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University: Pharos University in Alexandria.
Faculty: of Pharmacy and Drug Manufacturing

Program Specification

A- Basic Information:

1- Program Title: Master's degree in Pharmaceutical Sciences (Pharmacology & Toxicology)

2- Program Type: Single [✓] Double [ ] Multiple [ ]

3- Department (s): Department of Pharmacology and Therapeutics (PL)

- **Prof. Dr. Rasha Shaalan**

4- Date of program specifications approval: 8/10/2025

B- Special Information:

1. Program Aims:

The aim of the program is to produce postgraduates with advanced knowledge and understanding in the field of pharmacology, higher order critical, analytical, problem solving and transferable skills; ability to think rigorously and independently to meet higher level expectations of pharmaceutical industry, academics, and research. In addition to preparing researchers in some specialized fields including gene therapy, cell culture use in pharmacology, molecular pharmacology and neuropharmacology. In addition, the candidate will have a wide vision about development of new methods and tools to analyze and criticize any research scientifically, and to use different technological methods which add to his/her professional applications.

Graduate Attributes:

By the end of this program the graduates should be able to:

1. **Have the opportunity to continue their postgraduate education by doing a thesis that involves extensive literature surveys and laboratory-based practical work which make them able to pursue a career in different fields.**
2. **Have the ability of self-learning, problem solving, critical and analytical thinking, working in a team professionally and be aware about his role in community development.**
3. **Identify a research topic, key research questions and principles as well as applications of biostatistics, implement ethics as well as basic methodologies of scientific research in the fields of pharmacology and prepare a comprehensive written report that is professionally presented and contains all the required components of a master's thesis.**
4. **Apply principles of basic physiological processes to systemic disease states, interpret the impact of pharmacogenomics on drug efficacy and adverse effects and deal with laboratory testing which can be performed on many types of fluids from the body using analytical procedures, instrumentation, automation, and lab mathematics.**
5. **Explore the molecular mechanisms of cancer development and neurodegenerative disease and focus on the ethical and regulatory issues for this therapy.**

2- Intended Learning Outcomes (ILOs):

2/1- Knowledge and Understanding:

By completion of the program, students should be qualified to:

A1: Demonstrate expertise in highly specialized and advanced research by the design, execution, and preparation of written and oral reports based on research investigation.

A2: Recognize bioinformatics software and web-based applications; that are required to search for, analyze and submit molecular biology and gene technology data to learn how to access new information in pharmaceutical research and development of new drugs.

A3: Identify principles and applications of biostatistics.

A4: Identify the general functions and importance of different biological fluids.

A5: Describe the processes involved in gene organization, replication, expression, recombinant DNA biotechniques and the mechanisms of different molecular biology techniques used in diagnosis of genetic diseases.

A6: Explain the fundamental principles of pharmacology and cell signaling pathways to detect possible targets for drug action, molecular basis of different receptor types and how they can be modulated by different pharmacological agents.

A7: Explain the advanced principles of pharmacodynamics and pharmacokinetics and their roles in determining drug action, efficacy, and safety.

A8: Describe the organization and function of the autonomic nervous system, and the mechanisms by which cholinergic and adrenergic drugs act as agonists or antagonists.

A9: Identify the etiology, treatment, prevention and appropriate treatment for the various diseases causing alterations in body function.

A10: Describe different analytical and biochemical procedures, instrumentation, automation, safety and laboratory mathematics used in research.

A11: Explain the rationale for the usage of animal models in drug discovery and alternatives for animal models.

A12: Explain the molecular, cellular, and systemic mechanisms underlying toxic responses, including receptor-mediated toxicity, oxidative stress, apoptosis and necrosis pathways, and describe how toxicokinetic and toxicodynamic processes influence target organ toxicity.

A13: Demonstrate comprehensive understanding of advanced and emerging areas in toxicology, including toxicogenomics, risk assessment methodologies, and the toxicological implications of nanomaterials, environmental pollutants, and occupational exposures within regulatory, descriptive and forensic contexts.

A14: Define the biochemical mechanisms of CNS function and the biochemical processes disrupted in the CNS diseases.

A15: Identify how to promote health, prevent and treat diseases in special populations: geriatric, pediatric as well as in pregnant and lactating females by providing basic information on pharmaceutical care for these populations.

A16: Recognize different types of immune responses and the role of the immune system in the pathophysiology of various diseases and the new trends in the use of immune modulators to treat autoimmune disorders and immune-deficiency status as well as mechanisms of action, indications and contraindications of immuno-based drugs and new trends of immunization.

A17: Demonstrate comprehensive understanding of the genetic basis of drug action and variability; gene expression and polymorphisms; and the roles of pharmacogenetics and pharmacogenomics in drug metabolism, pharmacokinetics, pharmacodynamics, and the development of personalized therapies.

A18: Demonstrate an in-depth understanding of the molecular and cellular mechanisms underlying cancer development and progression, including gene regulation, oncogenes and tumour suppressor genes, cell cycle control, growth factor signaling, metastasis, hereditary factors, host defense mechanisms, and molecular approaches used in cancer diagnosis and therapy.

A19: Explain the biochemical principles underlying human health and disease, including the interpretation of clinical laboratory results related to metabolism, organ function, electrolyte and acid–base balance, endocrine regulation, and the biochemical basis of disorders such as diabetes, lipid abnormalities, and hormonal dysfunctions.

2/2- Intellectual Skills:

By completion of the program, students should be qualified to:

B1: Plan a research protocol to conduct independent and effective study.

B2: Evaluate information data from a variety of sources for planning different work strategies.

B3: Criticize published evidence-based information and problem solving by the aid of computer technology.

B4: Discover the scope of computational biology and bioinformatics software and web-based applications to analyze molecular biology and gene technology data for pharmaceutical research and drug design.

B5: Illustrate how to effectively present scientific data based on knowledge of biostatistics.

B6: Examine basic techniques of proteins, DNA & RNA extraction, separation and quantification.

B7: Analyze information in different fields of pharmacology and basic principles of cell signaling pathways to detect possible targets for drug action, molecular basis of different receptor types and their modulation by different pharmacological agents.

B8: Explain how structural and molecular biology, and modern enzymology have revolutionized the understanding of selective drug action and development of new therapies.

B9: Interpret the mechanisms of drug action on the autonomic nervous system and autocrine-paracrine mediators, and evaluate how these mechanisms influence therapeutic outcomes and potential adverse effects.

B10: Distinguish between the different orders of reactions and calculate the half-life time of drugs.

B11: Assess the mechanisms, risks, and target-organ effects of chemical and drug exposures.

B12: Evaluate strategies to prevent or mitigate toxicity in human health and environmental contexts.

B13: Discover the relation between the principles of pharmacokinetics and drug's therapeutic efficacy, toxicity and factors that modify responses to drugs.

B14: Evaluate and interpret clinical and pharmacological data to select the most appropriate drug therapy for a patient, taking into account the specific pathology and any comorbid conditions.

B15: Analyze therapeutic strategies for both acute and chronic clinical conditions with considering the various variables that influence these strategies and risks in medical practice.

B16: Outline the basics of the use of cell lines in drug screening, different types of instruments used in biological screening of drugs and different methodologies for in vivo modeling of various diseases.

B17: Relate the pharmacological properties, therapeutic uses, side effects and contraindications to the use of different classes of drugs in endocrine and metabolic disorders, respiratory disorders, gastrointestinal and liver diseases, renal diseases and chemotherapy.

B18: Explain synaptic neurotransmissions, mechanisms of neurodegenerative diseases and neurobiological applications in drug targeting.

B19: Evaluate the molecular and cellular mechanisms of cancer development, including the roles of oncogenes, tumor suppressor genes, and growth factor signaling, to understand tumor progression, metastasis, and the use of molecular markers in cancer diagnosis and therapy.

B20: Recognize the appropriate analytical instruments used in laboratory investigations and the appropriate correlations between the analyzed laboratory tests results and patients' medical condition according to validated laboratory techniques and calculations.

B21: Differentiate between major components of the immune system as well as different types of autoimmune diseases and how to effectively use immune modulators to treat both autoimmune disorders and immune-deficiency status together with pointing out the new trends of different diseases vaccination including cancer immune therapy.

B22: Outline the physiological characteristics of geriatric, pediatric subjects as well as pregnant and lactating females to promote health, prevent and treat diseases in these and other special populations.

B23: Interpret genetic and molecular data to predict individual variations in drug response, metabolism, and efficacy, for critically assessing the implications for personalized therapy and drug development.

B24: Analyze the cellular, molecular, and systemic mechanisms underlying human diseases, to evaluate the pathophysiological processes that predict disease progression for clinical decision-making.

2/3 - Professional skills:

By the end of this program, the graduate should be able to:

C1: Develop research skills, including knowledge of general principles and procedures of research methodology, statistical analysis, and scientific writing in the fields of pharmacy.

C2: Demonstrate ethical and professional conduct in handling patient or experimental data and following research ethics guidelines.

C3: Apply modern computational and digital tools (e.g., bioinformatics and data analysis software) in biomedical research.

C4: Develop competence, confidence and an enquiring investigative approach.

C5: Create comments on reports for situations related to the field of pharmacology including critical reviews of scientific articles and peer evaluation.

C6: Compile reviews and essays discussion competently for effective information management.

C7: Develop independent and self-critical learning ability by solving disease related cases.

C8: Design laboratory experiments and experimental results analysis and interpretation to investigate the mechanism of drug action and efficacy.

C9: Create skills required for conducting of standard pharmacological laboratory procedures and the usage of updated equipment related to the field of pharmacology appropriately.

C10: Evaluate standard methods for quantitative analysis of concentration-time profile.

C11: Collaborate effectively within multidisciplinary laboratory and clinical research teams.

C12: Integrate laboratory findings into real-world clinical and therapeutic contexts through translational thinking.

2/4 - General Skills:

By the end of this program the graduate should be able to:

D1: Use internet to search relevant materials in textbooks and electronic sources.

D2: Create skills of self-learning. group work and being effective as a leader or a member

D3: Apply oral, written and poster presentations.

D4: show problem solving skills by interpreting data, designing and carrying out experimental work.

D5: Develop skills of handling advanced tasks within given time limits

3- Academic Standards of program specification:

Academic Reference Standards (ARS) for Master Degree of Pharmaceutical Sciences (Pharmacology)

4- External references for standards (Benchmarks):

NA

5- Program Structure and Contents:

a- Program duration: Minimum of Two years

b- Program structure:

Subject Areas	Percentage
Basic sciences courses	**11.11%**
Specialized courses	**38.88%**
Thesis	**50.00%**

c- Program course Levels (in credit-hours system):

أولا:

(الفصل الدراسي الأول) 4 ساعات معتمدة مقررات عامة و4 ساعات معتمدة مقررات تخصصية.

First Semester:

No.	Course Code	Course Title	Credit Hours	إسم المقرر
1	PP 601	Research Methods & Scientific Writing	2	طرق البحث والكتابة العلمية
2	PL 601	Statistics & Biostatistics	1	الإحصاء والإحصاء الحيوي
3	PM 602	Bioinformatics	1	المعلوماتية الحيوية
4	PM 601	Molecular Biology & Genetics	1	الأحياء الجزيئية والوراثة
5	PL 702	Molecular Basis of Drug Actions	1	الأسس الجزيئية لتأثير العقاقير
6	PL 703	Introduction to Pharmacology	2	مقدمة علم الأدوية

ثانيا:

الفصل الدراسي الثاني 10 ساعات معتمدة مقررات تخصصية.

Second Semester:

No.	Course Code	Course Title	Credit Hours	إسم المقرر
1	PL 704	Advanced Pharmacology	3	علم الأدوية المتقدم
2	PL 705	Advanced Topics in Toxicology	2	مواضيع متقدمة في علم السموم
3	PL 706	Advanced Pharmacotherapeutics	2	العلاجيات الدوائية المتقدمة
4	PL 707	Applied Experimental Pharmacology	2	علم الأدوية التطبيقي التجريبي
5		Elective Course	1	مقرر اختيارى

المقررات الاختيارية المتاحة لدرجة ماجستير الأدوية والسموم:

No.	Course Code	Course Title	Credit Hours	إسم المقرر
1	PL L08	Therapeutics in Special Populations	1	علاجيات في الفئات الخاصة من الناس
2	PL L09	Pathophysiology of Human Disease	1	علم وظائف الأعضاء المرضى لأمراض الإنسان
3	PL L10	Pharmacogenomics & Pharmacogenetics	1	علم الوراثة الدوائي
4	PL L11	Immuno-Pharmacology	1	علم أدوية المناعة
5	PL L12	Cancer Biology	1	علم الأحياء الخاص بالسرطان
6	PL L13	Analysis of Body Fluids	1	تحليل سوائل الجسم
7	PL L14	Advanced Clinical Biochemistry	1	الكيمياء الحيوية الإكلينيكية المتقدمة
8	PL L15	Neurochemistry	1	الكيمياء العصبية

بحث رسالة الماجستير

Thesis Research

No.	Course Code	Course Title	Credit Hours	إسم المقرر
1	PL 800	Thesis Research	18	بحث رسالة الماجستير

d- Program Courses

a. Compulsory (17 h):

Course Code	Course Title	Credit Hours	Hours per Week			Level	Semester
			Lect.	Lab.	Tut.		
PP 601	Research Methods & Scientific Writing	2	2		—	General	First
PL 601	Statistics & Biostatistics	1	1		—	General	First
PM 602	Bioinformatics	1	1		—	General	First
PM 601	Molecular Biology & Genetics	1	1		—	Special	First
PL 702	Molecular Basis of Drug Actions	1	1		—	Special	First
PL 703	Introduction to Pharmacology	2	2		—	Special	First
PL704	Advanced Pharmacology	3	3		—	Special	Second
PL705	Advanced Topics in Toxicology	2	2		—	Special	Second
PL706	Advanced Pharmacotherapeutics	2	2		—	Special	Second
PL707	Applied Experimental Pharmacology	2	1	2	—	Special	Second
PL 800	Thesis Research	18			—	Thesis	-----

b. Elective courses (1 h):

Course Code	Course Title	Credit Hours	Hours per Week			Level	Semester
			Lect.	Lab.	Tut.		
PL L08	Therapeutics in Special Populations	1	1			Special	
PL L09	Pathophysiology of Human Disease	1	1			Special	
PL L10	Pharmacogenomics & Pharmacogenetics	1	1			Special	
PL L11	Immuno-Pharmacology	1	1			Special	
PL L12	Cancer Biology	1	1			Special	
PL L13	Analysis of Body Fluids	1	1			Special	
PL L14	Advanced Clinical Biochemistry	1	1			Special	
PL L15	Neurochemistry	1	1			Special	

- Required courses offered by any department could be mutually accepted as elective courses in other departments.
- Courses may be offered in the summer semester to meet the needs of the graduate students.

6- Program Courses Contents:

I. Required Courses:

Course Code or Number: PP 601
Course Title: Research Methods & Scientific Writing
Contents:

- **Research areas in various pharmacy disciplines.**
- **Drug literature retrieval and evaluation.**
- **Experimental design and methodology to optimize the in-vitro and in–vivo experiments.**
- **Design of single and multiple factors experiments (e.g. factorial design or others).**
- **Response surface design.**
- **Sampling techniques.**
- **Data collection, reliability, validity and analysis.**
- **Thesis preparation.**
- **Ethical conduct in research.**

Course Code or Number: PL 601
Course Title: Statistics & Biostatistics
Contents:

- **Data collection, presentation & distribution.**
- **Basic probability.**
- **Statistical building blocks.**
- **Confidence intervals.**
- **Regression analysis (parametric and non-parametric).**
- **Tests of statistical significance: Paired, pooled t tests & analysis of variance.**
- **Epidemiology.**
- **Statistical quality control.**
- **Robust statistics.**

Course Code or Number: PM 602
Course Title: Bioinformatics
Contents:

- **Definition, aims and components of bioinformatics.**
- **Biological archives and public organizations.**
- **Searching for drug side effects, interactions and publications.**
- **Comparative analysis of sequences.**
- **Protein structure and function and annotation of sequences.**
- **Bioinformatics tools for gene technology.**
- **Bioinformatics-based drug design.**
- **Genomics, proteomics and metabolomics.**

Course Code or Number: PM 601
Course Title: Molecular Biology & Genetics
Contents:

- **Basic principles in molecular biology.**
- **Macromolecular structure and interactions.**
- **Regulation of gene expression.**
- **Basis of inherited diseases and diagnostic molecular biology of genetic diseases.**
- **Genetic variation & DNA finger printing.**
- **Genomics, proteomics and bioinformatics.**
- **DNA cloning and manipulations, and gene therapy.**

Course Code or Number: PL 702
Course Title: Molecular Basis of Drug Actions
Contents:

- **Introduction: Molecular approaches to drug mechanism.**
- **Molecular pharmacology of receptors:**
- **Molecular basis of receptor subtypes.**
- **Receptor-ligand interactions.**
- **Signal transduction.**
- **Biochemical and molecular aspects of G-protein coupled receptors and their signaling mechanisms.**
- **Molecular pharmacology of ion channels.**
- **Molecular pharmacology of enzymes.**
- **Hormone action and signal transduction.**
- **Protein Therapeutics.**
- **Cell cycle checkpoints and anti-cancer drugs.**
- **Drug resistance/mechanisms.**

Course Code or Number: PL 703
Course Title: Introduction to Pharmacology
Contents:
In-depth knowledge and updated information in the following areas, with emphasis on research-relevant issues:

- **Advanced principles of pharmacodynamics and pharmacokinetics.**
- **Introduction to the autonomic nervous system.**
- **Cholinergic neurotransmission and drugs modifying it (agonists and antagonists).**
- **Adrenergic neurotransmission and drugs modifying it (agonists and antagonists).**
- **Pharmacology of autocrine-paracrine mediators.**

Course Code or Number: PL 704
Course Title: Advanced Pharmacology
Contents:

In depth knowledge and updated information in the following areas with emphasis on research-relevant issues:

- **Analgesic drugs (narcotic and non-narcotic agents).**
- **Drugs used in Parkinsonism, Alzheimer's, and senile dementia.**
- **Sedative-hypnotics, antipsychotic, antidepressant drugs.**
- **Antiepileptic drugs and drugs used in anesthesia and CNS Stimulants.**
- **Drugs used in the treatment of anemias.**
- **Antihyperlipidemic drugs.**

Drugs used in disorders of blood coagulation, hypertension, coronary artery insufficiency, heart failure and cardiac dysrhythmias.

Course Code or Number: PL 705
Course Title: Advanced Topics in Toxicology
Contents:

- **Molecular and Cellular Mechanisms of Toxicity**
  - **Receptor-mediated toxicity**
  - **Oxidative stress and redox signaling**
  - **Apoptosis and necrosis pathways**
- **Genetic and Epigenetic Toxicology**
  - **DNA damage and repair mechanisms**
  - **Epigenetic modifications and gene-environment interactions**
- **Toxicokinetics and Toxicodynamics**
  - **Absorption, distribution, metabolism, and excretion (ADME)**
  - **Biotransformation and enzyme systems**
- **Target Organ Toxicity**
  - **Hepatotoxicity, nephrotoxicity, neurotoxicity, cardiotoxicity, etc.**
- **Advanced Risk Assessment**
  - **Hazard identification and dose-response assessment**
  - **Exposure assessment and risk characterization**
  - **Use of in silico and in vitro models**
- **Regulatory and Forensic Toxicology**
  - **Global regulatory frameworks (EPA, FDA, REACH)**
  - **Toxicological aspects of forensic investigations**
- **Nanotoxicology and Emerging Contaminants**
  - **Toxicology of nanomaterials, microplastics, and endocrine disruptors**
- **Toxicogenomics and Systems Toxicology**
  - **Omics technologies in toxicology (genomics, proteomics, metabolomics)**
  - **Computational modeling and systems biology approaches**
- **Environmental and Occupational Toxicology**
  - **Ecotoxicology**
  - **Human health impacts from occupational exposure**
- **Case Studies and Contemporary Issues**
  - **Real-world toxicological events and their analysis**

Course Code or Number: PL 706
Course Title: Advanced Pharmacotherapeutics
Contents:

In-depth knowledge and updated information in the following areas, with emphasis on research-relevant issues:

- **Thyroid gland hormones, thyroid drugs and antithyroid drugs.**
- **Hormone and non-hormonal agents acting on bone mineral homeostasis.**
- **Insulin and oral antidiabetic drugs.**
- **Pharmacology of corticosteroids, sex hormones, anabolic steroids and antiandrogens.**
- **Pituitary gland hormones.**
- **Rational treatment of allergic disorders and pharmacology of bronchial asthma.**
- **Rational basis for treatment of allergic rhinitis and urticaria.**
- **Drugs used in peptic ulcer and reflux oesophagitis.**
- **Antiemetic agents.**
- **Drugs used in bowel and liver disorders, diuretics, antidiuretics, drugs used in urinary motility disorders and urinary antiseptics.**
- **Chemotherapeutic agents for treatment of bacterial, viral, fungal and tuberculous infections.**
- **Cancer Chemotherapy.**

Course Code or Number: PL 707
Course Title: Applied Experimental Pharmacology
Contents:

- **Introduction to experimental methods.**
- **Laboratory safety, instruments and automation.**
- **Experimental studies and ethics; information resources of experimental procedures.**
- ***In-vivo* modeling of various diseases (diabetes, inflammation, nephrotoxicity, hypertension...).**
- **Use of isolated tissues/organs preparation in the testing of drug efficacy.**
- **Cancer modeling.**
- **Use of transgenic animals in drug screening & bio evaluation.**
- **Use of cell lines in drug screening & bio evaluation.**
- **Basics of proteins, DNA & RNA extraction, separation and quantification.**

II. Elective Courses:

Course Code or Number: PL L08
Course Title: Therapeutics in Special Populations
Contents:

- Definition of aging process, theories of aging and the physiological characteristics of geriatric, pediatric, pregnant and lactating subjects.
- The pharmacokinetics & pharmacodynamics characteristics at extremes of age (elderly & infancy), pregnancy and lactation.
- Common adverse drug reactions and interactions at extremes of age (elderly & infancy), pregnancy and lactation.
- Major cardiovascular, CNS, GIT and endocrine disorders at extremes of age (elderly & infancy), pregnancy and lactation.
- Common childhood infections, teething, allergy and febrile disorders.
- Definition and categories of drug Teratogenicity and Mutagenicity
- Evidence-based guidelines for prescribing at extremes of age (elderly & infancy), pregnancy and lactation..

Course Code or Number: PL L09
Course Title: Pathophysiology of Human Disease
Contents:

- Cellular Injury, Inflammation, Fever and Healing.
- Diseases of Immunity.
- Neoplastic Disease
- Blood Disorders.
- Hemodynamic and Vascular Disorders.
- Cardiac Pathophysiology.
- Respiratory Pathophysiology.
- Gastrointestinal Pathophysiology.
- Hepatobiliary and Pancreatic Pathophysiology.
- Renal Pathophysiology.
- Endocrine Pathophysiology.
- Skeletal and Muscular Pathophysiology.
- Reproductive Disorders.
- Disorders of the Central Nervous System.
- Pain and trauma.

Course Code or Number: PL L10
Course Title: Pharmacogenomics & Pharmacogenetics
Contents:

- **Genetic structure of DNA and function. Pharmacogenetics and pharmacogenomics notions**
- **Functions and structures of RNA and proteins.**
- **Structures of genes and gene expressions; the method, variety and analysis of polymorphism.**
- **The importance of pharmacogenetics and pharmacogenomics in drug production and response.**
- **The changes depending on the genetic factors in drug pharmacokinetics and pharmacodynamics.**
- **The pharmacogenetics of enzymes in the drug metabolism.**
- **The pharmacogenetics of receptors in the drug metabolism.**
- **The pharmacogenetics of drug carriers in the drug metabolism.**
- **Pharnacogenomics and Proteomics.**
- **Gene therapy.**

Course Code or Number: PL L11
Course Title: Immuno-Pharmacology
Contents:

- **Introduction to the immune system and its components.**
- **Different types of immune-responses (innate, adaptive & abnormal).**
- **Drug-Immune system interactions.**
- **Immunopathology of various diseases.**
- **Major Autoimmune disorders and the use of immunosuppressants.**
- **Immune deficiency and the use of immunostimulants & other different therapeutic approaches.**
- **New trends & guidelines of immunization.**
- **The use of Monoclonal antibodies for treatment of various diseases.**
- **Interrelation between Cancer & immune system and new trends in cancer immunotherapy and vaccination.**
- **The Major Histocompatibility reactions and trends of its modulation**

Course Code or Number: PL L12
Course Title: Cancer Biology
Contents:

- **General aspects of gene regulation**: transcription, regulation of the regulators, transcription factors in muscle cell development and transcription factors in oncogenesis**.**
- **Oncogenes:** identification of oncogenes and tumour suppressor genes, tumour suppressor genes or recessive oncogenes, dominant oncogenes involved in signal transduction and transformed cell phenotype.
- **Cell cycle**: the cell cycle, tumour growth, gene expression and cell proliferation and molecular biology of the cell cycle.

- **Growth factors:** autocrine stimulation, growth factors and their receptors, growth factors and malignancy, specific growth factors, growth inhibitory cytokines and growth factors and their receptors as targets for anticancer therapy.
- **Cancer metastasis**: the clinical significance of invasion and metastasis, heterogeneity of the metastasis, metastasis organ distribution, circulating tumour cell arrest and extravasation, three step theory of invasion, laminin receptors, tumour cell motility factors, proteinases and tumour cell invasion from correlation to causality, natural proteinases inhibitors are invasion suppressors, angiogenesis and tumour invasion are functionally related, metastasis and tumourgenecity can be under separate genetic control, metastasis suppressor genes and new strategies for metastasis diagnosis and therapy.
- **Molecular approaches of cancer diagnosis:** Proposes of molecular test in cancer diagnosis, molecular markers in cancer diagnosis and techniques for detection of molecular markers in cancer diagnosis.
- **Hereditary factors and cancer**: Chromosomal alterations, recessively inherited syndromes and dominantly inherited syndromes.
- **Host anti-tumourgenesis mechanisms:** Anti-oxidants and DNA damage and repair mechanisms.

Course Code or Number: PL L13
Course Title: Analysis of Body Fluids
Contents:

- Blood serum.
- Urine.
- Cerebrospinal fluid.
- Peritoneal fluid
- Semen.
- Vaginal secretion.
- Bile.
- Pleural fluid.
- Saliva.

Course Code or Number: PL L14
Course Title: Advanced Clinical Biochemistry
Contents:

- Introducing clinical biochemistry.
- Interpretation of results.
- Nutritional assessment.
- Lipoprotein metabolism.
- Clinical disorders of lipids.
- Skeletal muscle disorders.
- Screening the newborn for disease.
- Fluid and electrolyte balance and imbalance.

- Acid-base concepts and metabolic disorders.
- Renal and Liver function tests.
- Cardiac function tests.
- Glucose metabolism and diabetes mellitus.
- Calcium regulation.
- Endocrinology and its disorders.

Course Code or Number: PL L15
Course Title: Neurochemistry
Contents:

- Fundamental Principles of Neurotransmission Intracellular messengers.
- Acetylcholine, Glutamate and GABA.
- Adenosine, ATP, and Purinergic Signaling.
- Biogenic amines.
- Neuropeptides.
- Extracellular matrix.
- Inflammatory mediators.
- Neurotrophic factors and Neuroprotection.
- Molecular mechanisms of neurodegenerative disease.

7- Program Admission Requirements:

Admission Requirements include:

1. **Holders of bachelor's degree in Pharmaceutical Sciences – minimum general grade Good (C+), or the equivalent of this grade from one of the universities recognized by the Supreme Council in the field of specialty, or from an equivalent foreign university.**
2. **In case the applicant is granted a Pass in his bachelor's degree and wants to register for a master's degree, he must obtain a specialty diploma with general grade (C +) at least, or pass the complementary courses determined by the department, with a general grade no less than (C +) and these courses are not part of the hours of the program.**
3. **The student gets the approval of the department council if he fulfills the terms set by the scientific department (if any) and then the approval of the faculty's Council.**

8- Regulations rules for program course completion:

To obtain a master's degree, 18 credit hours must be studied, in addition to 18 credit hours for the thesis, so that the total number of hours to obtain the degree is no less than 36 credit hours.

9- Methods and Rules of Student's Evaluation:

Methods	Program Intended Learning Outcomes
Written exams (Midterm & Final)	Knowledge & Understanding, Intellectual Skills and Professional Skills (If course contains case studies)
Practical exams (if any)	Intellectual Skills, Professional & Practical Skills
Continuous Assessment (Research projects/ Reports/ Assignments)	Knowledge & Understanding, Intellectual Skills, Professional Skills and General Skills

- **Examinations Procedure:**

1. **The final grade awarded to student in a course are distributed as follows:**
   - **30% for the continuous assessment.**
   - **10% for the mid-semester exam.**
   - **60% for the final written exam**

2. **Each credit hour is allotted a total of 100 points.**

- **Grading System:**

وصف التقدير	النسبة المئوية	رمز التقدير	نقاط التقدير
ممتـاز	100 - 97	A+	4.0
	97 أقل من - 90	A	3.85
	90 أقل من - 85	A-	3.7
جـيد جدا	85 أقل من - 80	B+	3.3
	80 أقل من - 75	B	3.0
جـيد	75 أقل من - 70	C+	2.7
	70 أقل من - 65	C	2.3
مـقبول	65 أقل من - 60	D	2.0
راسب	أقل من 60	F	0.0
راسب لائحة	أقل من 30% في الامتحان التحريري النهائي	BL	0.0
مرضى (خاص بالبحث)	-	NP	-
غير مرضى (خاص بالبحث)	-	NF	-
جارى حساب التقدير	-	IP	-

-	W	-	منسحب
-	MW	-	منسحب للتجنيد
-	I	-	غير مكتمل
-	E	-	غائب بعذر
0.0	NE	0.0	غائب بدون عذر
0.0	DN	0.0	محروم

X = Percentage Grade.

$$\text{Cumulative GPA} = \frac{\sum \text{Grade points x N° Cr. Hrs}}{\sum \text{Cr. Hrs}}$$

10- Evaluation of Program Intended Learning Outcomes:

Evaluator	Tool	Sample	% Contribution in Total Marks of Program Evaluation
5th Year Students	Questionnaires and Periodic Meetings	Questionnaires (20%)	25%
Graduate students	Questionnaires and Periodic Meetings	Questionnaires (20%)	25%
Stakeholders (Employers)	Questionnaires and Periodic Meetings	One meeting / year	25%
External Evaluator	Reviewing of the specifications of the program and the courses according to the bylaw	At least one reviewer professor in the specialty	25%

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