# Central University of Punjab

# Ph.D. Program in Biochemistry

## Batch - 2025

## Department of Biochemistry

**Graduate Attributes**

Students graduating from the program will contribute to the teaching and research needs in biochemistry and life sciences in academia, industry and research institutions at local, regional, national and international levels. They will be part of the scientific workforce that will transform health and agriculture sectors employing higher order thinking skills and capabilities.

**Ph.D. Program in Biochemistry Course Structure of the Program**

| Course Code | Course Title | L | P | Cr |
|---|---|---|---|---|
| BCH.701 | Research Methodology and Computer Applications | 4 | - | 4 |
| BCH.702 | Trends in Biochemistry | 4 | - | 4 |
| BCH.751 | Research and Publication Ethics | 2 | - | 2 |
| BCH.752 | Teaching Assistantship | 0 | 2 | 1 |
| UNI.753 | Curriculum, Pedagogy and Evaluation | 1 | 0 | 1 |
| | **Total Credits** | | | **12** |

**L: Lectures; P: Practical; Cr: Credits**

| L | T | P | Credits |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**Course Code: BCH.701**
**Course Title: Research Methodology and Computer Applications**

**Learning Outcomes**

Students will be able to:

**CLO 1:** Critically analyse, interpret, and synthesize existing scientific knowledge based on literature review.

**CLO 2:** Identify the knowledge gap and formulate a hypothesis and design experimental/theoretical work.

**CLO 3:** Apply good laboratory practices and biosafety protocols.

**CLO 4:** Apricate the crucial issues in research ethics, like responsibility for research, ethical clearance for experimental studies and scientific misconduct.

**CLO 5:** Perform hypothesis testing on small and large data samples.

**CLO 6:** Use correlation and linear regression methods to find a relationship and good of a fit for the given data.

**CLO 7:** Retrieve various biological data from the appropriate databases for analysis.

**CLO 8:** Compare protein structures and perform structure-based drug designing.

| Unit/ Hours | Content | Mapping with CLO |
|---|---|---|
| I<br>15 hours | **General Principles of Research:** Meaning and importance of research, Critical thinking, Formulating hypothesis and development of research plan, Review of literature, Interpretation of results and discussion. Bibliographic index<br>**Technical Writing:** Scientific writing, writing synopsis, Research paper, Poster preparation, oral presentations and Dissertations. Reference Management using various softwares such as Endnote, reference manager, Refworks, etc. Communication skills: defining communication; type of communication; techniques of communication, etc. | CLO 1 &<br>CLO 2 |
| II<br>15 hours | **Introduction and Principles of Good Lab Practices:** Good laboratory practices, Biosafety for human health and environment. Biosafety issues for using cloned genes in medicine, agriculture, industry, and eco-protection, Biological containment and physical containment, Biosafety in Clinical laboratories and biohazard management, Physical, Chemical & Biological hazards and their mitigation. Biosafety level/category of pathogens. Biosafety level of laboratories, WHO/CDC/DBT guidelines for biosafety.<br>**Research Ethics:** Ethical theories, Ethical considerations during research, consent. Animal handling/testing, Animal experimental models and animal ethics. Perspectives and methodology & Ethical issues of the human genome project, ICMR guidelines for biomedical and health research. Intellectual property protection (IPP) and intellectual property rights (IPR), WTO (World Trade Organization), WIPO (World Intellectual Property Organization), GATT (General Agreement on Tariff and Trade), TRIPs (Trade Related Intellectual Property Rights), TRIMS (Trade Related Investment Measures) and GATS (General Agreement on Trades in Services). Patents, Technology Development/Transfer Commercialization Related Aspects, Ethics. | CLO3 & CLO4 |

| | | |
|---|---|---|
| III<br>15 hours | **Computer Applications and Biostatistics:**<br>Introduction to spreadsheet, presentation tools. Reference Management software. Role of Cloud computing and HPC in life science research. Introduction to Big data in biology and big data analytics. Data types and sources – variables and types. Descriptive statistics of categorical data and continuous data. Estimation of parameters – hypothesis testing: tests of significance, type I and II errors, z test, t test, analysis of variance (ANOVA), chi-square goodness-of-fit test. Regression and correlation. Statistical packages and their applications. | CLO 5 &<br>CLO 6 |
| IV<br>15 hours | **Bioinformatics:** Biological data: sequence, structure, gene expression, pathways and molecular interactions. Primary Sequence and structure databases. GEO, KEGG Database. Introduction to Next generation Sequencing. Proteomics: Resources & repositories. Sequence analysis: Pair-wise sequence comparison, database searching methods-BLAST, FASTA, PHI-BLAST and Multiple sequence alignment. Molecular phylogeny-building phylogenetic trees.<br>Introduction to Protein structure, Structure comparison and visualization, Structure based protein classification: CATH and SCOP. Introduction to structure-based drug designing. Structural genomics initiatives. Deep Learning in protein structure prediction and Biomedical Image analysis. | CLO 7 &<br>CLO 8 |

**Suggested Reading:**


1. Gupta, S. (2010). *Research Methodology and Statistical Techniques*. Deep & Deep Publications (P) Limited, New Delhi.
2. Kothari, C.R., Garg, G. (2019). *Research Methodology: Methods and Techniques.* 4th Edition, New Age International (p) Limited. New Delhi.
3. Sahay, Vinaya and Pradumna Singh (2009). *Encyclopedia of Research Methodology in Life Sciences.* Anmol Publications. New Delhi.
4. Kauda J. (2012). *Research Methodology: A Project Guide for University Students*. Samfunds literature Publications.
5. Dharmapalan B. (2012). *Scientific Research Methodology*. Narosa Publishing
6. Norman, G. and Streiner, D. (2014). *Biostatistics:* The Bare Essentials. 4th Edition, PMPH-USA Limited.

7. Rao, P. P., S. Sundar and Richard, J. (2009). *Introduction to Biostatistics and Research Methods.* PHI learning.
8. Christensen, L. (2007). *Experimental Methodology*. Boston: Allyn & Bacon.
9. Fleming, D. O. and Hunt, D.L. (2006). *Biological Safety: Principles and Practices*. American Society for Microbiology, USA.
10. Rockman, H. B. (2004). *Intellectual Property Law for Engineers and Scientists*. Wiley-IEEE Press, USA.
11. Shannon, T. A. (2009). *An Introduction to Bioethics*. Paulist Press, USA.
12. Vaughn, L. (2012). *Bioethics: Principles, Issues, and Cases.* 2nd Edition, Oxford University Press, UK
13. Lesk, A.M. (2019). Introduction to Bioinformatics. 5th Edition, Oxford University Press, UK.
14. Ramsden, J. (2021). Bioinformatics: An Introduction (Series: Computational Biology). 4th Edition, Springer International Publishing.
15. Mount. D.W. (2004) Bioinformatics: Sequence and Genome Analysis. 2nd Ed., CSHL Press, New York.
16.Branden, C. and J. Tooze, (1999) Introduction to Protein Structure, 2nd Ed., Garland Science, USA.

| L | T | P | Credits |
|---|---|---|---|
| 4 | - | - | 4 |

**Course Code: BCH.702**
**Course Title: Trends in Biochemistry**

## (Select any four modules)

**Learning Outcomes**

**CLO-1** Understand and explain the biochemical and molecular mechanisms underlying beneficial plant-microbe interactions, and their applications in rhizoremediation, stress tolerance, and crop productivity.
**CLO-2** Evaluate the production and therapeutic potential of plant-derived compounds, including antimicrobial and anticancer agents, using callus cultures and modern analytical techniques.
**CLO-3** Apply advanced methodologies in metabolomics, transcriptomics, and bioinformatics to investigate plant responses to environmental stressors and analyze gene expression data.
**CLO-4** Demonstrate proficiency in laboratory techniques such as DNA/RNA extraction, cytotoxicity assays, microbial degradation experiments, and metabolite profiling (HPLC, GC-MS, NMR).

**CLO-5** Analyze vascular biology and thrombotic mechanisms and assess nanomedicine-based therapeutic and diagnostic platforms for cardiovascular diseases.
**CLO-6** Interpret immune responses in health and disease, and apply immunological techniques such as ELISA, flow cytometry, and antibody production in biomedical research.
**CLO-7** Investigate molecular and cellular hallmarks of cancer, including signaling pathways, tumor microenvironment, metastasis, and drug resistance, and utilize modern techniques in cancer diagnosis, drug development, and personalized therapy.
**CLO-8** Interpret mechanisms of microbial growth and drug resistance, and understand fungal pathogenesis and host immune evasion strategies relevant to human health.
**CLO-9** Investigate cancer biology and the role of non-coding RNAs, and utilize experimental and computational tools to study their function and therapeutic potential.
**CLO-10** Critically assess drug resistance, microbial pathogenesis, and emerging biotechnological applications, including CRISPR-Cas9 and AI-assisted drug discovery, with an emphasis on translational research and ethical practices.

**Module 1 (Prof. Ramakrishna Wusirika) - 15 Hours (CLO-1, CLO-2)**

**Mode:** Lectures + Laboratory Practicals + Assignments

**Module Objectives:**

- To provide a comprehensive understanding of plant-microbe interactions and plant-derived products, emphasizing their applications in environmental remediation, agriculture, and medicine.
- To understand the significance of plant natural products and callus cultures in producing antimicrobial and anticancer agents, alongside emerging technologies for studying plant-microbe dynamics and callus-based bioactive compound production.

**Plant-Microbe Interactions:** Beneficial interactions of plants with microbes for rhizoremediation, improvement of crop productivity and abiotic stress tolerance; Biochemical and molecular basis of the interactions; Emerging technologies to study the interactions.

**Plant Products and their Applications:** Plant natural products and plant-derived products (callus cultures); Antimicrobial and anticancer activity and production of drugs using callus cultures; Emerging technologies to study callus cultures and their activity.

**Suggested readings-**

- Lugtenberg, B., & Kamilova, F. (2009). Plant-Growth-Promoting Rhizobacteria. Annual Review of Microbiology, 63, 541–556.
- Singh, B. K., Trivedi, P., Egidi, E., Macdonald, C. A., & Delgado-Baquerizo, M. (2020). Microbial contributions to climate change through carbon cycle feedbacks. Nature Microbiology, 5, 1057–1065.
- Verpoorte, R., Contin, A., & Memelink, J. (2002). Biotechnology for the production of plant secondary metabolites. Phytochemistry Reviews, 1, 13–25.
- Published articles from Lab.


## Module 2 (Dr. Baljinder Singh)- - 15 Hours (CLO-3, CLO-4)

**Module 2- Advanced Research Techniques in Plant Biochemistry, Environmental Biotechnology, and Metabolomics**

**Mode:** Lectures + Laboratory Practicals + Assignments

**Module Objectives:**

- To provide students with a strong theoretical background in plant biochemistry, omics technologies, and environmental biotechnology.
- To train students in advanced experimental methodologies used in metabolomics, transcriptomics, and bioactive compound characterization
- ·To enable critical understanding of plant-microbe-environment interactions, transcriptional regulation in crops, and eco-biotechnological applications.

**Plant-Environment Interactions and Rhizosphere Biology-**Abiotic stress in plants: Microplastics, heavy metals, fluoride, and other pollutants, Rhizosphere metagenomic microbial diversity analysis

**Transcriptomics and Functional Genomics in Crop Plants-** Overview of transcription factors and gene regulatory networks, RNA extraction, library preparation (brief theory), Bioinformatics analysis-RNA-seq data processing, differential gene expression.

**Metabolomics-** Analytical techniques: HPLC, GC-MS, NMR – principles and applications, Metabolite profiling and pathway analysis.

**Environmental and Applied Biochemistry-**Biodegradation and microbial remediation of pollutants

Good Laboratory Practices (GLP), Scientific record keeping and data reproducibility, Ethics in biological research

**Laboratory Component (Runs Parallel to Theory):**

- DNA/RNA extraction from plant/rhizosphere samples
- Cytotoxicity assays on cancer cell lines
- Microbial growth and pollutant degradation experiments
- Bioinformatics tools: RNA-seq (Galaxy), BLAST, NCBI databases

**Suggested readings-**

- Conesa, A., et al. (2016). A survey of best practices for RNA-seq data analysis. Genome Biology.
- Lämmerhofer, M., & Weckwerth, W. (Eds.) (2013). Metabolomics in Practice: Successful Strategies to Generate and Analyze Metabolic Data. Wiley-VCH.
- Published articles from Lab.


## Module 3 (Dr. Sunil Kumar Singh)- - 15 Hours (CLO-5)

**Vascular Biology, Thrombosis, and Theranostic Nanomedicine**

**Mode:** Lectures + Laboratory Practicals + Assignments

**Module Objectives:**

- To elucidate the molecular and cellular mechanisms governing vascular homeostasis, thrombosis, and cardiovascular pathology.
- To critically analyze current and emerging diagnostic and therapeutic nanotechnologies in the context of thrombotic and vascular diseases.
- To foster translational research skills for designing and evaluating theranostic platforms targeting cardiovascular and thrombo-inflammatory conditions**.**

**Fundamentals of Vascular Biology**

Endothelial cell biology, vascular tone regulation, NO signaling, Mechanisms of vascular remodeling and inflammation, Atherosclerosis and endothelial dysfunction

**Cardiovascular and Thrombotic Complications**

Molecular basis of thrombosis: coagulation cascade, platelet activation, fibrinolysis, Hemostasis vs. pathological thrombus formation, Biomarkers of thrombosis.

**Nanomedicine in Vascular and Thrombotic Disorders**

Biomaterials, Nanoparticle-based drug delivery systems for vascular targeting, Functionalization strategies, Smart materials and Nano-bio interactions

**Theranostics and Translational Nanotechnology**

Theranostic design: dual-function nanosystems for imaging and therapy
Applications: vascular imaging, targeted antithrombotics , Regulatory and translational aspects of nanotheranostics.

**Laboratory Component (Runs Parallel to Theory):**

Cell Culture and Characterization, Platelet Isolation and Aggregation Assay, In Vitro Coagulation and Thrombin Generation Assay, Nanoparticle synthesis and characterization and Point-of-care Electrochemical device.

**Suggested Readings**


- Margarethe Geiger (Ed.) (2024), Fundamentals of Vascular Biology, Publisher: Springer Cham, ISBN: 978-3-031-64591-4
- Aird, W. C. (Ed.) (2007). Endothelial Biomedicine (2 Volumes). Publisher: Cambridge University Press. ISBN: 9780511546198

- Kulkarni, S.K. (2014). Nanotechnology: Principles and Practices, Publisher: Springer , ISBN: 9783319091709

## Module 4 (Dr. Manju Jain)- - 15 Hours (CLO-6)

**Mode:** Lectures + Laboratory Practicals + Assignments

**Module Objectives:**

- To understand different immune modalities and their crosstalk.
- To understand human diseases from an immunological perspective
- To learn known and emerging immunological approaches for disease diagnosis, prevention and treatment

**Basics Concepts:** Specificity, memory, discrimination of self from non-self, innate and acquired immunity, Humoral and cell-mediated immune response.

**The Immune system in health and disease:** Immune response and infectious diseases, congenital and acquired immunodeficiency, tolerance and autoimmune diseases, Transplantation and Tumor Immunology

**Characterization and analysis of cellular and soluble immune components: Manipulation of the immune response:** Regulation of unwanted immune responses and immunomodulation against autoimmunity, transplantation rejections, Cancer immuno-therapy**,** Vaccination strategies. Production of antibodies: monoclonal and polyclonal antibodies, Anti-immunoglobulin antibodies; hybridoma technology, antibody engineering, abzymes, specific and cross reactivity, precipitation and agglutination reactions, blood typing, RIA, ELISA, Microscopy and Imaging-Immunohistochemistry, Immunoprecipitation and co-immunoprecipitation, Immunoblotting.

**Laboratory Component (Runs Parallel to Theory):**

Immune-Cell culture, PBMC isolation, Flow cytometry, IHC, Cytokine ELISA, Antibody Isotypying

**Suggested readings-**

- Abbas, A. K., Lichtman, A. H., & Pillai, S. (2022). Basic Immunology: Functions and Disorders of the Immune System (6th ed.). Elsevier.
- Delves, P. J., Martin, S. J., Burton, D. R., & Roitt, I. M. (2021). Roitt's Essential Immunology (14th ed.). Wiley-Blackwell.
- Published articles from Lab.

## Module 5 (Dr. Shashank Kumar)- - 15 Hours (CLO-7)

**Mode:** Lectures + Laboratory Practicals + Assignments

**Module Objectives:**

- To provide an in-depth understanding of the molecular and cellular mechanisms underlying cancer development and progression, including carcinogenesis, DNA damage, tumor heterogeneity, and cell signaling pathways.

- To equip learners with the skills necessary to characterize bioactive compounds and evaluate their potential for pharmaceutical and clinical applications.

**Clinical and Molecular Cancer Biology:** Carcinogenesis and DNA Damage; Cell Signaling Pathways in Cancer; Tumor heterogeneity, microenvironment and metabolism; Metastasis and Angiogenesis; Cancer Diagnosis and Treatment; Therapeutic Approaches; Drug Resistance; Cancer Stem Cells; Clinical Trials, Targeted Therapy and Drug delivery; Personalized Medicine; Immunotherapy; Techniques in cancer research

**Biochemical activity and characterization of Plant Products:** Anticancer, Antibacterial, Hepato-protective, Anti-HIV, Metal toxicity, etc. Phytochemical extraction, LC-MS-MS, HPLC, GC-MS, Spectrophotometric, Thin layer choromatography, etc.

**Suggested readings-**

Weinberg, R. A. (2013). *The Biology of Cancer* (2nd ed.). Garland Science.

Sarker, S. D., Nahar, L. (Eds.). (2018). Computational Phytochemistry (1st ed.).

Elsevier.

## Module 6 (Dr. Vinay Kumar Bari) - 15 Hours (CLO-8)

**Functional genomics and antifungal drug resistance mechanisms**

Mode: Lectures + Laboratory Practicals + Assignments

Module Objectives:

- To learn and understand the fungal genome databases.
- To understand fungal diseases from an immunological perspective
- To learn about emerging fungal drug resistance mechanisms

**Basic Concepts:** Different modes of microbial growth, analyzing microbial growth, antifungal drug resistance mechanisms, minimum inhibitory concentration (MIC) & colony forming units (CFU) determination, and growth spot assay.

**Functional genomics:** fungal genome databases, yeast gene manipulation by conventional and CRISPR/Cas9 methods, deletion, overexpression, and cloning vectors.

**Fungal pathogenesis:** host interaction and immune suppression mechanisms, models of fungal pathogenesis in humans, and counter-defense cell systems.

**Nanoformulations:** Nanocarriers in drug delivery approaches, Nanoformulations for drug-resistant pathogenic fungi, Combinatorial drug interaction models

**Suggested readings-**


- Madigan, M. T., Bender, K. S., Buckley, D. H., Sattley, W. M., & Stahl, D. A. (2021). Brock Biology of Microorganisms (16th ed.). Pearson.
- Goffeau, A., & Wong, G. (2002). Functional genomics of yeast: from genes to networks. Nature Reviews Genetics, 3, 829–839.
- Willey, J. M., Sherwood, L. M., & Woolverton, C. J. (2014). Prescott's microbiology. McGraw-Hill.
- Pacesa, M., Pelea, O., & Jinek, M. (2024). Past, present, and future of CRISPR genome editing technologies. Cell, 187(5), 1076-1100.
- Wang, J. Y., & Doudna, J. A. (2023). CRISPR technology: A decade of genome editing is only the beginning. Science, 379(6629), eadd8643.
- Girdhar, V., Patil, S., Banerjee, S., & Singhvi, G. (2018). Nanocarriers for drug delivery: mini review. Current Nanomedicine (Formerly: Recent Patents on Nanomedicine), 8(2), 88-99.
- Kumari, N., Maharaj, S., Chattopadhyay, R., Singh, S. K., & Bari, V. K. (2025). Molecular Insights Into the Interplay Between Host Platelets and Fungal Pathogens. Current Clinical Microbiology Reports, 12(1), 1-21.


## Module 7 (Dr. Ravindresh Chhabra)- - 15 Hours (CLO-9)

**Non-coding RNAs and cancer biology**

**Mode:** Theory + Demonstration of basic experimental techniques + Assignments

**Module Objectives:**

- To understand the basics of cancer biology
- To be familiar with ncRNAs and their clinical relevance in cancer.
- To develop the basic skills in animal cell culture techniques and experimental methodologies for studying ncRNAs in cancer research

**Cancer:** Types of cancer (carcinoma, sarcoma, leukemia and lymphoma), causes and risk factors, origin of cancer, a brief introduction to current diagnostic and therapeutic approaches.

**Non-coding RNAs (ncRNAs) and their application in cancer research:** Definition and classification of ncRNAs, their biogenesis and cellular functions, Tumor suppressor and oncogenic ncRNAs, ncRNAs as biomarkers and therapeutic targets in cancer, ncRNAs in liquid biopsy samples, techniques to study ncRNAs (overexpression, silencing, localization), clinical trials and breakthroughs in use of ncRNAs in cancer, challenges in use of ncRNAs in clinical setup.

**Animal Cell Culture Techniques:** Primary and established cell lines. Functions of different constituents of culture medium. Importance of carbon dioxide in cell culture. Serum and serum-free defined media and its application. Preparation of cell culture media and trypsin solution. Subculturing of suspension and adherent cells. Cryopreservation of cell lines and revival of frozen stocks. Cell culture

assays (MTT assay, cell cycle assay, annexin, ROS assay, luciferase assay, scratch assay, transfection).

**Suggested readings-**


- Weinberg, R. A. (2023). *The Biology of Cancer* (3rd ed.). W.W. Norton & Company.
- Esteller, M. (2011). Non-coding RNAs in human disease. Nature Reviews Genetics, 12, 861–874.
- Márton É, Varga A, Domoszlai D, et al. (2025) Non-Coding RNAs in Cancer: Structure, Function, and Clinical Application. Cancers (Basel), 17(4):579.
- Chhabra, R. (2021). The journey of noncoding RNA from bench to clinic. In Translational Biotechnology (pp. 165–201).
- Freshney, R. I. (2021). Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications (8th ed.). Wiley-Blackwell.


**Module 8 (Dr. K. Vijay Kumar Reddy)- - 15 Hours (CLO-10)**

**Immunovascular Interactions & Cell-signaling mechanisms underlying Cardiovascular diseases:** Leukocyte-Endothelial interactions, Endothelial & myocardial dysfunction, Ischemia, hypertension, and Stroke. Inflammatory ( TNF-alpha, IL-1beta, IL-6) and growth factor ( VEGF, TGF-beta, **β**2-adrenergic receptor) signaling mechanisms underlying cardiac dysfunction. Single-cell sequencing and CRISPR-Cas9 gene knockout-assisted technology for identification of target proteins.

**Emerging Drug development Techniques for Cardiovascular diseases:**
Rational drug design, high-throughput screening analysis, application of artificial intelligence in the drug discovery and design, Multi-OMICS technologies, and nanotechnology in the drug-delivery

**Laboratory practices/hands-on training:**

- ELISA assay of cytokines (TNF-alpha, IL-1beta)
- PCR , SDS-PAGE and blotting techniques
- Nitric Oxide assay in the samples

**Suggested readings-**


- Libby, P. (2021). Inflammation in Atherosclerosis—From Pathophysiology to Practice. Journal of the American College of Cardiology, 78(4), 405–420.
- Stubbington, M. J. T., Rozenblatt-Rosen, O., Regev, A., & Teichmann, S. A. (2017). Single-cell transcriptomics to explore the immune system in health and disease. Science, 358(6359), 58–63.

| L | T | P | Credits |
|---|---|---|---|
| 2 | 0 | 0 | 2 |

**BCH.751: Research and Publication Ethics**

**Learning Outcomes:** Students will be able to:
**CLO1:** Familiarize with the ethics of research.
**CLO2:** Illustrate the good practices to be followed in research and publication.
**CLO3:** Judge the misconduct, fraud and plagiarism in research.
**CLO4:** Utilize various online resources and software to analyze their research output.

| Unit/ Hours | Content | Mapping with CLO |
|---|---|---|
| I<br>3 hours | **Philosophy and Ethics**<br>• Introduction to Philosophy: definition, nature and scope, content, branches<br>• Ethics: definition, moral philosophy, nature of moral judgements and reactions | **CLO1** |
| II<br>5 hours | **Scientific Conduct**<br>• Ethics with respect to science and research<br>• Intellectual honesty and research integrity<br>• Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)<br>• Redundant publications: duplicate and overlapping publications, salami slicing<br>• Selective reporting and misrepresentation of data | **CLO1 & CLO2** |
| III<br>7 hours | **Publication Ethics**<br>Publication ethics: definition, introduction and importance<br>• Best practices/ standards setting initiatives and guidelines: COPE, WAME, etc.<br>• Conflicts of interest<br>• Publication misconduct: definition, concept, problems that lead to unethical behaviour and vice versa, types<br>• Violation of publication ethics, authorship and contributor ship<br>• Identification of publication misconduct, complaints and appeals<br>• Predatory publishers and journals | **CLO2 & CLO3** |
| IV<br>4 hours | **Open Access publishing**<br>• Open access publications and initiatives<br>• SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies<br>• Software tool to identify predatory publication developed by SPPU<br>• Journal finder/journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer, Journal Suggester etc. | **CLO2** |

| | | |
|---|---|---|
| V<br>4 hours | **Publication Misconduct**<br>• Group Discussions: Subject-specific ethical issues, FFP, authorship; conflicts of interest; complaints and appeals: examples and fraud from India and abroad<br>• Software tools: Use of plagiarism software like Turnitin, Urkund and other open source software tools | **CLO2 & CLO3** |
| VI<br>7 hours | **Databases and Research Metrics**<br>• Databases: Indexing databases; Citation database: Web of Science, Scopus etc.<br>• Research Metrics: Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score; Metrics: h-index, g-index, i10 index, almetrics | **CLO4** |

**Course Title: Teaching Assistantship**

**Course Code: BCH.752**

| L | T | P | Credit |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

**Learning Outcomes:** **Total Hours: 30**

At the end of this skill development course, the scholars shall be able to

**CLO1:** familiarize themselves with the pedagogical practices of effective classroom delivery and knowledge evaluation system

**CLO2:** manage large and small classes using appropriate pedagogical techniques for different types of content

**Activities and Evaluation:**

· The scholars shall attend Master degree classes of his/her supervisor to observe the various transaction modes that the supervisor follows in the classroom delivery or transaction process one period per week.

· The scholars shall be assigned one period per week under the direct supervision of his/her supervisor to teach the Master degree students adopting appropriate teaching strategy(s).

· The scholars shall be involved in the examination and evaluation system of the Master degree students such as preparation of questions, conduct of examination and preparation of results under the direction of the supervisor.

· At the end of the semester, the supervisor shall conduct an examination of teaching skills learned by the scholar as per the following **evaluation criteria**:

  · The scholars shall be given a topic relevant to the Master degree course of the current semester as his/her specialization to prepare lessons and deliver in the classroom before the master degree students for one hour (45 minutes teaching + 15 minutes interaction).

  · The scholars shall be evaluated for a total of 50 marks comprising *content knowledge* (10 marks), *explanation and demonstration skills* (10 marks), *communication skills* (10 marks), *teaching techniques employed* (10 marks), and classroom interactions (10).

**Course Title: Curriculum, Pedagogy and Evaluation**

**Course Code**: **UNI.753**

| L | T | P | Credit |
|---|---|---|---|
| 1 | 0 | 0 | 1 |

**Total Hours: 18**

**Learning outcomes:**

After completion of the course, scholars shall be able to:
**CLO1:** analyze the principles and bases of curriculum design and development
**CLO2:** examine the processes involved in curriculum development
**CLO3:** develop the skills of adopting innovative pedagogies and conducting students' assessment
**CLO4:** develop curriculum of a specific course/programme

| Unit/ Hours | Content | Mapping with CLO |
|---|---|---|
| I<br>4 hours | **Bases and Principles of Curriculum**<br><br>1. Curriculum: Concept and Principles of curriculum development, Foundations of Curriculum Development.<br>2. Types of Curriculum Designs- Subject centered, learner centered, experience centered and core curriculum. Designing local, national, regional and global specific curriculum. Choice Based Credit System and its implementation. | CLO1 |
| II<br>4 hours | **Curriculum Development**<br>1. Process of Curriculum Development: Formulation of graduate attributes, course/learning outcomes, content selection, organization of content and learning experiences, transaction process.<br>2. Comparison among Interdisciplinary, multidisciplinary and trans-disciplinary approaches to curriculum. | CLO2 |
| III<br>3 hours | **Curriculum and Pedagogy**<br>1. Conceptual understanding of Pedagogy.<br>2. Pedagogies: Peeragogy, Cybergogy and Heutagogy with special emphasis on Blended learning, Flipped learning, Dialogue, cooperative and collaborative learning.<br>3. Three e- techniques: Moodle, Edmodo, Google classroom. | CLO3 |

| | | |
|---|---|---|
| IV<br>4 hours | **Learners' Assessment**<br><br>1. Assessment Preparation: Concept, purpose, and principles of preparing objective and subjective questions.<br>2. Conducting Assessment: Modes of conducting assessment – offline and online; use of ICT in conducting assessments.<br>3. Evaluation: Formative and Summative assessments, Outcome based assessment, and scoring criteria.<br>*Activity: Develop curriculum for a course/programme related to the research scholar's discipline.* | CLO3 &<br>CLO4 |

**Transaction Mode**

Lecture, dialogue, peer group discussion, workshop

**Evaluation criteria**

There shall be an end-term evaluation of the course for 50 marks for duration of 2 hours. The course coordinator shall conduct the evaluation.

**Suggested Readings**


- Allyn, B., Beane, J. A., Conrad, E. P., & Samuel J. A., (1986). *Curriculum Planning and Development*. Boston: Allyn & Bacon.
- Brady, L. (1995). *Curriculum Development*. Prentice Hall: Delhi. National Council of Educational Research and Training.
- Deng, Z. (2007). Knowing the subject matter of science curriculum, *Journal of Curriculum Studies*, 39(5), 503-535. https://doi.org/10.1080/00220270701305362
- Gronlund, N. E. & Linn, R. L. (2003). *Measurement and Assessment in teaching*. Singapore: Pearson Education
- McNeil, J. D. (1990). *Curriculum: A Comprehensive Introduction*, London: Scott, Foreman/Little
- Nehru, R. S. S. (2015). *Principles of Curriculum*. New Delhi: APH Publishing Corporation.

- Oliva, P. F. (2001). *Developing the curriculum* (Fifth Ed.). New York, NY: Longman
- Stein, J. and Graham, C. (2014). *Essentials for Blended Learning: A Standards-Based Guide*. New York, NY: Routledge.


**Web Resources**

https://www.westernsydney.edu.au/__data/assets/pdf_file/0004/467095/Fundamentals_of_Blended_Learning.pdf

https://www.uhd.edu/academics/university-college/centers-offices/teaching-learning-excellence/Pages/Principles-of-a-Flipped-Classroom.aspx

http://leerwegdialoog.nl/wp-content/uploads/2018/06/180621-Article-The-Basic-Principles-of-Dialogue-by-Renate-van-der-Veen-and-Olga-Plokhooij.pdf