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

Created by
Vareesh Pratap
B.Tech
Mechanical Engineering
Madan Mohan Malaviya University of Technology, Gorakhpur
College Teacher
Na
Cross-Checked by
K. V. P. Pradeep

May 31, 2016

[1]Funded by a grant from the National Mission on Education through ICT, http://spoken-tutorial.org/NMEICT-Intro. This Textbook Companion and Scilab codes written in it can be downloaded from the "Textbook Companion Project" section at the website http://scilab.in

Book Description

Title: Engineering Physics (volume - 1)

Author: B. K. Pandey and S. Chaturvedi

Publisher: Cengage Learning, New Delhi

Edition: 1

Year: 2009

ISBN: 9788131511787

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.

Contents

List of Scilab Codes

Chapter 1

Theory of relativity

Scilab code Exa 1.1 Calculation of fictitious forces

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

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

Scilab code Exa 1.4 Calculation of fringe shift

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

Scilab code Exa 1.5 Calculation of relative velocity

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

Scilab code Exa 1.7 Calculation of relative velocity

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

```
clc

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

Scilab code Exa 1.11 Calculation of relative velocity of circular lamina

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

Scilab code Exa 1.12 Calculation of percentage contraction in length

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

Scilab code Exa 1.13 Calculation of relative velocity

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

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

Scilab code Exa 1.14 Calculation of percentage contraction in rod

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

Scilab code Exa 1.15 Calculation of relative velocity

```
clc
```

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

Scilab code Exa 1.16 Calculation of relative velocity

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

Scilab code Exa 1.17 Calculation of distance traveled by meson

```
clc
// Given that
```

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

Scilab code Exa 1.18 Calculation of average distance traveled by meson

```
clc
// Given that
t_ = 2.2e-6 // proper life of mu mesons in sec
c = 3e8 // Speed of light in m/s
v = 0.8*c // velocity of meson beam in m/sec
// Sample Problem 18 on page no. 36
printf("\n # PROBLEM 18 # \n")
printf(" Standard formula used \n")
printf(" t = t_0/((1-v^2/c^2)^1/2) \n s = v*t \n")
t = t_ / sqrt(1 - (v / c)^2)
d = t * v
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 meson during mean life

```
clc

// Given that
t_ = 5e-8 // proper life of +pi mesons in sec
c = 3e8 // Speed of light in m/s
v = 2.4e8 // velocity of meson beam in m/sec
// Sample Problem 19 on page no. 37
printf("\n # PROBLEM 19 # \n")
printf(" Standard formula used \n")
printf(" t = t_0/((1-v^2/c^2)^1/2) \n s = v*t \n")
t = t_ / sqrt(1 - (v / c)^2)
d = t * v
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

```
clc
// Given that
c = 3e8 // speed of light in m/s
u= -1*0.8*c // speed of particle A in m/s
v = 0.8*c // speed of particle B in m/s

// Sample Problem 20 on page no. 40
printf("\n # PROBLEM 20 # \n")
```

```
printf(" Standard formula used \n")
printf(" u_x = u_x_ + v / (1+ v*u_x_/c^2) \n ")
u1 = (u-v) / (1 - ((u * v) / (c)^2))
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 experimenter

```
clc
// Given that
c = 3e8 // speed of light in m/s
u= 0.25*c // speed of radioactive atom in m/sec
v = 0.9*c // speed of beta particle wrt to atom in
    same direction in m/sec

// Sample Problem 21 on page no. 41
printf("\n # PROBLEM 21 # \n")
printf(" Standard formula used \n")
printf(" u_x = u_x_ + v / (1+ v*u_x_/c^2) \n ")
u1 = (u+v) / (1 + ((u * v) / (c)^2))
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

```
clc
// Given that
```

```
u_x_ = 3 //Particle velocity in X direction in m/sec
u_y_ = 4 //Particle velocity in Y direction in m/sec
u_z_ = 12 //Particle velocity in Z direction in m/sec
c= 3e8 // speed of light in m/sec
v = 0.8*c // velocity of frame of reference in m/sec

// Sample Problem 22 on page no. 42
printf("\n # PROBLEM 22 # \n")
printf(" Standard formula used \n")
printf(" u_x = u_x_ + v / (1+ v*u_x_/c^2) \n ")
u_x = (u_x_+v)/(1+v*u_x_/c^2) // velocity in X direction laboratory frame of reference in m/sec
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
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
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 mass

```
clc
// Given that
m_0 = 1 // let mass of the rod in kg
m = 1.5*m_0 // mass of moving rod in kg
l_0 = 1 // length of meter stick in m
c = 3e8 // speed of light in m/sec
// Sample Problem 24 on page no. 52
printf("\n # PROBLEM 24 # \n")
```

```
printf(" Standard formula used \n")
printf(" l = l_0/((1-v^2/c^2)^1/2) \n m = m_0/((1-v^2/c^2)^1/2) \n")

v = c*sqrt(1-(m_0/m)^2) // velocity of moving rod in m/sec
L = l_0 * sqrt(1- (v / c)^2)
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 of particle moving at high speed

```
clc
// Given that
m_0 = 1 // let mass of the particle in kg
c = 3e8 // speed of light in m/sec
v = c/sqrt(2) // velocity of moving particle in m/sec

// Sample Problem 25 on page no. 53
printf("\n # PROBLEM 25 # \n")
printf(" Standard formula used \n")
printf("\n m = m_0/((1-v^2/c^2)^1/2) \n")
m = m_0/sqrt(1-(v/c)^2) // mass of moving particle in kg

p = m*v // momentum of moving particle in kgm/sec
E = m*c^2 // total energy of particle in joule
KE = E - m_0*c^2 // kinetic energy in joule
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 mass 11 time rest mass

```
clc
// Given that
m_0 = 9.1e-31 // let mass of electron in kg
m = 11*m_0 // mass of moving electron
c = 3e8 // speed of light in m/sec
// Sample Problem 26 on page no. 53
printf("\n # PROBLEM 26 # \n")
printf(" Standard formula used \n")
printf("\n m = m_0/((1-v^2/c^2)^1/2) \n")
v= c*sqrt(1-(m_0/m)^2) // velocity of moving
    electron in m/sec
p = m*v // momentum of moving particle in kgm/sec
E = m*c^2 // total energy of particle in joule
KE = (m - m_0)*c^2/1.6e-19// kinetic energy in eV
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 500MeV

```
clc
// Given that
m_0 = 1.6e-27 // mass of proton in kg
KE = 500 // kinetic energy of electron in MeV
```

```
c = 3e8 // speed of light in m/sec
// Sample Problem 27 on page no. 54
printf("\n # PROBLEM 27 # \n")
printf(" Standard formula used \n")
printf("\n E = m*c^2 \n")
del_m = KE*1e6*1.6e-19/c^2 // change in mass of proton in kg
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 rest mass of proton

```
clc
// Given that
m_p = 1.6e-27 // mass of proton in kg
m_e = 9.1e-31 // mass of electron in kg
c = 3e8 // speed of light in m/sec
// Sample Problem 28 on page no. 54
printf("\n # PROBLEM 28 # \n")
printf(" Standard formula used \n")
printf("\n m = m_0/sqrt(1-(v/c)^2) \n")
v = c* sqrt(1-(m_e/m_p)^2) // velocity of moving electron in m/sec

printf("\n Velocity of moving electron is  %e m/sec. ",v)
// But real answer is 2.99e8 m/sec
```

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

```
clc
// Given that
m_0 = 1 // let rest mass of a particle be unity
c = 3e8 // speed of light in m/sec
rest_mass_energy = m_0*c^2 // rest mass energy of particle
KE = 3*rest_mass_energy // kinetic energy of particle
// Sample Problem 29 on page no. 55
printf("\n # PROBLEM 29 # \n")
printf(" Standard formula used \n")
printf("\n E = m*c^2 \n")
E_total = KE+ rest_mass_energy // total energy of particle
v = c * sqrt(1-(rest_mass_energy/E_total)^2) // velocity of moving electron in m/sec

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 its rest mass

```
clc
// Given that
m_0 = 1 // let rest mass of a particle be unity
c = 3e8 // speed of light in m/sec
rest_mass_energy = m_0*c^2 // rest mass energy of particle
E_total = 3*rest_mass_energy // kinetic energy of
```

```
particle
// Sample Problem 30 on page no. 55
printf("\n # PROBLEM 30 # \n")
printf(" Standard formula used \n")
printf("\n E = m*c^2 \n")

v = c * sqrt(1-(rest_mass_energy/E_total)^2) // velocity of moving electron in m/sec
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 half Mev kinetic energy

```
clc
// Given that
m_0 = 9.1e-31 // mass of electron in kg
c = 3e8 // speed of light in m/sec
KE = 1.5e6 // kinetic energy in eV
// Sample Problem 31 on page no. 56
printf("\n # PROBLEM 31 # \n")
printf(" Standard formula used \n")
printf("\n E = m*c^2 \n")

m = m_0+ KE*1.6e-19/c^2 // mass of moving electron in kg

v = c * sqrt(1-(m_0/m)^2) // velocity of moving electron in m/sec
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 electron

```
clc
// Given that
m_0 = 9.1e-31 // mass of electron in kg
c = 3e8 // speed of light in m/sec
v1 = 0.6*c // initial velocity of electron in m/sec
v2 = 0.8*c//final velocity of electron in m/sec
E_rest = 0.511 // rest mass energy of electron in
    MeV
// Sample Problem 32 on page no. 57
printf("\n # PROBLEM 32 # \n")
printf(" Standard formula used \n")
printf("\n E = m*c^2 \n")
KE1 = E_rest*1e6*((1-(v1/c)^2)^(-1/2) -1)// initial
    kinetic energy of particle
KE2 = E_rest*1e6*((1-(v2/c)^2)^(-0.5) -1)// final
    kinetic energy of particle

del_KE = (KE2 -KE1)*1.6e-19 // change in kinetic
    energy
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 potential of 1 million volts

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

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

```
clc
// Given that
BE = 13.6 // Binding energy of electron in eV
c = 3e8 // speed of light in m/sec

// Sample Problem 35 on page no. 60
printf("\n # PROBLEM 35 # \n")
printf(" Standard formula used \n")
printf("\n E = m*c^2 \n")
del_m = BE*1.6e-19/c^2 // loss of mass in kg
printf("\n Loss of mass in formation of one atom of
    hydrogen is %ekg.",del_m)
clc
```

Chapter 2

Interference

Scilab code Exa 2.1 Calculation of ratio of intensities

```
clc

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

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

```
clc
// Given that
I1 = 1 // let intensity of one source is unity
I2 = 100*I1 // Intensity of second source
a1 = 1 // let amplitude of first source is unity
// Problem 2 on page No. 83
printf("\n # Problem 2 # \n")
amp_ratio = sqrt(I2/I1) // Amplitude ratio of sources
a2 = a1*amp_ratio // Amplitude of second source
I_max = (a1+a2)^2 // Maximum Intensity
I_min = (a2-a1)^2 // Minimum Intensity
I_ratio = I_max/I_min // Ratio of maximum to minimum intensity
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

```
clc
// Given that
I_avg = 100 // let it is average intensity
var = 5 // Intensity variation in percentage
a2 = 1 // let amplitude of one source is unity
// Problem 3 on page No. 83
printf("\n # Problem 3 # \n")
I_max = I_avg+var// maximum intensity
I_min = I_avg - var // minimum intensity
I_ratio = I_max/I_min // Ratio of maximum to minimum intensity
```

```
amp_ratio = (1+sqrt(I_max/I_min))/(sqrt(I_max/I_min)
    -1) // Amplitude ratio of sources
a1 = a2*amp_ratio // Amplitude of second source
i_ratio = (a1/a2)^2 // Intensity ratio of two
    sources
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

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

Scilab code Exa 2.6 Calculation of third bright fringe and coincidental distance for two wavelengths

```
clc
// Given that
lambda1 = 6500 // wavelength of first source in
    angstrom
```

```
lambda2 = 5200 // wavelength of second source in
    angstrom
d = 2 // Spacing between sources in mm
D = 1.2 // Distance between source and screen
n = 3 // Order of bright fringe
// Sample Problem 6 on page no. 95
printf("\n # PROBLEM 6 # \n")
printf("\n Standard formula used \n x = D*n*lambda/d
     \n")
x_3 = D*n*lambda1*1e-10 / (d*1e-3) // Distance of
    third bright fringe from center
m = lambda2/(lambda1-lambda2)
x = D*m*lambda1*1e-10 / (d*1e-3) // distance of
    common fringe from center
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

```
clc
// Given that
lambda = 6000 // wavelength of first source in
    angstrom

d = 2 // Spacing between sources in mm
D = 0.1 // Distance between source and screen in
    meter
t = 0.5 // Thickness of plate in mm
shift = 5 // Shift of fringe in mm

// Sample Problem 7 on page no. 95
```

```
printf("\n # PROBLEM 7 # \n")
printf("\n Standard formula used \n x = D*(mu1)*n*lambda/d \n")
mu = 1+ shift*1e-3*d*1e-3/(D*t*1e-3) // Refractive index of Glass plate
printf("\n Refractive index of Glass plate is %f.",mu)
```

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

```
clc

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

Scilab code Exa 2.9 Calculation of distance between two coherent sources

```
clc
// Given that
lambda = 6000 // wavelength of source in angstrom
D = 1 // Distance between source and screen
Beta  = 0.5 // fringe width in mm
// Sample Problem 9 on page no. 96
printf("\n # PROBLEM 9 # \n")
printf("\n Standard formula used \n x = D*n*lambda/d
    \n")
d = D*lambda*1e-10/(Beta*1e-3) // Separation between
    sources
printf("\n Separation between sources is %fcm.",d
    *100)
```

Scilab code Exa 2.10 Calculation of wavelength of light

```
clc

// Given that
n = 4 // order of bright fringe
x_n = 10 // Separation of 4th bright fringe from
    center in mm
D = 1// Separation between source and screen in
    meter
d = 0.2 // Separation between coherent sources in mm

// Sample Problem 10 on page no. 97
printf("\n # PROBLEM 10 # \n")
printf("\n Standard formula used \n x = D*n*lambda/d
    \n")
lambda = x_n*1e-3*d*1e-3/(n*D) // Calculation of
    wavelength of sauce in meter
printf("\n Wavelength of sauce is %d Angstrom.",
```

```
lambda*1e10)
```

Scilab code Exa 2.11 Calculation of wavelength of light

```
clc
// Given that
n = 3 // order of dark fringe
m = 11 // Order of bight fringe
s = 8.835 // Separation between 4th dark and 11
    bright fringe
D = 100 // Separation between source and screen in
    centimeter
d = 0.5 // Separation between coherent sources in mm

// Sample Problem 11 on page no. 97
printf("\n # PROBLEM 11 # \n")
printf("\n Standard formula used \n x = D*n*lambda/d
    \n")
Beta = s*1e-3/(m - (2*n+1)/2) // Calculation of
    fringe width
lambda = Beta*d*1e-3/(D*1e-2) // Calculation of
    wavelength of sauce in meter
printf("\n Wavelength of sauce is %d Angstrom.",
    lambda*1e10)
```

Scilab code Exa 2.12 Calculation of changed fringe width

```
clc

```

```
// Given that
lambda1 = 6000 // Wavelength of first light in angstrom
lambda2 = 5000 // wavelength of second wave in angstrom
m = 0 // order of bright fringe
n = 10 // order of bright fringe
d1 = 12.34 // micrometer reading for first zero order in mm
d10 = 14.73 // micrometer reading for 10th order in mm
// Sample Problem 12 on page no. 98
printf("\n # PROBLEM 12 # \n")
printf("\n Standard formula used \n x = D*n*lambda/d \n")
s = d10 - d1 // Separation between zero order and 10 th order fringe
Beta1 = s*1e-3/(n-m) // Calculation of fringe width for wavelength 1
Beta2 = (Beta1/lambda1)*lambda2 // Calculation of fringe width for wavelength 2
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

```
clc

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

```

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

Scilab code Exa 2.14 Calculation of fringe width

```
clc


// Given that
mu = 1.5 // Refractive index of material
alpha = 1 // Refracting angle in degree

lambda = 6900 // Wavelength of light in angstrom
d1 = 20 // separation between source and biprism in
   cm
d2 = 80 // separation between screen and biprism in
   cm
// Sample Problem 14 on page no. 99
printf("\n # PROBLEM 14 # \n")
printf("\n Standard formula used \n x = D*n*lambda/d
    \n")
D = d1+ d2 // Separation between slit and screen in
   cm
d = 2*(mu-1)*(alpha*%pi/180)*d1 // Separation
```

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

Scilab code Exa 2.15 Calculation of wavelength of light

```
clc

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

Scilab code Exa 2.16 Calculation of thickness of plate

```
clc
```

```
// Given that
lambda = 5450 // Wavelength in angstrom
mu = 1.5 // Refractive index of material
n = 3 // order of fringe

// Sample Problem 16 on page no. 100
printf("\n # PROBLEM 16 # \n")
printf("\n Standard formula used \n (mu - 1)*t = n*
   lambda\n")
t = n*lambda*1e-10/(mu-1) // Calculation of
   thickness of glass plate
printf("\n Thickness of glass plate is %f mm.", t*1
   e3)
```

Scilab code Exa 2.17 Calculation of refractive index of sheet

```
clc
// Given that
lambda = 5460 // Wavelength in angstrom
t = 6.3e-4 // Thickness of plate in cm
n = 6 // order of fringe

// Sample Problem 17 on page no. 100
printf("\n # PROBLEM 17 # \n")
printf("\n Standard formula used \n (mu - 1)*t = n*
   lambda\n")
mu = n*lambda*1e-10/(t*1e-2) +1 // Calculation of
   thickness of glass plate
printf("\n Refractive index of sheet is %f.", mu)
```

Scilab code Exa 2.18 Calculation of refractive index of mica

```
clc
// Given that
lambda = 6e-5 // Wavelength in cm
t = 1.2e-6 // Thickness of plate in cm
n = 1 // order of fringe

// Sample Problem 18 on page no. 100
printf("\n # PROBLEM 18 # \n")
printf("\n Standard formula used \n (mu - 1)*t = n*
    lambda\n")
mu = n*lambda*1e-2/(t) +1  // Calculation of
    thickness of glass plate
printf("\n Refractive index of sheet is %f.", mu)
```

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

```
clc
// Given that
lambda = 5000 // Wavelength in angstrom
d = 5e-4 // Separation between slits in meter
D = 1//  Separation between screen and slit in m
t = 1.5e-6 // Thickness of plate in cm
mu = 1.5 // Refractive index of medium
a1 = 1 // let
a2 = a1 // let
```

```
// Sample Problem 19 on page no. 101
printf("\n # PROBLEM 19 # \n")
printf("\n Standard formula used \n (mu - 1)*t = n*
   lambda\n")
del_l = (mu -1)*t // Calculation of path difference
del_p = 2*%pi/(lambda*1e-10) * del_l // Calculation
   of phase difference
I = a1^2+a2^2+2*a1*a2*cos(del_p) // Intensity at
   center of screen
x = D*(mu-1)*t /d
printf("\n Intensity at center of screen is %d.",I)
printf("\n Shift due to sheet is %f mm.",x*1e3)
```

Scilab code Exa 2.20 Calculation of thickness of mica sheet

```
clc
// Given that
lambda = 5890 // Wavelength in angstrom
mu = 1.6 // Refractive index of material
n = 3 // order of fringe
// Sample Problem 20 on page no. 100
printf("\n # PROBLEM 20 # \n")

printf("\n Standard formula used \n (mu - 1)*t = n*
   lambda\n")
t = n*lambda*1e-10/(mu-1) // Calculation of
   thickness of mica sheet
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 appear dark in reflection

```
clc
// Given that
lambda = 5890 // Wavelength in angstrom
r = 60 // Angle of Refraction in degree
mu = 1.5 // Refractive index of material
n = 1 // order of fringe

// Sample Problem 21 on page no. 108
printf("\n # PROBLEM 21 # \n")
printf("\n Standard formula used \n 2*mu*t*cos(r) =
   n*lambda\n")
t = n*lambda*1e-10/(2*mu*cos(r*%pi/180)) //
   Calculation of thickness of sheet
printf("\n Thickness of sheet is %e mm.", t*1e3)
```

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

```
clc
// Given that
lambda = 5893 // Wavelength in angstrom
r = 0 // Angle of Refraction in degree
mu = 1.42 // Refractive index of material
n = 1 // order of fringe for black
m = 0.5 // order of bright fringe

```

```
// Sample Problem 22 on page no. 108
printf("\n # PROBLEM 22 # \n")
printf("\n Standard formula used \n 2*mu*t*cos(r) =
    n*lambda\n")
t_n = n*lambda*1e-10/(2*mu*cos(r*%pi/180)) //
    Calculation of thickness of sheet for black
t_m = m*lambda*1e-10/(2*mu*cos(r*%pi/180)) //
    Calculation of thickness of sheet for bright
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

```
clc
// Given that
lambda1 = 6.1e-7 // Wavelength in angstrom
lambda2 = 6.0e-7 // Wavelength in angstrom
i = asin(4/5) // Angle of incidence
mu = 4/3 // Refractive index of material

// Sample Problem 23 on page no. 109
printf("\n # PROBLEM 23 # \n")

printf("\n Standard formula used \n 2*mu*t*cos(r) =
    n*lambda\n")
n = lambda2/(lambda1-lambda2) // Calculation of
    order
r = asin(sin(i)/mu)
t = n*lambda1/(2*mu*cos(r)) // Calculation of
    thickness film
printf("\n Thickness of film is %e mm.", t*1e3)
```

Scilab code Exa 2.24 Calculation of thickness of film

```
clc
// Given that
lambda = 5890 // Wavelength in angstrom
i = 45 // Angle of incidence in degree
mu = 1.33 // Refractive index of soap film
n = 1 // order
// Sample Problem 24 on page no. 100
printf("\n # PROBLEM 24 # \n")
printf("\n Standard formula used \n 2*mu*t*cos(r) =
    n*lambda\n")
r = asin(sin(45*%pi/180)/mu)
t = n*lambda*1e-10/(2*mu*cos(r)) // Calculation of
    thickness film
printf("\n Thickness of film is %e mm.", t*1e3)
```

Scilab code Exa 2.25 Calculation of angle of wedge

```
clc
// Given that
lambda = 6000 // Wavelength in angstrom
mu = 1.4 // Refractive index of soap film
Beta = 2 // Fringe width in mm
// Sample Problem 25 on page no. 100
printf("\n # PROBLEM 25 # \n")
printf("\n Standard formula used \n Beta = lambda
    /(2*mu*theta)\n")
```

```
theta = lambda*1e-10/(2*mu*Beta*1e-3) // Calculation
    of angle of wedge
printf("\n Angle of wedge is %e rad.", theta)
```

Scilab code Exa 2.26 Calculation of wavelength of light

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

Scilab code Exa 2.27 Calculation of wavelength of light

```
clc
// Given that
n = 15 // Order of ring
m = 5 // Order of ring
D_n = 0.59 // Diameter of 15th fringe in cm
D_m = 0.336 // Diameter of 5th fringe in cm
r = 100 // Radius of curvature of lens
```

```

// Sample Problem 27 on page no. 100
printf("\n # PROBLEM 27 # \n")
printf("\n Standard formula used \n Beta = lambda/(2*mu*theta)\n")
p = n-m // Difference of orders
lambda = ((D_n*1e-2)^2 - (D_m*1e-2)^2)/(4*p*r*1e-2) // Calculation of wavelength
printf("\n Wavelength of light is %d angstrom.",lambda*1e10)
```

Scilab code Exa 2.28 Calculation of refractive index of liquid

```
clc

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

Scilab code Exa 2.29 Calculation of radius of curvature of lens and thickness of air film

```
clc
// Given that
lambda = 5900 // Wavelength of light in angstrom
n = 10 // Order of ring
D_n = 0.5 // Diameter of 10th fringe in cm

// Sample Problem 29 on page no. 118
printf("\n # PROBLEM 29 # \n")
printf("\n Standard formula used \n Beta = lambda
    /(2*mu*theta)\n")
r = (D_n*1e-2)^2/(4*n*lambda*1e-10) // Calculation
    of diameter of dark ring
t = n*lambda*1e-10/2 // calculation of thickness of
    air column
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

```
clc
// Given that
theta = 0.3 // Angle of wedge in degree
lambda1 = 5890 // Wavelength of light in angstrom
lambda2 = 5896 // Wavelength of light in angstrom

// Sample Problem 30 on page no. 100
printf("\n # PROBLEM 30 # \n")
printf("\n Standard formula used \n 2*t = (2n+1)*
    lambda/2\n")
n = (3*lambda2-lambda1)/(2*(lambda1-lambda2)) //
```

```
    Calculation of order
t = (lambda1*1e-10*lambda2*1e-10)/(lambda2*1e-10-
    lambda1*1e-10) // Calculation of thickness
x = t/(2*theta*%pi/180) // Calculation of Distance
    from apex
printf("\n Distance from apex is %f cm.",x*1e2)
// Answer in book is 5.56 cm
```

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

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

```
clc
// Given that
n = 4 // Order of ring
m = 12 // Order of ring
o = 20 // Order of ring
D_n = 0.4 // Diameter of 4th fringe in cm
D_m = 0.7 // Diameter of 12th fringe in cm

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

Scilab code Exa 2.33 Calculation of diameter of dark ring

```
clc
// Given that
theta = 0.3 // Angle of wedge in degree
lambda1 = 6e-5 // Wavelength of light in cm
lambda2 = 4.5e-5 // Wavelength of light in cm
r = 90 // Radius of curvature in cm
// Sample Problem 33 on page no. 120
printf("\n # PROBLEM 33 # \n")

printf("\n Standard formula used \n D_m^2 -D_n^2 = 4*p*r*lambda\n")
n = (lambda2*1e-2)/(lambda1*1e-2-lambda2*1e-2) // Calculation of order
D_n = sqrt(4*n*lambda1*1e-2*r*1e-2)
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 when conditions are changed

```
clc
// Given that
lambda1 = 6e-5 // Wavelength of light in cm
lambda2 = 4.5e-5 // Wavelength of light in cm
dif1 = 0.125 // Difference between square of diameter of two successive rings in cm^2
mu1 = 1 // Refractive index
mu2 = 1.33 // Refractive index of inserted medium
r1 = 1 // let initial radius is unity
r2 = 2*r1 // Final radius of lens
// Sample Problem 34 on page no. 120
printf("\n # PROBLEM 34 # \n")
printf("\n Standard formula used \n D_m^2 -D_n^2 = 4*p*r*lambda\n")
dif2 = lambda2*1e-2*dif1/lambda1*1e-2  // Calculation of difference between square of diameter of two successive rings in cm for lambda2

dif3 = mu1/mu2 * dif1 // Calculation of difference between square of diameter of two successive rings in cm for mu2
dif4 = r2/r1 * dif1
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)
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

```
clc

// Given that
lambda = 6000 // wavelength of light in angstrom
e = 0.1 // Width of slit in mm
d = 1 // Linear distance in mm
// Sample Problem 1 on page no. 137
printf("\n # PROBLEM 1 # \n")
printf(" Standard formula used \n")
printf(" lambda = e*sin(theta)  \n")
theta = asin(lambda*1e-10/(e*1e-3)) // Calculation of angle in radian
ang_wdt = 2*theta // Angular width of central maxima
y = d*ang_wdt // Total linear width of central maxima
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

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

Scilab code Exa 3.3 Calculation of width of slit

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

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

Scilab code Exa 3.4 Calculation of wavelength of light

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

Scilab code Exa 3.6 Calculation of wavelengths of light

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

```
m = 4 // Order of minima
n = 5 // Order of minima
e = 0.5 // Distance of center of 5th minima from
    center of maxima in cm
// Sample Problem 6 on page no. 141
printf("\n # PROBLEM 6 # \n")
printf(" Standard formula used \n")
printf(" lambda = e*sin(theta)  \n")
theta = y*1e-2/(f*1e-2) // Calculation of angle in
    radian
lambda_1 = theta*e*1e-2/m // Calculation of
    wavelength 1
lambda_2 = lambda_1*m/n // Calculation of wavelength
     2
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

```
clc

// Given that
lambda = 6000 // wavelength of light in angstrom
e = 1.2e-4 // Width of slit in cm

// Sample Problem 7 on page no. 142
printf("\n # PROBLEM 7 # \n")
printf(" Standard formula used \n")
printf(" lambda = e*sin(theta)  \n")
theta = asin(lambda*1e-10/(e*1e-2)) // Calculation
    of angle in radian
ang_wdt = theta*180/%pi // Angular width of central
    maxima
```

```
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

```
clc
// Given that
lambda = 6000 // wavelength of light in angstrom
e = 0.3 // Width of slit in mm
m = 1 // Order for first dark band
n = 3/2 // Order for first bright band
// Sample Problem 8 on page no. 143
printf("\n # PROBLEM 8 # \n")
printf(" Standard formula used \n")
printf(" lambda = e*sin(theta)  \n")
theta_d = m*asin(lambda*1e-10/(e*1e-3)) // Calculation of angle in radian
theta_b = n*asin(lambda*1e-10/(e*1e-3)) // Calculation of angle in radian
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 band

```
clc
// Given that
```

```
f = 50 // focal length of lens in cm
lambda = 5890 // Wavelength of light in angstrom
e = 0.03 // Width of slit in cm
m = 1 // Order for first dark band
n = 3/2 // Order for first bright band
// Sample Problem 9 on page no. 143
printf("\n # PROBLEM 9 # \n")
printf(" Standard formula used \n")
printf(" lambda = e*sin(theta)  \n")

theta_d = m*asin(lambda*1e-10/(e*1e-3)) //
    Calculation of angle in radian
theta_b = n*asin(lambda*1e-10/(e*1e-3)) //
    Calculation of angle in radian
y_d = theta_d*f*1e-2 // Calculation of linear
    distance of first dark band from center in m
y_b = theta_b*f*1e-2 // Calculation of linear
    distance of first dark band from center in m
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

```
clc

// Given that
d = 0.4 // separation between slits in mm
e = 0.08 // width of slit in mm
D = 170 // Separation between screen and source in
    cm
Beta = 0.25 // Fringe width in cm
```

```
// Sample Problem 10 on page no. 155
printf("\n # PROBLEM 10 # \n")
printf(" Standard formula used \n")
printf(" theta = 1.22*lambda/a  \n")
lambda = Beta*1e-2*d*1e-3/(d*1e-2) // Calculation of
    wavelength
ratio = (e+d)/e
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

```
clc

// Given that
n = 2 // order
N = 5000 // no. of lines per cm
theta = 30 // angle of deviation in degree
// Sample Problem 11 on page no. 155
printf("\n # PROBLEM 11 # \n")
printf(" Standard formula used \n")
printf(" n*lambda= sin(theta)/N  \n")
lambda= sin(theta*%pi/180)/(n*N*1e2)
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 order spectra

```
clc
// Given that
lambda= 5000 // wavelength of light in angstrom
n1 = 1 // order
n3 = 3 // order
N = 6000 // no. of lines per cm
// Sample Problem 12 on page no. 156
printf("\n # PROBLEM 12 # \n")
printf(" Standard formula used \n")
printf(" n*lambda= sin(theta)/N  \n")
theta_1 = 180/%pi*asin(n1*lambda*1e-8*N) //
    Deviation of first order spectra
theta_3 = 180/%pi*asin(n3*lambda*1e-8*N) //
    Deviation of third order spectra
theta_dif = theta_3- theta_1 // Difference in
    deviation of first and third order spectra
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

```
clc
// Given that
lambda= 5000 // wavelength of light in angstrom
theta = 90 // for maximum order
X = 2620 // no. of lines per inch
// Sample Problem 13 on page no. 156
printf("\n # PROBLEM 13 # \n")
printf(" Standard formula used \n")
printf(" n*lambda= sin(theta)/N  \n")
N = X/2.54 // no. of lines per cm
n= sin(theta*%pi/180)/(N*lambda*1e-8) // order
    calculation
```

```
printf("\n Number of orders visible is %d.",n)
```

Scilab code Exa 3.14 Calculation of order numbers for visible spectrum

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

Scilab code Exa 3.15 Calculation of number of lines per centimeter

```
clc
// Given that
lambda_1 = 6000 // wavelength of light in angstrom
lambda_2 = 4500 // wavelength of light in angstrom
```

```
theta = 30 // Angle in degree

// Sample Problem 15 on page no. 158
printf("\n # PROBLEM 15 # \n")
printf(" Standard formula used \n")
printf(" n*lambda= sin(theta)/N \n")
n = lambda_2/(lambda_1-lambda_2) // order calculation
e_d = n*lambda_1*1e-8/sin(theta*%pi/180)
N = 1/e_d // Number of lines per cm
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 first order

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

```
clc
// Given that
lambda = 5000 // mean wavelength in angstrom
n = 2 // order
N = 5000 // Grating lines per cm
theta = 30 // Angle in degree

// Sample Problem 18 on page no. 160
printf("\n # PROBLEM 18 # \n")
printf(" Standard formula used \n")
printf(" n*lambda= sin(theta)/N  \n")
e_d = n*lambda*1e-8/sin(theta*%pi/180)
N = 1/e_d // number of lines per unit length
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

```
clc

// Given that
lambda_1 = 5890 // wavelength of light in angstrom
m = 5 // order
n = 4 // order

```

```
// Sample Problem 19 on page no. 161
printf("\n # PROBLEM 19 # \n")
printf(" Standard formula used \n")
printf(" n*lambda= sin(theta)/N \n")
lambda_2 = n*lambda_1/5
printf(" \n The wavelength of %dth order spectrum is
    %d angstrom.\n",m,lambda_2 )
```

Scilab code Exa 3.20 Calculation of grating element

```
clc
// Given that
lambda_1 = 6000 // wavelength of light in angstrom
lambda_2 = 4800 // wavelength of light in angstrom
theta = asin(0.75) // Angle of diffraction

// Sample Problem 20 on page no. 165
printf("\n # PROBLEM 20 # \n")
printf(" Standard formula used \n")
printf(" n*lambda= sin(theta)/N \n")
n = lambda_2/(lambda_1-lambda_2) // order
    calculation
e_d = (n+1)*lambda_2*1e-8/sin(theta) // Grating
    Element
printf(" \n Grating Element is %e cm.\n",e_d )
```

Scilab code Exa 3.21 Calculation of angle of diffraction

```
clc
```

```
// Given that
lambda = 6000 // wavelength of light in angstrom
N = 200 // Grating element
n = 3 // order
d = 0.025 // diameter of wire in mm
// Sample Problem 21 on page no. 165
printf("\n # PROBLEM 21 # \n")
printf(" Standard formula used \n")
printf(" n*lambda= sin(theta)/N \n")
theta = 180/%pi*asin(N*n*lambda*1e-8)
theta_deg = floor(theta)
theta_min = (theta - theta_deg)*60// Angle of
    diffraction
e = 1/N - d*1e-1 // width of slit
ratio = 1/(N*e)
m = 1
n1 = ratio*m
printf(" \n Angle of diffraction for third order
    spectrum is %d degree and %f minute.\n",theta_deg
    , theta_min )
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

```
clc
// Given that
lambda = 5000 // wavelength of light in angstrom
theta = 30 // angle in degree
d_theta = 0.01 // angular separation in radian
```

```
// Sample Problem 22 on page no. 165
printf("\n # PROBLEM 22 # \n")
printf(" Standard formula used \n")
printf(" d_theta /d_lambda = n/(e+d)*cos(theta)  \n"
   )
d_lambda = lambda*cotg(theta*%pi/180)*d_theta
printf("\n Difference in two wavelengths is %f
   angstrom.",d_lambda)
```

Scilab code Exa 3.23 Calculation of dispersive power of grating

```
clc

// Given that
N = 4000 // Grating lines per cm
n = 2 // order
lambda = 5000 // wavelength of light in angstrom

// Sample Problem 23 on page no. 165
printf("\n # PROBLEM 23 # \n")
printf(" Standard formula used \n")
printf(" d_theta /d_lambda = n/(e+d)*cos(theta)  \n"
   )
theta = asin(n*lambda*1e-8*N) // Calculation of
   angle in radian
ratio = n*N/(cos(theta)) // where ratio = d_theta /
   d_lambda
printf("Dispersive power of grating is %d.",ratio)
```

Scilab code Exa 3.24 Determination of observed orders due to grating

```
clc
// Given that
N = 4000 // Grating lines per cm
theta = 90 // for maximum order
lambda_min = 5000 // minimum wavelength of light in angestrom
lambda_max = 7500 // maximum wavelength of light in angestrom
// Sample Problem 24 on page no. 165
printf("\n # PROBLEM 24 # \n")
printf(" Standard formula used \n")
printf(" lambda/d_lambda = n*N  \n")
n_max= sin(theta*%pi/180)/(N*lambda_min*1e-8) // minimum order observed
n_min= sin(theta*%pi/180)/(N*lambda_max*1e-8) // maximum order observed


printf("Visible orders are form %d to %d.",n_min, n_max)
```

Scilab code Exa 3.25 Calculation for the difference between two wavelengths

```
clc
// Given that
lambda = 5893 // mean wavelength in angstrom
n = 2 // order
N = 5000 // Grating lines per cm
theta = 2.5 // Separation in second

```

```
// Sample Problem 25 on page no. 166
printf("\n # PROBLEM 25 # \n")
d_theta = %pi/180*theta/60 // Angle in radian
d_lambda = d_theta*sqrt((1/(n*N)^2)-(lambda*1e-8)^2)
    // Difference in wavelengths
printf("Difference in wavelengths is %f angstrom.",
   d_lambda*1e8)
```

Scilab code Exa 3.26 Calculation of aperture of objective of telescope

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

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

```
clc
// Given that
a = 500 // Aperture of telescope in cm
```

```
lambda = 5500 // wavelength of light in angstrom
R = 3.8e5 // Distance of moon in km
// Sample Problem 27 on page no. 172
printf("\n # PROBLEM 27 # \n")
printf(" Standard formula used \n")
printf(" theta = 1.22*lambda/a  \n")
theta = 1.22*lambda*1e-10/(a*1e-2)  // calculation
    of angle in radians
x = R*1e3*theta // Calculation separation of two
    points in m
printf("\n Separation of two points is %fm.",x)
```

Scilab code Exa 3.28 Calculation of aperture of object

```
clc
// Given that
S = 5.55e-7 // separation between objects
lambda = 5461 // wavelength of light in angstrom

// Sample Problem 28 on page no. 173
printf("\n # PROBLEM 28 # \n")
printf(" Standard formula used \n")
printf(" S = 1.22*lambda/(2*NA)  \n")
NA = 1.22*lambda*1e-10/(2*S) // Calculation of
    numerical aperture
printf("\n Numerical aperture is %f.",NA)
```

Scilab code Exa 3.29 Calculation of resolving power of a microscope

```
clc
// Given that
NA = 0.12 // Numerical aperture
lambda = 6e-5 // wavelength of light in cm

// Sample Problem 29 on page no. 173
printf("\n # PROBLEM 29 # \n")
printf(" Standard formula used \n")
printf(" RP = 2*NA/lambda  \n")
RP = 2*NA/(lambda) // Resolving power for non self
    luminous objects
printf("\n Maximum resolution power is %d.",ceil(RP)
    )
```

Scilab code Exa 3.30 Calculation of maximum resolving power

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

Scilab code Exa 3.31 Calculation of minimum number of lines required

```
clc
// Given that
lambda_1 = 5890 // wavelength of light in angstrom
lambda_2 = 5896 // wavelength of light in angstrom
n = 2 // order
// Sample Problem 31 on page no. 174
printf("\n # PROBLEM 31 # \n")
printf(" Standard formula used \n")
printf(" RP = n*N  \n")
d_lambda = lambda_2-lambda_1 // Difference between
    wavelengths
lambda = (lambda_1+lambda_2)/2 // Average wavelength
N = lambda/(n*d_lambda) // Number of lines in
    grating
printf("\nMinimum number of grating required to
    resolve wavelengths is %d",N)
```

Scilab code Exa 3.32 Determining the ability of telescope

```
clc
// Given that
f = 4 // Focal length of telescope objective in m
d = 80 // Distance of window in m
l = 2 // Separation between wires of mesh in cm
a = 3  // Diameter of lens of telescope in cm
lambda = 5500 // wavelength of light in angstrom
```

```
// Sample Problem 32 on page no. 174
printf("\n # PROBLEM 32 # \n")
printf(" Standard formula used \n")
printf(" theta = 1.22*lambda/a  \n\n")
theta = 1.22*lambda*1e-10/(a*1e-2) // Angle which
    can be resolved
alpha = (l*1e-2/d) // Angle projected by wire mesh
if (theta<alpha) then
    printf("As theta = %e degree is smaller than
        alpha = %e degree\n so telescope will be able
         to observe wire mesh",theta,alpha)
else
   printf("As theta = %e degree is greater than
      alpha = %e degree so telescope will not be
      able to observe wire mesh",theta,alpha)
end
// alpha is 2.25e-4 degree in book
```

Scilab code Exa 3.33 Calculation of smallest angle between two stars

```
clc
// Given that
f = 4 // Focal length of telescope objective in m
d = 100 // Diameter of lens of telescope in inch
lambda = 5000 // mean wavelength of light in
    angstrom

// Sample Problem 33 on page no. 175
printf("\n # PROBLEM 33 # \n")
printf(" Standard formula used \n")
printf(" theta = 1.22*lambda/a  \n")
a = d*2.54/100 // Diameter of lens of telescope in
```

```
meter
theta = 1.22*lambda*1e-10/a  // Calculation of angle
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 are just resolved

```
clc
// Given that
f = 4 // Focal length of telescope objective in m
a = 0.01 // Diameter of lens of telescope in m
lambda = 5500 // wavelength of light in angstrom

// Sample Problem 34 on page no. 175
printf("\n # PROBLEM 34 # \n")
printf(" Standard formula used \n")
printf(" theta = 1.22*lambda/a  \n")
theta = 1.22*lambda*1e-10/(a)
x = f*theta // Separation between center of images in cm
printf("\n Separation between center of images is %e cm.",x*100)
```

Scilab code Exa 3.35 Calculation for the required objective for telescope

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

```
theta = 1e-3 // Separation between stars in degree
// Sample Problem 35 on page no. 175
printf("\n # PROBLEM 35 # \n")
printf(" Standard formula used \n")
printf(" theta = 1.22*lambda/a  \n")
a = 1.22*lambda*1e-10/(theta*%pi/180) // Calculation
    of diameter of telescope
printf("\n Diameter of telescope is %f cm.",a*100)
```

Scilab code Exa 3.36 Calculation of limit of resolution

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

Scilab code Exa 3.37 Calculation of resolving power of grating and smallest wavelength difference

```
clc
// Given that
```

```
N = 15000 // Grating lines per inch
w = 10 // Width in cm
n = 2 // Order
m =3 // Order
lambda = 6000 // wavelength of light in angstrom
// Sample Problem 37 on page no. 176
printf("\n # PROBLEM 37 # \n")
printf(" Standard formula used \n")
printf(" lambda/d_lambda = n*N  \n")
P_res = n*N // resolving power in nth order
d_lambda = lambda/P_res // Resolving power of
    grating
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

```
clc
// Given that
lambda = 5500 // wavelength of light in angstrom
theta = 30 // Semi angle of cone in degree
// Sample Problem 38 on page no. 138
printf("\n # PROBLEM 38 # \n")
printf(" Standard formula used \n")
printf(" S = 1.22*lambda/(2*sin(theta))  \n")
S = 1.22*lambda*1e-10/(2*sin(theta*%pi/180)) //
    Calculation of resolving limit of microscope
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 of smallest wavelength that can be resolved in third order

```
clc
// Given that
N = 6000 // Grating lines per cm
w = 10 // Width in cm
n = 2 // Order
m =3 // Order
lambda = 6000 // wavelength of light in angstrom
// Sample Problem 39 on page no. 177
printf("\n # PROBLEM 39 # \n")
printf(" Standard formula used \n")
printf(" lambda/d_lambda = n*N  \n")
n_tot = w*N // Total number of grating
P_res = n*n_tot // resolving power in nth order
d_lambda = lambda/(m*n_tot) // Resolving power of
    grating
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

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

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

```
clc
// Given that
```

```
theta_p = 53 // Polarizing angle of light in a substance in degree
// Sample Problem 2 on page no. 213
printf("\n # PROBLEM 2 # \n")
theta_r = 90- theta_p // Angle of refraction
mu = tan(theta_p*%pi/180)  // by Brewster's law
printf("Standard formula used \n mu=tan(Ip)\n")
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

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

Scilab code Exa 4.4 Analysis of polarization angle

```
clc
// Given that
mu_w = 1.33 // refractive index of water
mu_g = 1.54 // refractive index of glass
// Sample Problem 4 on page no. 3.24
```

```
printf("\n # PROBLEM 4 # \n")
Ip_1 = atan(mu_g / mu_w) * (180 / %pi)//calculation
   for polarizing angle for water
Ip_2 = atan(mu_w / mu_g) * (180 / %pi) //
   calculation for polarizing angle for glass
printf("Standard formula used \n mu=tan(Ip)\n")
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

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

Scilab code Exa 4.6 Calculation of refractive index of glass

```
clc
// Given that
theta_p = 51 // Polarizing angle of light in glass
   plate in degree
// Sample Problem 6 on page no. 214
```

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

Scilab code Exa 4.7 Calculation of polarization angle

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

Scilab code Exa 4.8 Calculation of angle of refraction

```
clc
// Given that
mu_g = 1.55 // refractive index of glass
// Sample Problem 8 on page no. 215
printf("\n # PROBLEM 8 # \n")
Ip = atan(mu_g) * (180 / %pi)//calculation for
    polarizing angle for glass
```

```
I_r = 90 - Ip // Angle of refraction
printf("Standard formula used \n mu=tan(Ip)\n")
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 liquid

```
clc
// Given that
Ip = 53 // Angle of polarization of light
// Sample Problem 9 on page no. 216
printf("\n # PROBLEM 9 # \n")
I_r = 90 - Ip // Angle of refraction
mu = tan(Ip*%pi/180) // Refractive index of water
printf("Standard formula used \n mu=tan(Ip)\n")
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

```
clc

// Given that
mu_o = 1.658 // refractive index of material for ordinary ray
```

```
mu_e = 1.486 // refractive index of material for
    extra ordinary ray
c = 3e8 // speed of light in m/sec
// Sample Problem 10 on page no. 216
printf("\n # PROBLEM 10 # \n")
v_o = c/mu_o // velocity of ordinary ray
v_e = c/mu_e // velocity of extra ordinary ray
printf("Standard formula used \n mu=tan(Ip)\n")
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

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

```
printf("\n Ratio of intensities is %d:1.",R)
```

Scilab code Exa 4.12 Calculation of percentage of passed light

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

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

Scilab code Exa 4.14 Calculation of thickness of plate

```
clc
// Given that
lambda = 5.89e-7 // wavelength of light in meter
mu_o = 1.658 // refractive index for ordinary light
mu_e = 1.486 // refractive index for extraordinary light

// Sample Problem 14 on page no. 218
printf("\n # PROBLEM 14 # \n")
t = lambda / (4 * (mu_o - mu_e))
// calculation for thickness of plate of quartz
printf("\n Standard formula used \n t = lambda / (4 * (mu_o - mu_e)) ")
printf("\n Thickness of plate of calcite is %e meter.",t)
```

Scilab code Exa 4.15 Calculation of thickness of quarter plate

```
clc
// Given that
lambda = 5.89e-7 // wavelength of light in meter
mu_o = 1.55 // refractive index for ordinary light
mu_e = 1.54 // refractive index for extraordinary
    light

// Sample Problem 15 on page no. 218
printf("\n # PROBLEM 15 # \n")
t = lambda / (4 * (mu_o - mu_e))
// calculation for thickness of plate of quartz
printf("\n Standard formula used \n t = lambda / (4
    * (mu_o - mu_e)) ")
printf("\n Thickness of plate of calcite is %e meter
    .",t)
```

Scilab code Exa 4.16 Calculation of thickness of plate

```
clc
// Given that
lambda = 5e-7 // wavelength of light in meter
mu_o = 1.5442 // refractive index for ordinary light
mu_e = 1.5533 // refractive index for extraordinary
    light

// Sample Problem 16 on page no. 218
```

```
printf("\n # PROBLEM 16 # \n")
t1 = lambda/(2*(mu_e - mu_o))
t3 = 3*t1
t5 = 5*t1
// calculation for thickness of plate of quartz
printf("\n Standard formula used \n t = lambda / (4
    * (mu_o - mu_e)) ")
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

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

Scilab code Exa 4.18 Calculation of constants and thickness of plate

```
clc
```

```
// Given that
lambda1 = 5000 // Wavelength of light in angstrom
theta1 = 30 // Optical rotation for lambda1 in degree
lambda2 = 4000 // Wavelength of light in angstrom
theta2 = 50 // Optical rotation for lambda2 in degree
t = 1 // Thickness of plate in mm
theta_max = 90 // Angle between prisms for maximum trnsition in degree
// Sample Problem 18 on page no. 219
printf("\n # PROBLEM 18 # \n")

printf("\n Standard formula used \n theta = a + b/(lambda)^2. \n")
b = (theta2-theta1)*(lambda1*1e-10*lambda2*1e-10)^2/((lambda1*1e-10)^2-(lambda2*1e-10)^2) // Calculation for constant b
a = theta1 -b/(lambda1*1e-10)^2 // Calculation of constant a

t_min = t* theta_max/theta1 // calculation of thickness of material for maximum thickness in mm
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

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

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

Scilab code Exa 4.20 Calculation of strength of solution

```
clc
// Given that
theta = 13 // rotation of plane of polarization in degree
s = 65 // specific rotation of sugar solution in degree per decimeter per unit concentration
l = 2 // length of Polari meter in decimeter
// Sample Problem 20 on page no. 221
printf("\n # PROBLEM 20 # \n")
c = theta / (s * l) // calculation for concentration of sugar solution
printf("\n Standard formula used \n c = theta / (s * l). \n")
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

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

Scilab code Exa 4.22 Calculation of differences in indices

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

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

Scilab code Exa 4.23 Calculation of optical rotation

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

Scilab code Exa 4.24 Calculation of percentage purity of solution

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

```
V = 1 // Volume of sugar in liter
theta = 9.9 // rotation of plane of polarization in degree
s = 66 // specific rotation of sugar in degree
l = 2 // length of Polari meter in decimeter
// Sample Problem 24 on page no. 222
printf("\n # PROBLEM 24 # \n")
c = theta*1000/(l*s) // concentration of dissolved sugar
purity = c*V*100/m // purity percentage of solution
printf("\n Standard formula used \n c = theta / (s * l). \n")
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

```
clc

// Given that
l = 2.945e-2 // coherent length of sodium light
lambda = 5890 // wavelength of light used in
    angstrom
c = 3e8 // speed of light
// Sample Problem 1 on page no. 242
printf("\n # PROBLEM 1 # \n")
n = l/(lambda*1e-10) // number of oscillation
    corresponding to coherent length
t = l/c // coherent time
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

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

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

```
clc
// Given that
k = 12400 // constant
lambda = 3.3913 // wavelength IR radiation

// Sample Problem 4 on page no. 243
printf("\n # PROBLEM 4 # \n")
E = k/(lambda*1e4) // Energy difference
printf("\n Energy difference is %feV.",E)
```

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

```
clc
k = 12400 // constant
lambda = 6943 // wavelength of radiation in angstrom
n = 3e19 // Total number of ions
// Sample Problem 5 on page no. 243
printf("\n # PROBLEM 5 # \n")
E = k/(lambda) // Energy difference
E_total = E*n*1.6e-19 // Total Energy emitted
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

```
clc
// Given that
h_w = 2e-3 // half width of gain profile of laser in nm
mu = 1 // refractive index
lambda = 6328 // wavelength of light used in angstrom
// Sample Problem 6 on page no. 244
printf("\n # PROBLEM 6 # \n")
L = (lambda*1e-10)^2/(2*mu*h_w*1e-9) // Length of cavity
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

```
clc

// Given that
mu1 = 1.42 // refractive index for core
mu2 = 1.40 // refractive index for cladding
// Sample Problem 1 on page no. 254
printf("\n # PROBLEM 1 # \n")
NA = sqrt(mu1^2 - mu2^2)
theta_0 = asin(NA) * (180 / %pi)
theta_deg = floor(theta_0)
theta_fract = theta_0 - floor(theta_0)
theta_min = theta_fract*60
printf("\n Standard formula used \n NA = sqrt(mu1^2 - mu2^2). \n theta_0 = asin(NA) * (180 / pi). \n")
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 acceptance angle

```
clc
// Given that
mu1 = 1.36 // refractive index for core
del_mu = 0.025 // relative refractive index

// Sample Problem  on page no. 255
printf("\n # PROBLEM 2 # \n")
mu2 = mu1*(1-del_mu) // refractive index of cladding
NA = mu1*sqrt(2*del_mu)
theta_0 = asin(NA) * (180 / %pi)
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")
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

```
clc
// Given that
mu2 = 1.59 // refractive index for cladding
NA = 0.2 // Numerical aperture
mu_water = 1.33 // refractive index of water
del_mu = 0.025 // relative refractive index
```

```

// Sample Problem 3 on page no. 256
printf("\n # PROBLEM 3 # \n")
mu1 = sqrt(NA^2+mu2^2) // refractive index of cladding
NA_w = sqrt(mu1^2 - mu2^2)/mu_water // Numerical aperture for water
theta_0 = asin(NA_w) * (180 / %pi) // Acceptance angle of fiber in water
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")
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 number of reflections

```
clc
// Given that
mu1 = 1.55 // refractive index for core
mu2 = 1.50 // refractive index for cladding
d = 50 // core diameter in micro meter
// Sample Problem 4 on page no. 256
printf("\n # PROBLEM 4 # \n")

NA = sqrt(mu1^2 - mu2^2) // numerical aperture
theta_c = asin(mu2 / mu1) * (180 / %pi) // critical angle in degree
theta_0 = asin(NA) * (180 / %pi) // Acceptance angle in degree
x= d*1e-6*tan(theta_c*%pi/180) // distance travelled between two successive collisions
```

```
N = 1/x // No. of reflections per meter
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")
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 cladding air boundary

```
clc
// Given that
mu1 = 1.45 // refractive index for core
mu2 = 1.40 // refractive index for cladding
mu = 1 // refractive index for air
// Sample Problem 5 on page no. 256
printf("\n # PROBLEM 5 # \n")
theta_c = asin(mu2 / mu1) * (180 / %pi) // critical
   angle in degree
theta_c_ = asin(mu/mu2) * (180 / %pi) // Acceptance
   angle in degree
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")
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

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

```
clc
```

```
// Given that
mu1 = 1.566 // refractive index for core
mu2 = 1.56 // refractive index for cladding
d = 50 // core diameter in micro meter
lambda = 0.84 // wavelength of propagating light in micro meter
// Sample Problem 7 on page no. 265
printf("\n # PROBLEM 7 # \n")
v = %pi*d*sqrt(mu1^2 - mu2^2)/lambda  // cut off number
N_max = v^2/2 // maximum number of modes
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

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

```
clc
// Given that
mu1 = 1.466 // refractive index for core
mu2 = 1.46 // refractive index for cladding
lambda = 1200 // wavelength of light in nano meter
V = 2.405 // cut off parameter
// Sample Problem 9 on page no. 267
printf("\n # PROBLEM 9 # \n")
t = V*lambda*1e-9/(2*%pi*sqrt(mu1^2-mu2^2)) //
   maximum radius of fiber
theta_c = asin(mu2 / mu1) * (180 / %pi)
NA = sqrt(mu1^2 - mu2^2)
theta_0 = asin(NA) * (180 / %pi)
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")
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

```
clc
// Given that
NA = 0.3 // numerical aperture of fiber
d = 200 // core diameter in micro meter
lambda = 0.9 // wavelength of propagating light in
    micro meter
// Sample Problem 10 on page no. 268
printf("\n # PROBLEM 10 # \n")
N_max = 2*(d/2)^2*%pi^2*NA^2/lambda^2
printf("\n Total number of propagating modes are %d.
    ",N_max)
```

Scilab code Exa 6.11 Calculation of operating wavelength and attenuation

```
clc
// given that

d = 9 // Diameter of ore of wire in mm
P_b = 180 // Threshold optical power for Brillouin
    scattering in mW
P_r = 1.9 // Threshold optical power for Raman
    scattering  W
nu = 1 // Bandwidth in GHz
 // Sample Problem 11 on page no. 278
printf("\n # PROBLEM 11 # \n")
ratio = P_b*1e-3/P_r // Calculation of ratios of
    powers
lambda = ratio*5.9*1e-2*(d*1e-3)^2/(4.4*1e-3*(d*1e
    -3)^2) // Calcualtion of wavelength
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")
```

```
printf("\n wavelength of laser is %fmicron. ",lambda
   )
```

Scilab code Exa 6.12 Calculation of attenuation

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

Scilab code Exa 6.13 Calculation of losses

```
clc
// Given that
l = 150 // length of fiber in meter
P_in = 10 // power of input signal in micro Watt
P_out = 8 // power of output signal in micro Watt
// Sample Problem 13 on page no. 280
printf("\n # PROBLEM 13 # \n")
alpha = (10 * log10(P_in / P_out))/l //calculation
   for absorption coefficient
```

```
printf("\n Standard formula used \n alpha=10/L*log(
   Pi/Po).\n")
printf("\n Attenuation loss is %f dB/m. ",alpha)
```

Scilab code Exa 6.14 Calculation of fiber losses

```
clc

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

Scilab code Exa 6.15 Calculation of output power

```
clc
// Given that
l = 10 // length of fiber in kilo meter
P_in = 900 // Power of input signal in micro watt
alpha = 2.3 // attenuation loss in dB
// Sample Problem 15 on page no. 281
printf("\n # PROBLEM 15 # \n")
```

```
P_out = P_in*10^(-alpha) // Power at output in
    microwatt
printf("\n Standard formula used \n alpha=10/L*log(
    Pi/Po).\n")
printf("\n Power at output end is %f micro Watt.",
    P_out)
// Answer given in book is 1.79 micro Watt
```

Scilab code Exa 6.16 Calculation of light pulse spread

```
clc
// Given that
l = 6 // length of fiber in kilo meter
mu1 = 1.48 // refractive index for core
NA = 0.28 // Numerical aperture
c = 3e8 // speed of light in m/sec
// Sample Problem 16 on page no. 284
printf("\n # PROBLEM 16 # \n")
t = l*1e3*(NA)^2/(2*c*mu1)
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 max bit rate and bandwidth length

```
clc
// Given that
l = 8 // length of fiber in kilo meter
mu1 = 1.50 // refractive index for core
```

```
delta = 2/100 // relative refractive index
c = 3e8 // speed of light in m/sec
// Sample Problem 17 on page no. 285
printf("\n # PROBLEM 17 # \n")
t = l*1e3*mu1*delta/c * 1e9
sigma = t/(2*sqrt(3))
BT_max = 1/(2*t) //
Length = BT_max*1e3*l

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