

M Sc (Master of Science) Life Sciences (Ayurveda Biology)

Curriculum



2020

The University of Trans-Disciplinary Health Sciences and Technology

(Private University established in Karnataka by ACT 35 of 2013)

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MSc Life Science (Ayurveda Biology) Program Handbook

Core courses: Semester – I

Course Code	:	MABC101	
Title of the course	:	Fundamentals of Ayurveda (Classroom)	
Number of credits	:	4	
Name of course co-ordinator	:	Dr. Girish Kumar. V	
			Contact Hrs (T+P)
Unit 1: Basic Principle of Ayurveda Introduction to the concepts of <i>Pancha Mahabhuta</i> , <i>Loka-Purusha samanyatha</i> , <i>Samanya-vishesha siddhanta</i> . Details on <i>tridoshas</i> , <i>Sapta dhatus</i> (7 tissues), <i>Tri malas</i> (3 major waste products). Concept of <i>prakrti</i> and its role in designing individualized medicine. <i>Agni</i> and <i>Ama</i> (undigested food waste) causing diseases. <i>Rasa-vipaka</i> , <i>dhatu poshana nyayas</i> . Essentials of Ayurvedic anatomical concepts like <i>srotas</i> , <i>sira</i> , <i>dhamani</i> and <i>marma</i> .			10 + 6
Unit 2: Concept of Wellness, Health & Disease in Ayurveda Introduction to Ayurvedic concept of health and wellness: normal states of <i>tridosha</i> , <i>7 dhatus</i> (tissues), <i>3 malas</i> (waste products) and <i>agni</i> (digestion). Imbalance in <i>agni</i> and formation of <i>ama</i> (undigested food waste) causing diseases.			6 + 3
Unit 3: Introduction to the Concept of Pathology in Ayurveda Theories on disease manifestation (<i>Shat Kriyakaala - Chaya, Prakopa, Prasara, Sthanasamshraya, Vyakti</i> and <i>Bheda</i>) and identification of stages of a disease – <i>Nidana</i> (cause), <i>Purvarupa</i> (prodromal symptoms), <i>Rupa</i> (manifested symptoms), <i>Samprapti</i> (pathogenesis) and <i>Upasaya</i> (therapeutic tests).			6 + 3
Unit 4: Clinical examination protocols as per Ayurveda An introduction to clinical diagnosis of diseases in Ayurveda: <i>Ashtasthana pareeksha</i> , <i>Trividha Pareeksha</i> and <i>Dashavidha Pareeksha</i> .			6+5
Unit 5: Introduction to Treatment Principles as per Ayurveda Introduction to Ayurvedic treatment approach: <i>Chikitsa Chatuspada</i> ,			6+5

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<i>Dvididhopakrama</i> (<i>Santarpana</i> - nourishment and <i>Apatarpana</i> -de-nourishment). <i>Shodhana Chikitsa</i> including <i>Poorvakarmas</i> and <i>Panchakarma</i> , <i>Sadhya-Asadhyata</i> of Diseases.	
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Course Code	:	MABC102 (Classroom)
Title of the course	:	Local health traditions and community health
Number of credits	:	2
Name of course co-ordinator	:	Dr. B.N. Prakash
		Contact Hrs (T+P)
Unit 1: Local Health Traditions Traditional medicine, Codified, non-codified, definitions, scope, potential, limitations; Documentation, Assessment & Promotion of LHT; Primary healthcare - Self-care, Healthcare system, 3 tier, household traditions, community healers.		8
Unit 2: Understanding Community health Origin, definition, scope, limitation, resources, ethics, field research; Prevalent community health issues - Communicable diseases; Health Policies and programs - Government interventions, success and limitations; Community engagement - Dynamics of the society, social and behavioural aspects, communication and co-ordination skills.		10
Unit 3: Traditional medicine perspective Basis of AYUSH principles from community health perspective, traditional healers' role.		4
Unit 4: Community based participatory research Data management and biostatistics- Collection, processing and methodology for research; Case studies: Practical examples of malaria research, copper research.		8

Course Code	:	MABC103
Title of the course	:	Biochemistry (Classroom)
Number of credits	:	4
Name of course co-ordinator	:	Dr. Megha
		Contact Hrs (T+P)
Unit 1: The Foundations of Biochemistry Biomolecules – The molecular logic of life: The chemical unity of diverse living organisms, composition of living matter. Macromolecules and their monomeric subunits; Water – interactions, ionization, biological buffers; carbohydrates- classification, basic structure; Amino acids and Proteins; Nucleotides and Nucleic Acids; Lipids; Vitamins.		10

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Unit 2: Biochemistry of metabolism Carbohydrate, Lipid, Amino Acids, Nucleotides; Metabolic Fates of Amino Groups; Nitrogen Excretion and the Urea Cycle; Pathways of Amino Acid Degradation. Oxidative phosphorylation - Electron-Transfer Reactions in Mitochondria; ATP Synthesis; Mitochondrial biochemistry	20
Unit 3: Clinical biochemistry Metabolic disorders, digestive disorders, hormonal regulation and metabolism; Nutritional Biochemistry - Function of nutrients.	10
Unit 4: Biochemistry of Proteins. Structure of proteins; Protein folding and denaturation; Protein interactions - ligand-receptor interactions; Protein interactions modulated by chemical energy; Downstream signalling in protein interactions; Protein-protein interaction in biology.	10
Unit 5: Enzymes Introduction; nomenclature and classification; Mode of action of enzyme; enzyme kinetics and regulation of enzyme action; Examples of enzyme reactions; isolation and characterization of enzymes; Enzymes in diagnosis and treatment.	10

Course Code	:	MABC104	
Title of the course	:	Molecular biology and genetics (Classroom)	
Number of credits	:	3	
Name of course co-ordinator	:	Dr. Lavanya Devi K	
			Contact Hrs (T+P)
Unit 1: Introduction to Molecular Biology Introduction to molecular biology, history of molecular Biology, Structural organization of genetic material: Structure of gene - Structure of DNA, RNA and proteins; Prokaryotic organization of a gene - concept of operon (lac and trp), promoter; Eukaryotic structure of gene- intron, exon, promoter and upstream elements; Genetic code; Organization of Human genome - Mitochondrial genome; Nuclear genome; Gene families - pseudogene, transposable elements, gene duplication; RNA genes- non coding RNA genes (tRNA and r RNA).			5
Unit 2: Structure and replication of nucleic acid Functions of genetic material: DNA replication - Models of DNA replication; Semi-conservative model of replication; Antiparallel nature of DNA, types of replication (Explanation, theory, types) Replication of double stranded DNA, Directions of DNA, Discontinuous replication, Okazaki fragments, Enzymes (Polymerases, ligases, isomerases), Chromosomal End replication problem;			6
Unit 3: Central Dogma of Life Central Dogma of Life: Transcription - Prokaryotic transcription; Eukaryotic transcription; Splicing; Regulation of gene expression (RNA interference); Translation - Structure of ribosomes- Prokaryotes and Eukaryotes; Protein synthesis in prokaryotes and eukaryotes; Post translational modification			10
Unit 4: Fundamentals of genetics Types of cells, structure of chromosome, gene, genome, cell division, Mitotic and			8

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Meiotic division Principles of genetics, Mendelian inheritance, extension of Mendelian inheritance, evolution of gene concept, Linkage and chromosomal mapping, linkage and crossing over, inbreeding depression and heterosis.	
Unit 5: Mutations, types of genetics and tissue culture Mutations: Types of mutations, chromosomal mutations, molecular mechanisms of gene mutations, detection of mutations, Population Genetics, Quantitative genetics and Evolutionary genetics, plant tissue culture, origin, totipotency of the plant cell, types of culture, applications of micropropagations.	8
Unit 6: Molecular Evolution Neutral theory of molecular evolution, Models of nucleotide substitution, p-distance, Poisson correction, Jukes-Cantor 69, Kimura-2-Parameter, Felsenstein 81, Hasegawa, Kishino and Yano 85, General Time Reversible (GTR), Rate heterogeneity (G), Rate Invariability (I), Model selection, Hierarchical Likelihood Ratio Test (hLRT), and locus selection	8

Course Code	:	MABC105	
Title of the course	:	Ecological principles (Classroom and field work)	
Number of credits	:	3	
Name of course co-ordinator	:	Dr. Chetan HC	
			Contact Hrs (T+P)
Unit 1: Introduction to Ecology "Theory: Introduction to principles of ecology – what it is and how do we study it; geology and climate; Biomes; Physical environment and biosphere; Water and temperature; Evolution and ecology - natural selection and relevance in human dominated world, speciation and sexual selection; eco-physiology ecology: Variations in temperature and water."; case studies to understand concepts			3+4
Unit 2: Population and community ecology Basics of population ecology; Life history; population distribution and abundance; Population growth and regulation; Population dynamics; Interactions (competition, predation, herbivory, mutualism, commensalism); Population genetics, Species assemblies – communities structure; ecological succession and community development; Species diversity; change in communities; community interactions and energy; The nature of communities; Biogeography (Island biogeography); Statistics in ecology.			8+4
Unit 3: Ecosystem ecology Concept of niche; ecological amplitude; Energy in ecosystem; pathways of elements in ecosystems; and nutrient regeneration in terrestrial and aquatic ecosystems; production; herbivory; predation; parasitism; energy flow and food webs; the role of human beings in the energy flow; nutrient supply and cycling: plant uptake and use, nitrogen dynamics, reactive nitrogen, nitrogen and phosphorus; trophic dynamics; global biogeochemical cycles and the carbon climate connection.			8+4
Unit 4: Biodiversity Levels and types of biodiversity; Distribution of species and species ranges (spatial			8+4

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and temporal); Theories of succession; human interactions with biodiversity; threats to biodiversity; resources competition and interactions.	
<p>Unit 5: Ecological applications Conservation ecology: landscape ecology, sustainable development, global change, planetary boundaries and resilience, restoration and conservation ecology; conservation science; ecosystem management: ecosystem services; principles, traditional ecological knowledge (TEK); urban ecology; demography and historical ecology; economic development and changes in global ecology, ecosystem stewardships: from ecosystems to ecosphere.</p>	8+4

Course Code	: MABC106
Title of the course	: Drug design in Ayurveda - principles and practices (Theory and Practical)
Number of credits	: 2
Name of course co-ordinator	: Dr. Subramanya Kumar
<p>Unit 1: Introduction to pharmaceuticals in Ayurveda (Bhaishajya Kalpana and Rasashastra) Introduction to Bhaishajya Kalpana (preparation of herbal drugs) and Rasashastra (preparation of metallic/mineral drugs). Paribhasha (technical terms) used in the context of Ayurvedic pharmaceuticals. Importance of Compound formulations over Ekamoolika Prayoga (single drug therapy)</p>	4+0
<p>Unit 2: Primary processing, basic and secondary pharmaceutical preparations of Ayurveda Knowledge about Pancha Vidha Kashaya Kalpana (basic pharmaceutical techniques). Swarasa (fresh juice), Kalka (paste), Kashaya (decoction), Phanta (hot infusion), Hima (cold infusion)- procedure of preparation, general dosage and 1-2 examples. Demonstration of Ardraka swarasa, Tulasi Kalka, Guduchi Kashaya, Panchakola phanta, Dhanyaka Hima. Knowledge about important compound formulations. Taila/ghrta paka (medicated oils and ghees), avaleha (confectioneries), Asava- Arishtas (fermented preparations), Vati-Gutika (pills, tablets), Bhasmas (calcined metals/minerals) and Rasaushadhis (metallic preparations). Introduction to contemporary pharmaceutical techniques and machinaries used in Ayurveda. Preservatives and stability enhancers.</p>	8+8
<p>Unit 3: Toxic medicinal plants and detoxification of herbal drugs of Ayurveda Introduction to toxic drugs of Ayurveda and principle of their purification. Purification procedures of Vatsanabha (Aconitum ferox Wall.), Gunja (Abrus precatorius), Vishatinduka (Strychnos nux-vomica L.), Parada (mercury) and Gandhaka (sulphur) will be briefed.</p>	2+4
<p>Unit 4: Fundamentals of Nutraceutical products design in Ayurveda. Concept of Ahara kalpana (nutraceuticals) in Ayurveda. Various food preparations in</p>	6+6

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Ayurveda: Paya, Vilepi, Manda, Yusha, Supa etc. Role of special food preparations in disease management (pathya kalpana). Concept of Viruddha ahara (incompatible foods and drinks) and its importance in nutraceutical design. Application of pathyakalpana as per contemporary requirements. Procedure of preparation of Odana (different rice preparations), Yusha (soups) will be briefed. Demonstration of preparation of Mudga Yusha (green gram soup).	
Unit 5: Network pharmacology Drug discovery, Target prediction, Protein metabolite interaction prediction, Predict protein:protein and drug:target interactions.	2+2

Course Code	:	MABL101
Title of the course	:	Molecular Biology and Biochemistry Lab (Practical)
Number of credits	:	2
Name of course co-ordinator	:	Dr. Mohan Kumar Patel
Unit 1: Fundamentals of lab experiments Biological safety laboratory procedures - General safety guidelines, safety equipment, hygiene practices, identification of hazardous chemicals, storage/disposal of hazardous and biological waste, storage of flammable chemicals and labelling; Lab equipment and Reagent preparations - Operation of equipment (autoclave, hot air oven, micropipettes, biosafety cabinets, etc.), calibration of equipment, train students to prepare and follow standard operating procedures (SOP) for all the equipment, preparation of molarity solutions, labelling and storage. Disposal of bio-hazard materials; proper handling and disposal infectious materials; personal care while handling bio-hazard materials; radioactive materials – safety measures and disposal.		10
Unit 2: Principles of cell culture Isolation and identification of microbes from various sources, Culturing microorganisms and growth curve of prokaryotes, Fundamentals of animal cell culture, Isolation and culture of primary cells (eg: from blood), Cell proliferation – cell growth and cytotoxicity; action of drugs on cell proliferation; cell migration – chemo attractants and chemotactic migration,.		20
Unit 3: Nucleic acid experiments Isolation of nucleic acid - DNA, RNA; PCR - normal PCR and RT PCR; Basics of rDNA technology.		20
Unit 4: Enzymology experiments Michelis Menton graph; Other routine enzyme assays.		10
Unit 5: Protein chemistry Protein preparation, PAGE, Immunological techniques of protein identification – ELISA and Western blot; Antibody labelling.		20

Core Courses: Semester - II

Course Code	: MABC201
Title of the course	: Cell biology and cell signalling (Classroom)
Number of credits	: 4
Name of course co-ordinator	: Dr. Ashwini Godbole
<p>Unit 1: Structural components of Cells Prokaryotic and eukaryotic cells: Structure, organization and function of cells; Sub-cellular structures- organelles, membrane systems and the cytoskeletons; Structure and function of cell wall, cell membrane, endoplasmic reticulum, Golgi complex, Vesicles, Lysosomes and Vacuoles; Cell cycle – prokaryotic and eukaryotic; Nucleus - Nuclear membrane, nucleolus, chromosomes; Cytoskeleton - Actin, Microtubules, role in cell division; Mitochondria - Structure (Membranes, matrix and intermembrane space) and function.</p>	10
<p>Unit 2: Cells and Molecules in Immunity Hematopoietic stem cells, stromal cells, hematopoietic growth factors, Lymphoid organs (primary and secondary) and Lymphoid cells (NK cells, B lymphocytes, T Lymphocytes), Mononuclear cells, Granulocytic cells, Mast cells, Dendritic cells-characteristics and functions. Antigen-types, properties. Hapten, adjuvants; Immunoglobulins: Structure types, properties and their function - Theory of antibody production; Diversity of immunoglobulin -VDJ recombination, class switching; Antigen-antibody interaction: Agglutination, complement fixation, precipitation; Hypersensitivity – Type I, II, III & IV; Auto-immunity.</p>	15
<p>Unit 3: Cell signalling. Biological membrane transport – The dynamic nature of plasma membrane; Transport of solute across membrane; Diffusion and active transport; Gated ion channels; membrane rafts and vesicular transport; exocytosis and endocytosis of substances; Biological signal transduction – General features of signal transduction; ligands and receptors in signalling; G-protein coupled receptors; tyrosine kinase receptor; Integrins; signalling in prokaryotes and eukaryotes; Special features - Gap junctions, Plasmodesmata, Cytoplasmic streaming, Extracellular matrix; cell junction and communication; Hormones: Diverse Structures for Diverse Functions; Tissue-Specific Metabolism: The Division of Labour; Hormonal regulation and metabolism; hormonal regulation and disease; hormones as diagnostic tools.</p>	20
<p>Unit 4: Cell communication Cytokines & Chemokines: Structure, function and their receptors; Cytokine therapy. Transplantation immunology: Types of grafts, grafts rejection, GVH reactions, mechanism of graft rejection, and prevention of graft rejection. Inflammatory diseases – immunology of inflammation. Immunogenetics,</p>	10

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Immunopharmacology, Immune regulation, Tolerance.	
Unit 5: Systemic Signalling. Hormones: Diverse Structures for Diverse Functions; Tissue-Specific Metabolism: The Division of Labour; Hormonal regulation and metabolism; hormonal regulation and disease; hormones as diagnostic tools.	5

Course Code	:	MABC202
Title of the course	:	Integrative Immunology (Classroom + Activity)
Number of credits	:	3
Name of course co-ordinator	:	Dr. C. N. Vishnuprasad
Unit 1: Fundamentals of Immunology Types of immunity - Humoral and cell-mediated, innate, acquired immunity; T cell and B-cell activation; Complement system - function and pathways; Cytokines; Immunohaematology: Blood groups-Blood transfusion; Major Histocompatibility complex. Vaccines and Immunization-Types and their characteristics; Monoclonal Antibodies – Hybridoma technology, Production and applications		8
Unit 2: Concept of Immunity in Ayurveda: Vyadhikshamtva Principles and concepts of <i>Vyadhi Kshamathwa</i> , <i>bala</i> and <i>Ojas</i> . <i>Swasthya</i> (wellness): the optimum status of <i>doshas</i> (humors), <i>dhatu</i> (tissue systems), <i>malakriya</i> (excretory functions) and <i>agni</i> (digestion and metabolism). Pleasant <i>atma</i> (self), <i>indriya</i> (organs), <i>manas</i> (mind). <i>Roga bala & Rogi bala</i> (strength and weakness of disease and diseased). Various factors effect <i>Vyadhikshmatva</i> and correction of deterioration of immunity.		8+2
Unit 3: Infection immunology. Microbial pathogenesis - virulence factors; Stages of pathogenesis; Invasion of host defence mechanism; antibiotic resistance; Immune defence against bacteria, viruses, fungi and parasites (with at least 2 examples). Biology of vaccine.		10
Unit 4: Inflammation and Disease immunology. Allergy, Hypersensitivities, and Chronic Inflammation; Tolerance, Autoimmunity, and Transplantation; Immunodeficiency Disorders; Immunology in disease - Cancer, diabetes and other diseases.		5
Unit 5: Therapeutic application of 'integrative immunity' Ayurveda - Scope of integrative immunology in prevention and management of both infectious and non-infectious diseases. Use of the concepts and practices of <i>Vyadhikshamatva</i> in preventive and promotive healthcare; a new perspective of disease management through built-up resilience within an individual. Discussions practitioners on immune disorders such as Rheumatoid arthritis.		8+4

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Course Code	:	MABC203
Title of the course	:	Medicinal plants and pharmacognosy (Classroom and Field)
Number of credits	:	3
Name of course co-ordinator	:	Dr. Subramanya Kumar
Unit 1: Wealth of Medicinal plants used in Traditional Systems of Medicine in India		4 + 0
Wealth of medicinal plants in Indian subcontinent. Numbers of medicinal plants documented in Ayurveda, Unani, Siddha, Homeopathy and Tibetan medicine Literature. An idea about the medicinal plants used in living traditions. Medicinal plants as a source of molecules in modern medicine. Introduction to <i>Dravya</i> (therapeutic agent), its classification.		
Unit 2: Understanding functional properties and pharmacological actions of plant drugs based on principles of Ayurveda		8 + 6
Theories on <i>dravya</i> (material-therapeutic agent), <i>rasa</i> (taste), <i>guna</i> (properties), <i>Veerya</i> (potency), <i>vipaka</i> (taste after digestion), <i>prabhava</i> (unanticipated action), <i>karma</i> (pharmacological actions) and common uses. It also briefs the Ayurvedic pharmacognosy and pharmacology of 25 selected Ayurvedic plant drugs and 10 metal/mineral drugs.		
Unit 3: Fundamentals of Plant taxonomy and Pharmacognosy		10 +10
Plant taxonomy: study of the following families with special reference to medicinally important plants – <i>Apocynaceae</i> , <i>Solanaceae</i> , <i>Rutaceae</i> , <i>Apiaceae</i> , <i>Fabaceae</i> , <i>Rubiaceae</i> , <i>Liliaceae</i> , <i>Poaceae</i> , <i>Lamiaceae</i> , <i>Brassicaceae</i> , <i>Papaveraceae</i> . Fundamentals of pharmacognosy: Definition, scope and applications in pharmacognosy. Classification and identification of drugs: Need for classification of drugs; taxonomic, morphological, organoleptic, therapeutic and microscopy criteria for classification of powdered drug, methods for documentation of raw drugs.		
Unit 4: Identification of Plant drug adulteration and substitutes		6 + 4
DRUG ADULTERATION: Types, methods of evaluation - biological, anatomical, physical, Phytochemical investigation. Global trend in herbal market. Status of Indian medicinal plant trade, medicinal plants prohibited from export. WHO regulation of herbal medicine.		
Unit 5: Cultivation, collection/harvest, primary processing and quality control of medicinal plants		6 + 4
Preliminary understanding about the use of medicinal plants. Quality control of crude drugs - Overview. Cultivation, Collection, Processing and storage of crude drugs: Factors influencing cultivation not medicinal plants.		

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Course Code	:	MABC204
Title of the course	:	Genomics and Bio-informatics (Classroom and Lab)
Number of credits	:	2
Name of course co-ordinator	:	Dr. Pavithra N
Unit 1: Introduction to Genomics and Bioinformatics		5
Introduction to Genome, C-value Paradox, Genome organization in different organisms such as bacteria, yeasts and humans, Gene regulation and evolution, Mapping genomes- genetic and physical mapping, introduction to instrumentations of Genomics study		
Unit 2: Experimental design for Genomic Projects		5+5
Sample (Plant, microbe, animal and human) collection, storage and transportation, DNA/RNA isolation and Quality check, Sanger Sequencing, Next Generation Sequencing (NGS) Technologies, NGS sample preparation and library construction, Comparisons of first generation and next generations sequencing, evolution of NGS technology		
Unit 3: Introduction to Bio-informatics		5+5
Introduction to Bioinformatics - BLAST, FASTA, NCBI, GenBank, Introduction to biological databases, Introduction to Computing-LINUX based command line, Introduction to Programming languages, Biostatistics and R program, Genome Browsers.		
Unit 4: Bioinformatics tools for DNA sequence data analyses		4+12
Local server and cloud data management, Challenges in handling big sequence data; Whole Genome; transcriptome and metagenome data analysis, Gene/Genome sequence data submission to database; Handling genomic sequence data in R; Whole genome and RNA-seq data analysis using R; Data Project.		

Course Code	:	MABC205
Title of the course	:	Principles of Conservation of Biodiversity (Classroom and Field)
Number of credits	:	3
Name of course co-ordinator	:	Dr. Abdul Kareem.
Unit 1: Basic concepts of biodiversity.		
Factors promote high diversity, latitudinal and altitudinal gradients of biodiversity; biodiversity extinctions; biodiversity values-evolutionary, economic, social, cultural and intrinsic values, threats to biodiversity-Indian context, important threatened/endemic plant and animal taxa of India, biodiversity and ecosystem services; Climate change and biodiversity.		
Unit 2: Concepts of biodiversity conservation		

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History of biodiversity conservation; Biodiversity conservation strategies: <i>in situ</i> conservation: Biosphere reserve, sanctuaries, national parks, ex situ conservation: botanical garden, zoological garden, in vitro conservation: germplasm or gene bank, tissue culture	
<p>Unit 3: Methods of biodiversity conservation</p> <p>Global approaches to biodiversity conservation, Indigenous approaches to biodiversity conservation, Indian initiatives in biodiversity conservation-biodiversity act 2002, Biodiversity Rules 2004, national biodiversity strategy and action plan (NBSAP), Plant Varieties Protection and Farmers Rights Act, 2001, protected area network (PAN)-biosphere reserves, national park, sanctuary, community conservation area, important bird areas; Biodiversity Conservation & Land Tenure Systems, Community based organisations for Biodiversity Conservation.</p>	
<p>Unit 4: International programmes for biodiversity conservation</p> <p>Convention on biological diversity (CBD), CITES, ITTA, UNFCCC, Kyoto Protocol, TRIPS, Ramsar Convention on Wetlands, Cartagena Protocol on Biosafety 2000 (CPB); The Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal, The Montreal Protocol, IPR.</p>	
<p>Unit 5: Conservation in Practice</p> <p>Field trips to different conservation models, discussion groups and guest speakers combine to cover the scientific knowledge, forest managers, local communities, NGOs and how these can be applied to the management, conservation and restoration of biodiversity.</p>	

Course Code	:	MABC206
Title of the course	:	Basics of Plant and Animal Physiology (Classroom)
Number of credits	:	2
Name of course co-ordinator	:	Dr. Mohan Kumar Patel.
<p>Unit 1: Photosynthesis & Respiration</p> <p>Photochemical process and reaction-Light and Dark reaction, carbon assimilation, physiological and ecological relation, CO₂ reduction in Calvin cycle, supplementary pathway of C fixation in C₄ and CAM plants and its significance, respiration and photo-respiration, Mitochondrial respiration, growth and maintenance respiration, cyanide resistant respiration and its significance.</p>		5
<p>Unit 2: Transpiration and translocation</p> <p>Translocation of photosynthates and its importance in sink growth, Driving force for transpiration, stomatal mechanism, plant factors influencing transpiration rate, Anti-transpirants. Water absorption, solute/ion transport.</p>		5
<p>Unit 3: Plant growth & development</p> <p>Hormonal signalling pathways.: Hormonal concept of growth and differentiation, plant</p>		5

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growth hormones and their physiological role, Growth Curve, Phytohormone in plant growth and development (Auxin, Cytokinine, ABA, Ethylene, Brassinosteroids, Strigolactones etc	
Unit 4: Human Developmental Biology Fertilization, Cleavage, Gastrulation, Somite Differentiation - Myotomes, Dermatomes, Bone, Limb Muscles – CNS – Peripheral nervous system. Fetal development- Somite Differentiation - Myotomes, Dermatomes, Bone, Limb Muscles – CNS – Peripheral nervous system;	7
Unit 5: Human Physiology & Homeostasis Cell Physiology – Membranes & tissues – energy balance – Neuronal and Hormonal communication – acid-base balance – Tissue structure and muscle physiology. Circulatory system – digestive system – respiratory system – endocrine system – reproductive system.	8

Course Code	:	MABL201
Title of the course	:	Medicinal plants & pharmacognosy Lab (practical)
Number of credits	:	2
Name of course co-ordinator	:	Dr. Noorunneesa Begam.
Unit 1: Morphological characteristics of plant families mentioned in theory.		5
Unit 2: Microscopic measurements of cells and Cell contents: Starch grains, calcium oxalate crystals and phloem fibres; Primary and secondary structures of plants , Shoot apex, secondary structures, Bark, wood excretory structures of medical and commercial importance.		10
Unit 3: Study of pharmacognostical features of <i>Sarpagandha</i> , <i>Jatamansi</i> , <i>Ashwagandha</i> , <i>Turmeric</i> , <i>Punarnava</i> , <i>Ephedra</i> , <i>Gymnema</i> , Senna, Amla, Gokshru, Issabgol, Black pepper, Banafsha, Arjun or any other commercially species specific to the region.		15
Unit 4: Botanical Survey - 1 trip, Preparation of herbarium sheets. Visit to Herbal Industry and Cultivation site.		20
Unit 5: Chromatography – TLC, Paper chromatography, column chromatography; Bioassay guided identification of molecules; HPLC and HPTLC; Chemical reactions of plant compounds.		10

Core Courses Semester – III

Course Code	:	MABC301
Title of the course	:	One Health and food safety (classroom)
Number of credits	:	3
Name of course co-ordinator	:	Dr. Kumar
<p>Unit 1: Introduction to One Health</p> <p>Origins of one health: A. Origin of one health concept, Definition of One Health, Definition of Health from different System of medicine, changing concepts of Health, Dimensions of Health, Challenges of Health, Health Threats. B. Interrelation of Human, Animal and Environmental health and its Interactions: Human and Animal interactions, Animal assisted interventions and Therapies, Integration of human, animal and environmental health, Barriers or challenges of one health. C. Common Disease in cattle - Antibiotic use, antibiotic residue in animal products and antibiotic resistance. Development of Ethno-veterinary practices and Development of alternatives to antibiotics . D. Scope of One Health: One health opportunities, Agro and Bio Terrorism, Antimicrobial resistance, Bio Security, Food safety, Global organizations working on One Health.</p>		15
<p>Unit 2: Zoonoses, Occupation health and Emerging diseases</p> <p>Basic Concepts of Zoonoses: Introduction to zoonoses, classification of zoonoses, transmission of zoonoses, Bacterial, Viral Zoonotic diseases, Rickettsial, Fungal and parasitic zoonoses. Occupational health: Introduction, Role of Health Professionals, Occupational health hazards and its implications in One health. Emerging diseases and One health : Infection and its process, Reservoir of infections, Modes of transmission, Infection disease control, Emerging and re- emerging diseases, Ebola, SARS – COVID (Corona), Nipha, Crimean Congo fever, Avian influenza, West Nile virus, Hendra infection.</p>		15
<p>Unit 3: Food Safety and One Health</p> <p>Safety of foods of animal and plant origin: Introduction, Hazards of chemicals used in food industry, physical and biological hazards, Food safety standard act 2006, FSSAI. Emerging food safety issues and its Management: Introduction, Traditional food safety system Vs Conventional food safety system, Emerging trends, Biotechnology and Nano technology in foods, Dairy technology and issues with Dairy foods, Hygienic monitoring of Food supply chain. Food borne diseases: Introduction, Classification, food borne disease surveillance, outbreaks, Prevention, Control of food borne diseases. One health perspective in Dairy Production and “well-being indicators (social, economic, ecological and personal)”.</p>		15

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Course Code	:	MABC302
Title of the course	:	Research Methodology and Biostatistics (Classroom and activities)
Number of credits	:	4
Name of course co-ordinator	:	Dr. C. N. Vishnuprasad
Unit 1: What is Research		4
<p>Aim and objective of Research; Fundamental principal of research; What is a research question versus an ordinary question; need to determine its boundaries; Is novelty a critical goal of research or can there also be other critical goals; Issues of Epistemology, methodology, data and validation in different knowledge domains; Challenges of translation of concepts and categories across knowledge domains.</p>		
Unit 2: Research design and methods of research		8
<p>Relationship between knowledge domain and research strategies in integrative clinical research; Speculation on traditional research methods based on Ayurveda knowledge system;</p>		
Unit 3: Communication in Research		6+12
<p>Communicating Research – Presenting research: data visualisation, telling a story, elevator pitch; Basics of Technical Communication; Barriers to Communication; Oral/visual Communication; The Art of Delivery, Effective Presentation Strategies, Use of audio visual Aids, Group Discussion, Negotiation, Small Talk; Written Communication – Writing research: tools for effective narrative builds, writing a title and abstract; Publishing research: types of articles, authorships, pre-prints, social media; Word choice and Syntax style, Number use, References, Plagiarism. Technical Proposal and Thesis Writing Methodology.</p>		
Unit 4: Research Ethics		6
<p>Professional standards, Ethical conduct in research. Plagiarism; Sharing of scientific knowledge; Principles and ethics in designing experiments; Data acquisition and analysis – raw data, storage of raw data, data analysis, confidentiality of data, converting raw data into results, appropriate statistical methods for analysis; Principles and ethics clinical trials, animal experiments and field studies - Nuremberg Code, Declaration of Helsinki, institutional ethics committee for clinical studies and animal studies; Intellectual Property Rights.</p>		
Unit 5: Statistics		6+9
<p>What is statistics? Evolution and introduction to statistics; Understand the data, types of data, usage of data, data collection source (primary, secondary, and tertiary); Where to use statistics?; How to apply statistics? --> graphical representation (seasonal data, forecasting), mean, median, mode, variability/ variance standard deviation, Confidence interval, measures of dispersion: range, mean deviation, variance & standard deviation; linear regression & correlation; Chi- square test; ANOVA,</p>		

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parametric and non-parametric test; Introduction to infographics;	
<p>Unit 6: Statistics</p> <p>Probability Theory: Concept of probability: sample space and events, independent events, mutually exclusive events. axioms of probability, conditional probability, additional and multiplication theorem of probability, Baye's theorem, Bernoulli trials, binomial distribution, normal distributions, Poisson distribution; Sampling Theory: Meaning and objective of sampling, Sampling Error, Types of Sampling, Sampling Distribution, Sampling Distribution of Sample Mean and Sample Proportion, Standard Error. Test of Hypothesis of Small and Large Samples: Standard Normal distribution, Chi-square distribution, Student's t distribution, F distribution, Analysis of Variance, Using R for statistical analysis: what is R and why is it important for biologists; Installation of R and its dependencies; Data types in R and rules followed during programming; Data structures in R. Descriptive statistics using R; Loops and conditional statements; Introduction to probability and hypothesis testing; Statistics for preclinical and clinical research.</p>	6+9

Core course: Semester - IV

Course Code	:	MABR401
Title of the course	:	Dissertation work
Number of credits	:	29
Name of course co-ordinator	:	Dr. Megha/Dr. C. N. Vishnuprasad
<p>Dissertation work will start in the third semester and will finish by the end of fourth semester by completing the submission of dissertation thesis and viva-voce). While nodal faculty is indicated above, it is envisaged that TDU faculty will either be a guide or co-guide on every students' dissertation. It is at the discretion of the TDU faculty and the student to arrive at a mutually agreed research plan. This plan may be executed on campus, or in partner institutions, or in research laboratories across India/ globally.</p>		

Proposed Electives: Semesters II & III

The students can select any two elective courses either from the above list of nine approved courses or any other course from diverse knowledge domains including, but not limited to, arts, social sciences, engineering and humanities offered online or offline by TDU or other national/international Universities or academic bodies such as colleges and research institutions. The student should ensure that the courses selected as elective are approved by TDU AR&OC and each elective course is equivalent to or more than “two credits” as per UGC norms.

Course Code	:	XXXXXXXX
Title of the course	:	Computational Biology (Classroom and Lab)
Number of credits	:	2
Name of course co-ordinator	:	Dr. Prasanna Koti
Unit 1: Data Structures and Algorithms		6+4
Graph data structures, De Bruijn graph, Shortest Paths, Suffix trees and arrays, String matching, Sorting and Merging algorithms. Applications with case studies and practical assignments.		
Unit 2: Frontiers of Systems Biology and Structural biology		6+4
Gene expression and protein activity, Biological pathways and networks, Protein structure and conformation, Protein stability and folding, structure prediction and modelling.		
Unit 3: Comparative and metagenomics		6+4
Comparative sequence data analysis of biological data collected from living and non-living, targeted and whole metagenomics, Functional and diversity analysis.		
Unit 4: Diseases and genome wide association studies		6+4
GWAS case studies in human disease such as Alzheimer's, cancer, <i>Dosha-Prakruti</i> etc.		

Course Code	:	XXXXXXXX
Title of the course	:	Biology of Metabolic Diseases
Number of credits	:	2
Name of course co-ordinator	:	Dr. C. N. Vishnuprasad
Unit 1: Introduction to metabolism		6
Reactions and Regulations involved in Metabolic Pathways, Carbohydrate Metabolism, Lipid Metabolism, Amino Acid Metabolism; Hormonal Regulation of Metabolism - A brief overview of hormone action on metabolism, Action of Insulin and Glucagon, Action of Epinephrine, Action of Cortisol, Action of Thyroid Hormone and Leptin;		

Unit 2: Metabolic Disorders Disorders of Carbohydrate Metabolism, Galactosemia, Fructose Intolerance, Glycogen Storage Disorders, Glucose 6-Phosphate Dehydrogenase Deficiency; Disorders of Lipid Metabolism - Refsum's Disease, Neiman-Pick Disease, Gaucher Disease, Tay-Sachs Disease; Disorders of Amino Acid Metabolism - Phenylketonuria, Albinism, Homocystinuria; Diabetes; Cardiovascular Disease and Stroke.	8
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Unit 3: Diagnosis and Treatment Options for Metabolic Disorders An Outline; Concepts of integrative medicine for the management of metabolic diseases; Ayurveda Biology framework for metabolic diseases; Integrative nutrition.	8
Unit 4: Discussion of Research and Review Articles on recent developments in metabolic disease research	8

Course Code	:	XXXXXXXX
Title of the course	:	Programming in Python (Classroom and Practical)
Number of credits	:	2
Name of course co-ordinator	:	Dr. Prasanna
Unit 1: Introduction to python Python environment and dependencies; Python data types and data structures; Writing basic functions and scripts		5+10
Unit 2: Data manipulation using pandas; Loops and conditional statements; Data visualization using python; String and pattern matching		5+10
Unit 3: Basics of Biopython; Handling sequence data; Building pipelines for sequence data; Data project.		5+10

Course Code	:	XXXXXXXX
Title of the course	:	Ayurveda Biology of Dietetics
Number of credits	:	2
Name of course co-ordinator	:	Dr. Girish Kumar
Unit 1: The Gut Ayurveda vs modern view: <i>Mala</i> ; <i>Trigunas: satva, rajas</i> and <i>tamas</i> , <i>Agni</i> in physiological and pathological status of <i>Agni</i> , gastrointestinal tract and digestion (<i>Khosta</i> and its role in health and disease), Metabolic waste (<i>ama</i>); Gut-mediated homeostasis, Gut-brain axis, Gut microbiome, Review of <i>Prakruti</i> and microbiome research papers		10
Unit 2: Rasapanchaka and Ahara Viddhi <i>Rasa-guna-veerya-vipaka-prabhava</i> ; Properties of commonly consumed fruits and vegetables; Dietetic Rules, Food pairings and <i>viruddha ahara</i> ; <i>Pathya</i> and <i>apathya</i> ; Design-a-diet based on <i>Prakruti</i>		10
Unit 3: Research methods and polices in food & nutrition Modern dietary assessment: ABCD; 24 hr recall, interview; Review of selected diet-related studies; FSSAI; Double burden of malnutrition		10

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Course Code	:	XXXXXXXX
Title of the course	:	Advanced Research Seminar
Number of credits	:	2
Name of course co-ordinator	:	Dr Megha
Unit 1: Theme: Genomics		
Lectures from experts who research on Ayurveda and human genomics & microbiome.		10
Unit 2: Theme: Ethnobotany		
Lectures from experts in traditional plants for food and medicine: conservation, mode of action studies and consumption from food systems point-of-view		10
Unit 3: Theme: Efficacy of traditional formulations		
Lectures from biomedical and Ayurveda experts engaged in mode of action/clinical/public health studies regarding efficacy of traditional medicine.		10

Course Code	:	XXXXXXXX
Title of the course	:	Gums and resins
Number of credits	:	2
Name of course co-ordinator	:	Dr. M. N. B. Nair
Unit 1:		
What are Natural gums, Gumresins and resins, types of gums and resins. How they are produced in Plants- Gum/resin ducts, gum/resin cavities, Mode of secretion and sustainable tapping of Gum and resins		15
Unit 2:		
Gums and resins in Industry (Dietetic food, Bakery products Beverages: Dairy product, Meat products, Salad dressings Sauces, Condiment Bases, Ketchups, Sweet pickle & liquor, Chewing gum, Medicine, Pottary etc.		15

Course Code	:	XXXXXXXX
Title of the course	:	Basics of Plant Taxonomy and Systematics
Number of credits	:	2
Name of course co-ordinator	:	Dr. Noorunnisa Begum
Unit 1: Principles of plant identification		
Latin diagnosis, definition and use of Taxonomic terms, History of Plant Taxonomy, in India, History of Plant classification, Need and aim of classification. Introduction to artificial, natural, phylogenetic and APG classification.		6
Unit 2: Need and aim of nomenclatures		
Introduction to International rules of Botanical Nomenclature, Brief outline on plant taxonomy with morphology, anatomy, embryology, palynology, cytology, and molecular systematics, Numerical taxonomy, Phytogeography and phytochemistry		6

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Unit 3: General Introduction to Molecular Systematic: Evolutionary theory and Tree of Life, Tree thinking, Convergent Vs. Divergent evolution, Homologous and Analogous traits, Character states: Synapomorphy, Sympleiomorphy and Homoplasy, Types of Clades: Monophyly, Paraphyly and Polyphyly, Orthologous Vs. Paralogous Sequences, Phenetics Vs. Cladistics, DNA Barcoding, and Major Loci Used in Molecular Systematics.	8
Unit 4: Computational Phylogenetics Theoretical framework of phylogenetics, Distance Vs. Discrete methods, Minimum Evolution, UPGMA, Neighbor Joining, Maximum Likelihood, Maximum Parsimony, Bayesian Inference, reconstruction of phylogeny from morphological data, Gene Tree Vs. Species tree, and lineage sorting.	4+4
Unit 5: Herbarium related field work Field work involving learning of 10 important families and preparation and submission of 10 voucher specimens	2+4

Course Code	:	XXXXXXXX
Title of the course	:	Wood Science
Number of credits	:	2
Name of course co-ordinator	:	Dr. M. N. B. Nair
Unit 1: What is wood, Types of wood, how it is formed, Dendrochronology and dendroclimatology physical properties, Natural defect in wood, secretory structure in the wood, heartwood formation.		15
Unit 2: Major uses of wood and special wood (Paper, musical instruments, derivatives of woods etc. Renewable material.		15

Course Code	:	XXXXXXXX
Title of the course	:	Policy and regulatory affairs
Number of credits	:	2
Name of course co-ordinator	:	Dr. Megha
Unit 1: AYUSH and integrated health related policies Creation of AYUSH ministry, AYUSH education, AYUSH drugs and cosmetics act (CDSCO act).		12
Unit 2: Biodiversity Forest rights act, Biological diversity acts and rules, Perspectives from stakeholders.		12
Unit 3: Food and nutraceuticals FSSAI, <i>Ayushman Bharath, Poshan Abhiyan,</i>		6

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Course Code	:	XXXXXXXX
Title of the course	:	Integrative Approach to Personalised Nutrition
Number of credits	:	2
Name of course co-ordinator	:	Gurmeet Singh
Unit 1: The Food Story – Need for Personalization		
The Food Paradox The Food Waves – Energy, Nutrition & Information Unified Theory of Food		
Unit 2: Personalization Through the Ages & Food Library		
Personalization Concepts from Ayurveda The Food Library USDA & NIN Food Composition Tables, Ayurveda Food Ingredients, FSSAI Ingredients Macronutrients, Micronutrients, Phytonutrients		
Unit 3: Principles for Personalization		
Principle of Moderation – Calories, DI, RDA Principle of Diversity – Power of variety on the plate Principle of Avoidance – What not to eat Principle of Top-ups – Needs and gaps Principle of Preference's – Genome, Microbiome, Sensory algorithms		
Unit 4: Practices		
Circadian rhythm & food Intermittent Fasting Food Pairing		
Unit 5: Unified Food Theory		
Integrating principles & practices		

Course Code	:	XXXXXXXX
Title of the course	:	Trans-Disciplinary Approach to Functional food Innovation & Design
Number of credits	:	2
Name of course co-ordinator	:	Gurmeet Singh
Unit 1: Innovation		
Ideating, Concept writing, Insight generation, Recipe creation, Prototyping Trans-disciplinary innovation & product design principles Case Study of Chyawanprash & Tea		
Unit 2: Innovation Portfolio & Risk Analysis		
Innovation Funnel Portfolio Approach DMUU – Decision Making Under Uncertainty – Proof's of Science, Manufacturing, Regulatory, Safety, Freedom to Operate, Consumer, Strategy Risk analysis Claims		
Unit 3: Business Case		
Product Costing, Investment, Operating Cost, Time Value of Money, Breakeven, ROI		
Unit 4: Case Studies of Trans-Disciplinary Functional Food Design		

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Deconstructing & Reconstructing traditional recipes for insights
 Ayurveda Chemistry, Ayurveda Physics, Ayurveda Biology – Transdisciplinary product design principles.
 Functional foods for iron deficiency anaemia, type-2diabetes, brain health, texturized vegetarian proteins
 Project – Pitch for a Functional food

Course Code	:	XXXXXXX		
Title of the course	:	Proteins Processing & Texturization to Create Future Foods		
Number of credits	:	3		
Name of course co-ordinator	:	Prof. Gurmeet Singh		
Unit 1: Proteins		Credits	Hours of teaching & Practice	Resource person
1. Introduction - Importance of Dietary Protein & our current sources of proteins			0.5 + 0	GS
2. Future Foods Challenges – nutritional, sustainability, animal ethics, health			1 + 0	GS
3. Nutritional importance of proteins			0.5 + 0	GS
4. Quality of proteins – amino acids, bioavailability (PDCAAS, DIAAS)			1 + 0	GS
Unit 2: Protein Processing		Credits	Hours of teaching & Practice	Resource person
1. Novel solutions to addressing Protein related future foods challenges – Plant Proteins			5 + 0	SB
2. Novel solutions to addressing Protein related future foods challenges – Fermentation			3 + 0	SB
3. Novel solutions to addressing Protein related future foods challenges – Cell-based technologies			3 + 0	SB
4. Protein Processing – Extraction			2	AM & MM
5. Protein Processing – Principles of Texturization			10	AM & MM
6. Protein Processing – Practices of Texturization			10	AM & MM
Unit 3: Productization		Credits	Hours of teaching & Practice	Resource person
- Formulating products using texturized products - Stabilizers, Emulsifiers, Antioxidants, Fortificants, Preservatives			1+4	AM & MM
- Protein Foods Analysis – Texture and other Analysis			1 + 4	AM, AM & MM

