Scilab Textbook Companion for Engineering Physics (volume - 1) by B. K. Pandey and S. Chaturvedi[1]

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Book Description

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Scilab numbering policy used in this document and the relation to the above book.

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

AP Appendix to Example(Scilab Code that is an Appednix to a particular Example of the above book)

For example, Exa 3.51 means solved example 3.51 of this book. Sec 2.3 means a scilab code whose theory is explained in Section 2.3 of the book.

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Chapter 1

Theory of relativity

Scilab code Exa 1.1 Calculation of fictitious forces

```
1  clc
2  // Given that
3  m = 6 // mass of object in kg
4  a= 5 // acceleration of object in m/s^2
5  g = 9.8 // acceleration due to gravity in m/s^2
6  // Sample problem 1 on page no. 10
7  printf("\n # Problem 1 \n")
8  F_down = m*(g+a) // force acting on a particle going
       downwards in N
9  F_up = m*(g-a)//force acting on a particle going
    upwards in N
10 printf("\n  Force acting on a particle while going
    upward is %f N \n  Force acting on a particle
    while going downward is %f N",F_up,F_down)
```

Scilab code Exa 1.2 Calculation of error involved I position of particle

```
1  clc
2  // given that
3  R = 6.4e8 // radius of earth in cm
4  T = 24*60*60 // time period of one revolution of
       earth around its own axis
5  t = 1 // time of 1 sec
6  printf(" \n # Problem 2 # \n")
7  omega = (2*%pi/T)// angular velocity of earth in
       theta/sec
8  alpha = omega^2 *R // Radial acceleration of earth
       in cm/sec^2
9  S = 1/2 * alpha*t^2 // altered distance of particle
       in one sec
10 printf(" Error involved in measurement of position
       for one minute is %f cm." ,S)
```

Scilab code Exa 1.4 Calculation of fringe shift

```
1  clc
2  //Given that
3  l = 9 // effective path length in m
4  lambda = 5000 // wavelength in angstrom
5  v = 3e4 // velocity of earth in m
6  c = 3e8 // Speed of light in m/s
7  // problem 4 page no 17
8  printf(" \n # Problem 4 # \n")
9  del_n = 2*l*v^2/(c^2*lambda*1e-10) // fringe shift
10 printf(" There will be a fringe shift of %f." , del_n)
```

Scilab code Exa 1.5 Calculation of relative velocity

```
1  clc
2  //Given that
3  l = 9 // effective path length in m
4  lambda = 6000 // wavelength in angstrom
5  del_n = 0.4 // fringe shift
6  c = 3e8 // Speed of light in m/s
7  // problem 5 page no 17
8  printf("\n # Problem 5 # \n")
9  v = c*sqrt(lambda*1e-10*del_n/(2*l)) // Speed of
       earth wrt ether in m/s
10 printf("Relative velocity of earth and ether is %e m
       /s", v)
11 // Whereas answre in book is 3.30e+4 m/sec
```

Scilab code Exa 1.7 Calculation of relative velocity

```
1  clc
2  // given that
3  del_D = 300 // Separation in distance in m
4  del_t = 4e-7 // separation in time in sec
5  c = 3e8 // speed of light in m/s
6  // Problem 7 on page 25
7  printf("\n # Problem 7 # \n")
8  v = del_t*c^2/del_D // velocity of one w.r.t other
       in m/s
9  printf("\n Velocity of one w.r.t other is %f*c m/s."
       ,v/c)
```

Scilab code Exa 1.10 Calculation of relative velocity

```
1  clc
2
3  // Given that
4  l_0 = 1// let initial length of rod in m
5  l = 0.99 // Observed length in m
6  c = 3e8 // speed of light in m/s
7  // Sample Problem 10 on page no. 27
8  printf("\n # PROBLEM 10 # \n")
9  printf(" Standard formula used \n")
10 printf(" l = l_0/((1-v^2/c^2)^1/2)  \n")
11 v = c* sqrt(1-(l/l_0)^2)// speed of rocket in m/s
12 printf("\n Speed of rocket is %e m/s.",v)
```

Scilab code Exa 1.11 Calculation of relative velocity of circular lamina

```
1  clc
2  // Given that
3  l_0 = 1// let initial length of rod in m
4  l = l_0/2 // Observed length in m
5  c = 3e8 // speed of light in m/s
6  // Sample Problem 11 on page no. 28
7  printf("\n # PROBLEM 11 # \n")
8  printf(" Standard formula used \n")
9  printf(" l = l_0/((1-v^2/c^2)^1/2)  \n")
10 v = c* sqrt(1-(l/l_0)^2)// speed of rocket in m/s
11 printf("\n Speed of moving lamina  is %e m/s.",v)
```

13

Scilab code Exa 1.12 Calculation of percentage contraction in length

```
1  clc
2  // Given that
3  l_0 = 1// let initial length of rod in m
4  c = 3e8 // speed of light in m/s
5  v = 0.8*c //  speed of frame of reference in m/s
6  // Sample Problem 12 on page no. 29
7  printf("\n # PROBLEM 12 # \n")
8  printf(" Standard formula used \n")
9  printf(" l = l_0/((1-v^2/c^2)^1/2)  \n")
10 l = l_0*sqrt(1-(v/c)^2) // apparent length of rod in
       m
11 change_l_per = 100*(l_0-l)/l_0
12 printf("\n Percentage contraction in length is %d
       percent. ",change_l_per)
```

Scilab code Exa 1.13 Calculation of relative velocity

```
1  clc
2  // Given that
3  l_0 = 100// let initial length of rod in m
4  l = 99 // Observed length in m
5  c = 3e8 // speed of light in m/s
6  // Sample Problem 13 on page no. 29
7  printf("\n # PROBLEM 13 # \n")
8  printf(" Standard formula used \n")
```

```
9  printf(" l = l_0 /((1-v^2/c^2)^1/2)  \n")
10 v = c* sqrt(1-(l/l_0)^2)// speed of rocket in m/s
11 printf("\n Speed of rocket ship is %e m/s.",v)
```

Scilab code Exa 1.14 Calculation of percentage contraction in rod

```
1  clc
2  // Given that
3  l = 100 // consider the length of the rod in meter
4  v = 2.4e8 // speed of rod in meter/sec
5  theta = %pi / 3 // direction of velocity of rod
       along its length in radian
6  // Sample Problem 14 on page no. 30
7  printf("\n # PROBLEM 14 # \n")
8  printf(" Standard formula used \n")
9  printf(" l = l_0 /((1-v^2/c^2)^1/2)  \n l^2 = l_x^2 +
       l_y^2 \n")
10 Lx = l * cos(theta)
11 Ly = l * sin(theta)
12 L_x = Lx * sqrt(1 - (v / 3e8)^2)
13 L_y = Ly
14 L = sqrt(L_x^2 + L_y^2)
15 p_l = ((l - L) / l) * 100
16 printf("\n Percentage length contraction is %f
       percent.",p_l)
```

Scilab code Exa 1.15 Calculation of relative velocity

```
1  clc
```

```
2  // Given that
3  t_0 = 12*60*60 // time of 12 hours in sec
4  t = t_0+30 // lose in time in sec for 12 hours
5  c = 3e8 // speed of light in m/s
6  // Sample Problem 15 on page no. 38
7  printf("\n # PROBLEM 15 # \n")
8  printf(" Standard formula used \n")
9  printf(" t = t_0/((1-v^2/c^2)^1/2) \n")
10 v = c * sqrt(1 - (t_0/t)^2)
11 printf("\n Speed of clock is %e meter/sec.",v)
```

Scilab code Exa 1.16 Calculation of relative velocity

```
1  clc
2  // Given that
3  t_0 = 24*60 // time of 24 hours in min
4  t = t_0+4 // lose in time in min for 24 hours
5  c = 3e8 // speed of light in m/s
6  // Sample Problem 16 on page no. 39
7  printf("\n # PROBLEM 16 # \n")
8  printf(" Standard formula used \n")
9  printf(" t = t_0/((1-v^2/c^2)^1/2) \n")
10 v = sqrt(2*(t/t_0 -1 ))*c // By binomial theoram
11 printf("\n Speed of clock is %e meter/sec.",v)
```

Scilab code Exa 1.17 Calculation of distance traveled by meson

```
1  clc
2  // Given that
```

```
3  t_ = 5e-8 // proper life of pi+ mesons in sec
4  c = 3e8 // Speed of light in m/s
5  v = 0.8*c // velocity of meson beam in m/sec
6  r = 1 / exp(2) // ratio of final flux to initial
      flux of the meson beam
7  // Sample Problem 17 on page no. 36
8  printf("\n # PROBLEM 17 # \n")
9  printf(" Standard formula used \n")
10 printf(" t = t_0/((1-v^2/c^2)^1/2) \n N = N_0*e^(-t/
      tau) \n")
11 t = t_ / sqrt(1 - (v / 3e8)^2)
12 T = t * log(1 / r)
13 d = T * v
14 printf("\n Distance travel by the beam is %f meter."
      ,d)
```

Scilab code Exa 1.18 `Calculation of average distance traveled by meson`

```
1  clc
2  // Given that
3  t_ = 2.2e-6 // proper life of mu mesons in sec
4  c = 3e8 // Speed of light in m/s
5  v = 0.8*c // velocity of meson beam in m/sec
6  // Sample Problem 18 on page no. 36
7  printf("\n # PROBLEM 18 # \n")
8  printf(" Standard formula used \n")
9  printf(" t = t_0/((1-v^2/c^2)^1/2) \n s = v*t \n")
10 t = t_ / sqrt(1 - (v / c)^2)
11 d = t * v
12 printf("\n Distance travel by the beam is %e meter."
      ,d)
```

Scilab code Exa 1.19 Calculation of mean life of pi meson and distance traveled by

```
1  clc
2
3  // Given that
4  t_ = 5e-8 // proper life of +pi mesons in sec
5  c = 3e8 // Speed of light in m/s
6  v = 2.4e8 // velocity of meson beam in m/sec
7  // Sample Problem 19 on page no. 37
8  printf("\n # PROBLEM 19 # \n")
9  printf(" Standard formula used \n")
10 printf(" t = t_0/((1-v^2/c^2)^1/2) \n s = v*t \n")
11 t = t_ / sqrt(1 - (v / c)^2)
12 d = t * v
13 printf("\n Mean life of +pi meson is %e sec \n
       Distance travel by the beam is %f meter.",t,d)
```

Scilab code Exa 1.20 Calculation of relative velocity

```
1  clc
2  // Given that
3  c = 3e8 // speed of light in m/s
4  u= -1*0.8*c // speed of particle A in m/s
5  v = 0.8*c // speed of particle B in m/s
6
7  // Sample Problem 20 on page no. 40
8  printf("\n # PROBLEM 20 # \n")
9  printf(" Standard formula used \n")
```

```
10  printf(" u_x = u_x_ + v / (1+ v*u_x_/c^2) \n ")
11  u1 = (u-v) / (1 - ((u * v) / (c)^2))
12  printf("\n Velocity of one particle relative to
       other is %e m/sec.",abs(u1))
```

Scilab code Exa 1.21 Calculation of relative velocity of beta particle by experime

```
1  clc
2  // Given that
3  c = 3e8 // speed of light in m/s
4  u= 0.25*c // speed of radioactive atom in m/sec
5  v = 0.9*c // speed of beta particle wrt to atom in
       same direction in m/sec
6
7  // Sample Problem 21 on page no. 41
8  printf("\n # PROBLEM 21 # \n")
9  printf(" Standard formula used \n")
10  printf(" u_x = u_x_ + v / (1+ v*u_x_/c^2) \n ")
11  u1 = (u+v) / (1 + ((u * v) / (c)^2))
12  printf("\n Velocity of one particle relative to
       other is %e m/sec.",abs(u1))
```

Scilab code Exa 1.22 Calculation of relative velocity vector in laboratory frame

```
1  clc
2  // Given that
3  u_x_ = 3 //Particle velocity in X direction in m/sec
4  u_y_ = 4 //Particle velocity in Y direction in m/sec
```

```
5  u_z_ = 12 //Particle velocity in Z direction in m/
       sec
6  c= 3e8 // speed of light in m/sec
7  v = 0.8*c // velocity of frame of reference in m/sec
8
9  // Sample Problem 22 on page no. 42
10 printf("\n # PROBLEM 22 # \n")
11 printf(" Standard formula used \n")
12 printf(" u_x = u_x_ + v / (1+ v*u_x_/c^2) \n ")
13 u_x = (u_x_+v)/(1+v*u_x_/c^2) // velocity in X
       direction laboratory frame of reference in m/sec
14 u_y = u_y_*sqrt(1-(v/c)^2)/(1+v*u_x_/c^2) //
       velocity in Y direction laboratory frame of
       reference in m/sec
15 u_z = u_z_*sqrt(1-(v/c)^2)/(1+v*u_x_/c^2) //
       velocity in Z direction laboratory frame of
       reference in m/sec
16 printf("\n Velocity of particle is %e i+ %f j+ %f k
       ",u_x,u_y,u_z)
```

Scilab code Exa 1.24 Calculation of meter stick moving a higher mass than rest mas

```
1  clc
2  // Given that
3  m_0 = 1 // let mass of the rod in kg
4  m = 1.5*m_0 // mass of moving rod in kg
5  l_0 = 1 // length of meter stick in m
6  c = 3e8 // speed of light in m/sec
7  // Sample Problem 24 on page no. 52
8  printf("\n # PROBLEM 24 # \n")
9  printf(" Standard formula used \n")
10 printf(" l = l_0/((1-v^2/c^2)^1/2) \n m = m_0/((1-v
       ^2/c^2)^1/2) \n")
```

```
11
12  v = c*sqrt(1-(m_0/m)^2) // velocity of moving rod in
        m/sec
13  L = l_0 * sqrt(1- (v / c)^2)
14  printf("\n Length as it appear to the observer is %f
        meter. ",L)
```

Scilab code Exa 1.25 Calculation of mass momentum total energy and kinetic energy

```
1  clc
2  // Given that
3  m_0 = 1 // let mass of the particle in kg
4  c = 3e8 // speed of light in m/sec
5  v = c/sqrt(2) // velocity of moving particle in m/
        sec
6
7  // Sample Problem 25 on page no. 53
8  printf("\n # PROBLEM 25 # \n")
9  printf(" Standard formula used \n")
10 printf("\n m = m_0/((1-v^2/c^2)^1/2) \n")
11 m = m_0/sqrt(1-(v/c)^2) // mass of moving particle
        in kg
12
13 p = m*v // momentum of moving particle in kgm/sec
14 E = m*c^2 // total energy of particle in joule
15 KE = E - m_0*c^2 // kinetic energy in joule
16 printf("\n Mass of particle is %fm_0 \n momentum of
        particle is %f*m_0*c \n Kinetic energy of
        particle is %f*m_0*c^2",m,p/c,KE/c^2)
```

Scilab code Exa 1.26 Calculation of kinetic energy and momentum of particle with m

```
1  clc
2  // Given that
3  m_0 = 9.1e-31 // let mass of electron in kg
4  m = 11*m_0 // mass of moving electron
5  c = 3e8 // speed of light in m/sec
6  // Sample Problem 26 on page no. 53
7  printf("\n # PROBLEM 26 # \n")
8  printf(" Standard formula used \n")
9  printf("\n m = m_0/((1-v^2/c^2)^1/2) \n")
10 v= c*sqrt(1-(m_0/m)^2) // velocity of moving
      electron in m/sec
11 p = m*v // momentum of moving particle in kgm/sec
12 E = m*c^2 // total energy of particle in joule
13 KE = (m - m_0)*c^2/1.6e-19// kinetic energy in eV
14 printf("\n  momentum of particle is %e kg m /sec \n
      Kinetic energy of particle is %e eV.",p,KE)
```

Scilab code Exa 1.27 Calculation of gain in mass by a proton accelerated through 5

```
1  clc
2  // Given that
3  m_0 = 1.6e-27 // mass of proton in kg
4  KE = 500 // kinetic energy of electron in MeV
5  c = 3e8 // speed of light in m/sec
6  // Sample Problem 27 on page no. 54
7  printf("\n # PROBLEM 27 # \n")
```

```
8  printf(" Standard formula used \n")
9  printf("\n E = m*c^2 \n")
10 del_m = KE*1e6*1.6e-19/c^2 // change in mass of
       proton in kg
11 printf("\n Change in mass of proton is %e kg. ",
       del_m)
```

Scilab code Exa 1.28 Calculation of speed of electron for which its mass equals re

```
1  clc
2  // Given that
3  m_p = 1.6e-27 // mass of proton in kg
4  m_e = 9.1e-31 // mass of electron in kg
5  c = 3e8 // speed of light in m/sec
6  // Sample Problem 28 on page no. 54
7  printf("\n # PROBLEM 28 # \n")
8  printf(" Standard formula used \n")
9  printf("\n m = m_0/sqrt(1-(v/c)^2) \n")
10 v = c* sqrt(1-(m_e/m_p)^2) // velocity of moving
       electron in m/sec
11
12 printf("\n Velocity of moving electron is  %e m/sec.
        ",v)
13 // But real answer is 2.99e8 m/sec
```

Scilab code Exa 1.29 Calculation of speed when kinetic energy of a body is thrice

```
1  clc
2  // Given that
```

```
3  m_0 = 1 // let rest mass of a particle be unity
4  c = 3e8 // speed of light in m/sec
5  rest_mass_energy = m_0*c^2 // rest mass energy of
       particle
6  KE = 3*rest_mass_energy // kinetic energy of
       particle
7  // Sample Problem 29 on page no. 55
8  printf("\n # PROBLEM 29 # \n")
9  printf(" Standard formula used \n")
10 printf("\n E = m*c^2 \n")
11 E_total = KE+ rest_mass_energy // total energy of
       particle
12 v = c * sqrt(1-(rest_mass_energy/E_total)^2) //
       velocity of moving electron in m/sec
13
14 printf("\n Velocity of moving electron is  %e m/sec.
       ",v)
```

Scilab code Exa 1.30 Calculation of speed when total energy of a body is thrice of

```
1  clc
2  // Given that
3  m_0 = 1 // let rest mass of a particle be unity
4  c = 3e8 // speed of light in m/sec
5  rest_mass_energy = m_0*c^2 // rest mass energy of
       particle
6  E_total = 3*rest_mass_energy // kinetic energy of
       particle
7  // Sample Problem 30 on page no. 55
8  printf("\n # PROBLEM 30 # \n")
9  printf(" Standard formula used \n")
10 printf("\n E = m*c^2 \n")
11
```

```
12  v = c * sqrt (1 -( rest_mass_energy/E_total )^2)  //
        velocity  of  moving  electron  in  m/sec
13  printf ("\n  Velocity  of  moving  electron  is    %e m/sec.
        " ,v )
```

Scilab code Exa 1.31 Calculation of mass and speed of an electron having one and h

```
1  clc
2  // Given  that
3  m_0 = 9.1e -31  //  mass  of  electron  in  kg
4  c = 3e8  //  speed  of  light  in  m/sec
5  KE = 1.5e6  //  kinetic  energy  in  eV
6  // Sample  Problem  31  on  page  no .  56
7  printf ("\n # PROBLEM  31  #  \n")
8  printf (" Standard  formula  used  \n")
9  printf ("\n E = m*c^2  \n")
10
11  m = m_0 + KE*1.6e -19/c^2  //  mass  of  moving  electron
        in  kg
12
13  v = c * sqrt (1 -( m_0/m )^2)  //  velocity  of  moving
        electron  in  m/sec
14  printf ("\n Mass  of  moving  electron  is %e kg  \n
        Velocity  of  moving  electron  is    %e m/sec .  " ,m ,v )
```

Scilab code Exa 1.32 Calculation of amount of work done to increase speed of an el

```
1  clc
2  // Given  that
```

```
3  m_0 = 9.1e-31 // mass of electron in kg
4  c = 3e8 // speed of light in m/sec
5  v1 = 0.6*c // initial velocity of electron in m/sec
6  v2 = 0.8*c//final velocity of electron in m/sec
7  E_rest = 0.511 // rest mass energy of electron in
       MeV
8  // Sample Problem 32 on page no. 57
9  printf("\n # PROBLEM 32 # \n")
10 printf(" Standard formula used \n")
11 printf("\n E = m*c^2 \n")
12 KE1 = E_rest*1e6*((1-(v1/c)^2)^(-1/2) -1)// initial
       kinetic energy of particle
13 KE2 = E_rest*1e6*((1-(v2/c)^2)^(-0.5) -1)// final
       kinetic energy of particle
14
15 del_KE = (KE2 -KE1)*1.6e-19 // change in kinetic
       energy
16 printf("\n Amount of work to be done is equal to %e
       J. ",del_KE)
```

Scilab code Exa 1.33 Calculation of speed of an electron accelerated through a pot

```
1  clc
2  // Given that
3  m_0 = 9e-31 // mass of electron in kg
4  c = 3e8 // speed of light in m/sec
5  KE = 1e6 // kinetic energy of electron in volts
6  // Sample Problem 33 on page no. 59
7  printf("\n # PROBLEM 33 # \n")
8  printf(" Standard formula used \n")
9  printf("\n E = m*c^2 \n")
10 v = c* sqrt(1-(1/(1+KE*1.6e-19/(m_0*c^2)))^2) //
       velocity of electron in m/sec
```

```
11 printf("\n Velocity of electron is %e m/sec. ",v)
```

Scilab code Exa 1.34 Calculation of speed of a 1one tenth MeV electron by classica

```
1 clc
2 // Given that
3 m_0 = 9.11e-31 // mass of electron in kg
4 c = 3e8 // speed of light in m/sec
5 KE = 1e5 // kinetic energy of electron in volts
6 E_rest = 512000 // rest mass energy of electron in
     eV
7 // Sample Problem 34 on page no. 60
8 printf("\n # PROBLEM 34 # \n")
9 printf(" Standard formula used \n")
10 printf("\n KE = m*v^2 \n E_total = KE+E_rest \n")
11 v_c = sqrt(2*KE*1.6e-19/m_0) // classical velocity
     of electron
12 E_total = KE + E_rest // energy of a moving electron
13 v_r = c * sqrt (1-(E_rest/E_total)^2)// relativistic
      velocity of electron
14 printf("\n Classical velocity of electron is %e m/
     sec \n Relativistic velocity of electron is %e m/
     sec.",v_c, v_r)
```

Scilab code Exa 1.35 Calculation of loss of mass in formation of 1 atom of hydroge

```
1 clc
2 // Given that
3 BE = 13.6 // Binding energy of electron in eV
```

```
4  c = 3e8 // speed of light in m/sec
5
6  // Sample Problem 35 on page no. 60
7  printf("\n # PROBLEM 35 # \n")
8  printf(" Standard formula used \n")
9  printf("\n E = m*c^2 \n")
10 del_m = BE*1.6e-19/c^2 // loss of mass in kg
11 printf("\n Loss of mass in formation of one atom of
       hydrogen is %ekg.",del_m)
12 clc
```

Chapter 2

Interference

Scilab code Exa 2.1 Calculation of ratio of intensities

```
1  clc
2
3  // Given that
4  lambda = 1 // let wavelength is unity
5  a = 1 // let amplitude is unity
6  del_x = lambda/8 // Path difference between two
       points on screen
7  // Problem 1 on page No. 82
8  printf("\n # Problem 1 # \n")
9  del_phase = 2*%pi*del_x/lambda // Phase difference
10 I1 = 2*a^2*(1+cos(del_phase)) // Intensity at that
       point
11 I0 = 4*a^2 // Intensity at center
12 ratio = I1/I0 // Ratio of intensities
13 printf("\n Ratio of intensities is %f",ratio)
```

Scilab code Exa 2.2 Calculation of ratio of maximum to minimum intensities

```
1  clc
2  // Given that
3  I1 = 1 // let intensity of one source is unity
4  I2 = 100*I1 // Intensity of second source
5  a1 = 1 // let amplitude of first source is unity
6  // Problem 2 on page No. 83
7  printf("\n # Problem 2 # \n")
8  amp_ratio = sqrt(I2/I1) // Amplitude ratio of
       sources
9  a2 = a1*amp_ratio // Amplitude of second source
10 I_max = (a1+a2)^2 // Maximum Intensity
11 I_min = (a2-a1)^2 // Minimum Intensity
12 I_ratio = I_max/I_min // Ratio of maximum to minimum
        intensity
13 printf("\n Ratio of intensities is %d : %d",I_max,
      I_min)
```

Scilab code Exa 2.3 Calculation of ratio of relative intensities of sources

```
1  clc
2  // Given that
3  I_avg = 100 // let it is average intensity
4  var = 5 // Intensity variation in percentage
5  a2 = 1 // let amplitude of one source is unity
6  // Problem 3 on page No. 83
7  printf("\n # Problem 3 # \n")
8  I_max = I_avg+var// maximum intensity
9  I_min = I_avg - var // minimum intensity
10 I_ratio = I_max/I_min // Ratio of maximum to minimum
        intensity
11 amp_ratio = (1+sqrt(I_max/I_min))/(sqrt(I_max/I_min)
      -1) // Amplitude ratio of sources
12 a1 = a2*amp_ratio // Amplitude of second source
```

```
13  i_ratio = (a1/a2)^2 // Intensity ratio of two
        sources
14  printf(" \n Ratio of intensities of sources is %d:1",
        ceil(i_ratio/100)*100)
```

Scilab code Exa 2.5 Calculation of spacing between slit

```
1  clc
2  // Given that
3  ang_width = 0.1 // Angular width in degree
4  lambda = 6e-5 // wavelength of light in cm
5  // Sample Problem 5 on page no. 94
6  printf(" \n # PROBLEM 5 # \n")
7  d = lambda/(ang_width*%pi/180) // Spacing between
        slit
8  printf(" \n Standard formula used \n D = a + b. \n d
        = (lambda * D) / fringe_width.\n")
9  printf(" \n Spacing between slit is %ecm. ",d)
```

Scilab code Exa 2.6 Calculation of third bright fringe and coincidental distance f

```
1  clc
2  // Given that
3  lambda1 = 6500 // wavelength of first source in
        angstrom
4  lambda2 = 5200 // wavelength of second source in
        angstrom
5  d = 2 // Spacing between sources in mm
6  D = 1.2 // Distance between source and screen
```

31

```
7  n = 3 // Order of bright fringe
8  // Sample Problem 6 on page no. 95
9  printf("\n # PROBLEM 6 # \n")
10 printf("\n Standard formula used \n x = D*n*lambda/d
        \n")
11 x_3 = D*n*lambda1*1e-10 / (d*1e-3) // Distance of
       third bright fringe from center
12 m = lambda2/(lambda1-lambda2)
13 x = D*m*lambda1*1e-10 / (d*1e-3) // distance of
       common fringe from center
14 printf("\n Distance of third bright fringe from
        center is %fcm \n. Common fringe will be formed
        at distance %fcm from center",x_3*100,x*100)
```

Scilab code Exa 2.7 Calculation of refractive index of transparent material

```
1  clc
2  // Given that
3  lambda = 6000 // wavelength of first source in
      angstrom
4
5  d = 2 // Spacing between sources in mm
6  D = 0.1 // Distance between source and screen in
      meter
7  t = 0.5 // Thickness of plate in mm
8  shift = 5 // Shift of fringe in mm
9
10 // Sample Problem 7 on page no. 95
11 printf("\n # PROBLEM 7 # \n")
12 printf("\n Standard formula used \n x = D*(mu1)*n*
      lambda/d \n")
13 mu = 1+ shift*1e-3*d*1e-3/(D*t*1e-3) // Refractive
      index of Glass plate
```

```
14 printf("\n Refractive index of Glass plate is %f.",
      mu)
```

Scilab code Exa 2.8 `Calculation of visible order in wavelength is replaced`

```
1 clc
2
3 // Given that
4 lambda1 = 7000 // wavelength of first source in
      angstrom
5 lambda2 = 5000 // wavelength of second source in
      angstrom
6 n = 10 // Order of bright fringe for first source
7 // Sample Problem 8 on page no. 96
8 printf("\n # PROBLEM 8 # \n")
9 printf("\n Standard formula used \n x = D*n*lambda/d
      \n")
10 x = n*lambda1*1e-10 // Path difference in m
11 m = x/(lambda2*1e-10)    // Order of bright fringe
      for second source
12 printf("\n Observed order will be %d.",m)
```

Scilab code Exa 2.9 `Calculation of distance between two coherent sources`

```
1 clc
2 // Given that
3 lambda = 6000 // wavelength of source in angstrom
4 D = 1 // Distance between source and screen
5 Beta  = 0.5 // fringe width in mm
```

```
6  // Sample Problem 9 on page no. 96
7  printf("\n # PROBLEM 9 # \n")
8  printf("\n Standard formula used \n x = D*n*lambda/d
       \n")
9  d = D*lambda*1e-10/(Beta*1e-3) // Separation between
       sources
10 printf("\n Separation between sources is %fcm.",d
      *100)
```

Scilab code Exa 2.10 Calculation of wavelength of light

```
1  clc
2
3  // Given that
4  n = 4 // order of bright fringe
5  x_n = 10 // Separation of 4th bright fringe from
      center in mm
6  D = 1// Separation between source and screen in
      meter
7  d = 0.2 // Separation between coherent sources in mm
8
9  // Sample Problem 10 on page no. 97
10 printf("\n # PROBLEM 10 # \n")
11 printf("\n Standard formula used \n x = D*n*lambda/d
       \n")
12 lambda = x_n*1e-3*d*1e-3/(n*D) // Calculation of
      wavelength of sauce in meter
13 printf("\n Wavelength of sauce is %d Angstrom.",
      lambda*1e10)
```

Scilab code Exa 2.11 Calculation of wavelength of light

```
1  clc
2  // Given that
3  n = 3 // order of dark fringe
4  m = 11 // Order of bight fringe
5  s = 8.835 // Separation between 4th dark and 11
       bright fringe
6  D = 100 // Separation between source and screen in
       centimeter
7  d = 0.5 // Separation between coherent sources in mm
8
9  // Sample Problem 11 on page no. 97
10 printf("\n # PROBLEM 11 # \n")
11 printf("\n Standard formula used \n x = D*n*lambda/d
       \n")
12 Beta = s*1e-3/(m - (2*n+1)/2) // Calculation of
       fringe width
13 lambda = Beta*d*1e-3/(D*1e-2) // Calculation of
       wavelength of sauce in meter
14 printf("\n Wavelength of sauce is %d Angstrom.",
       lambda*1e10)
```

Scilab code Exa 2.12 Calculation of changed fringe width

```
1  clc
2
3  // Given that
```

```
 4  lambda1 = 6000 // Wavelength of first light in
        angstrom
 5  lambda2 = 5000 // wavelength of second wave in
        angstrom
 6  m = 0 // order of bright fringe
 7  n = 10 // order of bright fringe
 8  d1 = 12.34 // micrometer reading for first zero
        order in mm
 9  d10 = 14.73 // micrometer reading for 10th order in
        mm
10  // Sample Problem 12 on page no. 98
11  printf("\n # PROBLEM 12 # \n")
12  printf("\n Standard formula used \n x = D*n*lambda/d
        \n")
13  s = d10 - d1 // Separation between zero order and 10
        th order fringe
14  Beta1 = s*1e-3/(n-m) // Calculation of fringe width
        for wavelength 1
15  Beta2 = (Beta1/lambda1)*lambda2 // Calculation of
        fringe width for wavelength 2
16  printf("\n Fringe width for wavelength %d angstrom
        is %f mm.",lambda2,Beta2*1e3)
```

Scilab code Exa 2.13 Calculation of distance between two coherent sources

```
1  clc
2
3  // Given that
4  lambda = 5890 // Wavelength of light in angstrom
5  d1 = 5 // separation between slit and biprism in cm
6  d2 = 75 // Distance between screen and biprism in cm
7  Beta = 9.424e-2 // Fringe width in cm
8
```

```
 9  // Sample Problem 13 on page no. 99
10  printf("\n # PROBLEM 13 # \n")
11  printf("\n Standard formula used \n x = D*n*lambda/d
        \n")
12  D = d1+ d2 // Separation between slit and screen in
        cm
13  d = D*1e-2*lambda*1e-10/(Beta*1e-2) // Calculation
        for separation between two coherent sources in m
14  printf("\n Separation between two coherent sources
        is %f cm.", d*1e2)
```

Scilab code Exa 2.14 Calculation of fringe width

```
 1  clc
 2
 3
 4  // Given that
 5  mu = 1.5 // Refractive index of material
 6  alpha = 1 // Refracting angle in degree
 7
 8  lambda = 6900 // Wavelength of light in angstrom
 9  d1 = 20 // separation between source and biprism in
        cm
10  d2 = 80 // separation between screen and biprism in
        cm
11  // Sample Problem 14 on page no. 99
12  printf("\n # PROBLEM 14 # \n")
13  printf("\n Standard formula used \n x = D*n*lambda/d
        \n")
14  D = d1+ d2 // Separation between slit and screen in
        cm
15  d = 2*(mu-1)*(alpha*%pi/180)*d1 // Separation
        between coherent sources
```

```
16  Beta = lambda*1e-10*D*1e-2/(d) // Calculation of
        fringe width in m
17  printf(”\n Fringe width is %f cm.”, Beta*1e2)
```

Scilab code Exa 2.15 Calculation of wavelength of light

```
1  clc
2
3  // Given that
4  D = 120 // Distance between eyepiece and screen in
        cm
5  d = 0.075 // DISTANCE BETWEEN TWO VIRTUAL COHERENT
        SOURCE in cm
6  x = 1.888 // Distance of 20th bright fringe from
        center in cm
7  n = 20 // Number of fringes
8  // Sample Problem 15 on page no. 99
9  printf(”\n # PROBLEM 15 # \n”)
10 printf(”\n Standard formula used \n x = D*n*lambda/d
        \n”)
11 Beta = x/n // Calculation of fringe width in m
12 lambda = Beta*d/D*1e-2 // Calculation of wavelength
13 printf(”\n Wavelength of light is %d angstrom.”,
        lambda*1e10)
```

Scilab code Exa 2.16 Calculation of thickness of plate

```
1  clc
2  // Given that
```

```
3  lambda = 5450 // Wavelength in angstrom
4  mu = 1.5 // Refractive index of material
5  n = 3 // order of fringe
6
7  // Sample Problem 16 on page no. 100
8  printf("\n # PROBLEM 16 # \n")
9  printf("\n Standard formula used \n (mu - 1)*t = n*
      lambda\n")
10 t = n*lambda*1e-10/(mu-1) // Calculation of
      thickness of glass plate
11 printf("\n Thickness of glass plate is %f mm.", t*1
      e3)
```

Scilab code Exa 2.17 Calculation of refractive index of sheet

```
1  clc
2  // Given that
3  lambda = 5460 // Wavelength in angstrom
4  t = 6.3e-4 // Thickness of plate in cm
5  n = 6 // order of fringe
6
7  // Sample Problem 17 on page no. 100
8  printf("\n # PROBLEM 17 # \n")
9  printf("\n Standard formula used \n (mu - 1)*t = n*
      lambda\n")
10 mu = n*lambda*1e-10/(t*1e-2) +1 // Calculation of
      thickness of glass plate
11 printf("\n Refractive index of sheet is %f.", mu)
```

Scilab code Exa 2.18 Calculation of refractive index of mica

```
1  clc
2  // Given that
3  lambda = 6e-5 // Wavelength in cm
4  t = 1.2e-6 // Thickness of plate in cm
5  n = 1 // order of fringe
6
7  // Sample Problem 18 on page no. 100
8  printf("\n # PROBLEM 18 # \n")
9  printf("\n Standard formula used \n (mu - 1)*t = n*
       lambda\n")
10 mu = n*lambda*1e-2/(t) +1  // Calculation of
       thickness of glass plate
11 printf("\n Refractive index of sheet is %f.", mu)
```

Scilab code Exa 2.19 Calculation of intensity at central maxima and its lateral sh

```
1  clc
2  // Given that
3  lambda = 5000 // Wavelength in angstrom
4  d = 5e-4 // Separation between slits in meter
5  D = 1// Separation between screen and slit in m
6  t = 1.5e-6 // Thickness of plate in cm
7  mu = 1.5 // Refractive index of medium
8  a1 = 1 // let
9  a2 = a1 // let
10 // Sample Problem 19 on page no. 101
11 printf("\n # PROBLEM 19 # \n")
12 printf("\n Standard formula used \n (mu - 1)*t = n*
       lambda\n")
13 del_l = (mu -1)*t // Calculation of path difference
14 del_p = 2*%pi/(lambda*1e-10) * del_l // Calculation
```

```
       of phase difference
15 I = a1^2+a2^2+2*a1*a2*cos(del_p) // Intensity at
       center of screen
16 x = D*(mu-1)*t /d
17 printf("\n Intensity at center of screen is %d.",I)
18 printf("\n Shift due to sheet is %f mm.",x*1e3)
```

Scilab code Exa 2.20 Calculation of thickness of mica sheet

```
1 clc
2 // Given that
3 lambda = 5890 // Wavelength in angstrom
4 mu = 1.6 // Refractive index of material
5 n = 3 // order of fringe
6 // Sample Problem 20 on page no. 100
7 printf("\n # PROBLEM 20 # \n")
8
9 printf("\n Standard formula used \n (mu - 1)*t = n*
      lambda\n")
10 t = n*lambda*1e-10/(mu-1) // Calculation of
      thickness of mica sheet
11 printf("\n Thickness of mica sheet is %e cm.", t*1e2
      )
```

Scilab code Exa 2.21 Calculation of smallest thickness of the plate which will app

```
1 clc
2 // Given that
3 lambda = 5890 // Wavelength in angstrom
```

```
4  r = 60 // Angle of Refraction in degree
5  mu = 1.5 // Refractive index of material
6  n = 1 // order of fringe
7
8  // Sample Problem 21 on page no. 108
9  printf("\n # PROBLEM 21 # \n")
10 printf("\n Standard formula used \n 2*mu*t*cos(r) =
       n*lambda\n")
11 t = n*lambda*1e-10/(2*mu*cos(r*%pi/180)) //
       Calculation of thickness of sheet
12 printf("\n Thickness of sheet is %e mm.", t*1e3)
```

Scilab code Exa 2.22 Calculation of least thickness for black and bright

```
1  clc
2  // Given that
3  lambda = 5893 // Wavelength in angstrom
4  r = 0 // Angle of Refraction in degree
5  mu = 1.42 // Refractive index of material
6  n = 1 // order of fringe for black
7  m = 0.5 // order of bright fringe
8
9  // Sample Problem 22 on page no. 108
10 printf("\n # PROBLEM 22 # \n")
11 printf("\n Standard formula used \n 2*mu*t*cos(r) =
       n*lambda\n")
12 t_n = n*lambda*1e-10/(2*mu*cos(r*%pi/180)) //
       Calculation of thickness of sheet for black
13 t_m = m*lambda*1e-10/(2*mu*cos(r*%pi/180)) //
       Calculation of thickness of sheet for bright
14 printf("\n Least thickness of sheet for \n Black :
       %e mm \n Bright: %e mm.", t_n*1e3,t_m*1e3)
```

Scilab code Exa 2.23 Calculation of thickness of film

```
1  clc
2  // Given that
3  lambda1 = 6.1e-7 // Wavelength in angstrom
4  lambda2 = 6.0e-7 // Wavelength in angstrom
5  i = asin(4/5) // Angle of incidence
6  mu = 4/3 // Refractive index of material
7
8  // Sample Problem 23 on page no. 109
9  printf("\n # PROBLEM 23 # \n")
10
11 printf("\n Standard formula used \n 2*mu*t*cos(r) =
      n*lambda\n")
12 n = lambda2/(lambda1-lambda2) // Calculation of
      order
13 r = asin(sin(i)/mu)
14 t = n*lambda1/(2*mu*cos(r)) // Calculation of
      thickness film
15 printf("\n Thickness of film is %e mm.", t*1e3)
```

Scilab code Exa 2.24 Calculation of thickness of film

```
1  clc
2  // Given that
3  lambda = 5890 // Wavelength in angstrom
4  i = 45 // Angle of incidence in degree
5  mu = 1.33 // Refractive index of soap film
```

```
 6 n = 1 // order
 7 // Sample Problem 24 on page no. 100
 8 printf("\n # PROBLEM 24 # \n")
 9 printf("\n Standard formula used \n 2*mu*t*cos(r) =
     n*lambda\n")
10 r = asin(sin(45*%pi/180)/mu)
11 t = n*lambda*1e-10/(2*mu*cos(r)) // Calculation of
      thickness film
12 printf("\n Thickness of film is %e mm.", t*1e3)
```

Scilab code Exa 2.25 Calculation of angle of wedge

```
 1 clc
 2 // Given that
 3 lambda = 6000 // Wavelength in angstrom
 4 mu = 1.4 // Refractive index of soap film
 5 Beta = 2 // Fringe width in mm
 6 // Sample Problem 25 on page no. 100
 7 printf("\n # PROBLEM 25 # \n")
 8 printf("\n Standard formula used \n Beta = lambda
     /(2*mu*theta)\n")
 9 theta = lambda*1e-10/(2*mu*Beta*1e-3) // Calculation
      of angle of wedge
10 printf("\n Angle of wedge is %e rad.", theta)
```

Scilab code Exa 2.26 Calculation of wavelength of light

```
 1 clc
 2 // Given that
```

```
3  theta = 10 // Angle in second
4  mu = 1.4 // Refractive index of soap film
5  Beta = 0.5 // Fringe width in cm
6  // Sample Problem 26 on page no. 100
7  printf("\n # PROBLEM 26 # \n")
8  printf("\n Standard formula used \n Beta = lambda
       /(2*mu*theta)\n")
9  lambda = (2*mu*Beta*1e-2*theta*(%pi/(60*60*180))) //
        Calculation of wavelength
10 printf("\n Wavelength of light is %d angstrom.",
       lambda*1e10)
```

Scilab code Exa 2.27 `Calculation of wavelength of light`

```
1  clc
2  // Given that
3  n = 15 // Order of ring
4  m = 5 // Order of ring
5  D_n = 0.59 // Diameter of 15th fringe in cm
6  D_m = 0.336 // Diameter of 5th fringe in cm
7  r = 100 // Radius of curvature of lens
8
9  // Sample Problem 27 on page no. 100
10 printf("\n # PROBLEM 27 # \n")
11 printf("\n Standard formula used \n Beta = lambda
       /(2*mu*theta)\n")
12 p = n-m // Difference of orders
13 lambda = ((D_n*1e-2)^2 - (D_m*1e-2)^2)/(4*p*r*1e-2)
        // Calculation of wavelength
14 printf("\n Wavelength of light is %d angstrom.",
       lambda*1e10)
```

Scilab code Exa 2.28 Calculation of refractive index of liquid

```
1 clc
2
3 // Given that
4 lambda = 6000 // Wavelength of light in angstrom
5 n = 6 // Order of ring
6 D_n = 3.1 // Diameter of 6th fringe in mm
7 r = 1 // Radius of curvature of curved surface
8 // Sample Problem 28 on page no. 100
9 printf("\n # PROBLEM 28 # \n")
10 printf("\n Standard formula used \n Beta = lambda
      /(2*mu*theta)\n")
11 mu = 2*(2*n-1)*lambda*1e-10*r/(D_n*1e-3)^2 //
      Calculation of refractive index of material
12 printf("\n Refractive index of material is %f.",mu)
```

Scilab code Exa 2.29 Calculation of radius of curvature of lens and thickness of a

```
1 clc
2 // Given that
3 lambda = 5900 // Wavelength of light in angstrom
4 n = 10 // Order of ring
5 D_n = 0.5 // Diameter of 10th fringe in cm
6
7 // Sample Problem 29 on page no. 118
8 printf("\n # PROBLEM 29 # \n")
```

```
9  printf("\n Standard formula used \n Beta = lambda
       /(2*mu*theta)\n")
10 r = (D_n*1e-2)^2/(4*n*lambda*1e-10) // Calculation
       of diameter of dark ring
11 t = n*lambda*1e-10/2 // calculation of thickness of
       air column
12 printf("\n Diameter of dark ring is %f m \n
       Thickness of air column is %em.",r,t)
```

Scilab code Exa 2.30 Calculation of distance from apex

```
1  clc
2  // Given that
3  theta = 0.3 // Angle of wedge in degree
4  lambda1 = 5890 // Wavelength of light in angstrom
5  lambda2 = 5896 // Wavelength of light in angstrom
6
7  // Sample Problem 30 on page no. 100
8  printf("\n # PROBLEM 30 # \n")
9  printf("\n Standard formula used \n 2*t = (2n+1)*
       lambda/2\n")
10 n = (3*lambda2-lambda1)/(2*(lambda1-lambda2)) //
       Calculation of order
11 t = (lambda1*1e-10*lambda2*1e-10)/(lambda2*1e-10-
       lambda1*1e-10) // Calculation of thickness
12 x = t/(2*theta*%pi/180) // Calculation of Distance
       from apex
13 printf("\n Distance from apex is %f cm.",x*1e2)
14 // Answer in book is 5.56 cm
```

Scilab code Exa 2.31 Calculation of radius of curvature of lens and thickness of f

```
1  clc
2  // Given that
3  lambda = 6000 // Wavelength of light in angstrom
4  n = 10 // Order of ring
5  D_n = 0.5 // Diameter of 10th fringe in m
6  // Sample Problem 31 on page no. 100
7  printf("\n # PROBLEM 31 # \n")
8  printf("\n Standard formula used \n Beta = lambda
       /(2*mu*theta)\n")
9  r = (D_n*1e-2)^2/(4*n*lambda*1e-10) // Calculation
       of diameter of dark ring
10 t = n*lambda*1e-10/2 // calculation of thickness of
       air column
11 printf("\n Diameter of dark ring is %f cm \n
       Thickness of air column is %e cm.",r*1e2,t*1e2)
```

Scilab code Exa 2.32 Calculation of diameter of dark ring

```
1  clc
2  // Given that
3  n = 4 // Order of ring
4  m = 12 // Order of ring
5  o = 20 // Order of ring
6  D_n = 0.4 // Diameter of 4th fringe in cm
7  D_m = 0.7 // Diameter of 12th fringe in cm
8
```

```
9  // Sample Problem 32 on page no. 100
10 printf("\n # PROBLEM 32 # \n")
11 printf("\n Standard formula used \n D_m^2 -D_n^2 =
      4*p*r*lambda\n")
12 D_o = sqrt((4*(o-n)/(4*(m-n)))* ((D_m*1e-2)^2-(D_n*1
      e-2)^2) + (D_n*1e-2)^2)
13 printf("\n Diameter of 20th ring is %f cm",D_o*1e+2)
```

Scilab code Exa 2.33 Calculation of diameter of dark ring

```
1  clc
2  // Given that
3  theta = 0.3 // Angle of wedge in degree
4  lambda1 = 6e-5 // Wavelength of light in cm
5  lambda2 = 4.5e-5 // Wavelength of light in cm
6  r = 90 // Radius of curvature in cm
7  // Sample Problem 33 on page no. 120
8  printf("\n # PROBLEM 33 # \n")
9
10 printf("\n Standard formula used \n D_m^2 -D_n^2 =
      4*p*r*lambda\n")
11 n = (lambda2*1e-2)/(lambda1*1e-2-lambda2*1e-2) //
      Calculation of order
12 D_n = sqrt(4*n*lambda1*1e-2*r*1e-2)
13 printf("\n Diameter of %dth dark ring is %f cm.",n,
      D_n*1e2)
```

Scilab code Exa 2.34 Calculation for difference in diameter of successive rings wh

49

```
1  clc
2  // Given that
3  lambda1 = 6e-5 // Wavelength of light in cm
4  lambda2 = 4.5e-5 // Wavelength of light in cm
5  dif1 = 0.125 // Difference between square of
       diameter of two successive rings in cm^2
6  mu1 = 1 // Refractive index
7  mu2 = 1.33 // Refractive index of inserted medium
8  r1 = 1 // let initial radius is unity
9  r2 = 2*r1 // Final radius of lens
10 // Sample Problem 34 on page no. 120
11 printf("\n # PROBLEM 34 # \n")
12 printf("\n Standard formula used \n D_m^2 -D_n^2 =
       4*p*r*lambda\n")
13 dif2 = lambda2*1e-2*dif1/lambda1*1e-2  //
       Calculation of difference between square of
       diameter of two successive rings in cm for
       lambda2
14
15 dif3 = mu1/mu2 * dif1 // Calculation of difference
       between square of diameter of two successive
       rings in cm for mu2
16 dif4 = r2/r1 * dif1
17 printf("\n For \n 1. Wavelength = %e cm, Difference
       between square of diameter of two successive
       rings is %f cm^2 \n 2. Refractive index %f,
       Difference between square of diameter of two
       successive rings is %f cm^2 \n .",lambda1,dif2*1
       e4,mu2,dif3)
18 printf(" \n 3.On doubling the radius, Difference
       between square of diameter of two successive
       rings will be %f cm^2.",dif4)
```

Chapter 3

Diffraction

Scilab code Exa 3.1 Calculation of angular and linear width of central maxima

```
1  clc
2
3  // Given that
4  lambda = 6000 // wavelength of light in angstrom
5  e = 0.1 // Width of slit in mm
6  d = 1 // Linear distance in mm
7  // Sample Problem 1 on page no. 137
8  printf("\n # PROBLEM 1 # \n")
9  printf(" Standard formula used \n")
10 printf(" lambda = e*sin(theta)  \n")
11 theta = asin(lambda*1e-10/(e*1e-3)) // Calculation
       of angle in radian
12 ang_wdt = 2*theta // Angular width of central maxima
13 y = d*ang_wdt // Total linear width of central
       maxima
14 printf("\n Total Angular width of central maxima is
       %erad \n Total linear width of central maxima
       %f cm.",ang_wdt,y*100)
```

Scilab code Exa 3.2 `Calculation of wavelength of light`

```
1  clc
2  // Given that
3  lambda = 6000 // wavelength of light in angstrom
4  e = 0.14 // Width of slit in mm
5  y = 1.6 // Separation between second dark bend and
       center in cm
6  d = 2 // Linear distance in mm
7  // Sample Problem 2 on page no. 137
8  printf("\n # PROBLEM 2 # \n")
9  printf(" Standard formula used \n")
10 printf(" lambda = e*sin(theta)  \n")
11 theta = asin(y*1e-2/d) // Calculation of angle in
       radian
12 lambda = theta*e*1e-3/2 // Calculation of wavelength
13 printf("\n Calculation of wavelength %d angstrom.",
       lambda*1e+10)
```

Scilab code Exa 3.3 `Calculation of width of slit`

```
1  clc
2  // Given that
3  lambda = 5000 // wavelength of light in angstrom
4  theta = 30 // Central maximum spread out at on side
5  // Sample Problem 3 on page no. 139
6  printf("\n # PROBLEM 3 # \n")
7  printf(" Standard formula used \n")
```

```
 8  printf (" lambda = e*sin (theta)   \n")
 9  e = lambda*1e-10 / sin (theta*%pi/180) // Calculation
        of width of slit
10  printf ("\n Width of slit is %ecm.",e*1e+2)
```

Scilab code Exa 3.4 `Calculation of wavelength of light`

```
 1  clc
 2  // Given that
 3  e = 0.2 // Width of slit in mm
 4  y = 0.5 // Separation between second dark bend and
       center in cm
 5  d = 2 // Linear distance in mm
 6  // Sample Problem 4 on page no. 140
 7  printf ("\n # PROBLEM 4 # \n")
 8  printf (" Standard formula used \n")
 9  printf (" lambda = e*sin (theta)   \n")
10  theta = y*1e-2/2 // Calculation of angle in radian
11  lambda = theta*e*1e-3 // Calculation of wavelength
12  printf ("\n Calculation of wavelength %d angstrom.",
       lambda*1e+10)
```

Scilab code Exa 3.6 `Calculation of wavelengths of light`

```
 1  clc
 2  // Given that
 3  f = 100 // focal length of lens in cm
 4  y = 0.05 // Separation between second dark bend and
       center in cm
```

```
5  m = 4  // Order of minima
6  n = 5  // Order of minima
7  e = 0.5  // Distance of center of 5th minima from
       center of maxima in cm
8  // Sample Problem 6 on page no. 141
9  printf("\n # PROBLEM 6 # \n")
10 printf(" Standard formula used \n")
11 printf(" lambda = e*sin(theta)  \n")
12 theta = y*1e-2/(f*1e-2) // Calculation of angle in
       radian
13 lambda_1 = theta*e*1e-2/m // Calculation of
       wavelength 1
14 lambda_2 = lambda_1*m/n // Calculation of wavelength
       2
15 printf("\n Wavelengths are %d and %d angestrom.",
       lambda_1*1e+10,lambda_2*1e+10)
```

Scilab code Exa 3.7 Calculation of half angular width

```
1  clc
2
3  // Given that
4  lambda = 6000 // wavelength of light in angstrom
5  e = 1.2e-4 // Width of slit in cm
6
7  // Sample Problem 7 on page no. 142
8  printf("\n # PROBLEM 7 # \n")
9  printf(" Standard formula used \n")
10 printf(" lambda = e*sin(theta)  \n")
11 theta = asin(lambda*1e-10/(e*1e-2)) // Calculation
       of angle in radian
12 ang_wdt = theta*180/%pi // Angular width of central
       maxima
```

```
13 printf("\n Total Angular width of central maxima is
       %d degree.",ceil(ang_wdt))
```

Scilab code Exa 3.8 Calculation of angle for first dark band and next bright band

```
1 clc
2 // Given that
3 lambda = 6000 // wavelength of light in angstrom
4 e = 0.3 // Width of slit in mm
5 m = 1 // Order for first dark band
6 n = 3/2 // Order for first bright band
7 // Sample Problem 8 on page no. 143
8 printf("\n # PROBLEM 8 # \n")
9 printf(" Standard formula used \n")
10 printf(" lambda = e*sin(theta)  \n")
11 theta_d = m*asin(lambda*1e-10/(e*1e-3)) //
       Calculation of angle in radian
12 theta_b = n*asin(lambda*1e-10/(e*1e-3)) //
       Calculation of angle in radian
13 printf("\n First dark band is formed at angle %e rad
       . \n First bright band is formed at angle %e rad.
       ",theta_d,theta_b)
```

Scilab code Exa 3.9 Calculation of distance for first dark band and next bright ba

```
1 clc
2 // Given that
3 f = 50 // focal length of lens in cm
4 lambda = 5890 // Wavelength of light in angstrom
```

```
 5  e = 0.03 // Width of slit in cm
 6  m = 1 // Order for first dark band
 7  n = 3/2 // Order for first bright band
 8  // Sample Problem 9 on page no. 143
 9  printf("\n # PROBLEM 9 # \n")
10  printf(" Standard formula used \n")
11  printf(" lambda = e*sin(theta)  \n")
12
13  theta_d = m*asin(lambda*1e-10/(e*1e-3)) //
        Calculation of angle in radian
14  theta_b = n*asin(lambda*1e-10/(e*1e-3)) //
        Calculation of angle in radian
15  y_d = theta_d*f*1e-2 // Calculation of linear
        distance of first dark band from center in m
16  y_b = theta_b*f*1e-2 // Calculation of linear
        distance of first dark band from center in m
17  printf("\n Linear distance of first dark band from
        center is %f cm \n Linear distance of next bright
         band   is %f cm",y_d*10,y_b*10)
```

Scilab code Exa 3.10 Calculation of wavelength of light and missing wavelengths

```
 1  clc
 2
 3  // Given that
 4  d = 0.4 // separation between slits in mm
 5  e = 0.08 // width of slit in mm
 6  D = 170 // Separation between screen and source in
      cm
 7  Beta = 0.25 // Fringe width in cm
 8
 9  // Sample Problem 10 on page no. 155
10  printf("\n # PROBLEM 10 # \n")
```

```
11  printf(" Standard formula used \n")
12  printf(" theta = 1.22*lambda/a   \n")
13  lambda = Beta*1e-2*d*1e-3/(d*1e-2) // Calculation of
        wavelength
14  ratio = (e+d)/e
15  printf("\n Missing order will be %d*n, where n is a
        natural number.",ratio)
```

Scilab code Exa 3.11 Calculation of wavelength of light

```
1  clc
2
3  // Given that
4  n = 2 // order
5  N = 5000 // no. of lines per cm
6  theta = 30 // angle of deviation in degree
7  // Sample Problem 11 on page no. 155
8  printf("\n # PROBLEM 11 # \n")
9  printf(" Standard formula used \n")
10 printf(" n*lambda= sin(theta)/N   \n")
11 lambda= sin(theta*%pi/180)/(n*N*1e2)
12 printf("\n Wavelength of spectral lines is %d
        angstrom.",ceil(lambda*1e10))
```

Scilab code Exa 3.12 Calculation of difference in deviation in first and third ord

```
1  clc
2  // Given that
3  lambda= 5000 // wavelength of light in angstrom
```

```
4  n1 = 1 // order
5  n3 = 3 // order
6  N = 6000 // no. of lines per cm
7  // Sample Problem 12 on page no. 156
8  printf(" \n # PROBLEM 12 # \n")
9  printf(" Standard formula used \n")
10 printf(" n*lambda= sin(theta)/N  \n")
11 theta_1 = 180/%pi*asin(n1*lambda*1e-8*N) //
        Deviation of first order spectra
12 theta_3 = 180/%pi*asin(n3*lambda*1e-8*N) //
        Deviation of third order spectra
13 theta_dif = theta_3- theta_1 // Difference in
        deviation of first and third order spectra
14 printf(" \n Difference in deviation of first and
        third order spectra is %f degree.",theta_dif)
```

Scilab code Exa 3.13 Calculation of number of visible orders

```
1  clc
2  // Given that
3  lambda= 5000 // wavelength of light in angstrom
4  theta = 90 // for maximum order
5  X = 2620 // no. of lines per inch
6  // Sample Problem 13 on page no. 156
7  printf(" \n # PROBLEM 13 # \n")
8  printf(" Standard formula used \n")
9  printf(" n*lambda= sin(theta)/N  \n")
10 N = X/2.54 // no. of lines per cm
11 n= sin(theta*%pi/180)/(N*lambda*1e-8) // order
        calculation
12 printf(" \n Number of orders visible is %d.",n)
```

Scilab code Exa 3.14 Calculation of order numbers for visible spectrum

```
1  clc
2  // Given that
3  N = 4000  // Grating lines per cm
4  theta = 90  // for maximum order
5  lambda_min = 4000  // minimum wavelength of light in
        angstrom
6  lambda_max = 7500  // maximum wavelength of light in
        angstrom
7  // Sample Problem 14 on page no. 157
8  printf("\n # PROBLEM 14 # \n")
9  printf(" Standard formula used \n")
10 printf(" lambda/d_lambda = n*N  \n")
11 n_max= sin(theta*%pi/180)/(N*lambda_min*1e-8)  //
        minimum order observed
12 n_min= sin(theta*%pi/180)/(N*lambda_max*1e-8)  //
        maximum order observed
13 printf("Visible orders are form %d to %d.",n_min,
        n_max)
```

Scilab code Exa 3.15 Calculation of number of lines per centimeter

```
1  clc
2  // Given that
3  lambda_1 = 6000  // wavelength of light in angstrom
4  lambda_2 = 4500  // wavelength of light in angstrom
5  theta = 30  // Angle in degree
```

```
6
7  // Sample Problem 15 on page no. 158
8  printf("\n # PROBLEM 15 # \n")
9  printf(" Standard formula used \n")
10 printf(" n*lambda= sin(theta)/N \n")
11 n = lambda_2/(lambda_1-lambda_2) // order
       calculation
12 e_d = n*lambda_1*1e-8/sin(theta*%pi/180)
13 N = 1/e_d // Number of lines per cm
14 printf(" \n Number of lines per cm is %d.\n",N )
```

Scilab code Exa 3.17 Calculation of angle of diffraction for maximum intensity in

```
1  clc
2  // Given that
3  lambda = 5000 // mean wavelength in angstrom
4  n_tot = 15000 // total number of lines
5  l = 3 // length in cm
6  n = 1 // order
7  // Sample Problem 17 on page no. 160
8  printf("\n # PROBLEM 17 # \n")
9  printf(" Standard formula used \n")
10 printf(" n*lambda= sin(theta)/N   \n")
11 e_d = l/n_tot
12 theta = 180/%pi*asin(n*lambda*1e-8/e_d) // Angle of
       diffraction for maximum intensity in first order
13 printf("\n Angle of diffraction for maximum
       intensity in first order \nis %f degree.",theta)
```

Scilab code Exa 3.18 Calculation of number of lines per centimeter in a grating

```
1  clc
2  // Given that
3  lambda = 5000 // mean wavelength in angstrom
4  n = 2 // order
5  N = 5000 // Grating lines per cm
6  theta = 30 // Angle in degree
7
8  // Sample Problem 18 on page no. 160
9  printf("\n # PROBLEM 18 # \n")
10 printf(" Standard formula used \n")
11 printf(" n*lambda= sin(theta)/N  \n")
12 e_d = n*lambda*1e-8/sin(theta*%pi/180)
13 N = 1/e_d // number of lines per unit length
14 printf("\n Number of lines per unit centimeter is %d
       lines/cm.",ceil(N))
```

Scilab code Exa 3.19 Calculation for the overlapping of spectral lines

```
1  clc
2
3  // Given that
4  lambda_1 = 5890 // wavelength of light in angstrom
5  m = 5 // order
6  n = 4 // order
7
8  // Sample Problem 19 on page no. 161
9  printf("\n # PROBLEM 19 # \n")
10 printf(" Standard formula used \n")
11 printf(" n*lambda= sin(theta)/N \n")
12 lambda_2 = n*lambda_1/5
13 printf(" \n The wavelength of %dth order spectrum is
```

```
        %d angstrom.\n",m,lambda_2 )
```

Scilab code Exa 3.20 Calculation of grating element

```
1  clc
2  // Given that
3  lambda_1 = 6000  // wavelength of light in angstrom
4  lambda_2 = 4800  // wavelength of light in angstrom
5  theta = asin(0.75)  // Angle of diffraction
6
7  // Sample Problem 20 on page no. 165
8  printf("\n # PROBLEM 20 # \n")
9  printf(" Standard formula used \n")
10 printf(" n*lambda= sin(theta)/N \n")
11 n = lambda_2/(lambda_1-lambda_2)  // order
       calculation
12 e_d = (n+1)*lambda_2*1e-8/sin(theta)  // Grating
       Element
13 printf(" \n Grating Element is %e cm.\n",e_d )
```

Scilab code Exa 3.21 Calculation of angle of diffraction

```
1  clc
2  // Given that
3  lambda = 6000  // wavelength of light in angstrom
4  N = 200  // Grating element
5  n = 3  // order
6  d = 0.025  // diameter of wire in mm
7  // Sample Problem 21 on page no. 165
```

```
8  printf(" \n # PROBLEM 21 # \n")
9  printf(" Standard formula used \n")
10 printf(" n*lambda= sin(theta)/N \n")
11 theta = 180/%pi*asin(N*n*lambda*1e-8)
12 theta_deg = floor(theta)
13 theta_min = (theta - theta_deg)*60// Angle of
       diffraction
14 e = 1/N - d*1e-1 // width of slit
15 ratio = 1/(N*e)
16 m = 1
17 n1 = ratio*m
18 printf(" \n Angle of diffraction for third order
       spectrum is %d degree and %f minute.\n",theta_deg
       , theta_min )
19 printf(" \n For n = %d, m = 1 is considered \n
       because the higher value of m results the order \
       nof absent spectrum more than given order %d.",n1
       ,n)
```

Scilab code Exa 3.22 `Calculation for the difference between two wavelengths`

```
1  clc
2  // Given that
3  lambda = 5000 // wavelength of light in angstrom
4  theta = 30 // angle in degree
5  d_theta = 0.01 // angular separation in radian
6  // Sample Problem 22 on page no. 165
7  printf(" \n # PROBLEM 22 # \n")
8  printf(" Standard formula used \n")
9  printf(" d_theta /d_lambda = n/(e+d)*cos(theta)  \n"
       )
10 d_lambda = lambda*cotg(theta*%pi/180)*d_theta
11 printf(" \n Difference in two wavelengths is %f
```

```
     angstrom." , d_lambda )
```

Scilab code Exa 3.23 Calculation of dispersive power of grating

```
1  clc
2
3  // Given that
4  N = 4000 // Grating lines per cm
5  n = 2 // order
6  lambda = 5000 // wavelength of light in angstrom
7
8  // Sample Problem 23 on page no. 165
9  printf("\n # PROBLEM 23 # \n")
10 printf(" Standard formula used \n")
11 printf(" d_theta /d_lambda = n/(e+d)*cos(theta)  \n"
       )
12 theta = asin(n*lambda*1e-8*N) // Calculation of
       angle in radian
13 ratio = n*N/(cos(theta)) // where ratio = d_theta /
       d_lambda
14 printf("Dispersive power of grating is %d.",ratio)
```

Scilab code Exa 3.24 Determination of observed orders due to grating

```
1  clc
2  // Given that
3  N = 4000 // Grating lines per cm
4  theta = 90 // for maximum order
```

```
5  lambda_min = 5000 // minimum wavelength of light in
       angestrom
6  lambda_max = 7500 // maximum wavelength of light in
       angestrom
7  // Sample Problem 24 on page no. 165
8  printf("\n # PROBLEM 24 # \n")
9  printf(" Standard formula used \n")
10 printf(" lambda/d_lambda = n*N   \n")
11 n_max= sin(theta*%pi/180)/(N*lambda_min*1e-8) //
       minimum order observed
12 n_min= sin(theta*%pi/180)/(N*lambda_max*1e-8) //
       maximum order observed
13
14
15 printf("Visible orders are form %d to %d.",n_min,
       n_max)
```

Scilab code Exa 3.25 Calculation for the difference between two wavelengths

```
1  clc
2  // Given that
3  lambda = 5893 // mean wavelength in angstrom
4  n = 2 // order
5  N = 5000 // Grating lines per cm
6  theta = 2.5 // Separation in second
7
8  // Sample Problem 25 on page no. 166
9  printf("\n # PROBLEM 25 # \n")
10 d_theta = %pi/180*theta/60 // Angle in radian
11 d_lambda = d_theta*sqrt((1/(n*N)^2)-(lambda*1e-8)^2)
       // Difference in wavelengths
12 printf("Difference in wavelengths is %f angstrom.",
       d_lambda*1e8)
```

Scilab code Exa 3.26 Calculation of aperture of objective of telescope

```
1  clc
2  // Given that
3  theta = 4.88e-6 // Separation between two stars in
       radian
4  lambda = 6000 // wavelength of light in angstrom
5  // Sample Problem 26 on page no. 172
6  printf("\n # PROBLEM 26 # \n")
7  printf(" Standard formula used \n")
8  printf(" theta = 1.22*lambda/a  \n")
9  a = 1.22*lambda*1e-10/(theta)  // calculation of
       aperture of objective
10 printf("\n Aperture of objective is %d cm.",(a*100))
```

Scilab code Exa 3.27 Calculation for the separation between two points on moon

```
1  clc
2  // Given that
3  a = 500 // Aperture of telescope in cm
4  lambda = 5500 // wavelength of light in angstrom
5  R = 3.8e5 // Distance of moon in km
6  // Sample Problem 27 on page no. 172
7  printf("\n # PROBLEM 27 # \n")
8  printf(" Standard formula used \n")
9  printf(" theta = 1.22*lambda/a  \n")
10 theta = 1.22*lambda*1e-10/(a*1e-2)  // calculation
       of angle in radians
```

66

```
11  x = R*1e3*theta // Calculation  separation  of  two
        points  in m
12  printf (" \n  Separation  of  two  points  is  %fm.",x)
```

Scilab code Exa 3.28 Calculation of aperture of object

```
1  clc
2  // Given  that
3  S = 5.55e-7 // separation  between  objects
4  lambda = 5461 // wavelength  of  light  in  angstrom
5
6  // Sample  Problem  28  on  page  no.  173
7  printf (" \n # PROBLEM  28 # \n")
8  printf (" Standard  formula  used  \n")
9  printf (" S = 1.22*lambda/(2*NA)  \n")
10 NA = 1.22*lambda*1e-10/(2*S) // Calculation  of
        numerical  aperture
11 printf (" \n  Numerical  aperture  is  %f.",NA)
```

Scilab code Exa 3.29 Calculation of resolving power of a microscope

```
1  clc
2  // Given  that
3  NA = 0.12 // Numerical  aperture
4  lambda = 6e-5 // wavelength  of  light  in  cm
5
6  // Sample  Problem  29  on  page  no.  173
7  printf (" \n # PROBLEM  29 # \n")
8  printf (" Standard  formula  used  \n")
```

```
9  printf(" RP = 2*NA/lambda   \n")
10 RP = 2*NA/(lambda) // Resolving power for non self
      luminous objects
11 printf("\n Maximum resolution power is %d.",ceil(RP)
      )
```

Scilab code Exa 3.30 Calculation of maximum resolving power

```
1  clc
2  // Given that
3  N = 40000 // Total number of lines on grating
4  lambda = 5000 // wavelength of light in angstrom
5  e_d = 12.5e-5 // Separation between centers of slits
        in cm
6  // Sample Problem 30 on page no. 173
7  printf("\n # PROBLEM 30 # \n")
8  printf(" Standard formula used \n")
9  printf(" n = e_d/lambda   \n")
10 n = e_d*1e-2/(lambda*1e-10) // Maximum possible
      order calculation
11 P_res = floor(n)*N // Maximum resolution power
12 printf("\nMaximum resolution power is %d.",P_res)
```

Scilab code Exa 3.31 Calculation of minimum number of lines required

```
1  clc
2  // Given that
3  lambda_1 = 5890 // wavelength of light in angstrom
4  lambda_2 = 5896 // wavelength of light in angstrom
```

```
 5  n = 2 // order
 6  // Sample Problem 31 on page no. 174
 7  printf("\n # PROBLEM 31 # \n")
 8  printf(" Standard formula used \n")
 9  printf(" RP = n*N  \n")
10  d_lambda = lambda_2-lambda_1 // Difference between
        wavelengths
11  lambda = (lambda_1+lambda_2)/2 // Average wavelength
12  N = lambda/(n*d_lambda) // Number of lines in
        grating
13  printf("\nMinimum number of grating required to
        resolve wavelengths is %d",N)
```

Scilab code Exa 3.32 Determining the ability of telescope

```
 1  clc
 2  // Given that
 3  f = 4 // Focal length of telescope objective in m
 4  d = 80 // Distance of window in m
 5  l = 2 // Separation between wires of mesh in cm
 6  a = 3  // Diameter of lens of telescope in cm
 7  lambda = 5500 // wavelength of light in angstrom
 8
 9  // Sample Problem 32 on page no. 174
10  printf("\n # PROBLEM 32 # \n")
11  printf(" Standard formula used \n")
12  printf(" theta = 1.22*lambda/a  \n\n")
13  theta = 1.22*lambda*1e-10/(a*1e-2) // Angle which
        can be resolved
14  alpha = (l*1e-2/d) // Angle projected by wire mesh
15  if (theta<alpha) then
16      printf("As theta = %e degree is smaller than
            alpha = %e degree\n so telescope will be able
```

```
             to  observe  wire  mesh”,theta ,alpha )
17 else
18      printf ("As  theta  =  %e  degree  is  greater  than
            alpha  =  %e  degree  so  telescope  will  not  be
            able  to  observe  wire  mesh”,theta ,alpha )
19 end
20 // alpha  is  2.25e−4  degree  in  book
```

Scilab code Exa 3.33 Calculation of smallest angle between two stars

```
1 clc
2 // Given  that
3 f = 4 // Focal  length  of  telescope  objective  in  m
4 d = 100 // Diameter  of  lens  of  telescope  in  inch
5 lambda = 5000 // mean  wavelength  of  light  in
     angstrom
6
7 // Sample  Problem  33  on  page  no .  175
8 printf ("\n # PROBLEM  33  #  \n")
9 printf (" Standard  formula  used  \n")
10 printf ("  theta  =  1.22* lambda/a   \n")
11 a = d*2.54/100 // Diameter  of  lens  of  telescope  in
     meter
12 theta = 1.22* lambda *1e-10/a   // Calculation  of  angle
13 printf ("\n Smallest  angle  between  two  stars  is  %e
     rad.",theta )
```

Scilab code Exa 3.34 Calculation of distance between centers of two stars which ar

```
1  clc
2  // Given that
3  f = 4 // Focal length of telescope objective in m
4  a = 0.01 // Diameter of lens of telescope in m
5  lambda = 5500 // wavelength of light in angstrom
6
7  // Sample Problem 34 on page no. 175
8  printf("\n # PROBLEM 34 # \n")
9  printf(" Standard formula used \n")
10 printf(" theta = 1.22*lambda/a  \n")
11 theta = 1.22*lambda*1e-10/(a)
12 x = f*theta // Separation between center of images
       in cm
13 printf("\n Separation between center of images is %e
       cm.",x*100)
```

Scilab code Exa 3.35 Calculation for the required objective for telescope

```
1  clc
2  // Given that
3  lambda = 5000 // wavelength of light in angstrom
4  theta = 1e-3 // Separation between stars in degree
5  // Sample Problem 35 on page no. 175
6  printf("\n # PROBLEM 35 # \n")
7  printf(" Standard formula used \n")
8  printf(" theta = 1.22*lambda/a  \n")
9  a = 1.22*lambda*1e-10/(theta*%pi/180) // Calculation
       of diameter of telescope
10 printf("\n Diameter of telescope is %f cm.",a*100)
```

Scilab code Exa 3.36 Calculation of limit of resolution

```
1  clc
2  // Given that
3  lambda = 5890 // wavelength of light in angstrom
4  a = 1 // Diameter of aperture in cm
5  // Sample Problem 36 on page no. 176
6  printf(" \n # PROBLEM 36 # \n")
7  printf(" Standard formula used \n")
8  printf(" theta = 1.22*lambda/a  \n")
9  theta = 1.22*lambda*1e-10/(a*1e-2) // Calculation of
       resolving limit of telescope
10 printf(" \n Resolving limit of telescope is %e rad.",
      theta)
```

Scilab code Exa 3.37 Calculation of resolving power of grating and smallest wavele

```
1  clc
2  // Given that
3  N = 15000 // Grating lines per inch
4  w = 10 // Width in cm
5  n = 2 // Order
6  m =3 // Order
7  lambda = 6000 // wavelength of light in angstrom
8  // Sample Problem 37 on page no. 176
9  printf(" \n # PROBLEM 37 # \n")
10 printf(" Standard formula used \n")
11 printf(" lambda/d_lambda = n*N  \n")
```

```
12  P_res = n*N // resolving power in nth order
13  d_lambda = lambda/P_res // Resolving power of
        grating
14  printf("Resolving power in 2nd order is %e \n
        Smallest wavelength that can be resolved is %d
        Angstrom.",P_res,d_lambda*100)
```

Scilab code Exa 3.38 Estimation of resolving limit of microscope

```
1  clc
2  // Given that
3  lambda = 5500 // wavelength of light in angstrom
4  theta = 30 // Semi angle of cone in degree
5  // Sample Problem 38 on page no. 138
6  printf("\n # PROBLEM 38 # \n")
7  printf(" Standard formula used \n")
8  printf(" S = 1.22*lambda/(2*sin(theta))  \n")
9  S = 1.22*lambda*1e-10/(2*sin(theta*%pi/180)) //
        Calculation of resolving limit of microscope
10 printf("\n Resolving limit of microscope is %e cm.",
        S*1e2)
```

Scilab code Exa 3.39 Calculation of resolving power in second order and Estimation

```
1  clc
2  // Given that
3  N = 6000 // Grating lines per cm
4  w = 10 // Width in cm
5  n = 2 // Order
```

```
6  m =3 // Order
7  lambda = 6000 // wavelength of light in angstrom
8  // Sample Problem 39 on page no. 177
9  printf("\n # PROBLEM 39 # \n")
10 printf(" Standard formula used \n")
11 printf(" lambda/d_lambda = n*N  \n")
12 n_tot = w*N // Total number of grating
13 P_res = n*n_tot // resolving power in nth order
14 d_lambda = lambda/(m*n_tot) // Resolving power of
        grating
15 printf("Resolving power in 2nd order is %e \n
        Smallest wavelength that can be resolved is %f
        Angstrom",P_res,d_lambda)
```

Chapter 4

POLARISATION

Scilab code Exa 4.1 Calculation of angle of polarization

```
1 clc
2 // Given that
3 theta = 45 // Critical angle of light in a substance
       in degree
4 // Sample Problem 1 on page no. 213
5 printf("\n # PROBLEM 1 # \n")
6 mu = sin(45*%pi/180) // Refractive index of medium
7 Ip = atan(mu) * (180 / %pi) // by Brewster's law
8 printf("Standard formula used \n mu=tan(Ip)\n")
9 printf("\n  Brewster Angle = %f degree",Ip)
```

Scilab code Exa 4.2 Calculation of angle of refraction and refractive index of wat

```
1 clc
2 // Given that
3 theta_p = 53 // Polarizing angle of light in a
     substance in degree
```

```
4 // Sample Problem 2 on page no. 213
5 printf("\n # PROBLEM 2 # \n")
6 theta_r = 90- theta_p // Angle of refraction
7 mu = tan(theta_p*%pi/180)   // by Brewster's law
8 printf("Standard formula used \n mu=tan(Ip)\n")
9 printf("\n Angle of refraction is %ddegree. \n
      Refractive index of material is %f.",theta_r,mu)
```

Scilab code Exa 4.3 Calculation of angle of polarization of water

```
1 clc
2 // Given that
3 mu = 1.33 // refractive index of water
4 // Sample Problem 3 on page no. 214
5 printf("\n # PROBLEM 3 # \n")
6 p = atan(mu)*180/%pi // Polarization angle
7 printf("Standard formula used \n mu=tan(Ip)\n")
8 printf("\n Polarization angle of water is %d degree"
     ,p)
```

Scilab code Exa 4.4 Analysis of polarization angle

```
1 clc
2 // Given that
3 mu_w = 1.33 // refractive index of water
4 mu_g = 1.54 // refractive index of glass
5 // Sample Problem 4 on page no. 3.24
6 printf("\n # PROBLEM 4 # \n")
```

```
7  Ip_1 = atan(mu_g / mu_w) * (180 / %pi)// calculation
      for  polarizing  angle  for  water
8  Ip_2 = atan(mu_w / mu_g) * (180 / %pi) //
      calculation  for  polarizing  angle  for  glass
9  printf("Standard  formula  used  \n mu=tan(Ip)\n")
10 printf("\n Polarizing  angle  for  water  to  glass  = %f
      degree,\n Polarizing  angle  for  glass  to  water  =
      %f degree",Ip_1,Ip_2)
```

Scilab code Exa 4.5 Calculation of refractive index of glass

```
1  clc
2  // Given  that
3  theta_p = 58.6 // Polarizing  angle  of  light  in  glass
        plate  in  degree
4  // Sample  Problem  5 on  page  no.  214
5  printf("\n # PROBLEM  5 # \n")
6  mu =  tan(theta_p*%pi/180)   // by  Brewster's  law
7  printf("Standard  formula  used  \n mu=tan(Ip)\n")
8  printf(" \n Refractive  index  of  material  is  %f.",mu)
```

Scilab code Exa 4.6 Calculation of refractive index of glass

```
1  clc
2  // Given  that
3  theta_p = 51 // Polarizing  angle  of  light  in  glass
      plate  in  degree
4  // Sample  Problem  6 on  page  no.  214
5  printf("\n # PROBLEM  6 # \n")
```

```
6 mu = tan(theta_p*%pi/180)   // by Brewster's law
7 printf("Standard formula used \n mu=tan(Ip)\n")
8 printf(" \n Refractive index of material is %f.",mu)
```

Scilab code Exa 4.7 Calculation of polarization angle

```
1 clc
2 // Given that
3 theta_c =45 // Critical angle of light in a
     substance in degree
4 // Sample Problem 7 on page no. 215
5 printf("\n # PROBLEM 7 # \n")
6 mu = sin(theta_c*%pi/180)   // by Brewster's law
7 p = atan(mu)*180/%pi // Polarization angle of light
     in a substance in degree
8 printf("Standard formula used \n mu=tan(Ip)\n")
9 printf(" \n Polarization angle of material is %f
     degree.",p)
```

Scilab code Exa 4.8 Calculation of angle of refraction

```
1 clc
2 // Given that
3 mu_g = 1.55 // refractive index of glass
4 // Sample Problem 8 on page no. 215
5 printf("\n # PROBLEM 8 # \n")
6 Ip = atan(mu_g) * (180 / %pi)//calculation for
     polarizing angle for glass
7 I_r = 90 - Ip // Angle of refraction
```

```
8  printf (" Standard formula used  \n mu=tan ( Ip )\n")
9  printf ("\n Polarizing angle for glass is %d degree.\
       n Corresponding angle of refraction is %d degree.
       ", Ip , ceil ( I_r ) )
```

Scilab code Exa 4.9 Calculation of angle of refraction and refractive index of liq

```
1  clc
2  // Given that
3  Ip = 53 // Angle of polarization of light
4  // Sample Problem 9 on page no. 216
5  printf ("\n # PROBLEM 9 # \n")
6  I_r = 90 - Ip // Angle of refraction
7  mu = tan ( Ip *%pi /180) // Refractive index of water
8  printf (" Standard formula used  \n mu=tan ( Ip )\n")
9  printf ("\nAngle of refraction is %d degree. \n
       Refractive index of material is %f", I_r , mu )
```

Scilab code Exa 4.10 Calculation of velocities of ordinary and extra ordinary rays

```
1  clc
2
3  // Given that
4  mu_o = 1.658 // refractive index of material for
       ordinary ray
5  mu_e = 1.486 // refractive index of material for
       extra ordinary ray
6  c = 3 e8 // speed of light in m/ sec
7  // Sample Problem 10 on page no. 216
```

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```
8  printf("\n # PROBLEM 10 # \n")
9  v_o = c/mu_o // velocity of ordinary ray
10 v_e = c/mu_e // velocity of extra ordinary ray
11 printf("Standard formula used \n mu=tan(Ip)\n")
12 printf("\n Velocity of ordinary ray is %e m/sec \n
       Velocity of extra ordinary ray is %e m/sec",v_o,
       v_e)
```

Scilab code Exa 4.11 Comparison of intensities of ordinary and extra ordinary rays

```
1  clc
2  // Given that
3  k = 1 // constant
4  lambda = 6000 // wavelength of light in angstrom
5  mu_o = 1.5442 // refractive index of material for
       ordinary ray
6  mu_e = 1.5532 // refractive index of material for
       extra ordinary ray
7  theta = 30 // Angle of incidence in degree
8  // Sample Problem 11 on page no. 216
9  printf("\n # PROBLEM 11 # \n")
10 I_e =  k * (cos(theta*%pi/180))^2 // intensity of
       extra ordinary ray
11 I_o =  k * (sin(theta*%pi/180))^2 // intensity of
       ordinary ray
12 R = I_e/I_o // ratio of intensities
13 printf("Standard formula used \n I = A^2*cos^2(theta
       )\n")
14 printf("\n Ratio of intensities is %d:1.",R)
```

Scilab code Exa 4.12 Calculation of percentage of passed light

```
1  clc
2  // Given that
3  I = 1 // Initial intensity
4  I_o = I/2 // Intensity after one reflection
5  lambda = 6000 // wavelength of light in angstrom
6  mu_o = 1.5442 // refractive index of material for
       ordinary ray
7  mu_e = 1.5532 // refractive index of material for
       extra ordinary ray
8  theta = 30 // Angle of between polaroids in
       degree
9  // Sample Problem 12 on page no. 217
10 printf("\n # PROBLEM 12 # \n")
11 I_theta =  I_o * (cos(theta*%pi/180))^2 // intensity
        of extra ordinary ray
12 I_per = I_theta *100/ I // Percentage of incident
       unpolarized light ray passing through second
       polaroid
13 printf("Standard formula used \n I = A^2*cos^2(
       theata)\n")
14 printf("\n Percentage of incident unpolarised light
       ray passing \n through second polaroid is %f.",
       I_per)
```

Scilab code Exa 4.13 Calculation of rotation of prism required

```
1  clc
2  // Given that
3  I = 1 // Initial intensity after polarization
4  I_theta = I - I/4 // Initial intensity after
       polarization on rotation
5  // Sample Problem 13 on page no. 217
6  printf(" \n # PROBLEM 13 # \n")
7  theta = acos(sqrt(I_theta/I))*180/%pi // Angle of
       rotation
8  printf(" Standard formula used \n I = A^2*cos^2(
       theata)\n")
9  printf(" \n Angle of rotation required is %d degree."
       ,ceil(theta))
```

Scilab code Exa 4.14 Calculation of thickness of plate

```
1  clc
2  // Given that
3  lambda = 5.89e-7 // wavelength of light in meter
4  mu_o = 1.658 // refractive index for ordinary light
5  mu_e = 1.486 // refractive index for extraordinary
       light
6
7  // Sample Problem 14 on page no. 218
8  printf(" \n # PROBLEM 14 # \n")
9  t = lambda / (4 * (mu_o - mu_e))
10 // calculation for thickness of plate of quartz
11 printf(" \n Standard formula used \n t = lambda / (4
       * (mu_o - mu_e)) ")
12 printf(" \n Thickness of plate of calcite is %e meter
       .",t)
```

Scilab code Exa 4.15 Calculation of thickness of quarter plate

```
1  clc
2  // Given that
3  lambda = 5.89e-7 // wavelength of light in meter
4  mu_o = 1.55 // refractive index for ordinary light
5  mu_e = 1.54 // refractive index for extraordinary
       light
6
7  // Sample Problem 15 on page no. 218
8  printf("\n # PROBLEM 15 # \n")
9  t = lambda / (4 * (mu_o - mu_e))
10 // calculation for thickness of plate of quartz
11 printf("\n Standard formula used \n t = lambda / (4
       * (mu_o - mu_e)) ")
12 printf("\n Thickness of plate of calcite is %e meter
       .",t)
```

Scilab code Exa 4.16 Calculation of thickness of plate

```
1  clc
2  // Given that
3  lambda = 5e-7 // wavelength of light in meter
4  mu_o = 1.5442 // refractive index for ordinary light
5  mu_e = 1.5533 // refractive index for extraordinary
       light
6
7  // Sample Problem 16 on page no. 218
```

```
8   printf(" \n # PROBLEM 16 # \n")
9   t1 = lambda/(2*(mu_e - mu_o))
10  t3 = 3*t1
11  t5 = 5*t1
12  // calculation for thickness of plate of quartz
13  printf(" \n Standard formula used \n t = lambda / (4
        * (mu_o - mu_e)) ")
14  printf(" \n Thickness of plate of calcite is \n %e
        meter ,\n %e meter , \n %e meter and so on .....",
        t1,t3,t5)
```

Scilab code Exa 4.17 Calculation of difference in refractive indices

```
1   clc
2   // Given that
3   lambda = 5086 // Wavelength of light
4   s = 29.73 // Specific rotation of fluid in deg/mm
5   // Sample Problem 17 on page no. 219
6   printf(" \n # PROBLEM 17 # \n")
7   del_mu = lambda*1e-7*s/180 // Calculation of
        differences in refractive index
8   printf(" \n Standard formula used \n theta = pi*d*
        del_mu/lambda. \n")
9   printf(" \n Differences in refractive indices is %e .
        ",del_mu)
```

Scilab code Exa 4.18 Calculation of constants and thickness of plate

```
1   clc
```

```
2  // Given that
3  lambda1 = 5000 // Wavelength of light in angstrom
4  theta1 = 30 // Optical rotation for lambda1 in
       degree
5  lambda2 = 4000 // Wavelength of light in angstrom
6  theta2 = 50 // Optical rotation for lambda2 in
       degree
7  t = 1 // Thickness of plate in mm
8  theta_max = 90 // Angle between prisms for maximum
       trnsition in degree
9  // Sample Problem 18 on page no. 219
10 printf(")\n # PROBLEM 18 # \n")
11
12 printf(")\n Standard formula used \n theta = a + b/(
       lambda)^2. \n")
13 b = (theta2-theta1)*(lambda1*1e-10*lambda2*1e-10)
       ^2/((lambda1*1e-10)^2-(lambda2*1e-10)^2) //
       Calculation for constant b
14 a = theta1 -b/(lambda1*1e-10)^2 // Calculation of
       constant a
15
16 t_min = t* theta_max/theta1 // calculation of
       thickness of material for maximum thickness in mm
17 printf(")\n Contents are as : \n a = %f deg/mm \n b =
       %e deg/mm angestrom^2 \n Thickness of plate
       required is %dmm.",a,b*1e10^2,t_min)
```

Scilab code Exa 4.19 Calculation of rotation of plane of polarization

```
1  clc
2  // Given that
3  lambda = 7620 // Wavelength of light in angstrom
4  mu_r = 1.53914 // refractive index of quartz for
```

```
     right handed circularly polarized light
5  mu_l = 1.5392 // refractive index of quartz for left
       handed circularly polarized light
6  t = 0.5 // thickness of plate in mm
7  // Sample Problem 19 on page no. 220
8  printf("\n # PROBLEM 19 # \n")
9  theta = %pi*t*(mu_l-mu_r)/(lambda*1e-7)*180/%pi //
       Rotation of plane of polarization
10 printf("\n Standard formula used \n theta = pi*t*(
       mu_l-mu_r)/(lambda). \n")
11 printf("\n Rotation of plane of polarization is %f
       degree.",theta)
```

Scilab code Exa 4.20 Calculation of strength of solution

```
1  clc
2  // Given that
3  theta = 13 // rotation of plane of polarization in
       degree
4  s = 65 // specific rotation of sugar solution in
       degree per decimeter per unit concentration
5  l = 2 // length of Polari meter in decimeter
6  // Sample Problem 20 on page no. 221
7  printf("\n # PROBLEM 20 # \n")
8  c = theta / (s * l) // calculation for concentration
        of sugar solution
9  printf("\n Standard formula used \n c = theta / (s *
       l). \n")
10 printf("\n Concentration of sugar solution = %f gm/
       cc or %d percent.",c,c*100)
```

Scilab code Exa 4.21 Calculation of specific rotation of solution

```
1 clc
2 // Given that
3 theta = 26.4 // rotation of plane of polarization in
       degree
4 c = 0.2 // Concentration of sugar solution in g/cm^3
5 l = 2 // length of Polari meter in decimeter
6 // Sample Problem 21 on page no. 221
7 printf("\n # PROBLEM 21 # \n")
8 s = theta/(c*l) // Specific rotation of sugar
       solution
9 printf("\n Standard formula used \n c = theta / (s *
       l). \n")
10 printf("\n Specific rotation of sugar solution is %d
       percent.",ceil(s))
```

Scilab code Exa 4.22 Calculation of differences in indices

```
1 clc
2 // Given that
3 lambda = 5086 // Wavelength of light in angstrom
4 s = 29.73 // specific rotation on deg/mm
5 // Sample Problem 22 on page no. 220
6 printf("\n # PROBLEM 22 # \n")
7 del_mu = lambda*1e-7*s/180 // Difference in indices
8 printf("\n Standard formula used \n theta = pi*t*(
     mu_l-mu_r)/(lambda). \n")
```

```
9  printf("\n Difference in indices is %e.",del_mu)
```

Scilab code Exa 4.23 Calculation of optical rotation

```
1  clc
2  // Given that
3  theta1 = 13 // rotation of plane of polarization in
       degree
4  c1 = 1 // let concentration of solution is unity
5  c2 = c1/3 // concentration of final solution
6  l1 = 2 // length of Polari meter in decimeter in 1st
        case
7  l2 = 3 // length of Polari meter in decimeter in 2nd
        case
8  // Sample Problem 23 on page no. 221
9  printf("\n # PROBLEM 23 # \n")
10 s = theta1/(l1*c1) // Specific rotation of solution
11 theta2 = s*l2*c2 // // rotation of plane of
       polarization in degree
12 printf("\n Standard formula used \n c = theta / (s *
       l). \n")
13 printf("\n Rotation of plane of polarization is %f
       degree.",theta2)
```

Scilab code Exa 4.24 Calculation of percentage purity of solution

```
1  clc
2  // Given that
3  m = 80 //  mass of sugar in gram
```

```
 4  V = 1 // Volume of sugar in liter
 5  theta = 9.9 // rotation of plane of polarization in
        degree
 6  s = 66 // specific rotation of sugar in degree
 7  l = 2 // length of Polari meter in decimeter
 8  // Sample Problem 24 on page no. 222
 9  printf("\n # PROBLEM 24 # \n")
10  c = theta*1000/(l*s) // concentration of dissolved
        sugar
11  purity = c*V*100/m // purity percentage of solution
12  printf("\n Standard formula used \n c = theta / (s *
        l). \n")
13  printf("\n Purity percentage of solution is %f
        percent.",purity)
```

Chapter 5

LASER

Scilab code Exa 5.1 Calculation of number of oscillation and coherent time

```
1  clc
2
3  // Given that
4  l = 2.945e-2 // coherent length of sodium light
5  lambda = 5890 // wavelength of light used in
       angstrom
6  c = 3e8 // speed of light
7  // Sample Problem 1 on page no. 242
8  printf("\n # PROBLEM 1 # \n")
9  n = l/(lambda*1e-10) // number of oscillation
       corresponding to coherent length
10 t = l/c // coherent time
11 printf("\n Number of oscillation corresponding to
       coherent length is %e \n Coherent time is %esec."
       ,n,t)
```

Scilab code Exa 5.2 Angular spread of beam

90

```
1  clc
2  // Given that
3  l = 4e5 // Distance of moon in km
4  lambda = 8e-7 // wavelength of light used
5  a = 5e-3 // Aperture of laser
6  c = 3e8 // speed of light
7  // Sample Problem 2 on page no. 242
8  printf("\n # PROBLEM 2 # \n")
9  theta = lambda/a  // Angular of spread
10 Areal_spread = (l*1000*theta)^2 // Areal spread
11 printf("\n Angular  spread  is %e rad. \n Areal
       spread is %em^2.", theta, Areal_spread)
```

Scilab code Exa 5.3 Calculation of number of oscillation and coherent time

```
1  clc
2  // Given that
3  l = 2.945e-2 // coherent length of sodium light
4  lambda = 5890 // wavelength of light used
5  c = 3e8 // speed of light
6  // Sample Problem 3 on page no. 242
7  printf("\n # PROBLEM 3 # \n")
8  n = l/(lambda *1e-10) // number of oscillation
       corresponding to coherent length
9  t = l/c // coherent time
10 printf("\n Number of oscillation corresponding to
       coherent length is %e \n Coherent time is %esec."
       ,n,t)
```

Scilab code Exa 5.4 Calculation of energy difference between levels

```
1 clc
2 // Given that
3 k = 12400 // constant
4 lambda = 3.3913 // wavelength IR radiation
5
6 // Sample Problem 4 on page no. 243
7 printf("\n # PROBLEM 4 # \n")
8 E = k/(lambda*1e4) // Energy difference
9 printf("\n Energy difference is %feV.",E)
```

Scilab code Exa 5.5 Calculation of energy of one photon and total energy available

```
1 clc
2 k = 12400 // constant
3 lambda = 6943 // wavelength of radiation in angstrom
4 n = 3e19 // Total number of ions
5 // Sample Problem 5 on page no. 243
6 printf("\n # PROBLEM 5 # \n")
7 E = k/(lambda) // Energy difference
8 E_total = E*n*1.6e-19 // Total Energy emitted
9 printf("\n Energy of one photon  is %feV. \n Total
       energy is %fJ",E,E_total)
```

Scilab code Exa 5.6 Calculation of maximum length of cavity

```
1 clc
2 // Given that
```

```scilab
3  h_w = 2e-3 // half width of gain profile of laser in
       nm
4  mu = 1 // refractive index
5  lambda = 6328 // wavelength of light used in
       angstrom
6  // Sample Problem 6 on page no. 244
7  printf(")\n # PROBLEM 6 # \n")
8  L = (lambda*1e-10)^2/(2*mu*h_w*1e-9) // Length of
       cavity
9  printf(")\n Required length of cavity is %dcm.",L
       *100)
```

Chapter 6

OPTICAL FIBRE

Scilab code Exa 6.1 Calculation of numerical aperture and acceptance angle

```
1  clc
2
3  // Given that
4  mu1 = 1.42  // refractive index for core
5  mu2 = 1.40  // refractive index for cladding
6  // Sample Problem 1 on page no. 254
7  printf("\n # PROBLEM 1 # \n")
8  NA = sqrt(mu1^2 - mu2^2)
9  theta_0 = asin(NA) * (180 / %pi)
10 theta_deg = floor(theta_0)
11 theta_fract = theta_0 - floor(theta_0)
12 theta_min = theta_fract*60
13 printf("\n Standard formula used \n NA = sqrt(mu1^2
       - mu2^2). \n theta_0 = asin(NA) * (180 / pi). \n"
       )
14 printf("\n  \n Numerical aperture = %f,\n Maximum
       incidence angle = %d degree %d min.",NA,theta_deg
       ,theta_min)
```

Scilab code Exa 6.2 Calculation of refractive index and numerical aperture and acc

```
1  clc
2  // Given that
3  mu1 = 1.36 // refractive index for core
4  del_mu = 0.025 // relative refractive index
5
6  // Sample Problem  on page no. 255
7  printf("\n # PROBLEM 2 # \n")
8  mu2 = mu1*(1-del_mu) // refractive index of cladding
9  NA = mu1*sqrt(2*del_mu)
10 theta_0 = asin(NA) * (180 / %pi)
11 printf("\n Standard formula used \n theta_c = asin(
      mu2 / mu1) * (180 / pi). \n NA = sqrt(mu1^2 - mu2
      ^2). \n theta_0 = asin(NA) * (180 / pi). \n")
12 printf("\n Refractive index of cladding is %f. \n
      Numerical aperture is %f.\n Acceptance angle is
      %f degree.",mu2,NA,theta_0)
```

Scilab code Exa 6.3 Calculation of acceptance angle

```
1  clc
2  // Given that
3  mu2 = 1.59 // refractive index for cladding
4  NA = 0.2 // Numerical aperture
5  mu_water = 1.33 // refractive index of water
6  del_mu = 0.025 // relative refractive index
7
```

```
8  // Sample Problem 3 on page no. 256
9  printf(" \n # PROBLEM 3 # \n")
10 mu1 = sqrt(NA^2+mu2^2) // refractive index of
       cladding
11 NA_w = sqrt(mu1^2 - mu2^2)/mu_water // Numerical
       aperture for water
12 theta_0 = asin(NA_w) * (180 / %pi) // Acceptance
       angle of fiber in water
13 printf(" \n Standard formula used \n theta_c = asin(
       mu2 / mu1) * (180 / pi). \n NA = sqrt(mu1^2 - mu2
       ^2). \n theta_0 = asin(NA) * (180 / pi). \n")
14 printf(" \n Acceptance angle of fiber in water is %f
       degree.",theta_0)
```

Scilab code Exa 6.4 Calculation of numerical aperture and acceptance angle and num

```
1  clc
2  // Given that
3  mu1 = 1.55 // refractive index for core
4  mu2 = 1.50 // refractive index for cladding
5  d = 50 // core diameter in micro meter
6  // Sample Problem 4 on page no. 256
7  printf(" \n # PROBLEM 4 # \n")
8
9  NA = sqrt(mu1^2 - mu2^2) // numerical aperture
10 theta_c = asin(mu2 / mu1) * (180 / %pi) // critical
       angle in degree
11 theta_0 = asin(NA) * (180 / %pi) // Acceptance angle
        in degree
12 x= d*1e-6*tan(theta_c*%pi/180) // distance travelled
        between two successive collisions
13
14 N = 1/x // No. of reflections per meter
```

```
15  printf(" \n Standard formula used \n theta_c = asin (
       mu2 / mu1) * (180 / pi). \n NA = sqrt(mu1^2 - mu2
       ^2). \n theta_0 = asin(NA) * (180 / pi). \n")
16  printf(" \n Numerical aperture = %f, \n Acceptance
       angle is %f degree. \n No. of reflections per
       meter is %d", NA, theta_0, N)
```

Scilab code Exa 6.5 Calculation of critical angle at core cladding boundary and cl

```
1  clc
2  // Given that
3  mu1 = 1.45 // refractive index for core
4  mu2 = 1.40 // refractive index for cladding
5  mu = 1 // refractive index for air
6  // Sample Problem 5 on page no. 256
7  printf(" \n # PROBLEM 5 # \n")
8  theta_c = asin(mu2 / mu1) * (180 / %pi) // critical
       angle in degree
9  theta_c_ = asin(mu/mu2) * (180 / %pi) // Acceptance
       angle in degree
10  printf(" \n Standard formula used \n theta_c = asin (
       mu2 / mu1) * (180 / pi). \n NA = sqrt(mu1^2 - mu2
       ^2). \n theta_0 = asin(NA) * (180 / pi). \n")
11  printf(" \n Critical angle at the core - cladding
       boundary is %f degree \n Critical angle at
       cladding - air boundary is %f degree", theta_c,
       theta_c_)
```

Scilab code Exa 6.6 Calculation of cut off perimeter and number of modes

```
1  clc
2  // Given that
3  mu1 = 1.50 // refractive index for core
4  mu2 = 1.48 // refractive index for cladding
5  a = 25 // core radius in micro meter
6  lambda = 830 // wavelength of propagating light in
        nano meter
7  al = 2 // for parabolic profile
8  // Sample Problem 6 on page no. 263
9  printf("\n # PROBLEM 6 # \n")
10 del = (mu1-mu2)/mu1
11 N_graded = (al/(al+2))*(2*%pi*a*1e-6/(lambda*1e-9))
        ^2 * mu1^2 * del // Number of modes for graded
12 N_step = (2*%pi*a*1e-6/(lambda*1e-9))^2 * (mu1^2 -
        mu2^2)/2 // number of modes for step graded
13 ratio = (N_step / N_graded)
14 printf("\n Number of modes in graded index fiber is
        %d.",N_graded)
15 printf("\n Number of modes in Step graded fiber is
        %d.",N_step)
16 printf("\n Approximate ratio of number of modes in
        different grade is %d.",ceil(ratio))
```

Scilab code Exa 6.7 Calculation of comparison of number of modes

```
1  clc
2  // Given that
3  mu1 = 1.566 // refractive index for core
4  mu2 = 1.56 // refractive index for cladding
5  d = 50 // core diameter in micro meter
6  lambda = 0.84 // wavelength of propagating light in
        micro meter
7  // Sample Problem 7 on page no. 265
```

```
8 printf("\n # PROBLEM 7 # \n")
9 v = %pi*d*sqrt(mu1^2 - mu2^2)/lambda   // cut off
      number
10 N_max = v^2/2 // maximum number of modes
11 printf("\n Cut off parameter of fiber is %f. \n
      Maximum number of modes is %d.",v,N_max)
```

Scilab code Exa 6.8 Calculation of cladding index and maximum acceptance angle

```
1 clc
2 // Given that
3 mu1 = 1.55 // refractive index for core
4 v_max = 2.405 // Maximum cut off number
5 d = 10 // core diameter in micro meter
6 lambda = 1.8 // wavelength of propagating light in
      micro meter
7 // Sample Problem 8 on page no. 266
8 printf("\n # PROBLEM 8 # \n")
9 NA = v_max*lambda/(%pi*d)
10 delta = 0.5*(NA/mu1)^2 // Normalized index
      difference
11 mu2 = mu1*(1- delta) // refractive index of cladding
12 theta_max = asin(NA)*180/%pi // maximum acceptance
      angle in degree
13 printf("\n Required maximum value of normalized
      difference is %f. \n Refractive index of cladding
       is %f. \n Maximum acceptance angle is %f degree.
      ",delta,mu2,theta_max)
```

Scilab code Exa 6.9 `Calculation of critical angle and numerical aperture and accep`

```
1  clc
2  // Given that
3  mu1 = 1.466 // refractive index for core
4  mu2 = 1.46 // refractive index for cladding
5  lambda = 1200 // wavelength of light in nano meter
6  V = 2.405 // cut off parameter
7  // Sample Problem 9 on page no. 267
8  printf("\n # PROBLEM 9 # \n")
9  t = V*lambda*1e-9/(2*%pi*sqrt(mu1^2-mu2^2)) //
       maximum radius of fiber
10 theta_c = asin(mu2 / mu1) * (180 / %pi)
11 NA = sqrt(mu1^2 - mu2^2)
12 theta_0 = asin(NA) * (180 / %pi)
13 printf("\n Standard formula used \n theta_c = asin(
       mu2 / mu1) * (180 / pi). \n NA = sqrt(mu1^2 - mu2
       ^2). \n theta_0 = asin(NA) * (180 / pi). \n")
14 printf("\n Maximum radius allowed for fiber is %f
       micro meter \nCritical angle = %f degree. \n
       Numerical aperture = %f,\n Maximum incidence
       angle = %f degree.",t*1e6,theta_c,NA,theta_0)
```

Scilab code Exa 6.10 `Calculation of total number of propagating modes`

```
1  clc
2  // Given that
3  NA = 0.3 // numerical aperture of fiber
4  d = 200 // core diameter in micro meter
5  lambda = 0.9 // wavelength of propagating light in
       micro meter
6  // Sample Problem 10 on page no. 268
7  printf("\n # PROBLEM 10 # \n")
```

```
8  N_max = 2*(d/2)^2*%pi^2*NA^2/lambda^2
9  printf("\n Total number of propagating modes are %d.
       ",N_max)
```

Scilab code Exa 6.11 Calculation of operating wavelength and attenuation

```
1  clc
2  // given that
3
4  d = 9 // Diameter of ore of wire in mm
5  P_b = 180 // Threshold optical power for Brillouin
       scattering in mW
6  P_r = 1.9 // Threshold optical power for Raman
       scattering  W
7  nu = 1 // Bandwidth in GHz
8   // Sample Problem 11 on page no. 278
9  printf("\n # PROBLEM 11 # \n")
10 ratio = P_b*1e-3/P_r // Calculation of ratios of
       powers
11 lambda = ratio*5.9*1e-2*(d*1e-3)^2/(4.4*1e
       -3*(d*1e-3)^2) // Calcualtion of wavelength
12 printf("\n Standard formula used \n P_b = 4.4*1e-3*d
       ^2*lambda^2*alpha.\nP_r = 5.9*1e-3*d^2*lambda^2*
       alpha \n")
13 printf("\n wavelength of laser is %fmicron. ",lambda
       )
```

Scilab code Exa 6.12 Calculation of attenuation

```
1 clc
2 // Given that
3 P_in = 100 // power of input signal in mW
4 P_out = 50 // power of output signal in mW
5 // Sample Problem 12 on page no. 280
6 printf("\n # PROBLEM 12 # \n")
7 alpha = (10 * log10(P_in / P_out))// calculation for
      absorption coefficient
8 printf("\n Standard formula used \n alpha=10/L*log(
      Pi/Po).\n")
9 printf("\n Attenuation loss is %f dB. ",alpha)
```

Scilab code Exa 6.13 Calculation of losses

```
1 clc
2 // Given that
3 l = 150 // length of fiber in meter
4 P_in = 10 // power of input signal in micro Watt
5 P_out = 8 // power of output signal in micro Watt
6 // Sample Problem 13 on page no. 280
7 printf("\n # PROBLEM 13 # \n")
8 alpha = (10 * log10(P_in / P_out))/l // calculation
      for absorption coefficient
9 printf("\n Standard formula used \n alpha=10/L*log(
      Pi/Po).\n")
10 printf("\n Attenuation loss is %f dB/m. ",alpha)
```

Scilab code Exa 6.14 Calculation of fiber losses

```
1 clc
2
3 // Given that
4 l = 1.5 // length of fiber in kilo meter
5 P_in = 1 // let power of input signal is unity
6 P_out = 1/4 // power of output signal in micro Watt
7 // Sample Problem 14 on page no. 281
8 printf("\n # PROBLEM 14 # \n")
9 alpha = (10 * log10(P_in / P_out))/l //calculation
      for absorption coefficient
10 printf("\n Standard formula used \n alpha=10/L*log(
      Pi/Po).\n")
11 printf("\n Attenuation loss is %d dB/km. ",alpha)
```

Scilab code Exa 6.15 Calculation of output power

```
1 clc
2 // Given that
3 l = 10 // length of fiber in kilo meter
4 P_in = 900 // Power of input signal in micro watt
5 alpha = 2.3 // attenuation loss in dB
6 // Sample Problem 15 on page no. 281
7 printf("\n # PROBLEM 15 # \n")
8 P_out = P_in*10^(-alpha) // Power at output in
      microwatt
9 printf("\n Standard formula used \n alpha=10/L*log(
      Pi/Po).\n")
10 printf("\n Power at output end is %f micro Watt.",
      P_out)
11 // Answer given in book is 1.79 micro Watt
```

Scilab code Exa 6.16 Calculation of light pulse spread

```
1  clc
2  // Given that
3  l = 6 // length of fiber in kilo meter
4  mu1 = 1.48 // refractive index for core
5  NA = 0.28 // Numerical aperture
6  c = 3e8 // speed of light in m/sec
7  // Sample Problem 16 on page no. 284
8  printf("\n # PROBLEM 16 # \n")
9  t = l*1e3*(NA)^2/(2*c*mu1)
10 printf("\n Time taken by light pulse is %f nsec.",t
       *1e9)
```

Scilab code Exa 6.17 Calculation of delay difference and rms pulse broadening and

```
1  clc
2  // Given that
3  l = 8 // length of fiber in kilo meter
4  mu1 = 1.50 // refractive index for core
5  delta = 2/100 // relative refractive index
6  c = 3e8 // speed of light in m/sec
7  // Sample Problem 17 on page no. 285
8  printf("\n # PROBLEM 17 # \n")
9  t = l*1e3*mu1*delta/c * 1e9
10 sigma = t/(2*sqrt(3))
11 BT_max = 1/(2*t) //
12 Length = BT_max*1e3*l
```

```
13
14  printf("\n Time taken by light pulse is %f nsec. \n
        RPM pulse is %f nsec",t,sigma)
15  printf("\n Maximum bit rate is %f M bit/sec \n
        Bandwidth length product is %dMHz km", BT_max*1e3
        ,Length)
```