VIDYASAGAR UNIVERSITY

Midnapore, West Bengal

PROPOSED CURRICULUM & SYLLABUS (DRAFT) OF

BACHELOR OF SCIENCE (HONOURS)

MAJOR IN BIOTECHNOLOGY

4-YEAR UNDERGRADUATE PROGRAMME

(w.e.f. Academic Year 2023-2024)

Based on

Curriculum & Credit Framework for Undergraduate Programmes

(CCFUP), 2023 & NEP, 2020

VIDYASAGAR UNIVERSITY
BACHELOR OF SCIENCE (HONOURS) MAJOR IN BIOTECHNOLOGY
(under CCFUP, 2023)

Level	YR.	SEM	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
								CA	ESE	TOTAL
B.Sc. (Hons.)	2nd	III	**SEMESTER-III**							
			Major-3	**BITHMJ03**	**T: Mammalian Physiology; P: Practical**	**4**	**3-0-1**	**15**	**60**	**75**
			Major-4	**BITHMJ04**	**T: Plant Anatomy and Physiology; P: Practical**	**4**	**3-0-1**	**15**	**60**	**75**
			SEC	**BITSEC03**	**P: Basics of Forensic Science (Practical)**	**3**	**0-0-3**	**10**	**40**	**50**
			AEC	**AEC03**	Communicative English -2 (***common for all programmes***)	**2**	**2-0-0**	**10**	**40**	**50**
			MDC	**MDC03**	Multidisciplinary Course -3 (***to be chosen from the list***)	**3**	**3-0-0**	**10**	**40**	**50**
			Minor-3 (Disc.-I)	**BITMIN03**	**T: Industrial Fermentations; P: Practical**	**4**	**3-0-1**	**15**	**60**	**75**
					Semester-III Total	**20**				**375**
		IV	**SEMESTER-IV**							
			Major-5	**BITHMJ05**	**T: General Microbiology; P: Practical**	**4**	**3-0-1**	**15**	**60**	**75**
			Major-6	**BITHMJ06**	**T: Chemistry-I (Physical Chemistry); P: Practical**	**4**	**3-0-1**	**15**	**60**	**75**
			Major-7	**BITHMJ07**	**T: Genetics; P: Practical**	**4**	**3-0-1**	**15**	**60**	**75**
			AEC	**AEC04**	MIL-2 (***common for all programmes***)	**2**	**2-0-0**	**10**	**40**	**50**
			Minor-4 (Disc.-II)	**BITMIN04**	**T: Enzymology; P: Practical**	**4**	**3-0-1**	**15**	**60**	**75**
			Summer Intern.	**INT**	**Internship/ Apprenticeship - activities to be decided by the Colleges following the guidelines to be given later**	**4**	**0-0-4**	**-**	**-**	**50**
					Semester-IV Total	**22**				**400**
					TOTAL of YEAR-2	**42**				**775**

MJ = Major, MI = Minor Course, SEC = Skill Enhancement Course, AEC = Ability Enhancement Course, MDC = Multidisciplinary Course, CA= Continuous Assessment, ESE= End Semester Examination, T = Theory, P= Practical, L-T-P = Lecture-Tutorial-Practical, MIL = Modern Indian Language

MAJOR (MJ)

MJ-3: Mammalian Physiology **Credits 04 (Full Marks: 75)**

MJ-3T: Mammalian Physiology **Credits 03**

Course contents:

UNIT I: Digestion and Respiration

Digestion: Mechanism of digestion & absorption of carbohydrates, Proteins, Lipids and nucleic acids. Composition of bile, Saliva, Pancreatic, gastric and intestinal juice
Respiration: Exchange of gases, Transport of O2 and CO2, Oxygen dissociation curve, Chloride shift.

UNIT II: Circulation
Composition of blood, Plasma proteins & their role, blood cells, Haemopoisis, Mechanism of coagulation of blood.
Mechanism of working of heart: Cardiac output, cardiac cycle, Origin & conduction of heart beat.

UNIT III: Muscle physiology and osmoregulation
Structure of cardiac, smooth & skeletal muscle, threshold stimulus, All or None rule, single muscle twitch, muscle tone, isotonic and isometric contraction, Physical, chemical & electrical events of mechanism of muscle contraction.
Excretion: modes of excretion, Ornithine cycle, Mechanism of urine formation.

UNIT IV: Nervous and endocrine coordination
Mechanism of generation & propagation of nerve impulse, structure of synapse, synaptic conduction, saltatory conduction, Neurotransmitters Mechanism of action of hormones (insulin and steroids)
Different endocrine glands– Hypothalamus, pituitary, pineal, thymus, thyroid, parathyroid and adrenals, hypo & hyper-secretions.

MJ-1P: Mammalian Physiology (Practical) **Credits 01**

General Experiments:

1. Finding the coagulation time of blood
2. Determination of blood groups
3. Counting of mammalian RBCs
4. Determination of TLC and DLC
5. Demonstration of action of an enzyme
6. Determination of Haemoglobin

Suggested Readings:

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.
2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition. John wiley & sons,Inc.

MJ-4: Plant Anatomy and Physiology **Credits 04 (Full Marks: 75)**

MJ-4T: Plant Anatomy and Physiology **Credits 03**

Course contents:

UNIT I: Anatomy

The shoot and root apical meristem and its histological organization, simple & complex permanent tissues, primary structure of shoot & root, secondary growth, growth rings, leaf anatomy (dorsi-ventral and isobilateral leaf)

UNIT II: Plant water relations and micro & macro nutrients

Plant water relations: Importance of water to plant life, diffusion, osmosis, plasmolysis, imbibition, guttation, transpiration, stomata & their mechanism of opening & closing.

Micro & macro nutrients: criteria for identification of essentiality of nutrients, roles and deficiency systems of nutrients, mechanism of uptake of nutrients, mechanism of food transport

UNIT III: Carbon and nitrogen metabolism

Photosynthesis- Photosynthesis pigments, concept of two photo systems, photphosphorylation, calvin cycle, CAM plants, photorespiration, compensation point

Nitrogen metabolism- inorganic & molecular nitrogen fixation, nitrate reduction and ammonium assimilation in plants.

UNIT IV: Growth and development

Growth and development: Definitions, phases of growth, growth curve, growth hormones (auxins, gibberlins, cytokinins, abscisic acid, ethylene

Physiological role and mode of action, seed dormancy and seed germination, concept of photo-periodism and vernalization

MJ-4P: Plant Anatomy and Physiology - Lab **Credits 01**

Experiments:

1. Preparation of stained mounts of anatomy of monocot and dicot's root, stem & leaf.
2. Demonstration of plasmolysis by *Tradescantia* leaf peel.
3. Demonstration of opening & closing of stomata
4. Demonstration of guttation on leaf tips of grass and garden nasturtium.
5. Separation of photosynthetic pigments by paper chromatography.
6. Demonstration of aerobic respiration.
7. Preparation of root nodules from a leguminous plant.

Suggested Readings:

1. Dickinson, W.C. 2000 Integrative Plant Anatomy. Harcourt Academic Press, USA.
2. Esau, K. 1977 Anatomy of Seed Plants. Wiley Publishers.
3. Fahn, A. 1974 Plant Anatomy. Pergmon Press, USA and UK.
4. Hopkins, W.G. and Huner, P.A. 2008 Introduction to Plant Physiology. John Wiley and Sons.
5. Mauseth, J.D. 1988 Plant Anatomy. The Benjammin/Cummings Publisher, USA.
6. Nelson, D.L., Cox, M.M. 2004 Lehninger Principles of Biochemistry, 4thedition, W.H.

Freeman and Company, New York, USA.
7. Salisbury, F.B. and Ross, C.W. 1991 Plant Physiology, Wadsworth Publishing Co. Ltd.
8. Taiz, L. and Zeiger, E. 2006 Plant Physiology, 4th edition, Sinauer Associates Inc .MA, USA

MJ-5: General Microbiology **Credits 04 (Full Marks: 75)**

MJ-5T: General Microbiology **Credits 03**

Course contents:

UNIT I

Fundamentals, History and Evolution of Microbiology.

Classification of microorganisms: Microbial taxonomy, criteria used including molecular approaches, Microbial phylogeny and current classification of bacteria.

Microbial Diversity: Distribution and characterization Prokaryotic and Eukaryotic cells, Morphology and cell structure of major groups of microorganisms e.g. Bacteria, Algae, Fungi, Protozoa and Unique features of viruses.

UNIT II

Cultivation and Maintenance of microorganisms: Nutritional categories of micro-organisms, methods of isolation, Purification and preservation.

UNIT III

Microbial growth: Growth curve, Generation time, synchronous batch and continuous culture, measurement of growth and factors affecting growth of bacteria.

Microbial Metabolism: Metabolic pathways, amphi-catabolic and biosynthetic pathways Bacterial Reproduction: Transformation, Transduction and Conjugation. Endospores and sporulation in bacteria.

UNIT IV

Control of Microorganisms: By physical, chemical and chemotherapeutic Agents

Water Microbiology: Bacterial pollutants of water coliforms and non coliforms. Sewage composition and its disposal.

Food Microbiology: Important microorganism in food Microbiology: Moulds, Yeasts, bacteria. Major food born infections and intoxications, Preservation of various types of foods. Fermented Foods.

MJ-5P: General Microbiology - Lab **Credits 01**

Experiments:

1. Isolation of bacteria & their biochemical characterization.
2. Staining methods: simple staining, Gram staining, spore staining, negative staining, hanging drop.
3. Preparation of media & sterilization methods, Methods of Isolation of bacteria from different sources.
4. Determination of bacterial cell size by micrometry.
5. Enumeration of microorganism - total & viable count.

Suggested Readings:

1. Alexopoulos CJ, Mims CW, and Blackwell M. (1996). Introductory Mycology. 4 th edition. John and Sons, Inc.
2. Jay JM, Loessner MJ and Golden DA. (2005). *Modern Food Microbiology*. 7thedition, CBS Publishers and Distributors, Delhi, India.
3. Kumar HD. (1990). Introductory Phycology. 2nd edition. Affiliated East Western Press.
4. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms. 12th edition. Pearson/Benjamin Cummings.
5. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
6. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.
7. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9 th edition. Pearson Education.
8. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.

MJ-6: Chemistry-I (Physical Chemistry) Credits 04 (Full Marks: 75)

MJ-6T: Chemistry-I (Physical Chemistry) Credits 03

Course contents:

1. Thermodynamics- Concept of energy, heat and work; thermodynamics functions- internal energy, entropy, enthalpy and free energy; bioenergetics- spontaneity equation in terms of entropy and concept of equilibrium; transport across membranes- Donnan equilibrium
2. Radioactivity- Alpha, beta, gamma radiation, law of radioactive decay, unit of radioactivity, idea of artificial. Radioactivity, application-radiolabelling

4. Electrochemistry- Electrolytic dissociation and conduction, ionic equilibrium, pH, indicator, acid base neutralization curve, buffer action, Bronsted acid, Henderson- Hasselbalch equation, preparation of buffer, buffer capacity

5. Properties of molecules- Structure of atom, Electronic theory of valency, dipole moment, hydrogen bonds, Van der Waals' interactions, Electrostatic interactions, Hydrophobic interactions;

6. Chemical Kinetics- Transition State theory, Arrhenius equation. preliminary ideas about zero, 1st and 2nd order reactions with examples,

MJ-6P: Chemistry-I (Physical Chemistry) - Lab Credits 01

Experiments on Physical Chemistry

1. Equilibrium constant of the reaction KI + I2 = KI3.
2. Solubility/solubility product in presence/absence of common ions and/or neutral electrolytes (e.g. Na- oxalate, Mg-carbonate, K-hydrogen tartarate, etc).

3. Conductometric and potentiometric titrations of an acid or a base (acid may be monobasic/
4. dibasic, and similarly for the base)
5. Kinetics of decomposition of H2 O2 and hydrolysis of an ester.
6. Verification of Beer's law and finding strengths of unknown solutions by colorimetry; (also, colour matching principle to find unknown concentrations)

MJ-7: Genetics **Credits 04 (Full Marks: 75)**

MJ-7T: Genetics **Credits 03**

Course contents:

UNIT I

Introduction: Historical developments in the field of genetics. Organisms suitable for genetic experimentation and their genetic significance

Cell Cycle: Mitosis and Meiosis: Control points in cell-cycle progression in yeast. Role of meiosis in life cycles of organisms.

Mendelian genetics: Mendel's experimental design monohybrid di-hybrid and tri-hybrid crosses, Law of segregation & Principle of independent assortment. Verification of segregates by test and back crosses, Chromosomal theory of inheritance Allelic interactions: Concept of dominance, recessiveness, incomplete dominance, co-dominance, semi-dominance, pleiotropy, multiple allele, pseudo-allele, essential and lethal genes, penetrance and expressivity.

UNIT II

Non allelic interactions: Interaction producing new phenotype complementary genes, epistasis (dominant & recessive), duplicate genes and inhibitory genes.

Chromosome and genomic organization: Eukaryotic nuclear genome nucleotide sequence composition – unique & repetitive DNA, satellite DNA. Centromere and telomere DNA sequences, middle repetitive sequences- VNTRs & dinucleotide repeats, repetitive transposed sequences- SINEs & LINEs, middle repetitive multiple copy genes, noncoding DNA. Genetic organization of prokaryotic and viral genome.

Structure and characteristics of bacterial and eukaryotic chromosome, chromosome morphology, concept of euchromatin and heterochromatin. packaging of DNA molecule into chromosomes, chromosome banding pattern, karyotype, giant chromosomes, one gene one polypeptide hypothesis, concept of cistron, exons, introns, genetic code, gene function.

UNIT III

Chromosome and gene mutations: Definition and types of mutations, causes of mutations, Ames test for mutagenic agents, screening procedures for isolation of mutants and uses of mutants, variations in chromosomes structure - deletion, duplication inversion and translocation (reciprocal and Robertsonian), position effects of gene expression, chromosomal aberrations in human beings, abonormalities– Aneuploidy and Euploidy.

Sex determination and sex linkage: Mechanisms of sex determination, Environmental factors and sex determination, sex differentiation, Barr bodies, dosage compensation, genetic balance theory, Fragile-X-

syndrome and chromosome, sex influenced dominance, sex limited gene expression, sex linked inheritance.

UNIT IV

Genetic linkage, crossing over and chromosome mapping: Linkage and Recombination of genes in a chromosome crossing over, Cytological basis of crossing over, Molecular mechanism of crossing over, Crossing over at four strand stage, Multiple crossing overs Genetic mapping.

Extra chromosomal inheritance: Rules of extra nuclear inheritance, maternal effects, maternal inheritance, cytoplasmic inheritance, organelle heredity, genomic imprinting.

Evolution and population genetics: In breeding and out breeding, Hardy Weinberg law (prediction, derivation), allelic and genotype frequencies, changes in allelic frequencies, systems of mating, evolutionary genetics, natural selection.

MJ-7P: Genetics - Lab **Credits 01**

Practical:

1. Permanent and temporary mount of mitosis.
2. Permanent and temporary mount of meiosis.
3. Mendelian deviations in dihybrid crosses
4. Demonstration of - Barr Body -Rhoeo translocation.
5. Karyotyping with the help of photographs
6. Pedigree charts of some common characters like blood group, color blindness and PTC tasting.
7. Study of polyploidy in onion root tip by colchicine treatment.

Suggested Reading:

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2006). Principles of Genetics. VIII Edition John Wiley & Sons.
2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings.
4. Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
5. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. IX Edition. Introduction to Genetic Analysis, W. H. Freeman & Co.

MINOR (MI)

MI – 3: Industrial Fermentations **Credits 04 (Full Marks: 75)**

MI – 3T: Industrial Fermentations **Credits 03**

Course contents:

UNIT I

Production of industrial chemicals, biochemicals and chemotherapeutic products. Propionic acid, butyric acid, 2-3 butanediol, gluconic acid, itaconic acid, Biofuels: Biogas, Ethanol, butanol, hydrogen biodiesel, microbial electricity, starch conversion processes; Microbial polysaccharides; Microbial insecticides; microbial flavours and fragrances, newer antibiotics, anti-cancer agents, amino acids.

UNIT II

Microbial products of pharmacological interest, steriod fermentations and transformations. Over production of microbial metabolite, Secondary metabolism – its significance and products. Metabolic engineering of secondary metabolism for highest productivity. Enzyme and cell immobilization techniques in industrial processing, enzymes in organic synthesis, proteolytic enzymes, hydrolytic enzymes, glucose isomerase, enzymes in food technology/organic synthesis.

UNIT III

Purification & characterization of proteins, Upstream and downstream processing, solids and liquid handling. Distribution of microbial cells, centrifugation, filtration of fermentation broth, ultra-centrifugation, liquid extraction, ion-exchange recovery of biological products. Experimental model for design of fermentation systems, Anaerobic fermentations.

UNIT IV

Rate equations for enzyme kinetics, simple and complex reactions. Inhibition kinetics; effect of pH and temperature on rate of enzyme reactions. Mathematical derivation of growth kinetics, mathematical derivations of batch and continuous culture operations; single stage CSTR; mass transfer in aerobic fermentation; resistances encountered; overall mass transfer co-efficient (Ka) determination, factors depending on scale up principle and different methods of scaling up. Metabolic engineering of antibiotic biosynthetic pathways.

MI-3P: Industrial Fermentations (Practical) **Credits 01**

Practical:

1. Comparative analysis of design of a batch and continuous fermenter.
2. Calculation of Mathematical derivation of growth kinetics.
3. Solvent extraction & analysis of a metabolite from a bacterial culture.
4. Perform an enzyme assay demonstrating its hydrolytic activity (protease/ peptidase/glucosidase etc.)

Suggested Reading:

1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.
3. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.
4. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.
5. Salisbury, Whitaker and Hall. Principles of fermentation Technology,

MI-4: Enzymology **Credits 04 (Full Marks: 75)**

MI-4T: Enzymology **Credits 03**

Course contents:

UNIT - I

Isolation, crystallization and purification of enzymes, test of homogeneity of enzyme preparation, methods of enzyme analysis. Enzyme classification (rationale, overview and specific examples) Zymogens and their activation (Proteases and Prothrombin). Enzyme substrate complex: concept of E-S complex, binding sites, active site, specificity, Kinetics of enzyme activity, Michaelis-Menten equation and its derivation, Different plots for the determination of Km and Vmax and their physiological significance, factors affecting initial rate, E, S, temp. & pH. Collision and transition state theories, Significance of activation energy and free energy.

UNIT – II

Two substrate reactions (Random, ordered and ping-pong mechanism) Enzyme inhibition types of inhibition, determination of Ki, suicide inhibitor. Mechanism of enzyme action: General mechanistic principle, factors associated with catalytic efficiency: proximity, orientation, distortion of strain, acid-base, nucleophilic and covalent catalysis. Techniques for studying mechanisms of action, chemical modification of active site groups, specific examples-: chymotrypsin, Iysozyme, GPDH, aldolase, RNase, Carboxypeptidase and alcohol dehydrogenase. Enzyme regulation: Product inhibition, feed backcontrol, covalent modification.

UNIT – III

Allosteric enzymes with special reference to aspartate transcarbomylase and phosphofructokinase. Qualitative description of concerted and sequential models. Negative cooperativity and half site reactivity. Enzyme - Enzyme interaction, Protein ligand binding, measurements analysis of binding isotherm, cooperativity, Hill and scatchard plots, kinetics of allosteric enzymes. Isoenzymes– multiple forms of enzymes with special reference to lactate dehydrogenase. Multienzyme complexes. Ribozymes. Multifunctional enzyme – e.g. Fatty Acid synthase.

UNIT – IV

Enzyme Technology: Methods for large scale production of enzymes. Immobilized enzyme and their comparison with soluble enzymes, Methods for immobilization of enzymes. Immobilized enzyme reactors. Application of Immobilized and soluble enzyme in health and industry. Application to fundamental studies of biochemistry. Enzyme electrodes.

Thermal stability and catalytic efficiency of enzyme, site directed mutagenesis and enzyme Engineering – selected examples, Delivery system for protein pharmaceuticals, structure function relationship in enzymes, structural motifs and enzyme evolution. Methods for protein sequencing. Methods for analysis of secondary and tertiary structures of enzymes. Protein folding invitro & invivo.

MI-4P: Enzymology (Practical) **Credits 01**

Practical:

1. Purification of an enzyme from any natural resource
2. Quantitative estimation of proteins by Bradford/Lowry's method.
3. Perform assay for the purified enzyme.
4. Calculation of kinetic parameters such as Km, Vmax, Kcat

Suggested Readings:

1. Biochemistry, Lubert Stryer, 6th Edition, WH Freeman, 2006.
2. Harper's illustrated Biochemistry by Robert K. Murray, David A Bender, Kathleen M.Botham, Peter J. Kennelly, Victor W. Rodwell, P. Anthony Weil. 28th Edition, McGrawHill, 2009.
3. Biochemistry, Donald Voet and Judith Voet, 2nd Edition, Publisher: John Wiley and Sons,1995.
4. Biochemistry by Mary K.Campbell & Shawn O.Farrell, 5th Edition, Cenage Learning, 2005.
5. Fundamentals of enzymology, Nicholas Price and Lewis Stevens, Oxford University Press,1999
6. Fundamentals of enzyme kinetics, Athel Cornish-Bowden Portland Press, 2004
7. Practical Enzymology, Hans Bisswanger Wiley–VCH, 2004
8. The Organic chemistry of enzyme-catalyzed reactions, Richard B. Silverman Academic Press ,2002

SKILL ENHANCEMENT COURSE (SEC)

SEC 3: Biosafety and instrumentation **Credits 03 (FM: 50)**

SEC3P: Biosafety and instrumentation

Course Outline:

Unit-1: Biosafety
Basic rules and regulations related to Biotechnological work, personal hygiene, sterility maintenance, Biotechnological Good Laboratory Practices and Biosafety. Level of Biosafety (BSL1-BSL4).

Unit-2: Basic instrumentation in biotechnology
Principle and applications of biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, water bath, shaker, light microscope, and pH meter used in the biotech laboratory.

Unit-3: Qualitative and quantitative analysis of biomolecules
Principle and applications of quantitative analysis through colorimeter and spectrophotometer. Principle and practical applications of different chromatographic approach (TLC, paper, column).

Unit-4: Separation of biomolecules
Agarose and polyacrylamide gel electrophoresis: principle, process and applications. Principle of centrifugation and its practical applications. Concept of RCF, rpm and sedimentation coefficient, density gradient centrifugation and ultracentrifugation.

Suggested Readings:

1. Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited. Cappucino J and Sherman N. (2010).
2. Practical Microbiology, Dubey and Maheshwari ,S.Chand Publication, First edition 2002
3. Introductory Practical Biochemistry, S.K. Sawhney and Randhir Singh, Narosa publisher (2016)
4. An Introduction to Practical Biochemistry, D.T. Plummer (2001)

INTERNSHIP/APPRENTICESHIP (INT)

Credit-04 Marks: 50 **(120 hours, 8 weeks)**

Guideline for internship/apprenticeship:

The internship program will commence at the beginning of the third semester and will be evaluated upon its completion at the end of the fourth semester.

1. Two or more neighbouring colleges can exchange students for internship programs. Mentors at the partnering colleges may offer these students courses related to their curriculum. The program content will vary depending on the mentor.
2. A student may visit an industry for industry-related issues or a research institution, laboratory, or university to engage in research-related activities under the guidance of an industry official, scientist, or professor.
3. A student may work at a company's outlet or similar type of office, hotel, hospital, nursing home, etc. to collect statistical data and analyse it with any statistical method under the supervision of the respective official or a faculty of his/her own college teacher or a teacher from another college/university/industry person.
4. Interns may engage in advanced learning in topics beyond their course curriculum, under the guidance of their respective mentor.
5. Interns may be assigned to develop a video lecture on any topic of their own choice with a proper title page for the video under the mentor's guidance.
6. Interns may be allowed to work as developer/ researchers etc. in local companies, labs, firms etc.

General instructions:

a) Each intern must maintain a daily logbook of activities.
b) At the end of the internship, a completion certificate must be obtained from the mentor, supervisor, or concerned authority.
c) Interns are expected to strictly adhere to the assigned tasks and deadlines.