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BENGALURU CITY UNIVERSITY

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No.BCU/Ph.D-Syllabus / 83 /2025-26 Date.13.06.2025

NOTIFICATION

Sub: Bio-Chemistry Ph.D Course Work Syllabus of Bengaluru City University

Ref: 1. The recommendations of the Board of Studies in Bio-Chemistry (PG)
2. Approval of the Vice-Chancellor dated.06.06.2025

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In pursuance to the recommendations of the Board of Studies in Bio-Chemistry (PG) and pending approval of the Academic Council, the Syllabus for Bio-Chemistry Ph.D Course Work of Bengaluru City University with is hereby notified for information of the concerned. Effective from the academic year 2025-26

The copy of the Syllabus is notified in the University Website: www.bcu.ac.in for information of the concerned.

REGISTRAR 13/6

To,

1. The Dean, Faculty of Science, BCU.
2. The Chairman & Members of BoS in Bio-Chemistry (PG), BCU.
3. The Principals of the concerned affiliated Colleges of BCU – through email.
4. The P.S. to Vice-Chancellor/Registrar/Registrar (Evaluation), BCU.
5. Office copy / Guard file.

Advanced Pharmacology and AI in Antidiabetic Drug Discovery

42 hours

Course Objective:

This course aims to equip students with an advanced understanding of antidiabetic pharmacology, including drug mechanisms, safety, pharmacogenetics, and regulatory insights, while integrating artificial intelligence tools to enhance drug discovery and personalize diabetes treatment.

Learning Objectives:

CLO1: Describe the classification, mechanisms of action, and PKPD properties of major antidiabetic drug classes.

CLO2: Evaluate the safety profiles, adverse effects, and risk mitigation strategies of antidiabetic medicationsfor special populations.

CLO3: Apply pharmacogenetic principles to assess how genetic polymorphisms affect antidiabetic drug responseand assist in personalized treatment strategies.

CLO4: Critically analyze the rationale for drug repurposing and combination therapies in diabetes management and interpret key regulatory frameworks.

CLO5: Utilize artificial intelligence and machine learning techniques to model drug-target interactions, predict therapeutic outcomes, and support data-driven discovery of antidiabetic therapies.

Module 1: Mechanisms of Action and PKPD of Antidiabetic Drugs **8 hours**

Classification of antidiabetic drugs (insulin, oral agents, injectables). Mechanism of action ofInsulin and insulin analogs, insulin secretogogues- Biguanides (Metformin), Sulfonylureas and meglitinides, PPARγ agonists-Thiazolidinediones (TZDs), DPP-4 inhibitors, GLP-1 receptor agonists, SGLT2 inhibitors.

Pharmacokinetics:Absorption routes (oral, subcutaneous, inhaled), Bioavailability and distribution. Hepatic metabolism and renal excretion.

Pharmacodynamics:Onset, peak, and duration of action (for insulin types), Dose-response relationships. Inter-individual variability in drug response. Therapeutic implications of PK/PD in clinical practice.

Module 2: Drug Safety, Adverse Effects, and Use in Special Populations **10 hours**

Common adverse effects:Hypoglycemia (insulin, sulfonylureas), Gastrointestinal intolerance (metformin, GLP-1 analogs). Urinary tract infections and genital mycoses (SGLT2 inhibitors). Weight gain vs weight loss potential of different agents.

Serious and rare adverse effects:Lactic acidosis (metformin). Pancreatitis (GLP-1 analogs,DPP-4 inhibitors and SGLT2 inhibitors). Bone fractures, body weight gain and fluid retention (TZDs). Cardiovascular safety concerns and benefits. Risk management and patient monitoring.

Special populations:Pediatric pharmacology (e.g., insulin dosing for growth needs). Elderly patients (polypharmacy, renal clearance, hypoglycemia risk). Pregnancy and gestational diabetes pharmacotherapy. Chronic kidney or liver disease considerations.

Module 3: Pharmacogenetics and Personalized Diabetes Therapy **8 hours**

Principles of pharmacogenetics and personalized medicine.

Key genetic polymorphisms affecting drug response:OCT1 transporter and metformin efficacy. CYP2C9 polymorphisms and sulfonylurea metabolism. ABCC8 and KCNJ11 mutations and sulfonylurea sensitivity. PPAR-γ gene variants and TZD response.

Utility of pharmacogenetic testing in real-world diabetes care. Clinical decision-making based on genotype and phenotype. Ethical considerations in pharmacogenomics.

Module 4: Drug Repurposing, Combination Therapies, and Regulatory Insights

8 hours

Concept and strategies for drug repurposing in diabetes:Use of statins, ACE inhibitors, anti-inflammatories, and GLP-1s,Glitazones/Thiazolidinediones (TDZs)in T2DM. Drug repositioning based on cardiovascular or renal protective effects.

Rational combination therapy:Mechanistic basis for dual and triple therapy. Fixed-dose combinations and their pharmacologic benefits. Patient adherence, pill burden, and polypharmacy concerns.

Overview of regulatory frameworks:FDA/EMA guidelines for antidiabetic drug approval. Role and structure of Cardiovascular Outcome Trials (CVOTs). Post-marketing surveillance and real-world evidence (RWE).

Module 5: AI/ML Foundations and Applications in Drug Discovery **8 hours**

AI/ML basics: supervised, unsupervised, deep learning. Feature extraction (SMILES, fingerprints, omics data). Data pre-processing, normalization, outlier handling. Drug target discovery using SVM, RF, and network biology. QSAR modelling, structure-based screening. Platforms: DeepChem, RDKit.

Predicting drug efficacy using clinical/genomic data. Adverse drug reaction modelling. Patient stratification using clustering (K-means, PCA, t-SNE). Personalization of drug regimens using AI models.

References

1. Ritter, J. M., Flower, R., Henderson, G., Loke, Y. K., & MacEwan, D. (2019). *Rang & Dale's Pharmacology* (9th ed.). Elsevier.
2. Brunton, L. L., Hilal-Dandan, R., &Knollmann, B. (2018). *Goodman & Gilman's: The Pharmacological Basis of Therapeutics* (13th ed.). McGraw-Hill Education.
3. DiPiro, J. T., Schwinghammer, T. L., DiPiro, C. V., & Boyce, W. L. (2023). *Pharmacotherapy: A Pathophysiologic Approach* (12th ed.). McGraw-Hill Education.
4. Holt, R. I. G., Cockram, C., Flyvbjerg, A., & Goldstein, B. J. (2017). *Textbook of Diabetes* (5th ed.). Wiley-Blackwell.

5. Altman, R., Flockhart, D., Huang, S.-M., Feero, W. G., & Bertino, J. S. (2012). *Principles of Pharmacogenetics and Pharmacogenomics*. Cambridge University Press.
6. Brown, N. (Ed.). (2020). *Artificial Intelligence in Drug Discovery*. Royal Society of Chemistry.
7. Cleophas, T. J., &Zwinderman, A. H. (2020). *Machine Learning in Medicine – A Complete Overview*. Springer.