

Republic of Yemen
Ministry of Higher Education & Scientific Research
21 September University for Medicals and Applied Sciences



Faculty of Clinical Pharmacy

Bachelor of Clinical Pharmacy & Pharm. D.

Course Specification of
Pharmaceutical Analytical Chemistry

Course Code. (02.04.246)

2022



T4: This Template is Developed and Approved by CAQA-Yemen, 2023

Prepared by:	Reviewed by:	Head of the Department:	Vice Dean for Quality Affairs	Dean of College:
Dr. Abdulelah Thabet	Prof. Ali Alkaf	Dr. -----	Dr. Abdulelah Thabet	Dr. Ali Alyahawi



I. General Information:

1.	Course Title:	Pharmaceutical Analytical Chemistry I			
2.	Course Code:	02.04.246			
3.	Credit Hours:	Credit Hours	Theory Contact Hours		Practical Contact Hours
			Lecture	Tutorial/Seminar	Lab
		3	2		2
4.	Level/ Semester at which this Course is offered:	2 nd Level / 1 st Semester			
5.	Pre –Requisite (if any):	General Chemistry			
6.	Co –Requisite (if any):	-			
7.	Program (s) in which the Course is Offered:	Bachelor of Clinical Pharmacy & Pharm. D.			
8.	Language of Teaching the Course:	English			
9.	Location of Teaching the Course:	Faculty of Clinical Pharmacy			
10.	Prepared by:	Dr. Abdulelah Thabet			
11.	Date and Number of Approval by Council:	2022			

II. Course Description:

This course designed together with the laboratory section to cover the basic principles and general concepts of the pharmaceutical analytical chemistry. Its purpose is to give students a strong foundation about qualitative and quantitative analysis methods, methods expressing of the concentrations, principles of volumetric analysis, acid-base titration equilibria, Precipitation titration, complex metric titration, and oxidation-reduction titration analysis methods). The course will also cover the practical applications of these methods to pharmaceutical compounds.



III. Course Intended Learning Outcomes (CILOs) : Upon successful completion of the course, students will be able to:		Referenced PILOs	
A. Knowledge and Understanding:		I, P or M/A	
a1	Recognize the basic principle of pharmaceutical analytical chemistry and the important terminology used in pharmaceutical analysis.		A4
a2	Describe different qualitative analysis methods, procedures, and their use for identification of drugs, and mention their advantage and disadvantages.		A4
a3	Identify the required calculations that are used in drugs analysis		A4
B. Intellectual Skills:			
b1	Select the suitable method for determination of different of pharmaceutical raw materials and final drug products depending on their chemical nature.		B2
b2	Calculate the concentration of different method of quantitative analysis and present the results.		B2
a3	Determine the functional groups that effect on acidity and basicity of pharmaceutical compounds and predict the pH of the compounds.		B2
C. Professional and Practical Skills:			
c1	Operate different pharmaceutical instrument and equipment in the lab effectively.		C2
c2	Practice the qualitative and quantitative estimation of pharmaceutical substances.		C2
c3	Summarize results of an analytical experiment, and the conclusions drawn from these results, in a written lab report.		C2
D. Transferable Skills:			
d1	Work independently or as a team member and effectively communicate with the teaching staff and colleagues to perform the report on results of an analytical experiment.		D1
d2	Manage the time in an work effectively.		D3
I= Introduced, P=Practiced or M/A= Mastered/Advanced			

(A) Alignment of Course Intended Learning Outcomes (Knowledge and Understanding) to Teaching Strategies and Assessment Methods:

Course Intended Learning Outcomes		Teaching Strategies	Assessment Strategies
a1	Recognize the basic principle of pharmaceutical analytical chemistry and the important terminology used in pharmaceutical analysis.	- Lecture - Instructor – student Interactive - Office hour	- Exam - Assignment - Quiz
a2	Describe different qualitative analysis methods, procedures, and their use for identification of drugs, and mention their advantage and disadvantages.	- Lecture - Instructor – student Interactive - Office hour	- Exam - Assignment - Quiz
a3	Identify the required calculations that are used in drugs analysis	- Lecture - Instructor – student Interactive - Office hour	- Exam - Assignment - Quiz

(B) Alignment of Course Intended Learning Outcomes (Intellectual Skills) to Teaching Strategies and Assessment Methods:

Course Intended Learning Outcomes		Teaching Strategies	Assessment Strategies
b1	Select the suitable method for determination of different of pharmaceutical raw materials and final drug products depending on their chemical nature.	- Lecture - Instructor – student Interactive - Exercises - Solving Problem Methods	- Problem-Solving Exercises. - Assignment - Quiz
b2	Calculate the concentration of different method of quantitative analysis and present the results.	- Lecture - Instructor – student Interactive - Exercises - Solving Problem Methods	- Problem-Solving Exercises. - Assignment - Quiz
b3	Determine the functional groups that effect on acidity and basicity of pharmaceutical compounds and predict the pH of the compounds.	- Lecture - Instructor – student Interactive - Exercises - Solving Problem Methods	- Problem-Solving Exercises. - Assignment - Quiz

(C) Alignment of Course Intended Learning Outcomes (Professional and Practical Skills) to Teaching Strategies and Assessment Methods:

Course Intended Learning Outcomes		Teaching Strategies	Assessment Strategies
c1	Operate different pharmaceutical instrument and equipment in the lab effectively.	- Lecture - Instructor – student Interactive - Self-Learning	- Exam - Assignment - Quiz

c2	Practice the qualitative and quantitative estimation of pharmaceutical substances.	▪	▪
c3	Summarize results of an analytical experiment, and the conclusions drawn from these results, in a written lab report.	- Lecture - Instructor – student Interactive - Self-Learning	- Exam - Assignment - Quiz
(D) Alignment of Course Intended Learning Outcomes (Transferable Skills) to Teaching Strategies and Assessment Methods:			
Course Intended Learning Outcomes		Teaching Strategies	Assessment Strategies
d1	Work independently or as a team member and effectively communicate with the teaching staff and colleagues to perform the report on results of an analytical experiment.	- Self-Learning - Seminar - Exercises	- Presentation - Assignment - Quiz
d2	Manage the time in an work effectively.	- Seminar - Instructor–student Interactive - Exercises	Presentation

IV. Course Contents:

A. Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	Contact Hours
1.	Introduction to analytical chemistry	a1-2, b1-2, d1	- Definitions, Classifications, and types of analytical Methods. - Qualitative and quantitative analysis. - Electrolytes may be classified volumetric methods:	1	2
2.	Solutions and Different Concentration definitions & expressions		- Solution types, Electrolytes Classifications & types - Concentration definitions & expressions: Strength of a Solution, Percentage (W/V, W/W & V/V), Mole Fraction, molarity, normality, molality, dilution, ppm, ppb, - Relation between different expressing the concentrations.	3	6
3.	Volumetric methods of analysis and titrations	a1-2, b1-2, d1	Definition, tools, types and Principle of volumetric analysis and titrations.	1	2
4.	Neutralization Reactions (Acid	a1,a4,b3, d1-3	- Chemical equilibria - Acid - base titration in aqueous medium:	3	6

	- base titration)		-Arhenius, Pronsted & 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. - Neutralization titrations and acid base systems in aqueous medium: - Titration of strong acids and bases - Titration of weak acids and bases. - Preparation of standard solutions - Pharmaceutical applications		
5.	Mid Exam	a1-2, b1-2		1	2
6.	Precipitation reactions & titrations	a1-2, b1-2, d1	- Fundamentals of precipitation titration - Solubility Rules - Precipitation Methods (Mohar's , Volahard's and Vajan's method) - Advantages and disadvantages of precipitation titration. - Precipitation titration curve. - Evaluate the precipitation titrations. - Pharmaceutical Applications	2	4
7.	Complexation reactions and titrations		- Fundamentals of complex formation reactions and complexing agents. - Mechanism of complex formation reaction and the methods used for equivalent point detection. - Effect of pH on the formation of metal ions complexes. - Complex formation titration curve. - The importance of EDTA particularly in the determination of water hardness. - Applications of complex formation reactions in Pharmaceutical.	2	4
8.	Redox reactions & titrations	a1-2, b1-2, d1	- Concepts of oxidation and reduction reactions & titrations, oxidizing and reducing agents in a redox reaction and Balance redox reaction equations. - Role of standard potential in expecting the completeness and the direction of a redox reaction & and write the symbol for a galvanic cell reaction - Calculate the electrode potential, equilibrium constant K_{eq} for a redox reaction and the potential of the titrated solution at any point during the titration. - Indicator for the redox titration - Redox titration curves, redox	2	4



			indicators, & factors affecting the redox titration. - Pharmaceutical applications.		
9.	Final Exam			1	2
Number of Weeks /and Units Per Semester				16	32

B. Practical Aspect (Lab/Clinical) (if any):

No.	Tasks/ Experiments	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
1	- Calibration of volumetric apparatus	1	2	c1- c3, d1
2	- Preparation and standardization of HCl and NaOH solutions	1	2	c1- c3, d1
3	- Acid-base titrations (Assay of sodium bicarbonate)	1	2	c1- c3, d1
4	- Acid-base titrations (Assay of benzoic acid)	1	2	c1- c3, d1
5	- Preparation and standardization of perchloric acid	1	2	c1- c3, d1
6	- Mid-Exam	1	2	c1- c3, d1
7	- Preparation and standardization of ammonium thiocyanate solution.	1	2	c1- c3, d1
8	- Preparation and standardization of a silver nitrate solution.	1	2	c1- c3, d1
9	- Precipitation titrations (Assay of sodium chloride)	1	2	c1- c3, d1
10	- Preparation and standardization of EDTA solution	1	2	c1- c3, d1
11	- Compleximetric titrations (Assay of Calcium lactate)	1	2	c1- c3, d1
12	- Preparation and standardization of ceric ammonium sulphatesolution	1	2	c1- c3, d1
13	- Preparation and standardization of potassium permanganate solution	1	2	c1- c3, d1
14	- Preparation and standardization of potassium iodide solution	1	2	c1- c3, d1
15	- Redox titrations (Assay of hydrogen peroxide)	1	2	c1- c3, d1
16	- Final Exam	1	2	c1- c3, d1
Number of Weeks /and Units Per Semester		16	32	

VII. Assignments:

No.	Assignments	Week Due	Mark	Aligned CILOs (symbols)
1	Assignment 1		2.5	All CILOs
2	Assignment 2:		2.5	All CILOs
Total				5

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

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1	Assignments	6th, 12th	5	5%	All CILOs
2	Practical Reports	2 nd -13 th	5	5%	c1-c3,d1
3	Midterm Exam (Theory)	Week 7	15	20%	a1-2, b1-2, d1
	Midterm Exam (Practical)	Week 7	10	10%	c1-c3,d1
4	Final Practical Exam	14 th	15	15%	c1-c3,d1
5	Final Exam (Theory)	Week 16	50	50%	a1-2, b1-2, d1
Total			100	100%	

IX. Learning Resources:

1- Required Textbook(s):

- 1- Pharmaceutical analysis: a textbook for pharmacy students and pharmaceutical chemists. 5th Edition, D. G. Watson. Churchill Livingstone. Edinburgh, Elsevier, 2020.
- 2- Fundamentals of Analytical Chemistry, 8th edition, Douglas A. Skoog, Donald M. West, F. James Holler and Stanley R. Crouch. 2004. Thomson Brooks/Cole, Belmont, USA.
- 3- Vogel's Textbook of qualitative chemical analysis, 5th edition, G H Jeffery, J Bassatt, J Mendham, R C Denny, 1979. Longman group UK Limited, London, England.

2- Essential References.

- 1- Lectures Notes and Practical Manual.
- 2- DEAN'S , 2004. Analytical Chemistry Handbook, 2nd edition, McGraw-Hill Handbooks, New York, USA .
- 3- Gary, D.C, 1986., Analytical Chemistry, 4th ed. John Wiley and Sons, New York.
- 4- Somenath Mitra, 2003. Sample Preparation Techniques in Analytical Chemistry, A John Wiley & Sons, Inc., Publication, Canada.

3- Electronic Materials and Web Sites etc.

1. J. Pharm. & Biomed. Anal.
2. J. Assoc. off Anal. Chem.
3. <https://asdlab.org/>
4. <https://www-library.ch.cam.ac.uk/list-useful-databases>
5. [https://www.udemy.com/topic/Analytical-Chemistry/?utm_source=adwords&utm_medium=udemyads&utm_campaign=LongTail la.EN cc.I &utm_content=deal4584&utm_term= . ag 78754165093 . ad 535700196361 . kw analytical% mistry%20course . de c . dm . pl . ti kwd- 363163594481 . li 9070209 . pd . &matchtype=b&gad_source=1&gclid=Cj0KCQiA5fetBhC9 AP1UMgGKiDXrQsYbJraSf6a3crBveN-a2c74lIpCCGzoRDovxmvHQHTOGMaAo4WEALw_wc](https://www.udemy.com/topic/Analytical-Chemistry/?utm_source=adwords&utm_medium=udemyads&utm_campaign=LongTail%20la.EN%20cc.I&utm_content=deal4584&utm_term=.ag%2078754165093%20ad%20535700196361%20kw%20analytical%20mistry%20course%20de%20c%20dm%20pl%20ti%20kwd-363163594481%20li%209070209%20pd%20.&matchtype=b&gad_source=1&gclid=Cj0KCQiA5fetBhC9AP1UMgGKiDXrQsYbJraSf6a3crBveN-a2c74lIpCCGzoRDovxmvHQHTOGMaAo4WEALw_wc)

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| 6. The Analytical Abstracts database (http://www.rsc.org/CFAA/AASearchPage.cfm) |
| 7. The Analytical Forum on ChemWeb (http://analytical.chemweb.com/search/search.exe) |

X. Course Policies: (Based on the Uniform Students' By law (2007))

1	Class Attendance: Class Attendance is mandatory. A student is considered absent and shall be banned from taking the final exam if his/her absence exceeds 25% of total classes.
2	Tardiness: A student will be considered late if he/she is not in class after 10 minutes of the start time of class.
3	Exam Attendance/Punctuality: No student shall be allowed to the exam hall after 30 minutes of the start time, and shall not leave the hall before half of the exam time has passed.
4	Assignments & Projects: Assignments and projects must be submitted on time. Students who delay their assignments or projects shall lose the mark allocated for the same.
5	Cheating: Cheating is an act of fraud that results in the cancelation of the student's exam or assignment. If it takes place in a final exam, the penalties stipulated for in the Uniform Students' Bylaw (2007) shall apply.
6	Forgery and Impersonation: Forgery/Impersonation is an act of fraud that results in the cancelation of the student's exam, assignment or project. If it takes place in a final exam, the penalties stipulated for in the Uniform Students' Bylaw (2007) shall apply.
7	Other policies: The University official regulations in force will be strictly observed and students shall comply with all rules and regulations of the examination set by the Department, Faculty and University Administration.

Faculty of Clinical Pharmacy

Bachelor of Clinical Pharmacy & Pharm. D.

Course Plan (Syllabus) of Pharmaceutical Analytical Chemistry

Course Code. 02.04.246

I. Information about Faculty Member Responsible for the Course:						
Name of Faculty Member:	Dr. Abdulelrah Thabet			Office Hours		
Location & Telephone No.:						
E-mail:				SAT	SUN	MON TUE WED THU

2022

II. Course Identification and General Information:

1.	Course Title:	Pharmaceutical Analytical Chemistry			
2.	Course Code:	02.04.246			
3.	Credit Hours:	Credit Hours	Theory Contact Hours		Practical Contact Hours
			Lecture	Tutorial /Seminar	Lab
		3	2		2
4.	Level/ Semester at which this Course is offered:	2 nd Level / 1 st Semester			
5.	Pre –Requisite (if any):	General Chemistry			
6.	Co –Requisite (if any):	-			
7.	Program (s) in which the Course is Offered:	Bachelor of Clinical Pharmacy & Pharm. D.			
8.	Language of Teaching the Course:	English			
9.	Location of Teaching the Course:	Faculty of Clinical Pharmacy			
10.	Prepared by:	Dr. Abdulelah Thabet			
11.	Date and Number of Approval by Council:	2022			

III. Course Description:

This course designed together with the laboratory section to cover the basic principles and general concepts of the pharmaceutical analytical chemistry. Its purpose is to give students a strong foundation about qualitative and quantitative analysis methods, methods expressing of the concentrations, principles of volumetric analysis, acid-base titration equilibria, Precipitation titration, complex metric titration, and oxidation-reduction titration analysis methods). The course will also cover the practical applications of these methods to pharmaceutical compounds.

IV. Course Intended Learning Outcomes (CILOs) :

Upon successful completion of the Course, student will be able to:

A. Knowledge and Understanding:

- | | |
|----|--|
| a1 | Recognize the basic principle of pharmaceutical analytical chemistry and the important terminology used in pharmaceutical analysis. |
| a2 | Describe different qualitative analysis methods, procedures, and their use for identification of drugs, and mention their advantage and disadvantages. |
| a3 | Identify the required calculations that are used in drugs analysis |

B. Intellectual Skills:

- | | |
|----|---|
| b1 | Select the suitable method for determination of different of pharmaceutical raw materials and final drug products depending on their chemical nature. |
| b2 | Calculate the concentration of different method of quantitative analysis and present the results. |
| b3 | Determine the functional groups that effect on acidity and basicity of pharmaceutical compounds and predict the pH of the compounds. |

C. Professional and Practical Skills:

- | | |
|----|---|
| c1 | Operate different pharmaceutical instrument and equipment in the lab effectively. |
| c2 | Practice the qualitative and quantitative estimation of pharmaceutical substances. |
| c3 | Summarize results of an analytical experiment, and the conclusions drawn from these results, in a written lab report. |

D. Transferable Skills:

- | | |
|----|---|
| d1 | Work independently or as a team member and effectively communicate with the teaching staff and colleagues to perform the report on results of an analytical experiment. |
| d2 | Manage the time in an work effectively. |
| d3 | |

V. Course Contents:

A. Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	Contact Hours
1.	Introduction to	a1-2, b1-2,	- Definitions, Classifications, and types	1	2

	analytical chemistry	d1	- of analytical Methods. - Qualitative and quantitative analysis. - Electrolytes may be classified volumetric methods:		
2.	Solutions and Different Concentration definitions & expressions		- Solution types, Electrolytes Classifications & types - Concentration definitions & expressions: Strength of a Solution, Percentage (W/V, W/W & V/V), Mole Fraction, molarity, normality, molality, dilution, ppm, ppb, - Relation between different expressing the concentrations.	3	6
3.	Volumetric methods of analysis and titrations	a1-2, b1-2, d1	Definition, tools, types and Principle of volumetric analysis and titrations.	1	2
4.	Neutralization Reactions (Acid - base titration)	a1,a4,b3, d1-3	- Chemical equilibria - Acid - base titration in aqueous medium: -Arrhenius, Pronsted & 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. - Neutralization titrations and acid base systems in aqueous medium: - Titration of strong acids and bases - Titration of weak acids and bases. - Preparation of standard solutions - Pharmaceutical applications	3	6
5.	Mid Exam	a1-2, b1-2		1	2
6.	Precipitation reactions & titrations	a1-2, b1-2, d1	- Fundamentals of precipitation titration - Solubility Rules - Precipitation Methods (Mohar's , Volahard's and Vajan's method) - Advantages and disadvantages of precipitation titration. - Precipitation titration curve. - Evaluate the precipitation titrations. - Pharmaceutical Applications	2	4
7.	Complexation reactions and titrations		- Fundamentals of complex formation reactions and complexing agents. - Mechanism of complex formation reaction and the methods used for equivalent point detection. - Effect of pH on the formation of metal ions complexes.	2	4

			- Complex formation titration curve. - The importance of EDTA particularly in the determination of water hardness. - Applications of complex formation reactions in Pharmaceutical.		
8.	Redox reactions & titrations	a1-2, b1-2, d1	- Concepts of oxidation and reduction reactions & titrations, oxidizing and reducing agents in a redox reaction and Balance redox reaction equations. - Role of standard potential in expecting the completeness and the direction of a redox reaction & and write the symbol for a galvanic cell reaction - Calculate the electrode potential, equilibrium constant K_{eq} for a redox reaction and the potential of the titrated solution at any point during the titration. - Indicator for the redox titration - Redox titration curves, redox indicators, & factors affecting the redox titration. - Pharmaceutical applications.	2	4
9.	Final Exam			1	2
Number of Weeks /and Units Per Semester				16	32

B. Case Studies and Practical Aspect:

No.	Tasks/ Experiments	Number of Weeks	Contact Hours
1	- Calibration of volumetric apparatus	1	2
2	- Preparation and standardization of HCl and NaOH solutions	1	2
3	- Acid-base titrations (Assay of sodium bicarbonate)	1	2
4	- Acid-base titrations (Assay of benzoic acid)	1	2
5	- Preparation and standardization of perchloric acid	1	2
6	- Mid-Exam	1	2
7	- Preparation and standardization of ammonium thiocyanate solution.	1	2
8	- Preparation and standardization of a silver nitrate solution.	1	2
9	- Precipitation titrations (Assay of sodium chloride)	1	2
10	- Preparation and standardization of EDTA solution	1	2
11	- Compleximetric titrations (Assay of Calcium lactate)	1	2
12	- Preparation and standardization of ceric ammonium sulphate solution	1	2
13	- Preparation and standardization of potassium permanganate solution	1	2
14	- Preparation and standardization of potassium iodide solution	1	2
15	- Redox titrations (Assay of hydrogen peroxide)	1	2
16	- Final Exam	1	2
Number of Weeks /and Units Per Semester		16	32



No.	Tasks/ Experiments	Number of Weeks	Contact Hours
1	- Calibration of volumetric apparatus	1	2
2	- Preparation and standardization of HCl and NaOH solutions	1	2
3	- Acid-base titrations (Assay of sodium bicarbonate)	1	2
4	- Acid-base titrations (Assay of benzoic acid)	1	2
5	- Preparation and standardization of perchloric acid	1	2
6	- Mid-Exam	1	2
7	- Preparation and standardization of ammonium thiocyanate solution.	1	2
8	- Preparation and standardization of a silver nitrate solution.	1	2
9	- Precipitation titrations (Assay of sodium chloride)	1	2
10	- Preparation and standardization of EDTA solution	1	2
11	- Compleximetric titrations (Assay of Calcium lactate)	1	2
12	- Preparation and standardization of ceric ammonium sulphate solution	1	2
13	- Preparation and standardization of potassium permanganate solution	1	2
14	- Preparation and standardization of potassium iodide solution	1	2
15	- Redox titrations (Assay of hydrogen peroxide)	1	2
16	- Final Exam	1	2
Number of Weeks /and Units Per Semester		16	32

VI. Teaching Strategies of the Course:

- Lecture
- Instructor – student Interactive
- Exercises
- Presentation
- Office hours
- Seminar
- Assignment
- Self-Learning

VII. Assessment Methods of the Course:

- Assignments
- Quiz
- Exam
- Oral Presentation

VIII. Assignments:

No.	Assignments	Week Due	Mark
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No.	Assignments	Week Due	Mark
1	Assignment 1		2.5
2	Assignment 2:		2.5
Total			

IX. Schedule of Assessment Tasks for Students During the Semester:

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1	Assignments	6th, 12th	5	5%	All CILOs
2	Practical Reports	2 nd -13 th	5	5%	c1-c3,d1
3	Midterm Exam (Theory)	Week 7	15	20%	a1-2, b1-2, d1
	Midterm Exam (Practical)	Week 7	10	10%	c1-c3,d1
4	Final Practical Exam	14 th	15	15%	c1-c3,d1
5	Final Exam (Theory)	Week 16	50	50%	a1-2, b1-2, d1
Total			100	100%	

X. Learning Resources:

1- Required Textbook(s):

- 1- Pharmaceutical analysis: a textbook for pharmacy students and pharmaceutical chemists. 5th Edition, D. G. Watson. Churchill Livingstone. Edinburgh, Elsevier, 2020.
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- 3- Vogel's Textbook of qualitative chemical analysis, 5th edition, G H Jeffery, J Bassatt, J Mendham, R C Denny, 1979. Longman group UK Limited, London, England.

2- Essential References.

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3- Electronic Materials and Web Sites *etc.*

1. J. Pharm. & Biomed. Anal.
2. J. Assoc. off Anal. Chem.
3. <https://asplib.org/>
4. <https://www-library.ch.cam.ac.uk/list-useful-databases>
5. https://www.udemy.com/topic/Analytical-Chemistry/?utm_source=adwords&utm_medium=udemyads&utm_campaign=LongTail_la.EN_cc.I&utm_content=deal4584&utm_term=.ag_78754165093_.ad_535700196361_.kw_analytical%&utm_content=deal4584&utm_term=.ag_78754165093_.ad_535700196361_.kw_analytical%20course_.de_c_.dm_.pl_.ti_kwd-363163594481_.li_9070209_.pd_.&matchtype=b&gad_source=1&gclid=Cj0KCQiA5fetBhC9AP1UMgGKiDXrQsYbJraSf6a3crBveN-a2c74lIIPCCGzoRDovxmvHQHTOGMaAo4WEALw_wc
6. The Analytical Abstracts database (<http://www.rsc.org/CFAA/AASearchPage.cfm>)
7. The Analytical Forum on ChemWeb (<http://analytical.chemweb.com/search/search.exe>)

XI. Course Policies: (Based on the Uniform Students' Bylaw (2007))

1	Class Attendance: Class Attendance is mandatory. A student is considered absent and shall be banned from taking the final exam if his/her absence exceeds 25% of total classes.
2	Tardiness: A student will be considered late if he/she is not in class after 10 minutes of the start time of class.
3	Exam Attendance/Punctuality: No student shall be allowed to the exam hall after 30 minutes of the start time, and shall not leave the hall before half of the exam time has passed.
4	Assignments & Projects: Assignments and projects must be submitted on time. Students who delay their assignments or projects shall lose the mark allocated for the same.
5	Cheating: Cheating is an act of fraud that results in the cancelation of the student's exam or assignment. If it takes place in a final exam, the penalties stipulated for in the Uniform Students' Bylaw (2007) shall apply.
6	Forgery and Impersonation: Forgery/Impersonation is an act of fraud that results in the cancelation of the student's exam, assignment or project. If it takes place in a final exam, the penalties stipulated for in the Uniform Students' Bylaw (2007) shall apply.
7	Other policies: The University official regulations in force will be strictly observed and students shall comply with all rules and regulations of the examination set by the Department, Faculty and University Administration.