Course Specification of Pharmaceutical Instrumental Analysis I

I. Course Identification and General Information:

1	**Course Title**	Pharmaceutical Instrumental Analysis I				
2	**Course Number & Code:**	Ph567				
3	**Credit hours:**	**C.H**				**Total**
		Th.	**Pr.**	**Tr.**	**Seminar.**	
		2	**2**			**3**
4	**Study level/ semester at which this course is offered:**	3rd level / 2nd semester				
5	**Pre –requisite (if any):**	Pharmaceutical Analytical Chemistry I & II				
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	**The department in which the course is offered:**	Department of Medicinal Chemistry, Pharmaceutical Organic and Analytical Chemistry				
10	**Location of teaching the course:**	Faculty of Pharmacy				

الموصف	نائب العميد لشؤون الجودة	رئيس القسم	عميد الكلية	عميدة مركز التطوير وضمان الجودة	رئيس الجامعة
د. يحيى الدخين	ا.د. محمود البريهي	ا.م.د.توفيق العبيدي	د.خالد الشوبة	ا.م.د. هدى العماد	ا.د. القاسم محمد عباس د. محمد عباس

11	**Prepared by:**	Dr. Yahya AL-Dokhain, Dr. Mohammed Hamidaddin
12	**Date of approval:**	

II. Course description:

The course aims to provide students with basic knowledge about the instrumental analysis of pharmaceutical substances. It focuses on the different spectroscopic methods of analysis. The course also covers the applications of these methods for some pharmaceutical substances.

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

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

1. Mention the basic principle of instrumental analysis of pharmaceutical substances and pharmaceutical preparations.
2. Explain the advantages and disadvantages different spectroscopic methods of analysis.
3. Recognize the applications of different spectroscopic methods of analysis.
4. Choose the appropriate spectroscopic methods of analysis for different pharmaceutical substances and pharmaceutical preparations.
5. Illustrate spectroscopic methods of analysis.
6. Analyze and interpret the results of spectroscopic methods of analysis
7. Operate different pharmaceutical instruments and equipments in the lab.
8. Practice spectroscopic methods for analysis of pharmaceutical substances and pharmaceutical preparations.
9. Handle and dispose the chemical and pharmaceutical preparations safely and effectively.
10. Communicate and cooperate effectively with the others as a team work to perform the report on the results of the method of analysis.
11. Apply the information technology skills, such as word processing and internet communication and online searches.
12. Manage the time in 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 abl to:	
A1-	Recognize the principles of physical, chemical, clinical, social, behavioral, health and pharmaceutical sciences.	**a1-**	Mention the basic principle of instrumental analysis of pharmaceutical substances and pharmaceutical preparations.
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	**a2-**	Explain the advantages and disadvantages different spectroscopic methods of analysis.
		a3-	Recognize the applications of different spectroscopic methods of 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-	Mention the basic principle of instrumental analysis of pharmaceutical substances and pharmaceutical preparations.	Lectures method, group discussion and tutorial	

a2-	Explain the advantages and disadvantages different spectroscopic methods of analysis.		Oral Exam, homework, report, Quizzes, Short answers and Written exam
a3-	Recognize the applications of different spectroscopic methods of 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:**	
B1-	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.	**b1-**	Choose the appropriate spectroscopic methods of analysis for different pharmaceutical substances and pharmaceutical preparations.
B3-	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.	**b2-**	Illustrate spectroscopic methods of analysis.
		b3-	Analyze and interpret the results of spectroscopic methods of analysis

Teaching And Assessment Methods For Achieving Learning Outcomes:

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

***Course Intended Learning Outcomes (*CILOs*) in* Intellectual Skills.** **After participating in the course, students would be able to:**	**Teaching strategies/methods to be used.**	***Methods of assessment***

b1-	Choose the appropriate spectroscopic methods of analysis for different pharmaceutical substances and pharmaceutical preparations.	Lectures method, group discussion and tutorial	Oral Exam, homework, report, Quizzes, Short answers and Written exam
b2-	Illustrate spectroscopic methods of analysis.		
b3-	Analyze and interpret the results of spectroscopic methods of analysis.		

(C) Professional and Practical Skills.

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

Program Intended Learning Outcomes (Sub- PILOs) in Professional and Practical Skills		Course Intended Learning Outcomes (CILOs) in Professional and Practical Skills	
After completing this program, students would be able to:		**After participating in the course, students would be able to:**	
C1-	Operate different pharmaceutical equipments and instruments and use emerging technologies in design, synthesis, pre-formulation, formulation, packaging, storage and analysis of pharmaceutical products according to GLP, GSP and cGMP guidelines.	**c1-**	Operate different pharmaceutical instruments and equipments in the lab.
C2-	Handle and dispose chemicals and pharmaceutical preparations safely and effectively.	**c2-**	Practice spectroscopic methods for analysis of pharmaceutical substances and pharmaceutical preparations.
		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 instruments and equipments in the lab.	Lectures method, group discussion and practical sessions	Oral Exam, homework, report, Quizzes, hort answers and Written exam
c2-	Practice spectroscopic methods for analysis of pharmaceutical substances and pharmaceutical preparations.		
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
After completing this program, students would be able to:	**After participating in the course, students would be able to:**

D2-	Employ proper documentation and filing systems in different pharmaceutical fields	**d1-**	Communicate and cooperate effectively with the others as a team work to perform the report on the results of an analytical method.
D5-	Apply information and communication technology and working effectively in a team.	**d2-**	Manage the time in work effectively.
		d3-	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 After participating in the course, students would be able to:		Teaching strategies/methods to be used.	Methods of assessment
d1-	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 answers and Written exam
d2-	Manage the time in work effectively.		
d3-	Apply the information technology skills, such as word processing and internet communication and online sear		

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 Pharmaceutical Instrumental Analysis**	a1, d1-3	- Definitions, Classifications and types of Instrumental Analysis - Instrumental methods of analysis-Advantages, comparison with other methods of analysis.	1	2

2.	**Spectroscopic methods**	a1, b1-3, d1-3	Electromagnetic radiation: Nature of electromagnetic radiation, the interaction between energy and matter, application of quantum mechanics theory, the absorption and emission of radiant energy by atoms and molecules.	1	2
3.	**UV-Visible spectroscopy** :	a1-3,b1-3, d1-3	Origin of UV spectra, chromophores and auxochromes, bathochromic and hypsochromic shift , choice of solvents, Beer-Lambert's Law, methods of color development, Instrumentation- single and double beam spectrophotometers. Single component analysis, Simultaneous spectrophotometry, Derivative spectrophotometry. Pharmaceutical Applications	2	4
4.	**Spectrofluorimetry**:	a1-3,b1-3, d1-3	- Definition, principles, instrumentation and pharmaceutical applications	1	2
5.	**Chemillumenscence**	a1-3,b1-3, d1-3	Definition, principles, instrumentation and pharmaceutical applications	1	2
6.	**Mid Exam**	a1-3,b1-3		1	2
7.	**Atomic absorption. flame emission spectroscopy**	a1-3,b1-3, d1-3	Definition, principles, instrumentation and pharmaceutical applications	2	4
8.	**Infra-red spectroscopy**	a1-3,b1-3, d1-3	-Theory, modes of vibration in polyatomic molecules, fingerprint and group frequency region, absorption frequencies of important organic functional groups, Instrumentation – single and double beam spectrophotometers, FTIR, pharmaceutical applications	2	4

9.	**H^1-NMR and C^{13} NMR**	a1-3,b1-3, d1-3	-Definition, principles, instrumentation-Nuclear Magnetic Resonance Spectroscopy (1H NMR and 13C NMR): Introduction, instrumentation , proton equivalent, coupling, chemical shift, intergration, J-coupling -pharmaceutical applications	2	4
10.	**Mass Spectroscopy:**	a1-3,b1-3, d1-3	Definition, principles, instrumentation, rules of fragmentation pattern pharmaceutical applications	2	4
	Final Exam	a1-3, 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 curve	c1-3, **d1-3**	1	2
2.	Location of λ max, determination of molar absorptivity and specific absorptivity, verification of Beer's law	c1-3, **d1-3**	2	4
3.	Study the effect of solvent / pH on λ max.	c1-3, **d1-3**	1	2
4.	UV-Spectrophotometric determination of Ciprofloxacin	c1-3, **d1-3**	1	2
5.	Vis-Spectrophotometric determination of diclofenac sodium	c1-3, **d1-3**	1	2
6.	Mid-Exam	c1,c2, c3	1	2
7.	Assignment of important absorption bands of indomethacin using IR spectroscopy	c1-3, **d1-3**	1	2

8.	Assignment of important absorption bands of phenobarbital using IR spectroscopy	c1-3, **d1-3**	1	2
9.	**IR analysis of caffeine**	c1-3, **d1-3**	1	2
10.	**Practice the explanation of ^{1}H NMR and ^{13}C NMR of some pharmaceutical substances.**	c1-3, **d1-3**	3	6
11.	**Practice the fragmentation of mass spectra of some pharmaceutical substances.**	c1-3, **d1-3**	2	4
12.	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 ,b1,b2, d1-3
2	**Oral Tests and Homeworkassignments**	Sporadic through the semester	10	7%	a2, b1-3, d1-3
3	**Attendance, Practical Reports and Practical mid-semester exam**	7th	30	20%	c1-3
5	**Theoretical mid-semester exam**	7th	30	20%	a1-3, b1-3
6	**Final Exam (theoretical)**	**16th**	50	33%	a1-3, b1-3
7	**Final Exam (practical)**	**16th**	20	13%	c1-3
	Total		**150**	**100%**	

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,,8th 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, 5th edition, Longman group UK Limited, London, England.

3-F.W. Fifield and D. Kealey, 2000, "Principles and Practice of Analytical Chemistry" 5thEdition, Blackwell Science, London.

2- Recommended Books and Reference Materials.

1- DEAN'S , 2004. Analytical Chemistry Handbook, 2nd 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, ,SpringerVerlag 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.
6. chemweb.com/search/search.exe)

I. Facilities Required:

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

1 - Accommodation:	- Well-equipped lecture halls with data show facilities, whiteboards, net connection, etc. - Well-equipped laboratories with all required equipment and reagents.
2 - Computing resources:	- Computer laboratory with internet facilities.

II. Course Improvement Processes:

1- Strategies for obtaining student feedback on effectiveness of teaching

- Student-based assessment of the effectiveness of teaching using a questionnaire designed by the Quality Assurance Unit at the end of the semester.
- Meeting with students and faculty (once per semester).

2- Other strategies for evaluation of teaching by the instructor or by the department.

- 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.
- Regular meeting and discussion of the course content between the Head of Department and the teaching staff of the course (for theory and practice).

3- Processes for improvement of teaching.

- 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.
- 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.

4- Processes for verifying standards of students' achievement

	▪ Checking of a sample of students' work by an independent faculty member. ▪ Periodic exchange and check marking of a sample of students' assignments with a faculty member from another institution. ▪ Adoption of scoring rubrics to assess the students' achievement (both for ongoing or summative assessments). ▪ Regular follow-up of laboratory logbooks to assess the practical achievement of students.
5- Procedures for periodically reviewing of course effectiveness and planning for improvement	
	▪ Student rating and feedback ▪ Peer rating and feedback ▪ Regular meeting of the Curriculum Committee of the faculty.
6- Course development plans	
	▪ Conducting regular workshops for the staff for improving their course specification skills. ▪ Regular revision of course specification and syllabus items.

VIII. Course Policies: (including plagiarism, academic honesty, attendance etc)	
The University Regulations on academic misconduct will be strictly enforced. Please refer to ----------	
1	**Class Attendance:** ▪ 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.
2	**Tardy:** - 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.

3	**Exam Attendance/Punctuality:** ▪ Exam attendance is obligatory unless being excused by the department and faculty.
	▪ Absence from assignments or exams will be dealt with according to the general policy of the university.
4	**Assignments & Projects:** ▪ Assignments: Written and oral; Laboratory logbook signed by the responsible demonstrator. ▪ Projects: Not applicable.
5	**Cheating:** ▪ Punishment of cheating will be according to the general policy of the university in this respect.
6	**Plagiarism:** ▪ 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.
7	**Other policies:** ▪ General policies of the Students' Affairs of the University and the Quality Assurance Unit.

Course Plan of Pharmaceutical Instrumental Analysis 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
E-mail			h				

II- Course Identification and General Information:

1-	Course Title:	Pharmaceutical Instrumental Analysis I				
2-	Course Number & Code:	Ph567				
3-	Credit hours:	C.H				Total
		Th.	Seminar	Pr.	F. Tr.	
		2	-	2		3
4-	Study level/year at which this course is offered:	3rd level /2nd semester				
5-	Pre –requisite (if any):	Pharmaceutical analytical chemistry I&II				
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				

الموصف نائب العميد لشؤون الجودة رئيس القسم عميد الكلية عميدة مركز التطوير وضمان الجودة رئيس الجامعة
د. يحيى الدخين ا.د. محمود البريهي ا.م.د.توفيق العبيدي د.خالد الشوبة ا.م.د. هدى العماد ا.د. القاسم محمد عباس د. محمد عباس

10-	**Mode of delivery:**	Regular
11-	**Location of teaching the course:**	Faculty of Pharmacy- Sana`a university

III- Course description:

The course aims to provide students with basic knowledge about the instrumental analysis of pharmaceutical substances. It focuses on the different spectroscopic methods of analysis. The course also covers the applications of these methods for some pharmaceutical substances.

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

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

1. Mention the basic principle of instrumental analysis of pharmaceutical substances and pharmaceutical preparations.
2. Explain the advantages and disadvantages different spectroscopic methods of analysis.
3. Recognize the applications of different spectroscopic methods of analysis.
4. Choose the appropriate spectroscopic methods of analysis for different pharmaceutical substances and pharmaceutical preparations.
5. Illustrate spectroscopic methods of analysis.
6. Analyze and interpret the results of spectroscopic methods of analysis
7. Operate different pharmaceutical instruments and equipments in the lab.
8. Practice spectroscopic methods for analysis of pharmaceutical substances and pharmaceutical preparations.
9. Handle and dispose the chemical and pharmaceutical preparations safely and effectively.
10. Communicate and cooperate effectively with the others as a team work to perform the report on th results of the method of analysis.
11. Apply the information technology skills, such as word processing and internet communication and online searches.
12. Manage the time in work effectively.

13. Course Content:

1 – Course Topics/Items:

a – Theoretical Aspect

Order	Topic List / Units	CILOs (symbols)	Sub-topic List	Week Due	Contact hours
11.	**Introduction to Pharmaceutical Instrumental Analysis**	a1, d1-3	- Definitions, Classifications and types of Instrumental Analysis - Instrumental methods of analysis-Advantages, comparison with other methods of analysis.	1	2
12.	**Spectroscopic methods**	a1, b1-3, d1-3	Electromagnetic radiation: Nature of electromagnetic radiation, the interaction between energy and matter, application of quantum mechanics theory, the absorption and emission of radiant energy by atoms and molecules.	2	2
13.	**UV-Visible spectroscopy** :	a1-3,b1-3, d1-3	Origin of UV spectra, chromophores and auxochromes, bathochromic and hypsochromic shift , choice of solvents, Beer-Lambert's Law, methods of color development, Instrumentation- single and double beam spectrophotometers. Single component analysis, Simultaneous spectrophotometry, Derivative spectrophotometry. Pharmaceutical Applications	3,4	4
14.	**Spectrofluorimetry**:	a1-3,b1-3, d1-3	- Definition, principles, instrumentation and pharmaceutical applications	5	2
15.	**Chemillumenscence**	a1-3,b1-3, d1-3	Definition, principles, instrumentation and pharmaceutical applications	6	2
16.	**Mid Exam**	a1-3,b1-3		7	2
17.	**Atomic absorption. flame emission spectroscopy**	a1-3,b1-3, d1-3	Definition, principles, instrumentation and pharmaceutical applications	8,9	4

18.	**Infra-red spectroscopy**	a1-3,b1-3, d1-3	-Theory, modes of vibration in polyatomic molecules, fingerprint and group frequency region, absorption frequencies of important organic functional groups, Instrumentation – single and double beam spectrophotometers, FTIR, pharmaceutical applications	10,11	4
19.	**H^1-NMR and C^{13} NMR**	a1-3,b1-3, d1-3	-Definition, principles, instrumentation-Nuclear Magnetic Resonance Spectroscopy (1H NMR and 13C NMR): Introduction, instrumentation , proton equivalent, coupling, chemical shift, intergration, J-coupling -pharmaceutical applications	12,13	4
20.	**Mass Spectroscopy:**	a1-3,b1-3, d1-3	Definition, principles, instrumentation, rules of fragmentation pattern pharmaceutical applications	14,15	4
	Final Exam	a1-3, b1-3		16	2
Number of Weeks /and Units Per Semester				**16**	**32**

b - Practical Aspect

Order	Tasks/ Experiments	CILOs (symbols)	Week Due	Contact Hours
13.	Calibration curve	c1-3, **d1-3**	1	2
14.	Location of λ max, determination of molar absorptivity and specific absorptivity, verification of Beer's law	c1-3, **d1-3**	2,3	4
15.	Study the effect of solvent / pH on λ max.	c1-3, **d1-3**	4	2
16.	UV-Spectrophotometric determination of Ciprofloxacin	c1-3, **d1-3**	5	2
17.	Vis-Spectrophotometric determination of diclofenac sodium	c1-3, **d1-3**	6	2

18.	Mid-Exam	c1,c2, c3	7	2
19.	Assignment of important absorption bands of indomethacin using IR spectroscopy	c1-3, **d1-3**	8	2
20.	Assignment of important absorption bands of phenobarbital using IR spectroscopy	c1-3, **d1-3**	9	2
21.	**IR analysis of caffeine**	c1-3, **d1-3**	10	2
22.	**Practice the explanation of ^{1}H NMR and ^{13}C NMR of some pharmaceutical substances.**	c1-3, **d1-3**	11-13	6
23.	**Practice the fragmentation of mass spectra of some pharmaceutical substances.**	c1-3, **d1-3**	14-15	4
24.	Final Exam	**c1-3**	16	2
Number of Weeks /and Units Per Semester			**16**	**32**

14. Teaching strategies of the course:

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

15. Assignments:

- Homework
- Reports

16. 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 ,b1,b2, d1-3
2	**Oral Tests and Homeworkassignments**	Sporadic through the semester	10	7%	a2, b1-3, d1-3
3	**Attendance, Practical Reports and Practical mid-semester exam**	7th	30	20%	c1-3
5	**Theoretical mid-semester exam**	7th	30	20%	a1-3, b1-3
6	**Final Exam (theoretical)**	**16th**	50	33%	a1-3, b1-3
7	**Final Exam (practical)**	**16th**	20	13%	c1-3
	Total		**150**	**100%**	

17. Students' Support:

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

18. 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,,8th 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, 5th edition, Longman group UK Limited, London, England.

3-F.W. Fifield and D. Kealey, 2000, "Principles and Practice of Analytical Chemistry" 5thEdition, Blackwell Science, London.

2- Recommended Books and Reference Materials.

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6- DEAN'S , 2004. Analytical Chemistry Handbook, 2nd 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.
12. chemweb.com/search/search.exe)

III. Facilities Required:

1 - Accommodation:	- Well-equipped lecture halls with data show facilities, whiteboards, net connection, etc. - Well-equipped laboratories with all required equipment and reagents.
3 - Computing resources:	- Computer laboratory with internet facilities.

IV. Course Improvement Processes:

6- Strategies for obtaining student feedback on effectiveness of teaching

- Student-based assessment of the effectiveness of teaching using a questionnaire designed by the Quality Assurance Unit at the end of the semester.
- Meeting with students and faculty (once per semester).

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

7- Other strategies for evaluation of teaching by the instructor or by the department.	
	▪ 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. ▪ Regular meeting and discussion of the course content between the Head of Department and the teaching staff of the course (for theory and practice).
8- Processes for improvement of teaching.	
	▪ 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. ▪ 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.
9- Processes for verifying standards of students' achievement	
	▪ Checking of a sample of students' work by an independent faculty member. ▪ Periodic exchange and check marking of a sample of students' assignments with a faculty member from another institution. ▪ Adoption of scoring rubrics to assess the students' achievement (both for ongoing or summative assessments). ▪ Regular follow-up of laboratory logbooks to assess the practical achievement of students.
10- Procedures for periodically reviewing of course effectiveness and planning for improvement	
	▪ Student rating and feedback ▪ Peer rating and feedback ▪ Regular meeting of the Curriculum Committee of the faculty.
6- Course development plans	

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	▪ Conducting regular workshops for the staff for improving their course specification skills. ▪ Regular revision of course specification and syllabus items.

IX. Course Policies: (including plagiarism, academic honesty, attendance etc)

The University Regulations on academic misconduct will be strictly enforced. Please refer to ----------

1	**Class Attendance:** ▪ 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.
2	**Tardy:** - 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.
3	**Exam Attendance/Punctuality:** ▪ Exam attendance is obligatory unless being excused by the department and faculty. ▪ Absence from assignments or exams will be dealt with according to the general policy of the university.
4	**Assignments & Projects:** ▪ Assignments: Written and oral; Laboratory logbook signed by the responsible demonstrator. ▪ Projects: Not applicable.
5	**Cheating:** ▪ Punishment of cheating will be according to the general policy of the university in this respect.
6	**Plagiarism:** ▪ 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.

7	**Other policies**: ▪ General policies of the Students' Affairs of the University and the Quality Assurance Unit.