

Scilab Textbook Companion for
Applied Physics-ii
by H. J. Sawant¹

Created by
Ajinkya S. Khair
B.E
Others
Mumbai University
College Teacher
Ashwini Sawant
Cross-Checked by
Bhavani Jalkrish

February 28, 2015

¹Funded 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: Applied Physics-ii

Author: H. J. Sawant

Publisher: Technical Publications, Pune

Edition: 1

Year: 2013

ISBN: 9789350388839

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	4
1 Interference of Light	8
2 Diffraction of Light	30
3 Fibre Optics	46
4 Lasers	62
5 Quantum Mechanics	65
6 Motion of Charged Particle in Electric and Magnetic Fields	93
7 Superconductivity	97

List of Scilab Codes

Exa 1.2.1	find the wavelength of light in the visible spectrum . . .	8
Exa 1.2.2	find the wavelength of light in the visible spectrum . . .	9
Exa 1.2.3	find the order of interference band	10
Exa 1.2.4	find the thickness of soap film	11
Exa 1.2.5	find the thickness of oil layer	12
Exa 1.2.6	find the thickness of film	13
Exa 1.2.7	find the minimum thickness of film	14
Exa 1.2.8	find the refractive index of oil	14
Exa 1.2.9	find the wavelength of light in the visible region	15
Exa 1.3.1	find wavelength of monochromatic light	16
Exa 1.3.2	calculate the angle of wedge	17
Exa 1.3.3	calculate the wavelength of light	18
Exa 1.3.4	find the number of fringes	18
Exa 1.3.5	find the diameter of wire	19
Exa 1.3.6	find the separation between consecutive bright fringes	20
Exa 1.4.1	find the ring number	21
Exa 1.4.2	find radius of curvature and thickness of film	21
Exa 1.4.3	find the radius of curvature	22
Exa 1.4.4	find the wavelength of light	23
Exa 1.4.5	find the refractive index of liquid	23
Exa 1.4.6	find the diameter of dark ring	24
Exa 1.4.7	find the diameter of dark ring	25
Exa 1.4.8	find the refractive index of liquid	25
Exa 1.4.11	find the diameter of ring	26
Exa 1.4.12	calculate the wavelength of light	27
Exa 1.7.1	find the thickness of coating	27
Exa 1.7.2	find the thickness of coating	28
Exa 2.2.1	calculate the width of slit	30

Exa 2.2.2	calculate the angular separation between first order minima	30
Exa 2.2.3	calculate wavelength of light	31
Exa 2.2.4	find half angular width of a principal maximum	32
Exa 2.2.5	find half angular width of central maximum	32
Exa 2.2.6	calculate the angle	33
Exa 2.3.1	calculate the missing orders	33
Exa 2.4.1	find the orders	34
Exa 2.4.2	find the number of lines per meter	35
Exa 2.4.3	calculate the wavelength of spectral line	35
Exa 2.4.4	find the angle of diffraction	36
Exa 2.4.5	calculate the number of lines per meter	37
Exa 2.4.6	find the longest wavelength	37
Exa 2.4.7	calculate the total number of lines	38
Exa 2.4.8	calculate total number of lines	38
Exa 2.4.9	calculate the highest order spectrum	39
Exa 2.4.10	find the order of absent spectra	40
Exa 2.4.11	calculate total number of lines	40
Exa 2.6.1	find angular separation and number of lines per meter	41
Exa 2.6.2	find the smallest wavelength interval	42
Exa 2.6.3	find the width of grating	42
Exa 2.6.4	find the resolving power of diffraction	43
Exa 2.6.5	calculate number of lines and the grating element	44
Exa 2.6.6	find the resolving power	44
Exa 3.3.1	find refractive index of cladding	46
Exa 3.3.2	find refractive index of core and acceptance angle	46
Exa 3.3.3	find the numerical aperture and acceptance angle	47
Exa 3.3.4	find the critical angle and angle of acceptance cone	48
Exa 3.3.5	the refractive index of cladding	49
Exa 3.3.6	calculate the fractional index change	49
Exa 3.3.7	calculate the maximum refractive index of cladding	50
Exa 3.3.8	calculate the acceptance angle	51
Exa 3.4.1	calculate normalized frequency and number of modes	51
Exa 3.4.2	calculate the maximum radius for fibre	52
Exa 3.4.3	find various parameters of fibre	53
Exa 3.4.4	calculate various parameters of fibre	55
Exa 3.4.5	calculate the number of modes	56
Exa 3.4.6	calculate various parameters of fibre	57

Exa 3.6.1	calculate the fibre attenuation	58
Exa 3.6.2	calculate the output power	59
Exa 3.6.3	calculate the fractional initial intensity	60
Exa 3.6.4	find the loss specification in cable	61
Exa 4.6.1	find the number of emitted photons	62
Exa 4.6.2	find the ratio of population of two energy levels	63
Exa 4.6.3	calculate the wavelength of photons	63
Exa 5.3.1	calculate de Broglie wavelength and velocity and time	65
Exa 5.3.2	calculate the velocity	66
Exa 5.3.3	calculate kinetic energy of an electron	67
Exa 5.3.4	find the wavelength of a beam of neutron	68
Exa 5.3.5	find the de Broglie wavelength of an electron	68
Exa 5.3.6	calculate the velocity and kinetic energy of neutron	69
Exa 5.3.7	find the de Broglie wavelength	70
Exa 5.3.8	find the momentum and energy of an electron	71
Exa 5.3.9	find the parameters for an electron wave	72
Exa 5.3.10	calculate the de Broglie wavelength and momentum of an electron	73
Exa 5.3.11	calculate the ratio of de Broglie wavelengths	74
Exa 5.3.12	calculate the velocity and de Broglie wavelength of an alpha particle	75
Exa 5.3.13	find the de Broglie wavelengths of photon and electron	76
Exa 5.3.14	find the de Broglie wavelength of an electron	77
Exa 5.7.1	find the accuracy in position of an electron	78
Exa 5.7.2	calculate the percentage of uncertainty	79
Exa 5.7.3	find the accuracy in position of an electron	80
Exa 5.7.4	find the accuracy in position of an electron	81
Exa 5.7.5	calculate the minimum time spent by the electrons	82
Exa 5.7.6	calculate the uncertainty in energy	83
Exa 5.7.7	find the time spent by an atom in excited state	84
Exa 5.15.1	find the energy of an electron for different states	85
Exa 5.15.2	find the ground state energy of an electron	86
Exa 5.15.3	calculate the probability of finding the particle	86
Exa 5.15.4	find the probability of finding the particle	87
Exa 5.15.5	find the lowest energy states	88
Exa 5.15.6	calculate the width of the well	90
Exa 5.15.7	calculate the energy and wavelength of the emitted photon	91

Exa 6.1.1	calculate radius of revolution and distance covered . . .	93
Exa 6.1.2	calculate radius and pitch	94
Exa 6.1.3	find the input voltage	95
Exa 6.5.1	calculate phase change	95
Exa 7.3.1	calculate critical temperature of element	97
Exa 7.3.2	find the critical field	97
Exa 7.3.3	calculate the critical current	98
Exa 7.3.4	calculate the isotopic mass	99

Chapter 1

Interference of Light

Scilab code Exa 1.2.1 find the wavelength of light in the visible spectrum

```
1 //Chapter -1,Example1.2.1 ,pg 1-11
2
3 i=45 //angle of
   incidence
4
5 u=1.2 //
   refractive index of soap film
6
7 t=4*10^-5 //
   thickness of soap film
8
9 r=asind(sind(i)/u) //by
   Snell 's law
10
11 //for dark band '2*u*t*cos(r) = n*lam '
12
13 wavelength_1=(2*u*t*cosd(r)/1)*10^8
   //for n=1
14
15 wavelength_2=(2*u*t*cosd(r)/2)*10^8
   //for n=2
```

```

16
17 wavelength_3=(2*u*t*cosd(r)/3)*10^8
                                //for n=3
18
19 //visible range of wavelengths is 4000 A. to 7000
    A.
20
21 printf('\n for n=1  wavelength = %.1f A.\n',
    wavelength_1)
22
23 printf('\n for n=2  wavelength = %.1f A.\n',
    wavelength_2)
24
25 printf('\n for n=3  wavelength = %.2f A.\n',
    wavelength_3)
26
27 printf('\n hence, none of the wavelengths from the
    visible region are absent in reflected light ')

```

Scilab code Exa 1.2.2 find the wavelength of light in the visible spectrum

```

1 //Chapter -1,Example1_2_2 ,pg 1-12
2
3 u=1.33                                //
    refractive index of soap film
4
5 t=5*10^-5                             //thickness
    of soap film
6
7 //for normal incidence
8
9 r=0                                    //angle of
    refraction
10
11 //for constructive interference      '2*u*t*cos(r)

```

```

    = (2*n-1)*wavelength/2'
12
13 wavelength_1=(2*u*t*cos(r)*2/(2*1-1))*10^8
    //for    n=1
14
15 wavelength_2=(2*u*t*cos(r)*2/(2*2-1))*10^8
    //for    n=2
16
17 wavelength_3=(2*u*t*cos(r)*2/(2*3-1))*10^8
    //for    n=3
18
19 wavelength_4=(2*u*t*cos(r)*2/(2*4-1))*10^8
    //for    n=4
20
21 //visible range of wavelengths is 4000 A. to 7000
    A.
22
23 printf('\n for n=1  wavelength = %.1f A.\n',
    wavelength_1)
24
25 printf('\n for n=2  wavelength = %.1f A.\n',
    wavelength_2)
26
27 printf('\n for n=3  wavelength = %.1f A.\n',
    wavelength_3)
28
29 printf('\n for n=4  wavelength = %.1f A.\n',
    wavelength_4)
30
31 printf('\n The wavelength will be reflected is
    wavelength = %.1f A.\n',wavelength_3)

```

Scilab code Exa 1.2.3 find the order of interference band

```
1 //Chapter -1,Example1_2_3 ,pg 1-12
```

```

2
3 u=4/3 //
   refractive index of soap film
4
5 t=1.5*10^-4 //
   thickness of soap film
6
7 wavelength=5*10^-5 //
   wavelength of light
8
9 i=45 //angle of
   incidece
10
11 r=asind(sind(i)/u) //by
   Snell 's law
12
13 n=2*u*t*cosd(r)/wavelength
   //for nth dark band
14
15 printf("\n the order of an interference band is n =
   %.0f",n)

```

Scilab code Exa 1.2.4 find the thickness of soap film

```

1 //Chapter -1,Example1_2_4 ,pg 1-13
2
3 //for constructive interference  $2 u t \cos(r) = (2$ 
    $n - 1) \text{ wavelength}/2$ 
4
5 u=1.33
6
7 i=45
8
9 r=asind(sind(i)/u) //by
   Snell 's law

```

```

10
11 n=1 //for
    minimum thickness
12
13 wavelength=5896*10^-8
14
15 t=(2*n-1)*wavelength/(4*u*cosd(r))
16
17 printf("\n the minimum thickness of soap film is t =
    %.7f cm",t)

```

Scilab code Exa 1.2.5 find the thickness of oil layer

```

1 //Chapter-1,Example1.2.5 ,pg 1-14
2
3 u=1.3 //
    refractive index of liquid
4
5 r=0 //angle
    of refraction for normal incidence
6
7 wavelength_1=7000 //
    wavelength of light
8
9 wavelength_2=5000 //
    wavelength of light
10
11 //for destructive interference '2*u*t*cos(r) =
    (2*n-1)*wavelength/2'
12
13 // 'n' order for 'wavelength_1' and 'n+1' order for '
    wavelength_2 '
14
15 //as LHS is same for both the wavelengths ,
    therefore

```

```

16
17 //((2*n-1)*7000/2 =(2*(n+1)-1)*5000/2
18
19 n=3 //number
    of orders
20
21 t=((2*n)-1)*wavelength_1/(4*u*cosd(r))
22
23 printf('\nThe thickness of oil layer is t = %.2f A.'
    ,t)

```

Scilab code Exa 1.2.6 find the thickness of film

```

1 //Chapter-1,Example1.2.6 ,pg 1-15
2
3 n=8
4
5 wavelength=5890*10^-8 //
    wavelength of light
6
7 u=1.46 //refractive
    index of oil
8
9 i=30 //angle of incidence
10
11 r=asind(sind(i)/u) //by Snell's
    law
12
13 t=n*wavelength/(2*u*cosd(r))
14
15 printf("\n the thickness of an oil film is t =%.7f
    cm",t)

```

Scilab code Exa 1.2.7 find the minimum thickness of film

```
1 //Chapter-1,Example1.2.7,pg 1-15
2
3 u=1.5 //refractive
   index of thin film
4
5 r1=60 //angle of refraction
6
7 wavelength=5890*10^-8 //
   wavelength of light
8
9 n=1 //for minimum
   thickness
10
11 t1=n*wavelength/(2*u*cosd(r1))
12
13 printf("\n the thickness of an oil film is t =%.7f
   cm",t1)
14
15 r2=0 //for normal
   incidence
16
17 t2=n*wavelength/(2*u*cosd(r2))
18
19 printf("\n the thickness of an oil film is t =%.7f
   cm",t2)
```

Scilab code Exa 1.2.8 find the refractive index of oil

```
1 //Chapter-1,Example1.2.8,pg 1-16
2
3 V=0.2 //volume of oil
4
5 A=10^4 //area
```

```

6
7 t=V/A //Thickness of
   oil film
8
9 r=0 //for normal
   incidence
10
11 n=1 //for 1st dark
   band
12
13 wavelength=5.5*10^-5 //
   wavelength of light
14
15 u=n*wavelength/(2*t*cosd(r))
16
17 printf('\nrefractive index of oil is u = %.3f',u)

```

Scilab code Exa 1.2.9 find the wavelength of light in the visible region

```

1 //Chapter -1,Example1.2.9 ,pg 1-17
2
3 u=1.2 //refractive
   index of oil film
4
5 t=2*10^-7 //thickness
   of oil film
6
7 r=60 //angle of refraction
8
9 //for destructive interference '2*u*t*cos(r) =
   (2*n-1)*wavelength/2'
10
11 wavelength_1=(2*u*t*cosd(r)*2/(2*1-1))*10^10
   //for n=1
12

```



```

13 wavelength_2=(2*u*t*cosd(r)*2/(2*2-1))*10^10
    //for    n=2
14
15 wavelength_3=(2*u*t*cosd(r)*2/(2*3-1))*10^10
    //for    n=3
16
17 //visible range of wavelengths is 4000*10^-10 m to
    7000*10^-10 m
18
19 printf('\n for n=1  wavelength = %.f A.\n',
    wavelength_1)
20
21 printf('\n for n=2  wavelength = %.f A.\n',
    wavelength_2)
22
23 printf('\n for n=3  wavelength = %.f A.\n',
    wavelength_3)
24
25 printf('\n The wavelength will be reflected is
    wavelength = %.f A.\n',wavelength_1)

```

Scilab code Exa 1.3.1 find wavelength of monochromatic light

```

1 //Chapter -1,Example1-3-1 ,pg 1-21
2
3 N=10
    //no of dark fringes
4
5 d=1.2
    //distance between consecutive fringes
6
7 B_air=d/N
    //
    fringe width in air
8

```

```

9 a=(40/3600)*(%pi/180)
  //angle made by film in radians
10
11 wavelength=2*a*B_air
  //as
  fringe width in air is 'B_air = wavelength
  /(2*a)'
12
13 printf("\nThe wavelength of monochromatic light is =
  %.8f cm\n",wavelength)

```

Scilab code Exa 1.3.2 calculate the angle of wedge

```

1 //Chapter -1,Example1-3-2 ,pg 1-22
2
3 wavelength=5893*10^-8
  //wavelength of light
4
5 B=0.1
  //fringe width
6
7 u=1.52
  //refractive index of glass wedge
8
9 a=(wavelength/(2*u*B))*3600*(180/%pi)
  //as fringe
  spacing is 'B = wavelength/(2*a*u)'
10
11 printf("\nThe angle of wedge is a =%.2f seconds \n"
  ,a)

```

Scilab code Exa 1.3.3 calculate the wavelength of light

```
1 //Chapter -1,Example1_3_3 ,pg 1-22
2
3 B=0.25
4
5 //fringe width
6
7 u=1.4
8
9 //refractive index of film
10
11 a=(20/3600)*(%pi/180)
12
13 // angle made by film in radians //
14
15 wavelength=2*a*B*u
16
17 //as fringe width is 'B = wavelength/(2*a*u)'
18
19 printf("\nThe wavelength of monochromatic light is =
20 %.8f cm\n",wavelength)
```

Scilab code Exa 1.3.4 find the number of fringes

```
1 //Chapter -1,Example1_3_4 ,pg 1-23
2
3 wavelength=5.82*10^-5
4
5 //wavelength of a monochromatic light
```

```

5 u=1.5
    //refractive index of glass
6
7 a=(20/3600)*(%pi/180)
    //
    angle made by glass film in radians
8
9 B=wavelength/(2*u*a)
    //The fringe width
10
11 N=1/B
    //the number of fringes per cm
12
13 printf("\nThe number of fringes per cm = %.f \n",N)

```

Scilab code Exa 1.3.5 find the diameter of wire

```

1 //Chapter-1,Example1_3_5 ,pg 1-24
2
3 wavelength=6*10^-5
    //wavelength of light
4
5 B=0.1
    //fringe width(as there are 10 fringes)
6
7 u=1
    //refractive index of air wedge
8
9 a=wavelength/(2*u*B)

```

```

    //as fringe spacing is      'B = wavelength/(2*a*u)
    ,
10
11 dist=10

    //distance of plane of rectangular pieces from
    wire
12
13 d=a*dist

    //as for small angle 'tan(a) = a = d/dist '
14
15 printf("\nThe diameter of wire is  d = %.3f cm\n",d)

```

Scilab code Exa 1.3.6 find the separation between consecutive bright fringes

```

1 //Chapter -1,Example1_3_6 ,pg 1-24
2
3 a=10^-4

    //as for small angle 'tan(a) = a'
4
5 wavelength=5900*10^-10
                                     //
    wavelength of light in air
6
7 u=1

    //refractive index of air
8
9 B=wavelength/(2*u*a)
                                     //The
    fringe width
10

```

```
11 printf("\nThe fringe width is B = %.5f m\n",B)
```

Scilab code Exa 1.4.1 find the ring number

```
1 //Chapter -1,Example1_4_1 ,pg 1-32
2
3 //let the diameter of nth dark ring be double the
  diameter of that of 40th ring
4
5 //as  $D_n^2 = 4R*n*wavelength$ 
6
7 n_1=40
8
9 //40 th dark ring
10
11 n=4*n_1
12
13 //as diameter is double
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100
101
102
103
104
105
106
107
108
109
110
111
112
113
114
115
116
117
118
119
120
121
122
123
124
125
126
127
128
129
130
131
132
133
134
135
136
137
138
139
140
141
142
143
144
145
146
147
148
149
150
151
152
153
154
155
156
157
158
159
160
161
162
163
164
165
166
167
168
169
170
171
172
173
174
175
176
177
178
179
180
181
182
183
184
185
186
187
188
189
190
191
192
193
194
195
196
197
198
199
200
201
202
203
204
205
206
207
208
209
210
211
212
213
214
215
216
217
218
219
220
221
222
223
224
225
226
227
228
229
230
231
232
233
234
235
236
237
238
239
240
241
242
243
244
245
246
247
248
249
250
251
252
253
254
255
256
257
258
259
260
261
262
263
264
265
266
267
268
269
270
271
272
273
274
275
276
277
278
279
280
281
282
283
284
285
286
287
288
289
290
291
292
293
294
295
296
297
298
299
300
301
302
303
304
305
306
307
308
309
310
311
312
313
314
315
316
317
318
319
320
321
322
323
324
325
326
327
328
329
330
331
332
333
334
335
336
337
338
339
340
341
342
343
344
345
346
347
348
349
350
351
352
353
354
355
356
357
358
359
360
361
362
363
364
365
366
367
368
369
370
371
372
373
374
375
376
377
378
379
380
381
382
383
384
385
386
387
388
389
390
391
392
393
394
395
396
397
398
399
400
401
402
403
404
405
406
407
408
409
410
411
412
413
414
415
416
417
418
419
420
421
422
423
424
425
426
427
428
429
430
431
432
433
434
435
436
437
438
439
440
441
442
443
444
445
446
447
448
449
450
451
452
453
454
455
456
457
458
459
460
461
462
463
464
465
466
467
468
469
470
471
472
473
474
475
476
477
478
479
480
481
482
483
484
485
486
487
488
489
490
491
492
493
494
495
496
497
498
499
500
501
502
503
504
505
506
507
508
509
510
511
512
513
514
515
516
517
518
519
520
521
522
523
524
525
526
527
528
529
530
531
532
533
534
535
536
537
538
539
540
541
542
543
544
545
546
547
548
549
550
551
552
553
554
555
556
557
558
559
560
561
562
563
564
565
566
567
568
569
570
571
572
573
574
575
576
577
578
579
580
581
582
583
584
585
586
587
588
589
590
591
592
593
594
595
596
597
598
599
600
601
602
603
604
605
606
607
608
609
610
611
612
613
614
615
616
617
618
619
620
621
622
623
624
625
626
627
628
629
630
631
632
633
634
635
636
637
638
639
640
641
642
643
644
645
646
647
648
649
650
651
652
653
654
655
656
657
658
659
660
661
662
663
664
665
666
667
668
669
670
671
672
673
674
675
676
677
678
679
680
681
682
683
684
685
686
687
688
689
690
691
692
693
694
695
696
697
698
699
700
701
702
703
704
705
706
707
708
709
710
711
712
713
714
715
716
717
718
719
720
721
722
723
724
725
726
727
728
729
730
731
732
733
734
735
736
737
738
739
740
741
742
743
744
745
746
747
748
749
750
751
752
753
754
755
756
757
758
759
760
761
762
763
764
765
766
767
768
769
770
771
772
773
774
775
776
777
778
779
780
781
782
783
784
785
786
787
788
789
790
791
792
793
794
795
796
797
798
799
800
801
802
803
804
805
806
807
808
809
810
811
812
813
814
815
816
817
818
819
820
821
822
823
824
825
826
827
828
829
830
831
832
833
834
835
836
837
838
839
840
841
842
843
844
845
846
847
848
849
850
851
852
853
854
855
856
857
858
859
860
861
862
863
864
865
866
867
868
869
870
871
872
873
874
875
876
877
878
879
880
881
882
883
884
885
886
887
888
889
890
891
892
893
894
895
896
897
898
899
900
901
902
903
904
905
906
907
908
909
910
911
912
913
914
915
916
917
918
919
920
921
922
923
924
925
926
927
928
929
930
931
932
933
934
935
936
937
938
939
940
941
942
943
944
945
946
947
948
949
950
951
952
953
954
955
956
957
958
959
960
961
962
963
964
965
966
967
968
969
970
971
972
973
974
975
976
977
978
979
980
981
982
983
984
985
986
987
988
989
990
991
992
993
994
995
996
997
998
999
```

Scilab code Exa 1.4.2 find radius of curvature and thickness of film

```
1 //Chapter -1,Example1_4_2 ,pg 1-32
2
3 //For dark rings  $D_n = \sqrt{4R*n*wavelength}$ 
4
5 n=10 //10th ring
6
7 Dn=0.5 //diameter of 10th ring
8
9 wavelength=5*10^-5 //wavelength of light
10
```

```

11 R=Dn^2/(4*n*wavelength)           //radius of curvature
12
13 t=Dn^2/(8*R)                       //thickness of film
14
15 printf('\nThe radius of curvature is R = %.2f cm\n',
        ,R)
16
17 printf('\nThe thickness of film is t = %.5f cm\n',t
        )
18
19 //mistake in textbook

```

Scilab code Exa 1.4.3 find the radius of curvature

```

1 //Chapter -1,Example1_4_3 ,pg 1-33
2
3 n_1=5                                 //5th
   ring
4
5 n_2=15                                 //15th
   ring
6
7 p=n_2-n_1                             //
   difference between rings
8
9 Dn_1=0.336                             //diameter of
   5th ring
10
11 Dn_2=0.59                             //diameter of
   15th ring
12
13 wavelength=5890*10^-8                 //
   wavelength of light
14
15 R=(Dn_2^2-Dn_1^2)/(4*p*wavelength)

```

```

    //radius of curvature
16
17 printf('\nThe radius of curvature is R = %.2f cm\n',
    ,R)

```

Scilab code Exa 1.4.4 find the wavelength of light

```

1 //Chapter -1,Example1.4.4 ,pg 1-33
2
3 //as n1 = nth ring n2 = (n+8)th ring
4
5 p=8 //
    difference between rings
6
7 Dn_1=0.42 //diameter of 5
    th ring
8
9 Dn_2=0.7 //diameter of
    15th ring
10
11 R=200 //
    radius of curvature
12
13 wavelength=(Dn_2^2-Dn_1^2)/(4*p*R)
    //wavelength of light
14
15 printf('\nThe wavelength of light is wavelength =
    %.6f cm\n',wavelength)

```

Scilab code Exa 1.4.5 find the refractive index of liquid

```

1 //chapter -1,Example1.4.5 ,pg 1-34
2

```



```

3 Dn_1=0.218 //Diameter of
   nth ring
4
5 Dn_2=0.451 //Diameter of (
   n+10)th ring
6
7 wavelength=5893*10^-8 //
   wavelength of light
8
9 R=90 //Radius of
   curvature
10
11 p=10
12
13 u=(4*p*wavelength*R)/(Dn_2^2-Dn_1^2) //
   Refractive index of liquid
14
15 printf('\nRefractive index of liquid is u = %.3f',u
   )

```

Scilab code Exa 1.4.6 find the diameter of dark ring

```

1 //chapter -1,Example1_4_6 ,pg 1-34
2
3 //For nth dark ring       $D_n^2 = 4*R*n*wavelength$ 
4
5 D_5=0.42 //Diameter of 5th dark
   ring
6
7 D_10=sqrt(2*D_5^2) //as number of ring
   double, the diameter is sqrt(2) times the
   diameter of original ring
8
9 printf('\nThe diameter of 10th dark ring is D10 = %
   .3f cm',D_10)

```

Scilab code Exa 1.4.7 find the diameter of dark ring

```
1 //Chapter -1, Example 1.4.7, pg 1-35
2
3 R=200
4
5 //radius of curvature
6
7 wavelength_1=6000*10^-8 //wavelength
8 of light for nth dark ring
9
10 wavelength_2=5000*10^-8 //wavelength
11 of light for (n+1)th dark ring
12
13 //as nth ring due to wavelength_1= 6000*10^-8 cm
14 is coincide with (n+1)th ring due to
15 wavelength_2=5000*10^-8 cm
16
17 //therefore  $6*n = 5*(n+1)$ 
18
19 n=5
20
21 Dn=sqrt(4*R*n*wavelength_1)
22
23 printf('\nDiameter of nth dark ring due to
24 wavelength 6000 A. is Dn = %.4f cm\n', Dn)
25
26 //wrong ans in textbook
```

Scilab code Exa 1.4.8 find the refractive index of liquid

```

1 //Chapter -1,Example1_4_8 ,pg 1-35
2
3 D_air=2.3 //
   Diameter of bright ring in air
4
5 D_liquid=2 //
   Diameter of bright ring in liquid
6
7 u=D_air^2/D_liquid^2 //Refractive
   index of liquid
8
9 printf('\n The refractive index of liquid is u = %
   .4f \n',u)

```

Scilab code Exa 1.4.11 find the diameter of ring

```

1 //Chapter -1,Example1_4_11 ,pg 1-37
2
3 D_4=0.4 //diameter
   of 4th dark ring
4
5 D_12=0.7 //diameter
   of 12th dark ring
6
7 const=D_4^2/(4*4) //
   assume (R*wavelength = const) for 4th dark ring
8
9 D_20=sqrt(4*20*const) //
   For 20th dark ring
10
11 printf('\nDiameter of 20th dark ring is D20 = %.3f
   cm\n',D_20)

```

Scilab code Exa 1.4.12 calculate the wavelength of light

```
1 //Chapter -1,Example1_4_12 ,pg 1-38
2
3 n_1=5 //5th
   ring
4
5 n_2=15 //15th
   ring
6
7 p=n_2-n_1 //
   difference between rings
8
9 Dn_1=0.336 //diameter of
   5th ring
10
11 Dn_2=0.59 //diameter of
   15th ring
12
13 R=100 //
   Radius of curvature
14
15 wavelength=(Dn_2^2-Dn_1^2)/(4*p*R)*10^8
   //wavelength of light
16
17 printf('\nwavelength of light is = %.f A.',
   wavelength)
```

Scilab code Exa 1.7.1 find the thickness of coating

```
1 //Chapter -1,Example1_7_1 ,pg 1-42
2
```

```

3 wavelength=560
    //wavelength of light in air
4
5 u=2.0
    //refractive index of silicon monoxide material
6
7 //The wavelength of 'wavelength_1' in a medium of
    refractive index 'u' is
8
9 wavelength_1=wavelength/u
10
11 t=wavelength_1/4
    //thickness of the film
12
13 printf("\nThe thickness of the film is = %.f nm\n",t
    )

```

Scilab code Exa 1.7.2 find the thickness of coating

```

1 //Chapter -1,Example1.7.2 ,pg 1-42
2
3 wavelength=6000
    //wavelength of light in air
4
5 u=1.2
    //refractive index of transparant material
6
7 wavelength_1=wavelength/u
    //The wavelength of wavelength_1 in a medium of

```

```
    refractive index 'u'  
8  
9 t=wavelength_1/4  
  
    //thickness of coating  
10  
11 printf("\nThe thickness of coating to eliminate  
    reflection is t = %.f A.\n",t)
```

Chapter 2

Diffraction of Light

Scilab code Exa 2.2.1 calculate the width of slit

```
1 //Chapter -2,Example2_2_1 ,pg 2-10
2
3 angle=30 //angle of
   incidence
4
5 n=1 //first
   minimum
6
7 wavelength=6500*10^-8 //
   wavelength of light
8
9 a=(n*wavelength)/sind(angle)
   //For minimum intensity in single slit
10
11 printf('\nvalue of a =%.5f cm\n',a)
```

Scilab code Exa 2.2.2 calculate the angular separation between first order minima

```

1 //Chapter -2,Example2_2_2 ,pg 2-10
2
3 a=6*10^-6 //width of
  slit
4
5 n=1 //for first
  minimum
6
7 wavelength=6000*10^-10 //
  wavelength of light
8
9 angle=2*asind(n*wavelength/a) //angular
  seperation
10
11 printf('\nThe angular seperation between first order
  minima is angle = %.4f degree\n',angle)

```

Scilab code Exa 2.2.3 calculate wavelength of light

```

1 //Chapter -2,Example2_2_3 ,pg 2-11
2
3 n2=2 //for
  second order minima
4
5 n3=3 //for
  third order minima
6
7 wavelength_3=4000 //
  wavelength of light for third order minima
8
9 //as second order minima is coincide with third
  order minima, n2*wavelength2= n3*wavelength_3
10
11 wavelength_2=n3*wavelength_3/n2
12

```



```
13 printf("\nwavelength of light for second order
    minima is = %.f A.",wavelength_2)
```

Scilab code Exa 2.2.4 find half angular width of a principal maximum

```
1 //Chapter -2,Example2_2_4 ,pg 2-11
2
3 a=0.16*10^-3 //width of
    slit
4
5 n=1 //for first
    minimum
6
7 wavelength=5600*10^-10 //
    wavelength of light
8
9 angle=asind(n*wavelength/a) //angular
    seperation
10
11 printf('\nThe half angular width of a principal
    maximum is angle = %.4f degrees\n',angle)
```

Scilab code Exa 2.2.5 find half angular width of central maximum

```
1 //Chapter -2,Example2_2_5 ,pg 2-11
2
3 a=12*10^-7 //width of
    slit
4
5 n=1 //for
    first minimum
6
```

```

7 wavelength=6000*10^-10 //
  wavelength of light
8
9 angle=asind(n*wavelength/a) //
  angular seperation
10
11 printf('\nThe half angular width of the central
  maximum is angle = %.1f degrees\n',angle)

```

Scilab code Exa 2.2.6 calculate the angle

```

1 //Chapter -2,Example2_2_6 ,pg 2-12
2
3 a=2*10^-6 //width of
  slit
4
5 n=1 //for
  first minimum
6
7 wavelength=6500*10^-10 //
  wavelength of light
8
9 angle=asind(n*wavelength/a) //angular
  seperation
10
11 printf('\nThe half angular width of a principal
  maximum is angle =%.2f degrees\n',angle)

```

Scilab code Exa 2.3.1 calculate the missing orders

```

1 //Chapter -2,Example2_3_1 ,pg 2-16
2
3 a=0.16 //width of slit

```

```

4
5 b=0.8 //width of slit
6
7 n=[1 2 3] //no of minima
8
9 m=((a+b)/a).*n
10
11 printf('\nthe missing orders are m = ')
12
13 disp(m)

```

Scilab code Exa 2.4.1 find the orders

```

1 //Chapter -2,Example2_4_1 ,pg 2-24
2
3 wavelength_1=5000
  //wavelength of light
4
5 wavelength_2=7000
  //wavelength of light
6
7 N=4000
  //number of lines per cm
8
9 m_1=1/((wavelength_1*10^-8)*N) //for wavelength=
  5000 A.
10
11 m_2=1/((wavelength_2*10^-8)*N) //for wavelength=
  7000 A.
12
13 printf('\nnumber of orders visible for 7000*10^-10
  meter are %.2f\n',m_2)
14

```

```
15 printf('\nnumber of orders visible for 5000*10^-10
    meter are %.1f\n',m_1)
```

Scilab code Exa 2.4.2 find the number of lines per meter

```
1 //Chapter -2,Example2_4_2 ,pg 2-24
2
3 //as a mth order of wavelength 5400 A. is
    superimposed on (m+1)th order of wavelength 4050
    A.
4
5 angle=30 // angle
    of diffraction
6
7 wavelength_1=5400 //
    for mth order
8
9 wavelength_2=4050 //
    for (m+1)th order
10
11 m=wavelength_2/(wavelength_1-wavelength_2)
12
13 N=(sind(angle)/(m*wavelength_1))*10^8
    //Number of lines
    per cm
14
15 printf('\nNumber of lines per cm N = %.2f',N)
```

Scilab code Exa 2.4.3 calculate the wavelength of spectral line

```
1 //Chapter -2,Example2_4_3 ,pg 2-25
2
```

```

3 //as 3rd order line of wavelength lam is coincide
  with 4th order wavelength 4992 A.
4
5 m_1=3

  //3rd order
6
7 m_2=4

  //for 4th order
8
9 wavelength_2=4992

  //for 4th
  order
10
11 wavelength_1=m_2*wavelength_2/m_1
12
13 printf('\nwavelength of light is = %.0f A.',
  wavelength_1)

```

Scilab code Exa 2.4.4 find the angle of diffraction

```

1 //Chapter -2,Example2_4_4 ,pg 2-25
2
3 wavelength=6328*10^-10 //
  wavelength of light
4
5 m1=1 //for
  first order
6
7 m2=2 //for
  second order
8
9 N= 6000*10^2 //Number
  of lines per unit length

```

```

10
11 angle_1=asind(N*m1*wavelength)
12
13 angle_2=asind(N*m2*wavelength)
14
15 printf('\nangle of diaffraction for 1st order minima
        is  ang1 = %.2f degrees ',angle_1)
16
17 printf('\nangle of diaffraction for 2nd order minima
        is  ang2 = %.2f degrees ',angle_2)

```

Scilab code Exa 2.4.5 calculate the number of lines per meter

```

1 //Chapter -2,Example2_4_5 ,pg 2-26
2
3 m=2 //ofr second
    order principal maximum
4
5 wavelength=5*10^-5 //
    wavelength of light
6
7 angle=30 //ang of
    diaffraction
8
9 N=sind(angle)/(m*wavelength)
10
11 printf('\nNumber of lines per cm is  N = %.f ',N)

```

Scilab code Exa 2.4.6 find the longest wavelength

```

1 //Chapter -2,Example2_4_6 ,pg 2-26
2

```

```

3 m=3                                     //third
   order
4
5 angle=90                                 //for normal
   incidence
6
7 N=7000                                   //Number of
   lines per meter
8
9 wavelength=(sind(angle)/(m*N))*10^8
10
11 printf('\nThe longest wavelength is lam = %.0f A. ',
   wavelength)

```

Scilab code Exa 2.4.7 calculate the total number of lines

```

1 //Chapter -2,Example2_4_7 ,pg 2-27
2
3 m=1                                       //first
   ordr spectrum
4
5 wavelength=6560*10^-8                    //
   wavelength of light
6
7 angle=16.2                               //angle
   of diffraction
8
9 N=2*sind(angle)/(m*wavelength)
10
11 printf('\nNumber of lines per 2 cm is N = %.0f',N)

```

Scilab code Exa 2.4.8 calculate total number of lines

```

1 //Chapter -2,Example2_4_8 ,pg 2-27
2
3
4 m=1

    //first ordr spectrum
5
6 wavelength=6.56*10^-5                                //wavelength of
    light
7
8 angle=18.23333333                                    //angle of
    diffraction
9
10 N=2*sind(angle)/(m*wavelength)
11
12 printf('\nNumber of lines per 2 cm is N = %.2f ',N)

```

Scilab code Exa 2.4.9 calculate the highest order spectrum

```

1 //Chapter -2,Example2_4_9 ,pg 2-27
2
3 N=5000                                                //Number of
    lines per meter
4
5 wavelength=6*10^-5                                    //
    wavelength of light
6
7 m_max=1/(N*wavelength)
8
9 printf('\nThe highest order spectrum is m = %.0f ',
    m_max)

```

Scilab code Exa 2.4.10 find the order of absent spectra

```
1 //Chapter -2,Example2_4_10 ,pg 2-28
2
3 N=5000*10^2 //
   Number of lines per meter
4
5 wavelength=6000*10^-10 //wavelength of
   light
6
7 m_max=1/(N*wavelength)
8
9 //for absent spectra
10
11 n=[1 2 3]
12
13 m=3*n //as b
   = 2a and m = ((a+b)/a)*n
14
15 printf('\n The order of absent spectra is m = %.0f '
   ,m_max)
```

Scilab code Exa 2.4.11 calculate total number of lines

```
1 //Chapter -2,Example2_4_11 ,pg 2-28
2
3 m=1
   //first ordr spectrum
4
```

```

5 wavelength=5790*10^-10
    wavelength of light
6
7 angle=19.994
    angle of diffraction
8
9 N=2.54*sind(angle)/(m*wavelength*100)
10
11 printf('\nNumber of lines per 2.54 cm is N = %.0f
    lines ',N)

```

Scilab code Exa 2.6.1 find angular separation and number of lines per meter

```

1 //Chapter -2,Example2_6_1 ,pg 2-31
2
3 wavelength_1=5893*10^-10
    light //wavelength of
4
5 wavelength_2=5896*10^-10
    light //wavelength of
6
7 m=2
    //for second order
8
9 N1=3000*10^2/0.5
    //Number of lines per meter
10
11 angle_1=asind(m*wavelength_1*N1)
    //for wavelength_1
12
13 angle_2=asind(m*wavelength_2*N1)

```

```

//for wavelength_2
14
15 angle_sep=angle_2-angle_1
16
17 printf('\n angular separation is %.4f degrees \n',
    angle_sep)
18
19 d_wavelength=3*10^-10
20
21 N=wavelength_1/(m*d_wavelength)
22
23 printf('\n The number of lines per meter is N = %.0
    f\n ',N)

```

Scilab code Exa 2.6.2 find the smallest wavelength interval

```

1 //Chapter -2,Example2_6_2 ,pg 2-32
2
3 wavelength=481 //
    wavelength of light
4
5 m=3 //for
    third order
6
7 N=620*5.05 //
    number of lines per meter
8
9 d_wavelength=wavelength/(m*N)
10
11 printf('\n The smallest wavelength interval is
    d_wavelength = %.4f nm\n',d_wavelength)

```

Scilab code Exa 2.6.3 find the width of grating

```

1 //Chapter -2,Example2_6_3 ,pg 2-33
2
3 wavelength=5890*10^-10
                                     //wavelength
   of light
4
5 d_wavelength=6*10^-10
6
7 m=2
   //for second order
8
9 N=wavelength/(d_wavelength*m)
10
11 W=N/500
                                     //
   as there are 500 lines/cm
12
13 printf('\n The width of grating is W = %.3f cm',W)

```

Scilab code Exa 2.6.4 find the resolving power of diffraction

```

1 //Chapter -2,Example2_6_4 ,pg 2-33
2
3 N=3*5000
                                     //
   number of lines
4
5 n_l=5000*10^2
                                     //
   number of lines per meter
6
7 wavelength=5890*10^-10
                                     //wavelength of
   light
8
9 m_max=1/(n_l*wavelength)
10
11 R_P_max=(m_max)*N

```

```
12
13 printf('\n The maximum R.P. = %.0f ',R_P_max)
```

Scilab code Exa 2.6.5 calculate number of lines and the grating element

```
1 //Chapter -2,Example2_6_5 ,pg 2-34
2
3 wavelength=5890*10^-10                                //wavelength
   of light
4
5 d_wavelength=6*10^-10
6
7 m=2
   //for second order
8
9 N=wavelength/(d_wavelength*m)
10
11 W=3                                                    //
   width of grating
12
13 width=W/N
14
15 printf('\nNumber of lines is N = %.0f \n',N)
16
17 printf('\n The grating element(width of line) is a+
   b =%.7f cm',width)
```

Scilab code Exa 2.6.6 find the resolving power

```
1 //Chapter -2,Example2_6_6 ,pg 2-34
2
```

```
3 m=2 //for second
   order
4
5 N=40000 //Number of
   lines
6
7 RP=m*N
8
9 printf('\n The resolving power is R.P. = %.0f',RP)
```

Chapter 3

Fibre Optics

Scilab code Exa 3.3.1 find refractive index of cladding

```
1 //Chapter -3,Example3_3_1 ,pg 3-6
2
3 NA=0.5
4
5 //Numerical aperture
6
7 n1=1.54
8
9 //refractive index of core
10
11 n2=sqrt(n1^2-NA^2)
12
13 //Numerical aperture is 'NA^2 = n1^2 - n2^2'
14
15 printf("\nThe refractive index of cladding is n2 =
16 %.3f\n",n2)
```

Scilab code Exa 3.3.2 find refractive index of core and acceptance angle

```

1 //Chapter -3,Example3_3_2 ,pg 3-6
2
3 NA=0.2

    //Numerical aperture
4
5 n2=1.59
                                     //
    refractive index of cladding
6
7 n1=sqrt(n2^2-NA^2)
                                     //Numerical
    aperture is 'NA^2 = n1^2 - n2^2'
8
9 printf("\nThe refractive index of core is n1 = %.1f\
    n",n1)
10
11 n0=1.33
                                     //
    refractive index of medium
12
13 angle_0=asind(NA/n0)
    //For medium numerical aperture is 'NA=n0*sin(
    angle_0)'
14
15 printf("\nThe acceptance angle is angle_0 = %.2f
    Degree\n",angle_0)

```

Scilab code Exa 3.3.3 find the numerical aperture and acceptance angle

```

1 //Chapter -3,Example3_3_3 ,pg 3-6
2
3 n1=1.49

    //refractive index f core

```



```

4
5 n2=1.44

    //refractive index of cladding
6
7 NA=sqrt(n1^2 - n2^2)                                //Numerical
    aperture is 'NA^2 = n1^2 - n2^2'
8
9 printf("\nThe Numerical aperture is N.A. = %.5f\n",
    NA)
10
11 angle_0=asind(NA)
    //for air numerical aperture is 'NA=sin(angle_0)'
12
13 printf("\nThe acceptance angle is angle_0 = %.1f
    Degree\n",angle_0)

```

Scilab code Exa 3.3.4 find the critical angle and angle of acceptance cone

```

1 //Chapter -3,Example3-3_4 ,pg 3-7
2
3 n1=1.6

    //refractive index f core
4
5 n2=1.3

    //refractive index of cladding
6
7 angle_c=asind(n2/n1)
    //Critical angle
8
9 printf("\nThe critical angle is angle_c = %.2f
    Degree\n",angle_c)

```

```

10
11 angle_0=asind(sqrt(n1^2-n2^2))
           //for air numerical
           aperture is 'NA=sin(angle_0)'
12
13 angle_cone=2*angle_0
14
15 printf("\nThe acceptance angle cone = %.3f Degree\n"
           ,angle_cone)
16
17 //mistake in textbook

```

Scilab code Exa 3.3.5 the refractive index of cladding

```

1 //Chapter 3,Example3-3.5 ,pg 3-7
2
3 angle_0=30
           //
           acceptance angle
4
5 n1=1.4
           //
           refractive index of core
6
7 n2=sqrt(n1^2-sind(angle_0)^2)
           //Numerical aperture is '
           NA^2 = n1^2 - n2^2' also numerical aperture is '
           NA=sin(angle_0)'
8
9 printf("\nThe refractive index of cladding is n2 =
           %.4f\n",n2)

```

Scilab code Exa 3.3.6 calculate the fractional index change

```

1 //Chapter -3,Example3_3_6 ,pg 3-8
2
3 n1=1.563
4
5 //refractive index f core
6
7 n2=1.498
8
9 //refractive index of cladding
10
11 delta=(n1-n2)/n1
12
13 //
14
15 fractional index change
16
17 printf("\nThe fractional index change is Delta = %
18 .4f \n",delta)

```

Scilab code Exa 3.3.7 calculate the maximum refractive index of cladding

```

1 //Chapter -3,Example3_3_7 ,pg 3-8
2
3 //as total internal reflection takes place for light
4   travlling within 5 degree of the fibre axis
5
6 angle_c=90-5
7
8 //critical angle
9
10 n1=1.50
11
12 //refractive index of core
13
14 n2=n1*sind(angle_c)
15
16 printf("\nThe maximum refractive index of cladding

```

```
is n2 = %.4f\n", n2)
```

Scilab code Exa 3.3.8 calculate the acceptance angle

```
1 //Chapter -3, Example3_3_8 , pg 3-8
2
3 //In air
4
5 angle_0_air=30
6
7 //acceptance angle of an optical fibre
8
9 NA=sind(angle_0_air)
10
11 aperture is 'NA^2 = n1^2 - n2^2' //Numerical
12 aperture is 'NA=sin(angle_0)' also numerical
13
14 n0=1.33
15
16 //refractive index of medium
17
18 angle_0=asind(NA/n0)
19
20 //For
21 medium numerical aperture is 'NA=n0*sin(angle_0)'
```

Scilab code Exa 3.4.1 calculate normalized frequency and number of modes

```
1 //Chapter -3, Example3_4_1 , pg 3-10
2
```

```

3 d=29*10^-6
    //diameter of core of step index fibre
4
5 wavelength=1.3*10^-6
    //wavelength of light
6
7 n1=1.52
    //refractive index of core
8
9 n2=1.5189
    //refractive index of cladding
10
11 V=%pi*d*sqrt(n1^2-n2^2)/wavelength           //Normalized
    frequency of the fibre
12
13 printf("\nThe normalised frequency of fibre is V =
    %.3f\n",V)
14
15 N=V^2/2
    //The number of modes
16
17 printf("\nThe number of modes = %.f\n",N)

```

Scilab code Exa 3.4.2 calculate the maximum radius for fibre

```

1 //Chapter -3, Example3_4_2 ,pg 3-10
2
3 //For single mode fibre , V < 2.405
4

```

```

5 V=2.405
    //normalized frequency of fibre
6
7 n1=1.47
    //refractive index of core
8
9 n2=1.46
    //refractive index of cladding
10
11 wavelength=1.3
    //wavelength
12
13 d=V*wavelength/(%pi*sqrt(n1^2-n2^2))
    //diameter of
    core
14
15 r=(d/2)
16
17 printf("\nThe maximum radius for fibre = %.3f um\n",
    r)

```

Scilab code Exa 3.4.3 find various parameters of fibre

```

1 //Chapter -3,Example3_4_3 ,pg 3-11
2
3 wavelength=1*10^-6
    //wavelength of light
4
5 r=50*10^-6

```

```

        //radius of core
6
7 delta=0.055

        //relative refractive index of fibre
8
9 n1=1.48

        //refractive index of core
10
11 n2=n1*(1-delta)

        //as      'delta= (n1-n2)/n1'
12
13 printf("\nThe refractive index of cladding  n2 = %.4
        f \n",n2)
14
15 NA=sqrt(n1^2-n2^2)
                                                //
        numerical aperture
16
17 printf("\nThe numerical aperture N.A. = %.3 f \n",NA)
18
19 angle_0=asind(NA)
                                                // as
        N.A.=sin(angle_0)
20
21 printf("\nThe acceptance angle is  angle_0 = %.2 f
        Degree\n",angle_0)
22
23 d=2*r
24
25 V=%pi*d*NA/wavelength
                                                //
        Normalized frequency of the fibre
26
27 printf("\nThe normalised frequency of fibre is  V =
        %.2 f\n",V)

```

```

28
29 N=V^2/2

    //The number of modes
30
31 printf("\nThe number of modes = %.f \n",N)

```

Scilab code Exa 3.4.4 calculate various parameters of fibre

```

1 //Chapter -3,Example3_4_4 ,pg 3-12
2
3 wavelength=1*10^-6

    //wavelength of light
4
5 d=6*10^-6

    //diameter of core
6
7 n1=1.45

    //refractive index of core
8
9 n2=1.448

    //refractive index of cladding
10
11 angle_c=asind(n2/n1)

    critical angle is 'sin(angle_c) = n2/n1' //
12
13 printf("\nThe critical angle is angle_c = %.f
    Degree\n",angle_c)
14
15 NA=sqrt(n1^2-n2^2)

```



```

16
17 angle_0=asind(NA)
    acceptance angle is      'sin(angle_0) = NA = sqrt(
    n1^2-n2^2)'
18
19 printf("\nThe acceptance angle is  angle_0 =  %.3f
    Degree\n",angle_0)
20
21 N=%pi^2*d^2*NA^2/(2*wavelength^2)
    //the
    number of modes propogating through fibre
22
23 printf("\nthe number of modes propogating through
    fibre is  N = %.f\n",N)

```

Scilab code Exa 3.4.5 calculate the number of modes

```

1 //Chapter -3,Example3.4.5 ,pg 3-12
2
3 wavelength=1*10^-6
    //wavelength of light
4
5 r=50*10^-6
    //radius of core
6
7 n1=1.50
    //refractive index of core
8
9 n2=1.48
    //refractive index of cladding

```

```

10
11 NA=sqrt(n1^2-n2^2)
                                     //
    numerical aperture
12
13 d=2*r
    //diameter of core
14
15 N=%pi^2*d^2*NA^2/(2*wavelength^2)
                                     //the
    number of modes propogating through fibre
16
17 printf("\nthe number of modes propogating through
    fibre is N = %.f\n",N)

```

Scilab code Exa 3.4.6 calculate various parameters of fibre

```

1 //Chapter -3,Example3.4.6 ,pg 3-13
2
3 wavelength=1.4*10^-6
    //wavelength of light
4
5 d=40*10^-6
    //diameter of core
6
7 n1=1.55
    //refractive index of core
8
9 n2=1.50
    //refractive index of cladding

```

```

10
11 NA=sqrt(n1^2-n2^2)

    //numerical aperture
12
13 printf("\nThe numerical aperture N.A. = %.4 f \n",NA)
14
15 delta=(n1-n2)/n1

    //Fractional index change
16
17 printf("\nThe fractional index change Delta = %.5 f\n
    ",delta)
18
19 V=%pi*d*NA/wavelength

    //Normalized frequency of the fibre
20
21 printf("\nthe V-number is V = %.2 f \n",V)

```

Scilab code Exa 3.6.1 calculate the fibre attenuation

```

1 //Chapter -3,Example3_6_1 ,pg 3-17
2
3 Pin=1

    //Input power in mW
4
5 Pout=0.3

    //output power in mW
6
7 P1=(-10)*log10(Pout/Pin)

    //Power loss

    or attenuation

```

```

8
9 L=0.1

    //Length of cable in km
10
11 a=P1/L

    //fibre attenuation
12
13 printf("\nThe fibre attenuation is a = %.2f dB/km\n"
    ,a)

```

Scilab code Exa 3.6.2 calculate the output power

```

1 //Chapter -3,Example3_6_2 ,pg 3-18
2
3 L=3

    //length of fibre in km
4
5 a=1.5

    //Loss specification in dB/km
6
7 Pin=9.0

    //input power in uW
8
9 P1=a*L

    //Power loss
10
11 Pout=Pin*10^(-P1/10)

    // as
    Power loss or attenuation is P1=(-10)*log10(

```

```

    Pout/Pin)
12
13 printf("\n\nThe output power Pout = %.3f uW\n",Pout)

```

Scilab code Exa 3.6.3 calculate the fractional initial intensity

```

1 //Chapter -3,Example3_6_3 ,pg 3-18
2
3 a=2.2
4
5 //ratio= Pout/Pin
6
7 //For a length of L=2 km
8
9 P11=a*2
10
11 ratio_1=10^(-P11/10)
    //
    as Power loss or attenuation is Pl=(-10)*log10(
    Pout/Pin)
12
13 printf("\n\nThe fractional initial intensity after 2
    km is %.3f \n",ratio_1)
14
15 //For a length of L=6 km
16
17 P12=a*6
18
19 ratio_2=10^(-P12/10)
    //
    as Power loss or attenuation is Pl=(-10)*log10(
    Pout/Pin)
20
21 printf("\n\nThe fractional initial intensity after 6
    km is %.3f \n",ratio_2)

```

Scilab code Exa 3.6.4 find the loss specification in cable

```
1 //Chapter -3,Example3_6_4 ,pg 3-19
2
3 Pin=8.6
    //Input power in mW
4
5 Pout=7.5
    //output power in mW
6
7 P1=(-10)*log10(Pout/Pin)
    //Power loss
    or attenuation
8
9 L=0.5
    //Length of cable in km
10
11 a=P1/L
    //Loss specification
12
13 printf("\nThe loss specification in cable is a = %
    .3 f dB/km\n",a)
```

Chapter 4

Lasers

Scilab code Exa 4.6.1 find the number of emitted photons

```
1 //Chapter -4,Example4_6_1 ,pg 4-7
2
3 P=3.147*10^-3 //output
   power
4
5 t=60 //time
6
7 wavelength=632.8*10^-9 //
   wavelength of He-Ne laser
8
9 h=6.63*10^-34 //Plancks
   constant
10
11 c=3*10^8 //
   velocity of light in air
12
13 N=P*t*wavelength/(h*c) //
   No. of photons emitted
14
15 printf("\nNo. of photons emitted each minute\n")
16
```

17 `disp(N)`

Scilab code Exa 4.6.2 find the ratio of population of two energy levels

```
1 //Chapter 4,Example4_6_2 ,pg 4-7
2
3 wavelength=694.3*10^-9 //
   wavelength of He-Ne laser
4
5 h=6.63*10^-34 //Plancks
   constant
6
7 c=3*10^8 //
   velocity of light in air
8
9 k=1.38*10^-23 //
   Boltzmann constant
10
11 T=300 //ambient
   temperature in kelvin
12
13 ratio=%e^-(h*c/(wavelength*k*T)) //
   ratio of population of two energy level in laser
14
15 printf("\nRatio of population of two energy level in
   laser N2/N1 is\n")
16
17 disp(ratio)
```

Scilab code Exa 4.6.3 calculate the wavelength of photons

```
1 //Chapter 4,Example4_6_3 ,pg 4-8
2
```



```
3 P=100*10^3 //
   avrage power per pulse
4
5 t=20*10^-9 //
   time duration
6
7 h=6.63*10^-34 //
   Plancks constant
8
9 c=3*10^8 //
   velocity of light in air
10
11 N=6.981*10^15 //
   No. of photons per pulse
12
13 wavelength=N*h*c/(P*t)*10^10
14
15 printf("\nWavelength of photons = %.f A.\n",
   wavelength)
```

Chapter 5

Quantum Mechanics

Scilab code Exa 5.3.1 calculate de Broglie wavelength and velocity and time

```
1 //Chapter -5,Example5-3-1 ,pg 5-5
2
3 h=6.63*10^-34 //
   Plancks constant
4
5 m=10^-2 //
   mass of an moving object
6
7 v1=1 //
   velocity of that object
8
9 wavelength_1=h/(m*v1)
10
11 printf("\nThe de Broglie Wavelength is\n")
12
13 disp(wavelength_1)
14
15 printf("meter\n")
16
17 wavelength_2=10^-10
```

```

//new de
    Broglie wavelength
18
19 v2=h/(m*wavelength_2)
//new velocity
    of an object
20
21 printf("\nThe new velocity of an object is\n")
22
23 disp(v2)
24
25 printf("meter/sec\n")
26
27 d=10^-3 //
    Distance travelled with speed v2
28
29 t=(d/v2)/(365*24*60*60) //time
    required to travel distance
30
31 printf("\nTime required to travel distance is\n")
32
33 disp(t)
34
35 printf("years\n")
36
37 //mistake in textbook

```

Scilab code Exa 5.3.2 calculate the velocity

```

1 //Chapter -5, Example5_3_2 , pg 5-6
2
3 h=6.63*10^-34 //
    Plancks constant
4

```

```

5 m=9.1*10^-31 //mass
   of an electron
6
7 wavelength=10^-10
   //de Broglie wavelength of an electron
8
9 v=h/(m*wavelength)
   //velocity of an electron
10
11 printf("\nThe velocity of an electron is v = %.1f m
   /s\n",v)

```

Scilab code Exa 5.3.3 calculate kinetic energy of an electron

```

1 //Chapter -5,Example5_3_3 ,pg 5-6
2
3 h=6.63*10^-34 //
   Plancks constant
4
5 m=9.1*10^-31 //mass
   of an electron
6
7 wavelength=5000*10^-10
   //de Broglie wavelength of an electron
8
9 e=1.6*10^-19 //
   charge on electron
10
11 E=h^2/(2*m*wavelength^2*e)
   //Kinetic energy of an electron
12
13 printf("\nKinetic energy of an electron is E = %.9f
   eV\n",E)

```

Scilab code Exa 5.3.4 find the wavelength of a beam of neutron

```
1 //Chapter -5,Example5_3_4 ,pg 5-7
2
3 E=0.025 //
   energy of neutron
4
5 h=6.63*10^-34 //
   Plancks constant
6
7 m=1.676*10^-27 //mass
   of a neutron
8
9 e=1.6*10^-19 //
   charge on electron
10
11 wavelength=h/sqrt(2*m*E*e)
   //The Wavelength of a beam of neutron
12
13 printf("\nThe Wavelength of a beam of neutron is\n")
14
15 disp(wavelength)
16
17 printf("meter\n")
```

Scilab code Exa 5.3.5 find the de Broglie wavelength of an electron

```
1 //Chapter -5,Example5_3_5 ,pg 5-7
2
3 E=120 //
   kinetic energy of an electron
4
```

```

5 h=6.63*10^-34 //
   Plancks constant
6
7 m=9.1*10^-31 //mass
   of an electron
8
9 e=1.6*10^-19 //
   charge on electron
10
11 wavelength=h/sqrt(2*m*E*e)
   //The de Broglie Wavelength of an electron
12
13 printf("\nThe de Broglie Wavelength of an electron
   is\n")
14
15 disp(wavelength)
16
17 printf("meter\n")

```

Scilab code Exa 5.3.6 calculate the velocity and kinetic energy of neutron

```

1 //Chapter -5,Example5_3_6 ,pg 5-7
2
3 h=6.63*10^-34 //
   Plancks constant
4
5 m=1.67*10^-27 //mass
   of a neutron
6
7 e=1.6*10^-19 //
   charge on electron
8
9 wavelength=10^-10
   //The de Broglie Wavelength of a neutron
10

```

```

11 v=h/(m*wavelength)
    //velocity of a neutron
12
13 printf("\nThe velocity of a neutron is v= %.f m/s\n
    ",v)
14
15 E=h^2/(2*m*wavelength^2*e)
    //Kinetic energy of a neutron
16
17 printf("\nKinetic energy of a neutron is E= %.5f eV
    \n",E)

```

Scilab code Exa 5.3.7 find the de Broglie wavelength

```

1 //Chapter -5,Example5_3_7 ,pg 5-8
2
3 //(1)
4 V=182 //
    Potential difference
5
6 wavelength_1=12.27*10^-10/sqrt(V)
    //The de Broglie wavelength of
    an electron accelerated through a potential diff
    . of 'V'
7
8
9 printf("\nThe de Broglie wavelength of an electron
    accelerated through a potential diff. of V is\n")
10
11 disp(wavelength_1)
12
13 printf("meter\n")
14
15 //(2)
16 h=6.63*10^-34 //

```

```

    Plancks constant
17
18 m=1
19
20 v=1
21
22 wavelength_2=h/(m*v)
23
24 printf("\nThe de Broglie wavelength of an object is\n")
25
26 disp(wavelength_2)
27
28 printf("meter\n")

```

Scilab code Exa 5.3.8 find the momentum and energy of an electron

```

1 //Chapter -5,Example5_3_8 ,pg 5-9
2
3 h=6.63*10^-34 //
   Plancks constant
4
5 m=9.1*10^-31 //mass
   of an electron
6
7 e=1.6*10^-19 //
   charge on electron
8
9 wavelength=10^-14
   //The de Broglie wavelength of an electron
10
11 p=h/wavelength
   //as the de Broglie wavelength of an electron is
   (lam=h/p)
12

```



```

13 printf("\nThe momentum of an electron is\n")
14
15 disp(p)
16
17 printf("kg-meter/sec\n")
18
19 E=p^2/(2*m*e)*10^-6
    //energy corresponds to momentum
20
21 printf("\nenergy of an electron is    E = %.2f MeV\n"
    ,E)

```

Scilab code Exa 5.3.9 find the parameters for an electron wave

```

1 //Chapter -5,Example5_3_9 ,pg 5-10
2
3 V=3000 //
    Potential difference
4
5 wavelength=12.27/sqrt(V) //
    The de Broglie wavelength of an electron
    accelerated through a potential diff. of 'V'
6
7 printf("\nThe de Broglie wavelength of an electron
    accelerated through a potential diff. of V is %
    .3f A.\n",wavelength)
8
9 h=6.63*10^-34 //
    Plancks constant
10
11 p=h/(wavelength*10^-10)
    //as the de
    Broglie wavelength of an electron is (wavelength=
    h/p)
12

```

```

13 printf("\nThe momentum of an electron is\n")
14
15 disp(p)
16
17 printf("kg-meter/sec\n")
18
19 wave_no=1/(wavelength*10^-10)
                                     //wave
    number
20
21 printf("\nThe wave number = %.f/m\n",wave_no)
22
23 d=2.04
    distance between planes
                                     //
24
25 n=1
    For first ordet reflection
                                     //
26
27 angle=asind(n*wavelength/(2*d))
    By Bragg's law '2dsin(angle)=n*wavelength'
                                     //
28
29 printf("\nThe Bragg angle = %.3f Degree\n",angle)

```

Scilab code Exa 5.3.10 calculate the de Broglie wavelength and momentum of an electron

```

1 //Chapter -5,Example5_3_10 ,pg 5-11
2
3 V=10*10^3
    Potential difference
                                     //
4
5 wavelength=12.27/sqrt(V)
    Broglie wavelength of an eThelectron accelerated
    through a potential difference of 'V'
                                     // de
6

```

```

7 printf("\nThe de Broglie wavelength of an electron
  accelerated through a potential difference of V
  is = %.4f A.\n",wavelength)
8
9 h=6.63*10^-34 //
  Plancks constant
10
11 p=h/(wavelength*10^-10) //The
  momentum of an electron
12
13 printf("\nThe momentum of an electron\n")
14
15 disp(p)
16
17 printf("kg-meter/sec\n")

```

Scilab code Exa 5.3.11 calculate the ratio of de Broglie wavelengths

```

1 //Chapter -5,Example5_3_11 ,pg 5-11
2
3 //a proton and alpha particle are accelerated by the
  same potential difference
4
5 m_p=1.67*10^-27 //mass of
  proton
6
7 m_a=4*m_p //
  mass of alpha particle (assume mass of alpha
  particle to be 4 times the mass of proton)
8
9 e=1.6*10^-19 //

```

```

    charge of proton
10
11 e_a=2*e

    //charge of an alpha particle
12
13 h=6.63*10^-34

    plancks constant //
14
15 wavelength_p=h/sqrt(2*m_p*e) //wavelength
    of proton
16
17 wavelength_a=h/sqrt(2*m_a*e_a) //wavelength of
    an alpha particle
18
19 ratio=wavelength_p/wavelength_a //ratio of
    the de Broglie wavelengths associated with
    proton and alpha particle
20
21 printf("\nthe ratio of wavelengths associated with
    proton and alpha particle = %.3f\n",ratio)

```

Scilab code Exa 5.3.12 calculate the velocity and de Broglie wavelength of an alpha particle

```

1 //Chapter -5, Example5_3_12 , pg 5-12
2
3 h=6.63*10^-34

    //Plancks constant
4

```

```

5 m=6.68*10^-27
    //mass of alpha particle
6
7 E=1.6*10^-16
    //energy asociated with alpha particle
8
9 wavelength=h/sqrt(2*m*E)
10
11 printf("\nThe de Broglie wavelength of an alpha
    particle\n")
12
13 disp(wavelength)
14
15 printf(" meter\n")
16
17 v=h/(m*wavelength)
    //velocity of an alpha particle
18
19 printf("\nThe velocity of an alpha particle v = %.2
    f m/s\n",v)

```

Scilab code Exa 5.3.13 find the de Broglie wavelengths of photon and electron

```

1 //Chapter -5, Example5_3_13 , pg 5-12
2
3 h=6.63*10^-34
    //Plancks constant
4
5 c=3*10^8

```

```

        //velocity of light in air
6
7 E=1.6*10^-19

        //energy of photon
8
9 wavelength_ph=h*c/E

        //The energy of photon is E=h*c/lamph
10
11 printf("\nThe de Broglie wavelength of a photon\n")
12
13 disp(wavelength_ph)
14
15 printf("meter\n")
16
17 m=9.1*10^-31

        //mass of an electron
18
19 wavelength_e=h/sqrt(2*m*E)
20
21
22 printf("\nThe de Broglie wavelength of an electron\n
        ")
23
24 disp(wavelength_e)
25
26 printf("meter\n")

```

Scilab code Exa 5.3.14 find the de Broglie wavelength of an electron

```

1 //Chapter -5, Example5_3_14 , pg 5-13
2
3 h=6.63*10^-34

```

```

4      //Plancks constant
5  m_0=9.1*10^-31

      //rest mass of electron
6
7  c=3*10^8

      //velocity of light in air
8
9  E=m_0*c^2

      //kinetic energy associated with
10
11 wavelength=h/sqrt(2*m_0*E)                                     //The
      de broglie wavelength of an electron
12
13 printf("\nThe de Broglie wavelength of an electron\n
      ")
14
15 disp(wavelength)
16
17 printf("meter\n")

```

Scilab code Exa 5.7.1 find the accuracy in position of an electron

```

1 //Chapter -5, Example5_7_1 , pg 5-26
2
3 unc=1*10^-4
      // as
      uncertainty is 0.01%
4
5 m=9.1*10^-31

```

```

//mass of
    an electron
6
7 h=6.63*10^-34
//Plancks
    constant
8
9 v=400
//
    speed of an electron
10
11 delta_v=unc*v
//
    error in measurement of speed
12
13 delta_x=h/(4*pi*m*delta_v)
//By
    Heisenberg's uncertainty principle
14
15 printf("\nThe accuracy in position of an electron
    Delta_x = %.5f m\n",delta_x)

```

Scilab code Exa 5.7.2 calculate the percentage of uncertainty

```

1 //Chapter -5,Example5_7_2 ,pg 5-27
2
3 delta_x=10*10^-9
//
    position is located within this distance
4
5 h=6.63*10^-34
//
    plancks constant
6
7 delta_px=h/(4*pi*delta_x)

```



```

8                                     //By
    Heisenberg's uncertainty principle
9 E=1.6*10^-16
                                     //
    Energy associated with an electron
10
11 m=9.1*10^-31
                                     //mass
    of an electron
12
13 p=sqrt(2*m*E)
                                     //
    momentum of an electron
14
15 percentage=delta_px*100/p
                                     //
    percentage uncertainty in momentum
16
17 printf("\npercentage uncertainty in momentum of an
    electron = %.4f \n",percentage)

```

Scilab code Exa 5.7.3 find the accuracy in position of an electron

```

1 //Chapter -5,Example5_7_3 ,pg 5-27
2
3
4 uncertainty=1*10^-4
                                     //as
    uncertainty is 0.01%
5
6 m=9.1*10^-31
                                     //mass of
    an electron
7

```

```

8 h=6.63*10^-34                                     //Plancks
    constant
9
10 v=4*10^5                                         //
    speed of an electron
11
12 delta_v=uncertainty*v                             //
    error in measurement of speed
13
14 delta_x=h/(4*%pi*m*delta_v)                       //By
    Heisenberg 's uncertainty priciple
15
16 printf("\nThe accuracy in position of an electron
    Delta_x = %.8f m\n",delta_x)

```

Scilab code Exa 5.7.4 find the accuracy in position of an electron

```

1 //Chapter -5,Example5_7_4 ,pg 5-27
2
3 uncertainty=1*10^-2                                 // as
    uncertainty is 1%
4
5 m=9.1*10^-31                                       //mass of
    an electron
6
7 h=6.63*10^-34                                     //Plancks
    constant
8

```

```

9 v=1.88*10^6                                     //speed
    of an electron
10
11 delta_v=uncertainty*v                           //
    error in measurement of speed
12
13 delta_x=h/(4*%pi*m*delta_v)                    //By
    Heisenberg's uncertainty principle
14
15 printf("\nThe accuracy in position of an electron
    Delta_x =\n")
16
17 disp(delta_x)
18
19 printf("meter\n")

```

Scilab code Exa 5.7.5 calculate the minimum time spent by the electrons

```

1 //Chapter -5, Example5_7_5 ,pg 5-28
2
3 //By Heisenberg's uncertainty principle
4
5 //(delta_E*delta_t)>=h/(4*%pi)
6
7 //therefore (h*c*delta_wavelength*delta_t/
    wavelength^2) >= h/(4*%pi)
8
9 wavelength=4*10^-7
    //wavelength of spectral line
10
11 c=3*10^8

```

```

12         //velocity of light in air
13 delta_wavelength=8*10^-15

14         //width of spectral line
15 delta_t=wavelength^2/(4*%pi*c*delta_wavelength)
16
17 printf("\nThe minimum time required by the electrons
18         in upper energy state Delta_t = \n")
19 disp(delta_t)
20
21 printf("sec\n")

```

Scilab code Exa 5.7.6 calculate the uncertainty in energy

```

1 //Chapter -5, Example 5-7-6 , pg 5-29
2
3 h=6.63*10^-34

4         //Plancks constant
5 e=1.6*10^-19

6         //charge of an electron
7 delta_t=1.4*10^-10

8         //time spent in excited state
9 delta_E=h/(4*%pi*delta_t*e)

10        //By Heisenberg's uncertainty principle (delta_E*

```

```

    delta_t >= h/(4*%pi)
10
11 printf("\nThe uncertainty in energy of Iridium in
    the excited state Delta_E = %.8f eV\n",delta_E)

```

Scilab code Exa 5.7.7 find the time spent by an atom in excited state

```

1 //Chapter -5,Example5_7_7 ,pg 5-29
2
3 //By Heisenberg 's uncertainty principle
4
5 //(delta_E*delta_t)>=h/(4*%pi)
6
7 //therefore (h*c*delta_wavelength*delta_t/
    wavelength ^2) >= h/(4*%pi)
8
9 wavelength=546*10^-9
    //wavelength of spectral line
10
11 c=3*10^8
    //velocity of light in air
12
13 delta_wavelength=10^-14
    //width of spectral line
14
15 delta_t=wavelength^2/(4*%pi*c*delta_wavelength)
16
17 printf("\nThe time spent by an atom in the excited
    state \n")
18
19 disp(delta_t)
20

```

```
21 printf("sec\n")
```

Scilab code Exa 5.15.1 find the energy of an electron for different states

```
1 //Chapter -5, Example5_15_1 , pg 5-41
2
3 //En=(n^2*h^2)/(8*m*e*L^2)           n = 1 , 2 , 3 , ....
4
5 e=1.6*10^-19
        //charge of an electron
6
7 h=6.63*10^-34                               //
        Plancks constant
8
9 m=9.1*10^-31
        //mass of an electron
10
11 L=2*10^-10
        //width
12
13 E1=h^2/(8*m*e*L^2)                               //For
        ground state n=1
14
15 printf("\nThe energy of an electron in ground state
        E1 = %.2f eV\n", E1)
16
17 E2=4*E1
        //For first excited state n=2
18
```

```

19 printf("\nThe energy of an electron in ground state
      E2 = %.2f eV\n", E2)
20
21 E3=9*E1

      //For second excited state n=3
22
23 printf("\nThe energy of an electron in ground state
      E3 = %.2f eV\n", E3)

```

Scilab code Exa 5.15.2 find the ground state energy of an electron

```

1 //Chapter -5, Example5_15_2 , pg 5-42
2
3 //En=(n^2*h^2)/(8*m*e*L^2)           n=1,2,3,....
4
5 //as width 'L' gets double ,the ground state energy
  becomes one-fourth
6
7 E=5.6*10^-3

      //Ground state energy of an electron
8
9 E_new=E/4

      //width is doubled
10
11 printf("\nThe new energy of an electron in ground
      state  E = %.4f\n", E_new)

```

Scilab code Exa 5.15.3 calculate the probability of finding the particle

```

1 //Chapter -5, Example5_15_3 , pg 5_42

```

```

2
3 //for box of width a , the normalised eigen
   functions are
4
5 //   'sci = sqrt(2/a)*sin(n*%pi*x/a)'
6
7 //   'sci_c = sqrt(2/a)*sin(n*%pi*x/a)'           complex
   conjugate
8
9 //for first excitation
10
11 n=2
12
13 //probability of finding the particle is           P =
   integral a/4 to 3a/4 of sci * sci_c
14
15 //as 'a' is constant width
16 //assume
17 a=1
18
19 function y=f(x),y= (2/a)*(sin(n*%pi*x/a))^2,
   // y = sci * sci_c
20 endfunction
21
22 P=intg(a/4,3*a/4,f)
23
24 printf('\nThe probability of finding the particle is
   P = %.1f',P)

```

Scilab code Exa 5.15.4 find the probability of finding the particle

```

1 //Chapter -5,Example5_15_4 ,pg 5_43
2
3 //probability of finding the particle is           P =
   integral x1 to x2 of sci * sci_c

```



```

4
5 //interval is (0,1/2)
6
7 x1=0
8
9 x2=1/2
10
11 //sci= x*sqrt(3)
12
13 //complex conjugate is   sci_c = x*sqtr(3)
14
15 function y=f(x),y=(x*sqrt(3))^2,
    // y = sci * sci_c
16 endfunction
17
18 P=intg(x1,x2,f)
19
20 printf('\n\nThe probability of finding the particle is
    P = %.3f ',P)

```

Scilab code Exa 5.15.5 find the lowest energy states

```

1 //Chapter -5,Example5_15_5 ,pg 5-44
2
3 //for an electron
4
5 e=1.6*10^-19 //
    electron charge
6
7 m_e=9.1*10^-31 //mass
    of an electron
8
9 L=10^-9 //width
    of well
10

```

```

11 h=6.63*10^-34 //Plank
    's constant
12
13 //the energy level are given by  $E_n = n^2 * h^2 / (8 * m$ 
     $* L^2)$ 
14
15 Ee1=(1^2)*(h^2)/(8*m_e*e*(L^2)) //for n = 1
16
17 Ee2=(2^2)*(h^2)/(8*m_e*e*(L^2)) //for n = 2
18
19 Ee3=(3^2)*(h^2)/(8*m_e*e*(L^2)) //for n = 3
20
21 printf('\n FOR AN ELECTRON')
22 printf('\n the lowest three energy states are
    obtained ')
23 printf('\n for n = 1 Ee1 = %.4f eV',Ee1)
24 printf('\n for n = 2 Ee2 = %.4f eV',Ee2)
25 printf('\n for n = 3 Ee3 = %.4f eV',Ee3)
26
27
28 //for the grain of dust
29
30 m=10^-9 //mass of
    grain of dust
31
32 l=10^-4 //width of
    well
33
34 E1=(1^2)*(h^2)/(8*m*e*(l^2)) //for n = 1
35
36 E2=(2^2)*(h^2)/(8*m*e*(l^2)) //for n = 2
37
38 E3=(3^2)*(h^2)/(8*m*e*(l^2))

```

```

//for n = 3
39
40 printf('\n\n FOR THE GRAIN OF DUST ')
41 printf('\n the lowest three energy states are
    obtained ')
42 printf('\n for n = 1 E1 = ')
43 disp(E1)
44 printf(' eV')
45 printf('\n for n = 2 E2 = ')
46 disp(E2)
47 printf(' eV')
48 printf('\n for n = 3 E3 = ')
49 disp(E3)
50 printf(' eV')

```

Scilab code Exa 5.15.6 calculate the width of the well

```

1 //Chapter -5,Example5_15_6 ,pg 1-45
2
3 E=38

    //potential energy
4
5 e=1.6*10^-19

    //charge of an electron
6
7 h=6.63*10^-34

    //Plancks constant
8
9 m=9.1*10^-31

    //mass of an electron
10

```

```

11 //the lowest energy of an electron for n=1 is      E=h
        ^2/(8*m*e*L^2)
12
13 L=sqrt(h^2/(8*m*e*E))
                                //
        width of the well
14
15 printf("\nThe width of the well is  L =\n")
16
17 disp(L)
18
19 printf("meter\n")

```

Scilab code Exa 5.15.7 calculate the energy and wavelength of the emitted photon

```

1 //Chapter -5,Example5_15_7 ,pg 1-45
2
3 e=1.6*10^-19
        //charge of an electron
4
5 h=6.63*10^-34
        //Plancks constant
6
7 m=9.1*10^-31
        //mass of an electron
8
9 c=3*10^8
        //speed of light in air
10
11 //The energy eigen values are given by      E=(h^2*n

```

```

    ^2)/(8*m*e*L^2)
12
13 L=5*10^-10

    //width of potential well
14
15 //as electron makes a transittion from its n=2 to n
    =1 energy level
16
17 E1=(1*h^2)/(8*m*e*L^2)
                                     //
    for n=1
18
19 E2=(4*h^2)/(8*m*e*L^2)
                                     //
    for n=2
20
21 E=E2-E1

    //The energy of emitted photon
22
23 printf("\nThe energy of emitted photon is E2-E1 = %
    .2f eV\n",E)
24
25 //The energy of photon in terms of wavelength is (h*
    c)/lam
26
27 wavelength=(h*c)/(E*e)
28
29 printf("\nThe wavelength of emitted photon is = %.9f
    m\n",wavelength)

```

Chapter 6

Motion of Charged Particle in Electric and Magnetic Fields

Scilab code Exa 6.1.1 calculate radius of revolution and distance covered

```
1 //Chapter -6,Example6_1_1 ,pg 6-6
2
3 m=9.1*10^-31 //
   mass of an electron in kg
4
5 v=2.5*10^6 //
   velocity of an electron
6
7 B=0.94*10^-4 //
   strength of uniform magnetic field
8
9 e=1.6*10^-19 //
   charge of an electron
10
11 angle=30
   //angle between velocity vector and field
   direction
12
13 r=m*v*sind(angle)/(B*e)*10^3 //radius
```

```

    of revolution
14
15 printf("\nradius of revolution  r = %.2f mm \n",r)
16
17 l=5*v*cosd(angle)*2*%pi*m/(B*e)           //
    distance coverd in five revolutions
18
19 printf("distance coverd in five revolutions  5l =%.3
    f m",l)

```

Scilab code Exa 6.1.2 calculate radius and pitch

```

1 //Chapter -6,Example6_1_2 ,pg 6-7
2
3 m=9.1*10^-31                               //
    mass of an electron in kg
4
5 v=3*10^7                                   //
    velocity of an electron
6
7 B=0.23                                     //
    strength of uniform magnetic field
8
9 e=1.6*10^-19                               //
    charge of an electron
10
11 angle=45                                  //
    angle between velocity vector and field direction
12
13 r=m*v*sind(angle)/(B*e)*10^3              //radius
    of revolution
14
15 printf("\nradius of revolution  r = %.3f mm\n",r)
16
17 l=v*cosd(angle)*2*%pi*m/(B*e)*10^3       //pitch

```

```

    f helical path
18
19 printf("pitch of helical path l = %.1f mm\n",l)

```

Scilab code Exa 6.1.3 find the input voltage

```

1 //Chapter -6,Example6_1_3 ,pg 6-7
2
3 y=1.5 //deflection
    in the beam
4
5 d=0.42 //distance
    between two plates
6
7 D=28 //distance of
    screen from center of plates
8
9 l=1.8 //length of
    plates
10
11 Va=1.6*10^3 //anode
    voltage
12
13 V=2*y*d*Va/(D*l)
14
15 Vin=V/6 //as
    amplifier gain is 60
16
17 printf("\nappplied voltage is Vin = %.2f V\n",Vin)

```

Scilab code Exa 6.5.1 calculate phase change

```

1 //Chapter -6,Example6_5_1 ,pg 6-16

```



```
2
3 dA=0.8 //minor
   axis
4
5 dB=2 //major
   axis
6
7 phase_shift=asind(dA/dB) //phase
   calculation
8
9 printf("\n phase shift = %.2f Degrees\n",phase_shift
   )
```

Chapter 7

Superconductivity

Scilab code Exa 7.3.1 calculate critical temperature of element

```
1 //Chapter -7,Example7_3_1 ,pg 7-6
2
3 Ho=2*10^5 //
   critical field at absolute zero
4
5 Hc=1*10^5 //
   critical field at given temperature
6
7 T=8 //
   temperature
8
9 Tc=T/sqrt(1-(Hc/Ho))
10
11 printf("\ncritical temperature of the element Tc = %
   .2f Kelvin" ,Tc)
```

Scilab code Exa 7.3.2 find the critical field

```

1 //Chapter -7,Example7_3_2 ,pg 7-7
2
3 Bo=3.06*10^-2 //
   critical field at absolute zero
4
5 Tc=3.7 //
   critical temperature
6
7 T=2 //
   temperature
8
9 Bc=Bo*(1-(T/Tc)^2)
10
11 printf("\ncritical field of wire Bc = %.5f T",Bc)

```

Scilab code Exa 7.3.3 calculate the critical current

```

1 //Chapter -7,Example7_3_3 ,pg 7-7
2
3 Ho=6.5*10^4 //
   critical field at absolute zero
4
5 Tc=7.18 //
   critical temperature
6
7 T=4.2 //
   temperature
8
9 r=0.5*10^-3 //
   radius of lead wire
10
11 Hc=Ho*(1-(T/Tc)^2)
12
13 Ic=2*pi*r*Hc
14

```

```
15 printf("\ncritical current for wire Ic = %.2f
    Amperes\n",Ic)
```

Scilab code Exa 7.3.4 calculate the isotopic mass

```
1 //Chapter -7,Example7_3_4 ,pg 7-8
2
3 Tc1=4.185 //critical
    temperature 1
4
5 Tc2=4.133 //critical
    temperature 2
6
7 M1=199.5 //isotopic mass
    of a metal at temperature T1
8
9 a=0.5
10
11 M2=(Tc1*sqrt(M1)/Tc2)^2
12
13 printf("\nisotopic mass is M2 = %.2f",M2)
```
