



SWAMI VIVEKANAND
SUBHARTI
UNIVERSITY
Meerut
UGC Approved



AN ISO 21001: 2018 ORGANIZATION

OFFICE OF THE REGISTRAR
Gp Capt M Yakoob
M-in-D (Retd.), M.Tech.
REGISTRAR
registrar@subharti.org

Ref.No.U-508(i)/SVSU/2025/ 1825

Date:27.01.2025

NOTIFICATION

It is hereby notified for information of all the concerned that the Academic Council in its 34th meeting held on 25-07-2024 vide resolution No.34(9) has approved the revised syllabus (as per NEP-2020) of the following ordinance:

Ordinance No.V-135(B13), relating to B.Sc.-Genetics & Genomics

The copy of above is enclosed and shall be applicable from Academic Session 2022-23 onwards.

This issues with the approval of the Hon'ble Vice Chancellor.

M. Yakoob
27/01/2025
Registrar

Ref.No.U-508(i)/SVSU/2025/ 1625

Date: 27.01.2025

Copy forwarded to information of:

1. Hon'ble Vice-Chancellor
2. Controller of Examination
3. Dean-Academics
4. Director-IQAC
5. Dean-Faculty of Science (for compliance please)
6. CTO (with a request to upload the ordinance on University website)
7. Additional Registrar-Academics
8. Guard File

M. Yakoob
27/01/2025
Registrar



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Subhartipuram, NH-58, Delhi-Haridwar Bypass Road, Meerut-250005 (U.P.) INDIA

SWAMI VIVEKANAND SUBHARTI UNIVERSITY

MEERUT



Syllabus

For

B.Sc. Genetics & Genomics

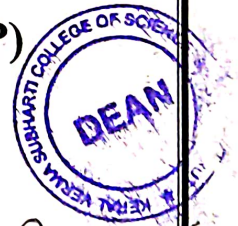
Under

National Education Policy-2020

Four Year Undergraduate Program (FYUP)

Effective From

2024-25



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DEPARTMENT OF ZOOLOGY
KERAL VERMA SUBHARTI COLLEGE OF SCIENCE

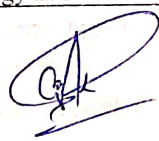
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for Head
Deptt. of Zoology
Faculty of Science
S.V.S.U., MEERUT

Semester-wise Titles of the Papers in B.Sc. (Genetic and Genomics)

Year	Sem.	Course Code	Paper Title	Theory/Practical	Credits
1	I	B130101T	Cell Biology, Bioinstrumentation and Biotechniques	Theory	04
		B130102P	Cytology and Biotechnical Lab	Practical	02
	II	B130201T	Biochemistry and Physiology	Theory	04
		B130202P	Biochemistry, Hematology and Physiology Lab	Practical	02
2	III	B130301T	Genetics and Molecular Biology	Theory	04
		B130302P	Genetics & Molecular Biology Lab	Practical	02
	IV	B130401T	Applied, Cancer and Clinical Genetics	Theory	04
		B130402P	Advanced Genetics and Genetic Counseling Lab	Practical	02
3	V	B130501T	Developmental, Population & Behavioural Genetics	Theory	04
		B130502T	Biostatistics and Bioinformatics	Theory	04
		B130503P	Developmental and Computational Biology lab	Practical	02
	VI	B130601T	Immunogenetics & Microbial Genetics	Theory	04
		B130602T	Genomics	Theory	04
		B130603P	Microbiology, Immunology and Genomics Lab	Practical	02
4	VI	B130701T	Biomolecules	Theory	04
		B130702T	Cell biology and Immunology	Theory	04
		B130703T	Genetics & Molecular Biology	Theory	04
		B130704T	Biostatistics & Bioinformatics	Theory	04
		B130705P	Biochemistry, Molecular Biology, Biostatistics & Bioinformatics Lab	Practical	04
	VI	B130801T	Fundamentals of Genome Science	Theory	04
		B130802T	Genetic Engineering	Theory	04
		B130803T	Omics	Theory	04
		B130804T	Computational Biology	Theory	04
		B130805P	Advanced Molecular Biology, Instrumentation, Computational Biology Lab	Practical	04



 Please find it's

Subject prerequisite

To study Genetics in undergraduate, a student must have studied Biology, Biotechnology or Life Science in Class 12.

Programme Objectives (POs)

1. The programme has been designed in such a way so that the students get the flavour of modern biology. It aims to enable the students to study basic genetics, advanced molecular genetics, human diseases and genomics.
2. The modern areas including cell biology and genetics, molecular biology, biochemistry, physiology followed by biostatistics, bioinformatics and genetic engineering have been included to make the study interesting and relevant to human studies which is the requirement in recent times.
3. The lab courses have been designed in such a way that students will be trained to join public or private labs and also go for higher studies.

Certificate Course in Medical Laboratory Technology

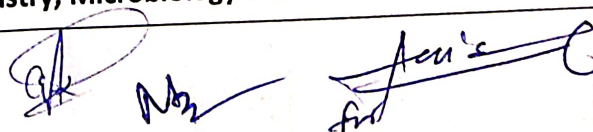
B.Sc I Programme Specific Outcomes (PSOs)

PSO1	Emphasis will be on physiological understanding abnormalities and anomalies associated with white blood cells and red blood cells. The course emphasizes cell identification, cell differentiation and cell morphology evaluation procedures. This will enhance hematology analytical skills along with skill of using many instruments.
PSO2	The students will have hands-on training in the techniques like microscopy, centrifugation and chromatography, and various biochemical techniques, preparation of slides which will help them in getting employment in pathology labs and contribute to healthcare system.
PSO3	The Certificate courses will enable students to apply for technical positions in government and private labs/institutes.

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A/S
Needs for

Diploma in Advanced Molecular Diagnostics	
B.Sc II Programme Specific Outcomes (PSOs)	
PSO1	The student at the completion of the course will be able to have a detailed and conceptual understanding of molecular processes viz. DNA to trait. The differential regulation of genes in prokaryotes and eukaryotes leads to the development of an organism from an embryo.
PSO2	The students will be able to understand and apply the principles and techniques of molecular biology which prepares students for further career in molecular biology. Independently execute a laboratory experiment using the standard methods and techniques.
PSO3	The Diploma courses will ensure employability in Hospitals/Diagnostics and Pathology labs with good hands-on training. It will also enable students to take up higher studies and Research as their career and work in renowned labs in the country and abroad.

Degree in Bachelor of Science	
B.Sc III Programme Specific Outcomes (PSOs)	
PSO1	<ul style="list-style-type: none"> The students will learn the principles of population, behavioral, microbial and immunogenetics.
PSO2	<ul style="list-style-type: none"> The principles of genetic engineering, gene cloning, and related technologies will enable students to play an important role in applications of biotechnology in various fields like agriculture, forensic sciences, industry and human health and make a career out of it. Students can have their own start-ups as well.
PSO3	<ul style="list-style-type: none"> Students will also come to know about the basic principle of life, how a cell divides leading to the growth of an organism and also reproduce to form new organisms.
PSO4	<ul style="list-style-type: none"> The basic tools of bioinformatics will enable students to analyze a large amount of genomic data and its application to evolutionary biology. Apply knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics existing software effectively to extract information from large databases and to use this information in computer modeling.
PSO5	<ul style="list-style-type: none"> The Degree courses will enable students to go for higher studies like Masters and Ph.D in Biotechnology, Genetics, Biochemistry, Microbiology and related fields.



V	Cell Signalling <ul style="list-style-type: none"> • Signal transduction • Intracellular signaling • Cell surface receptors, via G-protein linked receptors • JAK-STAT pathway 	8
VI	<ul style="list-style-type: none"> • Principle of Microscopy and Applications • Types of Microscopes: light microscopy, dark field microscopy, phase-contrast microscopy, • Fluorescence microscopy, confocal microscopy, electron microscopy 	8
VII	<ul style="list-style-type: none"> • Principle of Centrifugation • Types of Centrifuges: high speed and ultracentrifuge • Types of rotors: Vertical, Swing-out, Fixed-angle etc. • Principle and Types of Chromatography: paper, ion-exchange, gel filtration, HPLC, affinity 	8
VIII	<ul style="list-style-type: none"> • Biochemical techniques: Preparation of buffers and solutions • Measurement of pH • Principle of Colorimetry/Spectrophotometry: Beer-Lambert law • Measurement, applications and safety measures of radio-tracer techniques 	8

Suggested Readings:

1. Lodish et al: Molecular Cell Biology: Freeman & Co, USA (2004).
2. Alberts et al: Molecular Biology of the Cell: Garland (2002).
3. Cooper: Cell: A Molecular Approach: ASM Press (2000).
4. Karp: Cell and Molecular Biology: Wiley (2002). Pierce B. Genetics. Freeman (2004).

Course Books published in Hindi may be prescribed by the Universities and Colleges

Course prerequisites: To study this course, a student must have had the subject biology in class/12th

Suggested Continuous Evaluation Methods:

Total Marks: 25

House Examination/Test: 10 Marks

Written Assignment/Presentation/Project/Term Papers/Seminar: 10 Marks

Class performance/Participation: 5 Marks

Further Suggestions: None

At the End of the whole syllabus any remarks/suggestions: None

AK Nair *Harish C*

Programme/Class: Certificate		Year: First	Semester: First
Subject: GENETICS AND GENOMICS			
Course Code: B130102P		Course Title: Cytology and Biotechnical Lab	
Course outcomes: At the completion of the course students will learn Hands-on: <ol style="list-style-type: none"> 1. To use simple and compound microscopes. 2. To prepare slides and stain them to see the cell organelles. 3. To be familiar with the basic principle of life, how a cell divides leading to the growth of an organism and also reproduce to form new organisms. 4. To learn the principle and operation of basic bioinstruments. 5. To learn certain basic biotechniques in a laboratory setup. 			
Credits: 2		Core: Compulsory	
Max. Marks: 25+75		Min. Passing Marks: 40	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4			
Unit	Topics		Total No. of Lectures (60)
I	<ol style="list-style-type: none"> 1. To study the working principle and Simple, Compound and Binocular microscopes. 2. To study the working principle of various lab equipments such as pH Meter, Electronic balance, use of glass and micropipettes, Laminar flow, Incubator, Water bath, Centrifuge, Chromatography apparatus, etc. 		15
II	<ol style="list-style-type: none"> 1. To study different cell types such as buccal epithelial cells, neurons, striated muscle cells using Methylene blue. 2. To study the different stages of Mitosis in root tip of onion. 3. To study the different stages of Meiosis in grasshopper testis. 4. To prepare molecular models of nucleotides, amino acids, dipeptides using bead and stick method. 5. To check the permeability of cells using salt solution of different concentrations. 		15
III	<ol style="list-style-type: none"> 1. To prepare solutions and buffers. 2. Demonstration of differential centrifugation to fractionate different components in a mixture. 3. To identify different amino acids in a mixture using paper chromatography. 		15
V	Virtual Labs (Suggestive sites) https://www.vlab.co.in https://zoologysan.blogspot.com www.vlab.iitb.ac.in/vlab www.onlinelabs.in www.powershow.com https://vlab.amrita.edu https://sites.dartmouth.edu		15

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Suggested Readings:

1. Lodish et al: Molecular Cell Biology: Freeman & Co, USA (2004).
2. Alberts et al: Molecular Biology of the Cell: Garland (2002).

Course Books published in Hindi may be prescribed by the Universities and Colleges

Course prerequisites: To study this course, a student must have had the subject biology in class/12th.
The eligibility for this paper is 10+2 from Arts/Commerce/Science

Suggested Continuous Evaluation Methods:

Total Marks: 25

House Examination/Test: 10 Marks

Written Assignment/Presentation/Project/Term Papers/Seminar: 10 Marks


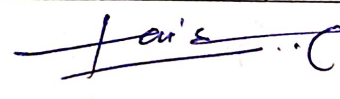
Class performance/Participation: 5 Marks

Further Suggestions: None

At the end of the whole syllabus any remarks/suggestions: University must ensure incorporation of all 04 units including virtual lab/practical evaluation.

S.K. Neeraj *fa's .C*

Programme/Class: Certificate	Year: First	Semester: First
Co-Curricular Course		
Course Code: Z010101	Course Title: First Aid and Basic Health	
Course outcomes:		
<ul style="list-style-type: none"> • Learn the skill needed to assess the ill or injured person. • Learn the skill to provide CPR to infants, children and adults. • Learn the skill to handle emergency childbirth • Learn the Basic sex education help young people navigate thorny questions responsibly and with confidence. • Learn the Basic sex education help youth to understand Sex is normal. It's a deep, powerful instinct at the core of our survival as a species. Sexual desire is a healthy drive. • Help to understand natural changes of adolescence • Learn the skill to identify Mental Health status and Psychological First Aid 		
Credits: 2 (1 Theory + 1 Practical)		
Max. Marks: 25 + 75	Compulsory	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 2-0-0		
Unit	Topics	No. of Lectures Total = 15 Theory + 30 Practical
I	<p>A. Basic First Aid</p> <ul style="list-style-type: none"> • Aims of first aid & First aid and the law. • Dealing with an emergency, Resuscitation (basic CPR). • Recovery position, Initial top to toe assessment. • Hand washing and Hygiene • Types and Content of a First Aid Kit <p>B. First Aid Technique</p> <ul style="list-style-type: none"> • Dressings and Bandages. • Fast evacuation techniques (single rescuer). • Transport techniques. <p>C. First aid related with respiratory system</p> <ul style="list-style-type: none"> • Basics of Respiration. 	2 (Theory) 10 (Practical)
	<ul style="list-style-type: none"> • No breathing or difficult breathing, Drowning, Choking, Strangulation and hanging, • Swelling within the throat, Suffocation by smoke or gases and Asthma. <p>D. First aid related with Heart, Blood and Circulation</p> <ul style="list-style-type: none"> • Basics of The heart and the blood circulation. • Chest discomfort, bleeding. <p>D. First aid related with Wounds and Injuries</p> <ul style="list-style-type: none"> • Type of wounds, Small cuts and abrasions • Head, Chest, Abdominal injuries • Amputation, Crush injuries, Shock <p>E. First aid related with Bones, Joints Muscles related injuries</p> <ul style="list-style-type: none"> • Basics of The skeleton, Joints and Muscles. • Fractures (injuries to bones). 	

II	<p>F. First aid related with Nervous system and Unconsciousness</p> <ul style="list-style-type: none"> • Basics of the nervous system. • Unconsciousness, Stroke, Fits – convulsions – seizures, Epilepsy. <p>G. First aid related with Gastrointestinal Tract</p> <ul style="list-style-type: none"> • Basics of The gastrointestinal system. • Diarrhea, Food poisoning. <p>H. First aid related with Skin, Burns</p> <ul style="list-style-type: none"> • Basics of The skin. • Burn wounds, Dry burns and scalds (burns from fire, heat and steam). • Electrical and Chemical burns, Sun burns, heat exhaustion and heatstroke. • Frost bites (cold burns), Prevention of burns, Fever and Hypothermia. <p>I. First aid related with Poisoning</p> <ul style="list-style-type: none"> • Poisoning by swallowing, Gases, Injection, Skin <p>J. First aid related with Bites and Stings</p> <ul style="list-style-type: none"> • Animal bites, Snake bites, Insect stings and bites <p>K. First aid related with Sense organs</p> <ul style="list-style-type: none"> • Basic of Sense organ. • Foreign objects in the eye, ear, nose or skin. • Swallowed foreign objects. <p>L. Specific emergency situation and disaster management</p> <ul style="list-style-type: none"> • Emergencies at educational institutes and work • Road and traffic accidents. • Emergencies in rural areas. • Disasters and multiple casualty accidents. • Triage. <p>M. Emergency Childbirth</p>	2 (Theory) 10 (Practical)
III	<p>Basic Sex Education</p> <ul style="list-style-type: none"> • Overview, ground rules, and a pre-test • Basics of Urinary system and Reproductive system. • Male puberty — physical and emotional changes • Female puberty — physical and emotional changes • Male-female similarities and differences • Sexual intercourse, pregnancy, and childbirth • Facts, attitudes, and myths about LGBTQ+ issues and identities • Birth control and abortion • Sex without love — harassment, sexual abuse, and rape • Prevention of sexually transmitted diseases. 	9 (Theory)
IV	<p>Mental Health and Psychological First Aid</p> <ul style="list-style-type: none"> • What is Mental Health First Aid? • Mental Health Problems in the India • The Mental Health First Aid Action Plan • Understanding Depression and Anxiety Disorders • Crisis First Aid for Suicidal Behavior & Depressive symptoms • What is Non-Suicidal Self-Injury? • Non-crisis First Aid for Depression and Anxiety • Crisis First Aid for Panic Attacks, Traumatic events • Understanding Disorders in Which Psychosis may Occur • Crisis First Aid for Acute Psychosis • Understanding Substance Use Disorder • Crisis First Aid for Overdose, Withdrawal • Using Mental Health First Aid 	2 (Theory) 10 (Practical)

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Suggested Readings:

- IndianFirstAidManual-<https://www.Indianredcross.org/publicatons/FA-manual.pdf>
- RedCrossFirstAid/CPR/AEDInstructorManual
<https://mhfa.com.au/courses/public/types/youthedition4>
- Finkelhor,D.(2009).Thepreventionofchildhoodsexualabuse.Durham,NH:CrimesAgainstChildrenResearchCenter.www.unh.edu/ccrc/pdf/CV192.pdf
- KantorL.&LevitzN.(2017).Parents'viewsonsexeducation inschools:HowmuchdoDemocratsandRepublicansagree?PLOS ONE, 12(7):e0180250.
- Orenstein,P.(2016).Girlsand sex:Navigatingthecomplex newlandscape.NewYork,NY:Harper.
- Schwiengershausen,E.(2015,May28).TheCut.www.thecut.com/2015/05/most-women-are-catcalled-before-they-turn-17.html
- Wiggins,G.&McTighe,J.(2008).Understandingbydesign.Alexandra,VA:ASCD.
- <https://marshallmemo.com/marshall-publications.php#8>

Suggested Continuous Evaluation Methods:

Assignments, Presentation, Group Discussion, and MCQ

Suggested equivalent online courses:

- <https://www.redcross.org/take-a-class/first-aid/first-aid-training/first-aid-online>
- <https://www.firstaidforfree.com/>
- <https://www.coursera.org/learn/psychological-first-aid>
- <https://www.coursera.org/learn/mental-health>

Further Suggestions:.....

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Programme/Class: Certificate		Year: First	Semester: Second
Subject: Genetics and Genomics			
Course Code: B130201T		Course Title: BiochemistryandPhysiology	
Course outcomes: The student at the completion of the course will learn:			
<ul style="list-style-type: none"> To develop a deep understanding of structure of biomolecules like proteins, lipids and carbohydrates How simple molecules together form complex macromolecules. To understand the thermodynamics of enzyme catalyzed reactions. Mechanisms of energy production at cellular and molecular levels. To understand systems biology and various functional components of an organism. To explore the complex network of these functional components. To comprehend the regulatory mechanisms for maintenance of function in the body. 			
Credits: 4		Core: Compulsory	
Max. Marks: 25+75= 100		Min. Passing Marks: 40	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:4-0-0			
Unit	Topics	Total No. of Lectures (60)	
I	Structure and Function of Biomolecules <ul style="list-style-type: none"> Structure and Biological importance of carbohydrates (Monosaccharides, Disaccharides, Polysaccharides and Glycoconjugates) Lipids (saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Glycolipids, Steroids) Structure, Classification and General properties of α-amino acids; Essential and non-essential α-amino acids, Levels of organization in proteins; Simple and conjugate proteins. 	8	
II	Enzyme Action and Regulation <ul style="list-style-type: none"> Nomenclature and classification of enzymes; Cofactors; Specificity of enzyme action Isozymes; Mechanism of enzyme action Enzyme kinetics; Factors affecting rate of enzyme-catalyzed reactions; Derivation of Michaelis-Menten equation, Concept of K_m and V_{max}, Lineweaver-Burk plot; Enzyme inhibition; Allosteric enzymes and their kinetics; Regulation of enzyme action 	8	
III	Metabolism of Carbohydrates and Lipids <ul style="list-style-type: none"> Metabolism of Carbohydrates: glycolysis, citric acid cycle, gluconeogenesis, phosphate pentose pathway Glycogenolysis and Glycogenesis Lipids---Biosynthesis of palmitic acid; Ketogenesis, β-oxidation and omega -oxidation of saturated fatty acids with even and odd number of carbon atoms 	8	
IV	Metabolism of Proteins and Nucleotides <ul style="list-style-type: none"> Catabolism of amino acids: Transamination, Deamination, Urea cycle Nucleotides and vitamins Review of mitochondrial respiratory chain, Oxidative phosphorylation, and its regulation 	6	

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V	Digestion and Respiration <ul style="list-style-type: none"> Structural organization and functions of gastrointestinal tract and associated glands Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins; Histology of trachea and lung Mechanism of respiration, Pulmonary ventilation; Respiratory volumes and capacities; Transport of oxygen and carbon dioxide in blood Respiratory pigments, Dissociation curves and the factors influencing it; Control of respiration 	7
VI	Circulation and Excretion <ul style="list-style-type: none"> Components of blood and their functions Haemostasis: Blood clotting system, Blood groups: Rh factor, ABO and MN Structure of mammalian heart Cardiac cycle; Cardiac output and its regulation, Electrocardiogram, Blood pressure and its regulation Structure of kidney and its functional unit; Mechanism of urine formation 	8
VII	Nervous System and Endocrinology <ul style="list-style-type: none"> Structure of neuron, resting membrane potential Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers Types of synapse Endocrine glands - pineal, pituitary, thyroid, parathyroid, pancreas, adrenal; hormones secreted by them Classification of hormones; Mechanism of Hormone action 	8
VIII	Muscular System Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle twitch; Motor unit, summation and tetanus	7

Suggested Readings:

- Nelson & Cox: Lehninger's Principles of Biochemistry: McMillan (2000)
- Zubay *et al.*: Principles of Biochemistry: WCB (1995)
- Voet & Voet: Biochemistry Vols 1 & 2: Wiley (2004)
- Murray *et al.*: Harper's Illustrated Biochemistry: McGraw Hill (2003) Elliott and Elliott:
- Biochemistry and Molecular Biology: Oxford University Press
- Guyton, A.C. & Hall, J.E. Textbook of Medical Physiology. XI Edition. Harcourt Asia PTE Ltd. /W.B. Saunders Company. (2006).
- Tortora, G.J. & Grabowski, S. Principles of Anatomy & Physiology. XI Edition John Wiley & sons (2006).
- Christopher D. Moyes, Patricia M. Schulte. Principles of Animal Physiology. 3rd Edition, Pearson Education (2016).
- Hill, Richard W., et al. Animal physiology. Vol. 2. Sunderland, MA: Sinauer Associates, (2004).
- Chatterjee C C Human Physiology Volume 1 & 2. 11th edition. CBS Publishers (2016).

Course Book published in Hindi may be prescribed by the Universities and Colleges

Course prerequisites: To study this course, a student must have had the subject biology in class/12th

Suggested Continuous Evaluation Methods:

Total Marks: 25

House Examination/Test: 10 Marks

Written Assignment/Presentation/Project/Term Papers/Seminar: 10 Marks

Class performance/Participation: 5 Marks

Further Suggestions: None

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Programme/Class: Certificate		Year: First	Semester: Second
Subject: Genetics and Genomics			
Course Code: B130202P/R		Course Title: Biochemistry, Hematology and Physiology Lab	
Course outcomes: The student at the completion of the course will be able to: <ul style="list-style-type: none"> • Understand the structure of biomolecules like proteins, lipids and carbohydrates • Perform basic hematological laboratory testing, • Distinguish normal and abnormal hematological laboratory findings to predict the diagnosis of hematological disorders and diseases. 			
Credits: 2		Core: Compulsory	
Max. Marks: 25+75= 100		Min. Passing Marks: 40	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-4			
Unit	Topics	Total No. of Lectures(60)	
I	<ol style="list-style-type: none"> 1. Ninhydrin test for α-amino acids. 2. Benedict's test for reducing sugar and iodine test for starch. 3. Test for sugar and acetone in urine. 4. Qualitative tests of functional groups in carbohydrates, proteins and lipids. 5. Action of salivary amylase under optimum conditions. 	20	
II	<ol style="list-style-type: none"> 1. Estimation of haemoglobin using Sahli's haemoglobinometer 2. Preparation of haemin and haemochromogen crystals 3. Counting of RBCs and WBCs using Haemocytometer 4. To study different mammalian blood cell types using Leishman stain. 5. Recording of blood pressure using a sphygmomanometer 6. Recording of blood glucose level by using glucometer 	15	
III	<ol style="list-style-type: none"> 1. Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid 2. Recording of simple muscle twitch with electrical stimulation (or Virtual) 3. Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex) 	10	
IV	Virtual Labs (Suggestive sites) <ol style="list-style-type: none"> 1. https://www.vlab.co.in 2. https://zoologysan.blogspot.com 3. www.vlab.iitb.ac.in/vlab 4. www.onlinelabs.in 5. www.powershow.com 6. https://vlab.amrita.edu 7. https://sites.dartmouth.edu 	15	

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Suggested Readings:

1. Clark & Switzer. Experimental Biochemistry. Freeman (2000)
2. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). Biochemistry, VI Edition, W.H. Freeman and Co., New York.
3. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons
4. Victor P. Eroschenko. (2008). di Fiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. & Wilkins.
5. Arey, L.B. (1974). Human Histology. IV Edition. W.B. Saunders.
6. Kesar, Saroj and Vashishta N. (2007). Experimental Physiology: Comprehensive Manual. Heritage Publishers, New Delhi

Course Books published in Hindi may be prescribed by the Universities and Colleges

Course prerequisites: To study this course, a student must have had the subject biology in class/12th
The eligibility for this paper is 10+2 from Arts/Commerce/Science

Suggested Continuous Evaluation Methods:

Total Marks: 25

House Examination/Test: 10 Marks

Written Assignment/Presentation/Project/Term Papers/Seminar: 10 Marks

Class performance/Participation: 5 Marks

Further Suggestions: None

At the End of the whole syllabus any remarks/suggestions: University must ensure incorporation of all 04 units including virtual labs in practical evaluation.

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Programme/Class: Certificate	Year:First	Semester:Second
CourseCode:Z020201	Co-CurricularCourse	
CourseTitle: Human Values and Environment studies		
<p>Courseoutcomes:</p> <p>The mission of the course on Human Values and Environmental Studies is to create morally articulatesolutions to be truthful and just and to become responsible towards humanity. The course seeks to establishacontinuousinterestinthelearnerstoimprovetheirthoughtprocesswithintenttodevelopanewgeneration of responsible citizens capable of addressing complex challenges faced by the society due todisruptionsin human interactions effectinghumanvalues.This course works towards</p> <ul style="list-style-type: none"> • Buildingfundamental knowledgeoftheinterplayof markets,ethics,and law, • Lookatvarious challengesfaced byindividual tocounther unethicalissues • Lookatcoreconceptsforbusiness ethics • Lookatcoreconceptsof anti-corruption • Lookatcoreconcepts for amorallyarticulatesolutionevolvertomanagement issuesingeneral, • Issuesof sustainable developmentforabetter environment. • Toknowhowenvironmentaldegradationhas taken place. • Beawareofnegotiationsandinternationaleffortstosaveenvironment. • Howtodevelopsustainably? • Effortstaken up byUNin Sustainable Development. • EffortstakenbyIndia inSustainableDevelopment. <p>• The course intends to create a sense of how to be more responsible towards the environment. Upon finishing of the course students will be able to come up with using ethical reasoning for decision making and frame ethical issues as well as operationalise ethical choices. The course integrates various facets of human values and environment.</p>		

Credits:2	Min.PassingMarks:40
Max.Marks: 100	
TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):L-T-P:2-0-0	
AsthecourserequirestwoareasofHumanValuesandEnvironmentStudiesinstitutionscanevenoptfora paralleldelivery	

Unit	Topic s	No. ofLecture s Total=30
I	HumanValues-Introduction-Values,Characteristics,Types,DevelopingValue systeminIndianOrganisation,ValuesinBusinessManagement,valuebased Organisation,Trans-culturalHumanvaluesinManagement.SwamiVivekananda's philosophyofCharacterBuilding,Gandhi'sconceptofSevenSins,APJAbdulKalam viewonrole ofparents andTeachers.	02
	HumanValuesandPresentPractices-Issues:CorruptionandBribe,Privacy PolicyinWebandSocialMedia,Cyberthreats,OnlineShoppingetc.RemediesUK	02
	BriberyAct,IntroductiontosustainablepoliciesandpracticesinIndian	03

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	<p>Economy. Principles of Ethics Secular and Spiritual Values in Management-Introduction-Secular and Spiritual values, features, Level of value implementation. Features of spiritual Values, Corporate Social Responsibility-Nature, Levels, Phases and Model of CSR, Corporate Governance. CSR and Modern Business Tycoons Ratan Tata, Azim Premji and Bill Gates.</p>	
II	<p>Holistic Approach in Decision making-Decision making, the decision making process, The Bhagavad Gita: Techniques in Management, Dharma and Holistic Management. Discussion through Dilemmas – Dilemmas in Marketing and Pharma Organisations, moving from Public to Private – monopoly context, Dilemma of privatisation, Dilemma on liberalization, Dilemma on social media and cyber security, Dilemma on Organic food, Dilemma on standardization, Dilemma on Quality standards. Case Studies</p>	03 03 02
III	<p>Ecosystem: Concept, structure & functions of ecosystem: producer, consumer, decomposer, food web, food chain, energy flow, Ecological pyramids Conservation of Biodiversity- In-situ & Ex-situ conservation of biodiversity Role of individual in Pollution control Human Population & Environment Sustainable Development India and UN Sustainable Development Goals Concept of circular economy and entrepreneurship</p>	7
IV	<p>Environmental Laws? International Advancements in Environmental Conservation Role of National Green Tribunal Air Quality Index Importance of Indian Traditional knowledge on environment</p>	8
	<p>Bioassessment of Environmental Quality Environmental Management System Environmental Impact Assessment and Environmental Audit</p>	

Suggested Readings:

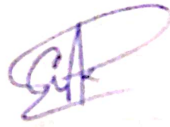
1. A foundation course in Human Values and Professional Ethics by RR. Gaur, R. Sangalet. al
2. JUSTICE: What's the Right Thing to Do? Michael J. Sandel.
3. Human Values by A. N. Tripathi New Age International
4. Environmental Management by N.K. Uberoi
5. <https://www.un.org/sustainabledevelopment/sustainable-development-goals/>
6. <https://www.india.gov.in/my-government/schemes>
7. <https://www.legislation.gov.uk/ukpga/2010/23/contents>
8. Daniel Kahneman, Thinking, Fast and Slow; Allen Lane Nov 2011 ISBN: 9780141918921

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Suggested Continuous Evaluation Methods:

In addition to the theoretical inputs the course will be delivered through case studies and dilemmas. Assignments, Presentation, Group Discussions. This will instill in student a sense of decision making and practical learning. The course participants can be evaluated on the following structure.

- Assignments (10)
- Presentation (10)
- Attendance (5)
- Final exam (75)



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Programme/Class: Diploma		Year: Second	Semester: Third
Subject: Genetics and Genomics			
Course Code: B130301T		Course Title: Genetics and Molecular Biology	
Course outcomes: The student at the completion of the course will be able to have: <ul style="list-style-type: none"> • Understand the basic principles of genetics and how genes (earlier called factors) are inherited from one generation to another. • Understand the Mendel's laws and the deviations from conventional patterns of inheritance. • Comprehend how environment plays an important role by interacting with genetic factors. • A detailed and conceptual understanding of molecular processes viz. DNA to trait. • A clear understanding of the processes of central dogma viz. transcription, translation etc. underlying survival and propagation of life at molecular level. • Understanding of how genes are ultimately expressed as proteins which are responsible for the structure and function of all organisms. • Learn how four sequences (3 letter codons) generate the transcript of life and determine the phenotypes of organisms. • How genes are regulated differently at different time and place in prokaryotes and eukaryotes. 			
Credits: 4		Core: Compulsory	
Max. Marks: 25+75		Min. Passing Marks: 40	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0			
Unit	Topic	Total No. of Lectures (60)	
I	<ul style="list-style-type: none"> • Basic principles of heredity: Mendel's laws, monohybrid and dihybrid crosses • Complete and Incomplete Dominance • Penetrance and expressivity 	7	
II	<ul style="list-style-type: none"> • Genic Sex-Determining Systems, Environmental Sex Determination, Sex Determination in <i>Drosophila</i>, Sex Determination in Humans • Sex-linked characteristics and Dosage compensation 	7	
III	<ul style="list-style-type: none"> • Extensions of Mendelism: Multiple Alleles, Gene Interaction • The Interaction Between Sex and Heredity: Sex-Influenced and Sex-Limited Characteristics • Cytoplasmic Inheritance, Genetic Maternal Effects 	8	
IV	<ul style="list-style-type: none"> • Genomic Imprinting, Anticipation • Interaction Between Genes and Environment: Environmental Effects on Gene Expression, • Inheritance of Continuous Characteristics 	8	
V	<ul style="list-style-type: none"> • Fine structure of gene • RNA polymerases • Transcription factors and machinery • Formation of initiation complex • Initiation, elongation and termination of transcription in prokaryotes and eukaryotes 	6	

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VI	<ul style="list-style-type: none"> • The Genetic code • Ribosome • Factors involved in translation • Aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase • Initiation, elongation and termination of translation in prokaryotes and eukaryotes 	8
VII	<ul style="list-style-type: none"> • Regulation of gene expression in prokaryotes: <i>lac</i> and <i>trp</i> operons in <i>E. coli</i> • Regulation at transcriptional level, Post-transcriptional modifications: Capping, Splicing, Polyadenylation • RNA editing. 	8
VIII	<ul style="list-style-type: none"> • Regulation of gene expression in eukaryotes • Role of chromatin in gene expression • Regulation at translational level, Post-translational modifications: protein folding etc. • Intracellular protein degradation • Gene silencing, RNA interference (RNAi) 	8

Suggested Readings:

1. Cooper: Cell: A Molecular Approach: ASM Press (2000).
2. Karp: Cell and Molecular Biology: Wiley (2002).
3. Watson et al. Molecular Biology of the Gene. Pearson (2004).
4. Lewin. Genes VIII. Pearson (2004).
5. Pierce B. Genetics. Freeman (2004).
6. De Robertis. Cell and Molecular Biology CCH, a Wolters Kluwer Business 8th Edition

Course Books published in Hindi may be prescribed by the Universities and Colleges

This course can be opted as an elective by the students of following subjects:
The eligibility for this paper is 10+2 with Biology as one of the subjects

Suggested Continuous Evaluation Methods:

House Examination/Test: 10 Marks

Written Assignment/Presentation/Project/Term Papers/Seminar: 10 Marks

Class performance/Participation: 5 Marks

Further Suggestions: None

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Programme/Class: Diploma		Year: Second	Semester: Third
Subject: Genetics and Genomics			
CourseCode: B130302P		CourseTitle: Genetics&MolecularBiologyLab	
Courseoutcomes: The student at the completion of the course will be able to <ul style="list-style-type: none"> • Understand the basic principles of genetics and how genes (earlier called factors) are inherited from one generation to another. • Prepare slides to study chromosomes. • Comprehend how environment plays an important role by interacting with genetic factors. 			
Credits: 2		Core: Compulsory	
Max.Marks: 25+75		Min. Passing Marks: 40	
TotalNo.ofLectures-Tutorials-Practical(inhoursperweek): L-T-P:0-0-4			
Unit	Topic	TotalNo.of Lectures(60)	
I	1. Maintenance of Drosophila culture as a genetic model. 2. Study of mutant phenotypes of Drosophila. 3. Preparation of polytene chromosomes. 4. Study of sex chromatin (Barr bodies) in buccal smear and hair bud cells (Human).	15	
II	1. To measure absorbance in Colorimeter or Spectrophotometer. 2. To prepare dilutions of Riboflavin and verify the principle of spectrophotometry.	15	
III	1. Demonstration of DNA extraction from blood or tissue samples. 2. To estimate amount of DNA using spectrophotometer.	15	
IV	VirtualLabs(Suggestivesites) www.labinapp.com www.uwlax.edu www.labster.com www.onlinelabs.in www.powershow.in https://vlab.amrita.edu info@premiereducationaltechnologies.com https://li.wsu.edu	15	

Suggested Readings:

1. Sambrook *et al.* Molecular Cloning Vols I, II, III. CSHL (2001).
2. Primrose. Molecular Biotechnology. Panima (2001).
3. Clark & Switzer. Experimental Biochemistry. Freeman (2000)

Course Books published in Hindi may be prescribed by the Universities and Colleges

This course can be opted as an elective by the students of following subjects:
The eligibility for this paper is 10+2 from Arts/Commerce/Science

Suggested Continuous Evaluation Methods:

House Examination/Test: 10 Marks

Written Assignment/Presentation/Project/ Term Papers/Seminar: 10 Marks

Class performance/Participation: 5 Marks

At the end of the whole syllabus any remarks/suggestions: University must ensure incorporation of all 04 units including virtual labs in practical evaluation.

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Programme: Certificate	Year: Second	Semester: Third
Course Code: Z030301	Co-Curricular Course	
Course outcomes:	Course Title: Physical Education and Yoga	
Students will learn the introduction of Physical Education, Concept of fitness and wellness, Weight management and lifestyle of an individual. The student will also learn about the relation of Yoga with mental health and value Education. In this course student will also learn about the aspects of the Traditional games of India.		
Credits: 2	Compulsory	
Max. Marks: 25+75	Min. Passing Marks:	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 2-0-0		
Unit	Topics	No. of Lectures Total=30
I	Physical Education: <ul style="list-style-type: none"> • Meaning, Definition, Aim and Objective. • Misconception About Physical Education. • Need, Importance and Scope of Physical Education in the Modern Society. • Physical Education Relationship with General Education. • Physical Education in India before Independence. Physical Education in India after Independence. 	6 Theory
II	Concept of Fitness and Wellness: <ul style="list-style-type: none"> • Meaning, Definition and Importance of Fitness and Wellness. • Components of Fitness. • Factor Affecting Fitness and Wellness. Weight Management: <ul style="list-style-type: none"> • Meaning and Definition of Obesity. • Causes of Obesity. • Management of Obesity. • Health problems due to Obesity. Lifestyle: <ul style="list-style-type: none"> • Meaning, Definition, Importance of Lifestyle. • Factor affecting Lifestyle. • Role of Physical activity in the maintains of Healthy Lifestyle. 	5 Theory 3 Practical
III	Yoga and Meditation: <ul style="list-style-type: none"> • Historical aspect of yoga. • Definition, types scopes & importance of yoga. • Yoga relation with mental health and value education. • Yoga relation with Physical Education and sports. • Definition of Asana, differences between asana and physical exercise. • Definition and classification of pranayama. • Difference between pranayama and deep breathing. • Practical: Asana, Suraya-Namaskar, Bhujang Asana, Naukasana, Halasana, Vajrasana, Padmasana, Shavasana, Makrasana, Dhanurasana, 	2 Theory 6 Practical

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	<p>Tad Asana. Pranayam: Anulom, Vilom.</p>	
IV	<p>Traditional Games of India:</p> <ul style="list-style-type: none"> • Meaning. • Types of Traditional Games- <ul style="list-style-type: none"> ✦ Gilli- Danda ✦ Kanche ✦ Stapu ✦ Gutte, etc. • Importance/ Benefits of Traditional Games. • How to Design Traditional Games. <p>Recreation in Physical Education:</p> <ul style="list-style-type: none"> • Meaning, Definition of Recreation. • Scope and Importance of Recreation. • General Principles of Recreation. • Types of Recreational Activities. • Aerobics and Zumba.(Fir India Movement) 	<p>2 Theory 6 Practical</p>

Suggested Readings:

Singh, Ajmer, Physical Education and Olympic Abhiyan, "Kalayani Publishers", New Delhi, Revised Addition, 2006

Patel, Shri Krishna, Physical Education, "Agrawal Publishers", Agra, 2014-15 Panday, Preeti, Sharirik Shiksha Sankalan, "Khel Sanskriti Prakashan, Kanpur

Kamlesh M.L., "Physical Education, Facts and foundations", Faridabad P.B. Publications.

B.K.S. Yengar, "Light and Yog. Yoga Deepika", George Allen and Unwin Ltd., London, 198:

Braj Bilari Nigam, Yoga Power "The Kpath of Personal achievement" Domen and Publist New Delhi, 2001.

Indira Devi, "Yoga for You", Gibbs, Smith Publishers, Salt Lake City, 2002 Domen and Publishers, New Delhi - 2001.

Jack Peter, "Yoga Master the Yogic Powers", Abhishek Publications, Chandigarh, 2004.

Janice Jerusalem, "A Guide To Yoga", Parragon Bath, Baiihe-2004.

नारंग, प्रियंका, परम्परागत भारतीय खेल, "स्पोर्ट्स पब्लिकेशन", नई दिल्ली, 2007

Suggested Continuous Evaluation Methods:

- Assignments (10)
- Presentation (10)
- Attendance (5)
- Final exam (75)

Suggested equivalent online courses:

- IGNOU.
- Rajarshi Tandan Open University.

Further Suggestions:.....

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Programme/Class: Diploma	Year: Second	Semester: Fourth
Subject: Genetics and Genomics		
CourseCode: B130401T	CourseTitle: Applied,CancerandClinicalGenetics	

Courseoutcomes:

The student at the completion of the course will be able to:

- Understand the principles of genetic engineering, and the applications of biotechnology.
- Get introduced to DNA testing and utility of genetic engineering in forensic sciences.
- To have an in-depth conception of Cancer Biology especially cancer pathophysiology.
- To better understand the molecular biology of Cancer i.e. at the gene level & different repair mechanisms that occur at the level of DNA.
- To simplify & clear the reasons for individual to individual variations & to understand the newer & classical modes of cancer therapy
- Study about the various diseases.
- Know the genetic risks & management to help the expecting couples to anticipate genetic disorders in developing foetus.
- Enable students to get employment in pathology/Hospital.

Credits:4

Core:Compulsory

Max. Marks:25+75

Min. Passing Marks: 40

Total No. of Lectures-Tutorials-Practical (in hours per week):L-T-P:4-0-0

Unit	Topic	Total No. of Lectures(60)
I	<ul style="list-style-type: none"> • Recombinant DNA Technology, Molecular cloning, Restriction Enzymes, DNA modifying enzymes, Cloning Vectors, Ligation, genomic libraries • Selection and identification of recombinant cells • Gene transfer techniques, Development of transgenics • Gene therapy, Crop and livestock improvement, • Development of DNA drugs and vaccines 	10
II	<ul style="list-style-type: none"> • Nucleic acid fractionation, detection by electrophoresis, DNA sequencing, polymerase Chain Reaction (PCR), primer designing, DNA fingerprinting, site directed mutagenesis, RFLP • Oligonucleotide synthesis, preparation of probes, hybridization, Southern, Northern and south-western blotting • Detection of proteins, PAGE, ELISA, western blotting, hybridoma technology • DNA diagnostics--genetic analysis of human diseases, detection of and unknown mutations 	8
III	<ul style="list-style-type: none"> • Characteristics of cancer cells, Apoptosis • Histopathology • Types of cancer and their symptoms • Cell transformation and tumorigenesis • Proto-oncogenes, Oncogenes, Tumour suppressor genes DNA repair genes • DNA repair mechanisms 	4
IV	<ul style="list-style-type: none"> • Metastasis • Tumour specific markers, DNA markers • Single Nucleotide Polymorphisms (SNPs) • Cancer therapy & treatment 	10

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V	<ul style="list-style-type: none"> • Epigenetic modifications • Genomic instability • Cancer and environment • Physical, Chemical, Biological carcinogens 	7
VI	<ul style="list-style-type: none"> • Human karyotype • Chromosomal anomalies and diseases • Pedigree analysis • Modes of inheritance, Autosomal dominant, Autosomal recessive, X-linked, Y-linked • Introduction to pathogenic organisms: viruses, bacteria, fungi, protozoa, and worms. • Structure, lifecycle, pathogenicity, including diseases, causes, symptoms and control of common parasites: <i>Trypanosoma</i>, <i>Giardia</i> and <i>Wuchereria</i> 	7
VII	<ul style="list-style-type: none"> • Inborn errors of metabolism • Triplet repeat disorders • Monogenic disorders • Multifactorial diseases • Genome imprinting syndromes • Mitochondrial syndromes 	8
VIII	<ul style="list-style-type: none"> • Predictive medicine • Association studies • Management of genetic disorders • Calculation of genetic risk • Population screening 	6

Suggested Readings:

1. Sambrook *et al.* Molecular Cloning Vols I, II, III. CSHL (2001).
 2. Primrose. Molecular Biotechnology. Panima (2001).
 3. Sudbery. Human Molecular Genetics. Prentice-Hall (2002).
 4. Wilson. Clinical Genetics - A Short Course, Wiley (2000).
 5. Pasternak. An Introduction to Molecular Human Genetics. Fitzgerald (2000).
- Course Books published in Hindi may be prescribed by the Universities and Colleges

This course can be opted as an elective by the students of following subjects:

The eligibility for this paper is 10+2 with Biology as one of the subjects

Suggested Continuous Evaluation Methods:

House Examination/Test: 10 Marks

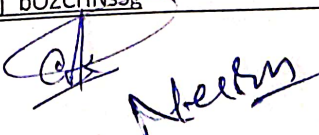
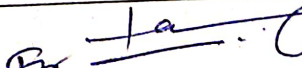
Written Assignment/Presentation/Project/Term Papers/Seminar: 10 Marks

Class performance/Participation: 5 Marks

Further Suggestions: None

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Programme/Class: Degree		Year: Second	Semester: Fourth
Subject: Genetics and Genomics			
CourseCode: B130402P/R		CourseTitle: AdvancedGeneticsandGeneticCounseling Lab	
Courseoutcomes: The student at the completion of the course will be able to: <ul style="list-style-type: none"> • Have hands-on training in molecular biology techniques. • Understand the principles of genetic engineering with hands-on experiments in mutation detection, testing of infectious diseases like Covid 19. • Get introduced to DNA testing and utility of genetic engineering in forensic sciences. • Have the feel of visiting clinics, pathology labs, hospitals to collect data and interact with the patients and their family. 			
Credits: 2		Core: Compulsory	
Max.Marks: 25+75		Min. Passing Marks: 40	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-4			
Unit	Topic	Total No. of Lectures(60)	
I	<ul style="list-style-type: none"> • Estimation of proteins in different samples • DNA extraction from blood. • Quantification of DNA using spectrophotometer. 	15	
II	<ul style="list-style-type: none"> • Agarose gel electrophoresis for detection of DNA. • Restriction digestion of Lambda DNA using teaching kit. • Preparation of human karyotype and study the chromosomal aberrations with respect to number, translocation, deletion etc. from the pictures provided. • To prepare family pedigrees. 	15	
III	<ul style="list-style-type: none"> • Demonstration of DNA fingerprinting using teaching kit. • Demonstration of Multiplex Polymerase Chain Reaction (mPCR) using teaching kit. • Visit to Clinic 	15	
IV	Virtual Labs (Suggestive sites) <ol style="list-style-type: none"> 1. Gel Documentation System-https://youtu.be/WPpt3-FanNE 2. Colorimeter-https://youtu.be/v4aK6G0bGuU 3. PCR Part 1-https://youtu.be/CpGX1UFSI4A 4. PCR Part 2-https://youtu.be/6lcHAYPTAEw 5. DNA isolation Part 1-https://youtu.be/QE7UI0JnY9A 6. DNA isolation part 2-https://youtu.be/-efr_HFeHxM 7. DNA curve-https://youtu.be/ubl8QxTeuG4 8. Spectrophotometer-https://youtu.be/ubl8QxTeuG4 9. Agarose Part 1-https://youtu.be/7gvHPFww-g 10. Agarose part 2-https://youtu.be/j_bOZCHNsSg 	15	

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Suggested Readings:

1. Sambrook *et al.* Molecular Cloning Vols I, II, III. CSHL (2001).

2. Primrose. Molecular Biotechnology. Panima (2001).

Course Books published in Hindi may be prescribed by the Universities and Colleges

This course can be opted as an elective by the students of following subjects:
The eligibility for this paper is 10+2 from Arts/Commerce/Science

Suggested Continuous Evaluation Methods:

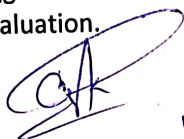
House Examination/Test: 10 Marks

Written Assignment/Presentation/Project/Term Papers/Seminar: 10 Marks

Class Performance/Participation: 5 Marks

Further Suggestions: None

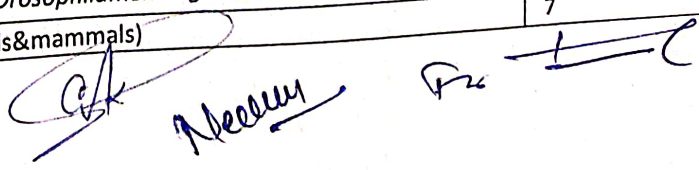
At the End of the whole syllabus any remarks/suggestions: University must ensure incorporation of all 04 units including virtual labs in practical evaluation.



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Programme/Class: Degree		Year: Third	Semester: Fifth
Subject: Genetics and Genomics			
Course Code: B130501T		Course Title: Developmental, Population & Behavioural Genetics	
Course outcomes:			
The student at the completion of the course will be able to: The student at the completion of the course will be able to:			
<ul style="list-style-type: none"> • Understand how the single cell formed at fertilisation forms an embryo and then a full adult organism. • Integrate genetics, molecular biology, biochemistry, cell biology, anatomy and physiology during embryonic development. • Understand a variety of interacting processes, which generate an organism's heterogeneous shapes, size, and structural features. • Learn about the genetic forces which are responsible for molecular evolution. • Learn the different kinds of traits, the influence of environment etc. • Understand the genetic basis of all behavioral disorders. 			
Credits: 4		Core: Compulsory	
Max. Marks: 25+75= 100		Min. Passing Marks: 40	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0			
Unit	Topic	Total No. of Lectures (60)	
I	<ul style="list-style-type: none"> • Microevolution and Macroevolution • Allele frequencies, genotype frequencies • Hardy-Weinberg equilibrium and conditions for its maintenance • Forces of evolution: mutation, migration, natural selection, genetic drift etc 	8	
II	<ul style="list-style-type: none"> • Quantitative genetics: Genotype and phenotype relation • Effect of environment, penetrance, expressivity, phenocopy • Gene interactions and modifying genes • Inheritance of quantitative traits—continuous and discontinuous variation • Polygenic inheritance, genetic variance, heritability 	7	
III	<ul style="list-style-type: none"> • Genetics of animal and human behavior • Selection studies, inbred strain studies • Twin and adoption studies • Linkage and association studies • Learning and memory 	7	
IV	<ul style="list-style-type: none"> • Psychological disorders • Mental retardation • Learning disorders • Mood disorders • Anxiety disorders • Personality disorders 	8	
V	<ul style="list-style-type: none"> • Gametogenesis, Fertilization • Cleavage pattern • Gastrulation, fate maps • Developmental mechanics of cell specification • Morphogenesis and cell adhesion 	7	
VI	<ul style="list-style-type: none"> • Genes and development • Molecular basis of development • Differential gene expression • Genetic determination of sex in <i>C. elegans</i>, <i>Drosophila melanogaster</i> and mammals 	8	
VII	<ul style="list-style-type: none"> • Early development of vertebrates (fish, birds & mammals) 	7	



	<ul style="list-style-type: none"> • Metamorphosis, regeneration and stem cells • Environmental regulation of development 	
VIII	<ul style="list-style-type: none"> • The dynamics of organ development • Development of eye, kidney, limb • Metamorphosis: the hormonal reactivation of development in amphibians, insects • Regeneration: salamander limbs, mammalian liver, Hydras • Aging: the biology of senescence 	8

Suggested Readings:

1. Essential Developmental Biology: Jonathan M. W. Slack, (3rd ed.), Wiley-Blackwell. (2012).
2. Developmental Biology: From a Cell to an Organism (Genetics & Evolution) eBook: Russ Hodge, Infobase Publishing. (2009).
3. Current Topics in Developmental Biology: Roger A. Pedersen, Gerald P. Schatten, Elsevier. (1998).
4. Developmental biology: Werner A. Müller, Springer Science & Business Media. (2012).
5. Human Embryology and Developmental Biology E-Book: Bruce M. Carlson, Elsevier Health Sciences. (2018).
6. Developmental Biology: Michael J. F. Barresi, Scott F. Gilbert, Oxford University Press. (2019).
7. Genetics: Benjamin Pierce, Freeman, 2004
8. Behavioural Genetics Plomin et al/ Freeman, 2001

Course Books published in Hindi may be prescribed by the Universities and Colleges

This course can be opted as an elective by the students of following subjects:

The eligibility for this paper is 10+2 with Biology as one of the subjects

Suggested Continuous Evaluation Methods:

House Examination/Test: 10 Marks

Written Assignment/Presentation/Project/Term Papers/Seminar: 10 Marks

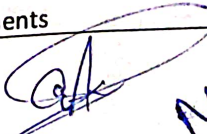
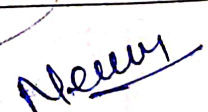
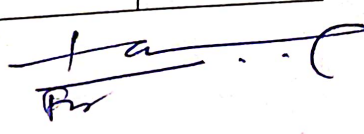
Class performance/Participation: 5 Marks

Further Suggestions: None

At the End of the whole syllabus any remarks/suggestions:

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Programme/Class: Degree		Year: Third	Semester: Fifth
Subject: Genetics and Genomics			
Course Code: B130502T		Course Title: Biostatistics and Bioinformatics	
Course outcomes: The student at the completion of the course will be able to: <ul style="list-style-type: none"> • Understand the importance of biostatistics in the study of population genetics. • Understand the available statistical softwares and learn to use them. • Get introduced to computers • Learn about the different databases available on the internet and utilize them. • Application of bioinformatic tools. 			
Credits: 4		Core Compulsory/Elective	
Max. Marks: 25+75= 100		Min. Passing Marks: 40	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0			
Unit	Topic	Total No. of Lectures (60)	
I	Biological Data <ul style="list-style-type: none"> • Data summarizing: frequency distribution • Graphical presentation—bar, pie diagram, histogram • Types of statistics: inferential and descriptive • Parametric and non-parametric tests Measures of central tendency <ul style="list-style-type: none"> • Calculations of mean, median, mode, • Elementary idea of probability and application 	12	
II	Measures of dispersion <ul style="list-style-type: none"> • Range and Mean deviation • Standard deviation • Skewness, Kurtosis Correlation 	6	
III	Correlation and regression <ul style="list-style-type: none"> • Types and methods of studying correlation • Karl Pearson's coefficient of correlation and determination • Regression equation (X on Y and Y on X) • Regression lines 	8	
IV	Tests of significance and their application <ul style="list-style-type: none"> • Tests of significance: one and two sample tests, t-test • Chi-square test, Z-test, F-test Analysis of variance ANOVA: one way and two way	10	
V	Computer Basics <ul style="list-style-type: none"> • Basics (CPU, I/O units) and operating systems • Concept of home pages and websites, World Wide Web, URLs, using search engines 	6	
VI	Databases <ul style="list-style-type: none"> • Databases: nucleic acids, genomes • Protein sequences and structures • Bibliography 	8	
VII	Sequence Analysis <ul style="list-style-type: none"> • Dynamic programming • Pairwise and multiple sequence alignments 	6	

	BLAST	
VIII	Phylogenetic Analysis <ul style="list-style-type: none"> • CLUSTALW • Phylogenetic analysis Protein structure prediction	4

Suggested Readings:

1. Biostatistical Analysis (Fourth Edition) by Jerrold H. Zarr, Pearson Education Inc., Delhi.
2. Statistical Methods (Eighth Edition) by G.W. Snedecor and W.G. Cochran, Willey Blackwell
3. Biostatistics (Tenth Edition) by W.W. Daniel and C.L. Cross, Wiley
4. Introductory Biological Statistics (Fourth Edition) by John E. Havel, Raymond E. Hampton and Scott J. Meiners
5. Westhead et al. Bioinformatics: Instant Notes. Viva Books (2003).

Course Books published in Hindi may be prescribed by the Universities and Colleges

This course can be opted as an elective by the students of following subjects:
The eligibility for this paper is 10+2 with Biology as one of the subjects

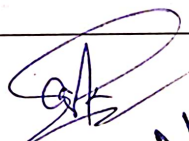
Suggested Continuous Evaluation Methods:

House Examination/Test: 10 Marks

Written Assignment/Presentation/Project/Term Papers/Seminar: 10 Marks

Class performance/Participation: 5 Marks

Further Suggestions: None

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Programme/Class: Degree		Year: Third	Semester: Fifth
Subject: Genetics and Genomics			
Course Code: B130503P		Course Title: Developmental and Computational Biology lab	
Course outcomes: The student at the completion of the course will be able to:			
<ul style="list-style-type: none"> Apply knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics existing software effectively to extract information from large databases and to use this information in computer modeling. Use bioinformatics tools to find out evolutionary/phylogenetic relationship of organisms using gene sequences. Get employment in Hospitals/Diagnostic and forensic labs/Counsel families with genetic disorders. Enable student to take up research in biological sciences. 			
Credits: 2		Core: Compulsory	
Max. Marks: 25+75= 100		Min. Passing Marks: 40	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-4			
Unit	Topic	Total No. of Lectures (60)	
I	<ul style="list-style-type: none"> Window preparation to study the development of chick at different time periods. Application to genetic problems, using statistical softwares. Measure the pre and post clitoral lengths of earthworms and calculate mean, median, mode, standard deviation etc. Measure the height and weight of all students in the class and apply statistical measures. 	10	
II	<ul style="list-style-type: none"> MS Word, MS Powerpoint, MS Excel, etc Adobe Photoshop, using internet, E-mail Search engines, home pages etc. 	15	
III	<ul style="list-style-type: none"> To learn sequence analysis using BLAST To learn Multiple sequence alignment using CLUSTALW Protein structure prediction (ExPasy, PROSITE). To learn about Phylogenetic analysis using the programme PHYLIP. To learn how to perform Primer designing for PCR using available softwares etc. 	20	
IV	Virtual Labs (Suggestive sites) <ol style="list-style-type: none"> Use softwares like Primer3, NEB cutter NCBI, BLAST, CLUSTALW, PHYLIP 	15	

Suggested Readings:

- Primrose & Twyman. Principles of Genome Analysis and Genomics. Blackwell (2003).
- Hartl & Jones. Genetics: principles & Analysis of Genes & Genomes. Jones & Bartlett (1998).
- Sambrook *et al.* Molecular Cloning Vols I, II, III. CSHL (2001).
- Primrose. Molecular Biotechnology. Panima (2001).

Course Books published in Hindi may be prescribed by the Universities and Colleges

This course can be opted as an elective by the students of following subjects:
The eligibility for this paper is 10+2 from Arts/Commerce/Science

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Programme/Class: Degree		Year: Third	Semester: Sixth
Subject: Genetics and Genomics			
Course Code: B130601T		Course Title: Immunogenetics & Microbial Genetics	
Course outcomes: The student at the completion of the course will be able to:			
<ul style="list-style-type: none"> Understand the basic concepts of immune system, antigen-antibody reaction including the molecular mechanisms. Understand the HLA concept, their organisation and expression and their significance in organ transplants. Understand the difference between monoclonal and polyclonal antibodies, cytokines and complement system. Understand the causes and effects of autoimmune diseases Hyperactivity reactions, various immunodeficiency diseases, their treatment and prevention. Learn about modern vaccines like conventional, DNA and recombinant vaccines. Learn about microbes, their life cycle, infectious diseases caused by them and their application in fermentation technology. 			
Credits: 4		Core: Compulsory	
Max. Marks: 25+75= 100		Min. Passing Marks: 40	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0			
Unit	Topic	Total No. of Lectures (60)	
I	<ul style="list-style-type: none"> Introduction to Immune system, Immunity and its types Innate and Adaptive Immunity Humoral and Cell mediated immunity 	6	
II	<ul style="list-style-type: none"> Structure and functions of different classes of immunoglobulins Activation and differentiation of B and T cells Immunoglobulin and T-cell receptor genes Molecular mechanism of antibody diversity. Monoclonal antibodies 	10	
III	<ul style="list-style-type: none"> HLA complex Organization of Class I and II HLA molecules Expression of HLA genes Cytokines 	8	
IV	<ul style="list-style-type: none"> Complement system Antigen processing and presentation Antigen-antibody interactions Autoimmune diseases Hypersensitivity reactions Immunodeficiencies Vaccines 	10	
V	<ul style="list-style-type: none"> Methods of gene transfer in bacteria: conjugation, transformation, transduction Genetic analysis of mutants Recombination and Genetic mapping 	6	
VI	<ul style="list-style-type: none"> Molecular biology of pathogens Mechanism of drug resistance 	4	

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VII	<ul style="list-style-type: none"> • Microbial and Fermentation technology • Methods of enzyme production • Immobilization of enzymes • Synthesis of microbial and recombinant products • Applications: Bioreactors 	10
VIII	<ul style="list-style-type: none"> • Lifecycles and advantages of organisms commonly used in genetic studies. • Genes and gene products in different model systems: T4 and λ phages, <i>E. coli</i>, <i>Saccharomyces cerevisiae</i> 	6

Suggested Readings:

1. Essential Immunology Roitt Blackwell, 2003
2. Immunology - A short Course Benjamin *eta* Wiley, 2000
3. Modern Microbial Genetics Streips & Yasbin Wiley 2002
4. Fundamentals of Bacterial Genetics Trun & Trempy, Blackwell, 2004
5. Microbiology: Principles & Explorations, Black, Wiley, 2002
6. Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis Kuby Immunology. WH Freeman (2007).
7. Delves Peter J., Martin Seamus J., Burton Dennis R., Roitt Ivan M. Roitt's Essential Immunology, 13th Edition. Wiley Blackwell (2017).
8. Shetty Nandini Immunology Introductory Textbook. New Age International. (2005)

Course Books published in Hindi may be prescribed by the Universities and Colleges

This course can be opted as an elective by the students of following subjects:
The eligibility for this paper is 10+2 with Biology as one of the subject

Suggested Continuous Evaluation Methods:

House Examination/Test: 10 Marks

Written Assignment/Presentation/Project/Term Papers/Seminar: 10 Marks

Class performance/Participation: 5 Marks

Further Suggestions: None

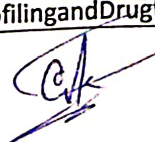
At the End of the whole syllabus any remarks/suggestions: None

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Programme/Class: Degree		Year: Third	Semester: Six
Subject: Genetics and Genomics			
Course Code: B130602T		Course Title: Genomics	
Course outcomes: The student at the completion of the course will learn: <ul style="list-style-type: none"> • The latest in DNA and protein sequencing and Human Genome Project. • The diversity of genomes and gene functions. • The genotype-phenotype interactions and how genetic makeup of individuals lead to differences in disease manifestations and response to drugs, toxicity etc. • The state-of-art techniques like microarray technology, 2D-electrophoresis, protein sequencing etc. 			
Credits: 4		Core: Compulsory	
Max. Marks: 25+75= 100		Min. Passing Marks: 40	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0			
Unit	Topic	Total No. of Lectures (60)	
I	<ul style="list-style-type: none"> • Overview of prokaryotic and eukaryotic genomes • Human genome project • Mapping strategies • Mitochondrial genome and nuclear genome 	8	
II	<ul style="list-style-type: none"> • Gene density • CpG islands • Gene families and superfamilies: gene duplication • Pseudogenes, repetitive DNA and transposable elements 	8	
III	<ul style="list-style-type: none"> • Conservation of genomes • Diversity of genomes • Genome size • Organization of genes 	8	
IV	<ul style="list-style-type: none"> • C-value, number of genes and complexity of genomes • Comparative genomics as an aid to gene mapping • Study of human disease genes 	8	
V	<ul style="list-style-type: none"> • Definition of transcriptome • Definition of proteome • Concept of transcriptomics, proteomic etc. 	4	
VI	<ul style="list-style-type: none"> • Microarray technology • 2D-electrophoresis • Protein sequencing • Prediction, diversity and multiplicity of protein and gene functions 	8	
VII	<ul style="list-style-type: none"> • Personalized medicine • Concept of pharmacogenomics and pharmacogenetics 	4	
VIII	<ul style="list-style-type: none"> • Genetic polymorphisms in drug metabolizing enzymes and drug targets • Effects on drug response • Gene chips: Applications in disease profiling and Drug target discovery 	12	


 No. For

Suggested Readings:

1. Primrose & Twyman. Principles of Genome Analysis and Genomics. Blackwell (2003).
2. Hartl & Jones. Genetics: principles & Analysis of Genes & Genomes. Jones & Bartlett (1998).

Course Books published in Hindi may be prescribed by the Universities and Colleges

This course can be opted as an elective by the students of following subjects:

The eligibility for this paper is 10+2 with Biology as one of the subjects

Suggested Continuous Evaluation Methods:

House Examination/Test: 10 Marks

Written Assignment/Presentation/Project/Term Papers/Seminar: 10 Marks

Class Performance/Participation: 5 Marks

Further Suggestions: None

At the end of the whole syllabus any remarks/suggestions: None

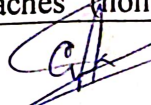
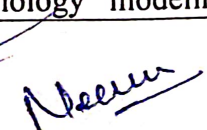
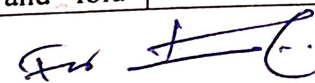
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Programme/Class: Degree		Year: Third	Semester: Sixth
Subject: Genetics and Genomics			
Course Code: B130603P		Course Title: Microbiology, Immunology and Genomics Lab	
Course outcomes: The student at the completion of the course will be able to: <ul style="list-style-type: none"> • Performs simple experiments pertaining to development biology, immunology and microbial technology. • Perform tests which will be useful in disease diagnostics. • Learn to grow small scale cultures. 			
Credits: 2		Core: Compulsory	
Max. Marks: 25+75= 100		Min. Passing Marks: 40	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4			
Unit	Topic	Total No. of Lectures (60)	
I	<ul style="list-style-type: none"> • To perform bacterial culture and calculate generation time of bacteria. • Preparation of competent cells • Gene cloning • Plasmid purification 	20	
II	<ul style="list-style-type: none"> • Determination of ABO Blood group • To perform immunoprecipitation experiment using teaching kit. • To perform ELISA using teaching kit. 	15	
III	1. <i>In silico</i> work	10	
IV	Virtual Labs (Suggestive sites) https://www.vlab.co.in/ba-nptel-labs-biotechnology-and-biomedical-engineering https://vlab.amrita.edu/?sub=3&brch=73 https://www.medicine.mcgill.ca/physio/vlab/immun/vlabmenuimmun.htm https://www.labster.com/simulations/introduction-to-immunology	15	
Suggested Readings: 1. Sambrook <i>et al.</i> Molecular Cloning Vols I, II, III. CSHL (2001). 2. Primrose. Molecular Biotechnology. Panima (2001). Course Books published in Hindi may be prescribed by the Universities and Colleges			
This course can be opted as an elective by the students of following subjects: The eligibility for this paper is 10+2 from Arts/Commerce/Science			
Suggested Continuous Evaluation Methods: House Examination/Test: 10 Marks Written Assignment/Presentation/Project / Term Papers/Seminar: 10 Marks Class performance/Participation: 5 Marks			
Further Suggestions: None			

At the end of the whole syllabus any remarks/suggestions: University must ensure incorporation of all 04 units including virtual labs in practical evaluation

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Programme/Class: Degree with Research		Year: Fourth	Semester: Seventh
Subject: Genetics and Genomics			
CourseCode: B130701T		CourseTitle: Biomolecules	
Courseoutcomes: The student at the completion of the course will be able to: The student at the completion of the course will be able to:			
•			
Credits: 4		Core: Compulsory	
Max.Marks: 25+75= 100		Min. Passing Marks: 40	
TotalNo.ofLectures-Tutorials-Practical(inhoursperweek): L-T-P:4-0-0			
Unit	Topic	TotalNo.of Lectures(60)	
I	<ul style="list-style-type: none"> Chemistry of nucleic acid (DNA, RNA), proteins, carbohydrates, lipids; Chemistry of nucleosides and nucleotides; nucleic acid structures and composition: A, B, and Z forms of DNA, super coiling of DNA, denaturation and renaturation kinetics, nucleotide sequence composition: unique, middle and highly repetitive DNA; primary, secondary & tertiary structure of protein, protein folding. 	7	
II	<ul style="list-style-type: none"> Isolation, detection and characterization of nucleic acids and proteins by various spectroscopic and biophysical (centrifugation) methods; Electrophoresis (Agarose gel electrophoresis, PFGE, PAGE), Southern, Northern and Western blotting/hybridization; Chromatographic methods for protein characterization (brief principles for all the methods may be provided). 	7	
III	<ul style="list-style-type: none"> Macromolecular structure determination: Basic concepts and principles of X-ray diffraction, crystallography; Spectroscopy: UV-Visible, fluorescence; Nuclear Magnetic Resonance (NMR), AAS, Circular Dichroism, Electron Microscopy: TEM, SEM, STM; cryo-EM, Atomic Force, Phase contrast, Fluorescence and Confocal microscopy; Automated DNA Sequencer. 	8	
IV	<ul style="list-style-type: none"> Structure-Prediction of Biomolecules with applications in Bioinformatics Structure classification of proteins (SCOP, CATH), Secondary structure prediction of various protein categories (e.g. transmembrane and helical proteins), RNA secondary structure prediction methods; Patterns, motifs and Profiles in sequences: Derivation and search methods; Derived Databases of patterns, motifs and profiles e.g. Prosite, Blocks, Prints-S, Pfam; Overview of tertiary structure prediction methods: algorithms for modeling protein folding; algorithms for 3D structure prediction with representative examples; Protein structure prediction by comparative modeling approaches (homology modeling and fold 	8	

recognition); ab initio structure prediction methods.

Suggested Readings:

1. Lehninger Principles of Biochemistry - David L. Nelson and Michael M. Cox (W.H. Freeman & Co Ltd)
2. Biochemistry - Donald Voet and Judith G. Voet (John Wiley & Sons, Inc)
3. Biochemistry - Jeremy M. Berg, Lubert Stryer, John Tymoczko and Gregory Gatto (W.H. Freeman)
4. Principles of Physical Biochemistry - Kensal Evan Holde, Curtis Johnson and Pui Shing Ho (Pearson)
5. Physical Biochemistry: Application to Biochemistry and Molecular Biology - David M Freifelder (W.H. Freeman)
6. Practical Biochemistry Principles and techniques - Ed Wilson and Walker (Cambridge University Press)

Course Books published in Hindi may be prescribed by the Universities and Colleges

This course can be opted as an elective by the students of following subjects:

The eligibility for this paper is 10+2 with Biology as one of the subject

Suggested Continuous Evaluation Methods:

House Examination/Test: 10 Marks

Written Assignment/Presentation/Project/Term Papers/Seminar: 10 Marks


Class performance/Participation: 5 Marks

Further Suggestions: None

At the End of the whole syllabus any remarks/suggestions:

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Neeraj *For*

Programme/Class: Degree with research		Year: Fourth	Semester: Seventh
Subject: Genetics and Genomics			
CourseCode: B130702T		Course Title: Cell Biology and Immunology	
Courseoutcomes: The student at the completion of the course will be able to:			
Credits: 4			
Max. Marks: 25+75= 100		Core Compulsory/Elective	
		Min. Passing Marks: 40	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0			
Unit	Topic	Total No. of Lectures (60)	
I	Cell Communication: Cellular structures and functions, General principles of cell-cell communication in prokaryotes and eukaryotes (multi-cellular organization), Paracrine, Autocrine and Endocrine signaling; Exosomes as mediators of cell-to-cell Communication, signaling through G-protein linked cell surface receptors, MAP kinase pathway; The Cell Cycle and programmed cell death: An overview of the cell cycle, components of the cell cycle control system, apoptosis, Necroptosis, Ferroptosis.	6	
II	Germ cells and early development; Stem cell concepts & Technologies; Developmental genetics: pattern formation genes, Homeotic Genes and evolution, Stages of Development, Germ layers and fate map, Cell fate and commitment, Mechanisms of Differentiation, Pattern formation, Organogenesis, Model organisms: Drosophila, C. elegans.	6	
III	Fundamental concepts of the Immune system: components of innate and acquired immunity; Antigens – immunogens, hapten, adjuvant, carrier. MHC – structure, HLA typing; Molecular basis of immune responses: Primary and secondary immune response; Immunoglobulins – class and structure, affinity, avidity, allotype, isotype, idiotype; Antibody genes and antibody diversity; VDJ recombination. Immunoassays, ELISA, Vaccine technology: Active and Passive immunization, recombinant DNA and protein-based vaccines, peptide vaccines, conjugate vaccines, cell-based vaccines.	8	
IV	Immune disorders: Graves' disease; Autoimmune diseases like Rheumatoid arthritis, Systemic Lupus Erythematosus, Type 1 diabetes, psoriasis, Myasthenia Gravis, Multiple sclerosis Cancer and immune system: Development of tumor, accumulation of somatic mutations, Types of tumor; special properties of cancer cells; oncogenes; tumor suppressor genes; tumor antigens; tumor evasion of the immune system; immunotherapy of cancer, liquid biopsy. Imaging techniques: Antibodies as in	8	



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vivo and *in vitro* probes; Immunofluorescence microscopy; Techniques for live cell imaging and fixed cells.

Suggested Readings:

1. Kuby Immunology-J. Punt, S. Stranford, P. Jones, and J. A. Owen (W.H. Freeman)
2. Cellular and Molecular Immunology-A. K. Abbas, A. H. Lichtman and S. Pillai (Elsevier)
3. Immunology and Immunotechnology-A. K. Chakrabarty (Oxford University Press.)
4. Molecular Biology of the Cell-Bruce Alberts (Garland Science)
5. The Problems Book-for Molecular Biology of the Cell-Tim Hunt, John Wilson (W. W. Norton & Company)
6. Molecular Cell Biology-H. Lodish, A. Berk, C. A. Kaiser, M. Krieger, A. Bretscher, H. Ploegh, A. Amon, K. C. Martin (W.H. Freeman) 2016.
7. Cell Biology-T. D. Pollard & William C. Earnshaw (Saunders Elsevier)
8. Cell and Molecular Biology: Concepts and Experiments-Gerald Karp (John Wiley & Sons)
9. Cells-Benjamin Lewin, Lynne Cassimeris, V. R. Lingappa, George Plopper (Jones and Bartlett Publishers)
10. The Cell: A Molecular Approach-Geoffrey M. Cooper & Robert E. Hausman (Sinauer Associates)
11. Developmental Biology-Scott F. Gilbert (Sinauer Associates Inc.)

Course Books published in Hindi may be prescribed by the Universities and Colleges

This course can be opted as an elective by the students of following subjects:
The eligibility for this paper is 10+2 with Biology as one of the subjects

Suggested Continuous Evaluation Methods:

House Examination/Test: 10 Marks

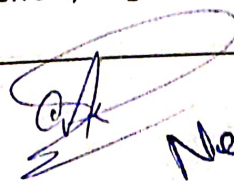
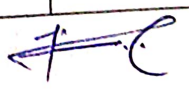
Written Assignment/Presentation/Project/Term Papers/Seminar: 10 Marks

Class Performance/Participation: 5 Marks

Further Suggestions: None

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Programme/Class: Degree with research		Year: Fourth	Semester: Seventh
Subject: Genetics and Genomics			
Course Code: B130703T		Course Title: Genetics & Molecular Biology	
Course outcomes: The student at the completion of the course will be able to: <ul style="list-style-type: none"> • Be able to understand how the cell functions as a unit of life. • Gain knowledge about the techniques and experiments that contributed to the understanding of molecular mechanisms of the cellular processes. • Be able to draw parallels between the physiological processes at the cellular and organismic levels. • Appreciate the importance of cell-cell adhesion and the extracellular matrix in the evolution of multicellular organisms. • It majorly emphasizes the concepts of central dogma of molecular biology spanning from DNA Replication till Protein Synthesis and Reverse transcription. 			
Credits: 4		Core: Compulsory	
Max. Marks: 25+75= 100		Min. Passing Marks: 40	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0			
Unit	Topic	Total No. of Lectures (60)	
I	<i>Classical genetics</i> <ul style="list-style-type: none"> • Mendel's Laws, concept of dominance, segregation, independent assortment, physical basis of inheritance; concept of gene, gene-gene interactions; multiple alleles; complementation; linkage, recombination and chromosome mapping (genetic) with examples for linkage/genetic mapping extra-chromosomal inheritance; transposable elements (Ac-Ds, IS, P-elements). Chromosomal aberrations: Numerical variations: euploidy and aneuploidy; Structural variations: deletion, duplication, inversion and translocation, Chromatin structure, DNA damage and repair; Epigenetic modifications. 	8	
II	<i>Basics of Human genetic diseases and population genetics</i> Mendelian genetic disease, and Non-Mendelian/common/complex genetic diseases; Construction and interpretation of pedigree, identification of genes causing Mendelian genetic disease and complex genetic disease; Genetic Diversity: concepts of allele, gene frequency; Hardy Weinberg Law and its application, Concepts of Evolution, mutational processes, evolution of mutation rates; evolution of DNA sequences; Natural selection and Genetic Drift: population bottleneck and founder effect; migration: demographic expansion, spatial expansion.	8	


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III	<p><i>Replication, transcription, translation and regulation of gene expression</i></p> <p>Central Dogma in molecular Biology, DNA Replication; Transcription; Translation in prokaryotes and eukaryotes, Concept of genetic code (degeneracy of codons, codon bias), Regulation of gene expression in prokaryotes– concept of operon (lac and trp), transcriptional and post transcriptional processing of mRNA in eukaryotes; Translation machinery and its regulation in eukaryotic system, post translational modifications.</p>	8
IV	<p><i>Tools and techniques of Molecular Biology</i></p> <p>Gene Cloning: Restriction endonuclease, DNA modifying enzymes, Different types of vectors for Cloning (plasmid, phasmid, cosmid, bacterial artificial chromosome, yeast artificial chromosome, mammalian artificial chromosome); PCR; Different modified PCR; quantitative PCR; ddPCR; DNA, RNA and protein probes (production, labeling by radioactive and non- radioactive method); Fluorescence in situ Hybridization (FISH); Basics of Array, Sequencing techniques and applications: Microarray(Basic principles and technology of cDNA microarrays and their applications, case studies); DNA, RNA and protein sequencing methods; DNA fingerprinting for parenting and forensics sciences.</p>	7

Suggested Readings:

1. *iGenetics-A Molecular Approach*-Peter J. Russell (Pearson Int. Edition)
2. *Concepts of Genetics*-Klug W.S., Cummings M.R., Spencer C.A. and Palladino M.A. (Pearson Int. Edition).
3. *Genes XII*-Lewin Benjamin (Jones & Bartlett publishers)
4. *Molecular Cell Biology*- Lodish H, Berk A, Kaiser C.A., Krieger M., Scott M.P., Bretscher A., Ploegh H. & Matsudaira P. (W.H. Freeman & Co.)
5. *Principles of Genetics*-Snustad D.P. and Simmons M.J. (John Wiley & sons Inc.)
6. *Principles of Genetics*-Robert H. Tamarin (Tata McGraw-Hill)
7. *An Introduction to Genetic Analysis*-Anthony J. F. Griffiths, Susan R. Wessler, Sean B. Carroll, John Doebley (W.H. Freeman)
8. *Gene Cloning and DNA Analysis*-T.A. Brown (Wiley-Blackwell)
9. *Principles of Gene Manipulation*-S.B. Primrose, R.M. Twyman and R.W. Old. (Blackwell Scientific Publishers)
10. *Molecular Biology of the Gene*- James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick (Pearson)
11. *Solving Problems in Genetics*-Richard Kowles (Springer)
12. *Molecular Population Genetics*-Matthew W. Hahn (OUP USA)
13. *Population Genetics*-Matthew B. Hamilton (Wiley-Blackwell)

Course Books published in Hindi may be prescribed by the Universities and Colleges

This course can be opted as an elective by the students of following subjects:
The eligibility for this paper is 10+2 from Arts/Commerce/Science

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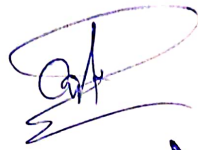
Suggested Continuous Evaluation Methods:

House Examination/Test: 10 Marks

Written Assignment/Presentation/Project/Term Papers/Seminar: 10 Marks

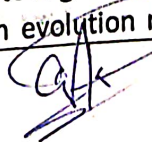
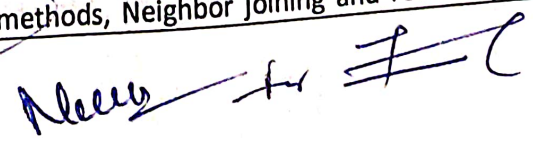
Class Performance/Participation: 5 Marks

Further Suggestions: None



Neelam for IIT

Programme/Class: Degree with research		Year:Fourth	Semester: Seventh
Subject:Genetics and Genomics			
CourseCode: B130704T		CourseTitle:Biostatistics & Bioinformatics	
Courseoutcomes: The student at the completion of the course will be able to:			
•			
Credits:4		Core: Compulsory	
Max.Marks:25+75= 100		Min. Passing Marks: 40	
TotalNo.ofLectures-Tutorials-Practical(inhoursperweek):L-T-P:4-0-0			
Unit	Topic	Total No. of Lectures(60)	
I	Statistics of dispersion: Variability, Range, Mean, mode, Mean deviation, Standard Deviation, Variance, central moments, Coefficient of Quartile deviation, Coefficient of variation, Coefficient of dispersion; Probability Distribution: Probability mass function for discrete random variables and probability density function for continuous random variables; Skewness, Kurtosis; Testing of Hypothesis: Concepts and importance in experimental research, type of errors; testing means, Significance of difference between means using Z-score; Large sample tests based on normal distribution – Test based on t and F distributions, Chi square test for goodness of fit, Correlation and Regression: Multiple correlation, Linear, logistic, and multiple regression; Multivariate Methods: PCA, MDS; Cluster analysis (Hierarchical, k-means, SOM); factor analysis; Modeling using Boolean Networks; Non-parametric and distribution-free statistics: Sign test, Wilcoxon's rank test and Spearman's rank correlation; MDR analysis, Analysis of Variance: One way and two way classifications of Anova, Post-hoc analysis, ROC curve analysis – applications in Biological Sciences.	8	
II	<ul style="list-style-type: none"> Biological databases: NCBI-GenBank, UniProt, DDBJ, EMBL, PDB, KEGG; Biological data handling and sequence manipulations by <i>in silico</i> techniques; NCBI different modules: ORF-finder, Taxonomy browser, BOLD, PubMed. Sequence analysis: Introduction to sequence analysis, local and global alignment, pairwise and multiple alignment, Substitution Matrix (introduction: PAM, BLOSUM), BLAST, FASTA algorithms. Sequence alignment algorithm: Dot matrix, Needleman-Wunsch algorithm, Smith-Waterman algorithm; Introduction to EMBOSS. 	7	
III	Basics of molecular phylogenetics <ul style="list-style-type: none"> Distance Based methods: clustering based methods, optimality based methods: Fitch-Margoliash and Minimum evolution methods, Neighbor joining and related 	8	


 Needs for 

	neighbor methods; Character Based methods: Maximum parsimony methods, Maximum likelihood method; Phylogenetic trees and other models; optimality criteria for selecting phylogenetic hypothesis; Phylogenetic tree evaluation: Bootstrap analysis, Interior branch testing.	
IV	Advanced molecular phylogenetics Fossils, Molecular clock; Haplotype analysis; estimation of population structure, molecular diversity indices, mismatch distribution, analyses of molecular variance (AMOVA); Migration analysis; Phylogenetic dating: p-statistic; Bayesian analysis; Markov Chain Monte Carlo; Comparative Genomics: Gene duplication and phylogeny, Gene order, Lateral and Horizontal gene transfer, Transposable elements, Metagenomics; Application of molecular phylogenetics: Examples of some entrepreneurship [e.g. 23 and me].	7

Suggested Readings:

1. Introduction to Biostatistics - Pranab K Banerjee. (S. Chand & Co.)
2. Biostatistics - P. N. Arora, P. K. Malhan (Himalaya Publishing House)
3. Essential Bioinformatics - Jin Xiong, (Oxford University Press)
4. Statistics in Biology and Psychology - Debajyoti Das and Arati Das (Academic Publishers)
5. Bioinformatics: Sequence and Genome Analysis - David W. Mount. (CSHL Press).
6. Bioinformatics and Functional Genomics - Jonathan Pevsner, (Wiley-Liss)
7. Structural Bioinformatics - P. E. Bourne and H. Weissig. (Wiley)
8. Introduction to Bioinformatics - Arthur W. Lesk (Oxford University Press.)
9. Bioinformatics - Principles and Applications - Z. Ghosh and B. Mallick (Oxford University Press.)

Course Books published in Hindi may be prescribed by the Universities and Colleges

This course can be opted as an elective by the students of following subjects: The eligibility for this paper is 10+2 with a one of the subject

Biology

Suggested Continuous Evaluation Methods:

House Examination/Test: 10 Marks

Written Assignment/Presentation/Project/Term Papers/Seminar: 10 Marks

Class performance/Participation: 5 Marks

Further Suggestions: None

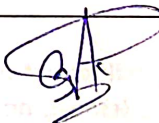
At the End of the whole syllabus any remarks/suggestions: None

SA
Needs for F/C

Programme/Class: Degree with Research		Year: Fourth	Semester: Seventh
Subject: Genetics and Genomics			
Course Code: B130705P		Course Title: Biochemistry, Molecular Biology, Biostatistics & Bioinformatics Lab	
Course outcomes: The student at the completion of the course will be able to:			
Credits: 2		Core: Compulsory	
Max. Marks: 25+75= 100		Min. Passing Marks: 40	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 0-0-4			
Unit	Topic	Total No. of Lectures (60)	
I	Biochemistry Lab <ol style="list-style-type: none"> Quantitative analysis of amino acids Protein estimation by Lowry/Bradford method Total sugar estimation by phenol-sulphuric acid reagent method Estimation of reducing sugar from biological sample pH metric titration of glycine for determination of pI Ascorbic acid estimation from lemon juice Chromatography techniques. Chromosome preparation for Karyotyping and Banding 	15	
II	Molecular Biology Lab Core Experiments: <ol style="list-style-type: none"> Isolation of DNA from different sources (Buccal swab, blood, animal & plant tissue) Agarose gel electrophoresis Quantitative & qualitative analysis of nucleic acid (NanoDrop, Qubit) Polymerase chain reaction: general 	15	
III	Advanced Experiments: <ol style="list-style-type: none"> PCR-multiplex & nested PCR PCR-RFLP Elution of PCR product Sanger sequencing Fragment analysis (e.g. SNaPshot multiplex genotyping assay) 	15	

SA *Meerly* for *ILC*

IV	Biostatistics & Bioinformatics Lab <ol style="list-style-type: none"> 1. Introduction to C, R, SPSS, MS Excel for statistical analysis 2. Primer designing: Primer3, Oligocalc, SMS2, BLAST 3. Handling of Databases: NCBI, BOLD etc. 4. Raw Sequence: Reading & Editing; Pre-submission sequence analysis and annotation 5. Sequence submission in NCBI-GenBank/BOLD 6. Basic phylogenetic analysis: Distance Based methods and Character Based methods 7. Advanced phylogenetic analysis, Molecular Clock 8. Structure-Prediction of Biomolecules with applications in Bioinformatics 	15
V	Virtual Labs (Suggestive sites) https://www.vlab.co.in https://zoologysan.blogspot.com www.vlab.iitb.ac.in/vlab	
Suggested Readings: Course Books published in Hindi may be prescribed by the Universities and Colleges		
This course can be opted as an elective by the students of following subjects: The eligibility for this paper is 10+2 from Arts/Commerce/Science		
Suggested Continuous Evaluation Methods: House Examination/Test: 10 Marks Written Assignment/Presentation/Project / Term Papers/Seminar: 10 Marks Class performance/Participation: 5 Marks		
Further Suggestions: None		


 Neelam for IITC

Programme/Class: Degree with Research **Year:** Fourth **Semester:** Eighth

Subject: Genetics and Genomics

Course Code: B130801T **Course Title:** Fundamentals of Genome Science

Course outcomes:
 The student at the completion of the course will be able to: The student at the completion of the course will be able to:
 •

Credits: 4 **Core:** Compulsory

Max. Marks: 25+75= 100 **Min. Passing Marks:** 40

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:4-0-0

Unit	Topic	Total No. of Lectures (60)
I	<p><i>Basic structural chemistry of biomolecules</i></p> <p>Chemistry of carbohydrates, Lipids, Amino Acids and Nucleic acids; Isolation and detection of Nucleic acids and protein; Electrophoresis; Basic concepts and principles of the tools for macromolecular structure determination: X-ray diffraction, crystallography, <i>Spectroscopy</i>: UV-Visible, fluorescence, Concept of microscopy - SEM, fluorescence, Confocal</p>	6
II	<p><i>Basic concept of genetics & biostatistics</i></p> <ul style="list-style-type: none"> Genetics: Mendelian and Non-Mendelian inheritance; Construction and interpretation of pedigree; Chromosomal aberrations; Chromatin structure, Basics of Epigenetic modifications; Biostatistics: Statistics of dispersion; Testing of Hypothesis; Non-parametric and distribution-free statistics; Analysis of Variance 	7
III	<p><i>Tools and techniques of Molecular Biology</i></p> <ul style="list-style-type: none"> Gene Cloning: Restriction endonuclease, DNA modifying enzymes, Different types of vectors for Cloning; PCR; Different modified PCR; quantitative PCR; Basics of Array and Sequencing techniques: Microarray (Basic principles and technology of cDNA microarrays); Evolution of DNA sequencing methods - from Sanger to NGS; Basic overview of NGS data handling; Introduction to Genome editing 	7
IV	<p><i>Application of Genomes science</i></p> <ul style="list-style-type: none"> Types of genetic variations; Identification of human biomarkers using genomics; Principles of inheritance and working with family-based genetic disorders; Genomics in child development and population-based carrier screening for genomic disorders; Genomics of cardiovascular disease and cancer; Concept of pharmacogenomics; Concept of genetic counseling; 	6

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Predicting disease in healthy (pre-symptomatic) people and its ethical concern.

Suggested Readings:

Course Books published in Hindi may be prescribed by the Universities and Colleges

This course can be opted as an elective by the students of following subjects:

The eligibility for this paper is 10+2 with Biology as one of the subject

Suggested Continuous Evaluation Methods:

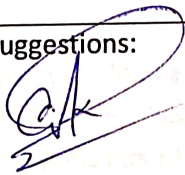
House Examination/Test: 10 Marks


Written Assignment/Presentation/Project/Term Papers/Seminar: 10 Marks

Class performance/Participation: 5 Marks

Further Suggestions: None

At the End of the whole syllabus any remarks/suggestions:



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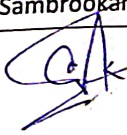
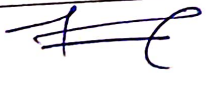
Programme/Class: Degree with research	Year: Fourth	Semester: Eighth
Subject: Genetics and Genomics		
CourseCode: B130802T	Course Title: Genetic Engineering	
Course outcomes: The student at the completion of the course will be able to:		

Credits: 4	Core Compulsory/Elective
Max. Marks: 25+75= 100	Min. Passing Marks: 40
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:4-0-0	

Unit	Topic	Total No. of Lectures (60)
I	<i>Cloning, Selection and expression of engineered DNA</i> <ul style="list-style-type: none"> Different types of cloning and expression techniques in prokaryotic and Eukaryotic model cell system (restriction cloning, TOPOTA cloning, PCR product cloning, and GATEWAY cloning technology); Construction and screening of genomic and cDNA library 	8
II	<i>Manipulation of animals and plants</i> <ul style="list-style-type: none"> Transfer of genes in animal oocyte; cloning of animals, Gene targeting; techniques of creating transgenic mice, homologous recombination and knockout mice; Direct and Indirect methods of Gene transfer and techniques of creating transgenic plants; Application, Biosafety measures and regulation. 	6
III	<i>Application of Genetic Engineering</i> <ul style="list-style-type: none"> Genetically engineered vaccine, Recombinant Enzyme in industry, production of biopharmaceuticals (insulin, interferon, tPA and growth hormones) 	6
IV	<ul style="list-style-type: none"> Gene therapy: DNA based diagnosis of genetic diseases and pathogen detection (HIV etc.); Genome editing (CRISPR-Cas9, CRISPR-Cas13, TALEN, LEAPER, Meganuclease, ZFN; Base editor; gene drive) 	8

Suggested Readings:

1. Introduction to Genetic Engineering - Rastogi and Pathak (Oxford University Press.)
2. Molecular Biotechnology: Principles and Applications of Recombinant DNA - B.R. Glick and J.J. Pasternak (ASM press)
3. Principle of Gene Manipulation & Genomics - S.M. Primrose, Twyman, and R.W. Old, (2006) (Blackwell Science Inc.)
4. Recombinant DNA - Genes and Genomes - A Short Course J.D. Watson, Richard M Myers, Amy A. Caudy and Jan A. Witkowski (W.H. Freeman and Company)
5. DNA Cloning: A Practical Approach - D.M. Glover and B.D. Hames, (IRL Press.)
6. Molecular Cloning: A Laboratory Manual - J. Sambrook and D. Russell (CHL Press.)


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7. Gene Cloning and DNA Analysis - An Introduction - T.A. Brown (Blackwell)
8. A Crack in Creation: Gene Editing and the Unthinkable Power to Control Evolution - Jennifer A. Doudna and Samuel H. Sternberg (Houghton Mifflin Harcourt)
9. Plant Genome Editing with CRISPR Systems: Methods and Protocols - Yi Ping Qi (Humana Press)
10. Genome Editing - Kursad Turksen (Ed.) (Springer)
11. Genome Editing and Engineering: From TALENs, ZFNs and CRISPRs to Molecular Surgery - Krishnarao Appasani (Ed.) (Cambridge University Press)

Course Books published in Hindi may be prescribed by the Universities and Colleges

This course can be opted as an elective by the students of following subjects:
The eligibility for this paper is 10+2 with Biology as one of the subject

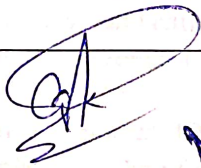
Suggested Continuous Evaluation Methods:

House Examination/Test: 10 Marks

Written Assignment/Presentation/Project/Term Papers/Seminar: 10 Marks

Class performance/Participation: 5 Marks

Further Suggestions: None



Neeru for JTC

Programme/Class: Degree with research		Year: Fourth	Semester: Eighth
Subject: Genetics and Genomics			
CourseCode: B130803T		Course Title: Omics	
Courseoutcomes: The student at the completion of the course will be able to:			
Credits: 4		Core: Compulsory	
Max.Marks: 25+75= 100		Min. Passing Marks: 40	
TotalNo.ofLectures-Tutorials-Practical(inhoursperweek): L-T-P:4-0-0			
Unit	Topic	TotalNo.of Lectures(60)	
I	<p><i>Concept of genome, genomics and epigenomics</i></p> <ul style="list-style-type: none"> Structural genomics: Eukaryotic organelle genomes (human and other organisms); Assigning loci to specific chromosome; high resolution chromosome mapping; markers for mapping (RFLP, single nucleotide polymorphism, microsatellite markers, copy number variation, methods for detection of markers), Physical mapping of genome; Linkage mapping; Using genome maps for genetic analysis - organizational principles of human genes: application of comparative genomics to understand the molecular mechanism; Genome sequencing: Whole genome shotgun sequencing; Introduction to various databases, genome browsers & associated tools: ENSEMBL, GeneCards, UCSC Genome Browser, Galaxy and their application; Overview of various genome scale projects: Human genome project, HapMap project, 1000 genome projects, Expressed sequence Tag (EST) project; ethical, legal, and social implications addressed by the Human Genome Project; Concept of Epigenomics, microRNA, long non-coding RNA; Concept of three dimensional genome 	8	
II	<ul style="list-style-type: none"> Functional Genomics: SAGE, characterize the proteome by ORF analysis, study of gene interactions by yeast two-hybrid system, study of developmental regulation by using DNA chips, Biomedical Genomics: Introduction to NGS-based targeted re-sequencing; Single cell sequencing; Experimental design: WES, Transcriptome, WGBS, ChIP-Seq; Concept of metabolomics; Molecular basis of genetic variations leading to medical disorders: Types of genetic variations; Identification of human biomarkers using genomics; Concept of Genome-wide association studies (GWAS), related databases and its limitations 	8	
III	<p><i>Impact of genomics in human development & healthcare</i></p> <p>Principles of inheritance and working with family-based genetic disorders: autosomal dominant, autosomal recessive, X-linked, Y-linked, Mitochondrial; Genomics in child development and population-based carrier screening for genomic disorders: newborn screening, preconception carrier screening; Genomics of cardiovascular disease and cancer; Concept of pharmacogenomics; Concept of genetic counseling; Predicting disease in healthy (pre-symptomatic) people and its ethical concern</p>	6	

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IV

Tools and Techniques for Proteomics

6

1. From Genomics to Proteomics, Strategies of Protein Separation and quantification: 2D gel electrophoresis, Liquid chromatography in Proteomics. Strategies of identification: MALDI-TOF mass spectrometry, ESI-TOF MS and MS-MS methods; Protein chips in functional proteomics, Medical proteomics in disease diagnosis; Pharmaceutical proteomics in drug discovery

Suggested Readings:

1. Principles of Proteomics- Richard Twyman (Garland Science)
2. Principles of Gene Manipulation and Genomics- Primrose S & Twyman R, and Old (Blackwell Pub)
3. Genomes III - T. A. Brown. (Garland Science)
4. Human Molecular Genetics- T. Strachan and A. P. Read, (Garland Science.)
5. Principles of Genome analysis- S.B. Primrose and R. M. Twyman (Blackwell Pub)
6. Genomics: Application in Human Biology -S.B. Primrose and R. M. Twyman. (Blackwell Pub.)
7. Functional Genomics: A practical Approach- S. P. Hunt and R. Livesey (Oxford University Press.)
8. DNA Microarray: A practical approach - M. Schlena (Oxford University Press.)
9. Discovering Genomics, proteomics and Bioinformatics - A. M. Campbell and L. J. Heyer. (Pearson)
10. Essentials of Genomics and Bioinformatics by C. W. Sensen (John Wiley & Sons Inc.)
11. Proteomics- T. Palzkill (Kluwer Academic pub.)
12. Protein and Proteomics by Richard J Simson (I K Publishers.)
13. Introduction to Proteomics: by D. C. Liebler, Tools for the New Biology (Humana Press.)
14. Molecular Biology of the Cell - B. Alberts, D. Bray, J. Lewis et al, (Garland Pub. N.Y)
15. Genomics- Cantor & Smith (John Wiley & Sons)
16. Introduction to Proteomics- Nawin C. Mishra (John Wiley Sons. Inc.)
17. A Primer of Genome Science - G. Gibson and S.V. Muse. (Sinauer Associates. Inc. Pub)
18. Genetic Counseling- Arthur L Caplan (Taylor & Francis Ltd)
19. A Guide to Genetic Counseling- Wendy R. Uhlmann, Jane L. Schuette, Beverly Yashar (Wiley-Blackwell)

Course Books published in Hindi may be prescribed by the Universities and Colleges

This course can be opted as an elective by the students of following subjects:
The eligibility for this paper is 10+2 from Arts/Commerce/Science

Suggested Continuous Evaluation Methods:

House Examination/Test: 10 Marks


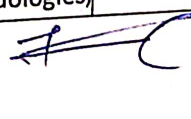
Written Assignment/Presentation/Project/Term Papers/Seminar: 10 Marks

Class performance/Participation: 5 Marks

Further Suggestions: None

SK
Neeraj for *ITC*

Programme/Class: Degree with research		Year: Fourth	Semester: Eighth
Subject: Genetics and Genomics			
Course Code: B130804T		Course Title: Computational Biology	
Course outcomes: The student at the completion of the course will be able to:			
Credits: 4		Core: Compulsory	
Max. Marks: 25+75= 100		Min. Passing Marks: 40	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0			
Unit	Topic	Total No. of Lectures (60)	
I	<i>Introduction to big data analysis</i> <ul style="list-style-type: none"> Introduction, distributed file system, Big Data and its importance, Drivers, Big data analytics, Big data applications. Algorithms, Matrix-Vector, Multiplication by Map Reduce; Data visualization. 	8	
II	<i>Handling of NGS data</i> <ul style="list-style-type: none"> Overview of different NGS data formats, Sequencing machine to raw sequence, Initial QC (e.g. Phred Score), Alignment, Post alignment processing, Depth and Coverage, Variant Calling, Annotation, data visualization (in IGV), Downstream analysis (PLINK, Haploview); handling of microarray data: data normalization, detection of over expression and under expression; handling of RNA sequencing data. 	7	
III	<ul style="list-style-type: none"> Principles of sequence annotation, resources for annotation, Coding sequence, intron-exon, promoter prediction: <i>in silico</i> structural and functional annotation of non-synonymous variants using various amino acid substitutions (AAS) tools; Access and uses of PANTHER database; use of PROMO-ALGGEN; <i>in silico</i> biophysical validation of variants using HOPE and NetSurfP; annotation of synonymous and intronic variants using different <i>in silico</i> tools - HSF, RegulomeDB, PredictSNP; visualization of the gene-gene interactions using GeneMANIA, protein-protein interactions using STRING, Pathway analysis. 	8	
IV	<ul style="list-style-type: none"> Molecular Modeling and Simulation: Force fields and their evaluation (e.g. AMBER); Monte Carlo and molecular dynamics simulations (e.g. GROMACS); Energy minimization techniques; Structure comparison using database formalisms (DALI, VAST); Drug designing: Classification of drug targets, characterization of drugs, Target discovery and validation methodologies, 	7	


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	Structure based drug design methods including computer-aided drug design (pharmacophore development) and recent technology developments; Target selection, Ligand (lead compound) design, optimization and analysis; Protein-ligand docking; QSAR; molecular descriptors; ADME parameters and their optimization; molecular diversity and CombiChem; case studies.	
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Suggested Readings:

1. Guidebook on Molecular Modeling in Drug Design - N.R. Cohen, Editor. (Academic Press.)
2. Introduction to Protein Structure - C. Branden and J. Tooze (Garland Publishing)
3. Molecular Modelling: Principles and Applications - Andrew Leach (Pearson Education)
4. Drug Discovery and Design - Scolnick, J., (Academic Press, London)
5. Bioinformatics - Principles and Applications - Z. Ghosh and B. Mallick (Oxford University Press)
6. Introduction to Computational Biology Maps, Sequences and Genomes - Michael S. Waterman (Chapman and Hall/CRC)

Course Books published in Hindi may be prescribed by the Universities and Colleges

This course can be opted as an elective by the students of following subjects: The eligibility for this paper is 10+2 with Biology as one of the subjects

Suggested Continuous Evaluation Methods:

House Examination/Test: 10 Marks

Written Assignment/Presentation/Project/Term Papers/Seminar: 10 Marks

Class performance/Participation: 5 Marks

Further Suggestions: None

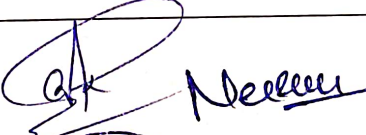

At the End of the whole syllabus any remarks/suggestions: None

GA
Neelam For *IF*

Programme/Class: Degree with Research		Year: Fourth	Semester: Eighth
Subject: Genetics and Genomics			
CourseCode: B130805P		CourseTitle: Advanced Molecular Biology, Instrumentation, Computational Biology Lab	
Courseoutcomes: The student at the completion of the course will be able to:			
Credits: 2		Core: Compulsory	
Max.Marks: 25+75= 100		Min. Passing Marks: 40	
TotalNo.ofLectures-Tutorials-Practical(inhoursperweek): L-T-P:0-0-4			
Unit	Topic	TotalNo.of Lectures(60)	
I	Advanced Molecular Biology Lab Core Experiments: 1. Introduction to Microbial culture/animal cell culture/plant tissue culture 2. Analysis of protein by SDS-PAGE 3. Western blotting and ELISA	15	
II	Advanced Experiments: 1. Isolation of genomic DNA from bacteria 2. Isolation of plasmid DNA & restriction enzyme analysis 3. Isolation of total RNA/poly-A mRNA and cDNA amplification by RT-PCR 4. Bacterial transformation & cloning, Selection of recombinant colonies 5. Real-time/quantitative PCR (q-PCR) 6. NGS library preparation 7. Targeted re-sequencing	15	
III	Instrumentation Lab 1. Spectroscopy: UV-Visible, fluorescence 2. NMR 3. AAS 4. Powder XRD 5. SEM 6. AFM 7. Phase contrast microscopy 8. Fluorescence microscopy 9. Confocal microscopy 10. Techniques for live cell imaging and fixed cells	15	

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IV	Computational Biology Lab <ol style="list-style-type: none"> 1. Introduction to Linux and common terminal commands 2. Python programming and packages 3. Information visualization using R, Python, Tableau/PowerBI 4. Acquisition and analysis of NGS data 5. Structural and functional annotation of variants 6. Pathway analysis 7. Molecular Modeling and Simulation 8. Drug designing 	15
V	Virtual Labs (Suggestive sites) https://www.vlab.co.in https://zoologysan.blogspot.com www.vlab.iitb.ac.in/vlab	
Suggested Readings: Course Books published in Hindi may be prescribed by the Universities and Colleges		
This course can be opted as an elective by the students of following subjects: The eligibility for this paper is 10+2 from Arts/Commerce/Science		
Suggested Continuous Evaluation Methods: House Examination/Test: 10 Marks Written Assignment/Presentation/Project / Term Papers/Seminar: 10 Marks Class performance/Participation: 5 Marks		
Further Suggestions: None		


 Neelesh For 
 Head
 Deptt. of Zoology
 Faculty of Science
 V.S.U., MEERUT

