Semester : **II** **Major Core IV**

Name of the Course : **Plant Diversity II -Pteridophyta, Gymnosperms and Palaeobotany**

Subject code : **PB2021**

Unit	Module	Topics	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
I. PTERIDOPHYTES – INTRODUCTION						
	1	Origin and evolution of vascular plants; Stelar evolution	4	To know the basics of vascular plants	Lecture	
	2	Telome theory; Apogamy and apospory	4	To understand about apogamy and apospory	Lecture, Charts	
	3	Economic importance of	4	To evaluate and categorize	Lecture,	Group discussions,

		Pteridophytes. Classification of pteridophytes by G.M. Smith		pteridophytes	PPT	Question – Answer sessions, Quiz.
II PTERIDOPHYTES – REPRODUCTION						
	1	Range of thallus structure, reproduction and evolution of gametophytes and sporophytes of the following orders: *Psilotales, Lycopodiales*	4	To evaluate the detailed information about different orders of pteridophytes	Lecture, Microscopic slides, PPT	
	2	*Selaginellales, Isoetales, Equisetales.*	5	To correlate the different orders of pteridophytes	Lecture, microscopic slides, live specimens, PPT	Short Test, Discussions, Microscopic observation, Quiz
III PTERIDOPHYTES – REPRODUCTION						
	1	*Ophioglossales, Osmundales, Filicales and Salviniales*	5	To evaluate the detailed information about different orders of pteridophytes	Lecture, microscopic slides, live specimens, PPT	
	2	Sporangial development - Eusporangiate and Leptosporangiate types, heterospory and origin of seed habit and soral evolution	4	To understand the different forms of sporangia	Lecture, Illustrations	Open Book Test, Microscopic observation, Continuous Internal Assessment I (CIA-I)

IV GYMNOSPERMS						
	1	Affinities and evolution of gymnosperms; Classification of gymnosperms (K.R. Sporne, 1965);	4	To evaluate and categorize Gymnosperms	Lecture, PPT	Microscopic observation, Short Test, Online Quiz
	2	General characters - morphological, reproductive characters, phylogeny and interrelationship of the orders - *Cycadales, Ginkgoales*	4	To understand the general characters of different orders of Gymnosperms	Lecture, Illustration, Permanent slides	
	3	*Coniferales* and *Gnetales.*	4	To understand the general characters of different orders of Gymnosperms	Lecture, Illustration, Permanent slides	
V PALAEOBOTANY						
	1	Geological time scale; Methods of fossilization and determination of the geological age of fossils, carbon dating	4	To assess the different methods of fossilization	Lecture, Permanent slides	Microscopic observation, Question –
	2	A brief study of the following fossil Pteridophytes: *Rhynia, Lepidodendron*	4	To know about the different fossil Pteridophytes	Lecture, Permanent slides	
	3	*Sphenophyllum*	4	To know	Lecture,	

		and *Calamites.*		about the different fossil Pteridophytes	Permanent slides, PPT	Answer session, Group Discussion, Continuous Internal Assessment II (CIA-II)
	4	A brief study of the following fossil Gymnosperms: *Lyginopteris, Cycadoidea*	3	about the different fossil Gymnosperms	Lecture, Permanent slides	
	5	*Pentaxylon* and *Cordaites.*	3	about the different fossil Gymnosperms	Lecture, Permanent slides, PPT	

Course Instructor: Dr. J. Celin Pappa Rani HOD: Dr. C. Jespin Ida

Semester : II Major Core V

Name of the Course : Research Methodology

Subject code : PB2022

Unit	Module	Topics	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
I. RESEARCH – INTRODUCTION						
	1	Research- Objectives of research, Types of research, Significance	2	To know the objectives of research	Lecture, PPT	
	2	Literature collection- Index card, reference card and Abstract card	2	To assess the literature collection	Lecture	
	3	Literature citation- Different systems	3	To evaluate the	Lecture	

		of citing references- Name year system, Citation sequence system and Alphabet number system		Literature citation		Short Test, Quiz, Question – Answer session, Thesis evaluation.
	4	Research report, components of a project report, tables, figures, foot note, thesis format, journal format- appendices	3	To understand the components of project report	Lecture, PPT, Models	
	5	E- Journal and e-book. Role of supervisors/ Guides in research	3	To understand about E- journal and e- book	Lecture, Models	
II MICROSCOPY						
	1	Microscopy – Principle, Instrumentation and uses of Light Microscope, Dark–Field Microscope	3	To operate microscope	Lecture, Operating microscopes	Lab test, Diagrammatic representation, Quiz
	2	Phase contrast Microscope, Fluorescent Microscope	3	To operate microscope	Lecture, Operating microscopes	
	3	Electron Microscope – SEM and TEM, Confocal Microscope	3	To operate microscope	Lecture, Operating microscopes	
	4	Micrometry; Photomicrometry	3	To measure microscopic specimens	Lecture, PPT	

III SPECTROPHOTOMETRY & CHROMATOGRAPHY						
	1	Spectrophotometer - Principle, Instrumentation and uses of UV–Vis Spectrometry, Atomic Adsorption Spectrometry	4	Able to operate Spectrophotometer	Lecture, PPT, Operating Spectrophotometer	Lab test, Short test, Diagrammatic representation, Continuous Internal Assessment I (CIA-I)
	2	Nuclear Magnetic Resonance Spectrometry, Flame Photometer	3	Able to operate Spectrophotometer	Lecture, Operating instruments	
	3	Chromatography – Affinity Chromatography, Ion exchange chromatography and High Performance Liquid Chromatography	4	Able to perform chromatography	Lecture, Experimental approach	
IV CENTRIFUGATION & ELECTROPHORESIS						
	1	Centrifugation – Principles of sedimentation, Types of rotors, Differential centrifugation, Density gradient centrifugation, Ultracentrifuge	4	Able to operate centrifuge	Lecture, Experimental approach	Lab test, Group
	2	Electrophoresis – Agarose gel electrophoresis (AGE), Sodium Dodecyl Sulphate-Polyacrylamide Gel Electrophoresis	4	Able to perform electrophoretic analysis	Lecture, Experimental approach	

		(SDS-PAGE)				discussion, Diagrammatic representation, Open book test.
	3	PCR – Principle and technique.	2	To understand and perform PCR	Lecture, Experimental approach	
	4	Cryobiology – Lyophilization and its application in Biology	3	To know about the importance of Cryobiology	Lecture, PPT	
V BIOSTATISTICS						
	1	Data collection and Analysis of data – Mean, Medium, Mode, Standard deviation, Standard error	4	To analyse and interpret different data	Lecture, Problem solving methods	Problem Solving Tests, Objective type test, Continuous Internal Assessment I (CIA-II)
	2	Student 'T' test, Chi – square test	2	To solve statistical data problems	Lecture, Problem solving methods	
	3	Correlation, Regression	2	To solve and correlate statistical data	Lecture, Problem solving methods	
	4	ANOVA, SPSS	3	To solve statistical data	Lecture, Problem solving methods	

Course Instructor: Dr. J. Albino Wins HOD: Dr. C. Jespin Ida

Semester : II Major Core VI

Name of the Course : Cell Biology and Biomolecules

Subject code : PB2023

Unit	Module	Topics	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
I CELL ORGANELLES						
	1	Cell Type: History and origin. Difference between Prokaryotic and Eukaryotic cell	2	To know the difference between Prokaryotic and Eukaryotic cell	Lecture	Short test, Group discussions, Microscopical Observations
	2	Plasma Membrane: History, Ultrastructure, and chemical composition of plasma membrane (Lamellar-models, micellar models and fluid mosaic model). Functions of plasma membrane	4	To understand the structure and importance of plasma membrane	Lecture, model, PPT	
	3	Mitochondria: History and structure of mitochondria, biogenesis and functions of mitochondria (Respiratory chain complex and Electron transport mechanism).	4	To understand the structure and functions of mitochondria	Lecture, model, PPT	

II CHROMOSOME AND CELL DIVISIONS						
	1	Endoplasmic Recticulum, Ribosome, Golgi Bodies: History, structure, functions and importance. Lysosomes, Centrioles, Microtubules: History, structure, functions and Importance	4	To know the structure and functions of Endoplasmic Recticulum, Ribosome, Golgi Bodies, Lysosomes, Centrioles, Microtubules.	Lecture, PPT, Video clippings	Class test, Open Book Test, Group discussion
	2	Nucleus: History, structure, functions and importance; Chromosomes: History, types and functions of chromosomes. Giant chromosomes, Polytene chromosome and Lamp brush chromosome	5	To learn about nucleus and chromosome,	Lecture, PPT, Experimental Approach	
	3	Cell Division: Mitosis (cell cycle stages, cytokinesis) Meiosis (reproductive cycle stages, synoptonemal complex, recombination nodules). Comparison	3	To differentiate mitosis and meiosis	Lecture, PPT, Experimental Approach	

		between meiosis and mitosis				
III CARBOHYDRATES						
	1	Carbohydrates - structure and properties of Monosaccharides - ring structure. Oligosaccharides - sucrose and maltose	6	To know about the structure and properties of biomolecules – Monosaccharides and Oligosacchardies.	Lecture, PPT	Class Test, Open Book Test, Group discussion, Continuous Internal Assessment I (CIA-I)
	2	Polysaccharides - starch, cellulose, pectin and agar - Glycosidic linkage formation	4	To understand the structure and properties of biomolecules - Polysaccharides	Lecture, Charts	
	3	Structure and properties of amino acids and proteins – Denaturation and renaturation of proteins.	5	To evaluate the importance of proteins and to assess the difference between Denaturation and renaturation.	Lecture, PPT	
	4	Purification of proteins	4	To enhance the skill in purifying proteins	Lecture, Experimental approach	
IV LIPIDS						
	1	Lipids- Classification- Structure and properties- Triglycerides, compound lipids- phospholipids-	3	To understand the structure and properties of lipids	Lecture, PPT	

		cholesterol				
	2	Structure-Biosynthesis of DNA and RNA	2	To evaluate the difference between the biosynthesis of DNA and RNA	Lecture, Video clippings	Class Test, Question – Answer session.
	3	Secondary metabolites-Alkaloids, Glycosides, Steroids and Terpenoids. Vitamins	4	To assess the importance of Secondary metabolites	Lecture, Models	
V ENZYMES						
	1	Enzyme - Nomenclature and classification - IUB system – properties, Active site	4	To categorize enzymes	Lecture, PPT	Class test, Group discussion, Continuous Internal Assessment II (CIA-II)
	2	Mechanism of enzyme action (Fisher's Lock and Key model and Koshland's Induced fit model) - Activation energy	3	To understand the mechanism of enzyme action	Lecture, Video clippings	
	3	Enzyme regulation - activators and inhibitors - coenzymes. Isoenzymes	3	To critically analyse the regulation of enzymes	Lecture, PPT	

Course Instructor: Dr. N. Benit HOD: Dr. C. Jespin Ida

Semester : II Elective II(a)

Name of the Course : Herbalism

Subject code : PB2024

Unit	Module	Topics	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
I TRADITIONAL MEDICINE						
	1	Medicinal Botany – Definition – Aim and Scope – History – Importance – Present status and future prospects of medicinal crops	4	Able to understand the importance of medicinal crops	Lecture	Short test, Group discussions.
	2	Traditional systems of medicine – Siddha, Ayurveda and Unani	4	To know the different traditional systems of medicine	Lecture, PPT	
	3	Conservation of Medicinal plants – in situ and ex situ; Herbal gardens	4	To understand the conservation strategies	Lecture, Visit to herbal garden	
II CULTIVATION OF MEDICINAL PLANTS						
	1	Study the following plants with reference to their habitat, systematic position, morphology, useful parts, cultivation of *Aloe vera*, *Ocimum*,	4	Able to cultivate medicinal plants	Lecture, PPT, Visit to botanical garden	

		Zingiber				
	2	*Catharanthus roseus, Phyllanthus amarus,*	4	Able to cultivate medicinal plants	Lecture, PPT	Question – Answer session, Group discussion
	3	*Emblica* and *Azadirachta*.	4	Able to cultivate medicinal plants	Lecture, PPT	
III OIL EXTRACTION						
	1	Methods of extraction of oil in the following plants – Eucalyptus, Cymbopogan	3	Able to understand the extraction procedures	Lecture, Video clippings	Short test, Multiple choice questions, Continuous Internal Assessment I (CIA-I)
	2	Rose and Santalum	3	Able to understand the extraction procedures	Lecture, Video clippings	
	3	Extraction procedures for active principles – Withaonalides, Hyocyamine, Vinblastine	4	Able to understand the extraction procedures	Lecture, Video clippings	
IV PHARMACOGNOSY						
	1	Pharmacognosy – Definition, Classification of drugs – Morphlogical, Taxonomical, Pharmacological and Chemical	4	To understand the basics of Pharmacognosy	Lecture	Group discussions, Short test,
	2	Collection and Processing of crude drugs – Antichemical, Phytochemical	5	Able to assess the processing of crude drugs	Lecture, Charts	

	3	Antimicrobial and Chemical	4	To evaluate the antimicrobial and chemical properties of drugs	Lecture, Charts	Open book test
V WHO GUIDELINES						
	1	Screening and WHO standardization of crude drugs (WHO guidelines)	3	To evaluate the standardization of crude drugs	Lecture, PPT	Multiple choice questions, Group discussions, Continuous Internal Assessment II (CIA-II)
	2	Physicochemical (Ash and Extraction values)	3	To assess the Physicochemical parameters	Lecture, Video clippings	
	3	Fluorescence analysis – Qualitative and Quantitative analysis	4	To differentiate Qualitative and Quantitative analysis	Lecture	
	4	Basic chromatographic and Spectroscopic analysis of crude drugs	3	To evaluate the analysis of crude drugs	Lecture, Video clippings	

Course Instructor: Dr. N. Benit HOD: Dr. C. Jespin Ida

Semester: **IV**

Name of the Course: **Plant Physiology and Metabolism**

Subject Code: **PB1741**

Teaching Plan

Unit	Modules	Topics	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
I ABSORPTION						
	1	Physico-chemical properties of water - water potential; Mechanism of absorption of water - active and passive transport - Apoplast and symplast concept	4	To understand the mechanism of active and passive transport of water	Lecture, PPT, Video clippings	Class test, quiz, microscopic evaluation, Formative Assessment I
	2	Transpiration - Stomatal mechanism. Antitranspirants	3	To know the basics of transpiration	Lecture, PPT, microscopic observation	
	3	Ascent of sap – SPAC; Mineral nutrition - criteria for essentiality. Macro and micro nutrients, their role and deficiency symptoms	4	To evaluate the role of micro and macronutrients in plants	Lecture, experimental approach	

	4	Absorption of solutes - passive, active diffusion and facilitated diffusion	4	To differentiate passive and active absorption of solutes	Lecture, video clippings	
	5	Hydroponics – Nutrient Film Technique (NFT)	2	To develop hydroponic technique	Lecture, PPT, Garden visit	
II PHOTOSYNTHESIS						
	1	Properties of light - Interaction between radiant energy and phosphorescence	2	To correlate different radiations of light	Lecture,	Online quiz, Group discussions, Class test
	2	Photosynthetic apparatus and thylakoid organization; Two pigment systems - Light harvesting systems. Reaction center, P680, P700, water oxidation complex	3	To understand the structure and organization in thylakoid	Lecture, PPT	
	3	Electron transport system - cyclic - non cyclic – photophosphorylation	3	To differentiate cyclic and noncyclic phosphorlation	Lecture, video clippings	
	4	Photosynthetic carbon reduction pathways in C3, C4 and CAM plants Photorespiration and its significance	4	To categorize different carbon reduction pathways	Lecture, PPT	
III RESPIRATION & NITROGEN METABOLISM						
	1	Respiration - Glycolysis – Anaerobic (Fermentation) and Aerobic (Kreb's cycle)	3	To understand aerobic and anaerobic respiration	Lecture, Chart	Class test, diagrammatic representation, Formative Assessment II
	2	Electron transport system and oxidative phosphorylation – mechanism, Energetics - Respiratory inhibitors - Cyanide resistant respiration; Integration	5	To know the basics and energetic mechanism of electron transport system	Lecture, PPT, Chart	

		of metabolic pathways				
	3	Nitrogen Metabolism – Sources of nitrogen. Biological nitrogen fixation – symbiotic and asymbiotic, Nitrate and Ammonia assimilation (GS-GOGAT pathway)	5	To learn nitrogen metabolism in plants	Lecture, Video clippings	
IV PLANT GROWTH REGULATORS						
	1	Plant growth regulators and elicitors: Physiological effect and mechanism of action of auxin, gibberellins, cytokinins, Ethylene, abscissic acid, morphactins, brassinosteroids	5	To know the basics of plant growth regulators and elicitors	Lecture, Chart	Class test, Group discussion, multiple choice questions, assignment on plant growth hormones
	2	Photomorphogenesis – phytochrome mediated photoresponses, Physiology of flowering; Fruit ripening	5	To learn about photomorphogenesis	Lecture, PPT	
V STRESS PHYSIOLOGY						
	1	Physiology of senescence and abscission; Biological clock	4	To understand the process of ageing in plants	Lecture, Video clippings	Class test, Online quiz, Formative Assessment III
	2	Stress physiology – biotic and abiotic stress-salinity stress, drought stress, water stress, freezing stress, radiation stress, and heavy metal stress, Stress proteins in plants – stress resistance mechanism	4	To categorize different stress factors	Lecture, PPT	

Course Instructor: Ms. J. Celin Pappa Rani **HOD: Dr. C. Jespin Ida**

Semester: **IV**

Name of the Course: **Environment and Conservation Biology**

Subject Code:PB1742

Teaching Plan

Unit	Modules	Topics	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
I HABITAT ECOLOGY						
	1	Habitat Ecology - Freshwater and Marine water ecology (ecosystems), Wetlands and their Characteristics – Classification of Wetlands and Examples	3	To know the basics of habitat ecology	Lecture, PPT	Group discussion, Class test, Formative assessment I
	2	Succession - Causes of succession, Types of succession; Process of succession; Concept of Climatic Climax	3	To learn the different parameters of succession	Lecture, Charts	
	3	Hydrosere; Xerosere; Applications of ecology	3	To correlate and categorize hydrosere and xerosere	Lecture, PPT	
II ECOSYSTEM						
	1	Structure of Ecosystem; Productivity of ecosystem; Food chains in ecosystem; Ecological Pyramids; Energy flow in ecosystem	3	To learn the basics of ecosystem	Lecture, Charts	Online quiz, Group discussion, Assignment on biogeochemical cycle
	2	Biogeochemical cycle – Water cycle, Gaseous cycle (Carbon cycle, Oxygen cycle, Nitrogen cycle); Sedimentary cycle	4	To correlate the different biogeochemical cycle	Lecture, PPT	

	3	Ecological Genetics of Population – Ecads, Ecotypes, Ecoclines, Ecospecies, Population Ecology - Characteristics of a population; Population Structure – Population Dispersal and interactions among population	4	To understand the characteristics and structure of population ecology	Lecture, Charts, PPT	
III PHYTOGEOGRAPHY						
	1	Phytogeography: Definition and Principles of Phytogeography, Distribution – Wides, Endemics and Discontinuous species; Theories of Discontinuous distribution; Factors affecting distribution of species	4	To learn the basics of Phytogeography	Learn, PPT	Group discussions, Class test, Formative assessment II
	2	Climate of India; Vegetation of India	3	To understand the climatic condition and vegetation of India	Lecture, Video clippings	
	3	Global environment changes – Global warming and Ozone depletion; Bioremediation	3	To know about the global environmental changes	Lecture, PPT	
	4	Biofouling, Biofilm and Biocorrosion, Carbon sequestration method, Carbon trading	4	To categorize Biofouling, Biofilm and Biocorrosion	Online quiz, Online assignments	
IV CURRENT PRACTICES IN CONSERVATION						
	1	Current practices in conservation: Habitat or	4	To understand the basics of conservation	Lecture, Field visit	Class test, assessing the report of Field

		Ecosystem Approaches - Species-based Approaches - Social Approaches: Chipko Movement				visit
	2	In-situ conservation – Afforestation, Social Forestry, Agroforestry, Botanical gardens, Zoos	3	To categorize different in situ conservation methods	Lecture, PPT, Field visit	
	3	Biosphere Reserves, National Parks, Sanctuaries, Protected Area Network, Sacred Groves and Sthalavrikshas	4	To categorize different in situ conservation methods	Lecture, PPT, Field visit	
	4	Ex-situ conservation: Cryopreservation, Gene Banks,Seed Banks, Pollen Banks, Sperm Banks, DNA Banks	4	To correlate the different ex situ conservation methods	Lecture, PPT	
V PROTECTION OF SPECIES						
	1	Status and protection of species in National and International levels	3	To differentiate national and international level of species protection	Lecture	Formative Assessment III, seminar, Online assignment
	2	Role of CITES and IUCN – Convention on Biological Diversity (CBD)	3	To understand the role of different treaties in species protection	Lecture, PPT	

	3	Nagoya Protocol – Man and Biosphere Programme (MAB)	2	To understand the role of different treaties in species protection	Lecture, PPT	
	4	Policies implemented by MoEF for biodiversity conservation – Salient features of Biological Diversity Act 2002 – Ecosystem restoration	3	To know about the policies for conservation	Lecture, PPT	

Course Instructor: Ms. L. Dyona **HOD: Dr. C. Jespin Ida**

Semester: **IV**

Name of the Course: **Applied Biotechnology**

Subject Code: **PB1743**

Teaching Plan

Unit	Modules	Topics	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
I RESTRICTION ENZYMES & LIBRARY CONSTRUCTION						
	1	Nomenclature, classification and properties of restriction enzymes	3	To know the basics of restriction enzymes	Lecture, chart	Formative Assessment I, online quiz, Seminar
	2	Types of cloning vectors – Plasmids, Cosmids, ssDNA phages, Ti plasmid	3	To categorize different cloning methods	Lecture, PPT	
	3	Yeast vectors – YIP, YEP, YRP and YAC ; shuttle	3	To differentiate yeast vectors	Lecture, PPT	

		vectors				
	4	Construction of genomic library; Construction of cDNA library	3	To construct genomic and cDNA library	Lecture, Video clippings	
II PLANT TISSUE CULTURE						
	1	Plant tissue culture – laboratory organization; sterilization of explants; MS media composition and preparation of media	4	To construct plant tissue culture laboratory	Lecture, Video clippings	Class test, Online Assignment
	2	Meristem culture; suspension culture; protoplast culture and somatic hybridization	3	To learn different culture methods	Lecture, video clippings	
	3	Production of haploid plants, Somatic embryogenesis	3	To learn different culture methods	Lecture, video clippings	
	4	Synthetic seed production Transgenic plants – Bt cotton, Golden rice	3	To know about transgenic plants	Lecture, video clippings	
III INDUSTRIAL BIOTECHNOLOGY						
	1	Industrial Biotechnology – Fermentor design	2	To design industrial fermentor	Lecture, PPT	Formative Assessment II, Assessment of Industrial Visit Report
	2	Batch culture; Continuous culture; Fed batch culture	3	To differentiate the different culture methods	Lecture, PPT	
	3	Immobilization of enzymes; Production of ethanol, acetic acid	3	To understand the production of alcohol and acids	Lecture, video clippings, Industrial Visit	
	4	Production of citric acid, Penicillin and Vitamin B_{12}	2	To understand the production of antibiotics and vitamins	Lecture, Video Clippings	

IV BIOSENSORS						
	1	Biosensors – Principle, types and applications; Biochips	3	To know the basics of biosensors	Lecture, PPT	Online Assignment, Group Discussion
	2	Biosafety – possible dangers of GEOs; biosafety guidelines; physical and biological containments	4	To differentiate the different containments	Lecture	
	3	Intellectual property rights; Process of patenting application	3	To know about IPR and patent rights	Lecture, PPT	
	4	Farmer's Rights and plant breeder's Rights.	3	To correlate Farmer's and Plant Breeder's Rights	Lecture, PPT	
V VACCINES & NANOTECHNOLOGY						
	1	Edible vaccines, Plantibodies; Gene therapy – types of gene therapy,	3	To understand the basics of vaccines and gene therapy	Lecture	Formative Assessment III, Seminar
	2	Production of monoclonal antibodies and its application	3	To learn the techniques for producing MAb	Lecture, Video Clippings	
	3	Production of DNA vaccine; Production of subunit vaccine	3	To differentiate the different vaccine production	Lecture, Video Clipping	
	4	Nanotechnology – nanomaterials, Synthesis of nanodrugs	3	To know the concepts of nanotechnology	Lecture, PPT	

Course Instructor: Ms. N. Benit **HOD: Dr. C. Jespin Ida**

Semester: **IV**

Name of the Course: **Industrial Microbiology (Elective IV)**

Subject Code: **PB1744**

Teaching Plan

Unit	Module	Topics	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
1. SCREENING & PRODUCTION MEDIUM						
	1	Screening and Production medium – Introduction, history and development of industrial microbiology, scope of industrial microbiology	4	To understand the basics of industrial microbiology	Lecture, PPT	Formative Assessment I, Online Assignent
	2	Screening techniques – Primary screening and Secondary screening; Strain development	3	To differentiate primary and secondary screening methods	Lecture, PPT	
	3	Preservation of microorganisms	2	To know about the methods of preserving microbes	Lecture	
	4	Characteristics of an ideal production medium; Raw materials used in fermentation medium	3	To characterize the different raw materials for fermentation	Lecture, PPT	
II FERMENTATION						
	1	Fermentation Process – Basic structure of a fermentor	3	To construct the fermentor	Lecture, Model	Group Discussion, Class Test
	2	Batch culture, Continuous culture, Semi continuous culture,	3	To correlate different culture methods	Lecture, PPT	

		Fed batch culture				
	3	Growth kinetics of microorganisms	3	To understand the growth kinetics of microorganisms	Lecture	
	4	Classification of fermentation process, Sterilization of equipment, media and air	4	To classify the process and sterilization in fermentation	Lecture, Video Clippings	
III TYPES OF FERMENTOR						
	1	Types of fermentor – Buble column reactor, Airlift fermentor, Fluidized bed reactor, Tower fermentor	3	To categorize the different types of fermentor	Lecture, PPT	Formative Assessment II, Online Quiz
	2	Immobilization – Methods of immobilization, Different types of immobilized enzyme reactors	4	To correlate the different types of immobilized enzyme reactors	Lecture, PPT	
	3	Solid – Liquid separation methods; Liquid – liquid extraction	3	To differentiate the extraction methods	Lecture, Video Clippings	
	4	Physical, Chemical and enzymatic methods of cell disruption	4	To understand the methods of cell disruption	Lecture, PPT	
IV MICROBIAL PRODUCTION OF FOOD						
	1	Microbial production of food – Production of single cell protein (SCP); Production of Bakers yeast;	3	To know the microbial production of various foods	Lecture, PPT	Class test, Group Discussion
	2	Production of bread, Production	4	To know the microbial	Lecture, Video	

		of wine; Production of beer;		production of various foods	Clippings, Preparation of wine	
	3	Production of whisky, Production of sauerkraut; Preparation of cheese.	3	To know the microbial production of various foods	Lecture, Video Clippings	
V PRODUCTION OF USEFUL PRODUCTS						
	1	Production of useful products – Antibiotics – Penicillin, Streptomycin;	4	To learn the production of antibiotics	Lecture, PPT	Formative Assessment III, Question and Answer session
	2	Production of Organic acids - Citric acid, Acetic acid;	3	To learn the production of organic acids	Lecture, PPT	
	3	Production of Enzyme - Amylase enzyme; Solvents - Ethyl alcohol; Amino acid - Glutamic acid; Vitamin – Vitamin B_{12}.	4	To understand the production of enzymes and vitamins	Lecture, Video Clippings	

Course Instructor: Ms. J. Albino Wins **HOD: Dr. C. Jespin Ida**