

FRAMEWORK FOR Ph.D. BIOCHEMISTRY (3 YEARS PROGRAM)**One-year course work: 18 Credit Hours****Two-years research work: Credit Hours as per HEC policy**

SEMESTER I		
Course Code	Name of Subject	Credit hours
BCH-711	Optional-I	3
BCH-712	Optional-II	3
BCH-713	Optional-III	3
	Total	09

SEMESTER II		
Course Code	Name of Subject	Credit hours
BCH-721	Optional-V	3
BCH-722	Optional-VI	3
BCH-723	Optional-VII	3
	Total	09

Course code	Subject	Credit Hours
BCH-831	Research Thesis	As Per HEC Policy

REVISED COURSES FOR PH.D. BIOCHEMISTRY

Serial No.	Course Title	Credit hours
1	Proteomics	3
2	Antioxidant Chemistry and Therapeutic Effects	3
3	Advances in novel drug delivery system	3
4	Medical Nutrition Therapy	3
5	The Neurobiology of stress	3
6	Special Topic in Biochemistry	3
7	Molecular Mechanism of Diseases	3
8	Forensic Serology and DNA analysis	3
9	Biochemistry of Drugs and their Resistance	3
10	Stem Cell and Therapeutics	3
	Research Thesis	As Per HEC Policy

Proteomics**(Cr. 3)**

Introduction to Proteomics; The Protein Content of Cells and Tissues, Recent Developments in the Field of Proteomics, Protein Content of Healthy and Diseased Tissue, Systematic Studies of Gene Expression Patterns; The Complex Interactions Associated with the Global Response of Cells, Tissues, and Organisms to Stimuli or Mutation. Interactions of Inorganic Ions with Proteins, Development of Proteomic Technologies and Their Application to Biotechnology, The Research Papers Describing Advances in Recent Proteomic Technologies and the application of proteomics to the study of bacterial, animal and plant cell cultures, Proteomic Analysis of Post Translational Modifications. Key tools of proteomics and their role in understanding the molecular and biochemical fundamentals of life.

Recommended Books

1. Liebler Daniel C. Introduction to Proteomics, Human Press, Totowa NJ, 2002.
2. Garrett R H and Grisham C M. Biochemistry, 3rd ed., Thomson, 2007.
3. Pratt C W and Cornely K. Essential Biochemistry, John Wiley & Sons, 2004.

Antioxidant Chemistry and Therapeutic Effects**(Cr. 3)**

Antioxidants Overview, Antioxidants Chemistry and Health Effects, Roll of Antioxidants in Defense Against Oxidative Damage to Plants and Animals and Food Materials. Sources of Natural Antioxidants and Their Classification, Flavonoids and Polyphenoles as Potential Natural Antioxidants. Methods of Extractions, Isolation, Purification and Characterization of Natural Antioxidants Extracts/Compounds, Measurement of Lipid Oxidation and Evaluation of Antioxidant Activity.

Recommended Books

1. Tilman Grune. Oxidants and Antioxidant Defense Systems. The hand Book of Environmental Chemistry. Vol. 2, Springer Berlin Heidelberg, New York, 2005.
2. Okezie I. Aruoma, Susan L. Cuppett. Antioxidant Methodology: In Vivo and in Vitro Concepts. AOAC Press, 1997.
3. Fereidoon Shahidi, Chi-Tang Ho. Antioxidant measurement and applications. American Chemical Society. 2007
4. Cadenas E and Packer L. Handbook of Antioxidants. Marcel and Dekker, Inc. New York, 2001.

Advances in Novel Drug Delivery Systems**(Cr. 3)**

Transdermal drug delivery systems (TDDS); Targeted drug delivery systems; Gastro-retentive drug delivery systems: Current approaches for the treatment of infectious diseases; Provesicles as surrogate carriers for improved drug delivery: Proliposomes, proniosomes, propharmacosomes and their characterizations; Resealed erythrocytes as drug delivery

system; Engineered bacteria as drug delivery systems; Delivery of pharmaceutical peptides and proteins, ; delivery of pharmaceutical peptides and proteins via microparticles, nanoparticles, liposomes, emulsions, hydrogels and self-regulated devices; Routes for the delivery of pharmaceutical peptides and proteins like oral, pulmonary, nasal, rectal and buccal delivery; Challenges in the delivery of pharmaceutical peptides and proteins

Recommended Books

1. Chien YW (1992), Novel drug delivery systems. Macel Dekker, USA.
2. Michael J, Rathbone, Hadgraft J, Michael S (2003), Modified-release drug delivery technology. Marcel Dekker, USA.
3. Monika SK (2010), Drug Delivery. Springer, USA.
4. Edith M, Donald E, Chickering (1999), Bioadhesive drug delivery systems: fundamentals, novel approaches, and development. Marcel Dekker, USA.
5. Wille JJ (2006), Skin delivery systems: transdermals, dermatologicals, and cosmetic actives. Wiley-Blackwell, USA.
6. Rolland A, Sean M (2003), Pharmaceutical gene delivery systems. CRC Press, USA.

Medical Nutrition Therapy

(Cr. 3)

Medical nutrition therapy of diabetes mellitus and hypoglycemia of non-diabetic origin. Cardiovascular disease, cancer and other risk factors. Nutrition and clinical manifestation of macro & microminerals. Nutrition and immune function, viral diseases and their food therapy. Molecular mechanism of food allergy and food intolerance. Anemia and nutrition care process. Pulmonary disease, asthma and Tuberculosis, Nutrition during Kidney disease and renal failure. Digestion and absorption of nutrients. Detoxification in Colon and Liver. Transportation of organic molecules across the plasma membrane. Supplementary food like fruits, vegetables, coffee and tea for treatment and maintenance of human health on the basis of age weight habits and socio-economic factors. Introduction of Nutritional Genomics: Disease at the chromosomal, molecular and mitochondrial level, Genetic and nutrition therapy. Nutrition therapy for Acid-Base disorder, Aging. Cardiovascular function, Renal function, neurologic function, immunocompetence, medications, Nutrition needs and nutrition issues.

Recommended Books:

1. Vasudevan, D.M and S.S. Kumari, 2007. Text book of Biochemistry 3rd ed. Jaypee brother's medical publishers Ltd. New Delhi.
2. Reginald, H.G and C. M. Gisham, 2006, Biochemistry 3rd ed. Brooks cole publishers.
3. Gerard J. T., B. R. Funke and C. L. Ember, 2004. Case. Microbiology of different foods, 8th ed. Pearson Education Inc. Singapore Pvt. Ltd.
4. Kathleen, L. M and S. E Stump.2000. Krause'Food&Diet Therapy, 11th ed. Elsevier, USA.

5. Rodney, B.2002. Concepts in Biochemistry, 2nd ed. Wadsworth group, Thomson learning & company Forest lodge Road Pacific Grove, USA.
6. Sylvia, E. S. 1992. Nutrition and Diagnosis related care. 3rd ed. Lea and Febiger. USA
7. Zemplen, J. and H. Domiel. 2004. Molecular Nutrition, CABI Publishing, Wallingford.UK.
8. Paul, I.R.E. Turner and D.Ross, 2004. Nutrition 2nd Jones and Bartlett Publishers, Canada.

The Neurobiology of Stress

(Cr. 3)

Homeostasis and Control Systems- Stress, stressors, stress Physiology. The Endocrine System: hormones and axes; The HPA axis Glucocorticoid receptor; Sympathetic Nervous system; Allostasis, Allostatic load, circadian rhythm and aging; Neurophysiology - cells, synapses, neurotransmission; circuits and systems; Neuroplasticity and adult neurogenesis; Memory, fear. The Genome and the epigenome Stress psychology. The social brain; Stress and psychopathologies – depression, anxiety, -PTSD; individual variability: controllability and social factors individual variability and resilience: GxE, biological sensitivity to context; Resilience and vulnerability – genetic and epigenetic factors, early life stress, Prenatal stress: metabolism, epigenetic, reproduction, Transgenerational transmission; Stress and Health Outcomes.

Recommended Books:

1. Handbook of Stress and the Brain Part 1: The Neurobiology of Stress, Volume 15; 1st Edition, Thomas Steckler N.H. KalinJ.M.H.M. Reul; Elsevier Science; 2005
2. Behavioral Neurobiology of Stress-related Disorders (Current Topics in Behavioral Neurosciences)2014th Edition by Carmine M. Pariante (Editor), M. Danet Lapiz-Bluhm (Editor) by Springer
3. Stress - From Molecules to Behavior: A Comprehensive Analysis of the Neurobiology of Stress Responses Editors(s): Prof. Dr. Hermona Soreq Prof. Dr. Alon Friedman; Prof. Dr. Daniela Kaufer First published:2 December 2009; Copyright © 2010 Wiley-VCH Verlag GmbH & Co. KGaA
4. Stress: Neurobiology and Neuroendocrinology; Marvin R. Brown, George F. Koob, Catherine Rivier Taylor & Francis, 28-Nov-1990

Special Topic in Biochemistry

(Cr. 3)

Topics under recent investigations and of current interest (the choice will depend upon the interest of the teacher offering this course).

Molecular Mechanisms of Diseases**(Cr. 3)**

A general introduction to Basic Mechanisms of Disease and Risk Factors; Origin and development of the disease; Genetic diseases. (Muscular dystrophy, bone deformities, skin diseases); Microbial Infections; Viral infections and its factors; Immunopathogenesis (Inflammation, Fibrosis, Hypersensitivity, Autoimmunity, Immunodeficiency); Degeneration; Pathogenesis of Cancer

Recommended Books:

1. Brownstein M. J and Khodursky A, Functional Genomics (Methods in Molecular Biology). Humana Press (2010).
2. Strachan T, Read A. P, Human Molecular Genetics, 4th ed, Garland Science, New York (2010).
3. Glazer A. N, MICROBIAL BIOTECHNOLOGY, Fundamentals of Applied Microbiology, Hiroshi Nikaido University of California, Berkeley (2008).
4. Updated research Published in Nature Review Cell & Molecular Biology.
5. Articles Published in Nature Review Genetics.

Forensic Serology and DNA Analysis**(Cr. 3)**

Essentials to Forensic Serology; Blood Serology; Semen Serology and saliva detection; Other biological fluids; Forensic genetics; Polymorphism DNA structure; STR's and SNP's; Screening of biological evidence; DNA extraction from evidence samples; Robotics in DNA extraction; Different DNA quantification methods; Amplification and Analysis of STR; Genotyping and Capillary Electrophoresis; Interpretation of genetic profiles; Artefacts in genotyping; Population genetics; Statistical interpretation; Lineage markers and familial searching; The basis of paternity and sibship testing; Non-human DNA typing; Role of Quality control and Quality Assurance in Forensic DNA and Serology; Criminal Justice System of Pakistan; Evidentiary value of DNA evidence.

Recommended Books:

1. Goodwin, William, Adrian Linacre, and SibteHadi. An introduction to forensic genetics. Vol. 2. John Wiley & Sons, 2011.USA.
2. Butler, J. M. (2009). Fundamentals of forensic DNA typing. Academic Press. 2nd Edition, New York, USA.
3. Butler, J. M. (2011). Advanced topics in forensic DNA typing: methodology. Academic Press. 1st Edition, New York, USA.
4. XanthéMallett, Teri Blythe, Rachel Berry Advances in Forensic Human Identification 2014 – CRC Press. USA.
5. Richard Li, Forensic Biology, Second Edition March 11, 2015, CRC Press. USA.

Biochemistry of Drugs and their Resistance**(Cr. 3)**

Indiscriminate use of medicines; Introduction to antibiotics; Classes of drugs and their mode of action; Drug side effects and drug-drug interactions; Mechanisms of drug resistance; Drug resistance detection; Antimicrobial prophylaxis and empiric therapy; Antimicrobial stewardship; Human consumption of antibiotics through food chain; Antibiotic Sensitivity Test; MRSA; Roll Back Malaria; Drug resistance issues: MDR, TDR and XDR Tuberculosis; Emerging and re-emerging drug resistance issues.

Recommended Books:

1. Antimicrobial Resistance Global Report on Surveillance. (2014) World Health Organization Geneva, Switzerland.
2. Antimicrobial Resistance Policy Government of Pakistan
3. Latest Research Articles from Journals

Stem Cells and Therapeutics**(Cr. 3)**

Introduction to stem cells; Principles and applications; Concept of the stem cells; Self-renewal and differentiation potential of stem cells; Maintaining Stemness: Interaction between HSCs and the cellular micro Environment; Stem cells and their specific molecular markers; Cell signaling in stem cells; Stem cells; Embryogenesis; Differentiation; Stem cells models, past, present and future; Immunobiology of stem cell transplantations; Types of stem cells and their clinical potential: Embryonic and nonembryonic stem cells; Adult stem cells; Induced pluripotent stem cells; Stem cells in regenerative medicine, Regenerative medicine and reprogramming; Hematopoietic stem cells and their therapeutic potential; Use of stem cells in burns and wounds, ocular diseases, diabetes, etc; Generation of specific cells from pluripotent stem cells; Commercial opportunities for iPSCs; Limitations in reprogramming and differentiation fields; Cancer stem cells and tumorigenesis; Stem cells and aging; Bioreactors of pluripotent stem cells and future challenges; Ethical issues in stem cell research

Recommended Books:

1. Ulrich, Henning, Davidson Negraes, Priscilla, Working with Stem Cells (Principles and Applications) edition illustrated, Springer, 2016
2. Tarik Regad, Thomas J. Sayers, Robert C. Rees, Principles of Stem Cell Biology and Cancer: Future Applications and Therapeutics 1st edition, John Wiley and Sons 6 March 2015
3. Kaushik D. Deb and Satish M. Totey, Stem Cells Technologies Basics and Applications New edition, Tata McGraw-Hill 2009
4. Paul Knoepfler., Stem Cells, An Insider's Guide, 1st edition, World Scientific Publishing Co.Pte. Ltd, 2013
5. Edited by D. Ho, Ronal Hoffman and Esmail D. Zanjani., Stem cell transplantation (Biology, Processing, Therapy) Wiley-Blackwell, 2006

6. Vertes, Alain A; Qureshi, Nasib; Caplan, Arnold I; More...Stem Cells in Regenerative Medicine: Science, Regulation and Business Strategy, 1st edition, Wiley Blackwell, 2015
7. Patrick J. Sullivan, and Elena K. Mortensen., Induced Stem Cells, Nova Science publisher's Inc; UK ed. Edition 2012

Research Thesis

The student shall submit a thesis on the subject of his/her research work.