

Name of the Programme: B. Sc (Hons) Biomedical Science (ACBR)

Detailed Structure of various DSC, DSE and GE courses to be followed from 2025-26

Sem.	List of Discipline Specific Core (DSC)	List of Discipline Specific Electives (DSE)	List of Generic Electives (GEs) along with mandatory GEs (in Bold Minimum 3) to be studied if a student wishes to make it a minor in Biomedical Science
	Sem. I & II		Sem. I & II (Category I; Level 100)
I	DSC-1-Bioorganic Chemistry		GE 1: Landmark Discoveries in Science
I	DSC-2-Cell Biology		GE 2: Pandemic: Challenges and Preparedness
I	DSC-3-Human Physiology and Anatomy I		GE 3: Understanding The Human Body Systems
II	DSC-4-Biochemistry		
II	DSC-5-Principles of Genetics		
II	DSC-6-Human Physiology and Anatomy II		
	Sem. III-VI	Sem. III-VI	Sem. III-VI (Category II; Level 200)
III	DSC-7-Medical Microbiology	DSE-1-Drug Design and Discovery	GE 4: Biochemical Basis of Life
III	DSC-8-Medicinal Chemistry	DSE-2-Fundamentals of Neuroscience	GE 5: Concepts in Medicinal Chemistry
III	DSC-9-Biostatistics	DSE-3-Green Chemistry Methods in Pharmaceutical and Industrial Applications	GE 6: Environment Sustainability and Biomedical Waste Management[%]
IV	DSC-10-Immunobiology	DSE-4-Industrial Microbiology	GE 7: Genetic Basis of Diseases
IV	DSC-11-Molecular Biology	DSE-5-Intellectual Property Rights for Biologists	GE 8: Health and Body Defense System
IV	DSC-12-Pharmacology	DSE-6-Medical Biochemistry	GE 9: Practices in Biosafety[%]
V	DSC-13-Genome Organization and Function	DSE-7-Medical Laboratory Technology	GE 10: Statistical Concepts in Biology
V	DSC-14-Medical Biotechnology	DSE-8-Proteins and Enzymes	GE 11: Diseases in Everyday Life
V	DSC-15-Human Pathology	DSE-9-Research Methodology*	
VI	DSC-16-Biophysics	DSE-10-Social and Preventive Medicine	
VI	DSC-17-Human Genetics		
VI	DSC-18-Toxicology		
VII	DSC-19-Bioinformatics and Omics		

	Sem. VII-VIII	Sem. VII-VIII	Sem. VII-VIII (Category III; Level 300)
VIII	DSC-20-Developmental Biology	DSE-11-Advanced Cell Biology	GE 12: Concepts in Biotechnology
		DSE-12-Advances in Pharmaceutical Science	GE 13: Pathological Basis of Disease
		DSE-13-Protein Structure and Function: Advanced Concepts and Biomedical Applications	GE 14: Pharmacological Science
		DSE-14-Advanced Bioorganic Chemistry	GE 15: Toxic Substances and Human Health
		DSE-15-Advanced Techniques in Forensic Sciences	
		DSE-16-Immune Response to Infection and Diseases	
		DSE-17-Model Organisms in Biomedical Research	
		DSE-18-Advanced Molecular Biology and Genetic Engineering	
		DSE-19- Bridging Ancient Medicine and Practices with Modern Biomedical Research	
		DSE-9-Research Methodology*	

- # The Generic Elective Paper titled as “Understanding Genetic Basis of Diseases” has been renamed as “Genetic Basis of Diseases”. The course content for the previously approved Generic Elective paper entitled “Drug and Vaccine” has been revised and updated under the new title, “Pharmacological Science.” Consequently, the earlier approved “Drug and Vaccine” Generic Elective paper has been officially withdrawn.
- ** New GE Courses for which syllabus is included here. For rest of the GE courses, syllabus is already approved and available on the University portal.
- % The two red highlighted courses have been transferred from the Discipline-Specific Elective (DSE) pool to the Generic Elective (GE) pool, with their syllabi unchanged. These are to be considered as GE courses.
- *Research Methodology shall be offered as one of the DSE courses in the VI and VII semester. Students can opt it in either VI or VII semester. However, Students planning to pursue a 4 year UG program are advised to choose research methodology in the VI semester.

ACBR

Category-I

BSc. (HONS.) Biomedical Sciences

DISCIPLINE SPECIFIC CORE COURSE– 4 (DSC-4): Biochemistry

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Biochemistry	04	03	0	01	Class pass XII	NIL

LEARNING OBJECTIVES

The objective of this course is to effectively incorporate the fundamentals of metabolism through key biochemical pathways and make learners appreciate the requirement for the stringency of their regulation; introduce various biochemical techniques used in the characterization of the proteins and a detailed account on how enzymes function: their kinetics, regulation and inhibition.

COURSE OUTCOMES

- Students will gain an understanding of fundamental biochemical principles of metabolism of biomolecules (Carbohydrates, Proteins, Lipids and Nucleic acids) and the associated bio- energetics. They will learn the biochemical reactions in metabolic pathways and understand their interrelations, logics and patterns.
- They will also understand the role of enzymes in the biochemical reactions and the connection between biochemical defects and metabolic disorders. Students would additionally gather a firm understanding and relevance of stringent regulation of metabolic pathways.
- Having understood the structural architecture of proteins in earlier semesters, students shall learn how biological molecules (especially proteins) are characterized through various analytical techniques such as types of column chromatography methods, Polyacrylamide Gel Electrophoresis (PAGE) that are used in contemporary biochemistry research laboratories.
- Students will get a grasp on central concepts underlying enzyme catalysis, kinetics and their mechanism of action. Effects of different kinds of enzyme-inhibitors will also be learned.
- Students would learn how coenzymes assist enzymes in catalyzing biochemical reactions and what is the criterion for their classification.
- Having studied the role of enzymes that regulate metabolic pathways in the third unit, students would learn the general properties of regulatory enzymes, their activity and kinetics.

COURSE CONTENT:

Unit I: Metabolic pathways and their allosteric regulation	(22 hrs)
Carbohydrates - Glycolysis, Gluconeogenesis, Tricarboxylic acid cycle and their regulation, Cori cycle, Hexose monophosphate shunt. Lipids - Mobilization of triglycerides, Metabolism of glycerol, Biosynthesis and β -oxidation of saturated fatty acids (palmitic acid) and their regulation. Significance of ketone bodies. Proteins - General over view, Transamination, Deamination, Glucose-Alanine cycle, Urea cycle and its regulation. Nucleic acid - General overview, an outline of purine and pyrimidine metabolism. Electron transport chain, Oxidative phosphorylation and Substrate-level phosphorylation.	
Unit II: Analytical methods in protein characterization	(08 Hours)
Introduction to spectrophotometry & Lambert-Beer's law, Column chromatography: Ion exchange chromatography, Gel filtration and Affinity chromatography, SDS-PAGE	
Unit III: Enzymes	(07 Hours)
Introduction to enzymes, Concept of Lock & key and 'Induced fit theory, Concept of activation energy and binding energy. Enzyme kinetics: Michaelis-Menten equation and its physiological significance. Concept of enzyme inhibition: types of inhibitors (competitive & non-competitive) and their examples.	
Unit IV: Coenzymes	(04 Hours)
Classification: various types and their function.	
Unit V: Regulatory Enzymes	(04 Hours)
General properties of allosteric enzymes. Enzyme regulation by covalent modification. Zymogens.	

PRACTICAL – 30 Hours

(Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Measurement of absorbance & %transmittance of a solution using spectrophotometer/colorimeter.

2. Preparation of standard plot and estimation of protein concentration by any one method: Biuret/Lowry/Bradford.
3. Estimation of glucose concentration by an enzymatic/non-enzymatic method.
4. Separation of biomolecules (sugar/amino acids) by thin-layer chromatography (TLC).
5. Separation of biomolecules by gel filtration/Calculation of void volume of Sephadex G-25 column, using Blue Dextran.
6. Analysis of SDS-PAGE as a separation technique (gel analysis).
7. To perform an assay of an enzyme under optimal conditions.
8. Determination of K_m , V_{max} and K_{cat} value of a given enzyme from the provided experimental data.

SUGGESTED READINGS:

- Nelson, D. L., & Cox, M. M. (2021). *Lehninger: Principles of Biochemistry* (8th ed.). Macmillan. ISBN:9781319322328
- Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology (2018). 8th ed. Hofmann A. and Clokie S.(Eds.) Cambridge University Press, Cambridge, U.K.
- Plummer, D.T. (2012). *An Introduction to Practical Biochemistry*. New Delhi, India: McGraw-Hill College.
- S. K. Sawhney / Randhir Singh. (2009): Introductory Practical Biochemistry, Narosa Publishers, ISBN-13 : 978-8173193026
- Donald Voet, Judith G. Voet (2021) Voet's Biochemistry, Adapted ed 2021, ISBN: 9789354243820.

BOOK FOR BASIC CONCEPTUAL READING

- Berg, J., Gatto, G., Stryer, L. and Tymoczko, J. L. (2019). *Biochemistry*. New York, USA: W. H. Freeman and Company.
- Devlin, (2011). *Textbook of biochemistry with clinical correlations*. UK: Wiley T & Sons.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE– 5 (DSC-5): PRINCIPLES OF GENETICS

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Principles of Genetics	04	03	0	01	Class XII pass	NIL

LEARNING OBJECTIVES:

The course intends to introduce students to Mendelian principles of inheritance, deviations from Mendelian inheritance and extra-nuclear inheritance, Introduction to pedigree analysis for autosomal and X-linked traits, Understanding of differences between prokaryotic and eukaryotic genome organization, transposons, and basic cytogenetics and Understanding of mechanisms of sex determination.

COURSE OUTCOMES:

- The flavour of genomics as a progression from Mendelian genetics will be introduced to the students. They will learn about classical experiments that led to discovery of the genetic material. They will also learn the structure of DNA.
- Students will be able to explain Mendelian laws of inheritance, deviations from monohybrid ratio (incomplete dominance, codominance, multiple alleles and lethal genes) and deviations from dihybrid ratio (gene-gene interactions, linkage). They must be able to distinguish sex-linked, sex-limited and sex-influenced traits. Students must also be able to interpret patterns of inheritance for autosomal and X-linked traits from pedigrees.
- Students would learn the concept of extra-nuclear inheritance.
- Students would learn the differences in genomes of prokaryotes and eukaryotes. They would also learn about transposable genetic elements with examples from prokaryotes and eukaryotes.
- The lectures will cover details of the structure of the chromosomes, the abnormalities that commonly occur at chromosomal level. Discussion of various types of mutations at the DNA level (deletion, addition, substitution), their consequence on gene structure/product and the diseases associated with these abnormalities.
- Students would gain insights into genetic and environmental sex determination mechanisms.

COURSE CONTENT:

Unit I: Overview of Changing Paradigms in Genetics	05 Hours
A brief overview of how genetic principles took shape, leading to the concept of a blueprint of life within the cell to the physical entity of DNA. Basic structure of DNA, salient features of the double helix, semi-conservative replication– Meselson and Stahl experiment. Also mention the surprises we have from genomics such as genetic variation between individuals. There are popular videos/presentations that can be used. The purpose is to ignite the curiosity of the students.	
Unit II: Concept of Genetic Inheritance	15 Hours
Concept of alleles, haploid and diploid status, phenotype and genotype, Mendel's laws of inheritance, dominant and recessive inheritance, test, back and reciprocal crosses with two examples each. Chromosomal theory of inheritance. Concept of linkage and crossing over, cytological proof of crossing over, genetic mapping: two and three-point cross over. Distinguishing recombination and complementation. Allelic interactions- dominance relationships- complete, incomplete and co-dominance, gene-gene interactions. Sex linked, sex-limited and sex-influenced traits. Gathering family history, pedigree symbols and construction of pedigrees for autosomal and sex linked traits (dominant and recessive).	
Unit III: Extra Nuclear Inheritance	05 Hours
Criteria for extra nuclear inheritance, plastid inheritance in <i>Mirabilis jalapa</i> , kappa particles in <i>Paramecium</i> , maternal effect- snail shell coiling, cytoplasmic inheritance (mitochondria and chloroplast).	
Unit IV: Genome Organization	07 Hours
Organization of Genomes in prokaryotes and eukaryotes. Establishing the Central Dogma. Nucleosomes organization and assembly. Euchromatin, heterochromatin- constitutive and facultative heterochromatin. Structure and significance of polytene and lampbrush chromosomes. Transposable genetic elements: Prokaryotic transposable elements- IS elements, Composite transposons; Eukaryotic transposable elements- Ac-Ds system in maize; Uses of transposons.	
Unit V: Cytogenetics and Mutations	08 Hours

Chromosome: Structure- centromere and telomere, types of chromosomes based on centromere. Karyotyping- banding pattern and nomenclature (G and Q banding). Structural abnormalities (Duplication, Insertion, Deletion, Translocation-Reciprocal and Non-Reciprocal) and associated syndromes. Numerical abnormalities (Aneuploidy and Euploidy) and associated syndromes. Spontaneous and induced mutations. Types of mutations: Point (Non-sense, miss-sense, silent, frameshift, insertion, deletion). Effects on the Gene products- loss of function and gain of function.	
Unit VI: Introduction to Mechanisms of Sex Determination	05 Hours
Chromosomal theory of sex determination, mechanisms of sex determination, environmental factors and sex determination in human and <i>Drosophila</i> . Barr bodies and dosage compensation.	

PRACTICAL – 30 Hours

(Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Observation of wild type and mutant phenotypes in *Drosophila*.
2. Preparation of culture media for *Drosophila* and study different stages of the life cycle of *Drosophila*.
3. Verification of Mendelian laws through *Drosophila* seeds – dominant, recessive and sex-linked
4. Study of Barr bodies.
5. Karyotyping with the help of photographs (normal and abnormal karyotypes).
6. Pedigree charts of some common characters like blood group, color blindness and PTC tasting.
7. Study of diploidy in onion root tip.
8. Study of polyploidy in onion root tip by colchicine treatment.
9. Study of polytene chromosomes.

SUGGESTED READINGS:

- Klug, W. S., Cummings, M., Spencer, C. A., Palladino, M. A., Darrell K. (2019). 12th Edition. *Concepts of genetics*. San Francisco, NY:Pearson ISBN-13: 9780134604718.
- Snustad, D.P. and Simmons, M.J. (2019). 7th Asia Edition. *Principles of genetics*. New York, USA: John Wiley and Sons. ISBN-13: 9781119657552.
- Gardner E. J., Simmons M. J. and Snustad D. P. (2006). 8th edition *Principles of genetics*. USA. Wiley. ISBN-13: 978-8126510436.

BOOK FOR BASIC CONCEPTUAL READING

- Cooper, G. M. and Hausman, R. E. (2019). 8th Edition. *The cell: A molecular approach*. Massachusetts, USA: Sinauer Associates. ISBN-13: 978-1605358635.
- Hardin, J., Bertoni, G. P., Becker, W.M. (2017). 9th Edition. *Becker's world of the cell*. NY:Pearso. ISBN-13: 978- 0805393934.
- Karp, G., Iwasa, J., Marshall W. (2018). 8th Edition. *Karp's Cell Biology*. New Jersey, USA: Wiley. ISBN-13: 978-1119456292.
- Kornberg, A. (2005). 2nd Edition. *DNA replication*. California, USA: University Science Books. ISBN-13: 978-1891389443.
- Griffith A. J. F., Wessler S. R., Carroll S. B. and Doebley J. (2011). 9th edition. *Introduction to Genetic Analysis*. W H Freeman & Co. ISBN-13 : 978-0716768876.
- Elrod, S and Stansfield, W. (2010). 5th edition. *Schaum's Outline of Genetics*. McGraw Hill. ISBN-13: 978-0071625036

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE– 6 (DSC-6): Human Physiology and Anatomy II

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Human Physiology and Anatomy II	04	03	0	01	Class XII pass	NIL

LEARNING OBJECTIVES:

- The course curriculum is a systematic presentation of physiological concepts to ensure appropriate depth and breadth of basic functioning of the human body and its interrelations with respect to heart, lung, kidney, gonads, endocrine glands and digestive system.
- It would give students exposure of physiological concepts needed as foundations for further studies in pharmacology, pathology and pathophysiology etc.
- It would provide a base to understand body defenses and the mechanisms of deranged function of human body
- The curricular objectives are focused primarily on normal body function. Accordingly, wherever possible clinical examples have been illustrated to the underlying physiological principles.

COURSE OUTCOMES:

Having successfully completed this course, students shall be able to learn and appreciate:

- The students will learn appreciate the structure and functioning of heart, pattern and significance of blood flow in the blood vessels, heart sounds, ECG and purpose of lymph and lymphatic circulation.
- The students would correlate how structure and function of lungs are so intricately designed and how they function with its blood flow and help giving vital oxygen to body. They would develop understanding for neural control and other regulators of respiration and understand daily phenomenon like coughing, sneezing, yawning etc.
- Kidneys are vital organs and students would learn the functional anatomy of a nephron and how it contributes in removing the toxic waste from our body in form of urine. The curriculum would outline the process of micturition and abnormalities associated with it. It would also highlight the role of kidney in controlling pH of the body and preventing acidosis/alkalosis
- The students would have insight into the anatomy of the female and male reproductive systems, including their accessory structures. The student would understand the role of hypothalamic and pituitary hormones in reproductive system. Trace the route of a sperm mother cell from its production till it can fertilize an oocyte. Explain the events in the ovary prior to ovulation, development and maturation of the sex organs and the emergence of

secondary sex characteristics during puberty.

- The students would be able to integrate the role of the endocrine system to maintain homeostasis in human body. Understand the chemical composition mechanisms of hormone action, their site of production, regulation, and effects of hormones of the pituitary, thyroid, parathyroid and adrenal, glands. Hormonal regulation of the reproductive system. The role of the pancreatic endocrine cells in the regulation of blood glucose In addition the contributions of hormones released by the heart, kidneys, and other organs with secondary endocrine functions. The student would be aware of several common diseases associated with endocrine system dysfunction.
- Students would be able to understand the organs of the alimentary canal from proximal to distal, and understand their function. Identify the accessory digestive organs and their functions. Describe the histology that is four fundamental tissue layers of the digestive tract. Contrast the contributions of the enteric and autonomic nervous systems to alimentary tract functioning. Gain awareness about common dysfunctions of digestive system like constipation, gastritis, ulcers, diarrhea etc.

COURSE CONTENT:

Unit-I: Cardiovascular System	09 Hours
Functional Anatomy of heart, The Cardiac Cycle, Electrocardiogram. Circulatory system: Bloodvessels, hemodynamics and regulatory mechanisms, Lymphatic circulation - hemodynamics and regulation, micro-circulation	
Unit-II: Respiratory system	09 Hours
Functional Anatomy of the respiratory system. Mechanisms of pulmonary ventilation, alveolarventilation, gaseous exchange, transport of gases, respiratory and nervous control and regulation of respiration	
Unit-III: Renal Physiology	06 Hours
Body fluid and electrolytes: their balances and imbalances. Functional Anatomy of kidney,Histology of nephron and its physiology, Urine formation, renal regulation of urine volume and osmolarity, acid-base balance. Urinary bladder: structure, micturition and its regulation	
Unit-IV: Reproductive System	06 Hours
Structure and function of male and female reproductive organ. Function and regulation of testicularand ovarian hormones. Gametogenesis (oogenesis and spermatogenesis), fertilization, implantation, parturition and lactation, menopause and basic concepts of infertility.	
Unit-V: Endocrine System	09 Hours

General mechanism of hormone action, Structure, function and regulation of the following glands and their secretions: Pituitary, Hypothalamus, Thyroid, Parathyroid, Adrenal, and Pancreas. Basic concepts about hypo and hyper secretion of hormones.	
Unit-VI: Gastrointestinal system	06 Hours
Anatomy and histology of digestive tract, gastrointestinal physiology: General principles of gut motility secretion, digestion, absorption and assimilation. Gastrointestinal hormones: their formation and action. Physiological anatomy and functions of liver and pancreas.	

PRACTICAL – 30 Hours

(Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Physiological data acquisition based experiments (ECG).
2. Physiological data acquisition-based experiments (EMG).
3. Physiological data acquisition-based experiments (PFT).
4. Blood Pressure recordings in humans.
5. Determination of specific gravity of blood.
6. Determination of osmotic fragility of RBC.
7. To study various types of contraceptives (condoms, IUD's, oral and injectable contraceptives)
8. To study different human organs and their sections through permanent slides. T. S. of thyroid, liver, thymus, spleen, ovary, artery, vein, capillaries, testis, pancreas, esophagus, adrenal, kidney (cortex and medulla), urinary bladder, urethra, fallopian tubes, epididymis, prostate glands, lungs, trachea, bronchioles, pituitary, heart. (Minimum 8 slides covering the systems mentioned in theory.)

SUGGESTED READINGS:

- Guyton and Hall Textbook of Medical Physiology, 14th edition (2020), J. E. Hall; W B Saunders and Company, ebook ISBN: 978-0-3236-4003-9; Hardcover ISBN: 978-0-3235-9712-8
- Human Physiology, 16th edition (2011), Stuart I. Fox; Tata McGraw Hill, ISBN10: 1260720462; ISBN13: 978-1-26-072046-4.
- Principles of Anatomy and Physiology, 16th edition (2020), Gerard J. Tortora and Bryan H. Derrickson; Wiley and Sons, ISBN: 978-1-119-66268-6. (e book), ISBN: 978-1-119-70438-

**GENERIC ELECTIVES (BIOMED-GE-04): PANDEMIC: CHALLENGES
AND PREPAREDNESS**

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Pandemic: Challenges and Preparedness BIOMED-GE- 04	4	3	-	1	XII Passed	Basic knowledge of Biology-

Learning Objectives

The Learning Objectives of this course are as follows:

- Current scenario of covid outbreak all over the world made everyone curious about pandemic, its challenges and how to prepare for dealing with it.
- In this context we designed this paper to make students aware about pandemics caused by various pathogens.
- Course describes different pandemic outbreaks and strategies adapted to combat the transmission of pathogen and their neutralization.
- The course also explains the different therapeutic approaches for the elimination and cure of patients suffering from pandemic infections.

Learning outcomes

The Learning Outcomes of this course are as follows:

- This unit helps students to understand the difference between endemic, epidemic and pandemic.
- It makes students familiar with various pandemics that have spread in last century and are caused by different types of pathogens such as virus, bacteria and fungi.
- Students will learn extent of spread of pandemic worldwide, its timeline, death rate and other statistical data.
- This unit will explain about the infectious diseases and process of invasion by microbes.

- It will also helpful to understand preventive measures of infection transmission and about mutant strains which are associated with recurrent outbreaks.
- Students will learn about different treatment strategies for the patients suffering from any infection, along with specific precautions for handling patients with co-morbidities/ elderly persons. The content of this unit will be helpful to explain about plasma therapy and booster doses. Some basic concept of psychological counselling will help to reduce the depression and anxiety faced by individuals during pandemic outbreak.
- This unit describes different methods and equipments used during an out breaks to minimize the contamination and cross transmission of infection and its spread.
- This will help students to learn the usage of PPE kits, mask, sanitization, quarantine and significance of social distancing.
- Current unit, emphasizes about the history of vaccine, process of active and passive immunization, different types of vaccines and their effectiveness to control any pandemic, vaccines developed in India against covid-19.
- Students will learn hands-on training for important techniques used in the detection and diagnosis of various types of pathogens and associated protocols.
- Last unit of the course will focus on awareness and sensitization programs (eg. SOPs), health and hygiene and many issues related to public health. Also possible global approach to strengthening the health infrastructure and disease surveillance shall be elaborated.

SYLLABUS OF BIOMED-GE-04

Unit I: Introduction to Pandemics:

(07 Hrs)

General concepts of endemic, epidemic and pandemic; Historical background of pandemics: Rabies, plague, small pox, cholera, Spanish Influenza, AIDS, Avian bird flu, Swine flu, MERS, SARS and covid-19 pandemic. Timeline of Covid- 19. Extent of spread, worldwide statistics and death rate. Statistics of affected nations worldwide and in India; symptoms, extent of spread and containment

Unit II: Infectious Disease:

(05 Hrs)

Structure of causative agent, invasion into human body, etiology and strategies currently used to block infection process, common mutant strains responsible further outbreaks of the pandemics

Unit III: Emerging Therapies, Natural Protection and strengthening immune system:

(06 Hrs)

Drugs used to cure Avian bird flu, Swine flu and covid-19. First line of treatment at home additional care of person with co-morbidities / elderly person. Convalescent plasma therapy, Placebo effect, alternative therapies and immunity boosters used during pandemic and psychological counseling and countering depression.

Unit IV: Precautions and Prevention:

(06 Hrs)

Quarantine protocol at home, for frequent fliers, hospital exposure, and workplace exposure. Precautionary measures such as PPE clothing, gloves, masks, social distancing, frequent washing of hands with soap, use of sanitizers, disinfection strategies.

Unit V: Vaccines: An effective tool for prevention of pandemics:

(09 Hrs)

Historical perspective of vaccination, active and passive immunization; Vaccination drive, types of vaccines: Live attenuated vaccines, inactivated vaccines, subunit vaccines, multivalent vaccine, recombinant vector vaccines and DNA vaccines. Types of vaccines developed against Covid-19 worldwide, Their effectiveness and side effects. Vaccines developed in India for adults (Covaxin and Covishield) and vaccines for children. Limitations in effective development of covid-19 vaccine.

Unit VI: Techniques for diagnosis and detection of disease:

(06 Hrs)

Antigen-antibody based detection techniques: Lateral flow technique, RAPID and RT-PCR test with complete protocol. Probes for virus detection.

Unit VII: Challenges and Preparedness:

(06 Hrs)

Awareness and sensitization programs (SOPs) about general health and hygiene. Funding in research on issues related to public health and protection of environment. Global health approach with multidisciplinary collaborations. Pandemic preparedness and disease surveillance with strong health infrastructure.

Practical component

(30 Hrs)

(Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. A case study of any one pandemic of past.
2. A case study of any one emerging pandemic.

3. Detection and diagnosis using antigen and antibody in the sample.
4. Demonstration of the PCR machine
5. Video demonstration of Covid-19 lateral flow technique
6. Demographic analysis of extent of spread both national and international.
7. Project work

Essential readings:

- Park, K. (2021), 26th Edition, *Park's Textbook of Preventive and Social Medicine*, Banarsidas Bhanot Publisher, ISBN-13 : . 978-9382219163
- Madigan M. T, Bender K.S, Buckley D.H, Sattley W.M, Stahl D.A (2021) 16th edition, Brock Biology of Microorganisms, Pearson Publisher, ISBN-139780135861717.
- Punt, J. Stranford, S. Jones, P. and Owen, J. (2019). 8th Edition. Kuby Immunology. New York, USA: W.H. Freeman and Company. ISBN- 13: 978-1464189784.
- Willey, J., Sherwood, L., and Woolverton, C.J. (2016). 10th Edition. Prescott's microbiology. New York, USA: McGraw-Hill Education. ISBN-13: 978-1259281594.

Suggestive readings:

- Bonita, Ruth, Beaglehole, Robert, Kjellström, Tord & World Health Organization. (2 (2006nd edition. *Basic Epidemiology*, World Health Organization, ISBN 978 92 4 154707 9.

GENERAL ELECTIVE -10 (BIOMED-GE -10): UNDERSTANDING THE HUMAN BODY SYSTEMS

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Understanding The Human Body System BIOMED-GE-10	4	3	-	1	XII Passed	Basic knowledge of Biology

Learning Objectives

The Learning Objectives of this course are as follows:

- This is an introductory course dealing with the structure and function of the human organism and the issues facing the human in today's world.
- It is intended for students with limited science background. It would make them familiar with basic physiological concepts.

Learning outcomes

The Learning Outcomes of this course are as follows:

- Students will have an increased understanding and appreciation for the workings of the human body. They will be familiar with the terminology and physiology of the major organ systems
- They will be able to explain the relation between form and function in biology, as expressed in molecular, cellular, and whole-organism physiology.
- Students will be able to recognize the anatomical structures and explain the physiological functions of the body systems.
- Recognize the anatomical structures and explain the physiological functions of the body systems. Develop scientific terminology to describe the parts and processes of the human body.

SYLLABUS OF BIOMED-GE-10:

Unit I: Body organization and Integumentary system

(05 Hrs)

General Anatomy of the body, Introduction to various kinds of body planes, cavities and their membranes, Tissues level of organization and classification (Types, origin, function & repair). Structure and functions of human skin. Blood as connective tissue

Unit II: Nervous System**(06 Hrs)**

Organization of the Central and Peripheral nervous system. Motor and sensory physiology. Nerve Physiology and Sensory Physiology (Special Senses)

Unit III: Muscular and Skeletal System**(04 Hrs)**

Functional anatomy of muscular system, types of muscles, neuromuscular junction structure property and transmission, General characteristics of muscle contraction using skeletal muscle as example.

Unit IV: Cardiovascular and Respiratory System**(06 Hrs)**

Functional Anatomy of heart, The Cardiac Cycle, Electrocardiogram.

Circulatory system: Blood vessels, hemodynamics and regulatory mechanisms.

Lymphatic circulation - hemodynamics and regulation, micro-circulation

Functional Anatomy of the respiratory system. Mechanisms of pulmonary and alveolar, gaseous exchange, transport of gases, respiratory and nervous control and regulation of respiration.

Unit V: Endocrine System**(06 Hrs)**

General mechanism of hormone action, Structure, function and regulation of the major gland of the body: Pituitary, Hypothalamus, Thyroid, Pancreas and Adrenals. Basic concepts about hypo and hyper secretion of hormones.

Unit VI: Gastrointestinal system**(06 Hrs)**

Anatomy and histology of the digestive tract. General principles of gut motility secretion, digestion, absorption and assimilation.

Unit VII: Renal Physiology**(06 Hrs)**

Functional anatomy of kidney, histology of nephron and its physiology, process of urine formation. Urinary bladder: structure, micturition and its regulation

Unit VII: Reproductive System**(06 Hrs)**

Structure and function of male and female reproductive organs. Basic concepts of gametogenesis (oogenesis and spermatogenesis), fertilization, implantation, menopause and contraception.

Practical component**(30 Hrs)**

(Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. To prepare a blood smear and identify different types of white blood cells.
2. Estimation of hemoglobin (Sahli's method)
3. Physiological data acquisition based experiments (ECG/PFT/EMG).
4. Blood Pressure recordings in humans.
5. To study a simple reflex arc
6. To study the sensation of taste, touch and smell.
7. To study various types of contraceptives (condoms, IUD's, oral and injectable contraceptives)
8. To study different human organs and their sections through permanent histological slides
T.S. of brain, spinal cord, skeletal fibers, cardiac muscles, skeletal muscles, T. S. of thyroid, liver, thymus, spleen, ovary, artery, vein, capillaries, testis, pancreas, esophagus, adrenal, kidney (cortex and medulla), urinary bladder, fallopian tubes, epididymis, lungs, trachea, heart.(Minimum 8 slides covering the systems mentioned in theory.)

Essential readings:

- Guyton and Hall Textbook of Medical Physiology, 14th edition (2020), J. E. Hall; W B Saunders and Company, ebook ISBN: 978-0-3236-4003-9; Hardcover ISBN: 978-0-3235-9712-8
- Principles of Anatomy and Physiology, 16th edition (2020), Gerard J. Tortora and Bryan H. Derrickson; Wiley and Sons, ISBN: 978-1-119-66268-6. (e book), ISBN: 978-1-119-70438-6 (for print book).
- Textbook of Practical Physiology, 9th edition (2019), CL Ghai; Jaypee Publication, ISBN-9789352705320.
- Human Physiology, 16th edition (2011), Stuart I. Fox; Tata McGraw Hill, ISBN10: 1260720462; ISBN13: 978-1-26-072046-4.

Suggestive readings:

- Ganong's Review of Medical physiology, 26th edition (2019), K. E. Barrett, S. M. Barman, S. Boitano and H. Brooks; Tata McGraw Hill, ISBN 978-1-26-012240-4 (for ebook) ISBN:978-1-26-012241-1 (for print Book)

Essential readings

- Cantor, C. R. and Smith, C. L. (2004). 1st Edition. Genomics: The science and technology behind the human genome project. New York, USA: John Wiley and Sons. ISBN-13: 978-0471461869.
- Old, R. W. and Primrose, S. B. (1994). 7th Edition. Principles of Gene Manipulation: an Introduction to Genetic Engineering. Boston: Wiley. ISBN-13: 978-0632037124.
- Joseph Sambrook, E.F. Fritsch, T. Maniatis. (1989). 2nd Edition. Molecular Cloning: A Laboratory Manual. New York, USA: Cold Spring Harbor Laboratory. Press ISBN- 978-0879693732.

Suggestive readings

- Glick, B. R. and Patten, C. L. (2022). 6th Edition. Molecular Biotechnology: Principles and Applications of Recombinant DNA. USA: ASM press, ISBN-13: 978-1683673668.
- Brown, T. A. (2020). 8th Edition. Gene cloning and DNA analysis: An introduction. New York, USA: John Wiley and Sons, ISBN-13: 978-1119640783.
- Karp, G. (2016). 8th Edition. Cell and Molecular Biology: Concepts and Experiments. United states: Wiley. ISBN-13: 9781538832462.
- Primrose, S. B. and Twyman, R. B. (2014). 7th Edition. Principles of Gene Manipulation and Genomics. New York, USA: John Wiley and Sons. ISBN-13: 978-1118653883.
- Green, M. R. and Sambrook, J. (2012). 4th Edition. Molecular Cloning: A Laboratory Manual (three-volume set). New York, USA: Cold Spring Harbor Laboratory Press ISBN-13: 978-1936113422

GENERIC ELECTIVES (GE-2): LANDMARK DISCOVERIES IN SCIENCE

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
LANDMARK DISCOVERIES IN SCIENCE	4	3	-	1	The student should have studied science (Biological science/physical sciences)	NA

Learning Objectives

The Learning Objectives of this course are as follows:

The objective of the course is to ensure students appreciate the convenience and comfort that they have is all because of discoveries and inventions of the past. Meticulous execution of historical experiments in very little resources would also motivate them towards doing valuable research with enormous facilities that they have. The historical accounts of science provide grounds for interpretation and may be useful in arousing appreciation of science. The course would provide: Detailed analysis of classically designed and executed experiments in Life Sciences over the years. It will provide a foundation of biology by uncovering various players in the machinery of biological processes. It will also be helpful in technical, scientific analysis with historical background for a robust understanding of various discoveries. Critical

analysis of the history of biology would surely help students comprehend futuristic scientific discoveries.

Learning outcomes

The Learning Outcomes of this course are as follows:

The students will be able:

- Students will be able to learn how was light manipulated during the past to peer into previously invisible world—those too small or too far away to be seen by the naked eye.
- Students will learn about experiments that had fundamental contribution to our present understanding of key molecular elements of life. They will understand how to examine microbial cells and colonies, using various techniques to manipulate color, size, and contrast in ways that helped Scientists to identify species and diagnose disease.
- Studying this unit, students would come to know that there were three group of Naturalists working simultaneously to find answers to inheritance, evolution and basic composition of life. Students will be divulged with hereditary aspects of life. They will get familiar with genes and their roles in living organisms.
- Having understood the relationship of genes and inheritance, students would find interesting to learn the mystical molecule that make up these genes. Sequential study of these experiments would step by step unravel the mystery of genetic material.
- Students at this point of course would be curious to know the structure of molecule that forms the genetic material. They would learn how the information present on DNA manifests itself as specific characteristic features and help in diversity among organisms.
- Students will be explained how the in depth knowledge about became the most important tool for in vitro research, modification and applications thereof.
- Students will be briefed about some landmark discoveries which helped the field of medicine to grow tremendously and played a significant role in improving the overall health of the human population.
- Students can be given small projects to write discoveries done in conventional way.
- They will be required to provide a descriptive view of the topics assigned to them. Students should highlight the research topic with reference to current understanding.

SYLLABUS OF GE-2

UNIT – I View of the invisible Biology

(6 Hours)

Rudimentary microscopes to magnify objects; Use of eye glasses as simplest microscopes - Flea or fly glasses; Observing nature in the new world under lens; Book of Optics; Scientific use of Microscopes; Importance of Malphigi microscope that used field lens; Compound Microscope; Robert Hooke's observations in Micrographia; Foldscope by Manu Prakash

UNIT – II Origin of Life – A question

(6 Hours)

Spontaneous generation versus biogenesis; Problem of spores; Microbiology and Medicine - Germ theory of Disease; Recognition of agents of infection – Koch's Postulates.

UNIT – III Understanding Biology by observations

(6 Hours)

A) Study of evolution of life: Darwins Theory (B) Study of Inheritance of Life: classical era with contributions of Aristotle, Epicurus, and others; Modern genetics: Gregor Johann Mendel, his work on pea plants, theory of Mendelian inheritance (C) Study of composition of Life : Levels of cellular and molecular organization; Cells, tissues and organs in our body; Pioneers of chromosome studies; Discovery of nucleic acids; Nuclein verified as a distinct chemical entity; Early identification of purines and pyrimidines; building blocks of Nucleic

acids and proteins; Chemistry of Nucleic acids; Levene's tetranucleotide hypothesis.

UNIT – IV DNA as the hereditary material – An experimental view (4.5 Hours)

Transformation: Classic work of Frederick Griffith; DNA as the Pneumococcal Transforming Factor; In vitro Transformation system; Announcement that the transforming Principle was DNA; Mirsky's Criticism; The Avery, MacLeod and McCarty proclamation; Additional experiments that supported DNA as the transforming principle; Hershey and Chase clinched the role of DNA as the Genetic Material

UNIT – V Solving the puzzle of DNA structure (4.5 Hours)

Early studies of diffraction of X Rays by DNA fibers – contributions of Rosalind Franklin; Use of X – rays in medicines and research; Erwin Chargaff's discovery of base complementarity in DNA; Watson and Crick model of DNA; Contribution of Linus Pauling; DNA is replicated in Semi-conservative Fashion; Deciphering the Genetic Code; One Gene One Enzyme Edict.

UNIT – VI Technical advancements in biology (6 Hours)

Polymerase Chain Reaction – a revolution in modern biology; DNA Manipulations using Restriction enzymes; Discovery of reverse transcriptase leading to development of RT-PCR for RNA amplification; Work of Stanley Cohen and Herbert Boyer; Advent of gene cloning - History and current applications

UNIT – VII Research as a backbone of modern medicine (6 Hours)

(A) Discovery of antimicrobial agents; Contribution of Joseph Lister and later by Alexander Flemming leading to Discovery of Magic bullets; (B) Control of Infectious Diseases – Variolation, mithridatism and vaccination from the view of Edward Jenner; Vaccine production strategies – with examples of BCG and SARS-CoV2 vaccines; Historical timeline of vaccination strategies; (C) Marie Curie – Use of radiation in medicine.

UNIT – VIII Project Work [On any one topic] (6 Hours)

Study historical research papers and provide a descriptive view of research that was carried out by Scientists as Minor Project.

(A) Ancient system of medicine

(B) Contribution of any one Indian Scientists in Biology

(C) Contribution of any Physicists or Chemists in Biology (for topics listed above)

Practical component (if any) - (30 Hours)

(Wherever wet lab experiments are not possible, the principles and concepts can be demonstrated through any other material or medium including videos/virtual labs etc.)

1. Comparison of invisible life under the view of microscopes versus foldscope.
2. Cells as a unit of life and observation under the microscopes.
3. How do the cells divide – a view under the microscope: (mount of an onion root tip, onion bud cells or grasshopper testis).
4. Mendel's laws of inheritance – clues from nature.
5. Extraction of genomic DNA
6. Use of electric field to analyse DNA and other biomolecules.
7. Sneak Peek through the discovery of Polymerase chain reaction (PCR): Demonstration of original method and comparison with today's sophistication.
8. To test Flemming's hypothesis that the mold killed the bacteria.
9. Group Discussion on Research Topics assigned to students.

Essential readings

- Alberts, B et al. (2014). 6th edition. Molecular Biology of the Cell. W. W. Norton & Company. ISBN-13 : 978-0815345244
- Bryson, B. (2003) A short history of nearly everything. Transworld Publishers. London W5 5SA. A Random House Group Company. ISBN: 9780552997041.
- Lodish H et al. (2003). 5th Revised edition. Molecular Cell Biology. W.H.Freeman& Co Ltd; ISBN-13 : 978-0716743668
- Green, M. R. and Sambrook, J. (2012). 4th Edition. Molecular Cloning: A Laboratory Manual, New York, United States: Cold Spring Harbor Laboratory Press, ISBN-13:978-1936113422.
- Kornberg, A. (2005). 2nd Edition. DNA Replication. California, United States: University Science Books, ISBN-13: 978-1891389443.

Suggestive readings -

- Watson, J. D. (2011) The Double Helix – A personal account of the discovery of the structure of DNA. Scribner. ISBN 9780743219174.
- Cooper, G. M. and Hausman, R. E. (2013). 6th Edition. The cell: A molecular approach. Massachusetts, USA: Sinauer Associates. ISBN-13:978-1605351551
- Karp, G. (2013). 7th Edition. Cell and molecular biology: Concepts and experiments. New Jersey, USA: Wiley Publishers. ISBN-978-0470483374.
- Cox, M. M. Doudna J. A. and Donnell, M. O. (2012). 1st Edition. Molecular Biology: Principles and Practice. London, United Kingdom: W H Freeman & Co Publishers, ISBN-13: 978-0-716-7998-8.
- Watson, J. D. Baker T. A. Bell, S. P. Gann, A. Levine, M. and Losick, R. (2013). 7th Edition. Molecular Biology of the Gene. New York, United States: Cold Spring Harbor Laboratory Press, ISBN-13: 978-0-321-76243-6.

GENERIC ELECTIVES (GE-3): TOXIC SUBSTANCES AND HUMAN HEALTH

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
TOXIC SUBSTANCES AND HUMAN HEALTH	4	3	-	1	Open to Students from all subjects	NA

Learning Objectives

The Learning Objectives of this course are as follows:

In daily life, humans are exposed to several toxic substances. Many household products, medicines, cosmetic products, paints, and even food and water may contain toxic substances.; Frequent or improper use of many consumer products or exposure to higher amounts than prescribed, may cause serious health problems. This paper introduces the common toxic substances to which humans are routinely exposed; and health related issues in case of toxicity.

6 (for print book).

- Textbook of Practical Physiology, 9th edition (2019), CL Ghai; Jaypee Publication, ISBN-9789352705320.

BOOK FOR BASIC CONCEPTUAL READING

- Ganong's Review of Medical physiology, 26th edition (2019), K. E. Barrett, S. M. Barman, S. Boitano and H. Brooks; Tata McGraw Hill, ISBN 978-1-26-012240-4 (for ebook)
ISBN:978-1-26-012241-1 (for print Book)

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.