# Analytical chemistry

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| **1** | **Course name** | **Analytical chemistry** |
| **2** | **Course Code** | **PH105** |
| **3** | **Course type: /general/specialty/optional** | **General** |
| **4** | **Accredited units** | **4 Units (Theoretical 3Hours/Week**<br>**Practical 2 hours/Week)** |
| **5** | **Educational hours** | **5 hours/week** |
| **6** | **Pre-requisite requirements** | **General chemistry** |
| **7** | **Program offered the course** | **Department of Pharmaceutical chemistry** |
| **8** | **Instruction Language** | **English Language** |
| **9** | **Date of course approval** | **12/2021** |

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| **Brief Description:** | Analytical chemistry is the science of obtaining, processing, and communicating information about the composition and structure of matter. In other words, it is the art and science of determining what matter is and how much of it exists. Analytical chemistry can be a challenging profession that makes significant contributions to many fields of science. It is one of the most popular fields of work for ACS chemists. The subject covers methods of analysis, neutralization in analytical chemistry, oxidation – reduction reactions, precipitimetry, gravimetric analysis, and complexometry topics. |
| **Textbooks required for this Course:** | Modern Analytical Chemistry. David Harvey . |
| **Course Duration** | 28 weeks |
| **Delivery** | Lectures (Tools: board, , data show and discussion). The lectures were added on the internet site of the faculty to be available to the students all the time as learning.<br>Practical Session (Tools: labs., boards, instruments, chemicals, glassware, equipment).<br>Assignments, seminars, research, and posters. |
| **Course Objectives:** | On successful completion of this course, students will be able:<br>1. to develop an understanding of the range and uses of analytical methods in chemistry. |

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| | 2. to establish an appreciation of the role of chemistry in quantitative analysis<br>3. to develop an understanding of the broad role of the chemist in measurement and problem solving for analytical tasks.<br>4. to provide an understanding of chemical methods employed for elemental and compound analysis.<br>5. to provide experience in some scientific methods employed in analytical chemistry.<br>6. to develop some understanding of the professional and safety responsibilities residing in working on chemical analysis. | |
| **Course Assessments** | Midyear exam | 20% |
| | Quizzes, reports, presentation | 10% |
| | Practical continuous assessment, exam | 10% |
| | Final Practical exam | 20% |
| | Final theoretical exam | 40% |
| | Total | 100% |
| **Content Breakdown Topical Coverage** | Content Breakdown Topical Coverage | |
| **Session 1 (Week 1)** | **I. Introduction**<br>• What is Analytical Chemistry?<br>• Qualitative and Quantitative analysis.<br>• The function of Analytical Chemistry . | |
| **Session 2 (Week 2)** | Methods of Analysis.<br>Stereochemistry<br>• Percentage concentration (Weight per weight- volume per volume) | |
| **Session 3 (Week 3)** | • Molar and formal concentration (Molarity and formality).<br>• Normal concentration (Normality). | |
| **Session 4 (Week 4)** | • Conversion from one concentration to another.<br>• Problems and calculations. | |
| **Session 5 (Week 5)** | Volumetric quantitative methods of analysis<br>• General principles (Titrimetric analysis, Titrate&Titrant).<br>• Types of titrimetric analysis (direct and back titration). | |
| **Session 6 (Week 6)** | Standards (primary & secondary substances).<br>Preparation of standard solutions by direct & indirect methods | |
| | Specific chemical reactions in analytical chemistry.<br>• Equilibrium concept. | |
| **Session 8 (Week 8)** | **II. Neutralization in analytical chemistry**<br>• Introduction.<br>• Acid – base theories.<br>• Acid – base strength.<br>• Leveling effect. | |
| **Session 9 (Week 9)** | Acidity of solutions pH.<br>• Calculation the pH of solution of strong acid and strong base.<br>• The ionic product of water.<br>• Calculation the pH of solutions of weak acid and weak base.<br>• Calculation the pH during titration. | |
| **Session 10 (Week 10)** | • Ionization of polyprotic acids. | |

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| | • Hydrolysis of salt.<br>• Buffer solutions.<br>• Calculation of pH of Buffer (Henderson equation).<br>• Problems and calculation. |
| **Session 11 (Week 11)** | Midyear Exam |
| **Session 12 (Week 12)** | |
| **Session 13 (Week 13)** | |
| **Session 14 (Week 14)** | |
| **Session 15 (Week 15)** | • Acid – Base Titration,<br>• Titration curves,<br>• Acid – base Indicators.<br>• Preparation of standard solutions of acid & base.<br>• End point detection. |
| **Session 16 (Week 16)** | • Acid-base Applications.<br>• Determination of carbonate in a mixture of carbonate and bicarbonate.<br>• Determination of carbonate in a mixture of carbonate and hydroxide.<br>• Determination of carbon dioxide in the atmosphere.<br>• Determination of nitrogen.<br>• Determination the original boric acid in a mixture of Boric and Borax. |
| **Session 17 (Week 17)** | Acid-base titration in Non-aqueous solvents:<br>• Introduction.<br>• Solvents.<br>• Choosing a solvent.<br>• End point detection. |
| **Session 18 (Week 18)** | **III. Oxidation – Reduction**<br>• Oxidation – Reduction reactions.<br>• Electro chemical cells.<br>• Cell calculation.<br>• Electrode potentials.<br>Factors affecting oxidation potentials |
| **Session 19 (Week 19)** | Titration curves.<br>• Oxidation – Reduction indicators, Oxidation – Reduction titration, Oxidation and Reduction Agents.<br>• The gram equivalent weight of an oxidizing Agent.<br>• Potassium permanganate titration.<br>• Preparation of standard solution.<br>• Determination of ferrous sulphate using potassium permanganate.<br>• Potassium dichromate titration.<br>• Ceric titrations. |
| **Session 20 (Week 20)** | Methods of titration involving Iodine (Iodimetry and Iodometryreactions).<br>• Iodine and sodium thiosulphate exercises. |
| **Session 21 (Week 21)** | **IV. Precipitimetry**<br>• Introduction,<br>• Solubility product.<br>• Formation of a precipitate, Types of precipitates, Types of precipitating reagents.<br>• Calculation of the solubility product from solubility.<br>• Calculation of the solubility from the solubility product. |

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| | • Factors affecting on the formation of a precipitate |
| **Session 22 (Week 22)** | Argentometric titration<br>• Preparation of standard solution of silver nitrate and sodium chloride.<br>• End point detection.<br>• Mohrs method for halides.<br>• Fajan's method for halides by using adsorption indicators.<br>• Volhard method for halides (indirect method). • |
| **Session 23 (Week 23)** | Applications<br>• Estimation of chloride anion.<br>• Estimation of chloride in presence of iodide and bromide.<br>• Estimation of chloride in presence of CN.<br>• Estimation of Bromide and iodide. |
| **Session 24 (Week 24)** | **V. Gravimetry**<br>• Gravimetric analysis,<br>• Precipitation,<br>• Post precipitation.<br>• Co-precipitation,<br>• Homogeneous<br>, • Calculation of gravimetric analysis |
| **Session 25 (Week 25)** | Applications:<br>• Determination of Chloride,<br>• Determination of Aluminum.<br>• Determination of Sulphate,<br>• Determination of Magnesium. |
| **Session 26 (Week 26)** | **VI. Complexometry**<br>• Formation of complexes.<br>• Chelating agents.<br>• Stability of metal complexes.<br>• Effect of pH on complex formations.<br>• Solubility of complexes. Complex formation titrations |
| **Session 27 (Week 27)** | • Ethylene – diamine – tetra – acetic acid (EDTA).<br>• Titration of metal ions using EDTA.<br>• End point detection by using metalo-chromic indicators.<br>• Types of EDTA titrations:<br>- Direct titration. |
| **Session 28 (Week 28)** | Indirect titration.<br>- Replacement titration.<br>- Alkalimetric methods.<br>- Titration of mixtures of metal ions.<br>- Determination of hardness in water.<br>- Masking and demasking agents. |
| | Final theoretical exam |
| **Practical Work** | 1- general laboratory techniques:<br>laboratory notebook (laboratory), Mass measurement,<br>how precision works in determining mass , and Size measurement |
| | 2.Adjustment in volume determination, pipette, calibration, burette calibration, quantitative transfer - sediment intake, moisture control, |

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| | reagents, sampling, evaporative |
| | 3-Methods of weighing: Determination of chloride in a dissolved sample, Determination of nickel in steel, Determination of tin in zero (lead), |
| | 4.Determination of sulfur in a dissolved sample, Determination of iron (homogeneous precipitation), Determination of copper and nickel in Monbel (electrical weight) |
| | 5. - Volumetric Methods |
| | Preparation & Standardization From solid and liquid |
| | 6.Titration of Sodium Carbonate withHydrochloric acid (Acid – Base Titration) |
| | 7.Titration of Sodium Hydroxide with Hydrochloric acid (Acid – Base Titration) |
| | 8. Standardization of potassium permanganate using oxalic acid (Reduction-Oxidation Titration) |
| | 9.Silver nitrate titrations by Mohrmethod (Precipitation titration) |
| | 10.Complex-formation titration (Water hardness) |
| | 11. Determination of iodine (Iodimetry titration). |
| | 12-Practical Exam |
| **Attendance Expectations** | Students are expected to attend every session of class, arriving on time, returning from breaks promptly and remaining until class is dismissed. Absences are permitted only for medical reasons and must be supported with a doctor's note. |
| **Generic Skills** | The faculty is committed to ensuring that students have the full range of knowledge and skills required for full participation in all aspects of their lives, including skills enabling them to be life-long learners. To ensure graduates have this preparation, such generic skills as literacy and numeric, computer, interpersonal communications, and critical thinking skills will be embedded in all courses. |
| **Course Change** | Information contained in this course outline is correct at the time of publication. Content of the courses is revised on an ongoing basis to ensure relevance to changing educational employment and marketing needs. The instructor will endeavor to provide notice of changes to students as soon as possible. Timetable may also be revised. |

# Organic chemistry 1

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| **1** | **Course name** | **Organic chemistry 1** |
| **2** | **Course Code** | **BH101** |
| **3** | **Course type: /general/specialty/optional** | **General** |
| **4** | **Accredited units** | **4 units (Theoretical 3 hr./Week 2 hr. Lab/Week)** |
| **5** | **Educational hours** | **5hrs/week** |
| **6** | **Pre-requisite requirements** | **General chemistry** |
| **7** | **Program offered the course** | **Pharmaceutical Chemistry** |
| **8** | **Instruction Language** | **English Language** |
| **9** | **Date of course approval** | **12/2021** |

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| **Brief Description:** | This course involves the study of the carbon compounds and chemical bonds, Stereochemistry. Also the course deals with knowledge about nucleophilic substitution and Elimination reaction of alkyl halides, and Synthesis and reactions of alkenes and alkynes. the subject provides the students scientific information about alcohols, ethers, and aromatic compounds, aldehydes and ketones and Carboxylic acids and their derivatives and amines compounds. The practical component of the course helps the students to get a better insight into essential process in chemical reactions, functional group identification and safety rules in chemical laboratory. |
| **Textbooks required for this Course:** | 1- Solomons, Fundamentals of organic chemistry text book, fourth edition. by T.W Graham Solomon. John Wiley and Sons INC. last edition.<br>2- FieserWilliamson, Organic experiments text book sixth edition. By F.Louis ,Fieser and L. Kenneth Williamson. D.C. heath and company Lexington, Massachusetts. Last edition.<br>3- Experimental organic chemistry text book, principles and practice.BlackWell Scientific publications.<br>4- Organic chemistry by Morrison and boyd |
| **Course Duration** | 28 weeks |
| **Delivery** | Lectures (Tools: board, data show). The lectures were added on the internet site of the faculty to be available to the students all the time as an *e*-learning.<br>Practical Session (Tools: labs., boards, instruments, chemicals, glassware, equipment).<br>Assignments, seminars, researches and posters. |
| **Course Objectives:** | **1.** To train students the fundamental theory and laboratory skills.<br>**2.** To familiarize students of organic chemical separation, purification, and resolution of optically active compounds.<br>**3.** To provide students with knowledge of nomenclature, synthesis,reactions, and the reaction mechanisms of organic compounds.<br>**4.** To demonstrate to students how to use the laboratory methods of |

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| | preparation, crystallization,purification, distillation, separation, extraction, determination of melting and boiling points …etc.<br>**5.** To learn about the common organometallic compounds and itsapplicationsfor organic synthesis.<br>**6.** To become familiar with many important organic products in the pharmaceutical industry. | |
| **Course Assessments** | - Midyear exam | 20% |
| | Quizzes, reports, presentation | 10% |
| | Practical continuous assessment, exam | 10% |
| | Final Practical exam | 20% |
| | Final theoretical exam | 40% |
| | Total | 100% |
| **Content Breakdown Topical Coverage** | Content Breakdown Topical Coverage | |
| | **Unit 1- Introduction to carbon compounds and chemical bonds** | |
| **Session 1 (Week 1)** | **1.1**The Structure of methane, ethane,Ethylene, and the ethyne $Sp^3$,$SP^2$ ,and $SP^3$- orbital hybridization.<br>**1.2** Restricted rotation and double bond ,cis-trans E, Z -isomers, conformational analysis of ethane ,butane ,and cyclohexane, relative stabilities of cycloalkanes ; Ring strain | |
| **Session 2 (Week 2)** | **1.3** The structural and geometrical isomers.<br>**1.4** Nomenclature of alkanes , alkenes, alkynes ,cycloalkanes and cycloalkenes,bicyclic and Spiro compounds . | |
| **Session 3 (Week 3)** | **1.5** Substituted and disubstitutedcycloalkanes, Bicyclic and polycyclic alkanes.<br>**1.6** Physical properties of alkanes and cycloalkanes | |
| **Session 4 (Week 4)** | **Unit 2- Stereochemistry; Chiral molecules**<br>**2.1** Isomerism.<br>**2.2** Enantiomers and chiral molecules, nomenclature of Enantiomers, properties of enantiomers; optical activity | |
| **Session 5 (Week 5)** | **2.3** Molecules with more than one stereocenter, stereoisomerism of cyclic compounds ,resolution of enantiomers, and Fischer projection. | |
| **Session 6 (Week 6)** | **Unit 3-. Nucleophilic substitution and Elimination reaction of alkyl halides**.<br>**3.1** Introduction ,physical properties of organic halides , reaction mechanisms $S_N1$ and $S_N2$ reactions and the stereochemistry of $S_N1$ reactions . | |
| **Session 7 (Week 7)** | **3.2** Elimination reaction of alkyl halides ; The $E_2$ and $E_1$ reactions, Substitution verses Elimination . | |
| **Session 8 (Week 8)** | **Unit 4**- **Synthesis of alkenes and alkynes**.<br>**4.1**Dehdrohalogenation of alkyl halides , Dehydration of alcohol and its mechanism, and ,Dehalogenation of *vic*-dibromides ,Hydrogenation of alkynes ,. | |
| **Session 9 (Week 9)** | **4.2** Carbocation stability and the occurrence of molecular rearrangements | |
| **Session 10 (Week 10)** | **Unit 5-Reactions of alkenes and alkynes**<br>**5.1** Additions reaction:Hydrogenation, Halogenation.<br>**5.2** Addition of HX and oxidation | |

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| **Session 11 (Week 11)** | Midyear exam |
| **Session 12 (Week 12)** | |
| **Session 13 (Week 13)** | |
| **Session 14 (Week 14)** | |
| **Session 15 (Week 15)** | **Unit 6- Alcohols and Ethers**:<br>**6.1** Structure and nomenclature**,** physical properties of alcohols and ethers.<br>**6.2** Synthesis of alcohols from alkenes, hydration of alkenes ,through oxymercuration-demercuration**,** through hydroboration **–**oxidation. |
| **Session 16 (Week 16)** | **6.3** Alcohols as acids, conversion of alcohols into mesylates and tosylates**,** conversion of alcohols into alkyl halides.<br>**6.4** Reaction of alcohols: with HX, $PBr_3$, $SOCl_2$.<br>**6.4** Reaction of alcohols: with HX, $PBr_3$, $SOCl_2$. |
| **Session 17 (Week 17)** | **6.6** Reaction of ethers: Reaction of epoxides.<br>**6.7** Alcohols fromcarbonyl compounds: Oxidation- Reduction and organometallic compounds, oxidation of alcohols, preparation of organ lithium and organ magnesium.<br>**6.8** Reaction of organ lithium and organ magnesium compounds |
| **Session 18 (Week 18)** | **Unit 7-Aromatic compounds**:<br>**7.1** Nomenclature of benzene derivatives ,the Kekule structure for benzene ,the stability of benzene ,aromatic ,antiaromatic ,nonaromatic, the annulenes aromatic ions , and benzeneoid aromatic compounds. |
| **Session 19 (Week 19)** | **7.2** Electrophilic aromatic substitution, halogenationnitration, sulfonation, Friedel-Crafts alkylation, FriedelCrafts acylation.<br>**7.3** Theory of substituent effects on orientation and reactivity in electrophilic aromatic substitution , synthetic applications |
| **Session 20 (Week 20)** | **Unit 8- Aldehydes and ketones: Nucleophilic addition to carbonyl group:**<br>**8.1** Nomenclature of aldehydes and ketones, physicalproperties, synthesis of aldehydes, synthesis of ketones.<br>**8.2** Nucleophilic addition to the carbon-oxygen double bond ,the addition of water and alcohols , acetals and ketals , hemiacetals and hemi ketal and cyclic ketals . |
| **Session 21 (Week 21)** | **8.3** the addition of hydrogen cyanide and sodium bisulfite, the addition of Ylides: The Wittig reaction, the addition of organo- metallic reagents: The Reformatskyreaction.<br>**8.4** Oxidation of aldehydes and ketones,TheBaeyr-Villger oxidation . |
| **Session 22 (Week 22)** | **8.5 Reaction of aldehydes and ketones : Aldol reactions** ,reaction via enols and enolate ions ,halogenation of ketones ,haloform reaction ,The Aldol reaction ,crossed Aldol reaction ,Claisen – Schmiditreactions,and cyclization via Aldol condensations |
| **Session 23 (Week 23)** | **Unit9- Carboxylic acids and their derivatives: Nucleophilic substitution at the acyl carbon**:<br>**9.1** Nomenclature and physical properties, acidity of carboxylic acids, dicarboxylicacids, esters, carboxylicanhydrides, acyl chlorides amides and nitriles. |

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| **Session 24 (Week 24)** | **9.2** Preparation of carboxylic acids **,** by oxidation of alkenes ,by oxidation of aldehydes and primary alcohols ,by oxidation of alkylbenzene ,by hydrolysis of cyanohydrins ,and by carbonation of Grignard reagents . |
| **Session 25 (Week 25)** | **9.3** Synthesis and reaction of acid derivatives: acyl chloride acid anhydrides ,esters ,lactones ,amides ,lactams ,and nitriles . |
| **Session 26 (Week26)** | **Unit 10- Amines:**<br>**10.1** Nomenclature ,physical properties and structure of amines ,basicity of amines ,amines as resolving agents, |
| **Session 27 (Week 27)** | **10.2** preparation of amines **,** through nucleophilic substitution reactions ,through reduction of nitro compounds ,through reductive amination and through reduction of amides,oximes and nitriles . |
| **Session 28 (Week 28)** | **10.3** Reaction of amines**:**Oxidation of amines, reaction with nitrous acids, reaction of primary arylamines with nitrouaacids, reaction of secondary amines with nitrouaacids, reaction of tertiary amines with nitrous acids.<br>**10.4** Replacement reaction of arendiazonium salts ,synthesis using diazonium salts. |
| | Final Exam |
| **Practical Work** | 1-Safety rules: Laboratory safety: Eye safety, fires, the hazarded of organic solvents, waste, solvents disposal, dispensing reagents, food in the laboratory, and first aid.<br>2- Determination of melting points<br>3- Determination of boiling points<br>4- Crystallization<br>5- Sublimation<br>6- Simple and fractional distillation<br>7- Vacuum and steam distillation.<br>8-Extraction with solvents.<br>9- Functional group identification ,alcohols ,aldehydes and ketones, esters , carboxylic acids , and phenols |
| | 10-Practical Exam |
| **Attendance Expectations** | Students are expected to attend every session of class, arriving on time, returning from breaks promptly and remaining until class is dismissed. Absences are permitted only for medical reasons and must be supported with a doctor's note. |
| **Generic Skills** | The faculty is committed to ensuring that students have the full range of knowledge and skills required for full participation in all aspects of their lives, including skills enabling them to be life-long learners. To ensure graduates have this preparation, such generic skills as literacy and numeric, computer, interpersonal communications, and critical thinking skills will be embedded in all courses. |
| **Course Change** | Information contained in this course outline is correct at the time of publication. Content of the courses is revised on an ongoing basis to ensure relevance to changing educational employment and marketing needs. The |

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| | instructor will endeavor to provide notice of changes to students as soon as possible. Timetable may also be revised. |

## Instrumental Analysis

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| **1** | **Course name** | **Instrumental Analysis** |
| **2** | **Course Code** | **PH209** |
| **3** | **Course type: /general/specialty/optional** | **Specialty** |
| **4** | **Accredited units** | **3 units(Theoretical 2 hours/week**<br>**Practical 2 hours /week)** |
| **5** | **Educational hours** | **4 hours /week** |
| **6** | **Pre-requisite requirements** | **Analytical Chemistry** |
| **7** | **Program offered the course** | **Department of Pharmaceutical chemistry** |
| **8** | **Instruction Language** | **English** |
| **9** | **Date of course approval** | **12/2021** |

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| **Brief Description:** | This course will provide students with a fundamental understanding of: Principle of working different pharmaceutical instruments that used for analysis, qualify and quantify the medicine.<br><br>Principle of different methods of separating,purifying, identifying, and titrating pharmaceutical substances usingdifferent standard methods. |
| **Textbooks required for this Course:** | book title & ISBN:<br>1. Pharmaceutical analysis David Watson 5 edition<br>2. British pharmacopeia 2016<br>3. Instrumental methods of analysis<br>4. Instrumental analysis<br>5. lecture notes |
| **Course Duration** | 24 weeks |
| **Delivery** | - Lectures (Tools: board, data show).<br>-Tutorials and group discussions.<br>-Assignments (if applicable), seminars, researches and posters.<br>-Videos.<br>- Practical classes (Lab experiments+ computerized experiments simulation).<br>The lectures are added on the internet site of the faculty to be available to the students all the time as an *e*-learning. |
| **Course Objectives:** | Upon completion of this course, the student will have reliably demonstrated the ability to: |

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| | 1. Identify the difference between qualification and quantification of drug and any other samples.<br>2. Identify the different types of instruments that used to qualify and quantify the medicine.<br>3. Learn students how we can prepare different types of samples for analysis.<br>4. Discover the mechanism of all types of spectral and electrochemical analysis instruments.<br>5. Familiarity with the methods of electrical analysis, spectroscopy, and various chromatographic methods of analysis.<br>6. To understand the foundations of the techniques used by devices and their applications. | |
| **Course Assessments** | Midyear exam | 20% |
| | Quizzes, reports, presentation | 10% |
| | Practical continuous assessment, exam | 10% |
| | Final Practical exam | 20% |
| | Final theoretical exam | 40% |
| | Total | 100% |
| **Content Breakdown Topical Coverage** | Content Breakdown Topical Coverage | |
| **Session 1 (Week 1)** | **1- Pharmaceutical analysis**<br>Definition<br>Identify the difference between qualification and quantification<br>Classification of pharmaceutical analysis<br>Different mechanisms used in pharmaceutical analysis<br>Aim of pharmaceutical analysis | |
| **Session 2 (Week 2)** | **2- Spectroscopy:(Spectral analysis)**<br>Definition<br>Different instruments used in spectral analysis<br>**Ultra-violet spectroscopy**<br>Definition<br>Principle of UV spectra | |
| **Session 3 (Week 3)** | Ultra-violet spectrophotometer<br>Application of UV spectroscopy | |
| **Session 4 (Week 4)** | **Infrared spectroscopy**<br>Definition<br>Theory of IR | |
| **Session 5 (Week 5)** | IR - spectrophotometer (device)<br>Application of IR spectra | |
| **Session 6 (Week 6)** | **Atomic spectroscopy**<br>Atomic absorption and fluorescence | |
| **Session 7 (Week 7)** | Theory of atomic absorption spectroscopy (AAS)<br>Atomic absorption (instrument) | |
| **Session 8 (Week 8)** | **Atomic spectroscopy (flame spectroscopy)**<br>Atomic emission and fluorescence<br>Theory of atomic emission spectroscopy (AES) | |

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| | Atomic Emission (instrument) |
| **Session 9 (Week 9)** | **Molecular Spectroscopy** – **Nuclear transitions**<br>**NMR,** introduction, theory, instrumentation, applications. |
| **Session 10 (Week 10)** | **Mass spectrophotometery:**<br>Introduction, theory, instrumentation, limitation, applications.<br>Fourier Transform Mass Spectrometry. |
| **Session 11 (Week 11)** | Midyear Exam |
| **Session 12 (Week 12)** | |
| **Session 13 (Week 13)** | |
| **Session 14 (Week 14)** | |
| **Session 15 (Week 15)** | **Non-spectroscopic analysis**<br>**Tubidemetry** |
| **Session 16 (Week 16)** | **Separation techniques:**<br>**Chromatographic Analysis**<br>General chromatographic techniques<br>HPLC<br>Theory of HPLC |
| **Session 17 (Week 17)** | Basic information for the different mechanism of HPLC<br>HPLC instrument<br>Application of HPLC |
| **Session 18 (Week 18)** | **GAS chromatography**<br>Theory of GAS chromatography<br>GAS chromatography instrument<br>Application of GAS chromatography |
| **Session 19 (Week 19)** | **Ion chromatography** |
| **Session 20 (Week 20)** | **Electrophoresis** |
| **Session 21 (Week 21)** | **Electrochemical analysis:**<br>Introduction. |
| **Session 22 (Week 22)** | **Potentiometry**<br>Theory of potentiometry<br>Potentiometer (device)<br>Application of Potentiometry |
| **Session 23 (Week 23)** | **Polarography**<br>Theory of polarography<br>Polarography (device)<br>Application of polarography |
| **Session 24 (Week 24)** | **Conductometry**<br>Theory of conductometry<br>Conductometric titrations<br>Application of conductumetry |
| **Session 25 (Week 25)** | **Amperometry**<br>Theory of amperomtry<br>Amperometry (device)<br>Application of amperometric titration |
| **Session 26 (Week 26)** | **Electrogravimetry**<br>Columetry<br>Flourometry |
| **Session 27 (Week 27)** | **Coulometry:** |

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| | Introduction, types of coulometery, parameters in coulometric analysis, applications. |
| **Session 28 (Week 28)** | **Thermal analysis:**<br>Introduction, thermogravimetry (TG), differential thermal analysis (DTA), differential scanning calorimetry (DSC), factors affecting DTA and DSC results, instruments for thermal analysis, applications. |
| | **Final theoretical exam** |
| Practical Work | Identify Ultra -violet instrument components |
| | Effect of solvent in Lmda max using phenol |
| | Identify Infrared instrument components |
| | Determination of Lasix |
| | Identify AAS instruments components |
| | Assay some metals by AAS instrument |
| | Identify HPLC instrument |
| | Identify GAS chromatographic instruments |
| | Assay quality of some medicines by using different pharmaceutical techniques according to BP |
| | Calibration curve using of UV of unknown concentration. |
| | final practical exam |
| **Attendance Expectations** | Students are expected to attend every session of class, arriving on time, returning from breaks promptly and remaining until class is dismissed. Absences are permitted only for medical reasons and must be supported with a doctor's note. |
| **Generic Skills** | The faculty is committed to ensuring that students have the full range of knowledge and skills required for full participation in all aspects of their lives, including skills enabling them to be life-long learners. To ensure graduates have this preparation, such generic skills as literacy and numeric, computer, interpersonal communications, and critical thinking skills will be embedded in all courses. |
| **Course Change** | Information contained in this course outline is correct at the time of publication. Content of the courses is revised on an ongoing basis to ensure relevance to changing educational employment and marketing needs. The instructor will endeavor to provide notice of changes to students as soon as possible. Timetable may also be revised. |

## Organic chemistry II

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| 1 | **Course name** | **Organic chemistry II** |
| 2 | **Course Code** | **BP 201** |
| 3 | **Course type: /general/specialty/optional** | **General** |
| 4 | **Accredited units** | **3 units (2 theoretical+ 1 Lab /week)** |
| 5 | **Educational hours** | **5 hours** |
| 6 | **Pre-requisite requirements** | **Organic I** |
| 7 | **Program offered the course** | **Bachelor Degree in Pharmaceutical Sciences** |
| 8 | **Instruction Language** | **English languish** |
| 9 | **Date of course approval** | **12/2021** |

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| **Brief Description:** | **Scope:** This subject imparts knowledge on stereo-chemical aspects of organic compounds and organic reactions, important named reactions, chemistry of important hetero cyclic compounds. |
| **Textbooks required for this Course:** | 1. Organic chemistry by I.<br>1. Finar, Volume-I & II.<br>2. A text book of organic chemistry – ArunBahl, B.S. Bahl.<br>3. Heterocyclic Chemistry by Raj K. Bansal<br>4. Organic Chemistry by Morrison and Boyd<br>5. Heterocyclic Chemistry by T.L. Gilchrist |
| **Course Duration** | 28 weeks |
| **Delivery** | Lectures (Tools: board, data show, video), Group interaction and discussion, self-directed activities.<br><br>Practical classes (Lab experiments+ preparation of a chemical compounds.<br><br>Lecture-based, Group interaction and discussion, self-directed activities, active participation, computer lab , lab experiments …..etc. |
| **Course Objectives:** | Upon completion of the course the student shall be able to<br>1. write the structure, name and the type of isomerism of the organic compound<br>2. write the reaction, name the reaction and orientation of reactions |

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| | 3. account for reactivity/stability of compounds,<br>4. prepare organic compounds.<br>5. understand the methods of preparation and properties of organic compounds<br>6. explain the stereochemical aspects of organic compounds and stereo chemical reactions | |
| **Course Assessments** | Midyear Examination | 20% |
| | Quizzes, reports, presentation… | 10% |
| | - Practical continuous assessment, exam | 10% |
| | Final Practical Exam | 20% |
| | Final theoretical Exam | 40% |
| | Total | 100% |
| **Content Breakdown Topical Coverage** | Content Breakdown Topical Coverage | |
| **Session 1 (Week 1)** | **Unit one:Chemistry of Heterocyclic Compounds:**<br><br>Nomenclature including IUPAC and trivial names still used by the chemical abstracts. | |
| **Session 2 (Week 2)** | Nomenclature including IUPAC and trivial names still used by the chemical abstracts. | |
| **Session 3 (Week 3)** | Chemistry: Including<br><br>a) The aromatic properties in terms of MO and resonance, the resonance theories, chemical reaction and the properties such as behavior towards electrophilic and nucleophilic reagents, basic and acidic properties, oxidation, reduction. | |
| **Session 4 (Week 4)** | Chemistry: Including<br><br>a) The aromatic properties in terms of MO and resonance, the resonance theories, chemical reaction and the properties such as behavior towards electrophilic and nucleophilic reagents, basic and acidic properties, oxidation, reduction. | |
| **Session 5 (Week 5)** | b) Methods of synthesis of following:<br><br>- Heterocyclic five membered ring with one heteroatom (pyrrole, thiophene and furan). | |
| **Session 6 (Week 6)** | - Heterocyclic six membered with one heteroatom (pyridine). | |
| **Session 7 (Week 7)** | - Fused heterocycles containioline and isoquinng five membered ring (indol, benzothiophene and benzofuran). | |
| **Session 8 (Week 8)** | - Fused heterocycles containing six membered ring (quinoline and isoquinoline). | |

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| **Session 9 (Week 9)** | - Five membered rings with two heteroatom (pyrazole, imidazole, oxazole and thiazole). |
| **Session 10 (Week 10)** | - Six membered rings with two nitrogen atoms (pyrimidine, pyridazine and pyridazine and pyrazine). |
| **Session 11 (Week 11)** | Midtyear Exam |
| **Session 12 (Week 12)** | |
| **Session 13 (Week 13)** | |
| **Session 14 (Week 14)** | |
| **Session 15 (Week 15)** | **Unit two: Chemistry of Carbohydrates:**<br>**-** Classifications, synthesis (descending, ascending and interoconversion) structure e and physical properties (optical activity and mutarotation) chemical reaction. |
| **Session 16 (Week 16)** | **-** Classifications, synthesis (descending, ascending and interoconversion) structure e and physical properties (optical activity and mutarotation) chemical reaction. |
| **Session 17 (Week 17)** | **-** Classifications, synthesis (descending, ascending and interoconversion) structure e and physical properties (optical activity and mutarotation) chemical reaction. |
| **Session 18 (Week 18)** | **-** Classifications, synthesis (descending, ascending and interoconversion) structure e and physical properties (optical activity and mutarotation) chemical reaction. |
| **Session 19 (Week 19)** | - Vitamin C synthesis with special reference to biological significance of deoxy and amino sugars. |
| **Session 20 (Week 20)** | - Vitamin C synthesis with special reference to biological significance of deoxy and amino sugars. |
| **Session 21 (Week 21)** | **Unit three**: **Polynuclear Compounds:**<br>- Fused ring aromatic compounds, naphthalene.<br>- Nomenclature of naphthalene.<br>- Reactions of naphthalene. |
| **Session 22 (Week 22)** | - Oxidation of naphthalene.<br>- Reduction of naphthalene.<br>- Dehydrogenation of hydraromatic compounds, aromatiztion. |
| **Session 23 (Week 23)** | - Nitration and halogenations of naphthalene.<br>- Orientation of electrophilic substitution in naphthalene.<br>- Friedel-Crafts acylation of naphthalene. |
| **Session 24 (Week** | - Sulfonation of naphthalene. |

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| **24)** | - Napthols.<br>- Orientation of electrophilic substitution in naphthalene derivatives. |
| **Session 25 (Week 25)** | - Synthesis of naphthalene derivatives by ring closure. The Hawoth synthesis.<br>- Anthracene and phenanthrene, nomenclature.<br>- Structure of anthracene and phenanthrene. |
| **Session 26 (Week 26)** | - Reactions of anthracene derivatives by ring closer, anthraquinone.<br>- Preparation of phenanthrene derivatives by ring closer.<br>- Carcinogenic hydrocarbons, arene oxides. |
| **Session 27 (Week 27)** | Review |
| **Session 28 (Week 28)** | Review |
| | Final theoretical exam |
| **Practical Work** | **Practical of Organic Chemistry II**<br><br>**Single step synthesis and preparations-(with reaction mechanism, determination of physical constants and calculation of percentage yield of the following:** |
| | **-** Synthesis of Aspirin.<br>- Acetylation. |
| | - Preparation of Acetanilide.<br>- Nitration.<br>- Preparation of Para nitro acetanilide. |
| | - hydrolysis.<br>- Preparation of para nitro aniline |
| | - Benzoylation.<br>- preparation of 2-Naphthyl benzoate. |
| | - Esterification.<br>- preparation of Methyl salicylate |
| | - Condensation reactions.<br>- preparation of Dibenzal acetone. |
| | - preparation of Barbituric acid. |
| | - Separation of binary and tertiary organic mixtures of compounds: (Reactions and principle, procedures and pilot separations). |
| | - Separation of organic mixtures of (carboxylic acid, Hydrocarbons, Phenols, Amines and Neutral organic compounds). |
| | Final Practical Exam |
| **Attendance Expectations** | Students are expected to attend every session of class, arriving on time, returning from breaks promptly and remaining until class is dismissed. Absences are permitted only for medical reasons and must be supported with a doctor's note. |
| **Generic Skills** | The faculty is committed to ensuring that students have the full range of knowledge and skills required for full participation in all aspects of their lives, including skills enabling them to be life-long learners. To ensure graduates have this preparation, such generic skills as literacy and numeric, computer, interpersonal |

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| | communications, and critical thinking skills will be embedded in all courses. |
| **Course Change** | Information contained in this course outline is correct at the time of publication. Content of the courses is revised on an ongoing basis to ensure relevance to changing educational employment and marketing needs. The instructor will endeavor to provide notice of changes to students as soon as possible. Timetable may also be revised. |

## Medicinal chemistry I

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| 1 | **Course name** | **Medicinal chemistry I** |
| 2 | **Course Code** | **BP306** |
| 3 | **Course type: /general/specialty/optional** | **General** |
| 4 | **Accredited units** | **4 units (3 hrs./week theoretical 2 hrs./week practical)** |
| 5 | **Educational hours** | **5 hours/week** |
| 6 | **Pre-requisite requirements** | **Organic chemistry I & II, Analytical Chemistry, Instrumental analysis** |
| 7 | **Program offered the course** | **Department of Pharmaceutical chemistry** |
| 8 | **Instruction Language** | **English** |
| 9 | **Date of course approval** | **12/2021** |

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| **Brief Description:** | • The course is designed to give students the important foundations of pharmaceutical chemistry. This course includes an introduction to the physicochemical properties of drugs and their relationship to absorption, distribution and metabolism and their effects on bioreceptors to cause physiological response. the course also includes a study in some detail of the chemical structure, the relationship between the chemical structure and activity, and the chemical aspects of drug biotransformation. In addition it includes the synthesis of the compounds, and certain therapeutic uses and adverse effects. | |
| **Textbooks required for this Course:** | • Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry Applied Therapeutics: The Clinical Use of Drugs.<br>• Foye's Principles of Medicinal Chemistry.<br>• Textbook of medicinal chemistry Volume**I.**<br>• Textbook of medicinal chemistry Volume**II**.<br>• Experiments in Pharmaceutical Chemistry.<br>• Advanced Practical Medicinal Chemistry.<br>• David G Watson-Pharmaceutical and medicinal chemistry. | |
| **Course Duration** | 28 weeks | |
| **Delivery** | • Lecture-based, Group interaction and discussion, medical clerkship …..etc. | |
| **Course Objectives:** | **By the end of the course, students should be able to:**<br>• Mention the physicochemical properties of different drugs<br>• Understanding the mode of action of drugs and way bonding to their receptors, and overcome adverse effect<br>• Development and synthesize new drugs<br>• Classify the newly discovered drugs. | |
| **Course Assessments** | Midyear exam | 20% |
| | Quizzes, reports, presentation | 10% |
| | Practical continuous assessment, exam | 10% |
| | Final Practical exam | 20% |
| | Final theoretical exam | 40% |
| | Total | 100% |
| **Content Breakdown Topical Coverage** | **Content Breakdown Topical Coverage** | |
| **Session 1 (Week 1)** | **Unit I: Introduction:**<br>Processes of drug discovery<br>Modern drug discovery<br>Biotechnology and Drug Discovery | |
| **Session 2 (Week 2)** | **Physicochemical Properties and biological activity:**<br>• Solubility and partition coefficient<br>• Ionized and unionized species (ionization constant)<br>• Surface activity (nature of receptor site)<br>• Hydrogen bonding and chelation | |
| **Session 3 (Week 3)** | • Receptor and drug-receptor interaction<br>• Concepts of:<br>i. Nonspecific and specific drugs<br>ii. Prodrugs and soft drugs<br>iii. Isosters and bioisosters | |

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| **Session 4 (Week 4)** | **Unit II: Drug metabolism:**<br>• General pathways of drug metabolism (Phase Iand II).<br>• Sites of drug biotransformation<br>• Factors Affecting Metabolism<br>• Drug Biotransformation Pathway (Phase 1), Monooxygenase, Human Hepatic Cytochrome P450 Enzyme System<br>• Drug Conjugation Pathways (Phase 2)<br>• Elimination Pathways |
| **Session 5 (Week 5)** | • Drug Metabolism and Age<br>• Genetic Polymorphism<br>• Oral Bioavailability<br>• Extrahepatic Metabolism<br>• Stereochemical Aspects of Drug Metabolism<br>• Structure-activity relationship, specific use and adverse effect. |
| **Session 6 (Week 6)** | **Unit III: Drugs acting on the autonomic nervous system:**<br>Introduction to ANS , Cholinergic Drugs:<br>**I.** Direct acting cholinergic agonists. |
| **Session 7 (Week 7)** | **II.** Indirect acting cholinergic agonists.<br>**III.** Cholinesterase inhibitors: synthesis of Carbachol, neostigmine bromide and Isofurophate. |
| **Session 8 (Week 8)** | • Anticholinergic Drugs or cholinergic blocking agents:<br>**I.** Parasympathetic postcholinergic - blocking agents (solanaceous alkaloids " and synthetic analogous", aminoalcohol ether, aminoalcohol ester, aminoamides, papaveracous alkaloids and their synthetic analogies).<br><br>**II.** Ganglionic blocking agents (curares "and related compound", succinylcholine, decamethonium. Gallamin, and hexafluorinium bromide)<br>- Synthesis of succinylcholine chloride. |
| **Session 9 (Week 9)** | • Adrenergic Drugs i. Direct sympathomimetic agent. indirect sympathomimetic agent<br>• Adrenergic Blockers: i. α-Adrenergic Blockers. ii. β-Adrenergic Blockers.<br>• Synthesis of Phenylepherine, Prazocin HCL and Atenolol. |
| **Session 10 (Week 10)** | **Unit IV: Diuretics:**<br>• Introduction of nephrons<br>• Site **1** diuretics carbonic anhydrase inhibitors<br>• Site **2** diuretics thiazide and thiazide-like drugs<br>• Site **3** diuretics high-ceiling or loop diuretics<br>• Site **4** diuretics potassium-sparing diuretics<br>• Miscellaneous diuretics. |
| **Session 11 (Week 11)** | Midyear Exam |
| **Session 12 (Week 12)** | |
| **Session 13 (Week 13)** | |
| **Session 14 (Week 14)** | |
| **Session 15 (Week 15)** | **Unit V: Drugs acting on cardiovascular system:**<br>• Cardiotonic agents<br>• Antianginal and vasodilators<br>**i.** Ester of nitrous and nitric acids<br>**ii.** Calcium antagonist: synthesis of Nifedipine and Diltiazem. |

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| | **iii.** Antiarrhythmic |
| **Session 16 (Week 16)** | • Antihypertensive agents<br>**i.** Agents affecting peripheral sympathetic nerve<br>**ii.** Centrally acting adrenergic drugs<br>**iii.** Drugs acting directly on smooth muscles (vasodilators):<br>**iv.** Angiotensin-converting enzyme inhibitors.<br>**v.** synthesis of hydralazine, Captopril and Methyldopa. |
| **Session 17 (Week 17)** | • Antihyperlipidemics: Synthesis of Clofibrate.<br>• Anticoagulants |
| **Session 18 (Week 18)** | **Unit VI: Antihistaminic agent:**<br>• H1-antagonist; synthesis of diphenhydramine, tripelenamine, and chlorpheniramine<br>• H1-antagonist; synthesis of cimetidine and ranitidine.<br>• Proton pump inhibitors |
| **Session 19 (Week 19)** | **Unit VII: Local anesthetics:**<br>• Synthesis of procaine, benzocaine, and lidocaine |
| **Session 20 (Week 20)** | **Unit VIII: Anti- diabetic drugs:**<br>• Insulin and its preparations.<br>• Oral hypoglycemic agents: Synthesis of Tolbutamide, Glyubenclamide and Phenformin HCL. |
| **Session 21 (Week 21)** | **Unit V: Antineoplastic and Immunoactive drugs:**<br>• Types of neoplasms<br>• Metastasis<br>• Synthesis of chlorambucil, thiotepa, |
| **Session 22 (Week 22)** | • Synthesis of cyclophosphamide, methotrexate. |
| **Session 23 (Week 23)** | • Synthesis of 6-mercaptopurine, and 5-fluorouracil. |
| **Session 24 (Week 24)** | • Immunoactive drugs: |
| **Session 25 (Week 25)** | **Unit VIII: Diagnostic agents:**<br>**Contrast media:**<br>• Barium sulphate |
| **Session 26 (Week 26)** | • Iodine compounds |
| **Session 27 (Week 27)** | Review |
| **Session 28 (Week 28)** | Review |
| | Final theoretical exam |

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| **Practical work (one/week)** | **Practical Part:**<br>**A. Identification of some drugs**<br>- To carry out characteristic chemical tests for identification of some studied in theory, as specified in the BP 1993 (VOL I & II).<br>**B. Assay of some drugs (with emphasis on the functional group analysis)**<br>• To carry out the assay (estimation and % purity) of some drugs studied in theory by following the procedures given in BP 1993 (VOL I & II) and emphasis will be given on the functional group wherever applicable.<br>• Phenols (or Chlorocresol or Chloroxylenol), Hydrogen peroxide, Formaldehyde, Methyl salicylate, Cephalexin, INH, Fusidic acid, Sulphur ointment, Benzoic acid and Salicylic acid ointment, Nicotinamide, Ascorbic acid, Diphenhydramine HCl, CPM, Chloroquine phosphate, Chlorambucil, Lidocaine HCl, Sulpha drugs (Sulphanilamide or Sulphacetamide sodium).<br>**C. Synthesis of some representative drugs:**<br>- Sulphanilamide<br>- Sulphacetamide<br>- Benzocaine<br>**Note:**<br>In addition to determination of the percentage purity of drug, the principle of calculations involved in the functional groups have to be studied during the assay of the drugs containing a distinct mono-functional group. |
| | **Final practical exam** |
| **Attendance Expectations** | Students are expected to attend every session of class, arriving on time, returning from breaks promptly and remaining until class is dismissed. Absences are permitted only for medical reasons and must be supported with a doctor's note. |
| **Generic Skills** | The faculty is committed to ensuring that students have the full range of knowledge and skills required for full participation in all aspects of their lives, including skills enabling them to be life-long learners. To ensure graduates have this preparation, such generic skills as literacy and numeric, computer, interpersonal communications, and critical thinking skills will be embedded in all courses. |

# Medicinal chemistry II

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| 1 | **Course name** | **Medicinal chemistry II** |
| 2 | **Course Code** | **BP405** |
| 3 | **Course type: /general/specialty/optional** | **General** |
| 4 | **Accredited units** | **4 units (3 hrs./week theoretical 2 hrs./week practical)** |
| 5 | **Educational hours** | **5 hours/week** |
| 6 | **Pre-requisite requirements** | **Medicinal chemistry I, Organic chemistry I & II, pharmacology I & II** |
| 7 | **Program offered the course** | **Department of pharmaceutical chemistry** |
| 8 | **Instruction Language** | **English** |
| 9 | **Date of course approval** | **12/2021** |

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| **Brief Description:** | The course includes the study of agents that used as antiseptic and disincentive, antimicrobial drugs as well as study of CNS depressant and stimulants, analgesic with knowledge of the relationship between structure and biological activity. The course also deals with the hormones and antineoplastic agents. It deals with studying the mechanism of action, synthesis and drug metabolism of some drugs. |
| **Textbooks required for this Course:** | • Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry Applied Therapeutics: The Clinical Use of Drugs.<br>• Foye's Principles of Medicinal Chemistry.<br>• Textbook of medicinal chemistry Volume**I.**<br>• Textbook of medicinal chemistry Volume**II**.<br>• Experiments in Pharmaceutical Chemistry.<br>• Advanced Practical Medicinal Chemistry.<br>• David G Watson-Pharmaceutical and medicinal chemistry. |
| **Course Duration** | 28 weeks |
| **Delivery** | • Lecture-based, Group interaction and discussion, medical clerkship …..etc. |
| **Course Objectives:** | **By the end of the course, students should be able to:**<br>• Mention the physicochemical properties of different drugs<br>• Understanding the mode of action of drugs and way bonding to their receptors, and overcome adverse effect<br>• Development and synthesize new drugs<br>• Classify the newly discovered drugs |
| **Course Assessments** | Midyear exam: 20%<br>Quizzes, reports, presentation: 10%<br>Practical continuous assessment, exam: 10%<br>Final Practical exam: 20%<br>Final theoretical exam: 40%<br>Total: 100% |
| **Content Breakdown Topical Coverage** | Content Breakdown Topical Coverage |
| **Session1( Week 1)** | **Unit I: Chemotherapy:**<br>• **Antiseptic and disinfectants:preparation, action, uses:**<br>a) Benzalkonium chloride: structure, action and uses.<br>b) Alcohols: Ethanol, Synthesis, concentration, uses as antiseptic.<br>c) Isopropyl alcohol: structure, uses, preparation.<br>d) Ethylene oxide: method of preparation, uses as antiseptics.<br>e) Formalin: structure, method of preparation, uses. |
| **Session 2(Week 2)** | a) Boric acid: structure and uses.<br>b) Gentian violet: structure, method of preparation, uses.<br>c) Phenol: preparation, mechanism of action, uses.<br>d) Cresol: (orth, meta, para): uses.<br>e) Hydrogen peroxide: composition, mechanism of action as an oxidizing agent, uses.<br>f) Chlorothymol: preparation, uses.<br>g) Chloroxylenol (Dettol)®: structure, uses.<br>h) Potassium permanganate: as an oxidizing agent, concentration, |

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| | uses.<br>i) Iodine: solubility, concentration, mechanism of action,<br>j) Sliver nitrate: medical uses.<br>k) Organic halogenated compounds as chloramine and Chloramine T: action, structure, uses.<br>l) Mercurochrome: structure, uses. |
| **Session 3 (Week 3)** | **Preservatives:**<br>a) Benzyl alcohol: composition, preparation, and methods of uses.<br>b) Beta-phenyl alcohol: composition, preparation, and methods of uses.<br>Sodium benzoate: composition, preparation, and methods of uses. |
| **Session 4 (Week 4)** | **Antimicrobial and antibiotics:**<br>**a)** Sulpha drugs and miscellaneous antibacterial, general method of synthesis of sulph drugs; trimethoprim and its synthesis |
| **Session 5 (Week 5)** | • **Antibiotics:**<br>a) Beta-lactam antibiotic; penicillin, cephalosporin, and beta-lactamase inhibitors.<br>b) Chloramphenicol including stereochemistry<br>c) Tetracycline<br>d) Polypeptide inhibitors; Bacitracin and polymycin B (as representatives)<br>e) Macrolide antibiotics: erythromycin (as representatives)<br>f) vi. Miscellaneous antibiotics: Fusidic acid, lincomycin and novobiocin |
| **Session 6 (Week6)** | • **Antimycobacterial agent:** concepts of multi-drug therapy (MDT)<br>a) Antitubercular agents: synthesis of PAS, INH, and ethambutol<br>b) ii. Antileprotic drug: synthesis of dapsone |
| **Session 7 (Week7)** | • **Antifungal agents:** synthesis of miconazole. |
| **Session 8 (Week 8)** | • **Antiviral agents** and an introduction of current anti-AIDS therapy |
| **Session 9 (Week9)** | • **Antimalarial agents**: synthesis of chloroquine and primaquine<br>• **Anthelmintics**: synthesis of diethylcarbamazine citrate, pyrantel pamoate, and mebendazole |
| **Session 10 (Week10)** | **Antiamoebics:** synthesis of metronidazole and diloxanide furoate |
| **Session 11(Week11)** | **Midyear exam** |
| **Session 12 (Week12)** | |
| **Session 13 (Week13)** | |
| **Session 14 (Week14)** | |
| **Session 15 (Week15)** | **Unit II: Central nervous system depressant:**<br>• General anesthesia<br>• Anxiolytic, Sedative, and hypnotic agent (synthesis of phenobarbital, diazepam, and gluethimide)<br>**a)** Benzodiazepines. Ii. Barbiturates<br>**b)** Miscellaneous sedative Hypnotics<br>-Amides and imides<br>-Alcohol and their carbamate derivatives<br>-Aldehydes and their derivatives |
| **Session 16 (Week16)** | • Antipsychotics<br>a) Synthesis of chlorpromazine, and haloperidol |

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| | b) Phenothiazine<br>c) Ring analogies of phenothiazines (Thioxanthines, Dibenzoxazepines, and Dibenzodiazepines) |
| **Session 17 (Week17)** | a) Fluorobutyrophenones<br>b) β-Aminoketones<br>c) Benzamides<br>d) Antimanic agents |
| **Session 18 (Week18)** | • Anticonvulsant or Antiepileptic drugs (synthesis of phenytoin, ethosuximide, carbamazepine, and valporic)<br>a) Barbiturates<br>b) Oxazolidinones<br>c) -Succinimides<br>d) Benzodiazepines<br>e) Ureas and monoacylureas (Phenacemide)<br>a) Misellaneous agents (primidone) |
| **Session 19 (Week19)** | • CNS depressant with skeletal muscle relaxant properties<br>a) Agents used in acute muscle spasm<br>b) Drugs used in spasticity |
| **Session 20 (Week20)** | **Unit III: CNS Stimulants:**<br>a) Analeptics<br>b) Methylxanthines<br>c) Central sympathomimetic agents (Psychomotor stimulants)<br>d) Monoamine oxidase inhibitors<br>e) Tricyclic antidepressant compound |
| **Session 21 (Week21)** | • Psychedelics<br>a) Indolethylamines<br>b) 2-Phenylethylamines<br>c) Agents possessing both indolethylamines and a phenylethylamines moiety<br>d) Dissociative agents<br>e) Depressant – intoxicants |
| **Session 22 (Week22)** | **Unit VI: Analgesic and NSAID:**<br>• Narcotic analgesics<br>**a)** Morphine derivatives<br>**b)** Morphinaons and benzomorphinons<br>**c)** Mepridine derivatives<br>• Antitussive agents |
| **Session 23 (Week23)** | • Non-narcotic analgesics (NSAID)<br>a) Salicylates<br>b) Arylacetic acid derivatives<br>c) Aniline and *P*-aminophenol derivatives<br>d) Pyrazolone and pyrazolidinone derivatives |
| **Session 24 (Week24)** | **Unit VII: Hormones:**<br>• Steroidal hormones (sex hormones)<br>a) Male sex hormones<br>b) Female sex hormones<br>c) Contraceptives |
| **Session 25 (Week25)** | d) Adrenocorticoids |

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| | e) Mineralocorticoids<br>• Other hormones<br>a) Thyroid hormone<br>b) Pancreatic hormones<br>c) Adrenal medulla hormones<br>d) Pituitary gland hormones and hypothalamic hormones |
| **Session 26 (Week26)** | **IX: Development of drugs (drug design):**<br>a) Genesis of drugs (natural sources, semisynthetic drugs, and synthetic drugs)<br>b) Serendipity (accidental discovery)<br>c) Random screening<br>d) Rationally directed random screening<br>e) Rationally directed metabolite approach<br>f) General processes (simplification "disjunction", replication, hybridization, and addition)<br>g) Special processes |
| **Session 27 (Week27)** | • Special processes<br>a) Vinylogy principle<br>b) Increase or decrease of the alkyl chain<br>c) Isosteric substitution (isosteres and bioisosters)<br>d) Introduction of bulky group<br>e) Electron withdrawing and electron donating groups<br>f) Others |
| **Session 28 (Week28)** | • Soft and hard drugs<br>• Methods of lead optimization (topless sequential methods "*pi,sigma, es*"<br>• Drug latentiation (Prodrugs, bioprecursors, and targeted drugs)<br>• Antimetabolite approach<br>Molecular modelling (docking small molecule, homology modelling and molecular dynamic) |
| | Final theoretical exam |
| **Practical work (one/week)** | ➢ **Practical Part:**<br>**A. Analysis of different examples of pharmaceutical chemicals and pharmaceutical dosage forms according to the official methods**<br>1. Anti-inflammatory (Methyl salicylate, Naproxen, Phenazone, Phenylbutazone, Indomethacin, and Aspirin)<br>2. Antibiotics (Amoxicillin, Penicillin, Benzyl penicillin, Cephalexin, Fusidic acid, and Cycloserine)<br>3. Diuretics (Ethacrynic acid, and furosemide)<br>4. Oral contraceptive (Ethinylestradiol, Ethisterone, and mestranol)<br>5. Antineoplastic (Melphalan, Lomustine, and Chlorambucil)<br>6. Hypoglycemic (Chlorpropamide, and Tolazamide)<br>7. Antituberculosis (Isoniazid, and Pyrazinamide)<br>8. Antihistaminic (Dimethydrinate, and Chlorpheniramine)<br>9. Sedative hypnotics (Chloral hydrate, Glutethimide, and mebrobamate)<br>10. Antiseptics (Mercurochrome, and Resorcinol)<br>**B. Analysis of active constituents of different pharmaceutical dosage forms**<br>1. Aerosol inhalations:<br>i. Isoprenalions sulphate inhalation: ferrous chelate formation |

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| | "spectrophotometry".<br>ii. Albuterol inhalation: colored derivative with *p*-dimethylaminoaniline "spectrophotometry".<br>2. Creams (analysis of triamcinolone cream by isoniazid method "spectrophotometry"<br>3. Ointments:<br>i. Sulphur ointment: by oxidation to thiosulphate (titration method).<br>ii. Benzoic and salicylic acid ointments by acid-base titration<br>4. Suppositories:<br>i. Glycerin suppositories: determination of glycerol content by oxidation with sodium metaperiodate by titration method.<br>ii. Neo-haemorrhan suppositories containing.<br>- Prednisolone acetate by phenyltetrazole method "spectrophotometry".<br>- Lignocaine (xylocaine) by acid-dye method: methyl orange or bromocresol purple by spectrophotometry<br>- Zinc oxide and aluminum acetate by Complexiметric method.<br>C. Docking programs (MOE, autodock and Schrodinger), homology modeling and molecular dynamics. |
| | **Final practical exam** |
| **Attendance Expectations** | Students are expected to attend every session of class, arriving on time, returning from breaks promptly and remaining until class is dismissed. Absences are permitted only for medical reasons and must be supported with a doctor's note. |
| **Generic Skills** | The faculty is committed to ensuring that students have the full range of knowledge and skills required for full participation in all aspects of their lives, including skills enabling them to be life-long learners. To ensure graduates have this preparation, such generic skills as literacy and numeric, computer, interpersonal communications, and critical thinking skills will be embedded in all courses. |

## Quality control and drug analysis

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| 1 | Course name | Quality control and drug analysis |
| 2 | Course Code | PH 406 |
| 3 | Course type: /general/specialty/optional | Specialty |
| 4 | Accredited units | 4 units (3 hours theoretical and 2 hours practical) |
| 5 | Educational hours | 5 hours/week |
| 6 | Pre-requisite requirements | Analytical chemistry, instrumental analysis, pharmaceutics and medicinal chemistry |
| 7 | Program offered the course | Department of pharmaceutical chemistry |
| 8 | Instruction Language | English |
| 9 | Date of course approval | 12/2021 |

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| **Brief Description:** | This course deals with the various aspects of quality control and quality assurance of pharmaceutical industries. It deals with the important aspects like cGMP, QC tests, documentation, quality certifications and regulatory affairs.<br>The subject also provides an opportunity for the student to learn GMP, GLP, CGMP, ICH rules in pharmaceutical dosage form. The course covers also the analytical criteria for drug quality assessment, Procedures of QC, Functional group analysis, Titrimetric methods of drug analysis and Stability studies. In addition, the course deals with study of the automation in pharmaceutical analysis, assay of drugs and related substance in biological fluids and radiopharmaceutical agents. | |
| **Textbooks required for this Course:** | 1. Good Laboratory Practice Regulations, 2nd Edition, Sandy Weinberg Vol. 69.<br>2. Quality Assurance of Pharmaceuticals- A compendium of Guide lines and Related materials Vol IWHO Publications.<br>3. How to Practice GMP's – P P Sharma.<br>4. ISO 9000 and Total Quality Management – Sadhank G Ghosh<br>5. The International Pharmacopoeia – Vol I, II, III, IV- General Methods of Analysis and Quality specification for Pharmaceutical Substances, Excipients and Dosage forms.<br>6. Good laboratory Practices – Marcel Deckker Series.<br>7. ICH guidelines, ISO 9000 and 14000 guidelines. | |
| **Course Duration** | 28 weeks | |
| **Delivery** | • Lecture-based, Group interaction and discussion, Use of video technique, practical classes. | |
| **Course Objectives:** | Upon completion of the subject student shall be able to;<br>1. know WHO guidelines for quality control of drugs<br>2. know Quality assurance in drug industry<br>3. know the regulatory approval process and their registration in Libya and international markets<br>4. appreciate EU and ICH guidelines for quality control of drugs.<br>5. understand the cGMP aspects in a pharmaceutical industry<br>6. appreciate the importance of documentation<br>7. understand the scope of quality certifications applicable to pharmaceutical industries<br>8. understand the responsibilities of QA & QC departments | |
| **Course Assessments** | Midyear exam | 20% |
| | Quizzes, reports, presentation | 10% |
| | Practical continuous assessment, exam | 10% |
| | Final Practical exam | 20% |
| | Final theoretical exam | 40% |
| | Total | 100% |
| **Content Breakdown Topical Coverage** | **Content Breakdown Topical Coverage** | |
| **Session 1 (Week 1)** | **Unit I: Introduction: (3 hr)**<br>• Definitions<br>• Drug quality control (QC), rules, QC lab. (official and industry), lab records. | |

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| | • Quality assurance (QA), documentation, self-inspection and validation process of food and drug administration of USK.<br>• Total quality management (TQM)<br>• Different types of ISO<br>• Organization dealing with drug legislations: FDA, European (EMEA), Japanese and ICH system. |
| **Session 2 (Week 2)** | **Unit II: GMP, GLP, CGMP, ICH rules (9 hr)** |
| **Session 3 (Week 3)** | • GMP, GLP, CGMP, ICH rules |
| **Session 4 (Week 4)** | • GMP, GLP, CGMP, ICH rules |
| **Session 5 (Week 5)** | **Unit III: introduction of new drugs: (3 hr)**<br>• Drug registration: FDA, IVH, European and Libyan system of registration.<br>• Stability testing for new drugs<br>• Drug approval process. |
| **Session 6 (Week 6)** | **Unit IV: Pharmaceutical quality control (3 hr)**<br>• Product specifications (reference standards, raw materials, recipient, in-process QC, finished product QC), batches recall, batch record. |
| **Session 7 (Week 7)** | **Unit V: Analytical criteria for drug quality assessment (2 hr)**<br>• Types of criteria judging drug quality, pharmacopeial standards (USP, BP, IP) specification of quality. |
| **Session 8 (Week 8)** | **Unit VI: Chemical purity and its control (2 hr)**<br>• Drug impurities and limit tests, chiral purity |
| **Session 9 (Week 9)** | **Unit VII: Procedures of QC (4 hr)**<br>• Logic sequence of QC<br>• Quarantine<br>• Sampling<br>• Interpretation of statistical data<br>• Integration of different results<br>• Types of errors<br>• Rejection of doubtful results<br>• Certificate of analysis<br>• Product release (raw materials, packaging materials and finished products) |
| **Session 10 (Week 10)** | **Unit VIII: Stability studies (4 hr)**<br>• Impurities and degradation products |
| **Session 11 (Week 11)** | Midyear Exam |
| **Session 12 (Week 12)** | |
| **Session 13 (Week 13)** | |
| **Session 14 (Week 14)** | |
| **Session 15 (Week 15)** | • Shelf life determination |
| **Session 16 (Week 16)** | **Unit IX: Dosage form analysis (3 hr)**<br>• Inhaled dosage form, solids, semisolids, liquids, drops, injectable drugs, transdermal patches, medicated forms.<br>• Multi-component dosage forms. |

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| **Session 17 (Week 17)** | **Unit X: Functional group analysis (9 hr)** |
| **Session 18 (Week 18)** | • Functional group analysis |
| **Session 19 (Week 19)** | • Functional group analysis |
| **Session 20 (Week 20)** | **Unit XI: Titrimetric methods of drug analysis (6 hr)**<br>• Volumetric methods (acid-base, gravimetry, complexiметry, redox titration, ..etc. |
| **Session 21 (Week 21)** | • Volumetric methods (acid-base, gravimetry, complexiметry, redox titration, ..etc. |
| **Session 22 (Week 22)** | **Unit XII: Instrumental methods of analysis (12 hr)**<br>• UV-Visible, diodarry, flourimetry, spectroscopy (IR, FTIR, NMR, MS) |
| **Session 23 (Week 23)** | • Electrochemical methods (polarography, potentiometry, conductimetry, ..etc |
| **Session 24 (Week 24)** | • Separation techniques (TLC, UP, TLC, GC, HPLC, CE) |
| **Session 25 (Week 25)** | • Treatment of chromatographic data: qualitative and quantitative analysis<br>• Hyphenation of separation techniques with detection tools. |
| **Session 26 (Week 26)** | **Unit XII: Automation in pharmaceutical analysis (2 hr)** |
| **Session 27 (Week 27)** | **Unit XIV: Assay of drugs and related substance in biological fluids (2 hr)**<br>Sample preparation; separation, and purification<br>Extraction procedures |
| **Session 28 (Week 28)** | **Unit XV: Radiopharmaceuticals (2 hr)**<br>Radiochemical methods, radioactive products, and radio labeling.<br>QC of radiopharmaceuticals. |
| | Final theoretical Exam. |
| **Practical work (one/week)** | **Practical Part:**<br>**Analysis of different dosage form**<br>Carrying out identification assay and physical parameters according to the official pharmacopeial methods and / or develop manufacturing companies' methods:<br>1. Assay of aspirin tablets using UV-visible -- BP 2013.<br>2. Assay of paracetamol tablets using UV-visible – BP 2013.<br>3. Assay of nalidixic acid suspension – BP 2013.<br>4. Assay of enalapril tablets by potentiometer titration.<br>5. Assay of sodium bicarbonate infusion by direct acid titration – BP 2013.<br>6. Assay of chloramphnicol eye drop by UV-visible – PB 2013.<br>7. Assay of pyridoxine tables by UV-visible.<br>8. Assay of ORS sachet by UV-visible.<br>9. Detection of Zn in insulin using atomic emission spectroscopy.<br>10. Assay of tretinoin(Retina A)® gel using UV-divisible—BP 2013.<br>11 Assay of Nifedipine tables using HPLC – BP 2013. |
| | **Final Practical Exam** |
| **Attendance Expectations** | Students are expected to attend every session of class, arriving on time, returning from breaks promptly and remaining until class is dismissed. Absences are permitted only for medical reasons and must be supported with a doctor's note. |
| **Generic Skills** | The faculty is committed to ensuring that students have the full range of knowledge and skills required for full participation in all aspects of their |

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| | lives, including skills enabling them to be life-long learners. To ensure graduates have this preparation, such generic skills as literacy and numeric, computer, interpersonal communications, and critical thinking skills will be embedded in all courses. |