

## **Instrumental and applied pharmaceutical analysis (1)**

### **1-Basic Information**

<b>Code</b>	: PA-313
<b>Level</b>	: Second level (third year pharmacy)
<b>Department:</b>	Pharmaceutical Analytical Chemistry
<b>Unit</b>	: 2 + 1=3 (hrs)
<b>Lecture</b>	: 2 hrs. /week
<b>Tutorial</b>	: (within practical classes)
<b>Practical</b>	: 1 hrs/week
<b>Total</b>	: 3 units / week

### **2- Aims of Course**

- To provide an overview of spectroscopic and electrochemical techniques appropriate for the modern chemical analysis laboratory.
- To develop a basic knowledge of potentiometry, conductometry, voltametry as analytical techniques.
- To develop a basic knowledge of spectrophotometry, spectrofluorimetry and atomic spectrometric analytical techniques.

### **3- Intended Learning Outcomes of the Course (ILOs)**

After successful finishing the course, students should be able to

#### **a- Knowledge and understanding:**

a1- demonstrate and understanding the basic principles spectroscopic and electrochemical analytical methods.

a3- explain different spectroscopic and electrochemical methods and the need for their use in pharmaceutical analysis.

a6- give knowledge about applications of spectroscopic and electrochemical methods for pharmaceutical analysis.

#### **2-Intellectual skill:**

b4- choose appropriate spectroscopic methods for the analysis of a material of pharmaceutical relevance.

b14 - evaluate the validity of the electrochemical and spectrometric methods in the analysis of target compound in complex matrices.

#### **c-Professional and practical skills:**

C2- interpret spectra, identification and quantitation of pharmaceutical compounds.

C7- use pH meter, potentiometer, conductmeter, spectrophotometer, spectrofluorometer and flame photometer in the identification and quantitation of pharmaceutical compounds.

**d-General and transferable skills:**

d1- validate and manipulate given spectra, potentiometric titration curves, conductometric titration curves, and voltograms.

d9-Participate in a research team or any analytical group for the development of analytical method for analysis of pharmaceutical compounds by spectrophotometric or electrochemical methods

d12- solve analytical problems in spectrophotometry, potentiometry, conductometry and voltametry

**4- Course Contents**

Topic	No. of hours	Lecture	Tutorial / Practical
1. Potentiometry	8	6	2
2. Conductometry	3	2	1
3. Voltametry	3	2	1
4. Spectrophotometry theory	6	4	2
5. Spectrophotometry applications	6	4	2
6. Spectrofluorimetry	5	2	2
7. Flame Emission, Atomic Absorption and Atomic Fluorescence Spectroscopy	8	6	2

**5-Teaching and learning methods:**

- 1- Lectures using Power Point and data show
- 2- demonstration videos
- 3- The black and white board.
- 4- The transparent sheets.
- 5- The discussion groups.
- 6- Practical sessions
- 7- Write report

**6-Teaching and learning methods for disables:**

Office hours and specialist workers help them in the laboratory

**7-Student assessment**

**a- Student assessment methods**

- 1- Written exam to assess their understanding of the scientific background
- 2- Oral exam to assess the skills of analyses and discussion.
- 3- Practical exam to assess their analytical professional skills.
- 4- Assignments to assess the ability to work in group.

**b- Assessment schedule:**

Week	Test	No.
6	First assignment	1.
8	Mid-term exam	2.
13	Practical exam.	3.
13	Sheet exam (Practical ).	4.
15	Final exam.	5.
15	Oral exam.	6.

**c-Weighing of assessment:**

%	Mark	Exam.
10	15	Mid-term exam
30	45	Practical exam.
13.3	20	Oral exam
46.7	70	Final exam.
100%	150	Total

**8- List of references:****a- Course notes**

Lecture notes prepared by staff members of pharmaceutical analytical chemistry department, 2009-2010.

**b- Essential books (Text books):**

- 1- Christian G.D., Analytical Chemistry, 5<sup>th</sup> Ed., John-Wiley and sons, Inc New york (1994).
- 2- " Principles of instrumental analysis 6<sup>th</sup> Ed., D.A. skoog, F.J. holler & S.R. Crouch, (2007).
- 3- "Modern Chemical Analysis and Instrumentation " , H. F. Walton & J. Reyes, (1980).
4. "Standard Methods of Chemical Analysis", 6<sup>th</sup> Ed., volume 3, part A, F. J. Welcher, D. Van Nostrand Company, Inc., Princeton,

5. "Quantitative Analysis", 4<sup>th</sup>. Ed., Prentice-Hall, R. A. Day and Jr./A. L. Underwood, Inc., Newjersey, 1980,
6. "Vogel's Textbook of Quantitative Chemical Analysis", 5<sup>th</sup>. Ed. J. Bassell, R. C. Denney, G. H. Jeffery and J. Menham,

**c- Recommended books**

- 1- "Quantitative Analytical Chemistry", 4<sup>th</sup>. Ed. Allyn and Bacon, Inc., . J. S. Fritz and G. H. Schenk, Boston, 1979,
2. "Instrumental Methods of Chemical Analysis", 5<sup>th</sup>. Ed., G. W. Ewing, McGraw-Hill book Company, New York, 1985,
3. "Instrumental Methods of Analysis", 6<sup>th</sup>. Ed., H. H. Willard, L. L. Merritt, J. A. Dean and F. A. Settle,D. Van Nostrand Co., New York, 1981,
4. "Atomic Absorption Catalogue", T. C. Dymott, Pye Unicam Ltd., 2<sup>nd</sup>. Ed., 1981.
5. Principles and Practice of Analytical Chemistry". F. W. Fifield and D. Kealey, " International Textbook Co. Ltd., 1975,
6. "Chemistry Experiments for Experimental Methods", D. T. Sawyer, W. R. Heineman and J. M. Beebe, John Wiley & Sons, Newyork, 1984,

**d-Periodicals, Web sites..etc**

- 1- J.Pharm. Biomed. Anal.
- 2- J.Assoc off.anal.Chem.
- 3-. Anal. Chem
- 4-. Talanta
5. <http://www.britannica.com/EBchecked/topic/183000/electrochemical-analysis>
- 6- <http://www.chm.davidson.edu/vce/Spectrophotometry/index.html>

**Matrix of the Intended Learning Outcomes (ILOs) of the Course**

Week	Topic		Knowledge and Understanding	Intellectual Skills	Professional and Practical Skills	General and Transferable Skills
	Theoretical	Practical				
1	Introduction of potentiometry	Introduction to Instrumental analysis	a1, a3, a6	b14	C7	d9, d12
2	Types of electrode	Potentiometric titration of weak acid and weak base, Determination of ammonium iron (II) sulphate	a1, a3, a6	b14	C7	d9, d12
3	Applications of potentiometry	Conductometric titration of strong acid with strong base, Conductometric titration of mixture of weak acid and strong acid with weak base	a1, a3, a6	b14	C7	d9, d12
4	Conductometry theory and applications	Construction of polarogram of Cd, Determination of Pb in solution	a1, a3, a6	b14	C7	d9, d12
5	Voltametry theory and applications	Determination of copper via amine complex formation using standard series method Absorption Spectrum of KMnO <sub>4</sub>	a1, a3, a6	b14	C7	d1, d9, d12
6	Spectrophotometry theory	Effect of pH upon the Absorption Curve of Sulphanilamide, Effect of pH upon the Absorption Spectrum of thymol Blue	a1, a3, a6	b4, b14	C2, C7	d1, d9, d12

Week	Topic		Knowledge and Understanding	Intellectual Skills	Professional and Practical Skills	General and Transferable Skills
	Theoretical	Practical				
7	Spectrophotometry theory	Determination of the Molar Ratio of Iron Thiocyanate Complex Determination of pKa of Methyl Orange	a1, a3, a6	b4, b14	C2, C7	d1, d9, d12
8	Instrumentation of spectrophotometry	Fluorimetric determination of Quinine Sulphate, Fluorimetric determination of iodide by quenching of Quinine Fluorescence	a1, a3, a6	b4, b14	C2, C7	d1, d9, d12
9	Applications of spectrophotometry	Comparison between phenolphthalein, eosin and Fluorescein Fluorescence	a1, a3, a6	b4, b14	C2, C7	d1, d9, d12
10	Spectrofluorometry theory and applications	Comparison between native Fluorescence of cyclohexane, benzene, benzoic acid , naphthaline and anthracene	a1, a3, a6	b4, b14	C2, C7	d1, d9
11	Flame Emission	-Determination of NaCl-KCl mixture	a1, a3, a6	b4, b14	C2, C7	d1, d9, d12
12	Atomic Absorption	-Discussion- Sketch for a diagram of AAS	a1, a3, a6	b4, b14	C2, C7	d1, d9, d12
13	Atomic Fluorescence Spectroscopy	Practical Examination	a1, a3, a6	b4, b14	C2, C7	d1, d9, d12

## Instrumental and applied pharmaceutical analysis (2)

### 1-Basic Information

<b>Code</b>	: PA-324
<b>Level</b>	: Second level (third year pharmacy)
<b>Department:</b>	Pharmaceutical Analytical Chemistry
<b>Unit</b>	: 2+ 1=3 hrs
<b>Lecture</b>	: 2hrs/week (2x13 = 26)
<b>Tutorial</b>	: (within practical classes)
<b>Practical</b>	: 1x13=13
<b>Total</b>	: 39 hrs

### 2- Aims of Course

- To Explain the theoretical aspects and parameters of chromatography
- To explain principle and application of different chromatographic techniques as high performance liquid chromatography (HPLC), gas chromatography(GC), thin layer chromatography(TLC) , and electrophoresis as separative and analytical techniques.
- To develop a basic knowledge about types of water, guidelines of drinking water , source of water pollution and water quality control procedures
- To develop a basic knowledge about oils and fats, and analytical methods used for testing rancidity, adulteration and analysis of oils and fats .

### 3- Intended Learning Outcomes of the Course (ILOs)

After successful finishing the course, students should be able to:

#### a- Knowledge and Understanding:

- a1: Demonstrate a comprehensive knowledge and clear understanding of the basic principles of different chromatographic techniques, guidelines for drinking water , water quality control and analysis of oils and fats.
- a3 Explain principles of various instruments as HPLC,, GC, electrophoresis for the analysis of pharmaceutical compounds.
- a6 Give appropriate knowledge concerning application of chromatographic techniques as open column chromatography, TLC, and HPLC. for the qualitative and quantitative analysis of a single pharmaceutical and or mixed compound (s) , as well as application of different analytical procedures for the quality control of water and oils and fats.

#### b- Intellectual Skills:

At the end of the course student should be able to:

- b4 Apply column chromatography and TLC technique for the identification and separation of a given compound as well as mixture of compounds
- b4 Select and apply the suitable HPLC method for the analysis of a given pharmaceutical compound.
- b4 Apply analytical method for the analysis of water.
- b4 Apply analytical method for detection adulteration, and analysis of oils and fats.
- b14 Assess water pollution and adulteration of oils and fats by different analytical procedures and interpretation of analytical results.

### **c- Professional and practical Skills:**

At the end of the course the student should be able to:

- C2 Use and apply different chromatographic tools and apparatus as as column, TLC plate, and HPLC instrument for the separation, identification and analysis of a given pharmaceutical compound as well as mixture of compounds.
- C2 Use and apply different laboratory procedures and techniques for the analysis of water and oils & fats.
- C7 Handle and dispose chemicals and pharmaceutical preparations.

### **d- General and Transferable Skills:**

By the end of the course the student should be able to:

- d1 Apply information technology including data base use, spreadsheet use and information data through computer and internet searches
- d9 Participate in a research team or any analytical group for :
- The separation, identification and analysis of different sample components using Column and TLC.
  - The quality control of water.
  - Detection of adulteration, rancidity, as well as analysis of oils and fats.
- d12 Manage his or her time effectively.
- d13 Solve analytical problem in water analysis, & testing adulteration of oils and fats.

## **4- Course Contents**

Topic	No. of hours	Lecture	Tutorial / Practical
1- Theoretical aspects of chromatography.	7	5	2
2- Principle and application of of different chromatographic techniques as high performance liquid chromatography, gas chromatography, thin layer chromatography, and electrophoresis as separative and analytical techniques.	7	5	2



3- Water pollution and water quality control procedures	12	8	4
4-Analysis of oils and fats and testing adulteration.	11	8	3

## 5- Teaching and Learning Methods

- 1- Data show
- 2- Black and white board
- 3- Laboratory experiments
- 4- Tutorial discussions

## 6- Teaching and learning methods for disables

No disable students.

## 7- Student Assessment

### a- Student Assessment methods

- 1- Written periodic exam
- 2- Practical exam
- 3- Practical sheet exam
- 4- Essay
- 5- Final exam

### b- Student Assessment Schedule

No.	Assessment	week
1.	Periodic exam.	13
2.	Practical sheet exam	13
3	Practical exam.	10
4.	Final exam.	15
5.	Oral exam.	15

### c- Weighting of Assessments

No.	Exam.	Mark	%
1.	Periodic exam.	15	10
2.	Final exam.	70	46.7
3.	Oral exam.	20	13.33
4.	Practical exam.	10	6.66
5.	Practical sheet	22	14.7
6-	Semester work	13	8.66
	Total	150	100%

## 8- List of References

### a- Course notes ;

Lecture notes and practical notes prepared by staff members of Pharm. Anal. Chem. Dept.

### b- Essential Books (Text Books)

- 1- "Analytical Chemistry ", Christian G. D., John-Wiley and Sons, Inc New York (1994).
- 2- Principles of instrumental analysis" D. A. Skoog, F.J. Holler and S.R. Crouch , 6<sup>th</sup> edn., Canada, (2007).
- 3- "Properties of water & water quality" R.Christian Jones; George Mason University, (2008).
- 3- " Oils , Fats , Waxes and Surfactants" F.E.Mohamed and M.M.Amer, Anglo-Egyptian Bookshop, Cairo, (1965).

### **c-Recommended Books**

- 1- "Introduction to high performance liquid chromatography"  
R.J.Hamilton and P.A. Sewell, Liverpool polytechnic, London, John Willey & sons, New York, (1999).
- 2- "Troubleshooting HPLC systems", A bench manual, P.C., Sadek, Ph.D, John Willey & sons, Inc. (2000).
- 3- " Handbook of water analysis" 2<sup>nd</sup> ed., edited by Leo M., L.Nollet, CRC press, (2007).
- 4- "Methods in food analysis" 2<sup>nd</sup> ed., Academic Press, London, (1976).

### **d- Periodicals, Web Sites, etc**

- 1- J. Pharm. & Biomed. Anal.
- 2- J. Assoc. off Anal. Chem.
- 3- J. water Research.

### Matrix of the Intended Learning Outcomes (ILOs) of the Course

Week	Topic		K&U	IS	PPS*	GTS*
	Theoretical	Practical				
1	1- Chromatography Principle of chromatography Classification of chromatographic methods	Chromatography: Column chromatography: Quantitative separation of a mixture of potassium permanganate and potassium dichromate	a1	b4	C2, C7	d1,d9,d12
2	1-Chromatography : Classification of chromatographic methods (cont.) Parameters of chromatography	Chromatography Quantitative thin layer chromatographic determination of phenol red , bromophenol blue mixture	a1,	b4	C2, C7	d1,d9,d12
3	1-Chromatography -Parameters of chromatography (cont.) -Techniques of chromatography: - Open column chromatography -Paper and thin layer chromatography	Chromatography Gas liquid chromatography High performanceliquid chromatography Manual dealing with an HPLC chromatogram	a1, a3, a 6	b4	C2	d1,d9,d12
4	1-Chromatography - Gas chromatography High pressure liquid chromaography	Chromatography Tutorial class discussion and Problems on chromatography	a3 a6	b4	—	d1, d12,d13
5	1-Chromatography -Super critical fluid chromatography -Electrophoresis	Water analysis: - -Physical examination -Chemical examination: Acidity, Alkalinity, Chloride	a1, a3	b4, b14	C2, C7	d1,d9,d12

Week	Topic		K&U	IS	PPS*	GTS*
	Theoretical	Practical				
	-Quantitative chromatographic methods		a6			
6	2-Water quality control: - Types of water applied in pharmacy. Water sources -Water treatment.,	Water analysis: *Determination of water hardness by four methods	a1	b4, b14-	C2	d1,d9,d12
7	2-Water quality control: -Physical examination. -Chemical examination:	Water analysis: - Tutorial class discussion	a1, a6	b4, b14-	C2	d1,d9,d12
8	-2-Water quality control: -Chemical examination (cont.)	Water analysis: Free and saline ammonia -Determination of <del>nitrite</del> -Determination of nitrate -Chemical oxygen demand(C.O.D)	a1, a6	b4, b14-	C2	d1,d9,d12
9	2-Water quality control: - Chemical examination (cont.) - Corrosion and plumbosolvency	Water analysis: -Residual chlorine -Metals - Report on water	a1, a6	b4, b14-	C2	d1,d9,d12,d13
10	3-Analysis of Oils and Fats:- Classification of lipids -Structure & composition of fats & oils.-Fatty acids.	Practical exam.	a1	b4, b14-	C2	d12
11	3-Analysis of Oils and Fats: -Nonglyceride components of fats & oils.	Analysis of oils and Fats -Physical examination:	a1	b4, b14-	C2	d1,d9,d12

Week	Topic		K&U	IS	PPS*	GTS*
	Theoretical	Practical				
	-Industrial preparation. -Oils and <b>fats</b> from animal sources -Manufacture of margarine	*Examination of colour, odour and taste. *Determination of specific gravity *Determination of refractive index *Colour tests				
12	3-Analysis of Oils and Fats: -Hydrogenation -Rancidity -Physical properties -Chemical properties	Analysis of ols and Fats -Chemical examination: *Determination of acid value *Determination of saponification value	a1	b4, b14-	C2	d1,d9,d12
13	3-Analysis of Oils and Fats: -Chemical properties (cont.). -Colour tests of oils. -Detection of hydrogenated oils. -Detection of adulteration in <b>fats</b> and oils.	Analysis of oils and Fats -Chemical examination: *Determination of iodine value by bromine/dioxane *Determination of peroxide value *Report on oils and <b>fats</b>	a1	b4, b14-	C2	d1,d9,d12, d13

\*PPS & GTS are evaluated by practical work