

# KARNATAK UNIVERSITY, DHARWAD

## Department of Applied Genetics

1. Programme code and Name of the Programme: M.Sc., and Ph.D.

2. Programme Outcomes (POs) for M.Sc., and Ph.D.

The Master of Science and Ph.D. program at Karnatak University would develop a scientific temper and creative abilities useful for societal wellbeing and development with advancement in the field of science and technology. The pregame ignites independent thinking responsible for self-learning as well as development of transferable quantitative skills enabling students to work with others demonstrating leadership and collaborative skill. Apart from scientific knowledge, the students will be imbued with realization of human values, a sense of social responsibility to become responsible and dutiful citizens.

3. Course outcomes (COs)

Course Code: PG71T101 - CT1.1 Biological Chemistry	<ul style="list-style-type: none"><li>• To understand the fundamental biochemistry principles, such as structure/function of biomolecules,</li><li>• To study the classification, characteristics and significance of Biomolecules</li><li>• To understand the importance of vitamins and enzymes in health and disease.</li></ul>
Course Code: PG71T102 - CT1.2 Genetics and Cytogenetics	<ul style="list-style-type: none"><li>• To understand the principles of inheritance as formulated by Mendel and its extensions.</li><li>• To understand the analysis of genetic data using statistical procedures.</li><li>• To understand structure and composition of animal and plant cells, nuclear content and the concept of cell cycle.</li><li>• To understand the concept chromosome number, structure, and behavior in human, animal and plant cells.</li><li>• To understand the application of genetic and cytogenetic techniques in human health and plant/animal breeding.</li></ul>
Course Code: PG71T103- CT1.3 General Microbiology	<ul style="list-style-type: none"><li>• To understand the source, isolation, enrichment, purification and also to know various physical and chemical means of sterilization.</li><li>• To understand the use of different media and staining purposes for isolation, culture, classification and identification of microbes.</li><li>• Master aseptic techniques and be able to perform routine culture handling tasks safely and effectively</li><li>• Comprehend the various methods for identification of unknown microorganisms</li><li>• Application of microbes for various purposes viz. industrial, hospital, diagnostic and agricultural purpose.</li></ul>

Course Code: PG71T104- CT1.4 Biophysical and biochemical techniques	<ul style="list-style-type: none"> <li>To understand the state-of-the-art biophysical methods that are being applied to study the structure and function of biological macromolecules and biological systems at the molecular level.</li> <li>To understand the principle, procedure and application of various analytical techniques viz. microscopy, chromatography, electrophoresis, centrifugation, spectroscopy etc.</li> <li>To understand the handling, storage, analysis and downstream processing of various biological macromolecules.</li> </ul>
Course Code: PG71P101- CP1.4 Practical-I	<ul style="list-style-type: none"> <li>To learn hands on about preparation of biological buffers, isolation and purification of biomolecules and its characterization.</li> </ul>
Course Code: PG71P102- CP1.5 Practical-II	<ul style="list-style-type: none"> <li>To learn hands on about collection, handling, identification and breeding of model organism <i>Drosophila melanogaster</i>, <i>Neurospora</i>, <i>Sordaria</i> and <i>Ascbolus</i>.</li> <li>To evaluate Mendelian principles and its extension using model organisms.</li> <li>To study nuclear events like chromosomal variations viz, aneuploidy, polyploidy and structural variations in chromosomes hands on.</li> </ul>
Course Code: PG71P103- CP1.6 Practical-III	<ul style="list-style-type: none"> <li>To learn hands on about microbial culture, differentiation, identification and classification.</li> <li>To study life cycles of different model microbes, biochemical analysis, effect of physical and chemical parameters on its growth.</li> </ul>
Course Code: PG71P104- CP1.7 Practical-IV	<ul style="list-style-type: none"> <li>To learn hands on about the various techniques used in physical, physiological and biochemical analysis of cells viz, centrifugation, microscopy, spectroscopy and biomolecule fractionation and separation.</li> </ul>
<b>M.Sc. Second Semester Applied Genetics</b>	
Course Code: PG71T201-CT2.1 Developmental & Evolutionary Genetics	<ul style="list-style-type: none"> <li>The course gives an in-depth insight into the development of animals, amphibian, insects, chick and birds. Molecular aspects of life - the central dogma.</li> <li>To understand basic genetic principles, both at the individual and population level, and appreciate the concept of natural selection as the driving force of evolution.</li> <li>To appreciate how interactions between organisms and the environment, between individuals within a species, and between individuals of different species can shape selective forces and evolutionary outcomes.</li> <li>To understand how genes control the development of organisms and appreciate the importance of development in evolutionary</li> </ul>

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Course Code: PG71T202 -CT2.2 Molecular Biology	<ul style="list-style-type: none"> <li>• The course gives an in-depth insight into the molecular aspects of life - the central dogma spanning from DNA Replication till Protein Synthesis and Reverse transcription.</li> <li>• It explains molecular aspects of genes and its regulation- genome- gene expressions heredity- recombination- protein synthesis- molecular basis of diseases- mutations genetic analysis etc.</li> </ul>
Course Code: PG71T203-CT2.3 Intermediary Metabolism	<ul style="list-style-type: none"> <li>• Describes the kinetics of enzymatic reactions and to understand enzyme substrate models and mechanism of enzyme catalysis also describes the fundamental concepts of metabolic pathways, importance and their regulatory mechanism</li> <li>• The Course gives an in-depth knowledge of all Biomolecules Metabolisms and their regulations.</li> </ul>
Course Code: PG71T204A – ET2.4 Molecular Cell Biology techniques (Elective paper)	<ul style="list-style-type: none"> <li>• The course is designed to non-genetics background students to understand basic principles of techniques applied in genetics and molecular biology.</li> <li>• The course discusses about the topics spanning from structure and function of nucleic acids to analytical techniques applied for nucleic acid analysis and modification viz. electrophoresis, PCR, nucleic acid detection and recombinant DNA techniques.</li> <li>• The course reveals computational biology and bioinformatics methodologies applied to interrogate genomes and proteomes.</li> </ul>
Course Code: PG71P201 – CP2.4 Practical-I	<ul style="list-style-type: none"> <li>• To learn hands on about selection, preparation, fixation, embedding section and staining of plant/animal tissues for developmental studies.</li> <li>• To learn principles of evolution and population genetics by experimentation and calculations.</li> </ul>
Course Code: PG71P202 – CP2.5 Practical-II	<ul style="list-style-type: none"> <li>• To learn isolation, purification separation, and quantification of nucleic acids from animals, plants and microbes.</li> <li>• To learn about mutation induction, mutant characterization and DNA repair.</li> <li>• To learn how gene expression induced by changing substrates in model organisms.</li> </ul>
Course Code: PG71P203 – CP2.6 Practical-III	<ul style="list-style-type: none"> <li>• To learn enzyme kinetics, detection and estimation of biomolecules, elements and hormones.</li> </ul>
<b>M.Sc. Third Semester Applied Genetics</b>	
Course Code: PG71T301-CT3.1 Genetic Engineering	<ul style="list-style-type: none"> <li>• To expose students to the concept of genetic engineering including the techniques, applications in various industries like agriculture, food, health, environment etc. and its limitations.</li> <li>• To train students in strategizing research methodologies employing genetic engineering techniques.</li> </ul>

Course Code: PG71T302 - CT3.2 Microbial Genetics & Technology	<ul style="list-style-type: none"> <li>• To understand metabolic regulation of various biochemical and physiological pathways in microbes and its application in metabolic engineering.</li> <li>• To understand biology and genetics of phages and its application.</li> <li>• To understand techniques involved strain improvement by mutagenesis, recombination and genetic engineering.</li> <li>• To understand fermentation technology and its application in industrial production.</li> </ul>
Course Code: PG71T303 - CT3.3 Human Genetics & Genetics Counselling	<ul style="list-style-type: none"> <li>• This course covers historical development of human genetics and its relationship with other biological science and medicine</li> <li>• To understand the pattern of polygenic and multi factorial diseases.</li> <li>• To understand the biochemical and molecular basis of human diseases like inborn errors of metabolism disorders, hemoglobin disorders and lysosomal storage disorders.</li> <li>• To understand principles, objectives and goals of genetic counselling.</li> </ul>
Course Code: PG71T304A-ET 3.4 (Elective paper): Genetic Disorder and Counselling	<ul style="list-style-type: none"> <li>• The course is designed for non-genetic background students to learn the basic principles of disease genetics and genetic counselling.</li> <li>• To understand cytological, molecular and biochemical basis of genetic diseases.</li> <li>• To understand principles, objectives and goals of genetic counselling.</li> </ul>
Course Code: PG71P301 – CP3.4 Practical-I	<ul style="list-style-type: none"> <li>• To learn hands on isolation of gene, cloning, expression and analysis of recombinant protein using bacterial host.</li> <li>• To learn PCR, sequencing, and reporter gene assays</li> </ul>
Course Code: PG71P302 – CP3.5 Practical-II	<ul style="list-style-type: none"> <li>• To learn hands on recombination and mutation in bacteria.</li> <li>• To learn fermentation techniques.</li> </ul>
Course Code: PG71P303– CP3.6 Practical-III	<ul style="list-style-type: none"> <li>• To learn hands on about detection of inborn errors of metabolism, cancer and other genetic diseases by cytogenetic, molecular, and biochemical methods.</li> </ul>
<b>M.Sc. Fourth Semester Applied Genetics</b>	
Course Code: PG71T401 - CT4.1	<ul style="list-style-type: none"> <li>• Recall the basic concepts of atomic structure and explain the fundamental principles and origin of spectral lines</li> <li>• Provide an overview of various bioinformatics tools, databases</li> </ul>

Bioinformatics	<p>available and sequence analysis.</p> <ul style="list-style-type: none"> <li>• Provide knowledge on database concept, management, retrieval along with utilization in gene and protein analysis.</li> <li>• Impart basic knowledge of patenting, intellectual property rights, laws available and copyrights.</li> </ul>
Course Code: PG71T402 -CT 4.2 Immunogenetics & Immunotechnology	<ul style="list-style-type: none"> <li>• To provide overview of immune system, antigen, antibody structure and interactions.</li> <li>• Understanding of innate and adaptive immunity along with major cells and molecules involved.</li> <li>• To integrate immunology with health and enrich the knowledge for autoimmune disorders,</li> <li>• To study hypersensitivity reaction, MHC and serological reactions</li> <li>• Develop understanding about immune system, antigen antibody interactions.</li> </ul>
Course Code: PG71T403 -CT 4.3 Molecular Diagnosis and Molecular Medicine	<ul style="list-style-type: none"> <li>• Recall the basic concepts of discovering human disease genes, cloning human disease genes</li> <li>• Provide an overview of various techniques like PCR, Protein blotting techniques, reverse line blotting, hybridization probs, DNA finger printing etc.,</li> <li>• Provide knowledge on molecular cytogenetics, molecular diagnosis of genetic diseases, concept and perspectives of molecular medicine.</li> </ul>
Course Code: PG71P401 – CP4.4 Practical-I	<ul style="list-style-type: none"> <li>• To learn hands on about how to search literature, nucleic acid and protein sequences using various databases.</li> <li>• To learn hands on about retrieval, alignment, comparison, structure prediction and phylogenetic analysis of nucleic analysis and proteins.</li> <li>• To learn molecular docking techniques.</li> </ul>
Course Code: PG71P402 – CP4.5 Practical-II	<ul style="list-style-type: none"> <li>• To learn techniques used in immunology viz. antibody purification, detection, antigen-antibody interaction and immunodiagnostic techniques.</li> </ul>
Course Code: PG71P403 – CP4.6 Practical-III	<ul style="list-style-type: none"> <li>• To learn hands on about molecular diagnosis of infectious diseases, hemoglobinopathies and human DNA fingerprinting.</li> </ul>
Course code: PG71P404B- CPJ 4.7 Project work/	<ul style="list-style-type: none"> <li>• Project is designed to train students to identify research problems and knowledge gaps in genetics of human, plants, animals and microbes.</li> <li>• To understand the basics of research methodology, experimental design, execution and trouble shooting.</li> </ul>

Dissertation	<ul style="list-style-type: none"> <li>• To develop communication skills required in the discipline including oral presentations of research data, published research articles, grant proposals, and poster presentations at conferences.</li> <li>• To inculcate the culture of teamwork and leadership skills including group analysis of data, working together in the research laboratory, joint compositions of written reports, substantive participation in research group meetings, etc.</li> <li>• Students are made aware of the economic impact and are supported in creating significant workforce opportunities in Genetics and associated disciplines as entrepreneurs or as employees.</li> </ul>
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### Ph.D. Applied Genetics

Course Code: PH7101 – Research methodology	<ul style="list-style-type: none"> <li>• To understand the research methodology</li> <li>• To study the classification, characteristics and significance of microscopes</li> <li>• To understand the importance of biostatistics</li> </ul>
Course Code: PH7102 – Applied Genetics	<ul style="list-style-type: none"> <li>• To understand the principles of inheritance as formulated by Mendel and its extensions.</li> <li>• To understand the analysis of genetic data using statistical procedures.</li> <li>• To understand structure and composition of animal and plant cells, nuclear content and the concept of cell cycle.</li> <li>• To understand the concept chromosome number, structure, and behavior in human, animal and plant cells.</li> <li>• To understand the application of genetic and cytogenetic techniques in human health and plant/animal breeding.</li> </ul>
Course Code: PH7103  Specialization: Biology and Genetics of Animals	<ul style="list-style-type: none"> <li>• This course covers historical development of human genetics and its relationship with other biological science and medicine</li> <li>• To understand the pattern of polygenic and multi factorial diseases.</li> <li>• To understand the biochemical and molecular basis of human diseases like inborn errors of metabolism disorders, hemoglobin disorders and lysosomal storage disorders.</li> </ul>
Course Code: PH7104  Genetics and molecular biology of plants	<ul style="list-style-type: none"> <li>• The course gives an in-depth insight into the molecular aspects of life - the central dogma spanning from DNA Replication till Protein Synthesis and Reverse transcription.</li> <li>• It explains molecular aspects of genes and its regulation- genome- gene expressions heredity- recombination- protein synthesis- molecular basis of diseases- mutations genetic analysis etc.</li> </ul>

Course Code: PH7105 Microbial Genetics	<ul style="list-style-type: none"> <li>To understand metabolic regulation of various biochemical and physiological pathways in microbes and its application in metabolic engineering.</li> <li>To understand biology and genetics of phages and its application.</li> <li>To understand techniques involved strain improvement by mutagenesis, recombination and genetic engineering.</li> <li>To understand fermentation technology and its application in industrial production..</li> </ul>
Course Code: PH7106 Molecular Medicine	<ul style="list-style-type: none"> <li>To provide overview of immune system, antigen, antibody structure and interactions.</li> <li>Understanding of innate and adaptive immunity along with major cells and molecules involved.</li> <li>To integrate immunology with health and enrich the knowledge for autoimmune disorders,</li> <li>To study hypersensitivity reaction, MHC and serological reactions</li> <li>Develop understanding about immune system, antigen antibody interactions. structural variations in chromosomes hands on.</li> </ul>
Course Code: PH7107 Developmental and molecular Genetics	<ul style="list-style-type: none"> <li>The course gives an in-depth insight into the development of animals, amphibian, insects, chick and birds. Molecular aspects of life - the central dogma.</li> <li>To understand basic genetic principles, both at the individual and population level, and appreciate the concept of natural selection as the driving force of evolution.</li> <li>To appreciate how interactions between organisms and the environment, between individuals within a species, and between individuals of different species can shape selective forces and evolutionary outcomes.</li> </ul>

#### 4. Detailed curriculum – module-wise or unit-wise – indicating the number of teaching hours

Paper Code	Title of the paper	Max. Marks	Internal Assessment	Total Marks	Credits	Teaching hrs
CT 1.1	Biological Chemistry	75	25	100	04	50 hrs
CT 1.2	Genetics & Cytogenetics	75	25	100	04	50 hrs
CT 1.3	General Microbiology	75	25	100	04	50 hrs
CT 1.7	Biophysical &	75	25	100	04	50 hrs
CP 1.4	Biochemical Techniques	40	10	50	02	48 hrs
CP 1.5	Biological Chemistry	40	10	50	02	48 hrs
CP 1.6	Practicals	40	10	50	02	48 hrs
CP 1.8	Genetics & Cytogenetics Practicals General Microbiology	40	10	50	02	48 hrs

	Practicals Biophysical & Biochemical Techniques Practicals					
CT 2.1	Developmental &	75	25	100	04	50 hrs
CT 2.2	Evolutionary Genetics	75	25	100	04	50 hrs
CT 2.3	Molecular Biology	75	25	100	04	50 hrs
ET 2.7	Intermediary Metabolism	75	25	100	04	50 hrs
CP 2.5	Molecular Biology Techniques (Elective)	40	10	50	02	48 hrs
CP 2.6	Developmental &	40	10	50	02	48 hrs
CP 2.7	Evolutionary Genetics Practicals Molecular Biology Practicals Intermediary Metabolism Practicals	40	10	50	02	48 hrs
CT 3.1	Genetic Engineering	75	25	100	04	50 hrs
CT 3.2	Microbial Genetics &	75	25	100	04	50 hrs
CT 3.3	Technology	75	25	100	04	50 hrs
ET 3.7	Human Genetics &	75	25	100	04	50 hrs
CP 3.4	Genetic Counselling	40	10	50	02	48 hrs
CP 3.5	Genetic Disorders &	40	10	50	02	48 hrs
CP 3.6	Counselling Genetic Engineering Practicals Microbial Genetics & Technology Practical Human Genetics & Genetic Counselling Practicals	40	10	50	02	48 hrs
CT 4.1	Bioinformatics	75	25	100	04	50 hrs
CT 4.2	Immunogenetics &	75	25	100	04	50 hrs
CT 4.3	Immunotechnology	75	25	100	04	50 hrs
CPJ 4.7	Molecular Diagnosis &	125	25	150	06	Week
CP 4.4	Molecular Medicine	40	10	50	02	ends
CP 4.5	Project work	40	10	50	02	48 hrs
	Bioinformatics Practical					48 hrs
CP 4.6	Immunogenetics & Immunotechnology Practicals Molecular Diagnosis & Molecular Medicine Practicals	40	10	50	02	48 hrs



<b>Ph.D. Course work</b>						
<b>Paper Code</b>	<b>Title of the paper</b>	<b>Max. Marks</b>	<b>Internal Assessment</b>	<b>Total Marks</b>	<b>Credits</b>	<b>Teaching hrs</b>
PH7101	Research methodology	50	50	100	04	48hrs
PH7102	Applied Genetics	50	50	100	04	48 hrs
PH7103	Biology and Genetics	50	50	100	04	48 hrs
PH7104	of Animals					
PH7105	Genetics and molecular	50	50	100	04	48 hrs
PH7106	biology of plants					
PH7107	Microbial Genetics	50	50	100	04	48 hrs
	Molecular Medicine	50	50	100	04	48 hrs
	Developmental and molecular Genetics	50	50	100	04	48 hrs