# Scilab Manual for
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June 8, 2026

# Contents

# List of Experiments

# Experiment: 1

# To find the transfer characteristics of FET

**Scilab code Solution 1.1** transfer characteristics of FET

```
1  clc;
2  close;
3  //Scilab 5.5.0;64 bit(windows 7)
4
5  IDSS=12;         // in mili−amperes
6  VP=-5;           // in volts
7
8  // Plotting transfer curve
9  VGS=[0:-0.01:VP];   // Gate source voltage in volts
10 // Using Shockley's equation
11 ID=IDSS*(1-VGS/VP).^2;    // Drain current in mili−
       amperes
12 plot(VGS,ID);
13 xtitle("Transfer Curve","VGS (V)","ID (mA)");
```

**Scilab code Solution 1.2** transfer characteristics of FET

```
1  clc;
2  close;
3  //Scilab 5.5.0;64 bit(windows 7)
4
5  IDSS=15;        // in mili-amperes
6  VP=-4;          // in volts
7
8  // Plotting transfer curve
9  VGS=[0:-0.01:VP];    // Gate source voltage in volts
10 // Using Shockley's equation
11 ID=IDSS*(1-VGS/VP).^2;      // Drain current in mili-
       amperes
12 plot(VGS,ID);
13 xtitle("Transfer Curve","VGS (V)","ID (mA)");
```

# Experiment: 2

# To find the transfer characteristics of FET for self bias configuration

**Scilab code Solution 2.1** transfer characteristics of FET for self bias

```
1  clc;
2  close;
3  //Scilab 5.5.0;64 bit(windows 7)
4
5  IDSS=5e-3; // in amperes
6  VP=-5; // in volts
7
8  // input circuit parameters
9  VDD=15; // in volts
10 RD=2.2e3; // in ohms
11 RS=1.6e3; // in ohms
12
13 // Plotting transfer characteristics
14 VGS=[0:-0.01:VP]; // Gate source voltage in volts
15 // Using Shockley's equation
16 ID=IDSS*(1-VGS/VP).^2; // Drain current in amperes
17 ID=ID*1e3; // Drain current in mili-amperes
```

```
18  plot(VGS,ID);
19  xtitle("Transfer  Characteristics","VGS (V)","ID (mA)
        ");
20
21  // Plotting  bias  line
22  // From  gate  source  circuit
23  ID=-VGS/RS; // Source  current  in  amperes
24  ID=ID*1e3; // Source  current  in  mili-amperes
25  plot(VGS,ID,"RED");
26
27  // Intersection  of  transfer  characteristics  with  the
        bias  curve
28  // Putting  VGS = -ID*RS  in  Shockley's  equation  and
        solving ,  we  get  ID^2*RS^2 + (2*RS*VP - VP^2/IDSS)
        *ID + VP^2
29  // Solving  the  equation
30  p_eq = poly([VP^2 (2*RS*VP-VP^2/IDSS) RS^2],"x","
        coeff");
31  p_roots= roots(p_eq);
32  IDQ=p_roots(1); // in  amperes
33  // Writing  the  KVL  for  the  output  loop
34  VDSQ=VDD-IDQ*(RD+RS); // in  volts
35  VS=IDQ*RS; // in  volts
36  VD=VDSQ+VS; // in  volts
37  IDQ=IDQ*1e3; // in  mili-amperes
38  disp(VDSQ,"VDSQ (V) =");
39  disp(IDQ,"IDQ (mA) =");
40  disp(VD,"VD (V) =");
41  disp(VS,"VS (V) =");
```

# Experiment: 3

# To find operating point of FET

**Scilab code Solution 3.1** operating point of FET

```
1  clc;
2  close;
3  // Scilab 5.5.0;64 bit(windows 7)
4
5  VP=-5;        // in volts
6  IDSS=18e-3; // in amperes
7
8  // input circuit parameters
9  VDD=18; // in volts
10 R1=400; // in kilo-ohms
11 R2=90;  // in kilo-ohms
12 RD=2e3; // in ohms
13 RS=2e3; // in ohms
14 // Applying Thevnin's theorem
15 VGG=VDD*R2/(R1+R2);   // in volts
16
17 // Plotting transfer characteristics
18 VGS=[VGG:-0.01:VP];    // Gate source voltage in
       volts
19 // Using Shockley's equation
20 ID=IDSS*(1-VGS/VP).^2; // Drain current in amperes
```

```scilab
21  ID=ID*1e3; // Drain current in mili−amperes
22  plot2d(VGS,ID,rect=[-5,0,3,12]);
23  xtitle("Transfer Characteristics","VGS (V)","ID (mA)
       ");
24
25  // Plotting bias line
26  // From the KVL for the gate−loop
27  ID=(-VGS+VGG)/RS; // Source current in amperes
28  ID=ID*1e3; // Source current in mili−amperes
29  plot(VGS,ID,"RED");
30
31  // Intersection of transfer curve with the bias
       curve
32  // Putting VGS = VGG−ID*RS in Shockley's equation
       and solving, we get
33  // ID^2*RS^2 + (2*RS*VP − 2*VGG*RS − VP^2/IDSS)*ID +
        (VGG−VP)^2
34  // Solving the equation
35  p_eq = poly([(VGG-VP)^2 (2*RS*VP-2*VGG*RS-VP^2/IDSS)
        RS^2],"x","coeff");
36  p_roots= roots(p_eq);
37  IDQ=p_roots(1); // in amperes
38  // Writing the KVL for the drain source loop
39  VDSQ=VDD-IDQ*(RD+RS); // in volts
40  IDQ=IDQ*1e3; // in mili−amperes
41  disp(VDSQ,"VDSQ (V) =");
42  disp(IDQ,"IDQ (mA) =");
```

# Experiment: 4

# To find the transfer characteristics of n channel enhancement type MOSFET

**Scilab code Solution 4.1** transfer characteristics of n channel enhancement type MOSFET

```
1  clc;
2  close;
3  //Scilab 5.5.0;64 bit(windows 7)
4
5  ID=6e-3; // in amperes
6  VGS=8;    // in volts
7  VT=3;     // in volts
8  // input circuit parameters
9  VDD=12; // in volts
10 RD=2e3; // in ohms
11
12 // Plotting transfer curve
13 k=ID/(VGS-VT).^2;   // in amperes per volt square
14 VGS=[3:0.01:VDD]; // Gate source voltage in volts
15 ID=k*(VGS-VT).^2;   // Drain current in amperes
       ...........(1)
```

```
16  ID=ID*1e3; // Drain  current  in  mili−amperes
17  plot(VGS,ID);
18  xtitle("Transfer  Curve","VGS  (V)","ID  (mA)");
19
20  // Plotting  bias  line
21  // From  the  simplified  dc  equivalent  circuit
22  VGS=[0:0.01:VDD]; // Gate  source  voltage  in  volts
23  ID=(VDD-VGS)/RD;   // Source  current  in  amperes
24  ID=ID*1e3; // Source  current  in  mili−amperes
25  plot(VGS,ID,"RED");
26
27  // Intersection  of  transfer  curve  with  the  bias
       curve
28  // Putting  VGS = VDD–ID*RD  in  equation  (1)  and
       solving ,  we  get  ID^2*RD^2 + (2*RD*VT − 2*VDD*RD −
       1/k)*ID + (VDD–VT)^2
29  // Solving  the  equation
30  p_eq = poly([(VDD-VT)^2 (2*RD*VT-2*VDD*RD-1/k) RD
       ^2],"x","coeff");
31  p_roots= roots(p_eq);
32  IDQ=p_roots(1);   // in  amperes
33  VGSQ=VDD-IDQ*RD; // in  volts
34  IDQ=IDQ*1e3;        // in  mili−amperes
35  disp(VGSQ,"VDSQ  (V)  =");
36  disp(IDQ,"IDQ  (mA)  =");
```

# Experiment: 5

# To find operating point of MOSFET

**Scilab code Solution 5.1** operating point of MOSFET

```
1  clc;
2  close;
3  //Scilab  5.5.0;64  bit(windows  7)
4
5  ID=5e-3;  // in  amperes
6  VGS=6;      // in  volts
7  VT=3;       // in  volts
8
9  // input  circuit  parameters
10 VDD=24;     // in  volts
11 R1=10;      // in  mega-ohms
12 R2=6.8;     // in  mega-ohms
13 RD=2.2e3;  // in  ohms
14 RS=0.75e3;// in  ohms
15 // Applying  Thevnin's  theorem
16 VGG=VDD*R2/(R1+R2);  // in  volts
17
18 // Plotting  transfer  characteristics
19 k=ID/(VGS-VT).^2;       // in  amperes  per  volt  square
```

```
20  VGS=[3:0.01:VGG];     // Gate source voltage in volts
21  ID=k*(VGS-VT).^2;      // Drain current in amperes
        ............. (i)
22  ID=ID*1e3; // Drain current in mili-amperes
23  plot(VGS,ID);
24  xtitle("Transfer Characteristics","VGS (V)","ID (mA)
        ");
25
26  // Plotting bias line
27  VGS=[0:0.01:VGG]; // Gate source voltage in volts
28  // Writing KVL for the gate-source loop
29  ID=(VGG-VGS)/RS; // Source current in amperes
30  ID=ID*1e3;        // Source current in mili-amperes
31  plot(VGS,ID,"RED");
32
33  // Intersection of transfer curve with the bias
        curve
34  // Putting VGS = VGG-ID*RD in equation (i) and
        solving, we get ID^2*RS^2 + (2*RS*VT - 2*VGG*RS -
        1/k)*ID + (VGG-VT)^2
35  // Solving the equation
36  p_eq = poly([(VGG-VT)^2 (2*RS*VT-2*VGG*RS-1/k) RS
        ^2],"x","coeff");
37  p_roots= roots(p_eq);
38  IDQ=p_roots(1); // in amperes
39  VGSQ=VGG-IDQ*RS; // in volts
40  // From the output circuit
41  VDSQ=VDD-IDQ*(RD+RS); // in volts
42  IDQ=IDQ*1e3; // in mili-amperes
43  disp(IDQ,"IDQ (mA) =");
44  disp(VDSQ,"VDSQ (V) =");
45  disp(VGSQ,"VGSQ (V) =");
```