



<b>Course Name:</b> Radiopharmacy	إسم المقرر: المستحضرات الصيدلانية المشعة
<b>Course Code &amp; No.:</b> 332 PHC	رقم المقرر ورمزه: 332 كمص
<b>Credits:</b> 1(1+0+0)	عدد الساعات: 1(1+0+0)
<b>Prerequisite:</b> 320 PHC	المتطلب: 320 كمص
<b>Level:</b> 7	المستوى: 7

**Course Description:**

This course will deal with the atomic & nuclear structure and, the reasons that lead to phenomenon of radioactivity. This also includes the radioactivity detectors, production of radioisotopes, preparation and, quality control of radiopharmaceuticals anlong with their specific use in different physiological conditions. The radiation hazards involved with radiation exposure and, protection from them will also be imparted.

**Course Objectives:**

- Understanding the radioactivity, radionuclide decay and, half life of radioisotopes.
- Acquire the knowledge and, skills to produce and, appropriately use radioisotopes & radiopharmaceuticals in research and/or, in clinical applications.

**Learning Outcomes:**

Upon successful completion of this course, students will be able to deal :

**1. Knowledge**

- 1.1 Describe different techniques to produce and, identify different radioisotopes and, radiopharmaceuticals
- 1.2 Describe radiation and, types of particles emitted from radionuclide.
- 1.3 Recognize the hazards involved with radiation exposure and, recommend precautionary measures.

**2. Cognitive Skills**

- 2.1 Differentiate among types of radioactivity detectors & counters and, judge their applicability.

**4. Communication, IT and Numerical Skills**

- 4.1 Calculate the half-life of radionuclide and, decipher the labels on radiopharmaceuticals.

**Course Contents:**

- Atomic structure (electronic structure of the atom, nuclear structure, the difference between chemical reactions and nuclear reactions)
- Isotopes (stable and radioactive isotopes, naturally occurring and artificially produced isotopes)
- Radioactive decay (decay mechanisms, radioactivity, definition, units and calculations, decay equations (transmutations, half-life and its significant, 14C Dating).
- Instruments and detectors for measuring radioactivity (Gas-filled detectors, liquid scintillators, solid scintillators, gamma counters and cameras).
- Production of radionuclides (reactors, cyclotron, generators)
- Radiolabeling
- Pharmacopoeial Monographs (British Pharmacopoea "BP", European Pharmacopoea "EP", United States Pharmacopoea "USP")
- Identification tests
- (99mTc and 123I human serum albumin by electrophoresis, 14C Urea by chromatography)



- Quality control of radiopharmaceuticals (radiochemical purity systems for radiopharmaceuticals, TLC for technetium radiopharmaceuticals, TLC for other radiopharmaceuticals, solid phase extraction cartridge methods)
- Formulary Section (non-radioactive reagents and diluents, radiopharmaceuticals, Technetium labeled denatured RBCs, Technetium in vitro labeling of RBCs, radiopharmaceuticals for gastric emptying, methods for concentrating 99mTc generator eluate)
- Adverse reactions and effects (adverse reactions and symptoms following administration, Unanticipated biodistribution of radiopharmaceuticals)

**Text Book(s):**

Textbook of Radiopharmacy. Theory and Practice. Ed CB Sampson. Gordon and Breach  
Radiopharmaceutical in Nuclear Pharmacy and Nuclear Medicine, Amazon, 2nd edition

**Additional suggested readings:**

Fundamentals of Nuclear Pharmacy, 6th Ed. Gopal B Saha, Springer, New York.  
The Radiopharmacy, A Technologist's Guide, EANM (European Association of Nuclear  
Medicine), Lantheus Medical Imaging, USA

<b>Course Name:</b> Pharmacopoeial Analysis	إسم المقرر: التحليل الدستوري
<b>Course Code &amp; No.:</b> 327 PHC	رقم المقرر ورمزه: 327 كمص
<b>Credits:</b> 4 (3+1+0)	عدد الساعات: 4(3+1+0)
<b>Prerequisite:</b> 124 PHC	المتطلب: 124 كمص
<b>Level:</b> 6	المستوى: 6

### Course Description:

The course is designed to teach the student how to use the pharmacopoeia, specially USP, BP and, EP. First, the student is entitled to know how to know the purity and, identify a pharmaceutical compound based on its physico-chemical properties in relation to different pharmacopoeial standards. Second, to check the trace elements presence in these compounds by applying limit tests. Third, how to assay the composition of a pharmaceutical compound *per se* or, in pharmaceutical preparation and, in a heterogeneous mixture. The course will also include introduction to statistical evaluation of data.

### Objectives:

- To give pharmacy students an understanding of the pharmacopoeial requirements which governs drug analysis.
- Equip students with analytical techniques required for pharmacopoeia-based analyses.

### Learning Outcomes:

Upon successful completion of this course, students will be able to:

#### 1. Knowledge

1.1 Describe the identity of pharmaceutical compounds through their physical and/or physicochemical properties.

#### 2. Cognitive Skills

2.1 Estimate the assay of pharmaceutical compounds in their pure and, mixture forms.

#### 5. Psychomotor Skills

5.1 Ability to employ HPLC methods and, evaluate chromatograms.

5.2 Examine the purity of pharmaceutical products.

### Course Contents:

- Introduction to the pharmacopoeias (definitions, abbreviation terms and history of pharmacopoeias)
- How to use the pharmacopoeia?
- Methods of analysis: (refractive index, optical rotation, absorption spectrophotometry, infrared, ultraviolet and visible, nuclear magnetic resonance, circular dichroism, thin layer chromatography, gas chromatography, liquid chromatography, size-exclusion chromatography, super critical fluid chromatography, density of solids, capillary electrophoresis).

- Limit tests (limit tests for anions (chloride, sulfate, phosphate), limit tests for cations (heavy metals, iron, calcium, potassium, ammonium, aluminum))
- Limit tests for related compounds (HPLC methods for identification and determination of related compounds, potentiometric and amperometric determination of related compounds, spectrophotometric methods for the determination of related compounds).
- Statistical evaluation of data (introduction, randomization and independence of individual treatment, assay depending upon quantitative responses, assay depending upon quantal responses, combination of assay results)
- Miscellaneous methods of analysis (Karl-Fischer method for the determination of water content in pharmaceutical compounds, Oxygen-flask method for the determination of organically-combined elements (halogens, sulfur, phosphorous, zinc, mercury, etc), Kjeldal method for the determination of organically-combined nitrogen in vaccines, diazometric determination of pharmaceutical compounds containing primary amino group, e.g., sulfonamides)

#### Practical Schedule:

- How to use the pharmacopoeia? How to read the pharmacopoeial monograph?
- Limit tests for acid radicals.
- Limit tests for basic radicals and, heavy metals.
- Limit for related substances in pharmaceutical compounds using HPLC (limit of 2-chloroethylamine in ifosfamide).
- Limit of related substances in pharmaceutical compounds using potentiometry (chloride ion in melphalan, chloride ion in ifosfamide).
- Limit of related compounds in pharmaceutical compounds using spectrophotometry (limit of salicylic acid in aspirin, limit of phenolic compounds in aspirin, limit of metaproterenone in metaproterenol)
- Diazometric determination of sulfonamides.
- Determination of water-content in pharmaceutical compounds using Karl-Fischer method.
- Analysis of cycloserine capsules, analysis of captopril tablets.
- Atomic absorption spectroscopic determination of zinc in insulin
- Polarimetric analysis and identification of pharmaceutical compounds.

#### Text Book(s)/Referrals:

Pharmaceutical Drug Analysis, 2nd ed, Ashutosh Kar, New Age Publications, New Delhi.  
Pharmaceutical Analysis: A Textbook for Pharmacy Students and Pharmaceutical Chemists, David G. Watson, Churchill Livingstone.  
Modern Analytical Chemistry, David Harvey, McGraw-Hill.

#### Additional suggested readings:

The United States Pharmacopoeia. The US Pharmaceutical Convention, Rockville.  
The British Pharmacopoeia. The Pharmaceutical Press, London.  
The European Pharmacopoeia. Council of Europe, Strasbourg.  
Practical Pharmaceutical Chemistry, A.H. Beckell and J.B. Stenlake. The Athlone Press, London.  
Vogel's Textbook of Quantitative Chemical Analysis, A I Vogel, Revised by G H Jeffery, J Bassett, J Mendham & R C Denney, Longman Scientific & Technical and, John-Wiley & Sons

## Medicinal Chemistry-II

Course Name: Medicinal Chemistry-II	إسم المقرر: الكيمياء الدوائية-2
Course Code & No.: 315 PHC	رقم المقرر ورمزه: 315 كمص
Credits:3 (2+1+0)	عدد الساعات: 3(2+1+0)
Prerequisite:225 PHC	المتطلب: 225 كمص
Level:5	المستوى: 5

### Course Description (AIM):

This course is designed to handle the relationship of chemical structure to biological activity and the general structural features required for specific mechanism of action. Topics of discussions include the effects of molecular modifications on receptor binding, distribution and metabolism as they relate to clinical response(s). Although the course outline reflects a pharmacological classification, the material covered will deal principally with the chemical, structure and biochemical properties as related to drug action at the molecular level and will relate to its therapeutic applications.

### Course Objectives:

- To provide students with knowledge and understanding of the chemistry of basic classes of medicinal agents.
- To develop the student's ability to understand mechanism of action, metabolism of medicinal drugs.
- To develop student's ability to understand the relation between structure and biological activity (SARs) of medicinal agents acting on specific target and producing pharmacological response.

### Course learning outcomes:

#### 1. Knowledge

Upon successful completion of this course, students will be able to:

- Recognize the nomenclature, physicochemical properties, chemical classification and chemical structure of medicinal agents.
- Describe the drug mechanism of action based on its chemical structure.

#### 2. Cognitive Skills

Upon successful completion of this course, students will be able to:

- Predict the effect of various substituents in a particular drug molecule with respect to biological response.
- Write the single and multistep synthesis of drug molecules from a simple chemical compound.

#### 3. Communication, Information Technology, Numerical

Upon successful completion of this course, students will be able to:

- Calculate the yield in a chemical synthesis.
- Calculate amount of active ingredient in pharmaceutical dosage forms.

#### 4. Psychomotor

Upon successful completion of this course, students will be able to:

- Perform preparation, identification, assay for some important medicinal agents.

## Course Contents:

### Theory

- Adrenergic drugs (biosynthesis and metabolism of catecholamines, stereochemistry of interaction with adrenergic receptor,  $\alpha$ -adrenergic receptors,  $\beta$ -adrenergic receptors, SAR of direct-acting sympathomimetics including catecholamines and imidazolines,  $\alpha$ -adrenergic agonists,  $\beta$ -adrenergic agonists, indirect-acting sympathomimetics, mixed-acting sympathomimetics,  $\alpha$ -adrenergic antagonists,  $\beta$ -adrenergic antagonists)
- Cholinergic drugs (cholinergic receptors, biosynthesis and metabolism of ACh, stereochemistry and interaction with the receptor, SAR of cholinergic drugs, cholinesterase inhibitors, anticholinergic drugs, antimuscarinic drugs, ganglionic blockers, neuromuscular blockers)
- Chemotherapeutic agents (local anti-infective agents, antifungal agents, antiscabious and antipedicular agents, anthelmintics, antiprotozoal agents, antileishmanial and antitrypanosomal drugs, antimalarial drugs, sulfonamides, antimycobacterial drugs (antitubercular drugs and antilepral drugs), synthetic antibacterial agents, antibacterial antibiotics, antiviral agents, antineoplastic agents, immunotherapy)
- Cardiovascular drugs (antianginal and vasodilators, calcium antagonists, anti-arrhythmic drugs, antihypertensive drugs, diuretics, antihyperlipidemics, anticoagulants, cardiac inotropics)
- Diagnostic drugs (X-ray contrast agents, MRI, radiopharmaceuticals, US)

### Lab Course: Practicals

Introduction of different methods of assay of drugs in dosage forms, calculations of percentage recovery of the drug, concentration representation, pharmacopoeial requirements, and limit of degradation products.

Preparation of benzimidazole, benzotriazole, benzil, benzoic acid, 2,3-diphenylquinoxaline

- Assay of calamine powder
- Assay of methylene blue solution
- Assay of hydrogen peroxide solution
- Assay of povidone iodine solution
- Assay of ampicillin capsules
- Assay of cephalexin capsules
- Assay of trimethoprim tablets
- Assay of acetylcholine chloride
- Assay of epinephrine injection
- Assay of phenylephrine eye drops
- Assay of methyl dopa tablets
- Assay of pilocarpine nitrate eye drops
- Assay of phenindione tablets
- Assay of resorcinol solution
- Assay of gallaminetriethiodide ampoules

### Teaching/Learning Methods and Contact Hours

#### Required Textbooks

1. Remington's Pharmaceutical Sciences, A. Gennaro, Mack Publishing Co: Eaton, Pennsylvania.
2. Drug Action, E Mutscher, CRC press, New York.
3. Wilson and Gisvold's Textbook of Organic, Medicinal and Pharmaceutical Chemistry, Jaime N. Delgado, Lippincott-Raven Publishers: Philadelphia-New York
4. Foye's Principles of Medicinal chemistry, David A. Williams, Lippincott: New York

	Lecture	Tutorial	Laboratory	Practical	Other:	Total
<b>Contact Hours</b>	30	-	-	30	-	60 hours

The following teaching strategies are used:

- Class room lectures
- Practical

#### Assessment and grading plan:

	Course outcome	Method of Assessment
1	Outcome 1	W
2	Outcome 2	W
3	Outcome 3	W, PB
4	Outcome 4	W, PB
	Assessment method	Proportion of Total Assessment
1	Mid-Term I Test	15%
2	Mid-Term II Test	15%
3	Laboratory examination	20%
4	Final Exam	50%

#### Course outcomes and Assessment

**W: Written**

**PB: Performance-Based**

## Recommended Textbooks and Reference Material

Burger's Medicinal Chemistry and Drug Discovery: Drug Discovery and Drug Development, Donald J. Abraham, John Wiley & Sons, Inc

## Electronic Materials

Online resources available at:

<http://www.pharmaexpert.ru/PASSOnline/>

<http://www.library.qu.edu.sa/Pages/default.aspx>

<http://www.phc.vcu.edu/310/>

<http://www.kubinyi.de/lectures.html>

[http://www.chemlin.net/chemistry/medicinal\\_chemistry.htm](http://www.chemlin.net/chemistry/medicinal_chemistry.htm)



<b>Course Name:</b> Medicinal Chemistry-I	إسم المقرر: الكيمياء الدوائية-1
<b>Course Code &amp; No.:</b> PHC 225	رقم المقرر 225 كمص
<b>Credits:</b> 3(2+1+0)	عدد الساعات: 3(2+1+0)
<b>Prerequisite:</b> PHC 122.124	المتطلب: 122.124 كمص
<b>Level:</b> 4	المستوى: 4

#### Course Description (AIM):

This course will handle the relationship of chemical structure to biological activity and the general structural features required for a specific mechanism of action. Topics of discussion will include the effects of molecular modifications on receptor binding, distribution and metabolism as they relate to clinical response. Although the course outline reflects a pharmacological classification, the material covered will deal principally with the chemical, structure and biophysical properties as related to drug action at the molecular level and will relate to therapeutic use.

#### Objectives:

- Understand the biological activity relationship with physicochemical properties of a drug molecule.
- Understand the metabolic process and, factors involved in metabolism of a drug
- Understand the drug discovery and, elements governing it

#### Course learning outcomes:

##### 1. Knowledge:

Upon successful completion of this course, students will be able to:

- a. Describe how drug functions at the molecular level.
- b. Demonstrate ability to know how to carry out a rational approach to drug design.
- c. Describe and, correlate the structure activity & quantitative structure activity relationships (SAR & QSAR)

##### 2. Cognitive

Upon successful completion of this course, students will be able to:

- a. Estimate the metabolic process and, factors involved in metabolism of a drug and, their implication in retro-metabolic drug design.
- b. Explain the relationships between physicochemical properties of drug, prodrug and, their biological activity.

##### 3. Communication, Information Technology, Numerical

Upon successful completion of this course, students will be able to:

- a. Calculate the active ingredient in pharmaceutical forms.

##### 4. Psychomotor

Upon successful completion of this course, students will be able to:

- a. Perform preparation, identification of some important medicinal agents.

## Course Contents:

- Introduction (sources of drugs, nomenclature of drugs, and classification of drugs). Drug action (pharmaceutical phase which includes cell membrane structure, transfer of drugs through membrane, pharmacokinetic phase which includes ADME, pharmacodynamic phase which includes receptors and drug receptor interactions)
- Physicochemical principle of drug action (drug solubility and distribution, partition coefficient, ionization, pH, pKa, the Hansch approach, Hammett equation, Taft equation (QSAR)).
- Metabolic changes of drugs (phase I, Phase II). Drug latentiation and prodrugs (carrier-linked and bioprecursor prodrugs). Chemical delivery system. Receptors and drug action (historic perspectives, receptor locations, receptor subtypes, affinity: the role of chemical bonding, rationale for the receptor site concept, interaction between drugs and receptor site, biologic response to drug-receptor interactions).
- Structural features and pharmacologic activity (optical isomerism and pharmacologic activity, geometric isomerism and pharmacologic activity, conformational isomerism and pharmacologic activity, isosterism and pharmacological activity).
- Drug development & drug discovery (search for a lead compound, optimization of a lead compound, preclinical trials, clinical trials,
- Combinatorial chemistry and solid-phase synthesis, computer –aided drug design).

## Practical Part

1. To Run TLC (Thin Layer Chromatography) of an Organic Compound's Sample.
2. To Use Chemistry Software ChemDraw/ACD for Structure Drawing & Molecular Properties Estimation
3. To Synthesize Benzoic Acid.
4. To Estimate the Partition Coefficient of an Organic Compound/Drug Sample.
5. To Measure Optical Rotation  $[\alpha]_D$  of a Known Organic Compound's Sample.
6. To Measure the Optical Rotation  $[\alpha]_D$  of an Unknown Sample.
7. To Determine Calcium Ions Content in a Pharmaceutical Formulation by Chelometric Estimation.
8. To Determine Magnesium Ions Content in an Antacid Formulation by Complexometric Analysis.
9. To Synthesize of Boric Acid from Borax.
10. To Determine the Contents of Boric Acid in Eye Drop Sample.
11. To Synthesize Hexamine.
12. To Synthesis Fluorescein from Resorcinol and, Phthalic Anhydride
13. To Synthesize Tetra-Bromo Fluorescein.
14. To Synthesize a Chalcone Derivative.
15. To Determine the Rate of Hydrolysis of Sucrose Sample Catalyzed by a Dilute HCl Solution

#### Required Textbooks

1. G. Thomas: Medicinal Chemistry: An introduction. John Wiley & Sons, Ltd  
Jaime N. Delgado,
2. G.Patrick, An introduction to Medicinal Chemistry.
3. Wilson and Gisvold's Textbook of Organic, Medicinal and Pharmaceutical Chemistry, Lippincott-Raven Publishers, Philadelphia- New York

#### Casebooks:

- Greta K. Gourley, James M. Holt (Editors) Casebook for Textbook of Therapeutics: Drug and disease management. 7th edition (2000). Lippincott Williams & Wilkins Publishers.
- Terry L. SchwInghammer<sup>1</sup> Joseph Dipiro, Robert Talbert, Gary Yee, Gary Matzke<sup>1</sup> Barbara G.

Wells, L. Michael Posey (Editors). Pharmacotherapy Casebook. 5th edition (2002). McGraw-Hill/Appleton & Lange.

#### Recommended Textbooks and Reference Material

Remington's Pharmaceutical Sciences, A. Gennaro, Mack Publishing Co: Eaton, Pennsylvania.  
Drug Action, E Mutscher, CRC press  
Foye's Principles of Medicinal chemistry, David A. Williams, Lippincott: New York  
Burger's Medicinal Chemistry and Drug Discovery: Drug Discovery and Drug Development,  
Donald J. Abraham, John Wiley & Sons, Inc

#### Electronic Materials

Online resources available at:

[www.ncbi.nlm.nih.gov/SNP/](http://www.ncbi.nlm.nih.gov/SNP/)

- Advanced Chemistry Development, ACD labs, Canada
- ChemDraw
- HyperChem, Gainesville, FL, USA.
- Discovery Software by Accelrys Inc., CA, USA
- Spartan Software, USA
- Lexicomp Online Academic W/ AHFS.
- Facts & Comparison Bundle including Trissel's.
- Martindale: The Complete Drug Reference.
- Access Pharmacy.

<b>Course Name:</b> Medicinal Chemistry-III	إسم المقرر: الكيمياء الدوائية-3
<b>Course Code &amp; No.:</b> PHC 320	رقم المقرر 320 كمص
<b>Credits:</b> 3(2+1+0)	عدد الساعات: 3(2+1+0)
<b>Prerequisite:</b> 315PHC	المتطلب: 315 كمص
<b>Level:</b> 6	المستوى: 6

#### Course Description (AIM):

This course will handle the relationship of chemical structure to biological activity and the general structural features required for a specific mechanism of action. Topics of discussion will include the effects of molecular modifications on receptor binding, distribution and metabolism as they relate to clinical response. Although the course outline reflects a pharmacological classification, the material covered will deal principally with the chemical, structure and biophysical properties as related to drug action at the molecular level and will relate to therapeutic use.

#### Objectives:

1. To provide students with knowledge and understanding of the chemistry of basic classes of medicinal agents.
2. To develop the student's ability to understand mechanism of action, metabolism of medicinal drugs.
3. To develop student's ability to understand the relation between structure and biological activity (SARs) of medicinal agents acting on specific target and producing pharmacological response.

#### Course learning outcomes:

##### 1. Knowledge:

Upon successful completion of this course, students will be able to:

- a. Recognize the nomenclature, physicochemical properties, chemical classification, synthesis, identification of medicinal agents.
- b. describe the drug mechanism, drug target interaction at molecular level.

##### 2. Cognitive

Upon successful completion of this course, students will be able to:

- a. Explain the metabolism of xenobiotics, and drugs depending on their chemical structure, and its role in pharmacological and toxicological effect.
- b. Predict the biological response and mechanism of action, if any, from a chemical structure of compounds affecting various receptors, enzymes and/or systems.

##### 3. Communication, Information Technology, Numerical

Upon successful completion of this course, students will be able to:

- a. Calculate the active ingredient in pharmaceutical forms.

##### 4. Psychomotor

Upon successful completion of this course, students will be able to:

- a. Perform preparation, identification of some important medicinal agents.

## Course Contents:

- CNS stimulants (analeptics, methyl xanthines, central sympathomimetic agents, MAO inhibitors, tricyclic and mechanistically related antidepressants).
- CNS depressants (general anesthetics, anxiolytic, sedative and hypnotics, antipsychotics, antimanic, anticonvulsants or antiepileptic drugs, narcotic analgesics, narcotic antagonists, antitussive agents, NSAIDs).
- Local anesthetics
- H1-antagonists and antiallergenic agents
- Gastrointestinal drugs.
  - Drugs used to manage peptic ulcer (gastric antacids, H2 receptor antagonists, proton pump inhibitors, chemical complexation, cytoprotective drugs, selective muscarinic (M1) antagonists)
  - Laxatives, Antidiarrheal drugs, Emetics, Antiemetics, Adsorbents, Digestant, Miscellaneous GI drugs
- Hormones
  - Steroidal hormones (nomenclature and stereochemistry, estrogens and antiestrogens, progestins, chemical contraceptive agents, androgens and anabolic drugs, antiandrogens and  $5\alpha$ -reductase inhibitors, adrenal cortex hormones)
  - Pancreatic hormones, Oral hypoglycemics
  - Thyroid hormones, Anti-thyroid hormones, Parathyroid hormones
  - Polypeptide hormones, Pituitary hormones, Placental hormones, Substance P

## Practical course

1. Functional Group Analysis
2. Assay of aspirin (spectro)
3. Assay of theophylline
4. Assay of indomethacine
5. Titrimetric determination of beta-lactam antibiotic
6. Assay of sulphonamides
7. Assay of ibuprofen
8. Synthesis of Aspirin
9. Synthesis of paracetamol
10. Synthesis of Phenacetin (1<sup>st</sup> Step)
11. Synthesis of Phenacetin (2<sup>nd</sup> Step)
12. Synthesis of Antipyrine
13. Synthesis of Phenytoin
  - 1<sup>st</sup> Step: Synthesis of Benzil
14. Synthesis of Phenytoin
  - 2<sup>nd</sup> Step: Condensation of Benzil
15. Synthesis of Thiobarbituric Acid
16. Assay of Steroids

#### Required Textbooks

1. Wilson and Gisvold's Textbook of Organic, Medicinal and Pharmaceutical Chemistry, Lippincott-Raven Publishers, Philadelphia- New York
2. Foye's Principles of Medicinal chemistry, David A. Williams, Lippincott: New York

#### Casebooks:

- Greta K. Gourley, James M. Holt (Editors) Casebook for Textbook of Therapeutics: Drug and disease management. 7th edition (2000). Lippincott Williams & Wilkins Publishers.
- Terry L. Schwlnghammer<sup>1</sup> Joseph Dipiro, Robert Talbert, Gary Yee, Gary Matzke<sup>1</sup> Barbara G. Wells, L. Michael Posey (Editors). Pharmacotherapy Casebook. 5th edition (2002). McGrawHilvAppleton & Lange.

#### Recommended Textbooks and Reference Material

Remington's Pharmaceutical Sciences, A. Gennaro, Mack Publishing Co: Eaton, Pennsylvania.  
Drug Action, E Mutscher, CRC press  
Burger's Medicinal Chemistry and Drug Discovery: Drug Discovery and Drug Development,  
Donald J. Abraham, John Wiley & Sons, Inc

#### Electronic Materials

##### Online resources available at:

- [www.ncbi.nlm.nih.gov/SNP/](http://www.ncbi.nlm.nih.gov/SNP/)
- Advanced Chemistry Development, ACD labs, Canada
- ChemDraw
- HyperChem, Gainesville, FL, USA.
- Discovery Software by Accelrys Inc., CA, USA
- Spartan Software, USA
- Lexicomp Online Acaemic W/ AHFS.
- Facts & Comparison Bundle including Trissel"s.
- Martindail: The Complete Drug Reference.
- Access Pharmacy.

<b>Course Name:</b> Natural Products Chemistry	اسم المقرر: كيمياء النواتج الطبيعية
<b>Course Code &amp; No.:</b> PHC 316	رقم المقرر: 316 كمص
<b>Credits:</b> 3 (2+1+0)	عدد الساعات: 3 (2+1+0)
<b>Prerequisite:</b> PHC 215	المتطلب: ٢١٥ كمص
<b>Level:</b> 5	المستوى: 5

### Course Description (AIM):

The course aims to provide pharmacy students with a primary knowledge of phytochemicals and enable the student to gain an understanding of the following general areas of study:  
The different classes of the natural compounds Methods of extraction, isolation, identification, assay and pharmacological activity and uses of natural compounds

### Objectives:

- To know the chemical structure of different classes of natural compounds.
- To know the extraction, isolation and identification of active compounds from natural sources and their physiological activity.

### Learning outcomes:

Upon successful completion of this course, students will be able to:

- Acquire basic knowledge of different classes of natural products.
- Illustrate the methods of identification and assay of active compounds.
- State the pharmacological activity, toxicity and uses of natural compounds.
- Gain an appreciation of how to deal with and to apply the given information to evaluate phytochemicals.
- Prepare extracts, isolates from natural sources.

### Course Contents:

#### Theoretical:

- Volatile oils:
- "Methods of preparation, composition of volatile oils and classification of the volatile oil components, Qualitative testing, pharmacological activity"
- Alkaloids:
- "Definition, classification, extraction, separation, qualitative testing, assaying, pharmacological activity"
- Carbohydrates
- "Classification, qualitative testing, uses"
- Glycosides
- "Definition, classification, extraction, separation, qualitative testing, assaying, pharmacological activity"
- Bitter principles, tannins & resins
- The course content is good but you have to give some more details about subjects that you feel are important such as opium alkaloids, ergot alkaloids, flavonoid and anthraquinone glycosides, saponins, tannins, etc...



**Practical:**

- Phytochemical screening of medicinal plants
- Qualitative tests for alkaloids
- Microchemical test for alkaloids
- Alkaloidal assays
- Assay of some volatile oil components
- Isolation of some natural compounds from their natural sources

**Evaluation methods:**

10-Periodicals  
20-(2 Midterm exams)  
20-Practical  
50 final exams.

**Text Book(s):**

W.C. Evans, "Trease and Evans, PHARMACOGNOSY" 16th Edition, BailliereTindal, London, Philadelphia, Toronto, Sydney, Tokyo (2009).  
Michael Heinrich, Fundamentals of Pharmacognosy and Phytotherapy, 1<sup>st</sup> edition, Churchill Livingstone, 2004, an imprint on Elsevier Limited, 2007.  
WHO monographs on selected medicinal plants, World Health Organization, Paperback Publisher, vol. 1, (1999)  
WHO monographs on selected medicinal plants, World Health Organization, Paperback Publisher, vol. 2, (2002)  
Richard J. P. Cannell. Natural Products Isolation. 1998. Humana Press Inc.  
Raphael Ikan. Natural Products; a Laboratory Guide. 2nd edition 1991. Academic Press.  
Kurt B.G. Torssell, "Natural Product Chemistry, Mechanistic Biosynthetic and Ecological Approach Apotekarsocieteten- Swedish. Pharmaceutical Pr Sweden (1997).

**Additional suggested readings:**

Ashtosh Kar, Pharmacognosy and Pharmacobiotechnology, 1<sup>st</sup> edition, 2008, New Age International (P) Ltd., Publishers.  
**James E. Robbers, Marilyn Speedie, Varo E. Tyler, Pharmacognosy and pharmacobiotechnology** Williams & Wilkins, Baltimore. 1996.  
Pengelly, Andrew, The constituents of medicinal plants: an introduction to the chemistry and therapeutics of herbal medicine. ALLEN & UNWIN. This edition first published in 2004.  
Paul M Dewick, Medicinal Natural Products, A Biosynthetic Approach, 1<sup>st</sup> edition, 1997, John Wiley and Sons Ltd. England. Reprinted 1998.  
Gunnar Samuelsson. Drugs of Natural Origin. 4th. edition 1999. Swedish Pharmaceutical press.  
J. Higgins, D.J. Best, J. Jones, "Biotechnology, Principles and Applications", Blackwell Scientific Publications (1985).  
Harborne, J.B., "Phytochemical Methods", 3rd. ed., Chapman Hall, London, New York (1998).  
David H. Attaway and Oskar R. Zaborsky. Modern Biotechnology. Volume 1, 1993. Plenum Press.  
Melanie J. C. Toxicology and Clinical pharmacology of Herbal Products. 2000 Humana Press Inc. James E. R. Marilyn K. S. and Varro E. T. Pharmacognosy and Pharmacobiotechnology. S. Grabley and R. Thiericke. Drug Discovery from Nature. 1999. Springer

## Organic Chemistry

<b>Course Name:</b> Organic Chemistry	الكيمياء العضوية	إسم المقرر:
<b>Course Code &amp; No.:</b> 103 PHC	103 كمص	رقم المقرر ورمزه:
<b>Credits:</b> 2 (2+0+0)	2 (2+0+0)	عدد الساعات: المعتمدة:
<b>Prerequisite:</b> None	بدون	المتطلب: السابق:
<b>Level:</b> 1	1	المستوى:

### Course Description (AIM):

This course is a comprehensive introduction in all aspects of organic chemistry, for new students. The course will qualify the students and prepare them with organic chemistry knowledge to further their studies.

### Objectives:

The primary goal of this course is to understand organic chemistry and to develop thinking skills related to the subject matter

### Course learning outcomes:

#### 1. Knowledge

Upon successful completion of this course, students will be able to:

- Recognize the principles of organic chemistry such as structures, nomenclature, classification and stereochemistry
- Write the methods of preparations, reactions and reaction mechanisms of different functional groups.

#### 2. Cognitive Skills

Upon successful completion of this course, students will be able to:

- Describe the atomic structure and types of hybridization and bonds
- Write the stereochemistry of organic molecules..

### Course Contents:

- Introduction (definition, structure of atoms, atomic orbitals, electronic configuration, bonding, types of hybridization, electron availability, resonance, inductive effect, electronegativity, polarity and dielectric constant, arrows in chemistry, reactions yields).
- Stereochemistry.
- Alkanes and cycloalkanes.
- Alkenes and dienes.
- Alkynes.
- Alkyl halides.
- Alcohols.
- Ethers and epoxides.

### Teaching/learning methods and Contact Hours

	Lecture	Tutorial	Laboratory	Practical	Other:	Total
Contact Hours	30	-	-	-	-	30 hours

#### The following teaching strategies are used:

- Class room lectures
- Laboratory Practical

#### Assessment and grading plan:

	Assessment methods	Proportion of Total Assessment
1	Mid-Term I Test	20%
2	Mid-Term II Test	20%
3	Final Exam	60%

#### Course outcomes and Assessment

	Course outcome	Method of Assessment
1	Outcome 1	W
2	Outcome 2	W

W: Written

#### Required Textbooks

- T.W. Graham Solomon, Organic Chemistry, John Wiley & Sons, Inc,
- Robert T. Morrison, Robert N. Boyd, Organic Chemistry, 6<sup>th</sup> Edition
- Ralph J. Fessenden, Organic Chemistry, Brooks Cole.
- I. L. Finar, Organic Chemistry: The Fundamental Principles, John Wiley & Sons

#### Recommended Textbooks and Reference Material

- Jerry March & Michael B. Smith, Advanced Organic Chemistry, 6th Ed, John Wiley & Sons
- Francis A. Carey, Richard J. Sundberg, Advance Organic Chemisrty, Part A: Structures and Mechanism
- Francis A. Carey, Richard J. Sundberg, Advance Organic Chemistry, Part B: Reactions and Synthesis

#### Electronic Materials

Online resources available at:

- <https://www.khanacademy.org/science/organic-chemistry>
- <http://www.chemguide.co.uk/orgmenu.html>
- <http://www.library.qu.edu.sa/Pages/default.aspx>
- <http://www.library.qu.edu.sa/Pages/default.aspx>



Course Name: Pharmaceutical Analytical Chemistry	اسم المقرر: الكيمياء التحليلية الصيدلانية
Course Code & No.: 124 PHC	رقم المقرر: 124
Credits: 4 (3+1+0)	عدد الساعات: 4 (3+1+0)
Prerequisite: 103 PHC	المتطلب: 103
Level: 2	المستوى: 2

**Course Description:**

Analytical chemistry is a measurement science consisting of a set of powerful ideas and, methods that are useful in determining the composition of materials. The course will cover both chemical methods of analysis with emphasis on volumetric category and, physicochemical methods of analysis (spectro-analytical instrumental methods). The course will cover the principle and, applications of each method, its laws, calculation, advantages and, limitations of each method. More attention will be given to its application in the field of pharmaceutical analysis.

**Course Objectives:**

- Understanding the theory and, practical aspects of titrimetry.
- Understanding the spectroscopic methods of pharmaceutical materials analyses.
- Understanding the chromatographic techniques for pharmaceutical materials purification.

**Learning Outcomes:**

Upon successful completion of this course, students will be able to deal:

**1. Knowledge**

- 1.a Describe the titrimetric techniques and, their use in sample analysis.
- 1.b Recognize HPLC usefulness and, its applications in qualitative and, quantitative analysis.

**2. Cognitive skills:**

- 2.a Estimate the chromatographic purity of a mixture of pharmaceutical compounds.

**4. Communication, IT and Numerical Skills**

- 4.a Evaluate spectra of drugs/organic-medical products for preliminary structure information.

**5. Psychomotor skills**

- 5.a Employ the spectroscopic and/or, chromatographic techniques including titrations in sample's analysis.

**Course Contents:**

- Introduction to analytical chemistry and, a review of elementary concepts.
- Qualitative & quantitative analyses, evaluation of quantitative analytical data.
- Acid-base titrations in aqueous medium (pH of strong acids and bases, weak acids and bases and salts, buffer solutions, titration curves, acid-base indicators, applications of acid-base titrations)
- Acid-base titrations in non-aqueous medium (types of solvents for non-aqueous titration, end-point determination in non-aqueous titrations)
- Precipitation titrations (titration curves for precipitation titrations, applications of precipitation titrations)
- Complex-formation titration (titrations with amino poly carboxylic acid, applications of Complexometric titrations)
- Oxidation-reduction titrations (Nernst equation and oxidation potential of redox system, applications of standard oxidants, applications of standard reductants)

**Text Book(s):**

Douglas A. Skoog & Donald M. West. Fundamentals of Analytical Chemistry. Sanders College Publishing, Philadelphia

Galen Ewing. Instrumental Methods of Chemical Analysis, McGraw-Hill, New York

Robert de Levie. Principles of Quantitative Chemical Analysis, McGraw-Hill, New York

Gary D. Christian and, James E O'Reilly, Instrumental Analysis, Prentice Hall, New York

J. Baiseit, R.C. Denney, G.H. Jeffery and J. Mendham, Vogel's Textbook of Quantitative Inorganic Analysis, Longman, Essex

**Additional suggested readings:**

Practical Pharmaceutical Chemistry, A.H. Beckell and J.B. Stenlake. The Athlone Press, London.

Pharmaceutical Drug Analysis, 2nd ed, Ashutosh Kar, New Age Publications, New Delhi.

Pharmaceutical Analysis: A Textbook for Pharmacy Students and Pharmaceutical Chemists, David G. Watson, Churchill Livingstone.

Modern Analytical Chemistry, David Harvey, McGraw-Hill.

- Laboratory Schedule:**
- Acid-base titrations (preparation and standardization of 0.1 N HCl, determination of zinc oxide, determination of borax, determination of boric acid, determination of ammonium salts, non-aqueous titration)
  - Precipitometric titrations (preparation and standardization of ammonium thiocyanate, determination of KCl by Mohr's method, determination of  $\text{NH}_4\text{Cl}$  by Volhard's method, determination of KCl and KI and their mixture by Fajan method, determination of sulfacetamide by Volhard's method)
  - Complexometric titrations (preparation and standardization of 0.05 M EDTA, determination of  $\text{Ca}^{++}$  and  $\text{Mg}^{++}$  and their mixture, determination of  $\text{ZnO}$ )
  - Oxidation-reduction titrations (preparation and standardization of 0.1 N potassium permanganate, assay of hydrogen-peroxide, assay of ferrous sulfate in tablets, bromometric determination of phenol, analysis of tincture iodine, determination of calcium lactate)
  - Spectrophotometric analysis (absorption spectrum of potassium dichromate, verification of Beer's law, absorption spectrum of sulfacetamide in 0.1 M HCl, analysis of two-component mixtures
  - Infrared spectrophotometry, IR and Mass Spectrometry (Study of the spectrum of some pharmaceutical compounds to show the different functional groups)
  - Fluorometric analysis (fluorescence spectra of ofloxacin and calibration graph and analysis of its tablets)
  - Potentiometric analysis (potentiometric determination of isoniazid against standard bromine using Platinum/calomel electrode system)
  - HPLC (inspection of a typical chromatogram and calculation of the resolution, NTP and HTEP)

- Potentiometric methods (indicator electrodes, instrument for cell potential measurements, direct potentiometric methods of analysis (the electromagnetic spectrum, emission, and, absorption of electromagnetic radiation, fluorescence and, phosphorescence)
- Applications of molecular spectroscopy (molecular absorption spectra, applications of absorption spectroscopy to qualitative analysis, quantitative analysis by ultraviolet and visible absorption measurement, applications of infrared absorption, molecular fluorescence spectroscopy and its application, NMR spectroscopy, mass spectrometry)
- Introduction to chromatographic separation (general description of chromatography, the rate-theory of chromatography, separation on column, qualitative and quantitative analysis by chromatography)
- GC
- HPLC

## Pharmaceutical Organic Chemistry

<b>Course Name:</b> Pharmaceutical Organic Chemistry	كيمياء العضوية	اسم المقرر:
<b>Course Code &amp; No.:</b> PHC 122	122 كمص	رقم المقرر: ورمزه
<b>Credits:</b> 4 (3+1+0)	4(3+1+0)	عدد الساعات:
<b>Prerequisite:</b> 103 PHC	103 كمص	المتطلب:
<b>Level:</b> 2	2	المستوى:

### Course Description (AIM):

This course will continue covering the organic functional groups that were not covered in the previous organic chemistry. This will include the rest of aliphatic compounds, aromatic compounds and heterocyclic chemistry, which will prepare the student properly to medicinal chemistry.

### Objectives:

- To make the students understand about the various functional group in organic/medicinal compounds
- To develop the student's ability to understand the organic reactions and their mechanism.

### Learning outcomes:

#### 1. Knowledge

Upon successful completion of this course, students will be able to:

- a. Recognize the various classes and subclasses of organic compounds and how the chemical and physical properties influence their behavior
- b. Describe the chemical reactions unique to each class or subclass of organic molecules and their role in synthetic chemistry

#### 2. Cognitive Skills

Upon successful completion of this course, students will be able to:

- a. Write the different reaction mechanisms and their importance in organic synthesis.
- b. Predict the possible major and minor products from a chemical reaction.
- c. Explain the methods of preparation, reactions and reaction mechanisms of common organic functional groups, their derivatives, and different aromatic systems

#### 2. Communication, Information Technology, Numerical

Upon successful completion of this course, students will be able to:

- a. Illustrate the chemical structures and organic reactions using chemistry software programmes.

### 3. Psychomotor

Upon successful completion of this course, students will be able to:

- a. Prepare organic/heterocyclic compounds of medicinal interest.
- b. Examine the organic molecules using chemical reactions for the identification of the functional groups.

#### Course Contents:

- Aldehydes and ketones.
- Carboxylic acids.
- Carboxylic acid derivatives.
- Aromatic compounds (aromaticity, electrophilic substitution, nucleophilic substitution, EAS and orientation)
- Phenols.
- Aromatic nitro and related compounds.
- Heterocyclic chemistry. (antibiotics, antiviral agents, antineoplastic agents, immunotherapy)

#### Practical

- Laboratory safety measures and precautions.
- Criteria of purity (determination of mp, bp, crystallization and distillation).
- Element tests for nitrogen, halogen and sulfur.
- Identification of alcohols.
- Identification of aldehydes and ketones.
- Identification of phenols and Thiols.
- Identification of carboxylic acids and salts
- Identification of esters, amides and imides.
- Preparation of aspirin.
- Preparation of p-bromoacetanilide.
- Preparation of phenolphthalein
- Follow up the reactions of the prepared compounds by TLC and calculation of the yields.

#### Teaching/learning methods and Contact Hours

	Lecture	Tutorial	Laboratory	Practical	Other:	Total
<b>Contact Hours</b>	45	-	-	30	-	75 hours

#### The following teaching strategies are used:

- Class room lectures
- Practical

**Assessment and grading plan:**

	Assessment method	Proportion of Total Assessment
1	Mid-Term I Test	15%
2	Mid-Term II Test	15%
3	Laboratory examination	15%
4	Log Book	5%
5	Final Exam	50%

**Course outcomes and Assessment**

	Course outcome	Method of Assessment
1	Outcome 1	W
2	Outcome 2	W
3	Outcome 3	W, PB
4	Outcome 4	W, PB

W: Written

PB: Performance-Based

**Required Textbooks**

- T.W. Graham Solomon, Organic Chemistry, John Wiley & Sons, Inc,
- Organic Chemistry, 6th Edition 6th Edition
- Robert T. Morrison, Robert N. Boyd, Organic Chemistry,
- Ralph J. Fessenden, Organic Chemistry, Brooks Cole.
- I. L. Finar, Organic Chemistry: The Fundamental Principles, John Wiley & Sons

**Recommended Textbooks and Reference Material**

- Jerry March & Michael B. Smith, Advanced Organic Chemistry, 6th Ed, John Wiley & Sons
- Francis A. Carey, Richard J. Sundberg, Advance Organic Chemisrty, Part A: Structures and Mechanism
- Francis A. Carey, Richard J. Sundberg, Advance Organic Chemistry, Part B: Reactions and Synthesis

**Electronic Materials**

Online resources available at:

- <https://www.khanacademy.org/science/organic-chemistry>
- <http://www.chemguide.co.uk/orgmenu.html>



<b>Course Name:</b> Pharmacognosy	اسم المقرر: علم العقاقير
<b>Course Code &amp; No.:</b> PHC 215	رقم المقرر: ٢١٥ كمص
<b>Credits:</b> 3 (2+1+0)	عدد الساعات: 3 (2+1+0)
<b>Prerequisite:</b> PHC 103, PHC 122	المتطلب: ١٠٣ كمص، ١٢٢ كمص
<b>Level:</b> 3	المستوى: 3

### Course Description (AIM):

Pharmacognosy course aims to provide the knowledge and understanding of the medicinal plants and to encourage students to take a broad and continuing interest in medicinal plants with emphasis to those available in the Saudi Arabia

Introduce the student to the different types of complementary and alternative medicine.

### Objectives:

- To know the modern concept and scope of pharmacognosy
- To understand the importance of natural products particularly medicinal plants as a source of drugs.
- To be able to apply their basic background in pharmacognosy to identify powdered drugs by microscopical examination.

### Learning outcomes

Upon successful completion of this course, students will be able to:

- Identify a wide range of medicinal plants, entire or dried.
- Recognize the active constituents of herbal drugs.
- Understand the active constituents pharmacological actions on the body .
- Aware of the influence of plant remedies on the psycho-social and spiritual aspects of a patient's being.
- Know in detail the toxicity and dosage range of the medicinal plants studied.
- Know in detail the contraindications and incompatibilities of the studied medicinal plants.
- Perform effective communication and positive relation with others and be able to work as an effective member in a team.
- Apply the ethical and professional standard of ethics in the laboratory.
- Identify any plant tissue under the microscope.

### Course Contents:

#### Theoretical:

- Introduction to Pharmacognosy and medicinal plants
- Examines individual plant remedies and discusses their botanical, pharmacognostic, pharmacological and therapeutic aspects, along with their indications in treatment, contraindications and incompatibilities, including dosage for elderly patients and children.

The plants are discussed from a traditional therapeutic aspect and modern scientific research and clinical experience is used to supplement and/or extend the understanding of the plant as a medicinal remedy. Specific indications are studied, as herb combinations and synergy. Examples of Leaf, herb, flower, seed, fruit, bark, subterranean and unorganized drugs

- Complementary and Alternative systems of medical practice (CAM) [Introduction, understanding how the body works, fields of practice and types].

**Practical:**

- How to examine powdered drug
- TLC profile of herbal drugs
- Leaf and herb drugs: Morphological and microscopical characters leaves and testing the active constituents (one example). Identification of powdered leaves by microscopical examination and TLC profile.
- Seed drugs: Morphological and microscopical characters seeds and testing the active constituents (one example). Identification of powdered seeds by microscopical examination and TLC profile.
- Fruit drugs: Morphological and microscopical characters fruits and testing the active constituents (one example). Identification of powdered fruits by microscopical examination and TLC profile.
- Bark drugs: Morphological and microscopical characters barks and testing the active constituents (one example). Identification of powdered barks by microscopical examination and TLC profile.
- Subterranean drugs: Morphological and microscopical characters subterranean drugs and testing the active constituents (one example). Identification of powdered leaves by chemical testing and TLC profile.

**Evaluation methods:**

20 practical  
30 (2 Midterm exams),  
50 final exams

**Text Book(s):**

WHO monographs on selected medicinal plants, World Health Organization, Paperback Publisher, vol. 1, (1999)

WHO monographs on selected medicinal plants, World Health Organization, Paperback Publisher, vol. 2, (2002)

W.C. Evans, "Trease and Evans, PHARMACOGNOSY" 16th Edition, Bailliere Tindall, London, Philadelphia, Toronto, Sydney, Tokyo (2009).

**Additional suggested readings:**

Gunnar Samuelsson. Drugs of Natural Origin. 4th. edition 1999. Swedish Pharmaceutical press.

J. Higgins, D.J. Best, J. Jones, "Biotechnology, Principles and Applications", Blackwell Scientific Publications (1985).

Harborne, J.B., "Phytochemical Methods", 3rd. ed., Chapman Hall, London, New York (1998).