



DOW UNIVERSITY OF HEALTH SCIENCES

SCHOOL OF POSTGRADUATE STUDIES

PROGRAM SPECIFICATION - SESSION 2026-27

Introduction of Institute & Program	Dow University of Health Sciences (DUHS) is one of the flag bearers of health science education and research in Pakistan. Manifested from the mission of the University, DUHS is continuously upgrading its research themes for MPhil in the progressively evolving field of Medical Technology. Medical Technology encompasses a broad allied health discipline and incorporates study of advancing technologies in healthcare i.e. devices to the healthcare systems for diagnosis, patient care, treatment and improvement of a person's health. Medical Technology is a vital part of the entire Health Care System. This professional field comprises the challenges and rewards of medicine and surgery and deals with the technical aspect of the same. The program course work is carefully sculpted to equip the PhD students to develop sound understanding of the basic to advance concepts of wide range of disciplines most notably, progress in medical technology research, functional materials in health technology, clinical optics and biomedical photonics, integration in cardiopulmonary bypass and extracorporeal life support, bioinformatics and artificial intelligence tools. The research themes of PhD in Medical Technology at DUHS are mostly focused on innovations leading to the technological solutions of modern day local and international healthcare problems particularly point-of-care testing, automations, health technologies, minimally invasive surgical and medical technologies, and diagnostic accuracy. In addition, an intrinsic mechanism has been set out to ensure smooth and timely completion of PhD in Medical Technology at DUHS.
Course Title (As approved by PM&DC/HEC)	PhD Medical Technology
Course Duration	3-8 years



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Type of Study	Full time
Study System	Semester system
Total Credit Hours	48
Credit Hours Distribution –Semester Wise	Course work =18 Thesis = 30
Study Hours Distribution	Study per Semester = 16 weeks Examination = 2 weeks Semester Break = 2 weeks Working Days = 8:30am - 3:00pm (except Friday)
Teaching Hours Distribution	Lecture hours/ Facilitation / Self Directed Studies/ Lab training
Modules Detail with Credit Hours	Semester 1 (General): covering Advanced concepts in medical technology, progress in medical technology research, ethics in medical technology research (List attached as annexure). Semester 2 (Subject Specific): Constituted by 800 level courses Elective Course I Elective Course II Elective Course III (Annexure attached at the end) Each course holds 3 credit hours
Assessment of Student	Continuous Internal Assessment = 30 % Final Examination = 70% Total = 100%
Teaching Institution	School of Postgraduate Studies
Degree Awarding Institution	Dow University of Health Sciences, Karachi



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List of Compulsory and Optional may be mentioned below:

S.No.	Course Codes	Course Title
Semester I Core Courses (Major Courses)		
1.	PHMT-AMT 831	Advanced Concepts in Medical Technology
2.	PHMT-IRD 831	Progress in Medical Technology Research
3.	PHMT-EMR 811	Ethics in Medical Technology Research
Semester II : Elective Courses (Specialized track courses)		
1.	PHMT-BINF 802	Bioinformatics and Computational Tools in Perfusion Research
2.	PHMT-CPTR 812	Advanced Cardiovascular Pharmacology and Translational Research in Cardiopulmonary Bypass
3.	PHMT-AIP 812	Artificial Intelligence and Predictive Analytics in Perfusion
4.	PHMT-MGCD 802	Molecular and Genetic Basis of Cardiovascular Diseases
5.	PHMT-IELS 832	Integration in Cardiopulmonary Bypass and Extracorporeal Life Support
6.	PHMT-NICU 812	Innovations and Advanced Clinical Strategies in Neonatal Intensive Care
7.	PHMT-RDIC 822	Advanced Respiratory Diagnostics and Pulmonary Rehabilitation in the Intensive Care Unit (ICU)
8.	PHMT-ARMT 802	Advanced Respiratory Medicine and Technology
9.	PHMT-ISIC 812	Infection Prevention and Control Practices in ICU
10.	PHOPT-AMNV 802	Advanced Molecular Neurobiology of Vision
11.	PHOPT-CLOP 802	Clinical Optometry



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S.No.	Course Codes	Course Title
12.	PHOPT-AODT-903	Advanced Ocular Disease and Therapeutics
13.	PHOPT-COBP 802	Clinical Optics and Biomedical Photonics
14.	PHMT-MCN 812	Advanced Molecular and Cellular Neurobiology
15.	PHMT-CSN 802	Computational and Systems Neuroscience
16.	PHMT-CNN 812	Clinical Neuroscience and Neuropathology
17.	PHMT-NTN 802	Emerging Neurotherapies and Translational Neuroscience
18.	PHMT-LHMS 812	Clinical Laboratory Leadership and Health Management Systems
19.	PHMT-DHCT 832	Diagnostic Histopathology and Cytological Techniques
20.	PHMT-DICC 832	Diagnostic Innovation Through Advanced Clinical Chemistry
21.	PHMT-IHTS 832	Integrated Hematopathology and Transfusion Science
22.	PHMT-MDTG 832	Molecular Diagnostics and Translational Genomics
23.	PHMT-TIGD 832	Translational Microbial Immunology and Genomic Diagnostics
24.	PHMT-APTR 812	Advanced Pharmacology and Translational Research in Surgery
25.	PHMT-BDSTP 802	Biomedical Device Technology in Surgical Practice
26.	PHMT-MIST 822	Minimally Invasive Surgical Technology
27.	PHMT-FMHT 802	Functional Materials in Health Technology



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List of topics for entry tests

Anatomy (15%)

1. Body Tissues and Membranes, and The Integumentary System
2. The Skeletal System
3. The Muscular System
4. The Nervous System
5. The Endocrine System
6. The Sensory System
7. Blood and the cardiovascular system
8. The Lymphatic System and Body Defenses
9. The Respiratory System
10. The Digestive System
11. The Urinary System and Excretion
12. The Reproductive System

Reference Reading:

https://drive.google.com/file/d/1PrwQ_1ccgtC6JzgUaNRB0uZYFfl8hpbG/view?usp=sharing

Physiology (15%)

1. General Physiology & Cell Physiology
2. Nerve & Muscle Physiology
3. Blood & Immunity
4. Cardiovascular System
5. Respiratory System
6. Renal & Body Fluids
7. Gastrointestinal System
8. Endocrine System
9. Reproductive Physiology
10. Neurophysiology & Special Senses

Biochemistry (10%)

1. Enzymology
 - Enzyme classification
 - Mechanism of enzyme action
 - Active site and enzyme specificity
 - Factors affecting enzyme activity
 - Competitive, noncompetitive and uncompetitive inhibition
 - Allosteric enzymes
 - Isoenzymes
 - Clinical importance of enzymes
2. Carbohydrate Metabolism
 - Glycolysis
 - TCA/Krebs cycle
 - Gluconeogenesis
 - Glycogenesis
 - Glycogenolysis



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- Pentose phosphate pathway
- Regulation of glucose metabolism
- 3. Lipid Metabolism
 - β -oxidation of fatty acids
 - Fatty acid synthesis
 - Ketone body formation and utilization
 - Cholesterol synthesis
 - Lipoproteins: HDL, LDL, VLDL, chylomicrons
 - Regulation of lipid metabolism
- 4. Amino Acid & Protein Metabolism
 - Transamination
 - Deamination
 - Urea cycle
 - Ammonia metabolism
- 5. Vitamins
 - Vitamin B1 – Thiamine
 - B2 – Riboflavin
 - B3 – Niacin
 - B6 – Pyridoxine
 - B9 – Folate
 - B12 – Cobalamin
 - Vitamin C
 - Vitamin A
 - Vitamin D
 - Vitamin E
 - Vitamin K

Microbiology (10%)

1. Introduction to microbiology and basic groups of microbiology
2. Introduction to eukaryotic and prokaryotic cells
3. Basic Bacteriology
4. Clinical Bacteriology
5. Basic virology
6. Basic parasitology
7. Basic Mycology
8. Infection control

Pathology (15%)

1. General Pathology & Cell Injury

- Definition and scope of pathology
- Causes of cell injury
- Reversible and irreversible cell injury
- Cellular adaptations: hypertrophy, hyperplasia, atrophy and metaplasia
- Necrosis and its common types
- Apoptosis
- Intracellular accumulations
- Pathological calcification



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2. Inflammation & Healing

- Acute inflammation
- Chronic inflammation
- Cardinal signs of inflammation
- Vascular changes in inflammation
- Role of neutrophils, macrophages and lymphocytes
- Granulomatous inflammation
- Tissue repair and wound healing

3. Hemodynamic Disorders

- Edema
- Hyperemia and congestion
- Hemorrhage
- Thrombosis
- Embolism
- Infarction and shock

4. Neurological, Gastrointestinal & Musculoskeletal Disorders

- Ischemia and stroke
- Meningitis and common CNS infections
- Gastritis and peptic ulcer disease
- Inflammatory bowel disease
- Osteoporosis and common metabolic bone disorders

5. Basic Systemic Pathology

- Anemia
- Atherosclerosis and ischemic heart disease
- Pneumonia, asthma and COPD
- Basic renal disorders
- Liver injury, hepatitis and cirrhosis
- Diabetes-related pathological changes
- Common infectious diseases and their tissue effects

Pharmacology — (10%)

1. General/Basic Pharmacology

- a. Pharmacokinetics: ADME, bioavailability, half-life, clearance, volume of distribution
- b. Pharmacodynamics: dose-response curves, receptor theory, agonists/antagonists, efficacy
- c. vs. potency
- d. Drug-receptor interactions, signal transduction pathways
- e. Routes of administration and factors affecting drug absorption

2. Systemic Pharmacology

- a. Autonomic nervous system drugs (cholinergics, adrenergics)
- b. CNS pharmacology (sedatives, anticonvulsants, antidepressants, antipsychotics)
- c. Cardiovascular drugs (antihypertensives, antiarrhythmics, anticoagulants)



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- d. Endocrine pharmacology (insulin, corticosteroids, thyroid drugs)
- e. Autacoids (histamine, serotonin, prostaglandins)
3. Toxicology & Drug Safety
 - a. Adverse drug reactions, drug interactions
 - b. Mechanisms of toxicity, LD50/therapeutic index
 - c. Teratogenicity, carcinogenicity basics
4. Chemotherapy/Antimicrobials
 - a. Antibiotic classes and mechanisms
 - b. Antifungal, antiviral, anticancer agent basics
 - c. Resistance mechanisms

Research — 15%

1. Research Methodology & Design
 - a. Types of study designs (experimental, observational, RCTs, cohort, case-control)
 - b. Sampling techniques and sample size determination
 - c. Hypothesis formulation, variables (independent/dependent/confounding)
 - d. In vivo/in vitro experimental models
2. Research Ethics & Regulatory Affairs
 - a. Animal ethics (3Rs principle, IACUC/ethical committee approval)
 - b. Human subject research ethics (informed consent, Declaration of Helsinki, IRB)
 - c. Plagiarism, authorship criteria (ICMJE), research misconduct
 - d. Good Laboratory/Clinical Practice (GLP/GCP)
3. Scientific Writing & Publication
 - a. Manuscript structure, abstract writing
 - b. Literature review, citation styles, reference management
 - c. Peer review process, impact factor, journal indexing (Q1/Q2, Scopus, PubMed)
4. Data Analysis & Critical Appraisal
 - a. Interpreting graphs/tables, systematic reviews, meta-analysis basics
 - b. Levels of evidence, bias types (selection, confounding)

Biostatistics (5%)

1. Foundations of Biostatistics

- Role of biostatistics in healthcare and medical research
- Types of data and variables
- Measurement scales
- Populations, samples, parameters, and statistics
- Descriptive vs. inferential statistics
- Sampling methods and sampling error
- Sources of bias and variability

2. Descriptive Statistics

- Frequency distributions and tables
- Measures of central tendency
- Measures of dispersion
- Percentiles, quartiles, and interquartile range
- Skewness and kurtosis



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- Graphical presentation of healthcare data
- Choosing appropriate descriptive statistics

3. Probability

- Basic probability concepts
- Conditional probability
- Independence
- Probability distributions
- Applications of probability in clinical decision-making

4. Common Probability Distributions

- Poisson distribution
- Normal distribution
- Standard normal distribution
- t-distribution
- Chi-square distribution
- F-distribution

5. Sampling and Sampling Distributions

- Central Limit Theorem
- Standard error
- Sample size considerations

6. Estimation and Confidence Intervals

- Point estimation
- Interval estimation
- Confidence intervals for means
- Confidence intervals for proportions
- Confidence intervals for differences between groups
- Interpretation of confidence intervals

7. Hypothesis Testing

- Null and alternative hypotheses
- Type I and Type II errors
- Statistical power
- P-values
- One-sided and two-sided tests
- Clinical vs. statistical significance
- Multiple testing considerations

8. Comparing Groups

- One-sample, independent-sample, and paired t-tests
- Chi-square tests
- Fisher's exact test
- Tests for proportions
- One-way ANOVA



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- Post-hoc comparisons
- Repeated-measures comparisons

AI and Technology (5%)

1. Artificial Intelligence (AI) and Machine Learning (ML) for Healthcare and Health Sciences: The Need for Best Practices
 - What is Machine Learning, AI vs. ML, Predictive vs. causal modelling, Biomedical AI/ML vs. general-purpose AI/ML, History and achievements of biomedical AI/ML, Why best practices are needed, Trust and adoption of AI/ML.
2. Foundations and Principles of AI/ML Systems
 - Computability and Provability; Computational Complexity; Complexity Classes; Heuristic vs. Formal AI Systems; Strategies for Handling Complex/Intractable Problems; Symbolic AI; Reasoning Under Uncertainty; AI Search; AI/ML Programming Languages; Foundations of ML Theory; Important Theoretical Concepts.
3. An Appraisal and Operating Characteristics of Major ML Methods Applicable in Healthcare and Health Science
 - Predictive Modelling Methods; Ensemble Methods; Regularization; Feature Selection and Dimensionality Reduction; Time-to-Event and Longitudinal Data.
4. Data Design in Biomedical AI/ML
 - Data Design Overview; Modelling Problem Types
5. Data Preparation, Transforms, Quality, and Management
 - Working with Healthcare Data; Data Preparation; Modelling Datasets and Feature Engineering; Data Quality; Missing Data; Data-Processing Ecosystems.

Reference Reading

https://drive.google.com/file/d/1QLoiPWU-6yFu7bKMI_pBaG7pinLc4cg4/view?usp=sharing