MSc Life Sciences (Ayurveda Biology)

(Revised Curriculum implemented from the academic year 2024 - 2025)

The University Of Trans-Disciplinary
Health Sciences and Technology

September 2024

The University of Trans-Disciplinary Health Sciences and Technology
(Private University established in Karnataka by ACT 35 of 2013)
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Overall structure of the curriculum

Semester	Course Title	Credit
1	Fundamentals of Ayurveda	3
1	Biochemistry	4
1	Molecular Genetics	2
1	Computational Biology I	2
1	Philosophy of Knowledge	1
1	Trans-disciplinary research seminars*	1
1	Medicinal Plants: Taxonomy, physiology and distribution*	3
1	Instrumentation and Experimental Biology Lab	4
Total credit Sem 1		**20**
Semester	**Course Title**	**Credit**
2	Advanced Human Physiology*	3
2	Systems and Molecular Pharmacology*	3
2	Cellular Signalling (Health & Disease)*	2
2	Pre-clinical and Clinical Research	1
2	Local Health Traditions and Community Health	1
2	Trans-disciplinary research seminars*	1
2	Immunology*	2
2	Computational Biology II	3
2	Phytochemistry Lab	4
Total credit Sem 2		**20**
Semester	**Course Title**	**Credit**
3	Research Methodology and Biostatistics	4
3	Stream Specific Elective - 1	2
3	Stream Specific Elective - 2	2
3	Stream Specific Elective - 3	2
Total credit Sem 3		**10**
3 & 4	Dissertation (Lab/ Clinic/ Field/ Industry)* [Credited Sem 4]	**30**
Total Credits for M.Sc.		**80**

* Denotes courses where concepts in Biology and Ayurveda are tackled together

Foundation Courses

Detailed description of courses.

Semester – I

Course Code	**:**	
Title of the course	**:**	**Fundamentals of Ayurveda**
Number of credits	**:**	**3**
Unit 1: Basic Principles of Ayurveda Introduction to Indian philosophical systems – *Sankhya, Nyaya, Vaisheshika* and Yoga; Introduction to the concepts of *Pancha Mahabhuta*, *Loka-Purusha samanyatha*, *Samanya-vishesha siddhanta*. Concept of *Prakruti* and its role in designing individualized medicine. Concepts of *Agni* and *Ama*. Concepts of *Rasa-vipaka, dhatu poshana, nyayas*. Essentials of Ayurvedic anatomical concepts like *srotas, sira, dhamani* and *marma*.		
Unit 2: Concept of Wellness & illness in Ayurveda Introduction to Ayurvedic concept of health; Individual variability inherent in states of *tridosha*, 7 *dhatus* (tissues), 3 *malas* (waste products) and *agni* (digestion).		
Unit 3: Introduction to the Concept of Pathology in Ayurveda Theories on disease manifestation (*Shat Kriyakaala - Chaya, Prakopa, Prasara, Sthanasamshraya, Vyakti* and *Bheda*) and identification of stages of a disease – *Nidana* (cause), *Purvarupa* (prodromal symptoms), *Rupa* (manifested symptoms), *Samprapti* (pathogenesis) and *Upasaya* (therapeutic tests).		
Unit 4: Clinical examination protocols as per Ayurveda An introduction to clinical diagnosis of diseases in Ayurveda: *Ashtasthana pareeksha*, *Trividha Pareeksha* and *Dashavidha Pareeksha*.		
Unit 5: Introduction to Treatment Principles as per Ayurveda Introduction to Ayurvedic treatment approach: *Chikitsa Chatuspada*, *Dvividhopakrama* (*Santarpana*-nourishment and *Apatarpana*-de-nourishment). *Shodhana Chikitsa* including *Poorvakarmas* and *Panchakarma*, *Sadhya-Asadhyata* of Diseases.		

Course Code	**:**	
Title of the course	**:**	**Biochemistry**
Number of credits	**:**	**4**
Unit 1: Water and Buffers Water – interactions, ionization, biological buffers; pH & pKa		
Unit 2: Structure and function of biomolecules Sugars and polysaccharides; Amino acids and Proteins; Nucleotides and Nucleic Acids; Fatty acids, sterols and Lipids;		
Unit 3: Protein structure, purification and detection Structure of proteins with antibodies as an example, Protein folding and neurodegeneration; Protein interactions - ligand-receptor interactions; Channels and transporters, Protein purification and detection: chromatography (TLC, HPLC), electrical (SDS-PAGE), ELISA, X-ray crystallography and cryo-EM.		
Unit 4: Enzymes Introduction; nomenclature and classification; Mode of action of enzyme; enzyme kinetics and regulation of enzyme action; Examples of enzyme reactions; Enzymes in diagnosis and treatment, Phytochemicals as enzyme inhibitors		
Unit 5: Cellular bioenergetics Glycolysis, Pentose Phosphate Pathway, Citric Acid Cyle, Oxidative phosphorylation - Electron-Transfer Reactions in Mitochondria; ATP Synthesis; Mitochondrial biochemistry and human health		
Unit 6: Cellular Metabolism		

Metabolic Fates of Amino Groups; Nitrogen Excretion and the Urea Cycle; Pathways of Amino Acid Degradation; Synthesis and breakdown of nucleic acids; Synthesis and breakdown of fatty acids with emphasis on inflammation
Unit 7: Systemic Metabolism Feeding and fasting cycles insulin signalling, fat metabolism – LDL, VLDL, HDL in circulation; Cori cycle and exercise physiology; Protein metabolism

Course Code	**:**	
Title of the course	**:**	**Molecular Genetics**
Number of credits	**:**	**2**
Unit 1: Introduction to Genetics Inheritance and evolution of the gene concept, Organization of Human genome, Mitochondrial genome; Gene families - pseudogene, transposable elements, gene duplication; Pedigree analysis,		
Unit 2: Structure and replication of DNA DNA structure, types of replication (Explanation, theory, types), Chromosomal End replication problem, Telomere replication and ageing		
Unit 3: Gene to protein. Central dogma, Genetic code, Prokaryotic organization of a gene - operon; Eukaryotic organisation of gene- intron, exon, promoter and upstream elements; Structure of ribosomes, rRNA and tRNA; Transcription - Prokaryotic transcription; Eukaryotic transcription; Splicing and post-translational modification: 5'capping, splicing, 3'polyadenylation; Translation: Protein synthesis in prokaryotes and eukaryotes; Types of Post-translational modifications.		
Unit 4: Gene regulation Regulation of gene expression: basic mechanisms, cis & trans elements, RNA interference, long non-coding RNA, Chromatin modifiers and epigenetics, Gene regulation and evolution		
Unit 5: Recent trends in recombinant DNA technology Plasmids and vectors; Restriction enzymes; Ligation and cloning; CRISPR- CAS9 and gene therapy		

Course Code	**:**	
Title of the course	**:**	**Computational Biology - I (Classroom and Lab)**
Number of credits	**:**	**2**
Unit 1: Hardware and software basics Computer hardware (monitor, CPU, RAM), Navigating MS office suite (email, word, excel, PowerPoint) for scientific work, Google workspace to manage courses and collaborative work		
Unit 2: Databases and Structural biology Commonly used databases for Protein sequence, structure and function, Structure prediction and modelling. Using PDB and docking software to study protein-drug interactions.		
Unit 3: Databases for genetic information BLAST, FASTA, NCBI, GenBank, Designing primers for PCR and using molecular markers for plant species identification – genetic, diagnostic and conservation applications.		
Unit 4: Genome wide association studies GWAS case studies in human disease such as Alzheimer's, cancer, *Dosha-Prakruti* etc		
Unit 5: Databases for phytochemical information		

Course Code	**:**	
Title of the course	**:**	**Philosophy of Knowledge**
Number of credits	**:**	**1**

Unit 1: Epistemology Introduction to epistemology – Theoretical and empirical knowledge; Introduction to western and Indigenous Logical Traditions; Philosophical and intercultural views on nature. Epistemology and ontology – a comparison of eastern and western perspectives.
Unit 2: Ayurveda Biology A cross-cultural approach to viewing biological change (Ayurveda Biology) - Functional correlations, health security, food security etc.
Unit 3: Biocultural diversity Health and conservation for global wellbeing using indigenous knowledge frameworks.

Course Code	**:**	
Title of the course	**:**	**Trans-disciplinary Research Seminars**
Number of credits	**:**	**1**
Weekly research publication discussions with curated research articles from diverse subjects including but not limited to Ayurveda, biology, medicine, conservation and policy.		

Course Code	**:**	
Title of the course	**:**	**Medicinal Plants: Taxonomy, Physiology and Distribution**
Number of credits	**:**	**3**
Unit 1: Fundamentals of Plant taxonomy and Pharmacognosy Diversity of ethno-botanical traditions of taxonomy and pharmacognosy; Critiques of modern taxonomy and pharmacognosy; Fundamentals of modern taxonomy and pharmacognosy - Definition, scope and applications. Classification and identification of drugs - taxonomic, morphological, organoleptic, therapeutic and microscopy criteria for classification of powdered drug, methods for documentation of raw drugs. Plant taxonomy (activity) - study of the following families with special reference to medicinally important plants – *Apocynacae, Solanaceae, Rutacae, Apiaceae, Fabaceae, Rubiaceae, Liliaceae, Poaceae, Lamiaceae, Brassicaceae, Papaveraceae*.		
Unit 2: Plant Physiology **Plant growth & development** – Basic plant cell structure and components**,** special features - Gap junctions, Plasmodesmata, Cytoplasmic streaming, Extracellular matrix; cell junction and communication. Hormonal signalling pathways (Auxin, Cytokinin, ABA, Ethylene, Brassinosteroids, Strigolactones etc.). **Photosynthesis & Respiration -** Light and Dark reaction, carbon assimilation, physiological and ecological relation, CO_2 reduction in Calvin cycle, supplementary pathway of C fixation in C4 and CAM plants and its significance, respiration and photo-respiration, **Transpiration and translocation -** stomatal mechanism, plant factors influencing transpiration rate, Anti-transmigrants. Water absorption, solute/ion transport. **Secondary metabolites production:** What are secondary metabolites, factors for their production, Shikimate pathway to Piperine.		
Unit 3: Wealth of Medicinal plants used in Traditional Systems of Medicine in India Wealth of medicinal plants in India used in and across folk, Ayurveda, Unani, Siddha, Homeopathy and Tibetan medical systems; Identification of controversial plant drugs, adulteration and substitution; Analysis of traded medicinal plants – global and Indian status; TQS, introduction to WHO regulations of herbal medicine		
Unit 4: Relevance of *in situ* conservation of medicinal plants (and other taxa). Influence of complex abiotic and biotic factors in in situ conditions (that cannot be replicated ex situ); Pioneering work on MPCA by FRLHT and TDU; Biodiversity in India, threats to biodiversity; Indian		

context – list of important threatened, endemic medicinal plants; Climate change and plant biodiversity; Role of regulatory and management bodies eg: National biodiversity authority, NMPB, CITES etc.;

Course Code	**:**	
Title of the course	**:**	**Instrumentation and Experimental Biology (Lab)**
Number of credits	**:**	**4**
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.		
Unit 1: Lab instrumentation Different types of instruments in the lab; Handling and working principles of instruments; Calibration of instruments; Personal and instrument safety; Potential hazardous from different types of instruments; SOPs for instruments; cleaning and routine maintenance; Data capturing and analysing; Basics of trouble shooting.		
Unit 2: Principles of culturing: bacteria and animal cells Isolation and identification of microbes from various sources, Culturing microorganisms and growth curve of prokaryotes, Fundamentals of animal cell culture, Cell proliferation – cell growth and cytotoxicity; action of drugs on cell proliferation; cell migration – chemo attractants and chemotactic migration.		
Unit 3: Nucleic acid experiments Isolation of nucleic acid - DNA, RNA; PCR and qRT PCR; Basics of rDNA technology.		
Unit 4: Enzymology experiments Michaelis Menton Kinetics		
Unit 5: Protein chemistry Protein isolation, SDS-PAGE, ELISA and Western blot		

Semester - II

Course Code	**:**	
Title of the course	**:**	**Advanced Human Physiology**
Number of credits	**:**	**3**
Unit 1: Functional unit of physiology – the animal cell Basic layout: Sub-cellular structures- organelles, membrane systems and the cytoskeletons; Structure and function of cell membrane, endoplasmic reticulum, Golgi complex, Vesicles, Lysosomes, Mitochondria; Nucleus - Nuclear membrane, nucleolus, chromosomes; Cytoskeleton - Actin, Tubulin, Cell division: mitosis and meiosis, Cell cycle (G1, S, G2, M)		
Unit 2: Fertilisation, Development and stem cells Foetal Development in Ayurveda, Fertilization, Cleavage, Gastrulation; Stem cells - stem cell differentiation, genome reprogramming, stem cell niches, pluripotency, stem cell therapy		
Unit 3: Organ Physiology		

Select tissue functioning from molecular perspective, and pharmacological interventions for disease management from Ayurvedic and modern perspective: Brain, Heart, Gut, Lung, Liver, Kidney and Reproductive organs.
Unit 4: Transdisciplinary perspective on disease manifestation and treatment One disease will be chosen for detailed discussion for pathophysiology and therapeutics from both Ayurveda and biology perspective e.g., liver cirrhosis IBS, male or female infertility, Parkinson's

Course Code	**:**	
Title of the course	**:**	**Systems and Molecular Pharmacology**
Number of credits	**:**	**3**
Unit 1: Introduction Definition, nature & sources of drugs; dosage forms; drug nomenclature; Complementary and alternative medicines;		
Unit 2: Principles of *dravyaguna vignana* Fundamental principles of Dravyaguna Shastra, General Introduction of Sapta padartha and Pancha padartha; Etymological derivation, definition and Classification of Rasa, Guna, Veerya, Vipaka and Prabhava; Understanding biomedical equivalence to pharmacological concepts of Ayurveda.		
Unit 3: Pharmacokinetics and pharmacodynamics Basics of pharmacokinetics, calculation of pharmacokinetic estimates (C-max, T max, T1/2, AUC (0-n), AUC (0-μ), Vd, Ke, Ka etc.); ADME - General Principles passage of drugs across biological membranes, factors affecting absorption, transport, bioavailability; Principles of drug action; mechanism of drug action - Receptors, Agonist, partial agonist, inverse agonist etc; Transducer mechanism; Dose-response relationship; Drug efficacy & potency; Therapeutic index - LD 50 & ED 50; Drug synergism and antagonism.		
Unit 4: Understanding functional properties and pharmacological actions of plant drugs based on principles of Ayurveda - Plant metabolites **-** Brief introduction to plant primary and secondary metabolites; major pathways and different classes of metabolites; chemo-prospection and bioassay guided identification of metabolites; role of endophytes in secondary metabolite production; role of secondary metabolites in plant resistance. Introduction to *Dravya* (therapeutic agent), its classification; Pharmacological parameters of *dravya* (material-therapeutic agent) - *rasa* (taste), *guna* (properties), *veerya* (potency), *vipaka* (taste after digestion), *prabhava* (unanticipated action), *karma* (pharmacological actions); Discussion on epistemological differences between Ayurveda and modern pharmacology; Ayurvedic pharmacognosy and pharmacology of 25 selected Ayurvedic plant drugs; *Abhava Prathinidhi Dravya* (alternate plant drugs).		

Course Code	**:**	
Title of the course	**:**	**Pre-clinical and Clinical Research**
Number of credits	**:**	**1**
Unit 1: What is Research? Types of research – Quantitative and qualitative; Hypothesis testing; ethics in research; 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; Analysing and representing data.		
Unit 2: Pre-clinical Research Model systems for pre-clinical research – Cell lines, Invertebrate and vertebra model systems for Ayurveda Biology; Exposure visits to research centres and industry.		
Unit 3: Clinical Research		

Introduction to clinical research; evidence generation through clinical research; Clinical research design - Observational studies, RCTs, Meta Analysis, Real world Data analysis, Whole Systems approaches, Circular approaches.

Course Code	**:**	
Title of the course	**:**	**Cellular signalling – Health and Disease**
Number of credits	**:**	**2**
Unit 1: Cell signalling – Introduction Biological signal transduction – General features of signal transduction; ligands and receptors in signalling; G-protein coupled receptors; tyrosine kinase receptor; Integrins;		
Unit 2: Systemic signalling. Hormones: Diverse Structures for Diverse Functions; Hormonal regulation and metabolism; hormonal regulation and disease; hormones as diagnostic tools.		
Unit 3: Cell signalling in the five *Indriyas* Sense of touch - cells and receptors; Sense of touch - signalling pathways and mechanism: Sense of smell - olfactory cells and receptor, mechanism of action; Sense of vision - photoreceptors and signalling, Signal transduction in vision, Photoreceptors, response to light and circadian rhythm; Sense of taste - taste receptors: location and function; Chemistry and biology of taste molecules, Transduction of signals in taste; Shadrasa concept in Ayurveda and its biological equivalence - discussion activity; Auditory system - cells and associated components, signalling in auditory system.		
Unit 4: Signalling in selected human disease. Cancer, Diabetes, Liver diseases, Kidney diseases, Microbial infections (Tetanus, Typhoid, Cholera); Gut microflora mediated signalling in neurodegeneration		

Course Code	**:**	
Title of the course	**:**	**Local health traditions and community health**
Number of credits	**:**	**1**
Unit- 1 Introduction to Local Health Traditions: Understanding traditional knowledge systems, world views, cultural diversity; Scope and potential of traditional knowledge systems; Health and well-being in Indian Local Health Traditions; Features of LHT's – Household traditions, Community healers, Medicinal plants: Human, animal, environmental health; Traditional foods, Lifestyles; Documentation and Assessment of Local Health Traditions; PBRs, Community livelihoods, Community enterprises; National and international health policy.		
Unit-2 Introduction to Community Health: Health: Myriad perspectives; Social Determinants of Health; Securing health for all – Approaches; DALYs, Epidemiological transition, Bradford hill criteria; Morbidity patterns; NCDs, Infectious diseases, Aging, Gender, Reproductive health.		
Unit 3: Ayurveda Biology for Community Health: Community Based Participatory Research; Ayur-Biology for community health/public health; LHT and Community health: Case studies.		
Unit 4: ; Regulatory landscape of traditional medicines and medicinal plants – from LHT to drug		

Course Code	**:**	
Title of the course	**:**	**Transdisciplinary Research Seminars**
Number of credits	**:**	**1**
Weekly discussions on curated research articles from diverse subjects including but not limited to Ayurveda, biology, medicine, conservation and policy. It will also include guest speakers and seminars from across the world.		

Course Code	**:**	
Title of the course	**:**	**Immunology**
Number of credits	**:**	**2**

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; Immuno-haematology: Blood groups-Blood transfusion; Major Histocompatibility complex. Vaccines and Immunization-Types and their characteristics; Monoclonal Antibodies – Hybridoma technology, Production and applications, CART in cancer therapy.

Unit 2: Concept of Immunity in Ayurveda: *Vyadhikshamtva*

Principles and concepts of *Vyadhi Kshamathwa*, *bala* and *Ojas*. *Swasthya* (wellness): the optimum status of *doshas* (humors), *dhatu* (tissue systems), *malakriya* (excretory functions) and *agni* (digestion and metabolism). Pleasant *atma* (self), *indriya* (organs), *manas* (mind). *Roga bala* & *Rogi bala* (strength and weakness of disease and diseased). Various factors effect *Vyadhikshmatva* and correction of deterioration of immunity.

Unit 3: Infection and disease immunology.

Microbes – types. Bacteria: gram negative and positive. Viruses. Microbial pathogenesis - virulence factors; Stages of pathogenesis; Host defence mechanism and pathogen resistance; Biology of vaccine; Allergy, Hypersensitivities, and Chronic Inflammation; Tolerance, Autoimmunity, and Transplantation; Immunodeficiency Disorders; Immunology in disease - Cancer, diabetes and other diseases.

Unit 4: 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 *Vyadhikshamatva* in preventive and promotive healthcare; a new perspective of disease management through built-up resilience within an individual.

Course Code	**:**	
Title of the course	**:**	**Computational Biology - II**
Number of credits	**:**	**3**

Unit 1: Introduction to Bio-informatics

Introduction to Computing-LINUX based command line, Introduction to Programming languages, Biostatistics and R program, Github and Genome Browsers.

Unit 2: Bioinformatics tools for DNA & RNA sequence data analyses

Whole genome sequencing: methods, challenges and utility; RNA-seq analysis – theory and case study; Microbiome: genomic and metagenome data analysis – theory and case study. Functional and diversity analysis

Unit 3: Applications to Ayurveda Research.

Plant identification using genetic markers; Prakriti and genomics, Clinical research in Ayurveda and Gut Microbiome,

Unit 4: Data Science basics for Ayurveda Research. Databases for ayurveda dravya (FRLHT work), Health Portal, Citizen's Science Portal, Model building in Ayurveda research for AI/ML tools for disease risk prediction, Retrospective and real world patient data analysis

Unit 5: Systems biology and Network Pharmacology

Biological pathways as networks; Drug discovery, Target prediction, Protein metabolite interaction prediction, Predict protein-protein and drug-target interactions.

Course Code	**:**	
Title of the course	**:**	**Phytochemistry (Lab)**

Number of credits	**:**	**4**
Unit 1: Morphological characteristics of selected plant families mentioned; 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.		
Unit 2: Study of pharmacognostical features of *Sarpagandha*, *Jatamansi*, *Ashwagandha*, *Turmeric*, *Punarnava*, *Ephedra*, *Gymnema*, Senna, Amla, Gokshru, Issabgol, Black pepper, Banafsha, Arjun or any other commercially species specific to the region.		
Unit 3: Solvent based extraction of secondary metabolites from plants.		
Unit 4: Chromatography – TLC, Paper chromatography, column chromatography; Bioassay guided identification of molecules; HPLC and HPTLC; Chemical reactions of plant compounds.		
Unit 5: Network Pharmacology		

Foundation Semester - III

Course Code	**:**	
Title of the course	**:**	**Research Methodology and Biostatistics (Classroom and activities)**
Number of credits	**:**	**4**
Unit 1: What is Research? What is a research question versus an ordinary question; need to determine its boundaries; Types of research theories – deductive, inductive, grounded, and axiomatic; Issues of Epistemology, methodology, data and validation in different knowledge domains		
Unit 2: Relativity of research design and methods of research in transdisciplinary domains Relationship between knowledge domain and research strategies in integrative clinical and pharmacological research; Speculation on traditional research framework and methods based on Ayurveda knowledge system (*padartha vignana*).		
Unit 3: Communication in Research 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.		
Unit 4: Research Ethics 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.		
Unit 5: Statistics: I		

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, parametric and non-parametric test; Introduction to infographics;
Unit 6: Statistics – II 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.

MSc Life Sciences (Ayurveda Biology)

(Revised Curriculum implemented from the academic year 2024 - 2025)

Stream Specific Elective Courses

The University Of Trans-Disciplinary
Health Sciences and Technology

September 2024

The University of Trans-Disciplinary Health Sciences and Technology
(Private University established in Karnataka by ACT 35 of 2013)
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List of courses

#	Topic
	Basic stream
1	Programming for Data Science
2	Integrative Biology of glucose metabolism
3	Pre-clinical models for Ayurveda Research
4	Nutritional Biochemistry
5	Mechanistic approach for interpreting traditional formulations
6	Microbiome in health and wellness
	Industry Stream
7	Drug design in Ayurveda - Principles and Practices
8	Traded, endemic and threatened medicinal plants of India
9	Quality Control of Herbal Drugs
10	Future Foods
	Clinical Science Stream
11	Integrative Personalized Nutrition
12	Basics of Clinical Research
13	Disease classification schemes and Personalised medicine
14	Applied Nutrition Science
15	Pashu Ayurveda and AMR

Note

TDU is envisaging three streams of specialisation for MSc Life Sciences (Ayurveda Biology) program, from a career perspective. They are Basic Science, Industry and Clinical research. Accordingly, TDU has identified a set of elective courses that are classified into three potential streams. However, considering the inter and transdisciplinary nature of life science education program, this is not a water-tight classification and students have the flexibility to mix and match as per their interest.

In addition to the below electives, students are allowed to take elective courses from all other sources, including humanities and arts, that are approved by UGC and TDU academic office such as Coursera, SWAYAM portal, etc. It is mandatory to ensure that the selected course is equivalent to 2-credits or delivered in minimum of 30 hrs of contact hours. Courses outside the TDU ecosystem will have to be approved by the Course Coordinators.

Basic Science Stream

Course Code	**:**	
Title of the course	**:**	**Programming for Data Science**
Number of credits	**:**	**2**
Unit 1: Introduction to R 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.		
Unit 2: Basic operations in R Descriptive statistics using R; Loops and conditional statements; Introduction to probability and hypothesis testing;		
Unit 3: Data visualization using R Handling genomic sequence data in R; Whole genome and RNA-seq data analysis using R; Data Project		
Unit 4: Introduction to python Python environment and dependencies; Python data types and data structures; Writing basic functions and scripts		
Unit 5: Data manipulation using pandas; Loops and conditional statements; Data visualization using python; String and pattern matching		
Unit 6: Basics of Biopython; Handling sequence data; Building pipelines for sequence data; Data project.		

Course Code	**:**	
Title of the course	**:**	**Integrative Biology of glucose metabolism**
Number of credits	**:**	**2**
Unit 1: Introduction to metabolism Reactions and Regulations involved in Metabolic Pathways; cross talk of carbohydrate and lipid metabolism; Hormonal Regulation of Metabolism - A brief overview of hormone action on metabolism, Action of Insulin and Glucagon, Action of Leptin.		
Unit 2: Glucose metabolism related disorders Diabetes and Obesity; Liver and kidney in impaired glucose metabolism; Ayurveda understanding of altered glucose metabolism.		
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.		
Unit 4: Discussion of Research and Review Articles on recent developments in metabolic disease research		

Course Code	**:**	
Title of the course	**:**	**Pre-clinical models for Ayurveda Research**
Number of credits	**:**	**2**
Unit 1: Introduction An introduction to pre-clinical models – cell-free and cell-based assays; cell models for studying various diseases (selected examples); laboratory animals; Model organisms in scientific research; Health Monitoring /Surveillance of lab animals. Non-vertebrate models for research – D. melanogaster and C. elegans		

Unit 2: Vertebrate models Mouse and rat model for research; Basics of handling the animals; Designing research protocols with animal models; Data collection and management; Mouse and rat models for various disease conditions – ex: diabetes, obesity, fever, infections.
Unit 3: Ethics and biological safety associated with animal experiments. Animal ethics and role of ethical committee; safety measures for handling animals; Collections and disposal of biological samples from animals;
Unit 4: Scope and limitations of lab/pre-clinical models Limitations of lab models to mimic the whole system functions; Body-on-a-chip concept; Challenges of equating the Ayurveda concepts with molecular perspective;

Course Code	**:**	
Title of the course	**:**	**Nutritional Biochemistry**
Number of credits	**:**	**2**
Unit 1: Introduction Digestion: The gastrointestinal tract (Parks); Chemistry of food [Food groups]; Regulation in cellular metabolism [gene & protein]; Signal transduction pathway essentials		
Unit 2: Macronutrients: Breakdown, absorption, transport and synthesis of Sugars, Protein, Lipid, Sterol		
Unit 3 Micronutrients: Select aspects of Acyl/acetyl transfers (pantothenate); Redox cofactors (niacin, riboflavin); Decarboxylations (thiamin); Niacin and alcohol metabolism; Carboxylations (biotin); 1-carbon transfer reactions (folate, B12); Decarboxylations, trans- & deaminations (pyridoxine); Vitamin K; Vitamin A (Eide); Vit. C and Se (Antioxidant nutrients); Vitamin E and carotenoids (Antioxidant nutrients); Fe (Metal nutrients); Cu (Metal nutrients); Zn (Metal nutrients); Calcium and Vitamin D		
Unit 4 Integration of Metabolism/Endocrinology - Fed-Fast Cycle/Starvation; Cellular regulators of metabolism; Obesity; Loss of Metabolic Integration/Diabetes; Nutritional Genomics; Gut Microbiome		

Course Code	**:**	
Title of the course	**:**	**Pashu Ayurveda and AMR**
Number of credits	**:**	**2**
Unit 1: Introduction Challenges in correlation of Pashu Ayurveda and veterinary science, Concept of one health and planetary health - interrelation of Human, Animal and Environmental health and its Interactions: Common health and disease conditions in livestock - Antibiotic use and AMR; Field experiments/outcomes of ethno-veterinary practices as alternatives to antibiotics.		
Unit 2 Classified list of plants used in *Pashu Ayurveda* and EVP for management of major clinical conditions that affects cattle, horses, elephants, goat, sheep and birds and their pharmacology (*Dravya Guna*); Plant based management of health and disease of cattle, sheep, goat, birds, piggery, elephants and horses from Ethnoveterinary practices – ex: lactation, infertility, mastitis, FMD and infections.		
Unit 3		

Various nutritional disorders of domestic and wild animals and their management; Feeding and diet of animals; Animal nutrition with herbs; Importance of *Rasayana* for better nutrition and wellness of animals; field visit and experiential learning.

Course Code	**:**	
Title of the course	**:**	**Mechanistic approach for interpreting traditional formulations**
Number of credits	**:**	**2**
Unit 1: Introduction Need of transdisciplinary framework for understanding biological changes; Understanding biological concepts of traditional medicine and equating them with contemporary biology – examples using *Ayurveda*; Concepts of network pharmacology mode of action by traditional medicines; multi-drug-multi-target mode of action versus lock and hypothesis of drug action.		
Unit 2 Bioassay models for studying polyherbal preparations – biochemical assays; cell-based bioassays; small organism models and animal models; Current understandings of multi-component drugs action at cellular and molecular levels; challenges using herbal formulations for studying mechanism of action.		
Unit 3 Bioassay guided identification of active molecules from traditional medicines – principles and procedures; in-silico approaches for drug discovery; Network pharmacology tools for delineating the multi-targeted mode of action of formulations.		

Course Code	**:**	
Title of the course	**:**	**Microbiome in health and wellness**
Number of credits	**:**	**2**
Unit 1: Introduction Evolution of microbial life on Earth; Symbiosis host-bacteria; Microbiome in early life; Basic ecology principles in ecosystems; Microbiome functions; Microbiota transfer – pregnancy, birth and postnatal; Microbiome development and functions in early life.		
Unit 2 Human superorganism and ecology of the microbiome; Nutritional modulation of the gut microbiome for metabolic health: animal models; gut microbiome for metabolic health: human obesity, Type-2 diabetes; gut microbiome for health and longevity.		
Unit 3 Pharmaceutical modulation of the gut microbiome for metabolic health; gut microbiome and host immunity; microbiome in skin and other areas of the human body; plant microbiome – role in health and defence of plants.		
Unit 4: Ayurveda microbiome interphase Correlating *Koshta* principles with gut microbiome function; Microbiome in modulation of *Agni* and *ama*; microbiome restoration through panchakarma procedures.		

Industry Stream

Title of the course	**:**	**Drug design in Ayurveda - Principles and Practices**
Number of credits	**:**	**2**
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 pharmaceutics. Importance of Compound formulations over *Ekamoolika Prayoga* (single drug therapy), eg: of innovation in Rasashasthra and processing.
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).
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.), *Vishatinduka* (*Strychnos nux-vomica* L.), *Parada* (mercury) and *Gandhaka* (sulphur) will be briefed. Concept of *Ahara kalpana* (nutraceutics) will be explained. Procedure of preparation of *Odana* (different rice preparations), *Yusha* (soups) will be briefed. Demonstration of preparation of *Mudga Yusha* (green gram soup).
Unit 4: Green chemistry in drug discovery Relevance of green chemistry; The 12 principles of green chemistry; green solvents in pharmaceutical industry; green solvents in the context of Ayurveda; Principles of *Murchana, arishta, asava* etc. in the context of green chemistry;
Unit 4: Relationship of food and medicine in Ayurveda Various food preparations in 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). Application of *pathyakalpana* (therapeutic diets) as per contemporary requirements; Strength of Ayurvedic concepts to design functional foods.

Course Code	**:**	
Title of the course	**:**	**Traded, endemic and threatened medicinal plants of India**
Number of credits	**:**	**2**
Unit – 1: Introduction Botanical, distribution and demand-supply analysis of traded, endemic and threatened medicinal plants of India;		
Unit 2: International regulations for medicinal plant management International regulations for good cultivation and collection practices, fair trade, negative lists and intellectual property and conservation related to medicinal plants; 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		
Unit 3: National Databases Features of: botmast database of medicinal plants of India, Food database of India (Ayurahaar), citizens portal.		
Unit 4: Conservation in Practice 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.		

Course Code	**:**	
Title of the course	**:**	**Quality Control of Herbal Drugs**
Number of credits	**:**	**2**
Unit 1: Basic tests for drugs – Pharmaceutical substances, Medicinal plants materials and dosage forms; WHO guidelines for quality control of herbal drugs; Ayurveda parameters of quality control;		
Unit 2: Quality assurance in herbal drug industry of cGMP, GAP, GMP and GLP in traditional system of medicine; WHO Guidelines on current good manufacturing Practices (cGMP) for Herbal Medicines WHO Guidelines on GACP for Medicinal Plants; Time and geography of plant collection.		
Unit 3: Traditional quality standards Principles and practices of TQS in various systems; correlating TQS with phytochemical properties; Collection of plants based on geography, time, season etc and their influence on medicinal properties; Relevance of using different vessels and energy sources for biotransformation; imperative of integrating TQS with modern quality control.		
Unit 4: Regulatory requirements for herbal medicines; WHO guidelines on safety monitoring of herbal medicines in pharmacovigilance systems; Comparison of various Herbal Pharmacopoeias; Role of chemical and biological markers in standardization of herbal products; Substitution vs adulteration of plants; *Abhava prathinidhi dravya* concept in Ayurveda.		

Course Code	**:**	
Title of the course	**:**	**Future Foods**
Number of credits	**:**	**2**
Unit 1: Innovation Ideating, Concept writing, Insight generation, Recipe creation, Prototyping, Trans-disciplinary innovation & product design principles; Self administered prakriti and swasthya software and their applications for personalization of food and medicine 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: Case Studies of Trans-Disciplinary Functional Food Design 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		

Clinical Research Stream

Title of the course	**:**	**Integrative Personalized Nutrition**
Number of credits	**:**	**2**
Unit 1: The Fate of Food Evolution of food, Composition of food, Fate of food – Ayurveda, Fate of Food - Nutrition Science, Comparative commentary on fate of food – papers.		
Unit 2: Personalized Nutrition Framework Body typing - DNA typing, Prakriti typing, Wellness Assessments - Markers & Risk factors, Medical history, Swasthya, Post-prandial responses, challenges of correlation of data from wearables to personalized solutions, Integrative personalised nutrition framework – papers.		
Unit 3: Food Typing & Diet Data Integrative Food Database - Ayur Ahaar, Integrative food typing parameters & relevance; Diet capture methodologies, Diet capture exercise.		
Unit 4: Personalizing Nutrition Nutrigenomics & Nutrigenetics, Microbiome, Diet Assessments - Principles of Balance, Moderation, Diversity, Avoidance, Preference, Personalization, Diet assessment exercise, Diet Indices, Integrative Algorithm for Personalization, Exercise on Designing recipes & functional foods - Kitchen Works		

Title of the course	**:**	**Basics of Clinical Research**
Number of credits	**:**	**2**
Unit 1: Introduction Clinical Research Aim and objective of clinical research; Research question and hypothesis generation; Evidence generation through clinical research; History of clinical research – Case studies of major modern clinical trials, Ayurveda and Chinese clinical texts; evidence framework in classical Ayurveda, Methods of evidence generation: for traditional clinical practice (PBE, real world clinical evidence) *vs* new untested clinical interventions.		
Unit 2: Research Design. Introduction to research designs, Discussion on observational studies, RCTs, Meta Analysis, Systematic Reviews etc, Real world Data, Whole Systems approaches, Circular approaches.		
Unit 3: Clinical trial Terminologies, phases of clinical trials, Basics of biostatistics for clinical research.		
Unit 4: Research Ethics Research ethics related to clinical studies.		
Unit 4: Practical – Project on HMIS (hospital clinical and non-clinical data management).		

Title of the course	**:**	**Disease classification schemes and Personalised medicine**
Number of credits	**:**	**2**
Unit 1: Introduction – ICD classification History of disease nomenclature in Modern medicine, ICD disease classification and its evolution, European disease classification, Controversies in disease nomenclature and classification.		
Unit 2: ACD classification. History of disease classification in Ayurveda, Different types of disease classification in Ayurveda (Eg-*Adhyatmika, adibhoutika, Adidaivika, Doshaja, Sahaja*, etc), Classification of *Vyadhis* as per Srotas and its importance in Ukta & Anukta Vyadhi; Design of algorithm based disease management; Homogenous diagnostic categories in Modern medicine *vs* variable classification systems in Ayurveda.		
Unit 3: Framework of Algorithm driven disease management Physiology-pathology and its dynamic nature, Precision-personalized-P4 medicine, Algorithms based approaches in disease management, Understanding diagnosis based on patient and disease specific		

factors, Chikitsa Sutra (treatment approaches) in Ayurveda and its application taking specific disease example.
Unit 4: Experiential learning Clinical rounds, discussions with *vaidyas*, retrospective data analysis.

Course Code	**:**	
Title of the course	**:**	**Applied Nutrition Science**
Number of credits	**:**	**2**
Unit 1: Introduction Macro and Micro nutrients: Basic chemistry, Foods, RDAs and Public Health Perspective		
Unit 2: Tackling Select Public Health Problems in India – Integrating Ayurveda and Modern dietary advice Protein insufficiency, Vitamin B12 and Vitamin D, Diabetes		
Unit 3: Diet planning *Ashtaahaar Viddhi Vishesaayatna* & ABCD, Dietary assessment (24hr recall), nutrient intake assignment, diet design and planning		
Unit 4: Current Research Select research publications on diet, nutrition science, wellbeing and disease modification		