KARNATAK UNIVERSITY
DHARWAD

DEPARTMENT
OF
BIOCHEMISTRY

Ph.D. COURSE WORK

SYLLABUS

2012-13

KARNATAK UNIVERSITY, DHARWAD
DEPARTMENT OF BIOCHEMISTRY

Regulations and Syllabus for Ph.D. Course work

As per the Amended regulations governing Ph.D. Programme (regulation 9.0) of the Karnatak University, Dharwad w.e.f. Academic year 2012-13, the candidates registered for Ph.D. degree shall undertake course work of one semester (16 weeks) on regular basis.

9.0 Course work

9.1 Registered Full-time and Part-time Ph.D. candidates shall undertake course work of one semester (16 weeks), normally in the parent department within one year from the date of provisional registration, failing which his/her registration shall be cancelled. However, if it is found necessary, course work may be carried out by doctoral candidates in sister departments/Institutes/ Research Centres recognized by the University for which due credit shall be given to such candidates.

9.2 The course work for Ph.D. programme shall comprise of three papers of 100 marks each, viz.,

i) **Course-I: Research Methodology** which include Quantitative /Qualitative methods and computer applications

ii) **Course-II: Cognate/Core Subjects**

iii) **Course-III: Area of Research.** This shall be followed by comprehensive Viva-Voce for 50 marks

However, it shall be noted here that Course-I and II are common for all the candidates in the particular Department/subject/ Discipline.

9.3 Each Course shall have 48 contact hours. Classes for Courses-I and II shall be arranged by the Chairperson of the P.G. Departments/Head of the recognized research centres, and that of Course-III by the concerned Research supervisor. Both the Full-time and Part-time candidates shall be attend atleast 75% of the classes in each paper to be eligible to appear for the examination.

9.4 The syllabus of Paper-I & II shall be framed by the Concerned Department consisting of the chairperson of the respective Department as Chairperson, two Research Supervisors, based on the seniority (including One Research Supervisor belonging to SC/ST Category wherever available). The syllabus of Paper-III shall be framed by the concerned Supervisors. The syllabi shall be placed before the concerned BOS for consideration and approval.

9.5 The candidates who fail to attend minimum of 75% of the classes in each of the courses shall not be eligible to appear for the examination and his/her provisional registration stands cancelled.

9.6 The following shall be the structure of Course work for Ph.D. Programme.

Sl. No.	Name of the Course	Contact Hours per Week	Maximum Marks			Examination Hours
			Continuous Assessment (IA)	Course-End Examination	Total	
01	Course-I: Research Methodology	03	50	50	100	02
02	Course-II: Cognate/Core Subject	03	50	50	100	02
03	Course-III Area of Research	03	50	50	100	02
Total			150	150	300	
Viva Voce					50	
Grand Total					350	

9.7 Continuous Internal Assessment (IA) Marks of the course work shall be awarded based on

a) Assignments-10 marks b) Seminars-10 marks c) Tests-30 marks.

Paper	Internal Assessment Components (Marks)				
	Test-I (15)	Test – II (15)	Seminar (10)	Assignment (10)	Total
1. Course-I: Research Methodology	5th week	9th week	12th Week	14th Week	50
2. Course-II: Cognate/Core Subject	5th week	9th week	12th Week	14th Week	50
3. Course-III: Area of Research	5th week	9th week	12th Week	14th Week	50

9.8 The question paper (in two sets) of Paper-I & II of the Semester end examinations shall be set by BOE (vide Regulation 9.4). the concerned Supervisors shall set the question paper/s (in two sets) in respect of Paper-III. The manuscripts of the question papers shall be submitted to the Registrar (Evaluation). Out of the two sets of question papers or each Paper, one shall be chosen randomnly by the Registrar (Evaluation).

9.9 The Semester-end examination shall be conducted in the 17th week and evaluation completed and results announced by the 18th week.

10.0 Examination and Evaluation of Answer Scripts

10.1 There shall be a Course-end Examination of two hours duration (for 50 marks per Course).

10.2 The Chairperson of the P.G. Department shall conduct the examination for all the candidates (i.e., including those who are working for Ph.D in other institutions) in the Department.

10.3 Each answer script of the Course-end examination shall be coded and assessed by two examiners (one internal Course teacher and another external- appointed by the Registrar (Evaluation) from the panel of examiners submitted by the Chairperson of the BOE). The marks awarded to the answer script shall be the average of these two evaluations.

10.4 If the difference in the marks between two evaluations exceeds 20% of the maximum marks, such a script shall be assessed by a third examiner appointed by the Registrar (Evaluation) from the panel of examiners submitted by the Chairperson of the BOE. The marks awarded to that script shall be the average of two nearer marks out of three evaluations.

11.0 Minimum Pass Marks and Improvement Examination:

11.1 The BOE shall prepare the Result sheet and submit it to the Registrar (Evaluation) who shall then declare the results and issue marks cards.

11.2 Minimum for pass in each written paper shall be 40% in the course-end examination and 50% in aggregate including the continuous internal assessment marks. However, there shall be no minimum for Viva-Voce as well as IA Marks. Every candidate shall compulsorily attend the Viva-Voce examination conducted by Respective Research supervisor and concerned Chairperson of the Department.

11.3 Failed candidates shall be allowed to reappear for the Ph.D. Course work examination only once within three months of the first examination. In case of failure of the candidate even after the re-examination, his/her provisional Registration shall be cancelled. There is no provision for improvement of IA marks.

Syllabus for Ph.D. Course work in Biochemistry

Course-I : RESEARCH METHODOLOGY

1. Research in biochemistry- An over view, Literature review, objectives of Research work, Approaches and methodology 6 hrs

2. Documentation and presentation of data, Analysis and interpretation of data, manuscript preparation 5 hrs

3. Biostatistics used for analysis of data 6 hrs

4. Computer applications/Bioinformatics, biochemical databases, web tools and software packages 8 hrs

5. Purification and characterization of biomolecules, Centrifugation, Chromatography, Electrophoresis, Spectrophotometry, GC-MS, NMR 8 hrs

6. Microscopic and Immunological techniques, Radio isotopes in biochemical research 6 hrs

7. Techniques in molecular biology; PCR, DNA Microarray, DNA sequencing and cloning techniques 9 hrs

48 hrs

Syllabus for Ph.D. Course work in Biochemistry

Course-II: Cognate/Core Subject- Biochemistry

1. **Introduction:** Basic concepts of Biochemistry, Cellular organization and composition, Analytical tools in structural biology

   3 hrs

2. **Biomacromolecules:** Structural organization of Proteins and Nucleic acids, structure –function relationships, Supramolecular assemblies, Polysaccharides, Glycoproteins, lipoproteins, membrane assembly molecules, proteoglycans, blood group antigens.

   8 hrs

3. **Enzymes:** Substrate specificity, coenzymes, Isoenzymes enzyme Kinetics, catalytic mechanisms, Regulation of enzyme activity, diagnostic enzymes, application of enzymes.

   6 hrs

4. **Metabolism:** Metabolic pathways-carbohydrates, lipids, aminoacids and nucleotides, metabolic interrelationships, Genetic disorders, metabolic regulations Hormonal control.

   6 hrs

5. **Molecular physiology:** Mechanism of action of Hormones, Signal transduction, Hormone Receptors, Neurotransmission, Vision, Muscle contraction, stem cells & their applications.

   5 hrs

6. **Molecular Biology:** DNA replication, transcription, translation, Regulations of Gene Expression.

   6 hrs

7. **Immunology**: Antigens, Immunoglobulins, Immune systems, Autoimmunity, Molecular immunology.

   6 hrs

8. **Biotechnology:** Recombinant DNA technology, Gene cloning, restriction enzymes, expression of foreign genes, transgenic organisms, plant biotechnology, Human gene therapy Molecular Diagnostics.

   8 hrs

Total 48 hrs

Syllabus for Ph.D. Course work in Biochemistry

Course-III: Area of Research

BIODEGRADATION AND BIOREMEDIATION

1. **Environmental Pollution:** A perspective review, Sources and toxicity of environmental pollutants, Xenobiotics 6 hrs

2. **Biodegradation:** Role of microbes in the degradation of environmental pollutants, Biodegradative pathways in microorganisms-bacteria, fungi and yeast. Aerobic and anaerobic biodegradation by pure and mixed cultures, cometabolism, biotransformation 9 hrs

3. **Persistent Organic pollutants (POPs):** Polycyclic aromatic hydrocarbons (PAHs), Polychlorinated biphenyls (PCBs), Halogenated and nitro aromatic compounds, Bioaccumulation and Biomagnification. 6 hrs

4. **Elucidation of biodegradative pathways:** Isolation and characterization of metabolic products by physico-chemical methods, oxygen-uptake and enzymatic studies. 8 hrs

5. **Enzymes of biodegradative pathways:** Monooxygenases, Dioxygenases, Esterases and Dehalogenases. Microbial enzymes and their industrial applications 6 hrs

6. Development of genetically engineered microbial strains for degradation of toxic organic pollutants 4 hrs

7. **Bioremediation:** Use of microbes in bioremediation of contaminated sites, **in situ** and **ex situ** bioremediation, bioagumentation, phytoremediation and their applications in environmental pollution control , Biological treatment , Immobilized microbial technology 9 hrs

48 hrs

Syllabus for Ph.D. Course work in Biochemistry

Course-III: Area of Research

GLYCOBIOLOGY

1. **Proteins**- Isolation, purification techniques for soluble and membrane bound proteins 5 hrs

2. Characterization of proteins for Primary, Secondary, Tertiary and Quaternary structure 10 hrs

3. **Carbohydrates**: Monosaccharides of biological origin, oligos, polysaccharides and their biological significance Methods used for characterization of carbohydrates, uses of enzymes, chemical methods, MALDI-TOF MS MS, NMR, Glycans, Complexity of glycans of glyconjugates, N and O linked glycans, biosynthesis and their characterization 13 hrs

4. **Carbohydrate binding proteins**: Lectins, classification structure, function and their applications. 10 hrs

5. **Cell biology**: Cell culture methods, cell based assays; proliferation, viability and apoptosis assays, Flowcytometry, confocal microscopy, Immunohistochemistry and western blotting, Cancer Biology. 10 hrs

48 hours

Syllabus for Ph.D. Course work in Biochemistry
Course-III: Area of Research
NEUROCHEMISTRY

UNIT-1 GROSS ANATOMY OF BRAIN 07 Hours

Components of the Central Nervous System (CNS), Cerebral topography, Topography of the Cerebellum and Brainstem, Development of the nervous system, The meninges, Covering of the brain and spinal cord (Dura Mater, Arachnoid Mater, Pia Mater). Cerebrospinal fluid -Formation, Circulation, Function and Composition. Blood-Brain Barrier (BBB).

UNIT-2 THE NEURON 07 Hours

The Neuron and its cellular components, Axonal Transport, Types of Neurons, Neuroglia, Myelinated Axons (PNS & CNS), Disorders associated with defected Myelination, Composition of Peripheral Nerves, Injury of the Neuronal cell body and Axonal damage, Recovery of Neuronal injury.

UNIT-3 NEUROTRANSMITTERS 08 Hours

Definition, Criteria for identifying neurotransmitter, Major classes of Neurotransmitter, its synthesis, removal, distribution and its physiological & clinical consideration, Receptors for Neurotransmitter, Mechanisms of regulation of receptors.

UNIT-4 PROTEIN KINASE AND PHOSPHATASES IN SIGNALLING 08 Hours

Introduction to reversible phosphorylation, Protein- serine/threonine and tyrosine kinase and phosphatase: structure and origin of protein phosphatase, effect of inhibitors on protein phosphorylation in intact cells. Calcineurin: its form, function and multiple roles in cell signaling with special emphasis on learning and memory.

UNIT- 5 INHERITED AND NEURODEGENERATIVE DISEASES 10 Hours

The Epilepsies, Phenotype and Mechanisms, Diseases Involving Myelin, Genetics of Neurodegenerative Diseases, Disorders of Amino Acid Metabolism, Lysosomal and Peroxisomal Diseases, Diseases of Carbohydrate, Fatty Acid and Mitochondrial, Metabolism, Disorders of Muscle Excitability, Neurodegenerative alpha-Synucleinopathies and Tauopathies, Neurodegenerative α-Synucleinopathies and Tauopathies, Motor Neuron Diseases.

Unit 6 BIOINFORMATICS 08 Hours

Biological Data bases: resource data base generation (genome projects), structural data bases (protein data bases), data base mining and applications.

Sequence analysis: Sequence alignment (Global and Local), sequence analysis of Nucleic acids and proteins (FASTA and BLAST), Restriction mapping, Pair wise and multiple alignments, phylogenetic analysis.

Drug designing: Structure prediction of proteins, modeling, Drug designing, Molecular docking, evaluation and validation.

Total Hours: 48 Hours

REFERENCES:

1. Essential Neuroscience, Revised First Edition, Allan Siegel and Hreday N. Sapru. Lippincot & Williams publishers, 2007
2. Molecular Pharmacology, Edition Second by Eric J. Nestler, Steven E. Hyman and Robert C. Malenka. Prentice Hall. 2008
3. Fundamentals of Neurophysiology, Third Revised Edition, Edited by R. F. Schmidt. BIOS Publishers, 2012
4. Neural Plasticity and Memory, From Genes to Brain Imaging. *Frontiers in Neuroscience*, Edited by Federico Bermúdez-Rattoni Publishers Prentice Hall., 2007
5. Neuroscience: Exploring the Brain, Third Edition, Mark F Bear, Barry W Connors, Michael A Paradiso.2015
6. Basic Neurochemistry, 7th edition, by George J Siegel. Publishers L Williams & Wilkins, 2006
7. Protein phosphorylation, OXFORD university Press D. G. Hardie 1999
8. Instant notes in Bioinformatics, D.R. West head, T.H. Parish and Twyman, 2002, Publishers BIOS, 2002
9. Bio scientific Problems Oxford OX4, IRE, UK., 2003
10. Bioinformatics, Genes, Proteins & Computers: C.A Orengo, D.T. Jones & J.M. Thornton. Publishers BIOS Scientific,2003
11. Introduction to Bioinformatics Teresa Attwood, David Parry-Smith. Publishers Prentice Hall, 2003

Syllabus for Ph.D. Course work in Biochemistry
Course-III: Area of Research
Protein Biology

UNIT- 1. PROTEINS AND AMINO ACIDS (8H)

Amino acids classification and chemistry. Proteins– primary structure – secondary – tertiary – quaternary – super secondary structures. Sequence determination – Ramachandran plot. Globular and fibrous proteins. Protein folding and dynamics – Molecular chaperones – heat shock proteins. Protein denaturation (pH, temperature, chaotropic agents), Protein-Protein interactions, Functional proteins: Structure and Drug targets.

Protein Folding: Folding pathways; Intermediates of protein folding; Compact Intermediates; Role of chaperons (trigger factor, prefoldin), heat shock proteins (Hsp70, Hsp90), chaperonins (Group I & II) and enzymes in protein folding (PDI, PPI), Protein folding disorders.

UNIT-2 BIOSIGNALING: **(10H)**

Biosignaling is also known as cell signal transduction) is the transmission of molecular signals from a cell's exterior to its interior. Signals received by cells must be transmitted effectively into the cell to ensure an appropriate response. This step is initiated by cell-surface receptors. Signal transducing receptors are of four general classes: Receptors that penetrate the plasma membrane and have intrinsic enzymatic activity or are enzyme associated (Enzyme-linked Receptors); Receptors that are coupled, inside the cell, to G proteins (7-TM Receptors);Receptors that are found intracellularly and upon ligand binding directly alter gene transcription (Nuclear Receptors); Ligand-gated ion channels.

Several small molecules within the cell act as intracellular messengers (also known as second messengers). These include cAMP, cGMP, nitric oxide, lipids and Ca2+ ions.

UNIT III - Protein Functioning (6H)

One of the most important functions of cell signalling is to control and maintain normal physiological balance within the body. Activation of different signalling pathways leads to diverse physiological responses, such as cell proliferation, death, differentiation, and metabolism.Proliferation of damaged or malfunctioning cells is often a key factor in the generation of disorders such as cancer, infectious diseases, inflammation, arteriosclerosis, arthritis, and neurodegenerative diseases.

Ageing: Theories of ageing – Ageing of stem cells – programmed cell death. Telomeres and Telomerase. Genes, epigenetic, nutrients regulations of ageing process. neurodegenerative – metabolic diseases. Anti-ageing approaches – stem cells and regeneration therapy.

UNIT- IV – PROTEIN EXPRESSION STUDIES (10H)

Genetic Engineering: Culture of *E. coli* cells & plasmid isolation, Preparation of competent cells, Transformation, Restriction enzymes, Ligation of DNA, Primers designing, Polymerase chain reaction, Generating Mutants, Sub-cloning of GFP protein. Mutagenesis: Effect of amino acid changes on protein function, site-directed mutagenesis

Expression Systems – *E. coli*, Yeast, Introduction, detection and purification of expressed protein - Engineering – Protein/peptide chemical synthesis - Protein-polynucleotide interactions

UNIT- V PURIFICATION OF PROTEINS AND ENZYMES: **(12)**

Extraction methods, Ammonium sulphate fractionation; Purification strategies: Gel filtration chromatography, Ion-Exchange chromatography, Affinity chromatography, Dye-ligand; Electrophoresis: SDS and Native, Western Blotting; Proteomics: 2DE and Mass Spectrometry.

Protein folding structure and function: Primary Structure, post translational modification of proteins (viz. glycosylation, N-terminal, modification, hydroxylation & modified amino acids). Secondary structure - UV, CD and fluorescence spectrophotometry. Quaternary structure - X-ray. Functional proteins - Hemoglobin and enzymes / peptide hormones.

Structural and functional aspects of proteins and DNA: Relationships between structure and function and their role in human diseases; Protein-DNA interactions; Protein-RNA interactions; Protein-protein interactions; Protein aggregation; Non-enzymatic glycosylation (Protein-sugar interaction); Methods to study these interactions.

UNIT- VI – PROTEOMIC APPROACH
(4H)

Data processing, Data mining; Bioinformatics – concept and applications; Biological databases – Primary and Secondary; Sequence Databases (EMBL, Gen Bank, DDBJ, SWISS-PROT, PIR, TrEMBL); Protein Family/Domain Databases (PROSITE, Pfam, PRINTS & SMART); Structure Database (PDB); Tools like BLAST, FASTA and EMBOS.

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- ✓ Nelson, D.L. and Cox, M.M. (2012) Lehninger's Principle of Biochemistry, W.H. Freeman, New York. 2. Voet, D. and Voet, J.G. (2010) Biochemistry. John Wiley and Sons Inc., New Jersey.
- ✓ Introduction to Protein Structure (Garland Press, Second Edition), by Carl Branden and John Tooze.
- ✓ Introduction to protein structure by Thomas Creighton DNA structure and function by R. Sinden
- ✓ Nucleic Acids: Structures, Properties, and Functions (University Science Books) edited by Victor Bloomfield, Donald Crothers, and Ignacio Tinoco.
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- ✓ Gene Cloning and Dna Analysis an Introduction T.A. Brown. Sixth Edition (2010).