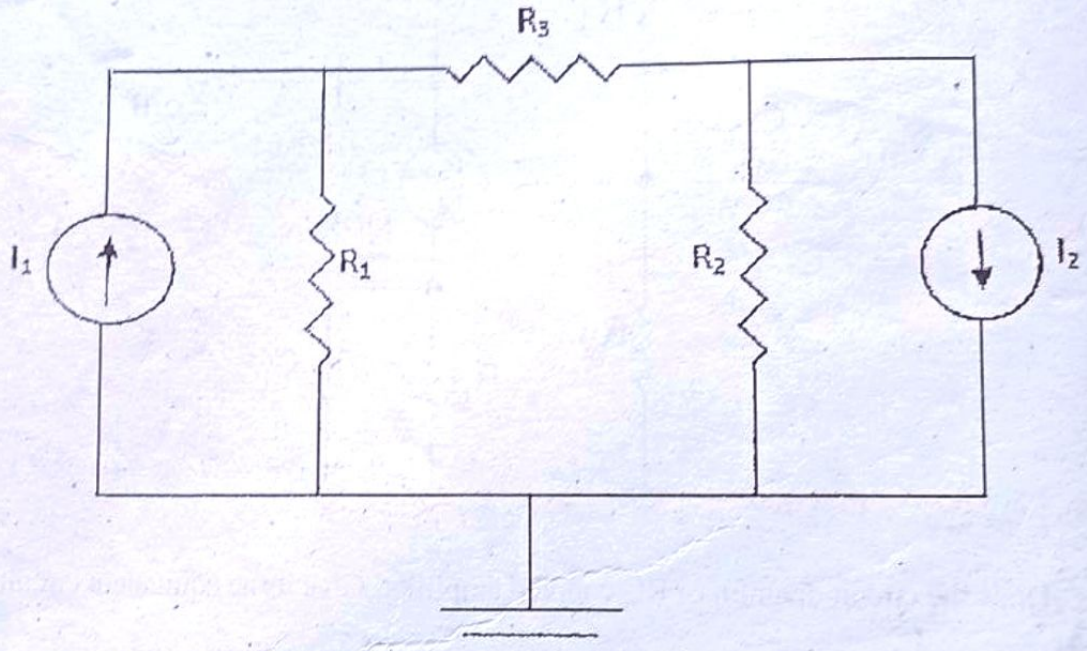
P.T.O.

6. (*a*) Explain the working of a transistor astable multivibrator. Obtain an expression for t period and draw the output waveform for both the transistors.

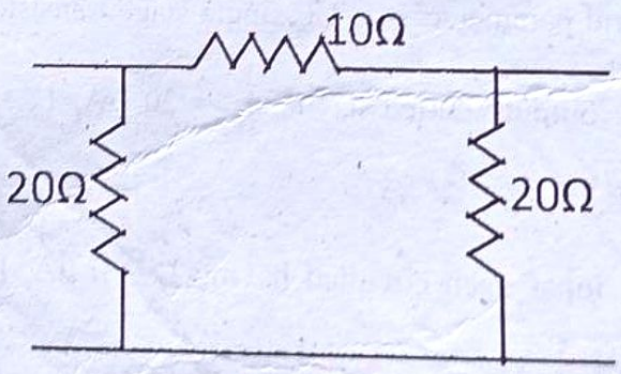
(*b*) Explain the working of a JFET. Draw and discuss the transfer and drain characteris of an *n*-channel JFET. Also give its equivalent circuit.

7. (*a*) What is amplitude modulation ? Show that the amplitude modulated wave consist carrier and two side bands.

(*b*) Determine the nodal voltages for the given network if $I_1 = 4$ A, $I_2 = 2$ A, $R_1 = 2$ $R_2 = 6\ \Omega$, $R_3 = 12\ \Omega$.



(*c*) Convert the following π to T network.



This question paper contains 4+1 printed pages]

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

S. No. of Question Paper : 928

4 DEC 2014

Unique Paper Code : 222504 E

Name of the Paper : Electronic Device (PHHT-518)

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

Semester : V

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. *All* questions carry equal marks.

Question No. 1 is compulsory. Use of scientific calculator is allowed.

All symbols have their usual meaning.

($h = 6.63 \times 10^{-34}$ Js, $K_B = 1.38 \times 10^{-23}$ J/K,

$q = 1.6 \times 10^{-19}$ C, $c = 3 \times 10^{8}$ m/s)

1. Answer the following questions (any *five*) :

(*a*) For a semiconductor material of a light emitting diode energy gap is 1.37 eV. What is the wavelength of the emitted light ?

P.T.O.

(*b*) A phase shift oscillator has three identical RC sections $R_L = R = 10\ k\Omega$ and $C = 0.01\ \mu F$. Determine the frequency of oscillation.

(*c*) What do you understand by Quiescent point of a transistor amplifier ?

(*d*) What do you understand by the static and dynamic resistance of a diode ?

(*e*) A certain transistor has a current gain of 0.99 in CB configuration. Calculate its current gain in CE configuration.

(*f*) Give a short note on Varactor diode.

(*g*) Show how does negative feedback in an amplifier improve its stability. 5×3=15

2. (*a*) What is the difference between Avalanche breakdown and Zener breakdown in a *p-n* junction diode.

(*b*) For an unbiased *p-n* junction, sketch the variation of the space charge, electric field and electric potential as a function of distance across the junction giving the relevant equations.

(*c*) A Germanium *p-n* step junction has donor density $N_d = 10^{17}\ cm^{-3}$ on *n* side and acceptor density $N_a = 10^{15}\ cm^{-3}$ on *p* side. Calculate the built-in potential at junction if intrinsic carrier density $n_i = 10^{13}\ cm^{-3}$. Assume KT/q = 0.026 V. 4,8,3

3. (*a*) Explain with a circuit diagram, how Zener diode is used in voltage regulation under both varying input and varying load conditions.

(*b*) Determine :

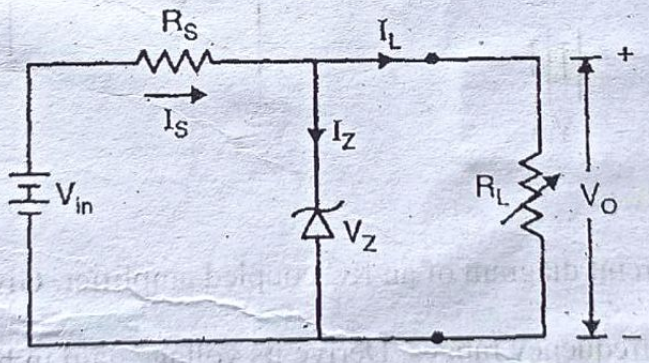
(*i*) output voltage V_o

(*ii*) voltage across R_s

(*iii*) Load current, I_L

(*iv*) input current I_s

(*v*) Current through Zener diode, I_z if V_{in} = 12 V, R_s = 5 kΩ, R_L = 10 kΩ and V_z = 8 V for the following circuit :

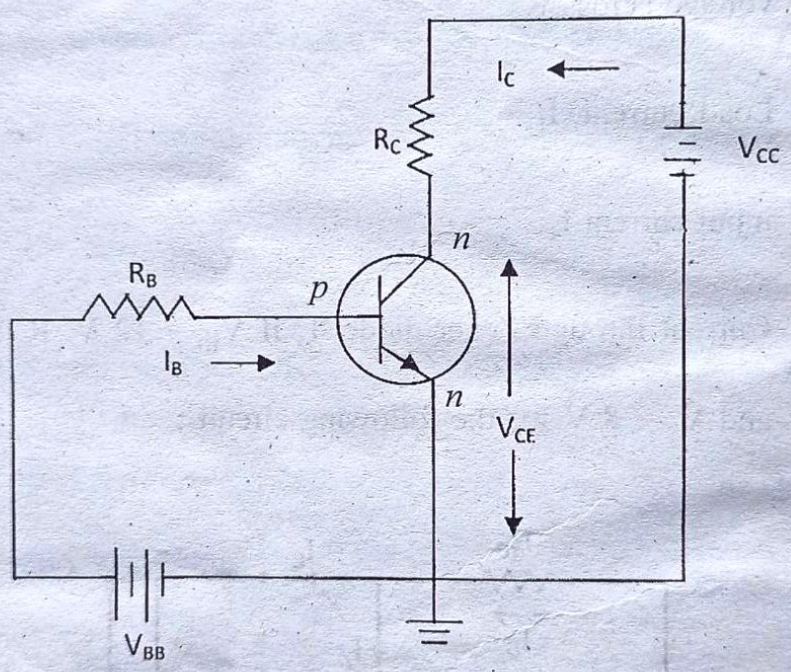


(*c*) How does a tunnel diode differ from a conventional *p-n* junction diode ? Show when do the bands become 'uncrossed', with the help of its energy band diagram. 5,5,5

P.T.O.

4. (*a*) Draw the voltage divider biasing circuit for a BJT. Explain qualitatively why such a circuit is an improvement on the fixed bias circuit as far as stability is concerned.

(*b*) For the given Si n-p-n transistor circuit, determine V_{BE}, I_B, I_C, I_E, V_{CE} and V_{CB} if $V_{BB} = 5$ V, $R_B = 10$ kΩ, $R_c = 10$ Ω, $V_{cc} = 10$ V and $\beta = 150$. 8,7



5. (*a*) Draw the circuit diagram of an RC coupled amplifier. Give its a.c. equivalent circuit in different frequency ranges. Derive its voltage gain in high frequency region.

(*b*) A transistor used in CE configuration has the following set of *h*-parameters :

$h_{ie} = 1$ kΩ, $h_{fe} = 100$, $h_{re} = 5 \times 10^{-4}$ and $h_{oe} = 2 \times 10^{-5}$ S with $R_s = 2$ kΩ and $R_c = 5$ kΩ.

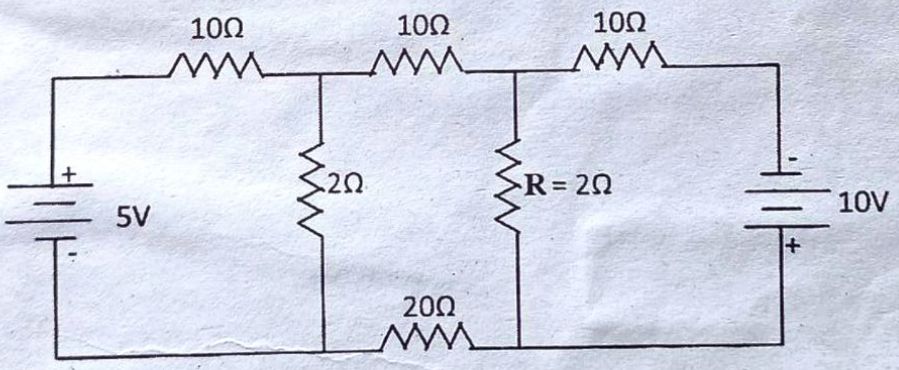
Determine input impedance, voltage gain, output impedance and current gain. 8,7

6. (a) How does a monostable multivibrator using transistors work ? Give the output waveform.

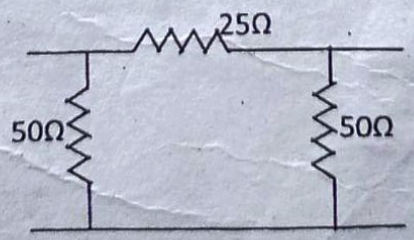
(b) What is the construction of a UJT ? How is UJT used as a relaxation oscillator ? Derive an expression for the frequency of oscillation. 7,8

7. (a) A sinusoidal carrier voltage is amplitude modulated by a sinusoidal voltage of 10 kHz to a depth of 30%. Calculate frequency and amplitude of two side bands if the carrier frequency and amplitude are 10 mHf and 20 V respectively. Also draw the frequency spectrum.

(b) Find the voltage across R using mesh analysis for the following circuit :



(c) Convert the following π to T network : 7,5,3



This question paper contains 4 printed pages. Dec 2012 *Your Roll No.* .....

C

Sl. No. of Ques. Paper : 8423
Unique Paper Code : 222504
Name of Paper : **PHHT-518 : Electronic Devices**
Name of Course : **B.Sc. (Hons) Physics Part III**
Semester : **V**
Duration : 3 hours *Maximum Marks* : 75

Attempt five questions in all. All questions carry equal marks.
Question No. 1 is compulsory. Attempt at least
***one** question from each Section.*

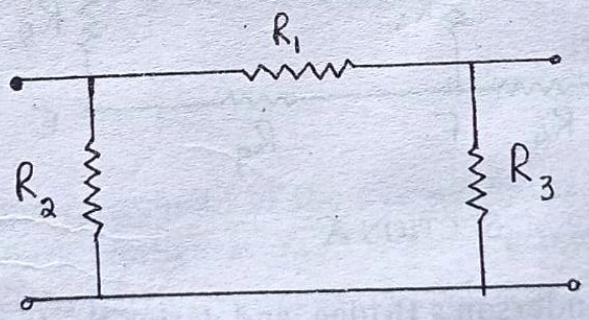
Use of scientific calculator is allowed.

(All symbols have their usual meaning.
$h=6\cdot63\times10^{-34}$ Js, $k_B=1\cdot38\times10^{-23}$ J/K, $q=1\cdot6\times10^{-19}$ C, $c=3\times10^8$ m/s)

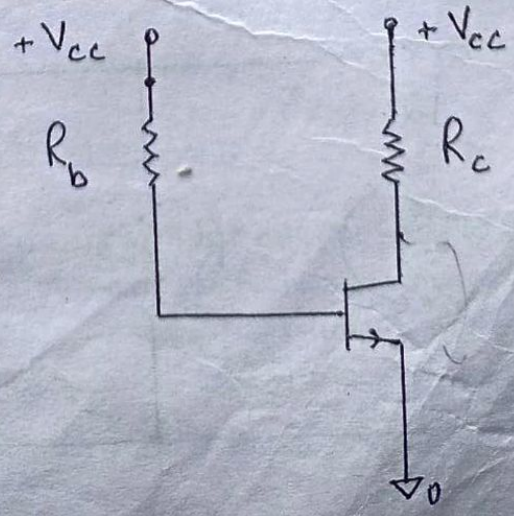
$3\times5=15$

1. Answer any *five* of the following:

(a) Convert the given network into its T equivalent circuit. Given $R_1=R_2=R_3=8\ \Omega$.



(b) Find the voltage at the collector in the circuit shown below.



P. T. O.

Given : $R_b = 240\,k\Omega$, $R_c = 2{\cdot}2\,k\Omega$, $V_{CC} = 12\,V$, $V_{BE} = 0{\cdot}7\,V$ and $\beta = 100$

(c) Show the position of the Fermi level in intrinsic, P-type and N-type semiconductor with suitable diagrams.

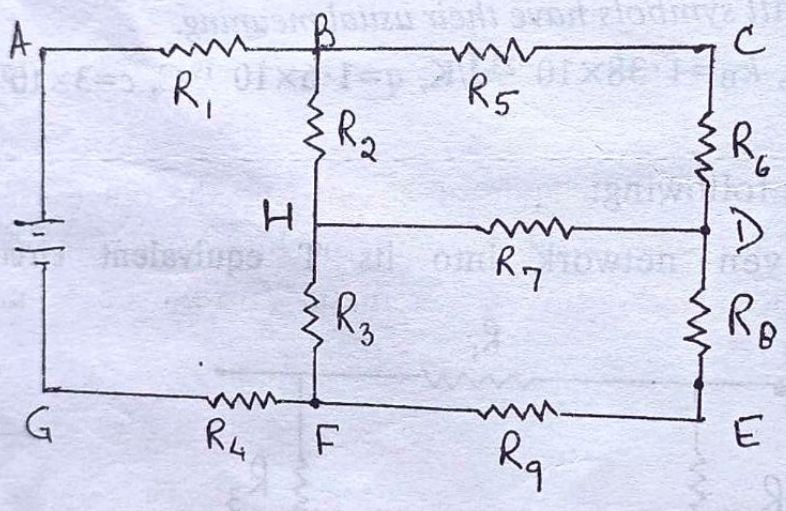
(d) Draw the output characteristics of an N-channel FET in the common source configuration.

(e) Draw the circuit diagram of a transistorized monostable multivibrator.

(f) Distinguish between Pulse Width and Pulse Amplitude Modulation.

(g) How does the junction capacitance of a reverse biased PN-junction diode vary with applied voltage? Which device makes use of this property?

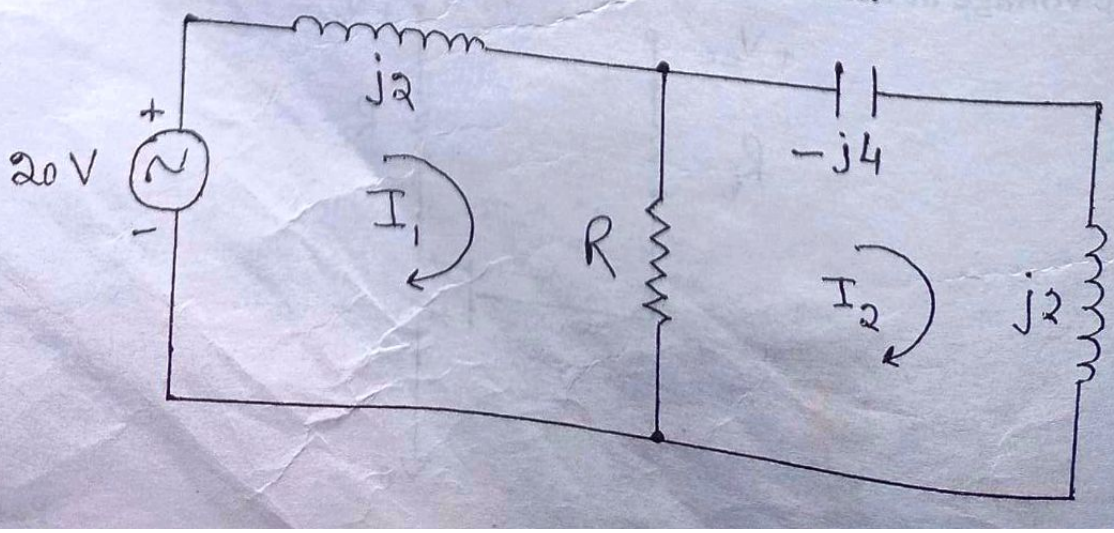
(h) Determine the number of (*i*) circuit elements, (*ii*) principal nodes and (*iii*) meshes, in the circuit shown below.



SECTION A

2. (a) Draw the circuit of an Anderson's Bridge, and derive the balance conditions. 11

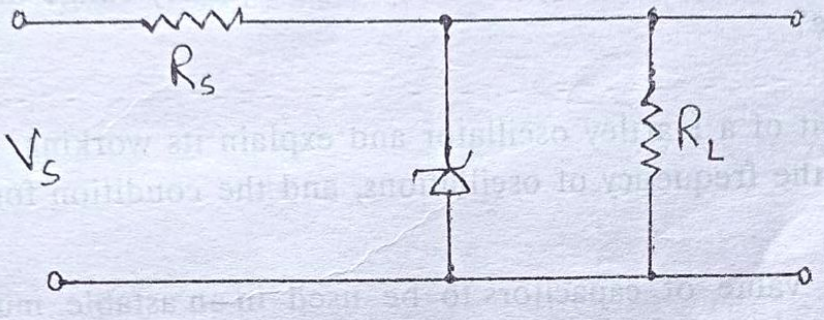
(b) Find the currents I_1 and I_2 in the given circuit, if $R = 8\,\Omega$. 4



3. (a) Derive an expression for the width of the depletion region across an abrupt PN junction, under unbiased condition. 11

(b) The reverse saturation current at 300 K of a PN junction Si diode is 1 nA. Find the voltage to be applied to obtain a forward current of 0·5 μA. 4

4. (a) Draw the circuit diagram of a centre-tapped full wave rectifier. Sketch the input and output waveforms, and explain the circuit operation. Derive the expressions for average current, rms current and rectification efficiency. 11



(b) For the given zener voltage regulator circuit find the range over which the supply voltage V_s can be varied, without the loss of regulation. The zener diode of 5 V and 0·5 W has a minimum current of 5 mA. Given : $R_L = 1\ k\Omega$, $R_S = 100\ \Omega$. 4

5. (a) Sketch the biasing arrangement of the two junctions in the active region of a BJT in common base configuration. Show the effect of the bias voltage on depletion regions and barrier voltages on each junction. Show the movement of charge carriers through BJT, and prove

$$I_C = \alpha I_\beta + (1+\beta) I_{CBO}.$$ 9

(b) If in a transistor the emitter current $I_E = 1{\cdot}2$ mA, and $\beta = 60$, find :

α, I_B and I_C 6

SECTION B

6. (a) Draw a circuit diagram showing voltage divider bias of an npn transistor in a CE amplifier. Explain how the emitter resistor improves the thermal stability of the circuit. Define and obtain an expression for the stability factor S. Also identify, and explain the working of, the bypass and coupling capacitors. 11

(b) An amplifier has voltage gain 100. It has a negative feedback ratio of 0·05. Find:

P.T.O.

(i) The voltage gain with negative feedback.

(ii) The feedback voltage when the input voltage is 50 mV. 4

7. (a) Draw the circuit of a CE single stage transistor amplifier. Draw the corresponding ac equivalent circuit using *h*-parameters. Calculate the voltage gain, current gain, input impedance and output impedance of the amplifier. 11

(b) Draw the frequency response curve of an RC coupled amplifier. Define cut-off frequencies and show them on the diagram. Which circuit elements are responsible for the change in gain in (i) low frequency range and (ii) high frequency range? 4

8. (a) Draw the circuit of a Hartley oscillator and explain its working. Derive the expression for the frequency of oscillations, and the condition for sustained oscillations. 11

(b) Determine the value of capacitors to be used in an astable multivibrator to generate a train of pulse 1 μsec wide at a repetition rate of 100 KHz. Given: $R_1=R_2=10\,k\Omega$. 4

9. (a) Why is modulation necessary in communication system? Draw the circuit of an amplitude modulator and explain its working. Find an expression for the total power in AM wave in terms of the unmodulated carrier power and the modulation index. 11

(b) Draw the characteristic curves of UJT. Explain how a UJT can be used as a relaxation oscillator. 4

This question paper contains **4** printed pages]

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

S. No. of Question Paper : **5770**

Unique Paper Code : **222504** 07 DEC 2015

F

Name of the Paper : **Electronic Devices (PHHT 518)**

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

Semester : **V**

Duration : **3 Hours**

Maximum Marks : **75**

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

Question No. **1** is compulsory.

Attempt *five* questions in all.

1. Answer the following questions (any *five*) :

(*a*) What is the difference between Avalanche breakdown and Zener breakdown in a *p-n* junction diode ? 3

(*b*) Explain why JFETs are referred to as normally ON devices. 3

(*c*) The distortion in an amplifier is found to be 3% when a negative feedback of 0.04 is applied. When the feedback is removed the distortion becomes 15%. Find the open loop gain. 3

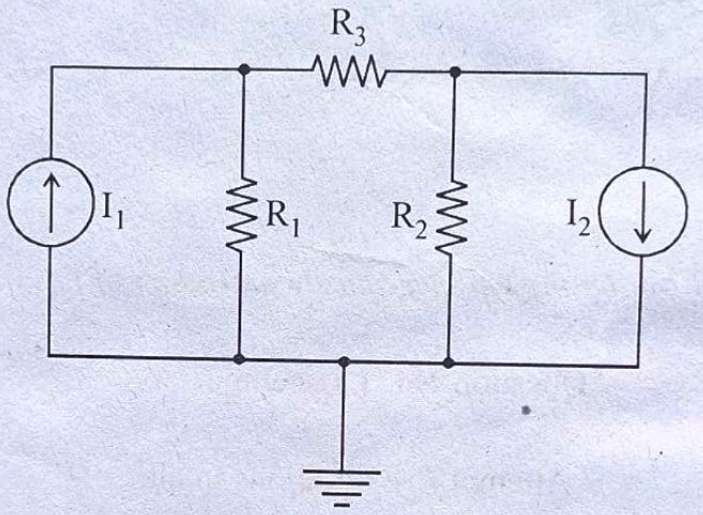
(*d*) Why negative feedback preferred over positive feedback in amplifier circuits ? 3

P.T.O.

(*e*) Draw the wave shape of the amplitude modulated wave if $m = 0.5$. 3

(*f*) For a semiconductor material of a light emitting diode energy gap is 1.37 eV. What is the wavelength of the emitted light ? 3

2. (*a*) Determine the nodal voltages for the given network if $I_1 = 4$ A, $I_2 = 2$ A, $R_1 = 2\ \Omega$, $R_2 = 6\ \Omega$, $R_3 = 12\ \Omega$. 7



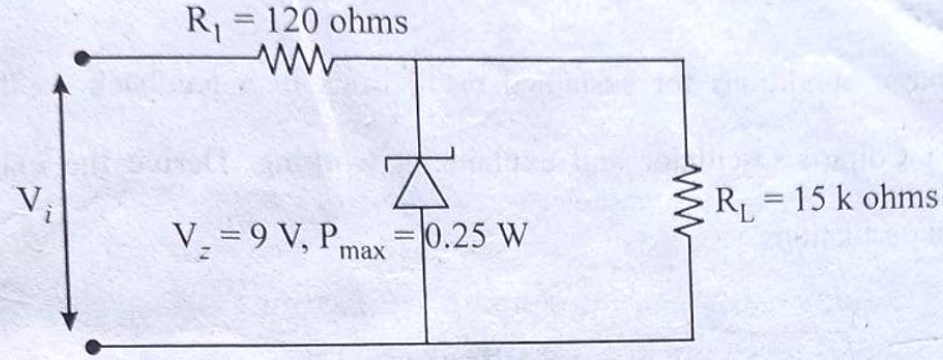
(*b*) For a four terminal network derive its π equivalent circuit in terms of short circuit and open circuit impedances. 8

3. (*a*) Explain the formation of depletion layer for a *p-n* junction diode. Derive expressions for the width of the depletion layer and potential barrier for an abrupt junction. 12

(*b*) A Germanium abrupt junction has donor density $N_d = 10^{17}/cm^3$ on *n*-side and acceptor density $N_a = 10^{15}/cm^3$ on *p*-side. Calculate the height of the potential barrier at the junction if intrinsic carrier density n_i equals $2 \times 10^{13}/cm^3$. Assuming $k_BT/e = 0.026$ eV. 3

4. (*a*) Explain how Zener diode is used in voltage regulation under both varying input and varying load conditions. 6

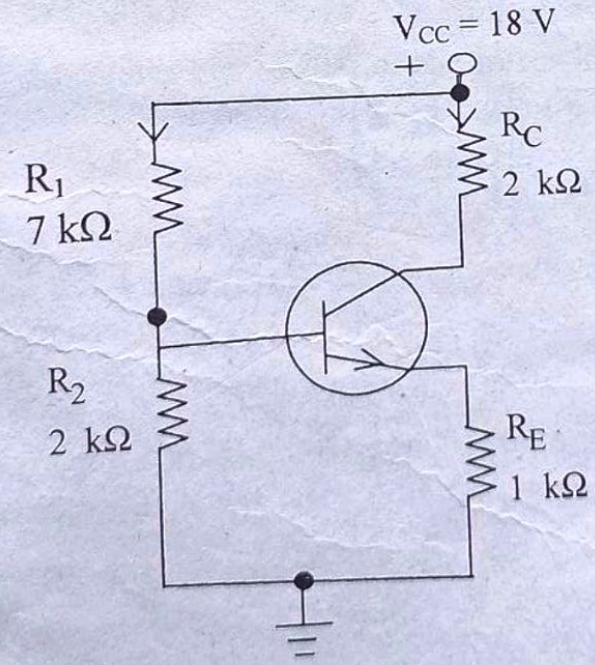
(*b*) In the given Zener voltage regulator circuit, find the range over which the supply voltage V_i can be varied, without loss of regulation. The Zener diode of 9 V and 0.25 Watts has a minimum current of 3 mA. 6



(*c*) Draw the V-I characteristics of a solar cell with necessary circuit diagram. 3

(*a*) Draw a circuit diagram showing the self-bias/voltage divider bias of *n-p-n* transistor in CE configuration, explaining how the self bias-biasing resistor improves the stability. Explain the function of bypass and coupling capacitor. 10

(*b*) For the following circuit draw the d.c. load line and determine the operating point (V_{BE} = 0.7 V). 5



P.T.O.

6. What is modulation ? Why is it necessary for transmission of signal ? Describe the characteristics of amplitude modulation. Show that the amplitude modulated wave consists of carrier and two side bands. 15

7. State the basic conditions for sustained oscillations in a feedback oscillator. Draw the circuit of a Colpitts Oscillator and explain its working. Derive the expression for the frequency of oscillations. 15

This question paper contains 4 printed pages.]

Your Roll No.....

. No. of Question Paper : 5776 H

nique Paper Code : 222504

ame of the Paper : PHHT-518 Electronic Devices

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

mester : V

ration : 3 Hours Maximum Marks : 75

structions for Candidates

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

Attempt any **FIVE** questions in all.

Question No. **1** is compulsory.

All questions carry equal marks.

Non-programmable calculators allowed.

($h = 6.63 \times 10^{-34}$ Js, $k_B = 1.38 \times 10^{-23}$ J/K, $q = 1.6 \times 10^{-19}$ C, $c = 3 \times 10^8$ m/s, $\varepsilon_0 = 8.85 \times 10^{-12}$ F/m)

Attempt any **five** of the following :

(i) Find the concentration of holes and electrons in p type silicon semiconductor at 300K having resistivity .02Ωcm, $\mu_p = 475$ m^2/Vs and $n_i = 1.45 \times 10^{10} cm^{-2}$.

P.T.O.

(ii) Distinguish between the zener breakdown and avalanche breakdown.

(iii) Show that $I_C = \beta I_B + (1 + \beta) I_{CBO}$, where the symbols have their usual meaning.

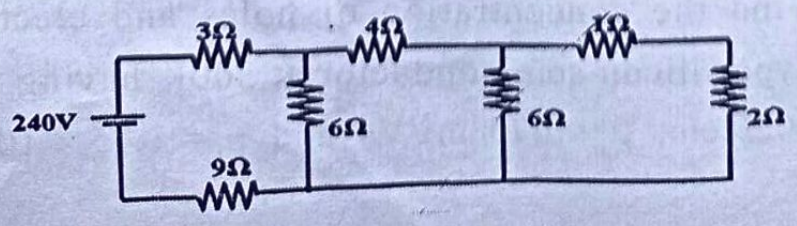
(iv) Explain the Barkhausen criterion for sustained oscillations.

(v) How many RC networks are required for a phase shift oscillator. Justify your answer.

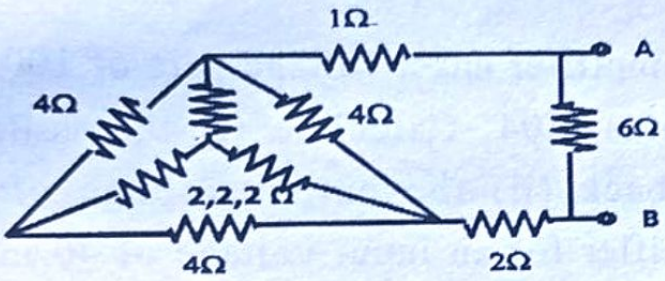
(vi) For an npn transistor in CE configuration $V_{CC} = 10V$; $V_{BB} = 5V$; $R_B = 10K\Omega$; $R_C = 100\Omega$ and $\beta = 150$. Find the value of V_{CB}.

(vii) A UJT Relaxation oscillator has a source voltage $V_{BB} = 40V$, $R = 50K\Omega$ and $C = 2000$ pF. Find the time period of oscillation of the firing voltage of UJT is 15V. (3×5=15)

2. (i) Determine the total resistance between points A and B shown in the figure using T and Pi transformations.



(ii) Draw the circuit diagram of a centre-tapped full wave rectifier. Derive an expression for ripple factor and rectification efficiency.



3. (i) Define drift and diffusion current for a doped semiconductor.

(ii) Obtain the expression for pn diode current equation.

(iii) For an abrupt Si p-n junction diode with $N_a = 10^{19} cm^{-3}$ and $N_d = 10^{16}\ cm^{-3}$, calculate the depletion layer width and barrier potential at T = 300 K. (Take $\varepsilon_r = 12$). (4,7,4)

4. (i) Draw the hybrid model equivalent circuit of a common emitter amplifier. Derive expressions for voltage gain, current gain, for a CE amplifier in terms of h parameters.

(ii) List the factors that affect the bias stability of a transistor.

(iii) Explain how addition of emitter resistance increases

the stability for a self biased CE amplifier. (8,3,4)

5. (i) Give the circuit diagram of a two stage RC coupled amplifier. Discuss its equivalent circuits in mid and high frequency regions. Also derive the expressions for voltage gain for these regions.

(ii) An amplifier has a voltage gain of 100. The feedback ratio is 0.04. Calculate (i) the voltage gain with feedback (ii) the output voltage of the feedback amplifier for an input voltage of 40 mV. (10,5)

6. (i) Draw the circuit of a Hartley oscillator. Derive an expression for the frequency of oscillation and condition for sustained oscillation.

(ii) Explain the working of an astable multivibrator. (9,6)

7. (i) Show mathematically that the amplitude modulated wave consists of a carrier and two sidebands of constant amplitude. Draw the frequency spectrum of an AM wave.

(ii) Give the circuit diagram of a diode detector and explain its working. (8,7)

8. (i) Explain the construction and working of a JFET. What is pinch off voltage.

(ii) Draw the output and Transfer characteristics for JFET as common source configuration. (9,6)

(500)