


NU/AC/19(3)/Pharm.D/Rev. TES-Syllb/22- **112**
Date: **23**.12.2022

NOTIFICATION

- Read: 1. **R-44 – Empowering Academic Council to approve Teaching & Examination Scheme, Syllabi, etc published vide notification No. NU-442 dated 27.01.2004**
2. **Notification No. NU-79 dated 15.10.2022 - Introduction of Academic Regulations of Pharm.D. programme under Faculty of Pharmacy**
3. **Notification No. NU-97 dated 21.10.2022- Introduction of Teaching & Examination Scheme of 1st to 6th year and Syllabi of 1st year of Pharm.D. programme**
4. **Note of Dean (I/c), Faculty of Pharmacy**
5. **Approval of Director General date 09.12.2022**

Sub: **Revision in Teaching & Examination Scheme of 1st to 6th year and Syllabi of the 1st year of Pharm.D. programme**

It is hereby notified for information of all concerned that the Director General; taking into consideration the note referred at serial 4 above and under the powers conferred upon him under Section 19(3) of Nirma University Act, has approves the revision in Teaching & Examination Scheme of 1st to 6th year and Syllabi of 1st year of **Pharm.D.** programme, to be made effective for the students admitted from academic year 2022-23 onwards as per **Appendix-A** attached herewith.


Executive Registrar

Encl.: Appendix-A [Pages 1 to 21]

To,

1. Dean, Faculty of Pharmacy
2. All Heads of Dept. (IP)
3. Dy. Registrar (Exam)

Copy to,

1. OS
2. Exam Section
3. Library
4. P.A. to ER

c.f.w.cs. to Director General

Annexure-III
Nirma University
Institute of Pharmacy
Teaching & Examination Scheme of Pharm. D.

Appendix - A

Not in use.
NU-112

First Year

Sr. No.	Course Code	Course Title	Teaching Scheme				Examination Scheme					
			No. of hours of Theory	No. of hours of Practical	No. of hours of Tutorial	Credit	Duration of Examination		Marks for Theory		Marks for Practical	
							YEE	PRE	YEE	SE	YEE	SE
1	PD101	Human Anatomy and Physiology	3	3	1	12	3.0	4.0	70	30	70	30
2	PD102	Pharmaceutics	2	3	1	10	3.0	4.0	70	30	70	30
3	PD103	Medicinal Biochemistry	3	3	1	12	3.0	4.0	70	30	70	30
4	PD104	Pharmaceutical Organic Chemistry	3	3	1	12	3.0	4.0	70	30	70	30
5	PD105	Pharmaceutical Inorganic Chemistry	2	3	1	10	3.0	4.0	70	30	70	30
6	PD106R M/PD10 6RB	Remedial Mathematics\$/Re medial Biology#	3	3#	1	8\$/12#	3.0	3.0#	70	30	70#	30#
		Total	13/16\$#	18	6	56/64\$/68 #						

PRE: Practical Examination

YEE: Year End Examination

SE: Sessional Examination

#Applicable ONLY for the students studied Mathematics / Physics / Chemistry at HSC and appearing for Remedial Biology (RB) course.

\$Applicable ONLY for the students studied Physics / Chemistry / Botany / Zoology at HSC and appearing for Remedial Mathematics (RM) course.

Nirma University
Institute of Pharmacy
Teaching & Examination Scheme of Pharm. D.

Second Year

Sr. No.	Course Code	Course Title	Teaching Scheme				Examination Scheme					
			No. of hours of Theory	No. of hours of Practical	No. of hours of Tutorial	Credit	Duration of Examination		Marks for Theory		Marks for Practical	
							YEE	PRE	YEE	SE	YEE	SE
1	PD201	Pathophysiology	3	-	1	8	3.0	-	70	30	-	-
2	PD202	Pharmaceutical Microbiology	3	3	1	12	3.0	4.0	70	30	70	30
3	PD203	Pharmacognosy & Phytopharmaceuticals	3	3	1	12	3.0	4.0	70	30	70	30
4	PD204	Pharmacology-I	3	-	1	8	3.0	-	70	30	-	-
5	PD205	Community Pharmacy	2	-	1	6	3.0	-	70	30	-	-
6	PD206	Pharmacotherapeutics-I	3	3	1	12	3.0	4.0	70	30	70	30
		Total	17	9	6	58						

PRE: Practical Examination

YEE: Year End Examination

SE: Sessional Examination

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Nirma University
Institute of Pharmacy
Teaching & Examination Scheme of Pharm. D.

Third Year

Sr. No.	Course Code	Course Title	Teaching Scheme				Examination Scheme					
			No. of hours of Theory	No. of hours of Practical	No. of hours of Tutorial	Credit	Duration of Examination		Marks for Theory		Marks for Practical	
							YEE	PRE	YEE	SE	YEE	SE
1	PD301	Pharmacology-II	3	3	1	12	3.0	4.0	70	30	70	30
2	PD302	Pharmaceutical Analysis	3	3	1	12	3.0	4.0	70	30	70	30
3	PD303	Pharmacotherapeu- tics-II	3	3	1	12	3.0	4.0	70	30	70	30
4	PD304	Pharmaceutical Jurisprudence	2	-	-	4	3.0	-	70	30	-	-
5	PD305	Medicinal Chemistry	3	3	1	12	3.0	4.0	70	30	70	30
6	PD306	Pharmaceutical Formulations	2	3	1	10	3.0	4.0	70	30	70	30
	Total		16	15	5	62						

PRE: Practical Examination

YEE: Year End Examination

SE: Sessional Examination

Nirma University
Institute of Pharmacy
Teaching & Examination Scheme of Pharm. D.
Fourth Year

Sr. No.	Course Code	Course Title	Teaching Scheme				Examination Scheme					
			No. of hours of Theory	No. of hours of Practical /Hospital Posting	No. of hours of Tutorial	Credit	Duration of Examination		Marks for Theory		Marks for Practical	
							YEE	PRE	YEE	SE	YEE	SE
1	PD401	Pharmacotherapeu- tics-III	3	3	1	12	3.0	4.0	70	30	70	30
2	PD402	Hospital Pharmacy	2	3	1	10	3.0	4.0	70	30	70	30
3	PD403	Clinical Pharmacy	3	3	1	12	3.0	4.0	70	30	70	30
4	PD404	Biostatistics & Research Methodology	2	-	1	6	3.0	-	70	30	-	-
5	PD405	Biopharmaceutics & Pharmacokinetics	3	3	1	12	3.0	4.0	70	30	70	30
6	PD406	Clinical Toxicology	2	-	1	6	3.0	-	70	30	-	-
	Total		15	12	6	58						

PRE: Practical Examination

YEE: Year End Examination

SE: Sessional Examination

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Nirma University
Institute of Pharmacy
Teaching & Examination Scheme of Pharm. D.
Fifth Year

Sr. No.	Course Code	Course Title	Teaching Scheme				Examination Scheme					
			No. of hours of Theory	No. of hours of Hospital posting*	No. of hours of Seminar	Credit	Duration of Examination		Marks for Theory		Marks for Practical	
							YEE	PRE	YEE	SE	YEE	SE
1	PD501	Clinical Research	3	-	1	8	3.0	-	70	30	-	-
2	PD502	Pharmacoepidemiology and Pharmacoeconomics	3	-	1	8	3.0	-	70	30	-	-
3	PD503	Clinical Pharmacokinetics & Pharmacotherapeutic Drug Monitoring	2	-	1	6	3.0	-	70	30	-	-
4	PD504	Clerkship *	-	-	1	2	-	-	-	-	70	30
5	PD505	Project work (Six Months)	-	20	-	8	-	-	-	-	100**	-
Total			8	20	4	32						

PRE: Practical Examination YEE: Year End Examination

SE: Sessional Examination

* Attending ward rounds on daily basis

** 70 Marks for Thesis work and 30 marks for Viva voce

Nirma University
Institute of Pharmacy
Teaching & Examination Scheme of Pharm. D.
Sixth Year

Sr. No.	Course Code	Course Title	Teaching Scheme				Examination Scheme					
			No. of hours of Theory	No. of hours of Hospital posting	No. of hours of Tutorial	Credit	Duration of Examination		Marks for Theory		Marks for Hospital posting	
							YEE	PRE	YEE	SE	YEE	SE
	PD601	Hospital Residency Training (Internship)#	-	-	-	40	-	-	-	-	100**	-

PRE: Practical Examination

YEE: Year End Examination

SE: Sessional Examination

Six months in General Medicine department, two months each in three other speciality departments

** 70 Marks for Thesis work and 30 marks for Viva voce

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NIRMA UNIVERSITY

Institute:	Institute of Pharmacy
Name of Programme:	Pharm. D
Course Code:	PD101
Course Title:	HUMAN ANATOMY & PHYSIOLOGY
Course Type:	(<input checked="" type="checkbox"/> Core/ <input type="checkbox"/> Value Added Course / <input type="checkbox"/> Departmental Elective/ <input type="checkbox"/> Institute Elective/ <input type="checkbox"/> University Elective/(<input type="checkbox"/> Open Elective Any other)
Year of introduction:	2022-2023

L	T	Practical component				C
		LPW	PW	W	S	
3	1	3	-	-	-	12

Course Learning Outcomes (CLO):

Upon completion of the course the student shall be able to:

1. Describe the structure (gross and histology) and functions of various organs of the human body.
2. Remember various homeostatic mechanisms and their imbalances of various systems.
3. Identify various tissues and organs of the different systems of the human body.
4. Appreciate coordinated working pattern of different organs of each system.
5. Explain interlinked mechanisms in the maintenance of normal functioning (homeostasis) of human body.
6. Perform hematological tests and also record blood pressure, heart rate, pulse and respiratory volumes.

Syllabus:

Total Teaching hours: 90 hours

Unit	Syllabus	Teaching hours
Unit-I	<p>Scope of anatomy and physiology, basic terminologies used in this subject (Description of the body as such planes and terminologies) Structure of cell – its components and their functions. Elementary tissues of the human body: epithelial, connective, Muscular and nervous tissues-their sub-types and characteristics Osseous system - structure, composition and functions of the Skeleton, Classification of joints, Types of movements of joints and disorders of joints Skeletal muscles a) Histology b) Physiology of Muscle contraction c) Physiological properties of skeletal muscle and their disorders (definitions)</p>	20 hours
Unit-II	<p>Haemopoietic System a) Composition and functions of blood b) Haemopoiesis and disorders of blood components (definition of disorder) c) Blood groups d) Clotting factors and mechanism e) Platelets and disorders of coagulation</p>	20 hours

Lymph a) Lymph and lymphatic system, composition, formation and circulation. b) Spleen: structure and functions, Disorders c) Disorders of lymphatic system (definition only)

Cardiovascular system a) Anatomy and functions of heart b) Blood vessels and circulation (Pulmonary, coronary and systemic circulation) c) Electrocardiogram (ECG) d) Cardiac cycle and heart sounds e) Blood pressure – its maintenance and regulation f) Definition of the following disorders Hypertension, Hypotension, Arteriosclerosis, Atherosclerosis, Angina, Myocardial infarction, Congestive heart failure, Cardiac arrhythmias

- | | | |
|-----------------|---|-----------------|
| Unit-III | <p>Respiratory system a) Anatomy of respiratory organs and functions b) Mechanism / physiology of respiration and regulation of respiration c) Transport of respiratory gases d) Respiratory volumes and capacities, and Definition of: Hypoxia, Asphyxia, Dybarism, Oxygen therapy and resuscitation.</p> <p>Digestive system a) Anatomy and physiology of GIT b) Anatomy and functions of accessory glands of GIT c) Digestion and absorption d) Disorders of GIT</p> <p>Urinary system a) Anatomy and physiology of urinary system b) Formation of urine c) Renin Angiotensin system – Juxtaglomerular apparatus - acid base Balance d) Clearance tests and micturition</p> | 20 hours |
| Unit-IV | <p>Nervous system a) Definition and classification of nervous system b) Anatomy, physiology and functional areas of cerebrum c) Anatomy and physiology of cerebellum d) Anatomy and physiology of mid brain e) Thalamus, hypothalamus and Basal Ganglia f) Spinal cord: Structure & reflexes – mono-poly-planter g) Cranial nerves – names and functions h) ANS – Anatomy & functions of sympathetic & parasympathetic N.S.</p> <p>Sense Organs a) Eye b) Ear c) Skin d) Tongue & Nose</p> | 15 hours |
| Unit-V | <p>Endocrine system a) Pituitary gland b) Adrenal gland c) Thyroid and Parathyroid glands d) Pancreas and gonads</p> <p>Reproductive system a) Male and female reproductive system b) Their hormones – Physiology of menstruation c) Spermatogenesis & Oogenesis d) Sex determination (genetic basis) e) Pregnancy and maintenance and parturition f) Contraceptive devices</p> <p>Sports physiology a) Muscles in exercise, Effect of athletic training on muscles and muscle performance, b) Respiration in exercise, CVS in exercise, Body heat in exercise, Body fluids and salts in exercise, c) Drugs and athletics</p> | 15 hours |

Text books

- Suggested Readings/References:**
1. Tortora Gerard J. and Nicholas, P. Principles of anatomy and physiology Publisher Harpercollins College New York.
 2. Wilson, K.J.W. Ross and Wilson's foundations of anatomy and physiology. Publisher: Churchill Livingstone, Edinburg.

Reference books

- a. Guyton Arthur, C. *Physiology of human body*. Publisher: Hltsaunders.
- b. Chatterjee, C.C. *Human physiology*. Volume 1&11. Publisher: medical allied agency, Calcutta.
- c. Peter L. Williams, Roger Warwick, Mary Dyson and Lawrence, H.
- d. Gray's anatomy. Publisher: Churchill Livingstone, London.

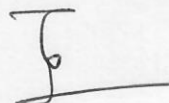
**Suggested List
of
Experiments:**

1. Study of tissues of human body
 - (a) Epithelial tissue.
 - (b) Muscular tissue.
2. Study of tissues of human body
 - (a) Connective tissue.
 - (b) Nervous tissue.
3. Study of appliances used in hematological experiments.
4. Determination of W.B.C. count of blood.
5. Determination of R.B.C. count of blood.
6. Determination of differential count of blood.
7. Determination of
 - (a) Erythrocyte Sedimentation Rate
 - (b) Hemoglobin content of Blood
 - (c) Bleeding time & clotting time.
8. Determination of
 - (a) Blood Pressure
 - (b) Blood group.
9. Study of various systems with the help of charts, models & specimens
 - (a) Skeleton system part I-axial skeleton.
 - (b) Skeleton system part II- appendicular skeleton.
 - (c) Cardiovascular system.
 - (d) Respiratory system.
 - (e) Digestive system.
 - (f) Urinary system.
 - (g) Nervous system.
 - (h) Special senses.
 - (i) Reproductive system.
10. Study of different family planning appliances.
11. To perform pregnancy diagnosis test.
12. Study of appliances used in experimental physiology.
13. To record simple muscle curve using gastrocnemius sciatic nerve preparation.
14. To record simple summation curve using gastrocnemius sciatic nerve preparation.
15. To record simple effect of temperature using gastrocnemius sciatic nerve preparation.
16. To record simple effect of load & after load using gastrocnemius sciatic nerve preparation.
17. To record simple fatigue curve using gastrocnemius sciatic nerve preparation.

Scheme of Practical Examination:

	Sessionals	Annual
Identification	04	10
Synopsis	04	10
Major Experiment	07	20
Minor Experiment	03	15
Viva	02	15
Max Marks	20	70
Duration	03hrs	04hrs

Note : Total sessional marks is 30 (20 for practical sessional plus 10 marks for regularity, promptness, viva-voce and record maintenance).

NIRMA UNIVERSITY

Institute:	Institute of Pharmacy
Name of Programme:	Pharm. D.
Course Code:	PD102
Course Title:	PHARMACEUTICS
Course Type:	(<input checked="" type="checkbox"/> Core/ <input type="checkbox"/> Value Added Course/ <input type="checkbox"/> Departmental Elective/ <input type="checkbox"/> Institute Elective/ <input type="checkbox"/> University Elective/ <input type="checkbox"/> Open Elective Any other)
Year of introduction:	2022-2023

L	T	Practical component				C
		LPW	PW	W	S	
2	1	3	-	-	-	10

Course Learning Outcomes (CLO):

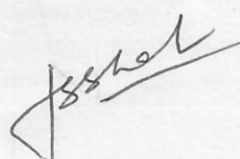
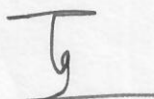
Upon completion of the course the student shall be able to:

1. Discuss history of pharmacy profession and various dosage forms
2. Explain various conversions systems used in pharmaceutical dispensing
3. Understand the concepts of dispensing methods for various dosage forms
4. Interpret types of prescriptions and study their handling
5. Solve pharmaceutical calculations and pharmaceutical incompatibilities related to dispensing of products
6. Prepare various types of dispensed products at small scale with suitable labeling and packaging

Syllabus:

Total Teaching hours: 60 hours

Unit	Syllabus	Teaching hours
Unit-I	<ol style="list-style-type: none"> 1. Introduction <ol style="list-style-type: none"> a. Introduction to dosage forms - classification and definitions b. Prescription: definition, parts and handling c. Posology: Definition, Factors affecting dose selection. Calculation of children and infant doses. 2. Historical back ground and development of profession of pharmacy and pharmaceutical industry in brief. 3. Development of Indian Pharmacopoeia and introduction to other Pharmacopoeias such as BP, USP, European Pharmacopoeia, Extra pharmacopoeia and Indian national formulary. 4. Weights and measures, Calculations involving percentage solutions, allegation, proof spirit, isotonic solutions etc. 5. Pharmaceutical calculations. 	15 hours

7  

Unit-II	Powders and Granules: Classification advantages and disadvantages, Preparation of simple, compound powders, Insufflations, Dusting powders, Eutectic and Explosive powders, Tooth powder and effervescent powders and granules.	10 hours
Unit-III	Monophasic Dosage Forms: Theoretical aspects of formulation including adjuvant like stabilizers, colorants, flavours with examples. Study of Monophasic liquids like gargles, mouth washes, Throat paint, Ear drops, Nasal drops, Liniments and lotions, Enemas and collodions. Biphasic Dosage Forms: Suspensions and emulsions, Definition, advantages and disadvantages, classification, test for the type of emulsion, formulation, stability and evaluation.	15 hours
Unit-IV	Suppositories and pessaries: Definition, advantages and disadvantages, types of base, method of preparation, Displacement value and evaluation. Incompatibilities: Introduction, classification and methods to overcome the incompatibilities.	10 hours
Unit-V	Galenicals: Definition, equipment for different extraction processes like infusion, Decoction, Maceration and Percolation, methods of preparation of spirits, tinctures and extracts. Surgical aids: Surgical dressings, absorbable gelatin sponge, sutures, ligatures and medicated bandages.	10 hours

Suggested Readings/References:	Text books
	1. Cooper and Gunns Dispensing for pharmacy students.
	2. A text book Professional Pharmacy by N.K.Jain and S.N.Sharma.

Reference books

1. Introduction to Pharmaceutical dosage forms by Howard C. Ansel.
2. Remington's Pharmaceutical Sciences.
3. Register of General Pharmacy by Cooper and Gunn.
4. General Pharmacy by M.L.Schroff.

Suggested List of Experiments:	1. Syrups
	a. Simple Syrup I.P
	b. Syrup of Ephedrine Hcl NF
	c. Syrup Vasaka IP
	d. Syrup of ferrous Phosphate IP
	e. Orange Syrup
	2. Elixir
	a. Piperizine citrate elixir BP
	b. Cascara elixir BPC
	c. Paracetamol elixir BPC
	3. Linctus
	a. Simple Linctus BPC
	b. Pediatric simple Linctus BPC
	4. Solutions
	a. Solution of cresol with soap IP
	b. Strong solution of ferric chloride BPC
	c. Aqueous Iodine Solution IP
	d. Strong solution of Iodine IP
	e. Strong solution of ammonium acetate IP

5. Liniments
 - a. Liniment of turpentine IP
 - b. Liniment of camphor IP
6. Suspensions
 - a. Calamine lotion
 - b. Magnesium Hydroxide mixture BP
7. Emulsions
 - a. Cod liver oil emulsion
 - b. Liquid paraffin emulsion
8. Powders
 - a. Eutectic powder
 - b. Explosive powder
 - c. Dusting powder
 - d. Insufflations
9. Suppositories
 - a. Boric acid suppositories
 - b. Chloral suppositories
10. Incompatibilities
 - a. Mixtures with Physical incompatibilities
 - b. Mixtures with Chemical and Therapeutic incompatibilities

Scheme of Practical Examination:

	Sessionals	Annual
Synopsis	05	15
Major Experiment	10	25
Minor Experiment	03	15
Viva	02	15
Max Marks	20	70
Duration	03hrs	04hrs

Note : Total sessional marks is 30 (20 for practical sessional plus 10 marks for regularity, promptness, viva-voce and record maintenance)

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NIRMA UNIVERSITY

Institute:	Institute of Pharmacy
Name of Programme:	Pharm.D
Course Code:	PD103
Course Title:	MEDICINAL BIOCHEMISTRY
Course Type:	(<input checked="" type="checkbox"/> Core/ <input type="checkbox"/> Value Added Course/ <input type="checkbox"/> Departmental Elective/ <input type="checkbox"/> Institute Elective/ <input type="checkbox"/> University Elective/(<input type="checkbox"/> Open Elective Any other)
Year of introduction:	2022-2023

L	T	Practical component				C
		LPW	PW	W	S	
3	1	3	-	-	-	12

Course Learning Outcomes (CLO):

Upon completion of the course the student shall be able to:

1. Remember structure and functions of biomolecules and their role in energy metabolism
2. Understand fundamentals of enzymes, enzyme kinetics and their applications.
3. Describe the basic metabolic pathways of carbohydrates, proteins, lipids and nucleic acid variety of metabolic disorders associated with metabolism biomolecules
4. Discuss immunochemical techniques and role of electrolytes in the body
5. Evaluate results of the liver, kidney function and lipid profile tests
6. Analyse different biomolecules qualitatively and/or quantitatively.

Theory Syllabus:

Total Teaching hours: 90 hours

Unit	Syllabus	Teaching hours
Unit-I	<p>Introduction to biochemistry: Cell and its biochemical organization, transport process across the cell membranes. Energy rich compounds; ATP, Cyclic AMP and their biological significance.</p> <p>Enzymes: Definition; Nomenclature; IUB classification; Factor affecting enzyme activity; Enzyme action; enzyme inhibition. Isoenzymes and their therapeutic and diagnostic applications; Coenzymes and their biochemical role and deficiency diseases.</p> <p>Carbohydrate metabolism: Glycolysis, Citric acid cycle (TCA cycle), HMP shunt, Glycogenolysis, gluconeogenesis, glycogenesis. Metabolic disorders of carbohydrate metabolism (diabetes mellitus and glycogen storage diseases); Glucose, Galactose tolerance test and their significance; hormonal regulation of carbohydrate metabolism.</p>	20 hours
Unit-II	<p>Lipid metabolism: Oxidation of saturated (β-oxidation); Ketogenesis and ketolysis; biosynthesis of fatty acids, lipids; metabolism of cholesterol; Hormonal regulation of lipid metabolism. Defective metabolism of lipids (Atherosclerosis, fatty liver, hypercholesterolemia).</p>	20 hours

Biological oxidation: Coenzyme system involved in Biological oxidation. Electron transport chain (its mechanism in energy capture; regulation and inhibition); Uncouplers of ETC; Oxidative phosphorylation;

Protein and amino acid metabolism: Protein turn over; nitrogen balance; Catabolism of Amino acids (Transamination, deamination & decarboxylation). Urea cycle and its metabolic disorders; production of bile pigments; hyperbilirubinemia, porphoria, jaundice. Metabolic disorder of Amino acids.

Unit III	Nucleic acid metabolism: Metabolism of purine and pyrimidine nucleotides; Protein synthesis; Genetic code; inhibition of protein synthesis; mutation and repair mechanism; DNA replication (semiconservative /onion peel models) and DNA repair mechanism. Introduction to clinical chemistry: Cell; composition; malfunction; Roll of the clinical chemistry laboratory. The kidney function tests: Role of kidney; Laboratory tests for normal function includes- a) Urine analysis (macroscopic and physical examination, quantitative and semiquantitative tests.); b) Test for NPN constituents. (Creatinine /urea clearance, determination of blood and urine creatinine, urea and uric acid); c) Urine concentration test; d) Urinary tract calculi. (stones).	20 hours
Unit-IV	Liver function tests: Physiological role of liver, metabolic, storage, excretory, protective, circulatory functions and function in blood coagulation. a) Test for hepatic dysfunction-Bile pigments metabolism; b) Test for hepatic function test- Serum bilirubin, urine bilirubin, and urine urobilinogen; c) Dye tests of excretory function; d) Tests based upon abnormalities of serum proteins. Selected enzyme tests. Lipid profile tests: Lipoproteins, composition, functions. Determination of serum lipids, total cholesterol, HDL cholesterol, LDL cholesterol and triglycerides.	15 hours
Unit V	Immunochemical techniques for determination of hormone levels and protein levels in serum for endocrine diseases and infectious diseases. Radio immuno assay (RIA) and Enzyme Linked Immuno Sorbent Assay (ELISA) Electrolytes: Body water, compartments, water balance, and electrolyte distribution. Determination of sodium, calcium potassium, chlorides, bicarbonates in the body fluids.	15 hours
Tutorials hours Tutorials will be based on above syllabus.		30 Hours

Suggested
Readings/
References:

Text books (Theory)

1. Harpers review of biochemistry - Martin
2. Text book of biochemistry – D. Satyanarayana
3. Text book of clinical chemistry- Alex kaplan & Laverve L. Szabo

Reference books (Theory)

1. Principles of biochemistry -- Lehninger

2. Text book of biochemistry -- Ramarao
3. Practical Biochemistry-David T.Plummer.
4. Practical Biochemistry-Pattabhiraman.

Suggested
List of
Experiments:

1. Qualitative analysis of normal constituents of urine.*
2. Qualitative analysis of abnormal constituents of urine.*
3. Quantitative estimation of urine sugar by Benedict's reagent method.**
4. Quantitative estimation of urine chlorides by Volhard's method.**
5. Quantitative estimation of urine creatinine by Jaffe's method.**
6. Quantitative estimation of urine calcium by precipitation method.**
7. Quantitative estimation of serum cholesterol by Libermann Burchard's method.**
8. Preparation of Folin Wu filtrate from blood.*
9. Quantitative estimation of blood creatinine.**
10. Quantitative estimation of blood sugar Folin-Wu tube method.**
11. Estimation of SGOT in serum.**
12. Estimation of SGPT in serum.**
13. Estimation of Urea in Serum.**
14. Estimation of Proteins in Serum.**
15. Determination of serum bilirubin**
16. Determination of Glucose by means of Glucoseoxidase.**
17. Enzymatic hydrolysis of Glycogen/Starch by Amylases.**
18. Study of factors affecting Enzyme activity. (pH & Temp.)**
19. Preparation of standard buffer solutions and its pH measurements (any two)*
20. Experiment on lipid profile tests**
21. Determination of sodium, calcium and potassium in serum.**

* indicate minor experiments & ** indicate major experiments

Scheme of Practical Examination:

	Sessionals	Annual
Synopsis	05	15
Major Experiment	10	25
Minor Experiment	03	15
Viva	02	15
Max Marks	20	70
Duration	03hrs	04hrs

Note : Total sessional marks is 30 (20 for practical sessional plus 10 marks for regularity, promptness, viva-voce and record maintenance)

NIRMA UNIVERSITY

Institute:	Institute of Pharmacy
Name of Programme:	Pharm.D
Course Code:	PD104
Course Title:	PHARMACEUTICAL ORGANIC CHEMISTRY
Course Type:	(<input checked="" type="checkbox"/> Core/ <input type="checkbox"/> Value Added Course/ <input type="checkbox"/> Departmental Elective/ <input type="checkbox"/> Institute Elective/ <input type="checkbox"/> University Elective/(<input type="checkbox"/> Open Elective Any other)
Year of introduction:	2022-2023

L	T	Practical component				C
		LPW	PW	W	S	
3	1	3	-	-	-	12

Course Learning Outcomes (CLO):

Upon completion of the course the student shall be able to:

1. Remember IUPAC name, structure and properties of organic compounds
2. Understand basic concepts of organic Chemistry
3. Explain reaction, reaction mechanism and orientation of reactions
4. Describe the name reactions and mechanism
5. Illustrate the test of purity, assay and uses of official compounds
6. Synthesize and identify the organic compounds

Theory Syllabus:

Total Teaching hours: 90

Unit	Syllabus	Teaching hours
Unit-I	<p>Structures and Physical properties: Polarity of bonds, polarity of molecules, M.P, Inter molecular forces, B.P, Solubility, non-ionic solutes and ionic solutes, protic and aprotic solvents, ion pairs, Acids and bases, Lowry bronsted and Lewis theories, Isomerism.</p> <p>IUPAC Nomenclature: Nomenclature of organic compound belonging to the following classes Alkanes, Alkenes, Dienes, Alkynes, Alcohols, Aldehydes, Ketones, Amides, Amines, Phenols, Alkyl Halides, Carboxylic Acid, Esters, Acid Chlorides And Cycloalkanes.</p> <p>Free radicals chain reactions of alkane: Mechanism, relative reactivity and stability.</p> <p>Nucleophilic aliphatic substitution mechanism: Nucleophiles and leaving groups, kinetics of second and first order reaction, mechanism and kinetics of SN2 reactions. Stereochemistry and steric hindrance, role of solvents, phase transfer catalysis, mechanism and kinetics of SN1 reactions, stereochemistry, carbocation and their stability, rearrangement of carbocation, role of solvents in SN1 reaction, Ion dipole bonds, SN2 versus SN1 solvolysis, nucleophilic assistance by the solvents.</p> <p>Dehydro halogenation of alkyl halides: 1,2 elimination, kinetics, E2 and E1 mechanism, elimination via carbocation, evidence for E2 mechanism, absence of rearrangement isotope effect, absence hydrogen exchange, the element effect, orientation and reactivity, E2 versus E1,</p>	20 hours

elimination versus substitution, dehydration of alcohol, ease of dehydration, acid catalysis, reversibility, orientation.

- Unit-II Electrophilic and free radicals addition:** Reactions at carbon-carbon, double bond, electrophile, hydrogenation, heat of hydrogenation and stability of alkenes, Markovnikov's rule, addition of hydrogen halides, addition of hydrogen bromides, peroxide effect, electrophilic addition, mechanism, rearrangement, absence of hydrogen exchange, orientation and reactivity, addition of halogen, mechanism, halohydrin formation, mechanism of free radicals addition, mechanism of peroxide initiated addition of hydrogen bromide, orientation of free addition, additions of carbene to alkene, cyclo addition reactions. **20 hours**
- Carbon-carbon double bond as substituents:** Free radical halogenations of alkenes, comparison of free radical substitution with free radical addition, free radical substitution in alkenes, orientation and reactivity, allylic rearrangements.
- Theory of resonance:** Allyl radical as a resonance hybrid, stability, orbital picture, resonance stabilisation of allyl radicals, hyper conjugation, allyl cation as a resonance hybrid, nucleophilic substitution in allylic substrate, SN1 reactivity, allylic rearrangement, resonance stabilisation of allyl cation, hyper conjugation, nucleophilic substitution in allylic substrate, SN2 nucleophilic substitution in vinylic substrate, vinylic cation, stability of conjugated dienes, resonance in alkenes, hyper conjugation, ease of formation of conjugated dienes, orientation of elimination, electrophilic addition to conjugated dienes, 1,4- addition, 1,2-versus 1,4-addition, rate versus equilibrium, orientation and reactivity of free radical addition to conjugated dienes.
- Unit-III Nucleophilic addition reaction:** Mechanism, ionisation of carboxylic acids, acidity constants, acidity of acids, structure of carboxylate ions, effect of substituent on acidity, nucleophilic acyl substitution reaction, conversion of acid to acid chloride, esters, amide and anhydride. Role of carboxyl group, comparison of alkyl nucleophilic substitution with acyl nucleophilic substitution. **20 hours**
- Mechanism** of aldol condensation, claisen condensation, cannizzaro reaction, crossed aldol condensation, crossed cannizzaro reaction, benzoin condensation, perkin condensation. Knoevenagel, Reformatsky reaction, Wittig reaction, Michael addition.
- Hoffman rearrangement:** Migration to electron deficient nitrogen, Sandmeyer's reaction, basicity of amines, diazotisation and coupling, acidity of phenols, Williamson synthesis, Fries rearrangement, Kolbe reaction, Reimer tiemann reactions.
- Unit IV Electrophilic aromatic substitution:** Effect of substituent groups, determination of orientation, determination of relative reactivity, classification of substituent group, mechanism of nitration, sulphonation, halogenation, friedel craft alkylation, friedel craft acylation, reactivity and orientation, activating and deactivating O,P,M directing groups, electron release via resonance, effect of halogen on electrophilic aromatic substitution in alkyl benzene, side chain halogenation of alkyl benzene, resonance stabilization of benzyl radical. **15 hours**
- Nucleophilic aromatic substitution:** Bimolecular displacement mechanisms, orientation, comparison of aliphatic nucleophilic substitution with that of aromatic.

Unit-V Oxidation reduction reaction.**15 hours**

Study of the following official compounds: preparation, test for purity, assay and medicinal uses of Chlorbutol, Dimercaprol, Glyceryl trinitrate, Urea, Ethylene diamine dihydrate, Vanillin, Paraldehyde, Ethylene chloride, Lactic acid, Tartaric acid, citric acid, salicylic acid, aspirin, methyl salicylate, ethyl benzoate, benzyl benzoate, dimethyl phthalate, sodium lauryl sulphate, saccharin sodium, mephenesin.

Alicyclic compounds: Preparations of cyclo alkanes, Bayer strain theory and orbital picture of angle strain.

Tutorials**30 Hours**

Tutorials will be based on above syllabus.

Suggested Readings/References:**Text books (Theory)**

1. T.R.Morrison and R. Boyd - Organic chemistry,
2. Bentley and Driver-Text book of Pharmaceutical chemistry
3. I.L.Finer- Organic chemistry, the fundamentals of chemistry

Reference books (Theory)

1. Organic chemistry – J.M.Cram and D.J.Cram
2. Organic chemistry- Brown
3. Advanced organic chemistry- Jerry March, Wiley
4. Organic chemistry- Cram and Hammered, Pine Hendrickson

Suggested List of Experiments**I. Introduction to the various laboratory techniques through demonstration involving synthesis of the following compounds (at least 8 compounds to be synthesised):**

1. Acetanilide / aspirin (Acetylation)
2. Benzanilide / Phenyl benzoate (Benzoylation)
3. P-bromo acetanilide / 2,4,6 – tribromo aniline (Bromination)
4. Dibenzylidene acetone (Condensation)
5. 1-Phenylazo-2-naphthol (Diazotisation and coupling)
6. Benzoic acid / salicylic acid (Hydrolysis of ester)
7. M-dinitro benzene (Nitration)
8. 9, 10 – Anthraquinone (Oxidation of anthracene) / preparation of benzoic acid from toluene or benzaldehyde
9. M-phenylene diamine (Reduction of M-dinitrobenzene) / Aniline from nitrobenzene
10. Benzophenone oxime
11. Nitration of salicylic acid
12. Preparation of picric acid
13. Preparation of O-chlorobenzoic acid from O-chlorotoluene
14. Preparation of cyclohexanone from cyclohexanol

II. Identification of organic compounds belonging to the following classes by :

Systematic qualitative organic analysis including preparation of derivatives Phenols, amides, carbohydrates, amines, carboxylic acids, aldehyde and ketones, Alcohols, esters, hydrocarbons, anilides, nitrocompounds.

III. Introduction to the use of stereo models: Methane, Ethane, Ethylene, Acetylene, Cis alkene, Trans alkene, inversion of configuration.

Scheme of Practical Examination:

	Sessional	Annual
Synopsis	05	15
Major Experiment	10	25
Minor Experiment	03	15
Viva	02	15
Max Marks	20	70
Duration	03hrs	04hrs

Note : Total sessional marks is 30 (20 for practical sessional plus 10 marks for regularity, promptness, viva-voce and record maintenance)



NIRMA UNIVERSITY

Institute:	Institute of Pharmacy
Name of Programme:	Pharm.D
Course Code:	PD105
Course Title:	PHARMACEUTICAL INORGANIC CHEMISTRY
Course Type:	(<input checked="" type="checkbox"/> Core/ <input type="checkbox"/> Value Added Course/ <input type="checkbox"/> Departmental Elective/ <input type="checkbox"/> Institute Elective/ <input type="checkbox"/> University Elective/(<input type="checkbox"/> Open Elective Any other)
Year of introduction:	2022-2023

L	T	Practical component				C
		LPW	PW	W	S	
2	1	3	-	-	-	10

Course Learning Outcomes (CLO):

Upon completion of the course the student shall be able to:

1. Understand principles of volumetric analysis, errors, acid-base and redox titrations
2. Describe the theory and principles of gravimetry and various types of titrations
3. Discuss principles of various limit tests, radiopharmaceutical chemistry and their importance in Pharmaceuticals
4. Express method of preparation, properties, assay principle and uses of some important inorganic pharmaceuticals
5. Explain biological functions and importance of essential trace elements, electrolyte replenishers and Pharmaceutical aids
6. Synthesize and analyze the inorganic pharmaceuticals

Theory Syllabus:

Total Teaching hours: 60

Unit	Syllabus	Teaching hours
Unit-I	Errors, Volumetric analysis, Acid-base titrations, Theory of indicators, Redox titrations	12 hours
Unit-II	Non aqueous titrations, Precipitation titrations, Complexometric titrations, Gravimetry	12 hours
Unit-III	Limit tests, Radio Pharmaceuticals	12 hours
Unit-IV	Medicinal gases, Acidifiers, Antacids, Cathartics, Antimicrobials, Dental Products,	12 hours
Unit-V	Essential Trace elements, Electrolyte replenishers, Pharmaceutical aids, Miscellaneous compounds	12 hours
Tutorials Teaching hours: Tutorials will be based on above syllabus		30 Hours

Suggested
Readings/
References:

Text books (Theory)

1. Pandeya, S.N., A text book Inorganic medicinal chemistry
2. Beckett, A.H and Stanlake, J. B. Practical Pharmaceutical chemistry
Vol- I & Vol-II, CBS Publishers
3. Rao P.G. Inorganic Pharmaceutical Chemistry, Vallabh Prakashan

Reference books (Theory)

- a. Anand & Chetwal. Inorganic Pharmaceutical Chemistry
- b. Nagavi, B.G. Pharmaceutical Inorganic Chemistry
- c. Kennedy, J.H. Analytical chemistry principles, Cengage Publishers
- d. I.P.1985 and 1996, Indian Pharmacopoeial Commission, Ministry of health and Family Welfare, Govt. of India.

Suggested
List of
Experiments

1. Limit test (6 exercises)

- a) Limit test for chlorides
- b) Limit test for sulphates
- c) Limit test for iron
- d) Limit test for heavy metals
- e) Limit test for arsenic
- f) Modified limit tests for chlorides and sulphates

2. Assays (10 exercises)

- a) Ammonium chloride- Acid-base titration
- b) Ferrous sulphate- Cerimetry
- c) Copper sulphate- Iodometry
- d) Calcilugluconate- Complexometry
- e) Hydrogen peroxide – Permanganometry
- f) Sodium benzoate – Nonaqueous titration
- g) Sodium chloride – Modified volhard's method
- h) Assay of KI – KIO₃ titration
- i) Gravimetric estimation of barium as barium sulphate
- j) Sodium antimony gluconate or antimony potassium tartarate

3. Estimation of mixture (Any two exercises)

- a) Sodium hydroxide and sodium carbonate
- b) Boric acid and Borax
- c) Oxalic acid and sodium oxalate

4. Test for identity (Any three exercises)

- a) Sodium bicarbonate
- b) Barium sulphate
- c) Ferrous sulphate
- d) Potassium chloride

5. Test for purity (Any two exercises)

- a) Swelling power in Bentonite
- b) Acid neutralizing capacity in aluminium hydroxide gel
- c) Ammonium salts in potash alum
- d) Adsorption power heavy Kaolin
- e) Presence of Iodates in KI

6. Preparations (Any two exercises)

- a) Boric acids
- b) Potash alum
- c) Calcium lactate
- d) Magnesium sulphate

Scheme of Practical Examination:

	Sessionals	Annual
Synopsis	05	15
Major Experiment	10	25
Minor Experiment	03	15
Viva	02	15
Max Marks	20	70
Duration	03hrs	04hrs

Note : Total sessional marks is 30 (20 for practical sessional plus 10 marks for regularity, promptness, viva-voce and record maintenance)

NIRMA UNIVERSITY

Institute:	Institute of Pharmacy
Name of Programme:	Pharm. D.
Course Code:	PD106RB
Course Title:	REMEDIAL BIOLOGY
Course Type:	(<input type="checkbox"/> \sqrt Core/ <input type="checkbox"/> Value Added Course / <input type="checkbox"/> Department Elective / <input type="checkbox"/> Institute Elective/ <input type="checkbox"/> University Elective/ <input type="checkbox"/> Open Elective / <input type="checkbox"/> Any other)
Year of Introduction:	2022 – 23

L	T	Practical component				C
		LPW	PW	W	S	
3	1	3	-	-	-	12

Course Learning Outcomes (CLOs):

Upon completion of the course the student shall be able to:

1. Understand the structure of plant tissues, classification and taxonomy of plant kingdom
2. Describe the morphology of various plant parts and plant physiology
3. Discuss the characteristics of fungi, yeast, Penicillium and bacteria
4. Explain the structure of animal cell, animal tissues and frog
5. Express the salient features of pisces, reptiles, aves, mammals and poisonous animals
6. Perform morphological and microscopical study of plant specimens and frog

Syllabus:

Total Teaching Hours: 90

Unit	Syllabus	Teaching hours
Unit- I	Introduction, General organization of plants and its inclusions, Plant tissues, Plant kingdom and its classification, Taxonomy of Leguminosae, Umbelliferae, Solanaceae, Liliaceae, Zingiberaceae, Rubiaceae	40 hours
Unit- II	Morphology of plants, Root, Stem, Leaf and its modifications, Inflorescence and Pollination of flowers, Morphology of fruits and seeds, Plant physiology	20 hours
Unit- III	Study of Fungi, Yeast, Penicillin and Bacteria	10 hours
Unit- IV	Study of Animal cell, Study animal tissues, Detailed study of frog	10 hours
Unit- V	Study of Pisces, Reptiles, Aves, General organization of mammals, Study of poisonous animals	10 hours

Tutorials

Tutorials will be based on above syllabus

Suggested
Readings/
References:

Text books (Theory)

- a. Text book of Biology by S.B.Gokhale
- b. A Text book of Biology by Dr.Thulajappa and Dr. Seetaram

Reference books

- a. Text book of Biology by B.V.Sreenivasa Naidu
- b. A Text book of Biology by Naidu and Murthy
- c. Botany for Degree students By A.C.Dutta.
- d. Outlines of Zoology by M. Ekambaranatha ayyer and T.N.Ananthakrishnan
- e. A manual for pharmaceutical biology practical by S.B.Gokhale and C.K.Kokate.

Suggested
List of
Experiments

1. Introduction of biology experiments
2. Study of cell wall constituents and cell inclusions
3. Study of Stem modifications
4. Study of Root modifications
5. Study of Leaf modifications
6. Identification of Fruits and seeds
7. Preparation of Permanent slides
8. T.S. of Senna, Cassia, Ephedra, Podophyllum.
9. Simple plant physiological experiments
10. Identification of animals
11. Detailed study of Frog
12. Computer based tutorial

Scheme of Practical Examination:

	Sessionals	Annual
Identification	04	10
Synopsis	04	10
Major Experiment	07	20
Minor Experiment	03	15
Viva	02	15
Max Marks	20	70
Duration	03hrs	04hrs

Note : Total sessional marks is 30 (20 for practical sessional plus 10 marks for regularity, promptness, viva-voce and record maintenance).

NIRMA UNIVERSITY

Institute:	Institute of Pharmacy
Name of Programme:	Pharm D
Course Code:	PD106RM
Course Title:	REMEDIAL MATHEMATICS
Course Type:	(<input checked="" type="checkbox"/> Core/ <input type="checkbox"/> Value Added Course/ <input type="checkbox"/> Departmental Elective/ <input type="checkbox"/> Institute Elective/ <input type="checkbox"/> University Elective/ <input type="checkbox"/> Open Elective Any other)
Year of introduction:	2022-2023

L	T	Practical component				C
		LPW	PW	W	S	
3	1	-	-	-	-	8

Course Learning Outcomes (CLO):

Upon completion of the course the student shall be able to:

1. Relate the theory and applications of basic mathematics with pharmacy.
2. Discuss applications of trigonometry for pharmaceutical computation.
3. Utilize the formulas of matrices and determinant for calculations related to pharmacy.
4. Understand calculus and analytical determinant for calculations related to pharmacy.
5. Evaluate differential equations and Laplace transform used in pharmaceutical sciences.

Syllabus:

Total Teaching hours: 90

Unit	Syllabus	Teaching hours
Unit-I	Algebra: Determinants, Matrices Trigonometry: Sides and angles of a triangle, solution of triangles	20 Hours
Unit-II	Analytical Geometry: Points, Straight line, circle, parabola	10 Hours
Unit-III	Differential calculus: Limit of a function, Differential calculus, Differentiation of a sum, Product, Quotient Composite, Parametric, exponential, trigonometric and Logarithmic function. Successive differentiation, Leibnitz's theorem, Partial differentiation, Euler's theorem on homogeneous functions of two variables Integral Calculus: Definite integrals, integration by substitution and by parts, Properties of definite integrals.	30 Hours
Unit-IV	Differential equations: Definition, order, degree, variable separable, homogeneous, Linear, heterogeneous, linear, differential equation with constant coefficient, simultaneous linear equation of second order.	20 Hours
Unit-V	Laplace transform: Definition, Laplace transform of elementary functions, Properties of linearity and shifting	10 Hours


Suggested
Readings/
References:

Text books

- a. Differential calculus By Shanthinarayan
- b. Text book of Mathematics for second year pre-university by Prof. B. M. Sreenivas

Reference books

- a. Integral calculus By Shanthinarayan
- b. Engineering mathematics By B. S. Grewal
- c. Trigonometry Part-I By S. L. Loney


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