Scilab Manual for
Electronics Devices and Circuit I
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Contents

List of Experiments

4

List of Figures

Experiment: 1

Determine Diode current for input DC voltage and temperature

Scilab code Solution 1.0 Determine Diode current for input DC voltage and temperature

```
1 //EX 1. Program Title:Determine Diode current for
      input DC voltage and temperature.///
2 //environment: Scilab 5.5.2
3 //Tested on OS: Windows 7 Professional, 64 bit
4 //Book: Electronics Devices and Circuit Theory by
      Robert Boylestead and Nashelsky
5 ////////////////////////////////////////////
6 clc;
7 clear all;
8 close;
9 mprintf('\n Required Data for ID=Is*(e^(VD/n*VT)-1)
      is:');
10 mprintf('\n');
11 VD=input('Enter the value of input DC Voltage in
      volts: ');//Note:Input DC voltage is int range of
       0 to 5
```

```
12  T=input('Enter the value of temperature in degree
        Celsius : ');//Note: temperature is in the degree
         celsius
13  p=273;
14  TK=p+T;
15  k=1.38e-23          //Joule per Kelvin      Boltzmann's
        Constant
16  k1=k*1e21           //zepto Joule per kelvin
17  q= 1.6e-19          // columb                 electron
        charge
18  q1=q*1e18            // atto coulomb          electron
        charge
19  Is=10e-12           // Amperes                Reverse
        saturation current
20  Is1=Is*1e9//nano amperes
21  n=1  ; // Ideality factor
22  mprintf('\n.
        \*****************************************************\
        ');
23  mprintf('\n Temperature                      TK:%2d
        K',TK);
24  mprintf('\n Ideality factor                  n:%2d  '
        ,n);
25  mprintf('\n Reverse saturation Current       Is:%.3f
        nA',Is1);
26  mprintf('\n Boltzmanns Constant..            k:%.5f
        zJ/K',k1);
27  mprintf('\n Electron charge..                q:%.2f
        aC',q1);
28  mprintf('\n Forward bias voltage           VD:%.2f
        V',VD);
29  mprintf('\n.
        \*****************************************************\
        ');
30  //////////////////////////////////////////
31  mprintf('\n Diode Current                ID=Is(e^x-1)'
        );
32  mprintf('\n Where..                      x=VD/(n*VT)')
```

```
     ;
33  mprintf('\n Thermal Voltage              VT=(k*TK)/q')
     ;
34  mprintf('\n. \***************Solution
     ***************************\');
35  [ID1,x,VT]=diode_current2(VD,TK)//Function of diode
     current
36  mprintf('\n Thermal Voltage............VT = %f V \n
     ',VT);      // Theramal Voltage Display
37  mprintf('\n');// Next line
38  mprintf('  ............................x=%f \n',x);
39  mprintf('\n');                           // Next line
40  mprintf('Diode Current................ID= %f mA \n',
     ID1);//Diode Current Display
41  mprintf('\n.
     \***********************************************************\
     ');
42
43
44  //Output
45
46  // Required Data for ID=Is*(e^(VD/n*VT)-1) is:
47  //Enter the value of input DC Voltage in volts: .45
48  //Enter the value of temperature in degree Celsius :
     27
49
50  //.
     *******************************************************
51  // Temperature                          TK:300 K
52   //Ideality factor                     n: 1
53   //Reverse saturation Current          Is:0.010 nA
54   //Boltzmanns Constant..               k:0.01380 zJ/K
55   //Electron charge..                   q:0.16 aC
56  // Forward bias voltage                VD:0.45 V
57  //.
     *******************************************************
```

```
58  //  Diode  Current                 ID=Is ( e ^x −1)
59  //  Where . .                       x=VD/ ( n ∗VT)
60  //  Thermal  Voltage                VT=(k ∗TK)/ q
61  // .  ∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗ Solution
        ∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗
62  //  Thermal  Voltage . . . . . . . . . . . . . VT =  0.025875  V
63
64   // . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . x=17.391304
65
66  //Diode  Current . . . . . . . . . . . . . . . ID=  0.000357  mA
67
68  // .
        ∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗
```

check Appendix AP 1 for dependency:

`diode_current2.sci`

Experiment: 2

To Plot the V-I Characteristics of semiconductor diode under forward Bias using Shockley equation

Scilab code Solution 2.0 To Plot the VI Characteristics of semiconductor diode under forward Bias using Shockley equation

```
1 //EX 2. Program Title:To Plot the V-I
       Characteristics of semiconductor diode under
2 //forward Bias using Shockley equation//
3 //
       ///////////////////////////////////////////////////
4 ///Environment: Scilab 5.5.2
5 //Tested on OS: Windows 7 Professional, 64 bit
6 //Book: Electronics Devices and Circuit Theory by
       Robert Boylestead and Nashelsky
7 //
       ////////////////////////////////////////////////////////////////////////////
8 clc;
```

```scilab
 9  clear all;
10  close;
11  xdel(winsid());///clear all the previous figures
        plots
12  /////////////////////////////Forward Bias
        Characterisices/////////////////////////////
13  VD_fw=input("Enter the Maximum Forward Voltage for
        input:")//note:it is positive value DC voltage
        press enter after givening input votage  in
        console
14  VD=[0:0.01:VD_fw];                    // Change in
        input volatage
15  ID=10e-12*(exp(VD/0.039)-1);   // Diode current
        equation
16  ID=ID*1e3;                        // Diode Current in
        miliampere
17  figure(1),plot(VD,ID,'*');// plotting VD and ID
18  xtitle("Diode Forward Bias characteristics","Diode
        Voltage VD (V)","Diode Current ID (mA)");//plot
19  /////////////////////////Reversed Biased
        Characteristics/////////////////////////////
20  VD_rev=input("Enter the Maximum Reverse Voltage for
        input:")//note:it is negative value DC voltage
        press enter after givening input votage  in
        console
21  VDr=[0:-0.01:-VD_rev];                  // Change in
        input volatage
22  IDr=-10e-12*(exp(VD/0.039)-1);   // Diode current
        equation
23  IDr=IDr*1e3;                      // Diode Current in
         miliampere
24  figure(2),plot(VDr,IDr,'*');// plotting –VD and –ID
25  xtitle(" Diode Reversed Bias characteristics","Diode
        Voltage –VD (V)","Diode Current –ID (mA)");//
        plot
26
27
28  //output
```

```
29
30
31 //Enter the Maximum Forward Voltage for input:5
32 //Enter the Maximum Reverse Voltage for input:5
```
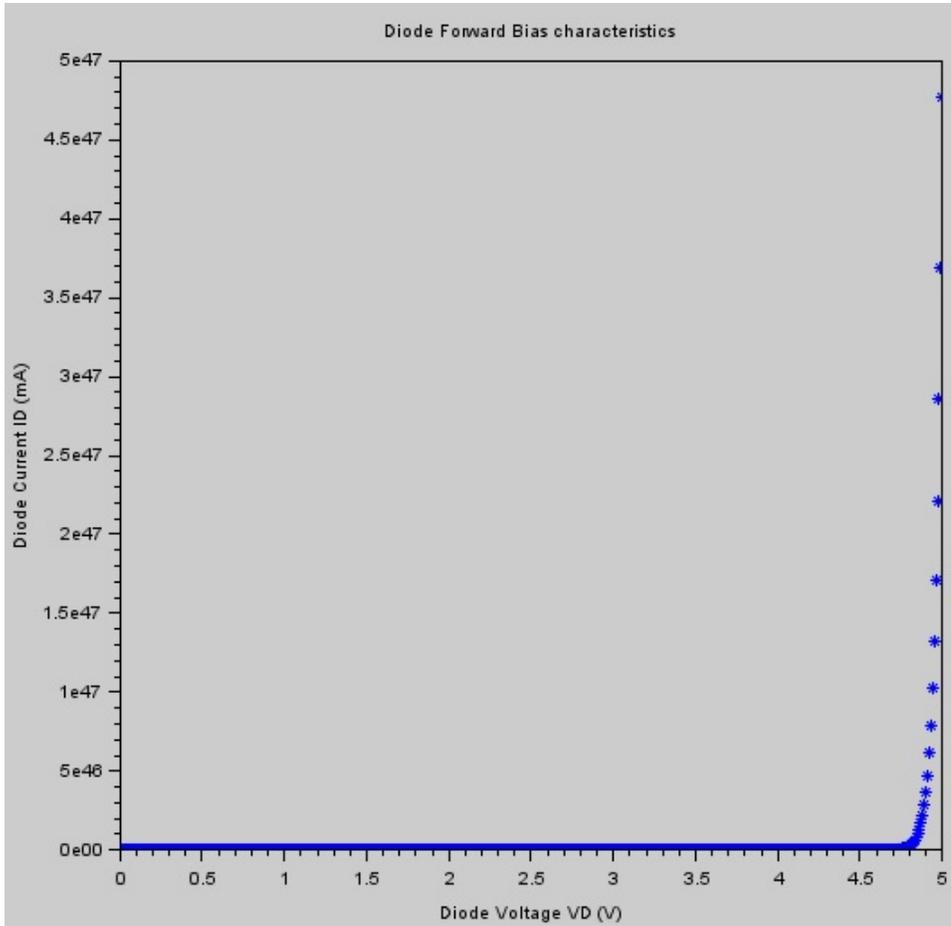
Figure 2.1: To Plot the VI Characteristics of semiconductor diode under forward Bias using Shockley equation
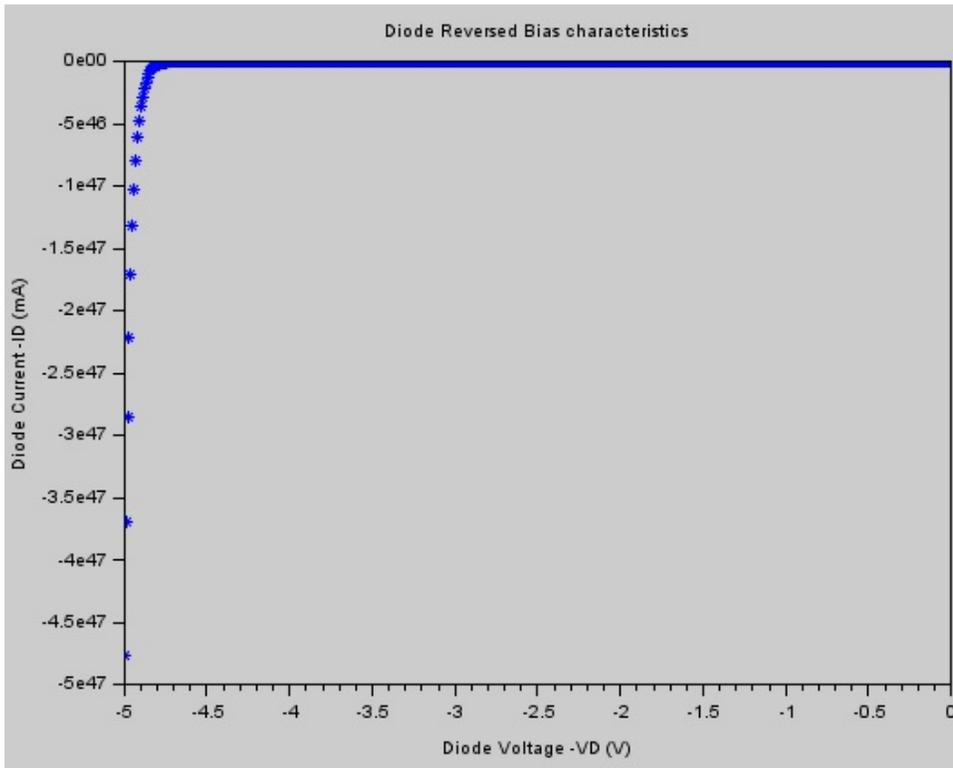
Figure 2.2: To Plot the VI Characteristics of semiconductor diode under forward Bias using Shockley equation

Experiment: 3

Determine static and dynamic resistance for PN junction diode using V-I characteristics

Scilab code Solution 3.0 Determine static and dynamic resistance for PN junction diode using VI characteristics

```
1  //EX 3 Program Title:Determine static and dynamic
       resistance for PN junction diode using VI
       characteristics  //////////
2  //environment: Scilab 5.5.2
3  //Tested on OS: Windows 7 Professional, 64 bit
4  //Book: Electronics Devices and Circuit Theory  by
       Robert Boylestead and Nashelsky
5  ////////////////////////////////////////
6  clc;
7  clear all;
8  close;
9  //
       ///////////////////////////////////////////////////////////
10 disp('*******DC resistances of diode can be
       calculated by using operating points on the
```

15

```scilab
        forward characteristic *********');
11  ID1=input("Enter the value of ID on the curve in mA
        ID:");//Note:Press enter

12

13  VD=input("Enter the Corresponding value of VD on the
         curve in V VD:");//Note:Press enter    //VD is in
        the range of 0V to 1V
14  ID=ID1*1e-3     /// miliampere Diode cuurent1
15  mprintf('\n
        \***********************************************************\
        ');
16  mprintf('\n For the operating points');
17  mprintf('\n Diode current        ID1:%.4f A',ID);
18  mprintf('\n Diode Voltage        VD1:%.1f V',VD);
19  RD=VD/ID;   /// Ohms DC resistance
20  mprintf('\n
        \***********************************************************\
        ');
21  mprintf('\n DC resistance is RD1:%.1f ohms',RD);
22  mprintf('\n
        \***********************************************************\
        ');
23  //disp('******AC resistances of diode can be
        calculated by Dawing straight line through
        operating points (VD,ID) and change in volages(
        VD1 and VD2) and corresponding change in currents
         (ID1 and ID2)is to be considered on the curve
        *********');//
24  ///Tangent line at ID is drawn and 2mA swing above
        and below is to be considered for ID2 and ID1
        respectively/////////
25  ID11=ID1-2  //in mili amperes
26  ID12=ID1+2   //in mili amperes
27  ////////////conversion/////////////
28  ID11=ID11*1e-3;
29  ID12=ID12*1e-3;
30  mprintf('\n
        \***********************************************************\
```

```scilab
     ');
31  mprintf('\n For calculation of AC resistance at the
         operating points ID');
32  mprintf('\n Diode current1          ID11:%.4f A',ID11)
         ;
33  mprintf('\n Diode current2          ID12:%.4f A',ID12)
         ;
34  if ID1<4 then     //when the characteristics curve ID
         current (below 4mA)exponential ch
                           anges in curve  more even VD
                         //changes
35      VD11=VD-0.05; //Swing of tangent line in
             downword direction and locating point
36                       //respective voltage is VD11 //
                         small change in voltage
37      VD12=VD+0.05;//Swing of tangent line in upword
             direction and locating point
38                       //respective voltage is VD12 //
                         small change in voltage
39    else
40        VD11=VD-0.01;//neligibal chane in voltage
               because steep curve when
41        VD12=VD+0.01;
42  end
43  mprintf('\n Diode Voltage1          VD11:%.2f V',VD11
         );
44  mprintf('\n Diode Voltage2          VD12:%.2f V',VD12
         );
45  mprintf('\n
         \*********************************************************\
         ');
46  /////////calaculation
47  delid1=ID12-ID11;                    //difference in
         upper current and lower current
48  delvd1=VD12-VD11;                    //difference in
         upper current and lower voltage
49  rd1=delvd1/delid1;                   // ac resisstance
         at ID=2mA
```

```
50  mprintf('\n AC resistance at    ID1 is rd1:%.4f ohm'
       ,rd1);
51  mprintf('\n.
       \**********************************************************\
       ');
52  /////////output//////////case1
53  //*****DC resistances of diode can be calculated by
       using
54   //    operating points on the forward
       characteristic*******
55   //     **
56  //Enter the value of ID on the curve in mA ID:2
57  //Enter the Corresponding value of VD on the curve
     in V VD:.5
58
59  //
       *********************************************************

60  // For the operating points
61  // Diode current        ID1:0.0020 A
62  // Diode Voltage        VD1:0.5 V
63   //
       **********************************************************

64   //DC resistance is RD1:250.0 ohms
65  //
       *********************************************************

66  //
       **************************************************************

67  // For calculation of AC resistance at the operating
       points ID
68  // Diode current1        ID11:0.0000 A
69  // Diode current2        ID12:0.0040 A
70  // Diode Voltage1        VD11:0.45 V
71  // Diode Voltage2        VD12:0.55 V
72  //
```

```
      ********************************************************************
73  //AC  r e s i s t a n c e   at       ID1  is  rd1 :25.0000  ohm
74  // .
      *********************************************************************

75
76  /// case2 /////////
77  //*******DC  r e s i s t a n c e s   of  diode  can  be  c a l c u l a t e d
      by  using
78  //         o p e r a t i n g   p o i n t s   on  the  forward
      c h a r a c t e r i s t i c *******
79  //         **
80  // Enter  the  value  of  ID  on  the  curve  in  mA  ID:25
81  // Enter  the  Corresponding  value  of  VD  on  the  curve
      in  V  VD: .7
82
83   //
        ***********************************************************

84  //  For  the  o p e r a t i n g   p o i n t s
85  //  Diode  c u r r e n t           ID1 :0.0250  A
86  //  Diode  Voltage           VD1 :0.7  V
87  //
        ***********************************************************

88  //  DC  r e s i s t a n c e   is  RD1:28.0  ohms
89  //
        ***********************************************************

90  //
        ***********************************************************

91  //  For  c a l c u l a t i o n   of  AC  r e s i s t a n c e   at  the  o p e r a t i n g
       p o i n t s   ID
92  // Diode  c u r r e n t 1           ID11 :0.0230  A
93  // Diode  c u r r e n t 2           ID12 :0.0270  A
94  //  Diode  Voltage1            VD11 :0.69  V
```

19

```
95  //  Diode  Voltage2           VD12:0.71  V
96  //
    **********************************************************
97  //  AC  resistance  at      ID1  is  rd1:5.0000  ohm
98  //
    **********************************************************
```

Experiment: 4

Design zener shunt regulator with variable load for given specification

Scilab code Solution 4.0 Design zener shunt regulator with variable load for given specification

```
1  //EX.4 Program Title:Design zener shunt regulator
       with variable load for given specification ///
2  ////////environment: Scilab 5.5.2
3  //Tested on OS: Windows 7 Professional, 64 bit
4  //Book: Electronics Devices and Circuit Theory  by
       Robert Boylestead and Nashelsky
5  /////////////////////////////////////////
6  clc;
7  clear all;
8  close;
9  //
       ///////////////////////////////////////////////////////////////
10 disp('For desiging Variable Load voltage regulator
       Circuit :');
11 Vi=input('Enter the Input Voltage in volts
```

```
                                       Vi:');//Note:Press  enter
     /// input voltage must be greater than dc
     regulated voltage////
12 Vz=input('Enter the required regulated DC output
     Voltage in volts    Vz:');//Note:Press  enter
13 Izm=input('Enter the value of Maxi. zener current in
       miliamperes     Izm:');//Note:Press  enter/
14 R=input('Enter the value of Series Resistance in
     kilo ohms            R:');//Note:Press  enter/
15 disp('According to given Circuit data:' );
16 Izm1=Izm*1e-3      //miliampere   Maximum Zener
     Current
17 R1=R*1e3          // Kilo ohms  Input Resistance
18 mprintf('\n Zener Voltage                        Vz:
     %1fv',Vz);
19 mprintf('\n Maximum Zener Current                Izm
     :%2fA',Izm1);
20 mprintf('\n Input Resistance                     R:
     %4dohms',R1);
21 mprintf('\n Input voltage                        Vi:
     %2dV',Vi);
22 mprintf('\n');
23 /////////////Calculate Value of Minimum RL
     /////////////////////////////////////////
24 mprintf('\n. \*****************Solution
     **************************************\');
25 RL_min=(R1*Vz)/(Vi-Vz);  //ohms min load resistance
26 mprintf('\n 1)Minimum Load Resistance
                         RL_min:%2dohms',RL_min);
27 /////////////Calculate Value of Minimum Load
     Current//////////////////////////////////
28 mprintf('\n.
     \******************************************************************\
     ');
29 VR=Vi-Vz;      // volts voltage across input
     resistance
30 mprintf('\n 2)Voltage Across R is
                         VR=%2dV',VR);
```

```scilab
31  IR=VR/R1;      // mili  amperes  Current  trhough  input
        resistance
32  IR=IR*1e3;   //amperes
33  mprintf('\n.
        \*****************************************************************\
        ');
34  mprintf('\n 3)Current  through  Input  Reistance  R  is
            IR:%.4fmA',IR);
35  IL_min=(IR*1e-3)-Izm1;      // mili  amperes  mini.  load
        current
36  //IL_min=IL_min*10e3;
37  mprintf('\n.
        \*****************************************************************\
        ');
38  mprintf('\n 4)Minimum  Load  Current
                            IL_min=%.3fA',IL_min);
39  mprintf('\n.
        \*****************************************************************\
        ');
40  ////////////Calculate  Value  of  Maximum  Load
        Resistance//////////////////////////////
41  RL_max=Vz/(IL_min);   // ohms  maxi.  load  resistance
42  //RL_max=RL_min*1e-3;
43  mprintf('\n 5)Maximum  Load  Resistance
                        RL_max:%dohms',RL_max);
44  mprintf('\n.
        \*****************************************************************\
        ');
45
46
47  //output//
48  // For  desiging  Variable  Load  voltage  regulator
        Circuit :
49  //Enter  the  Input  Voltage  in  volts
                                Vi:50
50  //Enter  the  required  regulated  DC output  Voltage  in
        volts    Vz:10
51  //Enter  the  value  of  Maxi.  zener  current  in
```

```
        miliamperes        Izm:32
52  //Enter  the  value  of  Series  Resistance  in  kilo  ohms
                R:1
53
54  //  According  to  given  Circuit  data:
55
56  //  Zener  Voltage                              Vz:10.000000
        v
57  //  Maximum  Zener  Current                     Izm:0.032000
        A
58  //  Input  Resistance                           R:1000ohms
59  //  Input  voltage                              Vi:50V
60
61  //.  *****************Solution
        **************************************
62  //  1)Minimum  Load  Resistance
        RL_min:250ohms
63  //.
        *****************************************************************
64  //  2)Voltage  Across  R  is                            VR=40
        V
65  //.
        *****************************************************************
66  //3)Current  through  Input  Reistance R  is        IR
        :40.0000mA
67  //.
        *****************************************************************
68  //  4)Minimum  Load  Current
        IL_min=0.008A
69  //.
        *****************************************************************
70  //  5)Maximum  Load  Resistance
        RL_max:1250ohms
71  //.
```

Experiment: 5

Design zener shunt regulator with fixed load for given specification

Scilab code Solution 5.0 Design zener shunt regulator with fixed load for given specification

```
1 //EX 5 Program:Design zener shunt regulator with
      fixed load for given specification ///
2 //environment: Scilab 5.5.2
3 //Tested on OS: Windows 7 Professional, 64 bit
4 //Book: Electronics Devices and Circuit Theory  by
      Robert Boylestead and Nashelsky
5 /////////////////////////////////////////
6 clc;
7 clear all;
8 close;
9 //
      //////////////////////////////////////////////////////////////////
10 disp('For desiging fixed  Load voltage regulator
      Circuit :' );
11 Vz=input("Enter the required regulated DC output
```

```
      Voltage in volts   Vz:");//Note:Press enter
12  Izm=input('Enter the value of maxi. zener current in
       miliamperes    Izm:');//Note:Press enter/
13  RL=input('Enter the value of load resistance in kilo
       ohms          RL:');//Note:Press enter/
14  R=input('Enter the value of Series resistance in
       ohms          R:');//Note:Press enter/
15  disp('For desiging fixed voltage regulator Circuit
       required data :' );
16  Izm1=Izm*1e-3       //miliamper   Maximum Zener
       Current
17  RL1=RL*1e3        // Kilo ohms  Input Resistance
18  mprintf('\n Zener Voltage                    Vz:%1f
       v',Vz);
19  mprintf('\n Maximum Zener Current             Izm:
       %2f A',Izm1);
20  mprintf('\n Input Resistance                 R:%4d
       ohms',R);
21  mprintf('\n Load Resistance                  RL:%.1
       f Ohms',RL1);
22  mprintf('\n');
23  /////////////Calculate  Minimum input Voltage
       ///////////////////////////////////
24  mprintf('\n. \***************Solution
       ****************************************\');
25  Vi_min=((RL1+R)*Vz)/RL1;// Volts Min. input Voltage
26  mprintf('\n 1)Minimum Input Voltage
                     Vi_min:%2dV',Vi_min);
27  /////////////Calculate Value of Minimum Load
       Current////////////////////////////////
28  mprintf('\n.
       \****************************************************************\
       ');
29  IL=Vz/RL1;      // mili amperes Load Cuuent
30  IL_ma=IL*1e3    // mil amperes
31  mprintf('\n 2)Load Current is
                            IL=%2fmA',IL_ma);
32  IR_max=Izm1+IL;    //  mili amperes maxi. Load Cuuent
```

27

```
33  IR_maxD=IR_max*1e3;    // miliamper
34  mprintf('\n.
       \************************************************************************\
       ');
35  mprintf('\n 3)Current through input Reistance R is
        IR_max:%.4fmA',IR_maxD);
36  Vi_max=(IR_max*R)+Vz; //Volts Maxi.input voltage
37  mprintf('\n.
       \*******************************************\');
38  mprintf('\n 4)Maximum input voltage
                        Vi_max=%2dV',Vi_max);
39  mprintf('\n.
       \************************************************************************\
       ');
40
41
42  //output//
43
44   //For desiging fixed voltage regulator Circuit :
45  //Enter the required regulated DC output Voltage in
        volts    Vz:20
46  //Enter the value of maxi. zener current in
        miliamperes     Iz:60
47  //Enter the value of load resistance in kilo ohms
               RL:1.6
48  //Enter the value of Series resistance in ohms
               R:220
49
50   //For desiging fixed voltage regulator Circuit
        required data
51         :
52
53   //Zener Voltage                          Vz:20.000000 v
54   //Maximum Zener Current                  Izm:0.060000 A
55  // Input Resistance                       R: 220 ohms
56  // Load Resistance                        RL:1600.0 Ohms
57
58  //.//  **************Solution
```

```
     *****************************************
59   //1)Minimum  Input  Voltage                    Vi_min
       :22V
60   //.
     **************************************************************

61   //  2)Load  Current  is                        IL
       =12.500000mA
62   //.
     **************************************************************

63   //  3)Current  through  input  Reistance  R  is    IR_max
       :72.5000mA
64   //.  *****************************************
65   //4)Maximum  input  voltage                   Vi_max
       =35V
66   //.
     **************************************************************
```

Experiment: 6

Determine output resistance,dc and ac of Common Emitter (CE) configuration

Scilab code Solution 6.0 Determine output resistance Betadc and Betaac of Common Emitter configuration

```
1 //EX 6 Program Title:Determine output resistance,
      dc and ac of Common Emitter configuration.///
2 //environment: Scilab 5.5.2
3 //Tested on OS: Windows 7 Professional, 64 bit
4 //Book: Electronics Devices and Circuit Theory  by
       Robert Boylestead and Nashelsky
5 ///////////////////////////////////////
6 clc;
7 clear all;
8 close;
9 //
      ///////////////////////////////////////////////////////////
10 disp('******On the output characteristics of CE
      confi. in active region select an operating point
      (VCEQ,ICQ) on load line *********');
```

```scilab
11  ICQ1=input("Enter the value of ICQ on the curve in
        mA ICQ: ");      //Note:Press enter
12  //draw horizontal line from operating point//0 mA to
          10 mA
13  IB1=input("Enter the value of IB corresponding to
        ICQ in uA IB: ");   //Note:Press enter
14  VCEQ=input("Enter the Corresponding value of VCEQ :
        ");               //Note:Press enter// Draw vertical
        line from operating point    //VCEQ is in the
        range of 0V to 20V
15  mprintf('\n.
        \***********************************************************\
        ');
16  ICQ=ICQ1*1e-3;
17  IB=IB1*1e-6;
18  mprintf('\n Operating point Collector Current
                    ICQ:%1f A',ICQ);
19  mprintf('\n Corresponding Base Current
                            IB:%1f A',IB);
20  mprintf('\n Recspective Collector to Emitter voltage
        is VCEQ:%1fV',VCEQ)
21  //
        ///////////////////////////////////////////////////////////

22  //****************Solution
        *****************************\');
23  //////////////Calculate Beta DC
        ///////////////////////////////
24  mprintf('\n.
        \***********************************************************\
        ');
25  Beta_DC=ICQ/IB;    // DC current gain
26  mprintf('\n 1)DC current gain of transistor in CE
        Confi.   Beta_DC=%2d ',Beta_DC);
27  mprintf('\n. \**********************Calculation of
        ac ****************\');
28  //For  calculation of  ac  by taking change(ib1 ib2)
        in base current on either side of Q-pointalong
```

```
            the  vertical  axis  of  about  equal  distance  to
            either  side  of  Q-point //
29   ib1 = IB1 -5;
30   ib2 = IB1 +5;
31
32   mprintf ( '\n   Base  current1                  ib1=%.2 f  uA '
        ,ib1);
33   mprintf ( '\n   Base  current2                  ib2=%.2 f  uA '
        ,ib2);
34   ib1 = ib1 *1 e -6;
35   ib2 = ib2 *1 e -6;
36   // at  the  two  intersections  of  ib1  and  ib2  and
            vertical  axis  the  two  level  of  ic1 , ic2   can  be
            determine  by  drawing  horizontal  line
37   ic1 = ICQ1 -0.5;
38   ic2 = ICQ1 +0.5;
39   mprintf ( '\n   Collector  current1               ic1=%.2
        f  mA ',ic1);
40   mprintf ( '\n   Collector  current2               ic2=%.2
        f  mA ',ic2);
41   ic1 = ic1 *1 e -3;
42   ic2 = ic2 *1 e -3;
43   mprintf ( '\n.
        \*****************************************************************\
        ');
44   Beta_AC =(ic2 - ic1 )/( ib2 - ib1 ); // AC  current  gain
45   mprintf ( '\n 2)AC  current  gain  of  transistor  in  CE
        Confi.   Beta_AC :%2d ',Beta_AC );
46   ///////////////// Calculate  Beta DC
        /////////////////////////////////
47   mprintf ( '\n.  \*************** Calculation  of  AC
        resistance ****************\ ');
48   // At  the  operating  point  tangent  is  drawwn  and
            either  side  of  ic1   ic2  respective  values  of  vce1
             vce2  is  considered  for  calculation  of  AC
            resistance  //  there  is  small  change  in  ic  for
            more  change  in  vce //
49   vce1 = VCEQ -5.2;
```

```
50  vce2=VCEQ+5.5;
51  mprintf('\n   Collector  to  emitter  voltage1
                      vce1=%2d  v',vce1);
52  mprintf('\n   Collector  to  emitter  voltage2
                      vce2=%2d  v',vce2);
53  mprintf('\n.
     \************************************************************\
     ');
54  R_out=(vce2-vce1)/(ic2-ic1);// AC resistance
55  R_out=R_out*1e-3;  // Kilo ohms
56  mprintf('\n 3)Dynamic Output resistance   is
                      R_out:%1dKohm',R_out);
57  mprintf('\n.
     \************************************************************\
     ');
58  //output/////
59   //******On the output characteristics of CE confi.
        in active
60   //       region select an operating point(VCEQ,ICQ)
        on load l
61   //       ine*********
62  //Enter the value of ICQ on the curve in mA ICQ: 2.7
63  //Enter the value of IB corresponding to ICQ in uA
        IB: 25
64  //Enter the Corresponding value of VCEQ : 7.5
65
66  //.
        *********************************************************

67  // Operating point Collector Current          ICQ
        :0.002700 A
68  // Corresponding Base Current                 IB
        :0.000025 A
69  // Recspective Collector to Emitter voltage is VCEQ
        :7.500000V
70  //.
        *********************************************************
```

```
71  //  1)DC  current  gain  of  transistor  in  CE  Confi.
        Beta_DC=108
72  //.  *********************Calculation  of   ac
        ****************
73  //   Base  current1             ib1=20.00  uA
74  //   Base  current2             ib2=30.00  uA
75  //   Collector  current1            ic1=2.20  mA
76  //   Collector  current2            ic2=3.20  mA
77  //.
        ***********************************************************
78  //  2)AC  current  gain  of  transistor  in  CE  Confi.
        Beta_AC:100
79  //.  ***************Calculation  of  AC  resistance
        ****************
80  //   Collector  to  emitter  voltage1            vce1=
        2  v
81  //   Collector  to  emitter  voltage2            vce2
        =13  v
82  //.
        ***********************************************************
83  //  3)Dynamic  Output  resistance   is
        R_out:10Kohm
84  //.
        ***********************************************************
```

Experiment: 7

Determine PIV, Vdc,Idc,Vrms,Pdc and Irms for Half Wave Rectifier.

Scilab code Solution 7.0 Determine PIV Vdc Idc Vrms Pdc and Irms for Half Wave Rectifier

```scilab
1  //EX 7 Program Title:Determine PIV,Vdc,Idc,Vrms,Pdc
       and Irms for Half Wave Rectifier.
2  //environment: Scilab 5.5.2
3  //Tested on OS: Windows 7 Professional, 64 bit
4  //Book: Electronics Devices and Circuit Theory  by
       Robert Boylestead and Nashelsky
5  //////////////////////////////////////
6  clc;
7  clear all;
8  close;
9  xdel(winsid());///clear all the previous figures
       plots
10 //
       //////////////////////////////////////////////////////////////
11 disp('For Half Wave Rectifier Analysis:' );
```

```
12  RL=input('Enter the value of Load Resistance in Ohms
             RL:');//Note:Press enter
13  Vac=input('Enter the value of Input AC Voltage in
        Volts      Vac:');//Note:Press enter
14  N1=input('Enter the Number of primary turns in trun
        ratio    N1:');//Note:Press enter/
15  N2=input('Enter the Number of Secondary turns in
        trun ratio N2:');//Note:Press enter/
16  mprintf('\n.
        \*********************************************\');
17  disp('Given data for Half Wave Rectifier is:');
18  mprintf(' Load Resistance            RL:%.2f ohm',RL
        );
19  mprintf('\n Input AC voltage          V1:%2d V',Vac
        );
20  mprintf('\n Number of Secondary turns  N2:%1d ',N2);
21  mprintf('\n Number of Primary turns    N1:%1d ',N1);
22  ////////////////////Voltage at Secondary
        ///////////////////////////////
23  mprintf('\n. \***************Solution
        ***************************\');
24  V2=Vac*(N2/N1);// Volts RMS secondary voltage
25  mprintf('\n 1) Voltage at Secondary is V2:%2d',V2);
26  ////////////////////Maximum Value at Secondary
        ///////////////////////////
27  mprintf('\n.
        \*********************************************\');
28  Vm=sqrt(2)*V2; //Volt peak value of Voltage
29  mprintf('\n 2)Maximum value of secondary voltage is
        Vm:%2d ',Vm);
30  mprintf('\n.
        \*********************************************\');
31  /////////////Load Current
        ///////////////////////////////
32  Im=Vm/RL;    // Amperes peak value of current
33  mprintf('\n 3)Maxi.value of load Current is Im:%1f A
        ',Im);
34  mprintf('\n.
```

```scilab
        \************************************************\');
35  /////////////Maximum Load Power
        //////////////////////////////////
36  Pmax=(Im^2)*RL;   ///Watts
37  mprintf('\n 4)Maximum Load Power is Pmax:%1f W',Pmax
        );
38  mprintf('\n.
        \************************************************\');
39  Vdc=0.318*Vm;    //Volts
40  mprintf('\n 5)Average Value of Output Voltage is Vdc
        :%1f V',Vdc);
41  mprintf('\n.
        \************************************************\');
42  Idc=Vdc/RL;      //Amperes DC Load current
43  mprintf('\n 6)Average value of Load current is Idc:
        %1f A',Idc);
44  mprintf('\n.
        \************************************************\');
45  Pdc=(Idc^2)*RL;     // Watts Average Power
46  mprintf('\n 7)Average Value Of load Power is Pdc:%1f
        W',Pdc);
47  mprintf('\n.
        \************************************************\');
48  PIV=Vm;    //Volts  Peak Inverse Voltage
49  mprintf('\n 8)Peak Inverse Voltage is PIV:%1d V',PIV
        );
50  mprintf('\n.
        \************************************************\');
51  Vr=Vdc*1.21;   //Volts  Ripple voltage
52  mprintf('\n 9)Ripple Voltage is Vr:%1f V',Vr);
53  mprintf('\n.
        \************************************************\');
54  Irms=Im/2;    //Amperes RMS Value of Current
55  mprintf('\n 10)RMS Value of  current is Irms:%1f mA'
        ,Irms);
56  mprintf('\n.
        \************************************************\');
57  //output//
```

```
58
59   //For Half Wave Rectifier Analysis:
60   //Enter the value of Load Resistance in Ohms
          RL:200
61   //Enter the value of Input AC Voltage in Volts
          Vac:230
62   //Enter the Number of primary turns in trun ratio
              N1:2
63   //Enter the Number of Secondary turns in trun ratio
              N2:1
64
65   //. **********************************************
66   // Given data for Half Wave Rectifier is:
67   // Load Resistance                RL:200.00 ohm
68   // Input AC voltage               V1:230 V
69   // Number of Secondary turns  N2:1
70   // Number of Primary turns      N1:2
71   //. ***************Solution
          **************************
72   //1) Voltage at Secondary is V2:115
73   //. **********************************************
74   // 2)Maximum value of secondary voltage is Vm:162
75   //. **********************************************
76   // 3)Maxi.value of load Current is Im:0.813173 A
77   //. **********************************************
78   // 4)Maximum Load Power is Pmax:132.250000 W
79   //. **********************************************
80   // 5)Average Value of Output Voltage is Vdc
          :51.717790 V
81   //. **********************************************
82   // 6)Average value of Load current is Idc:0.258589 A
83   //. **********************************************
84   // 7)Average Value Of load Power is Pdc:13.373649 W
85   //. **********************************************
86   // 8)Peak Inverse Voltage is PIV:162 V
87   //. **********************************************
88   // 9)Ripple Voltage is Vr:62.578526 V
89   //. **********************************************
```

```
90  // 10)RMS Value of   current  is  Irms:0.406586 mA
91  //.  *******************************************
```

Experiment: 8

Determine PIV, Vdc,Idc,Vrms,Pdc and Irms for center tapped transformer full Wave Rectifier.

Scilab code Solution 8.0 Determine PIV Vdc Idc Vrms Pdc and Irms for center tapped transformer full Wave Rectifier

```scilab
1  //EX 8 Program Title:Determine PIV, Vdc,Idc,Vrms,Pdc
      and Irms for center tapped transformer full Wave
      Rectifier. /
2  ///environment: Scilab 5.5.2
3  //Tested on OS: Windows 7 Professional, 64 bit
4  //Book: Electronics Devices and Circuit Theory by
      Robert Boylestead and Nashelsky
5  ////////////////////////////////////////
6  clc;
7  clear all;
8  close;
9
10 //
      /////////////////////////////////////////////////////////////
```

```scilab
11  disp('For Center Tapped Full Wave Rectifier Analysis
        :' );
12  RL=input('Enter the value of Load Resistance in Ohms
            RL:');//Note:Press enter
13  Vac=input('Enter the value of Input AC Voltage in
        Volts     Vac:');//Note:Press enter
14  N1=input('Enter the Number of primary turns
                      N1:');//Note:Press enter/
15  N2=input('Enter the Number of Secondary turns
                  N2:');//Note:Press enter/
16  mprintf('\n.
        \************************************************************
        ');
17  //
        ///////////////////////////////////////////////////////////

18  disp('To Analyse Center Tapped Full wave rectifier
        given data in the circuit is:' );
19  mprintf(' Load Resistance              RL:%2d ohm',
        RL);
20  mprintf('\n Input AC voltage            V1:%2d V',
        Vac);
21  mprintf('\n Number of Secondary turns   N2:%1d ',N2
        );
22  mprintf('\n Number of Primary turns     N1:%1d ',N1
        );
23  //////////////////Voltage at Secondary
        /////////////////////////////
24  mprintf('\n. \************Solution
        **********************************************\ ');
25  V2=Vac*(N2/N1);//Volts RMS voltage at secondary
26  mprintf('\n 1)Voltage at Secondary is V2:%2d',V2);
27  /////////////////Maximum Value at Secondary
        //////////////////////////
28  mprintf('\n.
        \************************************************************
        ');
```

```scilab
29  Vrms=sqrt(2)*V2; //Volt maxi. secondary voltage
30  mprintf('\n 2)Maximum value of secondary voltage is
        Vrms:%2d ',Vrms);
31  mprintf('\n.
        \*****************************************************************
        ');
32  Vm=Vrms/2; //Volt  maxi. voltage at half of
        secondary
33  mprintf('\n 3)Maximum voltage value of half-
        secondary Winding is Vm:%2d ',Vm);
34  mprintf('\n.
        \*****************************************************************
        ');
35  /////////////Load Current
        ///////////////////////////////
36  Im=Vm/RL;    // Amperes peak value of load current
37  mprintf('\n 4)Maxi.value of load Current is Im:%1f A
        ',Im);
38  mprintf('\n.
        \*****************************************************************
        ');
39  Idc=(2*Vm)/(3.14*RL);      //Amperes Load current
40  //Idc=Idc*1e3;  //mili amperes//
41  mprintf('\n 5)Average value of Load current is Idc:
        %1f A',Idc);
42  mprintf('\n.
        \*****************************************************************
        ');
43  Vdc=Idc*RL;   //Volts  dc Voltage
44  mprintf('\n 6)Average Value of Output Voltage is Vdc
        :%1f V',Vdc);
45  mprintf('\n.
        \*****************************************************************
        ');
46  Pdc=(Idc^2)*RL;     // Watts Average Power
47  mprintf('\n 7)Average Value Of load Power is Pdc:%1f
        W',Pdc);
48  mprintf('\n.
```

```
   \****************************************************************:
   ');
49 PIV=2*Vm;    //Volts
50 mprintf('\n 8)Peak Inverse Voltage is PIV:%1d V',PIV
      );
51 mprintf('\n.
   \****************************************************************:
   ');
52 Vr=Vdc*0.482;    //Volts  Ripple voltage
53 mprintf('\n 9)Ripple Voltage is Vr:%1f V',Vr);
54 mprintf('\n.
   \****************************************************************:
   ');
55 Irms=0.707*(Vm/RL);    //Amperes RMS Value of
      Current
56 Irms=Irms*1e3;  // Mili amperes
57 mprintf('\n 10)RMS Value of  current is Irms:%1f mA'
      ,Irms);
58 mprintf('\n.
   \****************************************************************:
   ');
59
60 //output//
61 // For Center Tapped Full Wave Rectifier Analysis:
62 //Enter the value of Load Resistance in Ohms
      RL:1000
63 //Enter the value of Input AC Voltage in Volts
      Vac:220
64 //Enter the Number of primary turns
      N1:1000
65 //Enter the Number of Secondary turns
      N2:100
66
67 //.
   *****************************************************************
68 // To Analyse Center Tapped Full wave rectifier
      given data in
```

43

```
69  //           the  circuit  is :
70  // Load  Resistance                    RL:1000  ohm
71  //  Input  AC  voltage                 V1:220  V
72   // Number  of  Secondary  turns      N2:100
73  //  Number  of  Primary  turns        N1:1000
74  //.  ************* Solution
        **********************************************
75  //  1) Voltage  at  Secondary  is  V2:22
76  //.
        ****************************************************************:

77  //2) Maximum  value  of  secondary  voltage  is  Vrms:31
78  //.
        ****************************************************************:

79  //  3) Maximum  voltage  value  of  half−secondary  Winding
         is  Vm:15
80  //.
        ****************************************************************:

81  //4) Maxi. value  of  load  Current  is  Im:0.015556  A
82  //.
        ****************************************************************:

83  //5) Average  value  of  Load  current  is  Idc:0.009909  A
84  //.
        ****************************************************************:

85   //6) Average  Value  of  Output  Voltage  is  Vdc:9.908503
         V
86  //.
        ****************************************************************:

87  //  7) Average  Value  Of  load  Power  is  Pdc:0.098178  W
88  //.
        ****************************************************************:

89   //8) Peak  Inverse  Voltage  is  PIV:31  V
```

```
90  // .
       *********************************************************************

91  // 9)Ripple Voltage is Vr:4.775898 V
92  // .
       *********************************************************************

93  // 10)RMS Value of  current is Irms:10.998339 mA
94  // .
       *********************************************************************
```

Experiment: 9

Determine PIV,Vdc,Idc,Vrms,Pdc and Irms for center full Wave bridge Rectifier

Scilab code Solution 9.0 Determine PIV Vdc Idc Vrms Pdc and Irms for full Wave bridge Rectifier

```scilab
1 //EX 9 Program Title:Determine PIV,Vdc,Idc,Vrms,Pdc
     and Irms for full Wave bridge Rectifier.
2 //environment: Scilab 5.5.2
3 //Tested on OS: Windows 7 Professional, 64 bit
4 //Book: Electronics Devices and Circuit Theory  by
     Robert Boylestead and Nashelsky
5 ////////////////////////////////////////
6 clc;
7 clear all;
8 close;
9 //
     ///////////////////////////////////////////////////////////////

10 disp('For Full Wave Bridge Rectifier Analysis:' );
```

```
11  RL=input('Enter the value of Load Resistance in Ohms
            RL:');//Note:Press enter
12  Vac=input('Enter the value of Input AC Voltage in
       Volts      Vac:');//Note:Press enter
13  N1=input('Enter the Number of primary turns in trun
       ratio    N1:');//Note:Press enter/
14  N2=input('Enter the Number of Secondary turns in
       trun ratio N2:');//Note:Press enter/
15  mprintf('\n.
       \*********************************************\');
16  //
       ///////////////////////////////////////////////////////////

17  disp('Given data for Full Wave Bridge Rectifier
       circuit is:' );
18  mprintf(' Load Resistance               RL:%2d ohm',RL)
       ;
19  mprintf('\n Input AC voltage            V1:%2d V',Vac
       );
20  mprintf('\n Number of Secondary turns  N2:%1d ',N2);
21  mprintf('\n Number of Primary turns    N1:%1d ',N1);
22  mprintf('\n');
23  /////////////////Voltage at Secondary
       /////////////////////////////
24  mprintf('\n. \***********Solution
       ************************************\');
25  V2=Vac*(N2/N1); // calculation of RMS secondary
26  mprintf('\n 1)Voltage at Secondary is
                          V2:%1dV',V2);
27  ////////////////Maximum Value at Secondary
       //////////////////////////
28  mprintf('\n.
       \*********************************************************\
       ');
29  Vrms=V2; //Volt Maxi voltage across secondary
30  mprintf('\n 2)Maximum value of secondary voltage is
             Vrms:%.1fV ',Vrms);
31  mprintf('\n.
```

```
   \*******************************************************\
   ');
32 Vm=Vrms*sqrt(2);  //Volt peak value of output
33 mprintf('\n 3)Maximum voltage value of secondary
      Winding is  Vm:%.1fV ',Vm);
34 mprintf('\n.
   \*******************************************************\
   ');
35 ///////////////Load Current
      /////////////////////////////////
36 Im=Vm/RL;    // Amperes peak value of output current
37 mprintf('\n 4)Maxi.value of load Current is
                     Im:%.2fA',Im);
38 mprintf('\n.
   \*******************************************************\
   ');
39 Idc=(2*Vm)/(3.14*RL);     //Amperes Load current
40 //Idc=Idc*1e3;  //mili amperes//
41 mprintf('\n 5)Average value of Load current is
                  Idc:%.2f A',Idc);
42 mprintf('\n.
   \*******************************************************\
   ');
43 Vdc=Idc*RL;    //Volts  Output DC voltage
44 mprintf('\n 6)Average Value of Output Voltage is
                 Vdc:%2dV',Vdc);
45 mprintf('\n.
   \*******************************************************\
   ');
46 Pdc=(Idc^2)*RL;     // Watts Average Power
47 mprintf('\n 7)Average Value Of load Power is
                     Pdc:%.1fW',Pdc);
48 mprintf('\n.
   \*******************************************************\
   ');
49 PIV=2*Vm;   //Volts  peak inverse voltage
50 mprintf('\n 8)Peak Inverse Voltage is
                           PIV:%1dV',PIV);
```

```
51  mprintf('\n.
       \*********************************************************\
       ');
52  Irms=0.707*(Vm/RL);      //Amperes RMS Value of
       Current
53  Irms=Irms*1e3;  // mili amperes
54  mprintf('\n 9)RMS Value of  current is
                               Irms:%.1fA',Irms);
55  mprintf('\n.
       \*********************************************************\
       ');
56
57
58  //output//
59
60   //For Full Wave Bridge Rectifier Analysis:
61  //Enter the value of Load Resistance in Ohms
       RL:200
62  //Enter the value of Input AC Voltage in Volts
       Vac:230
63  //Enter the Number of primary turns in trun ratio
          N1:4
64  //Enter the Number of Secondary turns in trun ratio
       N2:1
65
66  //. *********************************************
67  // Given data for Full Wave Bridge Rectifier circuit
       is:
68  //Load Resistance              RL:200 ohm
69  //Input AC voltage            V1:230 V
70  // Number of Secondary turns   N2:1
71  //Number of Primary turns    N1:4
72  //. **********Solution
       **********************************
73  // 1)Voltage at Secondary is
       V2:57V
74  //.
       **********************************************************
```

```
75  //2)Maximum value of secondary voltage is
        Vrms:57.5V
76  //.
        *********************************************************

77  // 3)Maximum voltage value of secondary Winding is
        Vm:81.3V
78  //.
        *********************************************************

79  // 4)Maxi.value of load Current is
        Im:0.41A
80  //.
        *********************************************************

81  // 5)Average value of Load current is
        Idc:0.26 A
82  //.
        *********************************************************

83   //6)Average Value of Output Voltage is
         Vdc:51V
84  //.
        *********************************************************

85  // 7)Average Value Of load Power is
        Pdc:13.4W
86  //.
        *********************************************************

87  // 8)Peak Inverse Voltage is
        PIV:162V
88  //.
        *********************************************************

89  // 9)RMS Value of  current is
        Irms:287.5A
```

90 // .
     ****

Experiment: 10

To find operating points and transfer curve of FET for fixed bias

Scilab code Solution 10.0 To find operating points and transfer curve of FET for fixed bias

```
1 //EX 10 Program Title:To find operating points and
       transfer curve of FET for fixed bias.
2 //environment: Scilab 5.5.2
3 //Tested on OS: Windows 7 Professional, 64 bit
4 //Book: Electronics Devices and Circuit Theory  by
       Robert Boylestead and Nashelsky
5 /////////////////////////////////////////////
6 clc;
7 clear all;
8 close;
9 //
       //////////////////////////////////////////////////////////////////////
10 disp('For FET Fixed Bias Circuit:' );
11 IDSS_1=input('Enter the value of Maxi.Drain to
       Sourse Current in mA   IDSS:');//Note:Press enter
```

```scilab
   /
12 Vp=input('Enter the value of Pinch off voltage in
      Volt(-Ve)            Vp:');//Note:Press enter///
      pinch off voltage is negative
13 RD_1=input('Enter the value of Drain resistance   in
      Kilo Ohms         RD:');//Note:Press enter///
14 VGG=input('Enter the value of Gate supply Voltage in
       volt(-Ve)     VGG:');//Note:Press enter///Gate
      supply voltage is negative
15 VDD=input('Enter the value of Drain supply Voltage
      in volt           VDD:');//Note:Press enter///Gate
      supply voltage is negative
16 mprintf('\n
      .***********************************************\
      ');
17 disp('Given data for FET Fixed Bias is:' );
18 IDSS=IDSS_1*1e-3    // mili amperes  Maxi Drain to
      Source Current
19 RD=RD_1*1e3    // kilo ohm   Emitter Resistance
20 mprintf(' Maximum Drain Current    IDSS:%.3fA',IDSS)
      ;
21 mprintf('\n Pinch-off voltage          Vp:%2dV',Vp);
22 mprintf('\n Drain Resistance          RD:%2dOhms',RD)
      ;
23 mprintf('\n Supply Voltage            VDD:%2dV',VDD);
24 mprintf('\n Gate Supply Voltage       VGG:%.1fV',VGG)
      ;
25 /////////////////Voltage at Secondary
      /////////////////////////////////
26 mprintf('\n
      .***********************************************\
      ');
27 mprintf('\n ****Shockley Equation:ID=IDSS*(1-VGS/VP)
      ^2*************');//Shockley Equation
28 mprintf('\n.
      \***********************************************\
      \n ');
29 VGS=[0:-0.01:Vp];
```

```scilab
30  ID=IDSS*(1-VGS/Vp).^2; //drain current using
        shockley equation
31  figure(2),plot(VGS,ID,'red');// plot of transfer
        characteristics
32  xtitle("Transfer characteristics of FET","VGS (V)","
        ID (mA)");
33  ////////////////////Calculatin of VDSQ  and IDQ
        /////////////////////
34  VGSQ=VGG;
35  IDQ=IDSS*(1-VGSQ/Vp).^2; // Drain Current
        Calculation
36  VDSQ=VDD-(IDQ*RD);           // Drain to Sourse voltage
        Calculation
37  IDQ=IDQ*1e3;        /// mili ampere conversion
38  mprintf('1)Operating Point Drain To Source Voltage
            VDSQ:%.2f V',VDSQ);//Display
39  mprintf('\n 2)Operating Point Drain Current
                    IDQ:%.2f mA',IDQ);
40  mprintf('\n.
        \*********************************************************\
        ');
41
42  //Output///
43  //For FET Fixed Bias Circuit:
44  //Enter the value of Maxi.Drain to Sourse Current in
        mA    IDSS:12
45  //Enter the value of Pinch off voltage in Volt(-Ve)
                Vp:-4
46  //Enter the value of Drain resistance  in Kilo Ohms
            RD:1.2
47  //Enter the value of Gate supply Voltage in volt(-Ve
        )        VGG:-1.5
48  //Enter the value of Drain supply Voltage in volt
                VDD:12
49
50  //
        .*******************************************************
```

```
51  //Given  data  for  FET  Fixed  Bias  is:
52  //  Maximum  Drain  Current        IDSS:0.012A
53   //Pinch−off  voltage          Vp:−4V
54  //  Drain  Resistance          RD:1200Ohms
55   //Supply  Voltage           VDD:12V
56   //Gate  Supply  Voltage        VGG:−1.5V
57  //
      .********************************************************
58  //  ****Shockley  Equation:ID=IDSS*(1−VGS/VP)
      ^2**************
59  //.
      *******************************************************
60  //  1)Operating  Point  Drain  To  Source  Voltage      VDSQ
      :6.38  V
61  //  2)Operating  Point  Drain  Current            IDQ
      :4.69  mA
62  //.
      *******************************************************
```
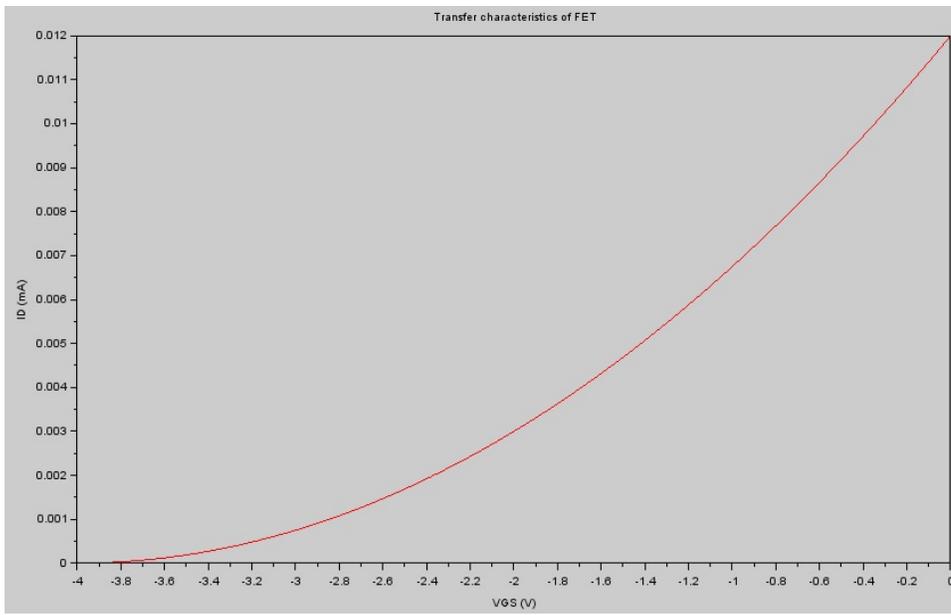
Figure 10.1: To find operating points and transfer curve of FET for fixed bias

Experiment: 11

To find operating points of BJT for voltage divider bias

Scilab code Solution 11.0 To find operating points of BJT for voltage divider bias

```scilab
1 //EX 11 Program Title:To find operating points of
      BJT for Voltage Divider bias.//////
2 //environment: Scilab 5.5.2
3 //Tested on OS: Windows 7 Professional, 64 bit
4 //Book: Electronics Devices and Circuit Theory  by
      Robert Boylestead and Nashelsky
5 //////////////////////////////////////
6 clc;
7 clear all;
8 close;
9 //
      ////////////////////////////////////////////////////////////////
10 disp('For BJT Voltage Divider Bias:' );
11 R1_1=input('Enter the value of Base resisance 1 in
      Kilo Ohms         R1:');//Note:Press enter/
12 R2_1=input('Enter the value of Base resistance 2 in
      Kilo Ohms         R2:');//Note:Press enter/
```

```scilab
13  RC_1=input('Enter the value of Collector resistance
       in Kilo Ohms    RC:');//Note:Press enter///
      collector resistance value should bel less than
      R1 and R2
14  RE_1=input('Enter the value of Emitter resistance
      in Kilo Ohms       RE:');//Note:Press enter///
      Emitter Resistance value should be less than
      collector resistanc
15  Betadc=input('Enter the value of Beta
                                     Betadc:');//Note:
      Press enter/
16  VCC=input('Enter the Supply Voltage in Volts
                             VCC:');//Note:Press enter
      /
17  R1=R1_1*1e3    // Kilo ohms   Base resistance 1
18  R2=R2_1*1e3     // Kilo ohms    base resistance 2
19  RC=RC_1*1e3     // Kilo ohms    Collector resistance
20  RE=RE_1*1e3    // kilo ohm    Emitter Resistance
21  //C1  uf  input capaciance open circuited in DC
      analysis
22  //C2  uf  output capaciance open circuited in DC
      analysis
23  VBE=0.7   //Volts Base to Emitter voltage
24  mprintf('\n.
      \***********************************************\');
25  disp('Given data for BJT Voltage Divider Bias is:')
      ;
26  mprintf(' Base resistance 1         R1:%.2f Ohms',R1)
      ;
27  mprintf('\n Base resistance 2        R2:%2d Ohms',R2
      );
28  mprintf('\n Collector resistance     RC:%2d Ohms',RC
      );
29  mprintf('\n Emitter resistance       RE:%2d Ohms',RE
      );
30  mprintf('\n CE DC Current Gain        Betadc:%2d V',
      Betadc);
31  mprintf('\n Collector Supply Voltage VCC:%2d V',VCC)
```

```
   ;
32 mprintf('\n Base to Emitter Voltage  VBE:%.1f V',VBE
      );
33 /////////////////Calculation of IB current to find
      out ICQ//////////////////////////
34 mprintf('\n.
      \***********************************************\');
35 Rth=(R1*R2)/(R1+R2);  // Thevenin Equivalent
      Resistance
36 Vth=(R2*VCC)/(R1+R2);   /// Open Circuit Thevenin
      Voltage
37 IB=(Vth-VBE)/(Rth+(Betadc+1)*RE);// Base Current
38 IB_=IB*1e6  // ampere for display
39 mprintf('\n Thevenin Equivalent Resistance    Rth:
      %2d Ohms',Rth);
40 mprintf('\n Open Circuit Thevenin Voltage     Vth:%
      .2f V',Vth);
41 mprintf('\n Base Current                      IB:%.2
      f uA',IB_);
42 //////////////////Calculatin of ICQ and VCEQ
      /////////////////////
43 mprintf('\n.
      \***********************************************\');
44 ICQ=Betadc*IB;  // Collector cueernt
45 ICQ_=ICQ*1e3    // ampere for display
46 VCEQ=VCC-ICQ*(RC+RE);  // collector to emitter
      voltage
47 mprintf('\n Operating Point Collector To Emitter
      Voltage   VCEQ:%.2f V',VCEQ);//Display
48 mprintf('\n Operating Point Collector Current
                  ICQ:%.4f mA',ICQ_);
49
50 ///output////
51
52
53 // For BJT Voltage Divider Bias:
54 //Enter the value of Base resisance 1 in Kilo Ohms
              R1:82
```

```
55  //Enter  the  value  of  Base  resistance  2  in  Kilo  Ohms
              R2:22
56  //Enter  the  value  of  Collector  resistance   in  Kilo
       Ohms     RC:5.6
57  //Enter  the  value  of  Emitter  resistance   in  Kilo
       Ohms       RE:1.2
58  //Enter  the  value  of  Beta
                                          Betadc:50
59  //Enter  the  Supply  Voltage  in  Volts
                                VCC:18
60
61  //. ********************************************
62  // Given  data  for  BJT  Voltage  Divider  Bias  is:
63  // Base  resistance  1        R1:82000.00  Ohms
64  // Base  resistance  2        R2:22000  Ohms
65  // Collector  resistance      RC:5600  Ohms
66  // Emitter  resistance        RE:1200  Ohms
67  // CE DC Current  Gain        Betadc:50  V
68  // Collector  Supply  Voltage  VCC:18  V
69  // Base  to  Emitter  Voltage   VBE:0.7  V
70  //. ********************************************
71  // Thevenin  Equivalent  Resistance     Rth:17346  Ohms
72  // Open  Circuit  Thevenin  Voltage      Vth:3.81  V
73  // Base  Current                IB:39.57  uA
74  //. ********************************************
75  // Operating  Point  Collector  To  Emitter  Voltage
       VCEQ:4.55  V
76  // Operating  Point  Collector  Current
       ICQ:1.9783  mA
```

Appendix

Scilab code AP 1

```
1  function [ID,x,VT]=diode_current2(VD,TK)
2  k=1.38e-23        //Joule per Kelvin      Boltzmann's
        Constant
3  q= 1.6e-19        // columb               Magnitude
        of electronics charge
4  Is=10e-12         // Amper                Reverse
        saturation current
5  n=1               //                      Ideality
        factor
6  ///////////////////////////////////////
7  VT=(k*TK)/q;
8  x=VD/(n*VT);
9  //
        /////////////////////////////////////////////////////////

10  ID=Is*(exp(x)-1);
11  endfunction
```

input