UNIVERSITY GRANTS COMMISSION

NET BUREAU

Subject: AYURVEDA BIOLOGY **Code No.: 105**

SYLLABUS

This Syllabus has 10 units.

Unit 1: History and Development of Ayurveda

Unit 2: Philosophy and Fundamental Principles of Ayurveda

Unit 3: Sharira Rachna and Kriya

Unit 4: Padartha Vijnana and Dravya Vijnana

Unit 5: Rasa Shastra, Bheshajya Kalpana and Ayurvedic Pharmacopeia

Unit 6: Disease Biology, Microbiology and Immunology

Unit 7: Genetics, Ayurgenomics, Cell and Molecular Biology

Unit 8: Physiology, Biochemistry and Nanotechnology

Unit 9: Biodiversity and Environmental Health, IPR and Entrepreneurship

Unit 10: Research Methodology, Biostatistics and Ayurveda-informatics

Unit 1: History and development of Āyurveda

i. Vedic origin & chronological development of Āyurveda
ii. Āyurveda and various schools
iii. Understanding and relevance of aṣṭāṅga *āyurveda*
iv. Basic Texts and commentaries of Āyurveda
v. Contribution of commentators to Āyurveda
vi. Introduction to bṛhattrayī and its importance
vii. Introduction to *laghutrayī* and its importance
viii. Basic understanding of nighaṇṭu and *kośa* of Āyurveda
ix. Contribution of contemporary publications in Āyurveda
x. Government initiatives for development of Āyurveda

Unit 2: Philosophy and Fundamental Principles of Ayurveda

i. *āyu - lakṣaṇa, paryāya, paribhāṣā* and *pramāṇa*
ii. Definitions of *śarīra, jñānendriya, karmendriya, mana, buddhi, citta, ahaṃkāra, ātmā*
iii. lokapuruṣa sāmya siddhānta, *ekadhātu puruṣa, ṣaḍdhātuja puruṣa, caturviṃśati tatvātmaka puruṣa* and their relevance
iv. Definitions of Ayurveda – *hitāyu - ahitāyu, sukhāyu - dukhāyu, trisūtra āyurveda* - hetu-liṅga-auṣadha-jñāna svastha ātura
v. svāsthya lakṣaṇa - - Dimensions of Health Corresponding to nature, *prakṛti, ṛtucaryā, dinacaryā, svasthavṛtta*
vi. *paṃcamahābhūta – ākāśa-vāyu-agni-jala-pṛthvī* and their specific properties
vii. Theories of *sāmānya* and *viśeṣa*
viii. padārtha – theories of *dravya-guṇa-karma-sāmānya-viśeṣa-samavāya*
ix. *doṣa – śarīrika* and *mānasika*
x. Introduction to *dhātu, mala, agni* and *srotas*

Unit 3: Sharira Rachna and Kriya

i. *Introduction to śarīra racanā kriyā*
ii. *garbhaśarīra (*fetal development*)* - *śukra, ārtava, garbhādhāna, garbha* and *māsānumāsika garbha*
iii. Introduction to *śarīra pramāṇa, saṃkhyā śarīra, aṅga-pratyaṅga-koṣṭhāṅga and āśaya*
iv. Introduction to *deha prakṛti* and *mānasa prakṛti*
v. Introduction to *doṣa, sapta dhātu* and *mala vijñāna*
vi. Definition and types of - *asthi, sandhi, snāyu, peśī, parva* and *kaṇḍarā*
vii. Definition, types and numbers of *srotas, dhamanī, śirā* and *nāḍī*
viii. *ojas* and its importance
ix. Definition of *agni* and types – *jaṭharāgni, dhātvāgni* and *bhūtāgni*
x. *marma* - Definition and types

Unit 4: Padartha Vijnana and Dravya Vijnana

i. *padārtha* – Definition and types - *saptapadārtha*
ii. Definition and types of *pramā, prameya, pramātā, pramāṇa* and *pramāṇa catuṣṭaya*
iii. *pramāṇa* - Definition and types - *āptopadeśa, pratyakṣa, anumāna* and *yukti pramāṇa*
iv. Origin of *dravya*, Definition and types - *kāraṇa* and *kārya dravya*
v. *auṣadha* and *āhāra dravya, āyuṣya – anāyuṣya dravya*
vi. Basic concept of *rasa pañcaka*
vii. *dravya* - nāma-rūpa-guṇa-karma-yoga-prayoga-saṃyoga vijñāna
viii. Basic concept, classification, and application *guṇa, vīrya* and *vipāka*
ix. Basic concept of *karma* and its classification
x. *dravya* in accordance with *karma* and its uses in health and disease

Unit 5: Rasa Shastra, Bheshajya Kalpana and Ayurvedic Pharmacopeia

- ***Rasa Shastra and bhaiṣajya Kalpana:***

i. Origin and Development of *rasa śāstra* and *bhaiṣajya kalpanā*
ii. *rasa* - Definition, Types of *rasa śodhana prakāra* and *saṃskāra*
iii. *uparasa sādhāraṇa rasa, ratna,* and *uparatna*, – Definition; Types of *śodhana* and *māraṇa*
iv. Principles of *auṣadha nirmāṇa, jāraṇa, māraṇa, satvapātana, nirvāpa* and *āvāpa*
v. Basic concept of *bhaiṣajya kalpanā*
vi. *rasaśālā* - Conventional and Contemporary aspects, Good Collection Practices and Good Manufacturing Practices
vii. Basic Pharmaceutical dosage forms and Secondary dosage forms of *āyurveda*
viii. Definition of *puṭa*, its types and use in various pharmaceutical forms
ix. *auṣadha sevana kāla* and *auṣadha sevana mārga*

- ***Pharmacopeia:***

i. Āyurvedic Pharmacopoeia of India (API) - Introduction, development and importance
ii. Āyurvedic Formulary of India (AFI) - Introduction, development and importance
iii. Drugs and Cosmetics Act, 1940 in relation to ASU Drugs and Standardization of ASU drugs
iv. Extra-pharmacopoeial drugs (Anukta dravya) not finding place in Ayurvedic Classics
v. Knowledge of pharmaco-vigilance in Āyurveda and conventional system of medicine
vi. Pharmacogenomics of active compounds of Āyurveda and multi-omics approach

Unit 6: Disease Biology, Microbiology, and Immunology

- ***Disease Biology:***

i. Definition of disease, Etiology and Pathology
ii. Congenital and Acquired diseases
iii. Communicable and Non-communicable diseases
iv. Genetic and Epigenetic factors in health and diseases
v. Autoimmune diseases and Lifestyle disorders
vi. Deficiency and Metabolic diseases
vii. Psychological disorders
viii. Benign tumors and various types of cancers

- ***Microbiology:***

i. Historical perspectives of *Microbiology*, Immunization, Epidemics and Pandemics
ii. Antimicrobial resistance, Immune response by microorganisms, Sterilization and disinfection
iii. Microbial Diversity and Physiology
iv. Gut-Brain axis (GBA) and Microbiome
v. Microorganisms isolation and characterization, culture media
vi. Environmental microflora, Bio-remediation, Dairy microbiology, Indicator organisms and tests and water borne diseases
vii. Genetic Recombination, Transformation, Conjugation and Transduction

- ***Immunology:***

i. Role of RBCs, WBCs, platelets and plasma proteins in immune mechanisms
ii. Biophysics of Immune System, Structure of antigen and antibody molecules, Antigen recognition by T cell and B cells, B-cell receptors, TCR gene rearrangement, antigen presentation and MHC/HLA complex
iii. Antigen antibody reactions, Innate immune cells, Pathogen-associated molecular pattern (PAMP), Pathogen recognition receptors (PRR) and Complement system
iv. Natural and Acquired immunity, cell-mediated immunity and toxicity and cytokines
v. Immunopathology and autoimmune diseases, transplant rejection and allergy, Immunomodulators
vi. Antibody isolation and purification, ELISA, immunoblotting, immunohistochemistry, immunoprecipitation, immune cell isolation, flow cytometry and Immunotherapy
vii. History of vaccines, attenuated vaccine, heat-killed vaccine, subunit vaccine, recombinant vaccine, DNA vaccine, RNA vaccine, dendritic cell-based vaccine, Virus-Like Particles, adjuvants and their role in vaccine

Unit 7: Genetics, Ayurgenomics, Cell and Molecular Biology

- ***Genetics and Ayurgenomics:***

i. Principles of Inheritance and Variation, Historical Perspectives of Genetics
ii. Human genome and its evolution
iii. Exploring genotype to phenotype correlation, Multi-OMIC and its correlation with *doṣa-prakṛti* and medicinal plants
iv. Basics of human genomics, regulatory mechanisms of genetic variation, its role in health, diseases and adaptation including drug response
v. Population genomics, Disease genomics, Pharmaco-genomics, Nutrigenomics, and scientific approaches and initiatives towards discovery of biomarkers
vi. Approach, limitation and challenges in discovery, development and delivery of P4 and P5 (Predictive, Preventive, Personalized, Participatory and Promotive) medicinal aspects of Āyurveda

- ***Cell and Molecular Biology:***

i. Plant and animal cells - Structure and Function
ii. Early evidences and Experiments of DNA as the genetic material, Chemistry of Nucleic acids, Nucleotides, Chargaff's rule
iii. Watson-Crick model and forms of DNA; types of RNAs, Concept of gene and genome, difference between prokaryotes and eukaryotic genes, C-value paradox, Triplexes, quadruplexes and aptamers
iv. DNA replication-conservative, semi-conservative and dispersive models, DNA replicative enzymes and mechanisms of DNA replication
v. Types of gene mutations - base substitution, frame shift mutation, insertion, deletion, missense, nonsense, reverse, suppressor and lethal mutations; DNA damage and repair mechanisms
vi. Gene expression and regulation in prokaryotes, structure of prokaryotic gene, structure and functions of RNA polymerase and its subunits
vii. Mechanism of Gene Transcription and Translation, Genetic code, Gene structure, expression and regulation in eukaryotes, RNA polymerases, Post-transcriptional modifications and Operon concept
viii. Basic concepts of Genetic Engineering and Biotechnology

Unit 8: Physiology, Biochemistry and Nanotechnology

- ***Physiology:***

i. Fundamentals of human physiology and cellular function
ii. Digestive System – Digestion, Absorption and Metabolism
iii. Respiratory and Circulatory Systems – Breathing and exchange of gases, Body fluids and circulation
iv. Nervous Systems – Central and Autonomic nervous system, Neurophysiology and Cerebrospinal fluids
v. Excretory and Endocrine Systems – Excretory products and their elimination from the body, acid-base regulation, Endocrine glands and Hormonal functions
vi. Reproductive System – Human reproductive physiology and Embryonic development
vii. Voluntary and Involuntary movements and their coordination

- ***Biochemistry:***

i. Concept of atoms and molecules, molecular interactions, stereochemistry and their importance in biological systems
ii. Carbohydrate chemistry and metabolism, Disorders associated with carbohydrate metabolism
iii. Lipid chemistry and metabolism, Disorders associated with lipid metabolism, Lipidomics
iv. Chemistry and metabolism of Proteins and Amino acids, Ramachandran plot, primary, secondary, tertiary and quaternary structure of proteins, Mechanisms and specificity of Enzymes, Coenzymes and Cofactors, Disorders associated with protein and amino acid metabolism, proteomics
v. Heme synthesis and disorders
vi. Structure, function and metabolisms of nucleic acids, DNA and RNA

- ***Nanotechnology:***

i. Physical properties and types of the nanoparticles, Nanoparticles of various basic pharmaceutical forms of Āyurveda and Green nanotechnology
ii. Synthesis of nanomaterials using different methods, Molecular basis of biosynthesis of nanomaterials, assessment of plant, animal and mineral-based drugs for nanomaterials
iii. Characterizations of nanoparticles - transmission electron microscope (TEM), scanning electron microscope (SEM), fluroscence microscopy, atomic force microscope (AFM), Energy-dispersive X-ray spectroscopy (EDX), UV – visible absorption; photoluminescence; Fourier-transform infrared spectroscopy (FTIR), Atomic absorption spectroscopy (AAS) and dynamic light scattering spectroscopy (DLS)
iv. Nanomaterials in bio-sensors and other applications and Interaction of nanomaterials
v. Molecular basis of nano-formulations

Unit 9: Biodiversity and Environmental Health, IPR and Entrepreneurship

- ***Biodiversity and Environmental Health:***

i. Biodiversity of Medicinal plants and animals, Concept and Practices of environmental health, Pathways for synthesis of primary and secondary metabolites and their uses

ii. Pharmacological properties of secondary and active metabolites of medicinal plants used in Āyurveda

iii. Concept of ecosystem, structure, function and types of ecosystem, energy flow in an ecosystem: food chain, food web and ecological succession

iv. Biodiversity and its conservation, Levels of biological diversity, biogeography zones of India, biodiversity patterns and global biodiversity hot spots, India as a mega-biodiversity nation

v. Renewable and non-renewable biological resources and their importance in longevity of life

vi. Degradation of biodiversity, loss of medicinal plants and animal life, and its impact on indigenous knowledge

- ***Intellectual Property Rights (IPR):***

i. Concept, meaning and types of Intellectual Property (IP), Origin, nature, philosophy and importance of Intellectual Property Rights (IPR), Current Best Practices (CBP) and legal framework of IPR

ii. Protection of Traditional Knowledge System (TKS), prevention of bio-piracy and bio-prospecting, benefits to national economy, conservation of environment, protection of livelihood of TK stake- holders, TKS and innovation in Indian medicine system

iii. Introduction to the Indian patent office and National Biodiversity Authority and their role in the protection of TKS, Different types of IPR protection in India, Indian Legislations – Patents Act of India (1970); Biological Diversity Act (2002), Convention of Biological Diversity (1992), Plant Protection Variety and Farmers Rights Act (2001) and Geographical Indication Act 1999 etc. with respect to TKS

iv. The role of databases and registers in the legal protection of TKS - Traditional Knowledge Digital Library (TKDL) through World Intellectual Property Organisation (WIPO)

v. WTO, TRIPS, World Intellectual Property Organisation (WIPO), Convention on

Biological Diversity (CBD); FAO; Nagoya Protocol on access and benefit-sharing

- ***Entrepreneurship:***

i. Definition of Entrepreneur, Entrepreneurial traits, and Entrepreneur versus Manager, Entrepreneurial decision processes, Ethical, Legal and Socio-cultural responsibilities

ii. Opportunities for Entrepreneurs in relation to food and drugs of Ayurveda for wellness

iii. Innovations and new ideas in Āyurveda R&D, Product planning, development and troubleshooting, Types of Āyurveda industries and manufacturing, and Competitive dynamics between the sub-industries

iv. Entrepreneurship development programs of public and private agencies (MSME, Ministry of Ayush, Make in India), Challenges in Āyurveda industry and decision-making, Patenting and Commercialization strategies

v. Laboratory to market - strategies and processes of negotiation with financiers, government and regulatory authorities, Pricing strategy, challenges in marketing in Āyurveda business, Distribution channels, supply chain, Analysis and management of customer needs

vi. Business preparation including statutory and legal requirements, business feasibility study, Financial management in capital procurement and cost management, Collaborations and partnership

Unit 10: Research Methodology, Biostatistics and Ayurveda-informatics

- ***Research Methodology***

i. Research Methodologies and Bioethics in Āyurveda

ii. Fundamental principles-based research in Āyurveda

iii. Food and drug-based research in Ayurveda

iv. Pre-clinical and Clinical trials - types, protocol designing and data management in accordance with the principles of Āyurveda.

v. Various extraction methods of plant materials, Concept of polarity for extraction and Solvents used for the extraction

vi. Purification of bioactive compounds through various chromatographic methods

vii. Identification of Functional Groups in Phytochemicals

- ***Biostatistics:***

i. Average, Mean, Mode, Median; Descriptive statistics, Various Statistical tests of significance and Analysis of variance

ii. Power and sample size calculation and Basic Principles of Statistical Inference

iii. Correlation analysis, Regression analysis and Survival analysis

iv. Genome Mapping Statistics and Bioinformatics

v. Types of data and its classification, multi-dimensional data, big data, meta data, linear algebraic treatment to data, matrices, eigen values and eigenvectors, and singular value decomposition.

vi. Exploratory data analysis, descriptive statistics and inferential statistics

- **Ayurveda-informatics:**

i. Chronological Development of Āyurvedic drug manufacturing industries

ii. Government policies and initiatives for the development of Āyurveda as traditional System of Medicine of India for the wellbeing of the world

iii. Ordinance, Rules and Regulations in the manufacturing of quality, safety and efficacy of Āyurvedic drugs for the consumers

iv. Review of important modern works on classical medicinal plants published by Ministry of AYUSH and ICMR, Govt of India

v. Important organizations of Ayurveda – National Commission for Indian System of Medicine (NCISM), Central Council for Research in Āyurvedic Sciences (CCRAS), Āyurvedic Pharmacopeia commission, National Medicinal Plants Board and Traditional Knowledge Digital Library (TKDL), etc

vi. Research publication portals in Āyurveda and contemporary medical science - DHARA, PubMed, Ayush Research Portal, Bioinformatics Centre and Research Management Informatic System

vii. Use of modern technology to confirm the various fundamental principles, drug research and development for communicable and non-communicable diseases

viii. Health informatics in Āyurveda in present global scenario