

**DISCIPLINE SPECIFIC ELECTIVES (DSE) COURSES
SEMESTER III/IV**

III/ IV	DSE 01	Proteins and Enzymes
	DSE 02	Practices in Biosafety
	DSE 03	Social and Preventive Medicine

DISCIPLINE SPECIFIC ELECTIVE COURSE –1 (DSE-1) PROTEINS AND ENZYMES

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		
PROTEINS AND ENZYMES	4	3	-	1	-----	NA

Learning objectives

The Learning Objectives of this course are as follows:

- The objective of this course is to provide an overview of protein biochemistry and enzymology.
- Proteins and enzymes, being the most versatile functional entities, hold several applications in life sciences research as well as in industry and biomedicine.
- The biochemical, structural, and functional aspects of the interaction of proteins and enzymes will be introduced in this course.

Learning outcomes

The Learning outcomes of this course are as follows: Having successfully completed this course, students shall be able to learn and appreciate:

- The unique features and characteristics of proteins and enzymes and their applications in research, medicine, and industry.
- The relationship between three-dimensional structure of proteins and enzymes and their functions.
- The basic mode of action of enzymes and their remarkable regulation.
- The protein misfolding and the diseases associated with it.
- The students would be able to understand the various biomedical applications of enzymes.
- The students would be able to gain hands-on experience in working with proteins and enzymes from various sources. Hence, it will improve their learning skills and imbibe the basic concepts of this field.

SYLLABUS OF DSE 01

Unit I: Structural organization of proteins (08 Hours)

Organization of protein structure- primary, secondary, tertiary, and quaternary. Secondary structures – helices, sheets and turns. Motifs, domains and their functional importance. Native and denatured state of a protein. Physico-chemical interactions that maintain the native structure of a protein.

Unit II: Protein folding and diseases related to protein misfolding (10 Hours)

Protein folding (Hydrophobic collapse), Anfinsen theory, Levinthal paradox and protein folding in the cytoplasm. Protein denaturation by chaotropic agents such as urea, GdnHCl.

Concept of how mutation causes protein misfolding (loss-of-function to toxic-gain-of function) and related diseases such as Alzheimer's disease, Prion diseases, Tay-Sachs disease and Huntington disease.

Unit III: Enzymes: characteristics and kinetics (14 Hours)

Classification of enzymes and nomenclature. Concept of multi-functional enzyme and multi-enzyme complex. Fischer's lock & key and Koshland's induced fit hypotheses. Enzyme specificity. Enzyme kinetics- Michaelis-Menten equation, Lineweaver-Burk plot. To understand the physiological significance of K_m , V_{max} , K_{cat} and the factors affecting enzyme activity. Basics of enzyme inhibition- reversible (competitive, uncompetitive, non-competitive) and irreversible inhibition.

Unit IV: Regulation of enzyme activity (06 Hours)

Allosteric regulation, feedback inhibition, reversible covalent modification (Phosphorylation, glycosylation and acetylation using example of glycogen phosphorylase/glycogen synthase). proteolytic activation- zymogens.

Unit V: Biomedical application of enzymes (07 Hours)

Applications of enzymes in the diagnosis of diseases using creatine kinase and glucose oxidase and in therapy (streptokinase). Enzyme inhibitors as drugs. Principle of enzyme immunoassay. Enzyme immobilization and its applications, concept of abzymes. Industrial applications of enzymes (biosensor - HRP; food industry- rennin; cosmetics-collagen, etc)

Practical Component (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. Enzyme-based diagnostic assay (any one).
2. Measurement of enzyme activity and calculation of specific activity of an enzyme.
3. Effect of pH on enzyme activity.
4. Effect of temperature on enzyme activity
5. Visualization of 3D protein structure using suitable software.
6. Analysis of type of enzyme inhibition from the given experimental data
7. To study the effect of protein denaturants such as acid, alkali, heat and any organic solvent on protein.
8. Study of images of various toxic protein oligomeric species, associated with human diseases (amyloids, disordered aggregates, amorphous aggregates).

Essential readings:

- Nelson, D. L., & Cox, M. M. (2021). *Lehninger: Principles of Biochemistry* (8th ed.). Macmillan. ISBN: 9781319322328.
- Berg, J., Gatto, G., Stryer, L. and Tymoczko, J. L. (2019). *Biochemistry*. New York, USA: W. H. Freeman and Company.
- Voet, D., Voet J., Pratt, C. (2018). *Principles of Biochemistry*(5thed.) Wiley Blackwell. ISBN: 978-1-119451662.
- Plummer, D. (2017) *An Introduction to Practical Biochemistry*, (3rd ed.). McGraw-Hill College; ISBN-13: 978-0070841659.

- Devlin, (2011). Textbook of Biochemistry with Clinical Correlations. UK: Wiley T & Sons.
- Campbell, M. K. and Farrel, S. O. (2012) (7thed.). Biochemistry. Boston, USA: Brooks/Cole Cengage Learning. ISBN: 13:978-1-111-42564-7
- Nicholes,C.P., Lewis, S. (1999). Fundamentals of Enzymology (3rd ed.). Oxford University Press Inc. (New York), ISBN:0 19850229 X
- Cooper, T.G. (2011). The Tools of Biochemistry (2nded.). Wiley-Inter science Publication (New Delhi). ISBN: 13:9788126530168.
- Sheehan, D. (2009). Physical Biochemistry (2nded.). Wiley-Blackwell (West Sussex), ISBN: 9780470856024/ISBN: 9780470856031.

DISCIPLINE SPECIFIC ELECTIVE COURSE -02 (DSE-02) PRACTICES IN BIOSAFETY

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		
PRACTICES IN BIOSAFETY	4	3	-	1	-----	NA

Learning objectives

- Recent advances in the field of Biomedical Research have brought into focus the need for certain practices and strategies to prevent exposure to pathogens and toxins.
- The inventions in the field of Genetic Engineering have significantly influenced agriculture, medicine and food processing industry. Thus implementation of biosafety enables number of procedures and rules that will be helpful in protecting humans and environment from disease causing microorganisms, pests, additives, contaminants and residues etc.
- Topics such as responsible use of biotechnology, biosafety levels, genetically modified (GM) food, biosafety regulations, impact of biotech processes on environment are of major significance in present scenario.

Learning outcomes

- In this students would understand application of biotechnology in different fields like agriculture, environment, industrial manufacturing, food processes, health and medicine etc. It will enable them to recognize implication of recombinant biomolecules and organisms on our society.
- This would enable students to know about various hazardous biological substances one can come across while working in the laboratory or day today life, and the steps taken to minimize the risk. The students would understand different regulations for handling biohazard and radioactive material.
- The course should kindle the inquisitiveness in students about genetically modified and living modified organisms (GMO & LMO) and their impact on the environment.

SYLLABUS OF DSE-02

Unit I: Introduction to biosafety

(04 Hours)

Historical background of Biosafety, definition of biosafety, application of biosafety and need for biosafety.

Unit II: Social responsibility of biotechnology and biomedical research

(08 Hours)

Legal and socio-economic impacts of biotechnology. Social responsibility towards safety measures. Social and ethical implications of biological weapons (Bioterrorism). Implication of recombinant biomolecules and organisms. Implication of gain of function research. Importance of biotechnology: benefits and limitations of transgenic to human health, society and the

environment.

Unit III: Biosafety and importance of containment facility (08 Hours)

Components of biosafety (biohazard and biosecurity), measures of biosafety, containment (good laboratory practices and techniques, safety equipment, design facility), types of containment (physical and biological). Biosafety levels (BSL 1, 2, 3, 4), barriers (physical and secondary).

Unit-IV: Genetically modified organism: concerns and challenges (10 Hours)

Government of India definition of genetically modified organisms (GMOs) and living modified organisms (LMOs), roles of institutional biosafety committee, review committee on genetic manipulation (RCGM), genetic engineering approval committee (GEAC) for GMO applications in food and agriculture, environmental release of GMO in rDNA biosafety guidelines of India. Biosafety assessment procedures for biotech foods and related products, including transgenic food crops, case studies of relevance. Biosafety assessment of pharmaceutical products such as drugs/vaccines etc.

Unit-V: Handling and transportation of GM, infectious and radioactive materials (09 Hours)

Classification of infectious organisms, transportation of genetically modified/infectious organisms, General preparation of shipments for transport: Basic triple packaging system, marking of packages, labelling, precautions, monitoring strategies and methods for detecting transgenic; radiation safety and non-radio -isotopic procedures.

Unit VI: Biosafety guidelines and regulations (06 Hours)

Aim of biosafety guidelines, biosafety and risk assessment issues; regulatory framework; national biosafety policies and law, the Cartagena protocol on biosafety, WTO and other international agreements related to biosafety.

Practical component (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)

1. Protocol for development of recombinant / engineered proteins as therapeutics
2. Preparation of comparative account on BSL 1, 2,3,4. (poster, oral presentation, video)
3. Categorization of list of provided hazardous materials and its handling & disposal
4. To study GEAC guidelines on genetically modified crops (Bt-cotton/Bt-brinjal)
5. To develop an understanding of the role and composition of an ethical committee for research by a presentation mode.
6. To study and develop a flowchart to demonstrate spread and containment of any two infectious diseases (typhoid, SARS, Ebola, Dengue, Tuberculosis and Covid).
7. Preparation of chart explaining significance of various symbols used in chemistry and biology laboratories/ reagent bottles and equipment.

Essential Readings:

- Beauchamp, T.L and Childress, J.F. (2013). 8th edition. Principles of biomedical ethics. Oxford, UK: Oxford University Press. ISBN 9780190640873.
- Helga, K. and Peter, S. (2016). 3rd edition. A companion to bioethics. New Jersey, USA: John Wiley and Sons. ISBN 9781118941508.
- Hunt, E. F. and Colander, D. C. (2019). 17th edition. Social science: An introduction to the study of society. Boston, USA: Pearson/Allyn and Bacon. ISBN 9781138592537.

- Peter, A. S. and Viens, A. M. (2008). 1st edition. The Cambridge textbook of bioethics. Cambridge, UK: Cambridge University Press. ISBN 9780521872843.
- Sateesh, M.K. (2008). 1st edition. Bioethics and Biosafety. New Delhi, India: I K International Pvt Ltd. ISBN 978-8190675703.

Suggestive readings for basics:

- Rajmohan, J. (2006). 1st edition. Biosafety and bioethics. New Delhi, India: Isha Books. ISBN 13: 9788182053779.
- Rebecca, G.; James, F. H.; Karim, M. M.; Cholani, W. (2011). 1st edition. Environmental safety of genetically engineered crops. Michigan, USA: Michigan State University Press. ISBN 978-1611860085.
- Sreekrishna, V. (2007). 1st edition. Bioethics and biosafety in biotechnology. New Delhi, India: New Age International (P) Ltd. ISBN 978-8122420852.
- Tomme, Y. (2004). 1st edition. Genetically modified organisms and biosafety. Gland, Switzerland: World Conservation Union publications. ISBN 2831707986

DISCIPLINE SPECIFIC ELECTIVE COURSE –03 (DSE-03) SOCIAL AND PREVENTIVE MEDICINE

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		
SOCIAL AND PREVENTIVE MEDICINE	4	3	-	1	Student should have studied science (Biological science/ Physical sciences)	NA

Learning objectives

- The origin of medicine to alleviate human suffering from disease, and control of disease is as old as origin of human itself. Various civilizations practiced their own methods to treat and control diseases.
- The modern form of medicine that has evolved over time, is composed of two main branches viz: Curative medicine and Preventive medicine/Public health. It has been realized that causes of diseases are multifactorial- a disease can have multiple causes/factors such as social, economic, genetic, psychological and environmental factors.
- In the centre of modern medicine is epidemiology, which is concerned with measuring distribution patterns and determinants of disease in a Population/community, and needs of health related services.
- The health related services are delivered through health programmes and health systems to various risk groups such as at risk-mothers, at risk-infants, elderly or chronically ill patients.

Learning outcomes

- Introduction to various concepts of health and disease, factors determining health of individuals or population/community, interaction of factors in causing disease. Students will also be introduced to the concepts of levels of prevention adopted to achieve a state of health or to preserve health.
- Epidemiology is in the core of basic science of social preventive and medicine, and is concerned with study/measurement of the distribution and determinants of health related issues. Students will be introduced to the concepts of epidemiology, various methods and approaches that are used to measure the intensity and distribution of health related issues in the community/population.
- Introduction to the various definitions/ concepts related to natural history of disease viz: mode of disease transmission and progress of infection/disease in the host. Students would get opportunity to learn natural history of communicable disease, diagnosis, treatment and control, and various health programmes for prevention (with examples of certain prevalent diseases in India. Through examples of few diseases prevalent in India and globally, epidemiology of those diseases which are considered as lifestyle diseases or multi-factorial diseases will be introduced.
- The definition of health also includes dimensions of social and mental well-being.

Therefore, mental illness has been recognized as one of the important health issues. Students will be introduced to the various types of mental illness and its prevention.

- Infertility is a worldwide problem, and estimates of infertility in India are about 4-6 percent. Childlessness is social and demographic implications. The etiology of infertility is variable. Mother and children are considered as special-risk group in a population, and is a priority group in any community. The mother, and the growth and development of fetus/ infants are at the risk of several health problems. Further, under certain circumstances, their survival too is at risk. The multitude of problems affecting the health of mother and child constitutes serious health problems in a developing country. Students will be introduced to the various maternal and child health related problems/ complications (and their prevention), from conception to the birth of infants.
- Health has been declared a fundamental human right and has to be delivered by the governments to all. Therefore, there is a system to promote and provide health services to every individual living in urban or rural settings. Students will be introduced briefly about the system of health care and various levels of health care in India.

SYLLABUS OF DSE-3

Unit I: Basic concepts of health and disease (06 Hours)

Definition, determinants and indicators of health and disease, demography (transition, and sources of demographic data, registries), survey methodology including census procedures and sampling. epidemiological triad. Multi-factorial aetiology of disease. Concepts of prevention and control.

Unit II: Epidemiology and epidemiological methods (06 Hours)

Definition and history, components of epidemiological studies viz. disease frequency, distribution and determinants. Basic measurements/tools in epidemiology: rates, ratios and proportions (mortality and morbidity rates and ratios, prevalence, incidence); epidemiological studies: descriptive, analytical, randomized controlled trials. Concept of association and causation. Brief introduction to modern epidemiological tools.

Unit III: Epidemiology of diseases (16 Hours)

Various definitions: epidemic, endemic, pandemic, sporadic, nosocomial infections etc. Cases, carriers, transmission of disease, concept of incubation period, generation time, communicable period and secondary attack rate.

- a. Communicable diseases: control and health care programs for of national importance (extent of problem in India and worldwide, main clinical features, diagnosis, treatment & resistance, immunization and prevention practices, health programmes (if applicable):

Respiratory infections:

Tuberculosis

Intestinal infections:

Cholera

Arthropod-borne infections:

Malaria

Zoonosis:

Rabies

Sexually transmitted infection:

AIDS

- b. Non-communicable disease: control and health care programs for of national importance (extent of problem, diagnosis, treatment and control, health programmes (if applicable): Hypertension, stroke, diabetes, breast cancer.

Unit IV: Mental health (05 Hours)

Introduction and scope. Features of mentally healthy person, signs of poor mental health, types of mental health (anxiety and depression), and prevention. National Mental Health Programme

(NMHP).

Unit V: Infertility, mother and child health

(06 Hours)

Measures of fertility and factors affecting fertility, child health, maternal health, immunization programme.

Unit VI: Health care system in India

(06 Hours)

Concept of health care, levels of health care, brief introduction to Primary Health Care in India (village level, sub-centre level, primary health centre level, community health centre level, hospitals). National Programme for Health Care of the Elderly (NPHCE).

Practical component

(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. To explore any publically available database for tuberculosis/typhoid and study its epidemiology in the Indian population.
2. To study the epidemiology of malaria including geographical and seasonal distributions in India through a public database.
3. To study various parameters like risk factors, incidence, prevalence, mortality rate and DALYs. for any specific type of cancer prevalent in India through NCRP or any other public database.
4. To study the burden and causes of any hematological disorder in the Indian population.
5. To explore and analyse various national and international disease databases like ICMR/WHO/CDC/ etc.
6. To prepare a questionnaire for any health condition studied in S.No. 1-5.
- 7-10. To prepare a poster/ presentation using any digital media to communicate about the epidemiology and to create awareness about any health condition studied in S.No. 1-5.

Essential reading

- Park, K. (2021), 26th Edition, *Park's Textbook of Preventive and Social Medicine*, Banarsidas Bhanot Publisher, ISBN-13 : 978-9382219163.

Suggestive reading for basics

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