



## Course Specification of Pharmaceutical Analytical Chemistry I

### I. Course Identification and General Information:

1	<b>Course Title</b>	Pharmaceutical Analytical Chemistry I				
2	<b>Course Number &amp; Code:</b>	Ph534				
3	<b>Credit hours:</b>	<b>C.H</b>				<b>Total</b>
		<b>Th.</b>	<b>Pr.</b>	<b>Tr.</b>	<b>Seminar.</b>	
		2	2			3
4	<b>Study level/ semester at which this course is offered:</b>	2 <sup>nd</sup> level / 1 <sup>st</sup> semester				
5	<b>Pre –requisite (if any):</b>	General Pharmaceutical Chemistry				
6	<b>Co –requisite (if any):</b>					
7	<b>Program (s) in which the course is offered:</b>	Bachelor of Pharmacy				
8	<b>Language of teaching the course:</b>	English				
9	<b>The department in which the course is offered:</b>	Department of Medicinal Chemistry, Pharmaceutical Organic and Analytical Chemistry				
10	<b>Location of teaching the course:</b>	Faculty of Pharmacy				
11	<b>Prepared by:</b>	Dr. Yahya AL-Dokhain, Dr. Mohammed Hamid-Addeen				



12	Date of approval:	
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## II. Course description:

The course is concerned with the fundamental knowledge about the basic principles of the quantitative chemical analysis including, acid-base reactions, redox reaction, complexometric and precipitometric analysis. The course will also cover the applications of these methods to pharmaceutical compounds.

## III. Intended learning outcomes (ILOs) of the course:

**At the end of this course the students should be able to:**

1. Recognize the basic principle of pharmaceutical analytical chemistry and its classification.
2. Describe the important terminology used in pharmaceutical analysis.
3. Recognize different method of quantitative analysis of drugs in different pharmaceutical preparations and mention their advantage and disadvantages.
4. Identify the required calculations that are used in drugs analysis.
5. Select the suitable method for determination of different pharmaceutical preparations depending on the chemical nature of the drugs.
6. Diagram the schemes that explain different method of quantitative analysis.
7. Determine the functional groups that affect on acidity and basicity of pharmaceutical compounds and predict the pH of the compounds.
8. Operate different pharmaceutical instrument and equipment in the lab.
9. Practice the qualitative and quantitative estimation of pharmaceutical substances.
10. Handle and dispose the chemical and pharmaceutical preparations safely and effectively.
11. Communicate and cooperate effectively with the others as a team work to perform the report on the results of the method of analysis.
12. Apply the information technology skills, such as word processing and internet communication and online searches.
13. Manage the time in an work effectively.



IV. Intended learning outcomes (ILOs) of the course:			
(A) Knowledge and Understanding:			
Alignment Course Intended Learning Outcomes (CILOs) to Program Intended Learning Outcomes (PILOs) in: Knowledge and Understanding.			
Program Intended Learning Outcomes (Sub-PILOs) in: Knowledge and Understanding		Course Intended Learning Outcomes (CILOs) in: Knowledge and Understanding	
After completing this program, students would be able to:		After participating in the course, students would be able to:	
A1-	Recognize the principles of physical, chemical, clinical, social, behavioral, health and pharmaceutical sciences.	a1-	Recognize the basic principle of pharmaceutical analytical chemistry and its classification.
		a2-	Describe the important terminology used in pharmaceutical analysis.
A2-	Recognize the physicochemical properties, preparation, structure activity relationship (SAR), toxicity and the modern methods of analysis of various substances of chemical and natural products of therapeutic potential as well as the basic principle of drug discovery, design and development.	a3-	Recognize different method of quantitative analysis of drugs in different pharmaceutical preparations and mention their advantage and disadvantages.
		a4-	Identify the required calculations that are used in drugs analysis
Teaching And Assessment Methods For Achieving Learning Outcomes:			
Alignment Learning Outcomes of Knowledge and Understanding to Teaching and Assessment Methods:			
Course Intended Learning Outcomes (CILOs) in Knowledge and Understanding After participating in the course, students would be able to:		Teaching strategies/methods to be used	Methods of assessment
a1-	Recognize the basic principle of pharmaceutical analytical chemistry and its classification.		

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الدخين      ا.د. محمود البريهي      ا.م.د. توفيق العبيدي      د. خالد الشوية      ا.م.د. هدى العماد      ا.د. القاسم محمد عباس د. محمد عباس



a2-	Describe the important terminology used in pharmaceutical analysis.	Lectures method, group discussion and tutorial	Oral Exam, homework, report, Quizzes, Short answers and Written exam
a3-	Recognize different method of quantitative analysis of drugs in different pharmaceutical preparations and mention their advantage and disadvantages.		
a4-	Identify the required calculations that are used in drugs analysis		

### (B) Intellectual Skills:

Alignment Course Intended Learning Outcomes (CILOs) to Program Intended Learning Outcomes (PILOs) in: **Intellectual skills**

Program Intended Learning Outcomes (Sub-PILOs) in Intellectual skills		Course Intended Learning Outcomes (CILOs) of Intellectual Skills	
After completing this program, students would be able to		After participating in the course, students would be able to:	
<b>B1-</b>	Consolidate the chemical, biochemical and physiological principles to construct the pharmacophores of the structure and their effect on the stability, pharmacokinetic and pharmacodynamic profiles of the drug.	<b>b1-</b>	Select the suitable method for determination of different pharmaceutical preparations depending on the chemical nature of the drugs.
<b>B3-</b>	Design different types of safe and effective pharmaceutical dosage forms and develop novel methods of qualitative and quantitative analytical and biological analysis for pharmaceutical and biopharmaceutical products that support pharmaceutical research.	<b>b2-</b>	Diagram the schemes that explain different method of quantitative analysis.
		<b>b3-</b>	Determine the functional groups that affect on acidity and basicity of pharmaceutical compounds and predict the pH of the compounds.

### Teaching And Assessment Methods For Achieving Learning Outcomes:

Alignment Learning Outcomes of Intellectual Skills to Teaching Methods and Assessment Methods:

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<b>Course Intended Learning Outcomes (CILOs) in Intellectual Skills.</b>		<b>Teaching strategies/methods to be used.</b>	<b>Methods of assessment</b>
<b>After participating in the course, students would be able to:</b>			
<b>b1-</b>	Select the suitable method for determination of different pharmaceutical preparations depending on the chemical nature of the drugs.	Lectures method, group discussion and tutorial	Oral Exam, homework, report, Quizzes, Short answers and Written exam
<b>b2-</b>	Diagram the schemes that explain different method of quantitative analysis.		
<b>b3-</b>	Determine the functional groups that affect on acidity and basicity of pharmaceutical compounds and predict the pH of the compounds.		

### (C) Professional and Practical Skills.

Alignment Course Intended Learning Outcomes (CILOs) to Program Intended Learning Outcomes (PILOs) in: Professional and Practical Skills

<b>Program Intended Learning Outcomes (Sub- PILOs) in Professional and Practical Skills</b>		<b>Course Intended Learning Outcomes (CILOs) in Professional and Practical Skills</b>	
<b>After completing this program, students would be able to:</b>		<b>After participating in the course, students would be able to:</b>	
<b>C1-</b>	Operate different pharmaceutical equipments and instruments and use emerging technologies in design, synthesis, preformulation, formulation, packaging, storage and analysis of pharmaceutical products according to GLP, GSP and cGMP guidelines.	<b>c1-</b>	Operate different pharmaceutical instrument and equipment in the lab.

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C2-	Handle and dispose chemicals and pharmaceutical preparations safely and effectively.	c2-	Practice the qualitative and quantitative estimation of pharmaceutical substances.
		c3-	Handle and dispose the chemical and pharmaceutical preparations safely and effectively.
C3-	Extract, isolate, purify, identify and formulate the natural products and assure their rational use.		
C5-	Conduct research studies and utilize the results in different pharmaceutical fields.		

### Teaching And Assessment Methods For Achieving Learning Outcomes:

Alignment Learning Outcomes of Professional and Practical Skills to Teaching and Assessment Methods:

Course Intended Learning Outcomes (CILOs) in Professional and Practical Skills After participating in the course, students would be able to:		Teaching strategies/methods to be used	Methods of assessment
c1-	Operate different pharmaceutical instrument and equipment in the lab.	Lectures method, group discussion and practical	Oral Exam, homework, report, Quizzes, hort answers and
c2-	Practice the qualitative and quantitative estimation of pharmaceutical substances.	sessions	Written exam
c3-	Handle and dispose the chemical and pharmaceutical preparations safely and effectively.		

### (D) General / Transferable Skills:

Alignment Course Intended Learning Outcomes (CILOs) to Program Intended Learning Outcomes (PILOs) in: **General and Transferable skills**

Program Intended Learning Outcomes (PILOs) in General / Transferable skills	Course Intended Learning Outcomes (CILOs) in General / Transferable skills
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After completing this program, students would be able to:		After participating in the course, students would be able to:	
<b>D2-</b>	Employ proper documentation and filing systems in different pharmaceutical fields	<b>d1-</b>	Communicate and cooperate effectively with the others as a team work to perform the report on the results of an analytical method.
<b>D5-</b>	Apply information and communication technology and working effectively in a team.	<b>d2-</b>	Manage the time in an work effectively.
		<b>d3-</b>	Apply the information technology skills, such as word processing and internet communication and online searches.

### Teaching And Assessment Methods For Achieving Learning Outcomes:

Alignment Learning Outcomes of General and Transferable skills to Teaching and Assessment Methods.

Course Intended Learning Outcomes (CILOs) in General and Transferable Skills		Teaching strategies/methods to be used.	Methods of assessment
After participating in the course, students would be able to:			
<b>d1-</b>	Communicate and cooperate effectively with the others as a team work to perform the report on the results of an analytical method.	Lectures method, group discussion and practical sessions	Oral Exam, homework, report, Quizzes, Short





d2-	Manage the time in an work effectively.		answers and Written exam
d3-	Apply the information technology skills, such as word processing and internet communication and online searches.		

## V. Course Content:

### 1 – Course Topics/Items:

#### a – Theoretical Aspect

Order	Topic List / Units	CILOs (symbols)	Sub-topic List	Number of weeks	Contact hours
1	Introduction to analytical chemistry	a1-2 , b2, d1-3	- Definitions - Classifications, types of analytical techniques. - Qualitative and quantitative analysis	1	2
2	Basic Tools of Analytical Chemistry	a1-2, a4, b3, d1-3	-Review the fundamental concepts of the nucleus, relative atomic mass and molecular mass, moles and equivalents. - Methods of expressing the concentrations: molarity, normality, molality, dilution, ppm, ppb, Weight, Volume, and Weight-to-Volume Ratios	1	2
3	Volumetric methods of analysis	a1-3 , b1-3, d1-3	Definition, tools, types and Principle of volumetric analysis	1	2
4	Acid - base titration	a1,a4,b3, d1-3	<u>1-Acid - base titration in aqueous medium:</u> -Arhenius, Pronsted and Lewis definitions - -pH of acids, base and salt solutions, buffer solutions and Henderson-Hasselbach equations. Factors affecting pH of buffers, buffer capacity. Acid base indicators, - Principle, mechanism, neutralization titration curves	4	8

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			- Pharmaceutical applications 2- <u>Acid - base titration in nonaqueous medium:</u> Theory, advantages and limitation, non-aqueous solvents, ionization and dissociation in nonaqueous media, titration of weak acids and bases, indicators in non-aqueous titration, preparation of standard solutions, Pharmaceutical applications		
5	<b>Precipitation titrations</b>	a1,a3,a4,b1, d13	- Solubility product constant, -Principle of precipitation reaction, - Factors affecting solubility of precipitates, -Types of argentimetric titration and end point detection in Mohr's, Volhard's, Fajan's methods. - Pharmaceutical applications	2	4
6	<b>Mid Exam</b>	a1-4, b1-3		1	2
7	<b>Redox titration</b>	a1,a3,a4,b1, d13	-Theory of redox reactions, strength and equivalent weights of oxidizing agents and reducing agents. - redox titration curves, redox indicators. - Iodometry and iodimetry -Pharmaceutical applications	3	6
8	<b>Complexation Titration</b>	a1,a3,a4,b1, d13	-Concepts of complexation and chelation - coordination number of metal ions, ligands, and chelating agents, titrants. -Stability constant of complex, factors affecting the stability of complex., - methods of end point detection - Pharmaceutical applications	2	4



9	Final Exam	a1-4, b1-3		1	2
Number of Weeks /and Units Per Semester				16	32

b - Practical Aspect				
Order	Tasks/ Experiments	CILOs (symbols)	Number of Weeks	Contact Hours
1	Calibration of volumetric apparatus	c1,c2, c3, <b>d1-3</b>	1	2
2	Preparation and standardization of HCl and NaOH solutions	c1,c2, c3, <b>d1-3</b>	1	2
3	Assay of sodium bicarbonate	c1,c2, c3, <b>d1-3</b>	1	2
4	Assay of benzoic acid,	c1,c2, c3, <b>d1-3</b>	1	2
5	Preparation and standardization of perchloric acid	c1,c2, c3, <b>d1-3</b>	1	2
6	Preparation and standardization of sodium methoxide solutions	c1,c2, c3, <b>d1-3</b>		
6	Mid-Exam	c1,c2, c3	1	2
7	Preparation and standardization of potassium permanganate solution	c1,c2, c3, <b>d1-3</b>	1	2
8	Preparation and standardization of potassium iodide solution	c1,c2, c3, <b>d1-3</b>	1	2
9	Assay of hydrogen peroxide	c1,c2, c3, <b>d1-3</b>	1	2
10	Preparation and standardization of ammonium thiocyanate solution.	c1,c2, c3, <b>d1-3</b>	1	2
11	Preparation and standardization of a silver nitrate solution.	c1,c2, c3, <b>d1-3</b>	1	2
12	Assay of sodium chloride.	c1,c2, c3, <b>d1-3</b>	1	2
13	Preparation and standardization of EDTA solution	c1,c2, c3, <b>d1-3</b>	1	2

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14	Assay of Calcium lactate	c1,c2, c3, d1-3	1	2
15	Preparation and standardization of ceric ammonium sulphate solution	c1,c2, c3, d1-3	1	2
16	Final Exam	c1-3	1	2
Number of Weeks /and Units Per Semester			16	32

### VI. Teaching strategies of the course:

Lectures method, Discussions, Small group discussions, Tutorials and Practice session.

### VII. Assignments:

- Homework
- Reports

### VIII. Schedule of Assessment Tasks for Students During the Semester:

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes (CILOs symbols)
1	Attendance, Participation, reports and quizzes	All Weeks	10	7%	a1,a3,a4,b1,b2, d1-3
2	Oral Tests and Homework assignments	Sporadic through the semester	10	7%	a2, a4, b1-3,d1-3
3	Attendance, Practical Reports and Practical mid-semester exam	7 <sup>th</sup>	30	20%	c1-3



5	Theoretical mid-semester exam	10 <sup>th</sup>	30	20%	a1-4, b1, b2
6	Final Exam (theoretical)	16 <sup>th</sup>	50	33%	a1-4, b1, b2
7	Final Exam (practical)	16 <sup>th</sup>	20	13%	c1-3
<b>Total</b>			<b>150</b>	<b>100%</b>	

### IX. Students' Support:

Office Hours/week	Other Procedures (if any)
Two contact hours per week	None



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## X. Learning Resources:

### 1- Required Textbook(s) ( maximum two ).

- 1- Douglas A. Skoog, Donald M. West, F. James Holler and Stanley R. Crouch. 2004. Fundamentals of Analytical Chemistry, 8<sup>th</sup> edition, Thomson Brooks/Cole, Belmont, USA.
- 2- G H Jeffery, J Bassatt, J Mendham, R C Denny, 1979. Vogel's Textbook of qualitative chemical analysis, 5<sup>th</sup> edition, Longman group UK Limited, London, England.
- 3- F.W. Fifield and D. Kealey, 2000, "Principles and Practice of Analytical Chemistry" 5<sup>th</sup> Edition, Blackwell Science, London.

### 2- Recommended Books and Reference Materials.

- 1- DEAN'S, 2004. Analytical Chemistry Handbook, 2<sup>nd</sup> edition, McGraw-Hill Handbooks, New York,
- 2- Gary, D.C, 1986., Analytical Chemistry, 4th ed. John Wiley and Sons, New York.
- 3- Somenath Mitra, 2003. Sample Preparation Techniques in Analytical Chemistry, A John Wiley & Sons, Inc., Publication, Canada.
- 4- K. Danzer, 2007. Analytical Chemistry Theoretical and Metrological Fundamentals, Springer Verlag Berlin Heidelberg.
- 5- Lectures Notes and Practical Manual.

### 3- Electronic Materials and Web Sites etc.

1. the Analyst;
2. J. Pharm. & Biomed. Anal.
3. J. Assoc. off Anal. Chem.
4. The Analytical Abstracts database (<http://www.rsc.org/CFAA/AAsearchPage.cfm>)
5. The Analytical Forum on ChemWeb (<http://analytical.chemweb.com/search/search.exe>)
6. chemweb.com/search/search.exe)

## I. Facilities Required:

- Well-equipped lecture halls with data show facilities, whiteboards,

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<b>1 - Accommodation:</b>	net connection, etc. - Well-equipped laboratories with all required equipment and reagents.
<b>2 - Computing resources:</b>	- Computer laboratory with internet facilities.
<b>II. Course Improvement Processes:</b>	
<b>1- Strategies for obtaining student feedback on effectiveness of teaching</b>	
	<ul style="list-style-type: none"> <li>Student-based assessment of the effectiveness of teaching using a questionnaire designed by the Quality Assurance Unit at the end of the semester.</li> <li>Meeting with students and faculty (once per semester).</li> </ul>
<b>2- Other strategies for evaluation of teaching by the instructor or by the department.</b>	
	<ul style="list-style-type: none"> <li>Assessment of the course syllabus and contents by the teachers using a questionnaire designed by the Quality Assurance Unit of the university at the end of the semester.</li> <li>Regular meeting and discussion of the course content between the Head of Department and the teaching staff of the course (for theory and practice).</li> </ul>
<b>3- Processes for improvement of teaching.</b>	
	<ul style="list-style-type: none"> <li>Revision of the course specification and its teaching strategies every three academic years after consideration of all issues raised by the teachers and/or students during regular meetings and discussions.</li> <li>Exploring any possible defects in the course that might be encountered by the teaching staff and their mitigation in subsequent improved versions of course specification.</li> </ul>
<b>4- Processes for verifying standards of students' achievement</b>	
	<ul style="list-style-type: none"> <li>Checking of a sample of students' work by an independent faculty member.</li> <li>Periodic exchange and check marking of a sample of students' assignments with a faculty member from another institution.</li> <li>Adoption of scoring rubrics to assess the students' achievement (both for ongoing or summative assessments).</li> <li>Regular follow-up of laboratory logbooks to assess the practical achievement of students.</li> </ul>





5 <sup>th</sup> Procedures for periodically reviewing of course effectiveness and planning for improvement	
	<ul style="list-style-type: none"> <li>▪ Student rating and feedback</li> <li>▪ Peer rating and feedback</li> <li>▪ Regular meeting of the Curriculum Committee of the faculty.</li> </ul>
6- Course development plans	
	<ul style="list-style-type: none"> <li>▪ Conducting regular workshops for the staff for improving their course specification skills.</li> <li>▪ Regular revision of course specification and syllabus items.</li> </ul>

VIII. Course Policies: (including plagiarism, academic honesty, attendance etc)	
The University Regulations on academic misconduct will be strictly enforced. Please refer to -----	
1	<b>Class Attendance:</b> <ul style="list-style-type: none"> <li>▪ Attendance of all lectures and practical sessions is required. Unexcused absence exceeding 25% of the lectures or practical sessions will disqualify the student from entering the final exam.</li> </ul>
2	<b>Tardy:</b> <p>- Roll will be called in the very beginning of each lecture and practical class. Retardation for more than three weeks without a reasonable excursion, the student involved shall not be allowed to attend the class any longer and consequently shall be considered to be absent.</p>
3	<b>Exam Attendance/Punctuality:</b> <ul style="list-style-type: none"> <li>▪ Exam attendance is obligatory unless being excused by the department and faculty.</li> <li>▪ Absence from assignments or exams will be dealt with according to the general policy of the university.</li> </ul>
4	<b>Assignments &amp; Projects:</b> <ul style="list-style-type: none"> <li>▪ Assignments: Written and oral; Laboratory logbook signed by the responsible demonstrator.</li> <li>▪ Projects: Not applicable.</li> </ul>



5	<p><b>Cheating:</b></p> <ul style="list-style-type: none"> <li>Punishment of cheating will be according to the general policy of the university in this respect.</li> </ul>
6	<p><b>Plagiarism:</b></p> <ul style="list-style-type: none"> <li>Plagiarism in written essays, reports, etc. is not accepted, and students who plagiarize the works of others will be punished according to the general policy of the university.</li> </ul>
7	<p><b>Other policies:</b></p> <ul style="list-style-type: none"> <li>General policies of the Students' Affairs of the University and the Quality Assurance Unit.</li> </ul>

## Course Plan of Pharmaceutical Analytical Chemistry I

I- Information about Faculty Member Responsible for the Course:							
Name of Faculty Member	Dr. Yahya AL-Dokhain, Dr. Mohammed Hamid-Addeen			Office Hours			
Location & Telephone No.		SAT	SUN	MON	TUE	WED	THU

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## II- Course Identification and General Information:

1-	Course Title:	Pharmaceutical Analytical Chemistry I				
2-	Course Number & Code:	Ph534				
3-	Credit hours:	<b>C.H</b>				<b>Total</b>
		<b>Th.</b>	<b>Seminar</b>	<b>Pr.</b>	<b>F. Tr.</b>	
		2	-	2		3
4-	Study level/year at which this course is offered:	2 <sup>nd</sup> level /1 <sup>st</sup> semester				
5-	Pre –requisite (if any):	General Pharmaceutical Chemistry				
6-	Co –requisite (if any):	-				
7-	Program (s) in which the course is offered	Bachelor of Pharmacy				
8-	Language of teaching the course:	English				
9-	System of Study:	Semesters				
10-	Mode of delivery:	Regular				
11-	Location of teaching the course:	Faculty of Pharmacy- Sana`a university				

## III- Course description:

The course is concerned with the fundamental knowledge about the basic principles of the quantitative chemical analysis including, acid-base reactions, redox reaction, complexometric and precipitometric analysis. The course will also cover the applications of these methods to pharmaceutical compounds.

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الدخين      ا.د. محمود البريهي      ا.م.د.توفيق العبيدي      د.خالد الشوية      ا.م.د. هدى العماد      ا.د. القاسم محمد عباس د. محمد عباس



#### IV- Intended learning outcomes (ILOs) of the course:

At the end of this course the students should be able to:

14. Recognize the basic principle of pharmaceutical analytical chemistry and its classification.
15. Describe the important terminology used in pharmaceutical analysis.
16. Recognize different method of quantitative analysis of drugs in different pharmaceutical preparations and mention their advantage and disadvantages.
17. Identify the required calculations that are used in drugs analysis.
18. Select the suitable method for determination of different pharmaceutical preparations depending on the chemical nature of the drugs.
19. Diagram the schemes that explain different method of quantitative analysis.
20. Determine the functional groups that affect on acidity and basicity of pharmaceutical compounds and predict the pH of the compounds.
21. Operate different pharmaceutical instrument and equipment in the lab.
22. Practice the qualitative and quantitative estimation of pharmaceutical substances.
23. Handle and dispose the chemical and pharmaceutical preparations safely and effectively.
24. Communicate and cooperate effectively with the others as a team work to perform the report on the results of the method of analysis.
25. Apply the information technology skills, such as word processing and internet communication and online searches.
26. Manage the time in an work effectively.

#### V- Course Content:

##### 1 – Course Topics/Items:

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a – Theoretical Aspect					
Order	Topic List / Units	CILOs (symbols)	Sub-topic List	Week Due	Contact hours
1	Introduction to analytical chemistry	a1-2 , b2, d1-3	<ul style="list-style-type: none"> <li>- Definitions</li> <li>- Classifications, types of analytical techniques.</li> <li>- Qualitative and quantitative analysis</li> </ul>	1	2
2	Basic Tools of Analytical Chemistry	a1-2, a4, b3, d13	<ul style="list-style-type: none"> <li>-Review the fundamental concepts of the nucleus, relative atomic mass and molecular mass, moles and equivalents.</li> <li>- Methods of expressing the concentrations: molarity, normality, molality, dilution, ppm, ppb, Weight, Volume, and Weight-to-Volume Ratios</li> </ul>	2	2
3	Volumetric methods of analysis	a1-3 , b1-3, d1-3	Definition, tools, types and Principle of volumetric analysis	3	2
4	Acid - base titration	a1,a4,b3, d1-3	<p><u>1-Acid - base titration in aqueous medium:</u></p> <ul style="list-style-type: none"> <li>-Arhenius, Pronsted and Lewis definitions -</li> <li>-pH of acids, base and salt solutions, buffer solutions and Henderson-Hasselbach equations. Factors affecting pH of buffers, buffer capacity. Acid base indicators,</li> <li>- Principle, mechanism, neutralization titration curves</li> <li>- Pharmaceutical applications</li> </ul> <p><u>2- Acid - base titration in nonaqueous medium:</u></p> <p>Theory, advantages and limitation, non-aqueous solvents, ionization and dissociation in nonaqueous media, titration of weak acids and bases,</p>	4-7	8
			indicators in non-aqueous titration, preparation of standard solutions, Pharmaceutical applications		

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5	<b>Precipitation titrations</b>	a1,a3,a4,b1, d13	- Solubility product constant, -Principle of precipitation reaction, - Factors affecting solubility of precipitates, -Types of argentimetric titration and end point detection in Mohr's, Volhard's, Fajan's methods. - Pharmaceutical applications	8,9	4
6	<b>Mid Exam</b>	a1-4, b1-3		10	2
7	<b>Redox titration</b>	a1,a3,a4,b1, d13	-Theory of redox reactions, strength and equivalent weights of oxidizing agents and reducing agents. - redox titration curves, redox indicators. - Iodometry and iodimetry -Pharmaceutical applications	11-13	6
8	<b>Complexation Titration</b>	a1,a3,a4,b1, d13	-Concepts of complexation and chelation - coordination number of metal ions, ligands, and chelating agents, titrants. -Stability constant of complex, factors affecting the stability of complex,. - methods of end point detection - Pharmaceutical applications	14,15	4
9	<b>Final Exam</b>	a1-4, b1-3		16	2
<b>Number of Weeks /and Units Per Semester</b>				<b>16</b>	<b>32</b>

## b - Practical Aspect

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Order	Tasks/ Experiments	CILOs (symbols)	Week Due	Contact Hours
1	Calibration of volumetric apparatus	c1,c2, c3, <b>d1-3</b>	1	2
2	Preparation and standardization of HCl and NaOH solutions	c1,c2, c3, <b>d1-3</b>	2	2
3	Assay of sodium bicarbonate	c1,c2, c3, <b>d1-3</b>	3	2
4	Assay of benzoic acid	c1,c2, c3, <b>d1-3</b>	4	2
5	Preparation and standardization of perchloric acid , Preparation and standardization of sodium methoxide solutions	c1,c2, c3, <b>d1-3</b>	5	2
6	Mid-Exam	c1,c2, c3	6	2
7	Preparation and standardization of potassium permanganate solution	c1,c2, c3, <b>d1-3</b>	7	2
8	Preparation and standardization of potassium iodide solution	c1,c2, c3, <b>d1-3</b>	8	2
9	Assay of hydrogen peroxide	c1,c2, c3, <b>d1-3</b>	9	2
10	Preparation and standardization of ammonium thiocyanate solution.	c1,c2, c3, <b>d1-3</b>	10	2
11	Preparation and standardization of a silver nitrate solution.	c1,c2, c3, <b>d1-3</b>	11	2
12	Assay of sodium chloride.	c1,c2, c3, <b>d1-3</b>	12	2
13	Preparation and standardization of EDTA solution	c1,c2, c3, <b>d1-3</b>	13	2
14	Assay of Calcium lactate	c1,c2, c3, <b>d1-3</b>	14	2
15	Preparation and standardization of ceric ammonium sulphate solution	c1,c2, c3, <b>d1-3</b>	15	2
16	Final Exam	<b>c1-3</b>	16	2
<b>Number of Weeks /and Units Per Semester</b>			<b>16</b>	<b>32</b>

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الدخين      ا.د. محمود البريهي      ا.م.د.توفيق العبيدي      د.خالد الشوبية      ا.م.د. هدى العماد      ا.د. القاسم محمد عباس د. محمد عباس



## VI- Teaching strategies of the course:

Lectures method, Discussions, Small group discussions, Tutorials and Practice session.

## VII- Assignments:

- Homework
- Reports

## VIII- Schedule of Assessment Tasks for Students During the Semester:

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes (CILOs symbols)
1	Attendance, Participation, reports and quizzes	All Weeks	10	7%	a1,a3,a4,b1,b2, d1-3
2	Oral Tests and Homework assignments	Sporadic through the semester	10	7%	a2, a4, b1-3,d1-3
3	Attendance, Practical Reports and Practical mid-semester exam	7 <sup>th</sup>	30	20%	c1-3
5	Theoretical mid-semester exam	10 <sup>th</sup>	30	20%	a1-4, b1, b2
6	Final Exam (theoretical)	16 <sup>th</sup>	50	33%	a1-4, b1, b2
7	Final Exam (practical)	16 <sup>th</sup>	20	13%	c1-3
<b>Total</b>			<b>150</b>	<b>100%</b>	

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### IX- Students' Support:

Office Hours/week	Other Procedures (if any)
Two contact hours per week	None



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## X- Learning Resources:

### 1- Required Textbook(s) ( maximum two ).

- 3- Douglas A. Skoog, Donald M. West, F. James Holler and Stanley R. Crouch. 2004. Fundamentals of Analytical Chemistry, 8<sup>th</sup> edition, Thomson Brooks/Cole, Belmont, USA.
- 4- G H Jeffery, J Bassatt, J Mendham, R C Denny, 1979. Vogel's Textbook of qualitative chemical analysis, 5<sup>th</sup> edition, Longman group UK Limited, London, England.
- 3-F.W. Fifield and D. Kealey, 2000, "Principles and Practice of Analytical Chemistry" 5<sup>th</sup> Edition, Blackwell Science, London.

### 2- Recommended Books and Reference Materials.

- 6- DEAN'S, 2004. Analytical Chemistry Handbook, 2<sup>nd</sup> edition, McGraw-Hill Handbooks, New York,
- 7- Gary, D.C, 1986., Analytical Chemistry, 4th ed. John Wiley and Sons, New York.
- 8- Somenath Mitra, 2003. Sample Preparation Techniques in Analytical Chemistry, A John Wiley & Sons, Inc., Publication, Canada.
- 9- K. Danzer, 2007. Analytical Chemistry Theoretical and Metrological Fundamentals, SpringerVerlag Berlin Heidelberg.
- 10- Lectures Notes and Practical Manual.

### 3- Electronic Materials and Web Sites etc.

7. the Analyst;
8. J. Pharm. & Biomed. Anal.
9. J. Assoc. off Anal. Chem.
10. The Analytical Abstracts database (<http://www.rsc.org/CFAA/AASearchPage.cfm>)
11. The Analytical Forum on ChemWeb (<http://analytical.chemweb.com/search/search.exe>)
12. chemweb.com/search/search.exe

## III. Facilities Required:

- Well-equipped lecture halls with data show facilities, whiteboards,

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<b>1 - Accommodation:</b>	net connection, etc. - Well-equipped laboratories with all required equipment and reagents.
<b>3 - Computing resources:</b>	- Computer laboratory with internet facilities.
<b>IV. Course Improvement Processes:</b>	
<b>6- Strategies for obtaining student feedback on effectiveness of teaching</b>	
	<ul style="list-style-type: none"> <li>Student-based assessment of the effectiveness of teaching using a questionnaire designed by the Quality Assurance Unit at the end of the semester.</li> <li>Meeting with students and faculty (once per semester).</li> </ul>
<b>7 Other strategies for evaluation of teaching by the instructor or by the department.</b>	
	<ul style="list-style-type: none"> <li>Assessment of the course syllabus and contents by the teachers using a questionnaire designed by the Quality Assurance Unit of the university at the end of the semester.</li> <li>Regular meeting and discussion of the course content between the Head of Department and the teaching staff of the course (for theory and practice).</li> </ul>
<b>8- Processes for improvement of teaching.</b>	
	<ul style="list-style-type: none"> <li>Revision of the course specification and its teaching strategies every three academic years after consideration of all issues raised by the teachers and/or students during regular meetings and discussions.</li> <li>Exploring any possible defects in the course that might be encountered by the teaching staff and their mitigation in subsequent improved versions of course specification.</li> </ul>
<b>9- Processes for verifying standards of students' achievement</b>	
	<ul style="list-style-type: none"> <li>Checking of a sample of students' work by an independent faculty member.</li> <li>Periodic exchange and check marking of a sample of students' assignments with a faculty member from another institution.</li> <li>Adoption of scoring rubrics to assess the students' achievement (both for ongoing or summative assessments).</li> <li>Regular follow-up of laboratory logbooks to assess the practical achievement of students.</li> </ul>



<b>1<sup>0</sup>- Procedures for periodically reviewing of course effectiveness and planning for improvement</b>	
	<ul style="list-style-type: none"> <li>▪ Student rating and feedback</li> <li>▪ Peer rating and feedback</li> <li>▪ Regular meeting of the Curriculum Committee of the faculty.</li> </ul>
<b>6- Course development plans</b>	
	<ul style="list-style-type: none"> <li>▪ Conducting regular workshops for the staff for improving their course specification skills.</li> <li>▪ Regular revision of course specification and syllabus items.</li> </ul>

<b>IX. Course Policies: (including plagiarism, academic honesty, attendance etc)</b>	
<b>The University Regulations on academic misconduct will be strictly enforced. Please refer to -----</b>	
<b>1</b>	<b>Class Attendance:</b> <ul style="list-style-type: none"> <li>▪ Attendance of all lectures and practical sessions is required. Unexcused absence exceeding 25% of the lectures or practical sessions will disqualify the student from entering the final exam.</li> </ul>
<b>2</b>	<b>Tardy:</b> <p>- Roll will be called in the very beginning of each lecture and practical class. Retardation for more than three weeks without a reasonable excursion, the student involved shall not be allowed to attend the class any longer and consequently shall be considered to be absent.</p>
<b>3</b>	<b>Exam Attendance/Punctuality:</b> <ul style="list-style-type: none"> <li>▪ Exam attendance is obligatory unless being excused by the department and faculty.</li> <li>▪ Absence from assignments or exams will be dealt with according to the general policy of the university.</li> </ul>
<b>4</b>	<b>Assignments &amp; Projects:</b> <ul style="list-style-type: none"> <li>▪ Assignments: Written and oral; Laboratory logbook signed by the responsible demonstrator.</li> <li>▪ Projects: Not applicable.</li> </ul>





5	<b>Cheating:</b> <ul style="list-style-type: none"><li>Punishment of cheating will be according to the general policy of the university in this respect.</li></ul>
6	<b>Plagiarism:</b> <ul style="list-style-type: none"><li>Plagiarism in written essays, reports, etc. is not accepted, and students who plagiarize the works of others will be punished according to the general policy of the university.</li></ul>
7	<b>Other policies:</b> <ul style="list-style-type: none"><li>General policies of the Students' Affairs of the University and the Quality Assurance Unit.</li></ul>