Scilab Manual for
Electronics Devices and Circuit I
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April 21, 2026

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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(eˆx−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
```
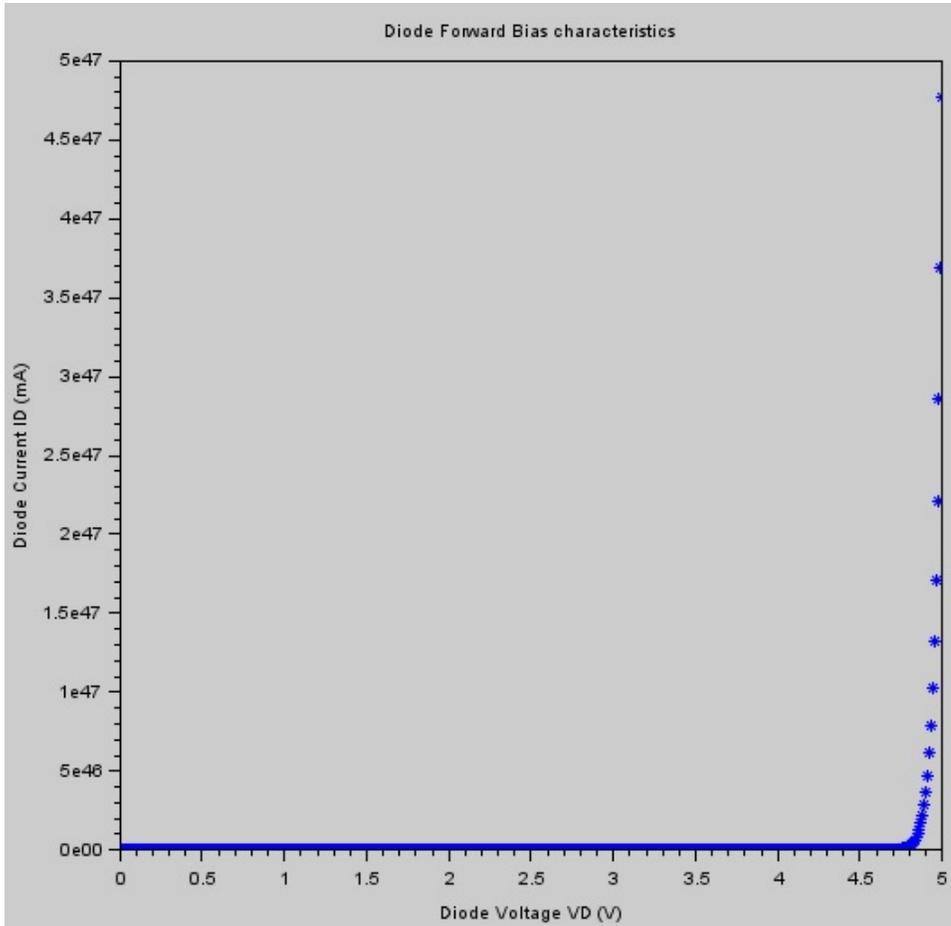
Figure 2.1: To Plot the VI Characteristics of semiconductor diode under forward Bias using Shockley equation
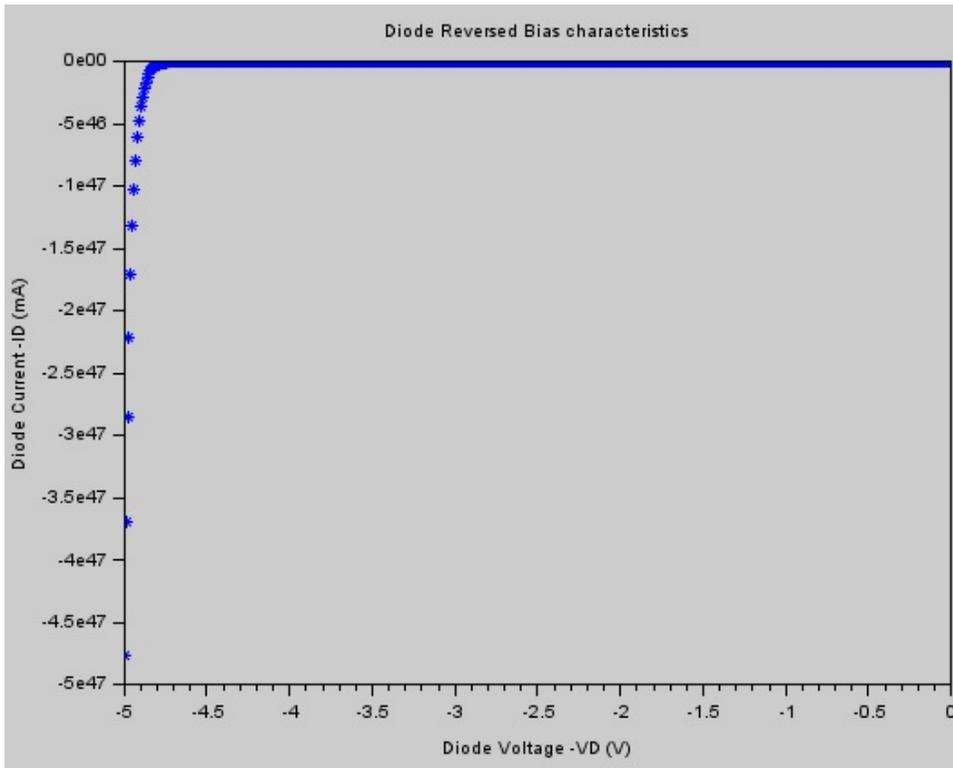
Figure 2.2: To Plot the VI Characteristics of semiconductor diode under forward Bias using Shockley equation

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
```

```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 :%.4 f  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  //
```

18

```
      ****************************************************************
73  //AC resistance at    ID1 is rd1:25.0000 ohm
74  //.
      ****************************************************************

75
76  ///case2/////////
77  //*******DC resistances of diode can be calculated
      by using
78  //        operating points on the forward
      characteristic*******
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 operating points
85  // Diode current           ID1:0.0250 A
86  // Diode Voltage          VD1:0.7 V
87  //
      **********************************************************

88  // DC resistance is RD1:28.0 ohms
89  //
      **********************************************************

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

91  // For calculation of AC resistance at the operating
       points ID
92  //Diode current1           ID11:0.0230 A
93  //Diode current2           ID12:0.0270 A
94  // Diode Voltage1           VD11:0.69 V
```

```
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

```scilab
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
```

```scilab
                                      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);
```

22

```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  //.
```

24

$* *$

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
```

```scilab
        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
```

```
33  IR_maxD = IR_max * 1 e 3 ;   //  miliamper
34  mprintf ( ' \n .
        \ ********************************************************************
        ' ) ;
35  mprintf ( ' \n  3 ) Current  through  input  Reistance  R  is
          IR_max :%.4 fmA ' , 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

```scilab
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*********');
```

```
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
```

31

```
        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=%.2f uA'
        ,ib1);
33  mprintf('\n  Base current2                  ib2=%.2f uA'
        ,ib2);
34  ib1=ib1*1e-6;
35  ib2=ib2*1e-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*1e-3;
42  ic2=ic2*1e-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;
```

```scilab
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 //
       ////////////////////////////////////////////////////////////////
```

```
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.
         \***********************************************************
         ');
```

41

```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
```

```
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

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

49

```
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  //.
       ********************************************************
```
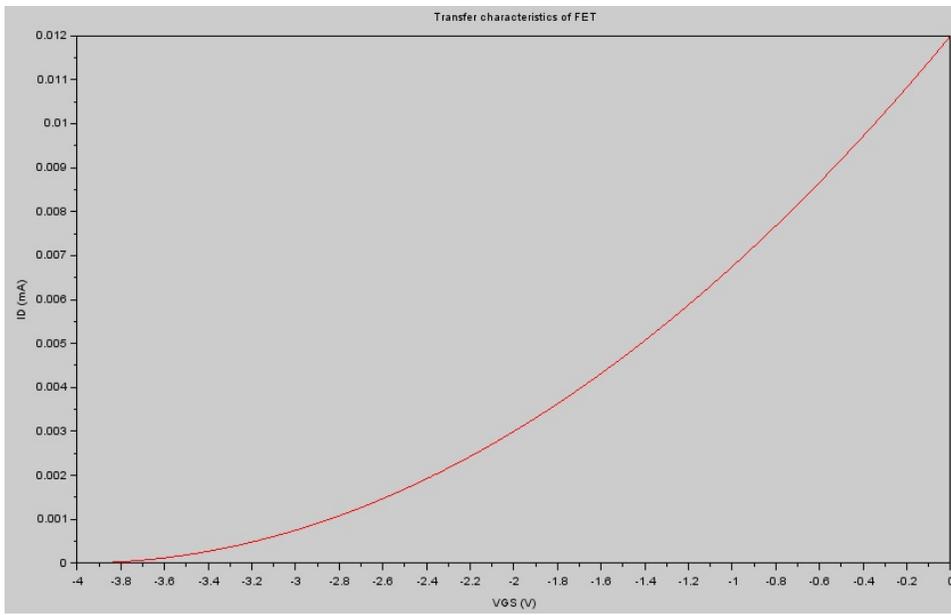
Figure 10.1: To find operating points and transfer curve of FET for fixed bias

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/
```

```
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