Curriculum for MD/ MS Ayurveda
(PRESCRIBED BY NCISM)

अभ्यासात्प्राप्यते दृष्टिः कर्मसिद्धिप्रकाशिनी।

Semester II
Applied Basics of Rasashastra and Bhaishajya Kalpana
(Pharmaceutics and Clinical Pharmacy)
(SUBJECT CODE : AYPG-AB-RB)

(Applicable from 2024-25 batch, from the academic year 2024-25 onwards until further notification by NCISM)

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BOARD OF AYURVEDA
NATIONAL COMMISSION FOR INDIAN SYSTEM OF MEDICINE
NEW DELHI-110026

PREFACE

Treatment success greatly depends on the quality of medicines and their judicial application. Rasashastra and Bhaishajya Kalpana deal not only with assuring quality during manufacturing but also in advising the rational application of herbal and herbomineral products.

Yoga Vijnana and Prayoga Vijnana which are comparable with pharmaceutics and pharmaceuticals form the base of study here. After successful completion of the course a postgraduate in Rasshatra and Bhaishajya Kalpana shall be the specialist in 'Ayurvedic Pharmaceutics and Pharmaceuticals, He is expected to have fundamental and applied knowledge in Rasashastra and Bhaishajya Kalpana in detail and also ability to understand the processes described in Rasashastra in the light of chemistry and chemical technology, He should have classical and contemporary knowledge on drug manufacturing including newer dosage forms and drug development and the ability to identify the need and areas of research in Rasashastra and Bhaishajyakalpana, He must be familiar with the drug standardization and quality control as well as quality assurance methods and related equipment with adequate knowledge of standard databases about drug and ability for preparation of drug dossier; He needs to be familiar with drugs & cosmetic and other relevant acts with the knowledge of pharmacovigilance. He is expected to have the ability to authenticate raw materials of Rasashastra along with understanding and application of material and operational management, clinical pharmacy, and pharmacy practice.

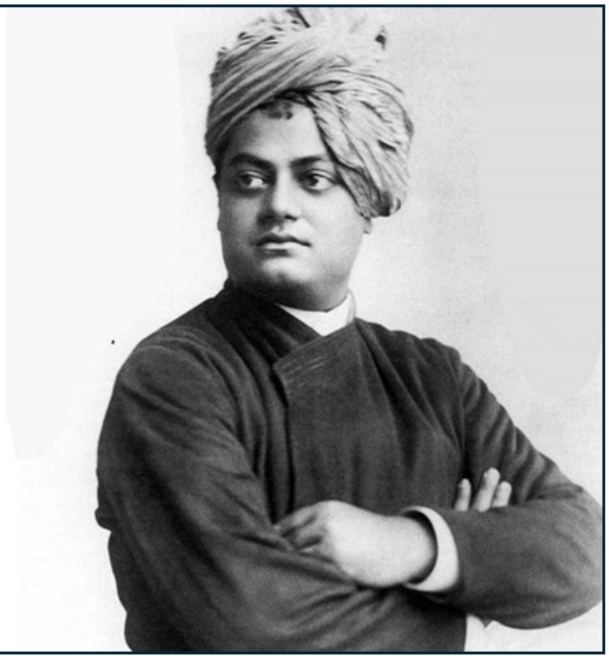
Competence is the ability to perform a role or task effectively by integrating knowledge, skills, personal attitudes, and values. It also involves applying knowledge and skills gained through experience and learning.

After successfully implementing competency-based learning in undergraduate studies, it is now essential to revise and update the postgraduate syllabus for *Rasashastra* and *Bhaishajya Kalpana* to align with a Competency-Based Dynamic Curriculum. This updated syllabus is designed to equip postgraduates with the core competencies expected in these fields. Along with cognitive and psychomotor skills, greater emphasis is placed on experiential learning to enhance practical expertise.

INDEX

We want that education by which **character** is formed, **strength of mind** is increased, the **intellect** is expanded, and by which one can **stand on one's own feet.**

-Swami Vivekananda



NCISM

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Curriculum for MD/ MS Ayurveda

Applied Basics of Rasashastra and Bhaishajya Kalpana (AYPG-AB-RB)

Summary & Credit Framework

Semester II

Module Number & Name	Credits	Notional Learning Hours	Maximum Marks of assessment of modules (Formative assessment)
M1. Pharmaceutics and Pharmaceutical Technology	2	60	50
M2. Databases and Information Systems for Metal, Mineral, and Plant Research	2	60	50
M3. Essential Chemistry :- Unlocking the Rasashastra Techniques	2	60	50
M4. Concept, understanding, application, SOPs and chemical changes of Shodhana and Marana procedures	2	60	50
M5. Principles, specification, SOPs of handling of classical and advanced instruments	3	90	75
M6. Animal house and Animal handling technique	1	30	25
M7. Classical and Advanced quality control techniques for Ayurveda Formulations	2	60	50
M8. Nano-science, nano-technology and its application in Ayurveda	2	60	50
	16	**480**	**400**

Credit frame work

AYPG-AB-RB consists of 8 modules totaling 16 credits, which correspond to 480 Notional Learning Hours. Each credit comprises 30 hours of learner engagement, distributed across teaching, practical, and experiential learning in the ratio of 1:2:3. Accordingly, one credit includes 5 hours of teaching, 10 hours of practical training, 13 hours of experiential learning, and 2 hours allocated for modular assessment, which carries 25 marks.

Important Note: The User Manual MD/MS Ayurveda is a valuable resource that provides comprehensive details about the curriculum file. It will help you understand and implement the curriculum. Please read the User Manual before reading this curriculum file. The curriculum file has been thoroughly reviewed and verified for accuracy. However, if you find any discrepancies, please note that the contents related to the MSE should be considered authentic. In case of

difficulty and questions regarding the curriculum, write to syllabus24ayu@ncismindia.org.

Course Code and Name of Course

Course code	Name of Course
AYPG-AB-RB	Applied Basics of Rasashastra and Bhaishajya Kalpana

Table 1 : Course learning outcomes and mapped Program learning outcomes

CO No	A1 Course learning Outcomes (CO) AYPG-AB-RB At the end of the course AYPG-AB-RB, the students should be able to-	B1 Course learning Outcomes mapped with program learning outcomes.
CO 1	Elucidate classical Ayurvedic knowledge in alignment with multidisciplinary principles applied to Ayurveda pharmaceuticals.	PO1,PO3,PO7
CO 2	Evaluate the use of classical texts of Rasashastra and Bhaishajya Kalpana in research and drug development.	PO1,PO5,PO7
CO 3	Classify, identify, and authenticate raw drugs using both ancient Ayurvedic and contemporary methods.	PO1,PO2,PO3,PO7
CO 4	Apply quality control (QC) and quality assurance (QA) processes for in-process control and finished products, integrating classical methods with modern technical advancements.	PO2,PO3,PO5,PO7
CO 5	Identify global healthcare needs and research areas, and design, develop, and manufacture innovative dosage forms in compliance with regulatory standards.	PO1,PO2,PO3,PO7,PO8
CO 6	Justify the clinical administration of Ayurvedic formulations and adapt them for emerging health conditions.	PO4,PO6,PO7,PO8
CO 7	Analyze the application of material and operational management, pharmacy practice, and pharmacology in Ayurvedic pharmaceutics.	PO1,PO5,PO6
CO 8	Evaluate current and emerging trends in Ayurvedic pharmaceutics with a focus on interdisciplinary scientific advancements.	PO5,PO7,PO8

Table 2 : Course contents (Modules- Credits and Notional Learning Hours)

2A Module Number	2B Module & units	2C Number of Credits	Notional Learning hours			
			2D Lectures	2E Practical Training	2F Experiential Learning including modular assessment	2G Total
1	**M-1 Pharmaceutics and Pharmaceutical Technology** This module Pharmaceutics and Pharmaceutical Technology provides a comprehensive foundation in pharmaceutics and pharmaceutical technology,covering the entire spectrum of pharmaceutical design, formulation, manufacture, and evaluation. It also delves into the pharmaceutical industry, regulatory frameworks, and product development processes. Additionally, the module explores various pharmaceutical dosage forms, formulation principles, and Good Manufacturing Practices, while introducing the fundamental principles of biopharmaceutics and pharmacokinetics. • **M1U1 Introduction to Pharmaceutics** 1.1. Definition and scope of pharmaceutics 1.2. Historical development of pharmaceutics 1.3. Pharmaceutical industry overview 1.4. Regulatory frameworks (FDA, etc.) 1.5. Pharmaceutical product development process • **M1U2 Pharmaceutical Dosage Forms** 2.1. Classification of dosage forms 2.2. Solid dosage forms (tablets, capsules, etc.)	2	10	20	30	60

2.3. Liquid dosage forms (solutions, suspensions, etc.)
2.4. Semi-solid dosage forms (ointments, creams, etc.)
2.5. Parenteral dosage forms (injections, infusions, etc.)

• **M1U3 Pharmaceutical Formulation**

3.1. Principles of pharmaceutical formulation
3.2. Excipients and their functions
3.3. Solid dosage forms
3.4. Liquid and semi-solid dosage forms
3.5. Parenteral dosage forms

• **M1U4 Pharmaceutical Manufacturing and Quality Control**

4.1. Good Manufacturing Practices (GMP& cGMP)
4.2. Quality control and quality assurance
4.3. Packaging and labelling
4.4. Portability and storage

• **M1U5 Biopharmaceutics**

5.1. Biopharmaceutics and pharmacokinetics
5.2. Bioavailability and bioequivalence
5.3. Pharmaceutical dissolution and absorption
5.4. Pharmaceutical product development and optimization

2	**M-2 Databases and Information Systems for Metal, Mineral, and Plant Research** This module, Databases and Information Systems for Metal, Mineral, and Plant Research, provides a comprehensive introduction to databases and information systems, focusing on metal, mineral, and plant research. This module will provide the fundamental principles of databases, data retrieval languages, and various databases relevant to the field, including metal, mineral, and plant databases. The module will also cover advanced database searching and utilization techniques, database integration, and applications in research and industry. • **M2U1 Introduction to Databases and Information Systems** 1.1. Overview of databases and information systems 1.2. Types of databases (relational, object-oriented, etc.) 1.3. Database management systems (DBMS) 1.4. Data retrieval and querying languages (SQL, etc.) 1.5. Introduction to metal, mineral, and plant databases • **M2U2 Metal and Mineral Databases** 2.1. Overview of metal and mineral databases 2.2. USGS Mineral Database 2.3. Mineral Database 2.4. Webmineral Mineral Database 2.5. Introduction to Metal Databases • **M2U3 Plant Databases** 3.1. Overview of plant databases	2	10	20	30	60

	3.2. The Plant List (TPL) 3.3. International Plant Names Index (IPNI) 3.4. Royal Botanic Gardens, Kew (RBG Kew) databases 3.5. Introduction to plant genetic databases (e.g., PlantGDB) • **M2U4 Database application** 4.1. Database applications in research and industry 4.2. Using databases for decision-making and policy development 4.3. Future directions: emerging trends and technologies in database development 4.4. Group project: developing a database application for metal, mineral, or plant research • **M2U5 Challenges and limitation of Databases** 5.1. Challenges in Pharmaceutical Formulation Development 5.2. Limitations of In Vitro and In Vivo Testing 5.3. Regulatory Challenges in Pharmaceutical Product Approval 5.4. Scalability and Manufacturing Challenges					
3	**M-3 Essential Chemistry :- Unlocking the Rasashastra Techniques** This module Essential Chemistry - Unlocking the Rasashastra Techniques integrates fundamental chemistry principles with traditional Ayurvedic practices,enhancing understanding and application of Rasashastra techniques. By exploring the connections between chemistry and Ayurveda, learners will gain adeeper	2	10	20	30	60

understanding of the processing methods and transformations involved in Rasashastra, ultimately enabling them to develop and optimize Ayurvedic formulations.

- **M3U1 Atomic, Molecular Structure, and Periodic Table Elements**

  1.1. Importance of knowledge of chemistry for understanding various processing methods of Rasashastra and Oushadha nirmana.
  1.2. Atomic structure, Periodic table, Chemical bonding, Isomerism -Application of these principles in Shodhana, Marana, Amruteekarana and Chaturvidha Rasayana etc.
  1.3. Periodic Table, Main group elements, Transition metals: understanding of chemical properties of non-metals, metals, variable oxidation states, thermal stability, and the ability to form complex compounds

- **M3U2 Specialized Chemistry Fields-An Outline**

  2.1.Crystallography- detoxification, transformation of compound
  2.2.Organometallic chemistry- Chaturvidha Rasayana
  2.3. Bioinorganic chemistry- Amruteekarana (Metal-Carbon bond-stable compound formation)
  2.4. Application in Shodhana, Marana, Amruteekarana, Chaturvidha Rasayana

- **M3U3 Organic Chemistry**

  3.1. Structure of organic molecules: understanding of Herbal components,
  3.2. Interaction of herbs and animal products with metals for detoxification, compound formation, and compound stability.
  3.3. Functional groups: Reactivity and properties of organic molecules influencing compound action

	• **M3U4 Phytochemistry** 4.1. Definition and significance of phytochemistry 4.2. Overview of plant-based bioactive compounds 4.3. Classes of Phytochemicals 4.4. Extraction methods 4.5. Phytochemical screening • **M3U5 Metallurgy** 5.1. Introduction to metallurgy and general physicochemical methods of extraction of metals from ores 5.2. Common ores used in Rasashastra and their Satvapatana from metallurgical point of view					
4	**M-4 Concept, understanding, application, SOPs and chemical changes of Shodhana and Marana procedures** This module, Concept, understanding, application, SOPs, and chemical changes of Shodhana and Marana procedures provides a comprehensive understanding of Shodhana (purification/ Detoxification/ modification/Potentiating) and Maran (incineration) procedures in Ayurvedic pharmaceutical manufacturing. It covers the fundamental principles, applications, and standard operating procedures (SOPs) of Shodhana and Marana processes, including the chemical changes involved. The module also explores real-world case studies, troubleshooting techniques, and future directions in Shodhana and Marana procedures, providing a solid foundation for practical application in Ayurvedic pharmaceutical manufacturing.	2	10	20	30	60

• **M4U1 Shodhana and Marana Procedures**

1.1. Overview of Shodhana and Marana procedures
1.2. Importance of purification and incineration in Ayurvedic pharmaceutical manufacturing
1.3. Principles of Shodhana and Marana procedures
1.4. Applications of Shodhan and Maran procedures in Ayurvedic pharmaceutical manufacturing

• **M4U2 SOP of Shodhana Processes**

2.1. Types of Shodhana procedures (physical, chemical, biological)
2.2. Methods of Shodhana (filtration, sedimentation, distillation, etc.)
2.3. SOPs for Shodhana procedures

• **M4U3 SOP of Marana process**

3.1. Types of Marana procedures (incineration, calcination, etc.)
3.2. Methods of Marana (oxidation, thermal decomposition, etc.)
3.3. SOPs for Marana procedures

• **M4U4 Chemical Changes involved in Shodhana and Marana processes**

4.1. Chemical changes involved in Shodhan procedures
4.2. Chemical Changes involved in Marana procedures

• **M4U5 Shodhana and Marana- Case Studies, troubleshooting and emerging trends**

	5.1. Case studies of Shodhana and Marana procedures in Ayurvedic pharmaceutical manufacturing 5.2. Troubleshooting and optimization of Shodhana and Marana procedures 5.3. Future directions and emerging trends in Shodhana and Marana procedures					
5	**M-5 Principles, specification, SOPs of handling of classical and advanced instruments** This module Principles, specifications, SOPs for handling classical and advanced instruments describes the principles, specifications, and SOPs for handling classical instruments like Puta and Musha, and their modern aspects. It also deals with the principles, types, and applications of chromatography, spectroscopy, and microscopy in the standardization of Ayurvedic formulations, demonstration of the use of advanced characterization instruments like PSA, XRD, XRF, SEM-EDAX, TEM, TGA, DTA, and VSM analysis. It also deals with the SOPs for calibration, troubleshooting, and maintenance of various instruments. This module discusses the integration of the knowledge of instrumental analysis for the standardization and quality control of Ayurvedic medicines. • **M5U1 Puta and its modern aspects** 1.1. Introduction, principles, and specifications of Puta 1.2. SOPs for handling Puta 1.3. Modern aspects of Puta (automation, computerization, etc.) 1.4. Troubleshooting and maintenance of Puta • **M5U2 Musha and its modern aspects**	3	15	30	45	90

2.1. Introduction, principles, and specifications of Puta.
2.2. SOPs for handling Musha
2.3. Modern aspects of Musha (automation, computerization, etc.)
2.4. Troubleshooting and maintenance of Musha

- **M5U3 Chromatography**

3.1. Scope and applications of chromatography in herbal drug standardization (identification of active compounds, adulterant detection, phytochemical analysis, and quality assurance).
3.2. Principle and types of chromatography, including TLC, HPTLC, HPLC, LC-MS, and GC-MS.
3.3. Instrumentation of chromatography, including equipment and tools used in different types of chromatography.
3.4. Data analysis in chromatography, including interpretation of chromatograms and spectra.
3.5. Chromatography's Limitations, challenges, and prospects in pharmaceutical and phytochemical research

- **M5U4 Spectroscopy**

4.1. Introduction, principles, and types (IR, UV, NMR, AAS, ICP, etc.) of spectroscopy.
4.2. Specifications of spectroscopy instruments
4.3. SOPs for handling spectroscopy instruments
4.4. Troubleshooting and maintenance of spectroscopy instruments

- **M5U5 Microscopy**

	5.1. Introduction, principles, and types of microscopy (optical, petrological, electron, etc.) 5.2. Specifications of microscopy instruments 5.3. SOPs for handling microscopy instruments 5.4. Use of micrometer in microscopy • **M5U6 Calibration techniques** 6.1. Introduction, principles, and types of calibration (instrument calibration, method calibration, etc.) 6.2. SOPs for calibration 6.3. Troubleshooting and maintenance of calibration instruments • **M5U7 Overview of characterization instruments** 7.1. Overview of advanced characterization instruments and their significance in the standardization of Ayurvedic medicines. 7.2. Principles and applications of working mechanism and Applications of instrumental methods: PSA, XRD, XRF, SEM-E-Dax, TEM, TGA, DTA, VSM analysis					
6	**M-6 Animal house and Animal handling technique** Tehniques, emphasizing animal care and welfare. It covers the principles of animal house design, sanitation, and hygiene practices, as well as species-specific handling techniques, animal health, and disease prevention. The module also explores advanced animal handling techniques, animal welfare, and research ethics.	1	5	10	15	30

• **M6U1 Introduction to animal house management**

1.1. Overview of animal house management
1.2. Animal house design and layout
1.3. Record-keeping and documentation

• **M6U2 Study of animal behaviour**

2.1. Introduction to Animal Behaviour
2.2. Types of Animal behaviour.
2.3 Animal communication and their body language

• **M6U3 Species-specific handling techniques**

\3.1. Rodents (mice, rats, etc.)
3.2. Non-human primates
3.3. Aquatic animals
3.4. Other specialized species (e.g., birds, reptiles)

• **M6U4 Animal health and disease prevention**

4.1. Common diseases in laboratory animals
4.2. Vaccination and immunization programs
4.3. Parasite control and management

• **M6U5 Animal welfare and ethics**

5.1. Animal welfare principles and ethics

	5.2. Humane endpoints and euthanasia methods 5.3. Case studies and group discussions on animal welfare and ethics					
7	**M-7 Classical and Advanced quality control techniques for Ayurveda Formulations** This module, Classical and Advanced Quality Control Techniques for Ayurveda Formulations, provides a comprehensive understanding of quality control and quality assurance in Ayurveda formulations. It covers classical and advanced quality control techniques, including quality control parameters, regulatory requirements, and documentation. The module also explores quality control parameters for various dosage forms, including solid, semi-solid, and liquid formulations. • **M7U1 Quality Control and Quality Assurance** 1.1. Importance of quality control in Ayurveda 1.2. Quality Assurance of Ayurveda Products 1.3. Quality control parameters (identity, purity, etc.) 1.4. Regulatory requirements for quality control 1.5. Documentation and record-keeping • **M7U2 Classical aspects of the quality control parameter for Ayurvedic formulations** 2.1 Mana and their application in quality control 2.2 Avaleha siddhi Lakshana 2.3 Sneha paka Siddhi Lakshana 2.4 Sandhana Siddhi Lakshana 2.5 Guggulu paka lakshana	2	10	20	30	60

	2.6 Bhasma/Pishti pariksha • **M7U3 Quality Control parameter for solid dosage forms** 3.1 Churn, kwatha churna, lepa 3.2 Kshara, Lavana, Satva 3.3 Tablets, pills, and Varti 3.4 Khalveeya, Parpati, and Kupipakwa Rasayana 3.5 Lauha/Mandura • **M7U4 Quality Control parameter for semi-solid dosage forms** 4.1. Rasakriya/Avaleha/Paka 4.2. Anjana • **M7U5 Quality Control parameter for liquid and gaseous dosage forms** 5.1. Kashaya 5.2. Arka 5.3. Sharkara 5.4. Asava-arishta 5.5. Netra Bindu/Karna Bindu 5.6. Aerosols/sprays					
8	**M-8 Nano-science, nano-technology and its application in Ayurveda** This module Understanding Nano-Science, Nano-Technology, and its Application in	2	10	20	30	60

Ayurveda covers integration of nano-science and nano-technology withAyurveda, exploring its potential to revolutionize the field of traditional medicine. This module explores the fundamentals of nanotechnology, its applications in Ayurvedic formulations, and the regulatory and safety aspects of this emerging field.

- **M8U1 Introduction to Nanotechnology**

  1.1.Definition and history of nanotechnology
  1.2. Basic principles and applications of nanotechnology
  1.3. Understanding Nanoscale

- **M8U2 Ayurvedic Formulations and Nanotechnology**

  2.1.Overview of Ayurvedic formulations and their limitations
  2.2.Potential of nanotechnology in Ayurvedic formulations
  2.3.Characterization micro/nanoparticles in Bhasma
  2.4. Characterization micro/nanoparticles in Kupipakwa Rasayana and Pottali
  2.5. Characterization of micro-nano sized particles generated during Bhavana
  2.6. Synthesize silver nanoparticles (AgNPs) using the chemical precipitation method and grasp the fundamental principles underlying nanoparticle synthesis
  2.7. Market Survey of Nano-Based Herbal Formulations

- **M8U3 Nanocarriers for Ayurvedic Formulations**

  3.1.Types of nanocarriers (liposomes, nanoparticles, etc.)
  3.2. Advantages and limitations of nanocarriers in Ayurvedic formulations
  3.3. Conversion of Taila into Oil in water nano emulsion and its characterization

	• **M8U4 Regulatory Aspects and Safety Concerns** 4.1. Regulatory frameworks for nanotechnology-based Ayurvedic formulations 4.2. Safety concerns and toxicity issues related to nanotechnology-based Ayurvedic formulations • **M8U5 Recent Advances and Future Directions** 5.1. Recent advances in nanotechnology-based Ayurvedic formulations 5.2. Future directions and potential applications 5.3. Exploring the Future of Nanomedicine with Ayurvedic Formulations					
		16	**80**	**160**	**240**	**480**

Table 3 : Modules - Unit - Module Learning Objectives and Session Learning Objective- Notional Learning Hours- Domain-Level- TL Methods

3A Course Outcome	3B Learning Objective (At the end of the (lecture/practical training /experiential learning) session, the students should be able to)	3C Notional learning Hours	3D Lecture/ Practical Training/ Experiential Learning	3E Domain/ Sub Domain	3F Level (Does/Shows how/Knows how/Know)	3G Teaching Learning Methods
Module 1 : Pharmaceutics and Pharmaceutical Technology						
Module Learning Objectives **(At the end of the module, the students should be able to)** 1. Discuss the fundamental principles and scope of pharmaceutics and pharmaceutical technology. 2. Describe the different types of pharmaceutical dosage forms and their formulation principles. 3. Discuss the importance of Good Manufacturing Practices (GMP) and quality control in pharmaceutical manufacturing. 4. Apply biopharmaceutic principles to pharmaceutical product development and optimization. 5. Illustrate the pharmaceutical product development process and regulatory frameworks governing the pharmaceutical industry.						
Unit 1 Introduction to Pharmaceutics 1.1. Definition and scope of pharmaceutics 1.2. Historical development of pharmaceutics 1.3. Pharmaceutical industry overview 1.4. Regulatory frameworks (FDA, etc.) 1.5. Pharmaceutical product development process **References:** 4,40,42,43,44,45,46,47,48,49						

3A	3B	3C	3D	3E	3F	3G
CO 1	Define pharmaceutics and describe its scope and historical development	1	Lecture	CC	Knows-how	L&PPT
CO 2,CO 5	Discuss Pharmaceutical industry overview, market size (national and international) and regulatory framework	1	Lecture	CAP	Knows-how	DIS,L_VC
CO 5	Demonstrate regulatory frameworks (FDA,etc.)	2	Practical Training 1.1	PSY-SET	Shows-how	D
CO 4,CO 7	Demonstrate pharmaceutical product development process	2	Practical Training 1.2	PSY-GUD	Shows-how	D,PT
CO 5	Identify applications suiting various regulatory frameworks	3	Experiential-Learning 1.1	PSY-ADT	Does	PL,PBL
CO 4,CO 7	Enlist and evaluate challenges and solutions in the pharmaceutical product development process	3	Experiential-Learning 1.2	CE	Knows-how	PL,PBL

Unit 2 Pharmaceutical Dosage Forms

2.1. Classification of dosage forms
2.2. Solid dosage forms (tablets, capsules, etc.)
2.3. Liquid dosage forms (solutions, suspensions, etc.)
2.4. Semi-solid dosage forms (ointments, creams, etc.)
2.5. Parenteral dosage forms (injections, infusions, etc.)

References: 50,51,52,53,54

3A	3B	3C	3D	3E	3F	3G
CO 1,CO 5	Classify various pharmaceutical dosage forms	1	Lecture	CC	Knows-how	L,PBL

CO 1	Identify and categorise classical Ayurvedic dosage forms	2	Practical Training 1.3	CAN	Knows-how	D,DIS
CO 1	Identify and categorise modified Ayurvedic dosage forms	2	Practical Training 1.4	CAN	Knows-how	D,DIS
CO 1,CO 5	Explore, identify, and collect various classical and modified pharmaceutical dosage forms	3	Experiential-Learning 1.3	PSY-MEC	Does	FV,PBL, RLE

Unit 3 Pharmaceutical Formulation

3.1. Principles of pharmaceutical formulation
3.2. Excipients and their functions
3.3. Solid dosage forms
3.4. Liquid and semi-solid dosage forms
3.5. Parenteral dosage forms

References: 55,56,57,58,59,181

3A	3B	3C	3D	3E	3F	3G
CO 1	Describe the principles of pharmaceutical formulations, excipients, and their functions	1	Lecture	CAP	Knows-how	L&PPT ,PL
CO 1,CO 5	Discuss formulation of parenteral dosage forms	1	Lecture	CC	Knows-how	L_VC,PL
CO 1,CO 5	Formulate Solid Dosage Forms selecting appropriate excipients	4	Practical Training 1.5	PSY-GUD	Shows-how	D,DIS,PT
CO 1,CO 5	Formulate liquid Dosage Forms selecting appropriate excipients	4	Practical Training 1.6	PSY-GUD	Shows-how	D,DIS,PT
CO 1,CO 5	Identify an Appropriate Excipient According to Solid and Liquid Dosage Form	6	Experiential-	PSY-	Does	BS,PrBL

			Learning 1.4	MEC		

Unit 4 Pharmaceutical Manufacturing and Quality Control

4.1. Good Manufacturing Practices (GMP& cGMP)
4.2. Quality control and quality assurance
4.3. Packaging and labelling
4.4. Portability and storage

References: 187,188,189,190,191

3A	3B	3C	3D	3E	3F	3G
CO 3,CO 4,CO 5	Discuss Good Manufacturing Practices (GMP& cGMP)	1	Lecture	CC	Knows-how	L&PPT ,L_VC
CO 3,CO 4	Discuss pharmaceutical stability and shelf life	1	Lecture	CAP	Knows-how	L&PPT ,L_VC,PL
CO 3,CO 4,CO 5	Evaluate GMP audit and compliance.	2	Practical Training 1.7	CE	Does	CD,L&PPT ,PT
CO 3,CO 4,CO 5	Demonstrate, design and evaluate pharmaceutical packing and labelling	2	Practical Training 1.8	PSY-GUD	Shows-how	DIS,L_VC,PT
CO 3,CO 4,CO 5	Design and develop Pharmaceutical Packaging systems and labelling	4	Experiential-Learning 1.5	PSY-MEC	Does	DIS,PT,PBL

Unit 5 Biopharmaceutics

5.1. Biopharmaceutics and pharmacokinetics
5.2. Bioavailability and bioequivalence
5.3. Pharmaceutical dissolution and absorption

5.4. Pharmaceutical product development and optimization

References: 187,188,189,190,191

3A	3B	3C	3D	3E	3F	3G
CO 6,CO 7,CO 8	Describe biopharmaceutics and pharmacokinetics	1	Lecture	CC	Knows-how	L&PPT
CO 6,CO 7,CO 8	Describe bioavailability and bioequivalence	1	Lecture	CAP	Knows-how	L&GD
CO 4,CO 5,CO 8	Discuss pharmaceutical product development and optimization	1	Lecture	CAP	Knows-how	BS,DIS,L
CO 7,CO 8	Design and Optimize Pharmaceutical Formulation for Enhanced Bioavailability	7	Experiential-Learning 1.6	PSY-MEC	Does	DIS,PT,PBL,SDL

Practical Training Activity

Practical No	Name	Activity details
Practical Training 1.1	Demonstration of regulatory frameworks (FDA,etc.)	The teacher will demonstrate a scenario where a pharmaceutical company is developing a new drug for a specific disease condition. He will identify and explain key regulations and guidelines the company must follow for IND (Investigational New Drug) application submission. Students are asked to explore specific regulatory guidelines applicable to different regulatory bodies, construct the process of application, and present
Practical Training 1.2	Demonstration of pharmaceutical product development process	The teacher will demonstrate a video presentation (15 to 25 minutes) on the pharmaceutical product development process, covering introduction to a selected drug candidate, discovery and target identification, preclinical testing and formulation development, clinical trials, regulatory submission and approval, and commercialization and post-marketing surveillance.
Practical Training 1.3	Identify and categorise Classical Ayurvedic dosage forms	Each student will identify and classify different classical dosage forms mentioned in Ayurvedic classics into solid, liquid, and semi-solid categories under the guidance of the teacher. Students will record observations and characteristics of each dosage form.

Practical Training 1.4	Identification and categorisation of modified Ayurvedic dosage forms	Each student will identify and classify different modified Ayurvedic dosage forms into solid, semi-solid, liquid, and gaseous categories under the guidance of the teacher. Students will examine and sort samples of different dosage forms, such as tablets, capsules, solutions, suspensions, ointments, creams, and infusions. Students will record observations and characteristics of each dosage form.
Practical Training 1.5	Formulation of Solid Dosage Forms selecting appropriate excipients	The teacher will design and prepare a simple tablet formulation using a model drug and excipients. Measure and mix the ingredients, compress the tablets and evaluate their physical characteristics. Students will be instructed to prepare the tablet following the same steps.
Practical Training 1.6	Formulation of liquid Dosage Forms selecting appropriate excipients	The teacher will prepare a simple syrup formulation using a model drug and excipients. Measure and mix the ingredients, dissolve the solids, and evaluate the physical and chemical characteristics of the syrup. Students are instructed to prepare a syrup following the same steps.
Practical Training 1.7	GMP audit and compliance evaluation	The teacher will explain the importance of GMP and cGMP in drug manufacturing. He will provide the checklist to conduct an audit. Under his guidance students will conduct a mock audit to evaluate compliance with Good Manufacturing Practices (GMP) and current Good Manufacturing Practices (cGMP) in a pharmaceutical manufacturing setting. Assess documentation, personnel training, equipment maintenance, and facility cleanliness. In the case of non-GMP certified teaching pharmacy, the student can conduct a mock audit and note down the observations comparing with checklist and present his findings mentioning the shortcomings if any, and required components to match GMP standards
Practical Training 1.8	Demonstration, designing, and evaluation of pharmaceutical packaging and labelling	The teacher will demonstrate a standard packaging and labeling design with a suitable example. He will then assign each student the task of designing and evaluating a pharmaceutical packaging and labeling system for a specific product, considering factors such as container closure systems, labeling requirements, and tamper-evident features. The teacher will assess the system's compliance with regulatory requirements and industry standards.
Experiential learning Activity		
Experiential learning No	**Name**	**Activity details**
Experiential-Learning 1.1	Recognising applications suiting various regulatory	The teacher will assign individual students a scenario where a pharmaceutical company is developing a new drug (different dosage forms) for different health conditions. Identify key regulations and guidelines the company must follow for IND (Investigational New Drug) application submission. Review a case study of a company receiving an FDA warning letter for GMP violations and

	frameworks	propose corrective actions. Prepare a short presentation summarizing findings and recommendations.
Experiential-Learning 1.2	Listing out challenges and solutions in the pharmaceutical product development process	Each student will be assigned to identify challenges in pharmaceutical product development of different dosage forms, such as poor solubility and regulatory compliance issues. Design potential solutions and analyze case studies of companies that overcame similar challenges. Present solutions and receive peer feedback, then reflect on key takeaways and implications for real-world scenarios
Experiential-Learning 1.3	Exploration, identification and collection of various classical and modified pharmaceutical dosage forms	Each student will be informed to visit a pharmacy or hospital dispensary. The department obtains prior permission from the pharmacy or head of the institution as applicable. In the case of a hospital dispensary Students are made in batches depending on the size of the dispensary and post. Students are sent one by one and asked to collect samples from specific dosage forms. Search and collect samples of different dosage forms, such as tablets, capsules, solutions, suspensions, ointments, creams, injections, and infusions. Samples manufactured by different pharmacies may be collected and compared. Record the name, category, and characteristics of each dosage form. Return to the classroom and create a display or presentation showcasing the collected dosage forms
Experiential-Learning 1.4	Selection of an Appropriate Excipient According to Solid and Liquid Dosage Form	Students will perform an experiential exercise to select and justify appropriate excipients for solid and liquid dosage forms. They will choose an active pharmaceutical ingredient (API) and a specific dosage form, and then determine the required characteristics of the dosage form. Students will then select an excipient to help achieve the desired characteristics and justify their selection. This exercise will help students understand the role of excipients in pharmaceutical formulation and apply theoretical knowledge to practical problems. By completing this exercise, students will develop their critical thinking and problem-solving skills in pharmaceutical formulation.
Experiential-Learning 1.5	Designing and development of Pharmaceutical Packaging systems and labelling	The teacher will assign each student to design and develop a pharmaceutical packaging system for a specific product, considering factors such as container closure systems, labelling requirements (based on dosage forms and ingredients), and tamper-evident features. Students will be asked to review the labels of various dosage forms available in the dispensary, evaluate them, and present their observations
Experiential-Learning 1.6	Optimization of Pharmaceutical Formulation for Enhanced Bioavailability	The teacher will allot each student a poorly soluble drug and students will be instructed to design a novel pharmaceutical formulation to enhance its bioavailability. Students will conduct literature research, formulate hypotheses, design experiments, and test the formulation. Evaluate the results using pharmacokinetic parameters and present findings in a written report and oral presentation

Modular Assessment	
Assessment method	**Hour**
I**Instructions—**Conduct a structured Modular assessment. The assessment will be for 50 marks for this module. Keep a structured marking pattern. Use different assessment methods in each module for the semester. Keep a record of the structured pattern used for assessment. Calculate the Modular grade point as per Table 6C. Select any two activities for 25 marks each (2x25=50 Marks) 1. Create a database of bioequivalence and bioavailability studies for different drug products. 2. Select a pharmaceutical product and research its stability and storage requirements. 3. Investigate the role of excipients in the bioavailability of a pharmaceutical product. 4. Develop a manufacturing process for the dosage form, including selecting equipment, developing a batch record, and evaluating process validation. 5. Provide each student with a sample pharmaceutical product that is missing some information. Discuss the importance of each missing label and how it could impact patient safety or compliance. OR Any practical in converted form can be taken for assessment.(25 Marks) and Any experiential learning method in converted form can be taken for assessment (25 marks)	4

Module 2 : Databases and Information Systems for Metal, Mineral, and Plant Research

Module Learning Objectives
(At the end of the module, the students should be able to)

1. Describe the fundamental concepts of databases and information systems, including types of databases and database management systems.
2. Acess metal, mineral, and plant databases for research and development, including advanced searching techniques and data analysis.
3. Integrate multiple databases and apply database applications in research, industry, and decision-making.
4. Evaluate the challenges and limitations of databases in metal, mineral, and plant research.
5. Design and develop a database application for metal, mineral, or plant research, incorporating emerging trends and technologies.

Unit 1 Introduction to Databases and Information Systems

1.1. Overview of databases and information systems
1.2. Types of databases (relational, object-oriented, etc.)
1.3. Database management systems (DBMS)
1.4. Data retrieval and querying languages (SQL, etc.)
1.5. Introduction to metal, mineral, and plant databases

References: 69,70,71,72,73,74,75

3A	3B	3C	3D	3E	3F	3G
CO 1	Describe overview of databases and information systems, types of databases (relational, object-oriented, etc.), and database management systems (DBMS).	1	Lecture	CC	Knows-how	L&PPT ,L_VC
CO 1	Describe data retrieval and querying languages (SQL, etc.) and an overview of metal, mineral, and plant databases.	1	Lecture	CAP	Knows-how	L&PPT

CO 1	Demonstrate various searching techniques of databases	2	Practical Training 2.1	PSY-GUD	Does	D,PT
CO 1	Demonstrate Modelling, Querying, and Analytics of Data	2	Practical Training 2.2	PSY-GUD	Does	D
CO 1	Design and Implement a Simple Database for a Plant Nursery	6	Experiential-Learning 2.1	PSY-MEC	Shows-how	CBL,DIS,PAL,PT

Unit 2 Metal and Mineral Databases

2.1. Overview of metal and mineral databases
2.2. USGS Mineral Database
2.3. Mineral Database
2.4. Webmineral Mineral Database
2.5. Introduction to Metal Databases

References: 76,77,78,79,80,81,82

3A	3B	3C	3D	3E	3F	3G
CO 3,CO 4,CO 7	Describe overview of metal and mineral databases, USGS (U.S. Geological Survey)	1	Lecture	CC	Knows-how	BL,L_VC
CO 3,CO 4,CO 7	Discuss Mineral and metal Databases, including their applications and significance.	1	Lecture	CAP	Knows-how	DIS,FC
CO 3,CO 4,CO 7	Analyze USGS Mineral Database	2	Practical Training 2.3	CAN	Does	D,PrBL
CO 3,CO 4,CO 7	Analysis and integration of Web mineral Database	3	Practical Training 2.4	CS	Does	DIS,PL,PBL
CO 3,CO 4,CO	Search, explore and analyze Metal Database and Applications.	3	Practical	CAP	Does	CD,D

7			Training 2.5			
CO 3,CO 4,CO 7	Analyse Web mineral Database and Metal Database	6	Experiential-Learning 2.2	CAN	Does	DIS,PSM

Unit 3 Plant Databases

3.1. Overview of plant databases
3.2. The Plant List (TPL)
3.3. International Plant Names Index (IPNI)
3.4. Royal Botanic Gardens, Kew (RBG Kew) databases
3.5. Introduction to plant genetic databases (e.g., PlantGDB)

References: 83,84,85,86,87,88,89,90,91,92,93,94,95

3A	3B	3C	3D	3E	3F	3G
CO 3,CO 4,CO 7	Illustrate overview of plant databases, The Plant List (TPL), and International Plant Names Index (IPNI).	1	Lecture	CC	Knows-how	L&PPT ,L_VC
CO 3,CO 4,CO 7	Describe Royal Botanic Gardens, Kew (RBG Kew) databases and introduction to plant genetic databases (e.g., PlantGDB).	1	Lecture	CC	Knows-how	L&PPT ,L_VC
CO 3,CO 4,CO 7	Demonstrate techniques to explore Plant Databases	4	Practical Training 2.6	CAN	Does	D,DIS,PT
CO 3,CO 4,CO 7	Explore and analyse plant database	6	Experiential-Learning 2.3	CAN	Does	DIS,PER, PrBL

Unit 4 Database application

4.1. Database applications in research and industry
4.2. Using databases for decision-making and policy development

4.3. Future directions: emerging trends and technologies in database development
4.4. Group project: developing a database application for metal, mineral, or plant research

References: 96,97,98,99,100,101,102

3A	3B	3C	3D	3E	3F	3G
CO 3,CO 4,CO 7	Discuss database applications in research and industry, and use databases for decision-making and policy development.	1	Lecture	CC	Knows-how	DIS,L&P PT
CO 3,CO 4,CO 7	Analyze future directions in database development and applications, including emerging trends and technologies, and group project guidelines	1	Lecture	CAP	Knows-how	DIS,L&P PT
CO 3,CO 4,CO 7	Analyse case studies of Database Applications in Metal, Mineral, or Plant Research	4	Practical Training 2.7	CE	Shows-how	CD,D,DIS
CO 3,CO 4,CO 7	Apply and justify case studies of Database Applications in Metal, Mineral, or Plant Research	6	Experiential-Learning 2.4	PSY-MEC	Does	CD,DIS,PAL,PER

Unit 5 Challenges and limitation of Databases

5.1. Challenges in Pharmaceutical Formulation Development
5.2. Limitations of In Vitro and In Vivo Testing
5.3. Regulatory Challenges in Pharmaceutical Product Approval
5.4. Scalability and Manufacturing Challenges

References: 103,104

3A	3B	3C	3D	3E	3F	3G
CO 3,CO 4,CO	Identify Database-Related Challenges in Pharmaceutical Development:	1	Lecture	CC	Know	L&GD

7						
CO 3,CO 4,CO 7	Discuss data Quality, Integration, Security, Scalability, and Regulatory Compliance	1	Lecture	CAN	Knows-how	DIS,L&P PT
CO 3,CO 4,CO 7	Perform a role play related to the challenges and limitations of databases	2	Experiential-Learning 2.5	AFT-RES	Does	DIS,PBL, RP

Practical Training Activity

Practical No	Name	Activity details
Practical Training 2.1	Demonstration of various searching techniques for databases	The teacher will demonstrate selected searching techniques for databases and demonstrate. Students will be informed to follow the techniques using various MeSH(Medical Subject Headings) terms
Practical Training 2.2	Demonstration of Modelling, Querying, and Analytics of Data	Teacher will Create a data model for a metal, mineral, or plant-related database. Students will be asked to write complex SQL (Structured Querry Language) queries to retrieve and analyze data. Perform data analytics tasks such as data visualization, data mining, and predictive modelling
Practical Training 2.3	Demonstration of techniques to search and extract data from the USGS Mineral Database	The teacher will show how to search and extract data from the USGS Mineral Database on a specific mineral or metal. Students will be asked to follow the technique and extract the data for the assigned mineral. They are then asked to analyze and present the data in a report.
Practical Training 2.4	Analyse and integrate Web mineral Database	The teacher will demonstrate searching data for minerals from multiple databases and show how to integrate data from multiple metal and mineral databases to solve a real-world problem. Students will be advised to follow the technique to present the integrated database and discuss the challenges and limitations.
Practical Training 2.5	Search and explore Metal Database and Applications	The teacher will demonstrate the technique to search and explore metal databases, including their applications and significance. Students will be advised to follow the technique and search metal databases and present a case study on the use of metal databases in industry or research
Practical Training 2.6	Demonstration of techniques to explore	The teacher will demonstrate the techniques to search and extract data from The Plant List (TPL) and International Plant Names Index (IPNI) on a specific plant species or family. Students will be instructed to follow the technique, gather the data, analyze

	Plant Databases	
Practical Training 2.7	Analysis of case studies of Database Applications in Metal, Mineral, or Plant Research	The teacher will demonstrate selected case studies of database applications in metal, mineral, or plant research and will explain how to evaluate the effectiveness of the database applications, identify best practices, and discuss potential improvements and future directions.
Experiential learning Activity		
Experiential learning No	**Name**	**Activity details**
Experiential-Learning 2.1	Design and Implement a Simple Database for a Plant Nursery	Students will be assigned to design a simple database for a plant nursery. Create three tables: Plant/metal/mineral, Customer, and Order. Define the relationships between the tables. Use a DBMS to create the database and insert sample data. Write SQL queries to retrieve and manipulate data. Perform basic operations like adding a new plant, updating customer addresses, and deleting an order.
Experiential-Learning 2.2	Analyse Web mineral Database and Metal Database	Each student will be assigned a different metal/mineral (from the groups mentioned in Rasashastra like, Maharasa, Uparasa, Sadharana Rasa, Sudhavarga, Loha etc)and asked to conduct an in-depth analysis of the Webmineral, Mineral Database, and research metal databases to identify trends, patterns, and correlations. Present their findings and insights.
Experiential-Learning 2.3	Exploration and analysis of plant database	Each student will be asked to carry out an independent research project using The Plant List (TPL) and the International Plant Names Index (IPNI) to investigate a specific plant-related question or hypothesis. Collect and analyze data, and present findings in a research paper or presentation.
Experiential-Learning 2.4	Apply and justify case studies of Database Applications in Metal, Mineral, or Plant Research	Each student will analyze different case studies of database applications in selected metal, mineral, or plant research. Students will evaluate the effectiveness of the database applications, identify best practices, present the same, and get feedback from peers.
Experiential-Learning 2.5	Perform a role play related to the challenges and limitations of	Participate in a team role-play to resolve database challenges in a pharmaceutical company. Your team comprises a Database Administrator, Research Scientist, Regulatory Affairs Specialist, and IT Manager. Address data quality issues, integration problems, and data security and regulatory compliance concerns. Work together to identify problems, discuss solutions, and agree

	databases	on an implementation plan.

Modular Assessment	
Assessment method	**Hour**
Instructions—Conduct a structured Modular assessment. The assessment will be for 50 marks for this module. Keep a structured marking pattern. Use different assessment methods in each module for the semester. Keep a record of the structured pattern used for assessment. Calculate the Modular grade point as per Table 6C. Select any two activities for 25 marks each (2x25=50 Marks) 1. Create a comprehensive database that integrates data from USGS mineral database and web mineral database. 2. Choose a specific plant species and demonstrate how to use plant database (TPL, IPNI etc) to gather information on that species. 3. Create a presentation on the challenges and limitations of databases, including security, scalability and data quality issues. OR Any practical in converted form can be taken for assessment(25 Marks) AND Any experiential learning method in converted form can be taken for assessment (25 marks)	4

Module 3 : Essential Chemistry :- Unlocking the Rasashastra Techniques

Module Learning Objectives
(At the end of the module, the students should be able to)

- Describe the role of basic chemistry principles in Rasashastra
- Apply chemical concepts effectively in Rasashastra
- Integrate chemical concepts with traditional Ayurvedic practices
- Correlate essential chemistry concepts with Ayurvedic principles to enhance comprehension of Ayurvedic principles and practices.
- Demonstrate the ability to apply their knowledge in the field of Ayurveda.

Unit 1 Atomic, Molecular Structure, and Periodic Table Elements

1.1. Importance of knowledge of chemistry for understanding various processing methods of Rasashastra and Oushadha nirmana.
1.2. Atomic structure, Periodic table, Chemical bonding, Isomerism -Application of these principles in Shodhana, Marana, Amruteekarana and Chaturvidha Rasayana etc.
1.3. Periodic Table, Main group elements, Transition metals: understanding of chemical properties of non-metals, metals, variable oxidation states, thermal stability, and the ability to form complex compounds

References: 105,106

3A	3B	3C	3D	3E	3F	3G
CO 8	Describe the role of basic chemistry principles and their application in Rasashastra	1	Lecture	CK	Know	BL,FC,L &PPT
CO 8	Analyse chemical bonding types and principles and isomerism and their significance in better understanding of different Rasashastra processes such as Shodhana, and Marana.	5	Practical Training 3.1	PSY-GUD	Shows-how	BL,FC,PER

CO 8	Apply the knowledge Periodic Table for Chemical Properties of Main Group and Transition Metals	6	Experiential-Learning 3.1	PSY-MEC	Does	DIS,PER,PrBL

Unit 2 Specialized Chemistry Fields-An Outline

2.1.Crystallography- detoxification, transformation of compound
2.2.Organometallic chemistry- Chaturvidha Rasayana
2.3. Bioinorganic chemistry- Amruteekarana (Metal-Carbon bond-stable compound formation)
2.4. Application in Shodhana, Marana, Amruteekarana, Chaturvidha Rasayana

References: 107,108,109,110,111

3A	3B	3C	3D	3E	3F	3G
CO 8	Describe the principles of crystallography and an overview of organometallic and bioinorganic chemistry	1	Lecture	CK	Know	BL,DIS,L&PPT
CO 8	Demonstrate the essential fundamental principles of crystallography and organometallic principles with special reference to Rasashastra procedures	5	Practical Training 3.2	CC	Knows-how	BL,DIS,L_VC,PER

Unit 3 Organic Chemistry

3.1. Structure of organic molecules: understanding of Herbal components,
3.2. Interaction of herbs and animal products with metals for detoxification, compound formation, and compound stability.
3.3. Functional groups: Reactivity and properties of organic molecules influencing compound action

References: 112,113,114

3A	3B	3C	3D	3E	3F	3G
CO 8	Describe the structure of organic molecules	1	Lecture	CK	Know	BL,L&PPT

CO 8	Discuss the interaction of herbs and animal products with metals	1	Lecture	CC	Knows-how	DIS,FC,JC
CO 8	Explore and identify different functional groups and discuss their influence on molecular interactions and therapeutic efficacy.	6	Experiential-Learning 3.2	CAN	Knows-how	BL,DIS,PL,PER,PrBL

Unit 4 Phytochemistry

4.1. Definition and significance of phytochemistry
4.2. Overview of plant-based bioactive compounds
4.3. Classes of Phytochemicals
4.4. Extraction methods
4.5. Phytochemical screening

References: 115,116,117,118

3A	3B	3C	3D	3E	3F	3G
CO 8	Describe the significance of phytochemistry	1	Lecture	CC	Knows-how	IBL,L&PPT
CO 8	Describe the overview of plant-based bioactive components	1	Lecture	CC	Knows-how	DIS,FC,L&PPT
CO 8	Discuss different types of extraction methods including solvent selection	1	Lecture	CC	Knows-how	BL,DIS,L_VC
CO 8	Demonstrate different types of extraction methods including solvent selection	4	Practical Training 3.3	PSY-GUD	Shows-how	DL,DIS,DA
CO 8	Demonstrate qualitative identification of phytoconstituents in single herbs and herbal formulations	3	Practical Training 3.4	PSY-GUD	Shows-how	DL,DIS,DA,LRI

CO 8	Demonstrate extraction of different herbal formulations using various extraction techniques and solvents	3	Experiential-Learning 3.3	PSY-MEC	Does	DL,DIS,PT,PrBL
CO 8	Identify phytoconstituents in Herbs and Herbal Formulations: A Practical Approach	3	Experiential-Learning 3.4	PSY-MEC	Does	DIS,DA,LRI,PBL

Unit 5 Metallurgy

5.1. Introduction to metallurgy and general physicochemical methods of extraction of metals from ores
5.2. Common ores used in Rasashastra and their Satvapatana from metallurgical point of view

References: 119,120,121

3A	3B	3C	3D	3E	3F	3G
CO 8	Define metallurgy and describe its scope	1	Lecture	CK	Know	DIS,L&PPT
CO 8	Describe general physicochemical methods of extraction of metals from ores	1	Lecture	CK	Know	BL,DIS,L_VC
CO 8	Discuss common ores used in Rasashastra and their Satvapatana with metallurgical point of view	1	Lecture	CC	Knows-how	DIS,FC
CO 8	Demonstrate different types of metals and their properties.	3	Practical Training 3.5	PSY-GUD	Shows-how	DL,DIS
CO 8	Differentiate various types of metals based on their properties.	4	Experiential-Learning 3.5	PSY-ORG	Does	DIS,PT,PSM
CO 8	Differentiate metals using basic metal identification techniques	4	Experiential-Learning 3.6	PSY-ORG	Does	DIS,PBL

Practical Training Activity

Practical No	Name	Activity details
Practical Training 3.1	Analysis of chemical bonding types, principles, and isomerism	The teacher will assign students video resources on chemical bonding and isomerism. Students will watch videos and take notes. They will be asked to present their notes on a basic understanding of the relevant chemistry concept with an interpretation relating to the Shodhana and Marana process.
Practical Training 3.2	Demonstration of the essential fundamental principles of crystallography and organometallic principles with special reference to Rasashastra procedures	Department/College will arrange an online lecture/Webinar on exploring the principles of Crystallography, its applications, and its significance in understanding compound structures. Encourage critical thinking and the exchange of ideas under peer learning.: After completing the Online lecture/Webinar, students will present their key points and findings.
Practical Training 3.3	Demonstration of different types of extraction methods including solvent selection	The teacher will select an herb and a formulation and demonstrate extraction following different methods and solvents. The teacher will explain the process of recording the percentage yield and physical status of the respective extracts. Different herbs and formulations will be selected for each session to avoid repetition.
Practical Training 3.4	Demonstration of qualitative identification of phytoconstituents in single herbs and herbal formulations	The teacher will select an herb and a formulation and extract the same in specific solvents. Extracts will be tested for phytoconstituents by Test Tube methods. Different herbs and formulations will be selected for each session to avoid repetition.
Practical Training 3.5	Demonstration of different types of metals and their properties.	The teacher will select different metal samples and demonstrate their properties like, malleability, ductility, heat conductivity, electrical conductivity, density, reactivity with acids, etc.
Experiential learning Activity		

Experiential learning No	Name	Activity details
Experiential-Learning 3.1	Exploration of the Periodic Table: Chemical Properties of Main Group and Transition Metals	Individual students will be assigned a project on the periodic table. Each student will be given a different group of elements, such as main group metals or transition metals. They will be required to conduct a literature survey and prepare an experimental design, including data analysis and interpretation. Students will then present their findings, followed by a class discussion.
Experiential-Learning 3.2	Exploration and identification of different functional groups and discuss their influence on molecular interactions and therapeutic efficacy.	Each student will be assigned a project to identify the functional groups present in the organic molecules of a given formulation. They will then conduct a reactivity analysis and assess the impact on the formulation's properties and implications. Students will document how these factors contribute to the desired therapeutic outcome, stability, and shelf life. The compiled results will be presented and discussed.
Experiential-Learning 3.3	Extraction Techniques in Herbal Formulations: A Hands-on Approach	Each student will be provided with different samples of herbal and polyherbal formulations. They will then extract the samples using various extraction techniques and solvents. The yield will be recorded, and the physical status of the extracts will be noted. To ensure a diverse learning experience, different herbs and formulations will be selected for each session.
Experiential-Learning 3.4	Identification of phytoconstituents in Herbs and Herbal Formulations: A Practical Approach	The teacher will assign a specific herb and formulation to each student. Students will then extract the allotted herb using designated solvents. The resulting extracts will be tested for phytoconstituents using qualitative test tube methods. To ensure a diverse learning experience, different herbs and formulations will be selected for each session.
Experiential-Learning 3.5	Test different types of metals for their properties.	Each student will be provided with various metal samples. They will then investigate the physical and chemical properties of each metal, such as color, texture, malleability, magnetic properties, reactivity with acid solutions, and thermal conductivity. The observations will be recorded, and the properties of each metal will be noted. To ensure a comprehensive learning experience, different metal samples will be selected for each session.
Experiential-Learning 3.6	Hands-on experience with basic metal	Each student will be provided with various metal samples and will perform hands-on experiments to identify the metals using basic techniques. They will observe and record the physical properties and perform simple chemical tests to identify the metals. The

	identification techniques	observations and results will be noted

Modular Assessment

Assessment method	Hour
Instructions: Conduct a structured Modular assessment. Assessment will be for 50 marks for this module. Keep a structured marking pattern. Use different assessment methods in each module for the semester. Keep a record of the structured pattern used for assessment. Calculate the Modular grade point as per Table 6C. Select any two activities for 25 marks each (2x25=50 Marks) 1. Investigate chemical bonding in Ayurvedic herb-drug interactions, Study isomerism in Ayurvedic compounds, and develop a chemical bonding-based model for Ayurvedic formulation design. 2. Ask the students to design and develop Ayurvedic formulations using the principles of atomic structure, periodic table, chemical bonding, and isomerism. 3. Conduct a cost-benefit analysis of the process of Satvapatana of iron ore, including the costs of extraction, purification, and conversion. 4. Research and present on the bioinorganic chemistry of metal ions used in Ayurvedic formulations, including their coordination chemistry and biological activity. OR Any practical in converted form can be taken for assessment.(25 marks) AND Any experiential learning method in converted form can be taken for assessment (25 marks)	4

Module 4 : Concept, understanding, application, SOPs and chemical changes of Shodhana and Marana procedures

Module Learning Objectives
(At the end of the module, the students should be able to)

1. Demonstrate a comprehensive understanding of Shodhana (purification/ Detoxification/ modification/Potentiating) and Maran (incineration) procedures.
2. Describe the fundamental principles, applications, and standard operating procedures (SOPs) of Shodhana and Marana processes.
3. Describe the chemical changes involved in the Shodhana and Marana processes.
4. Analyze real-world case studies of Shodhana and Marana procedures.
5. Apply troubleshooting techniques for common issues in Shodhana and Marana processes.
6. Plan future directions in Shodhana and Marana procedures.

Unit 1 Shodhana and Marana Procedures

1.1. Overview of Shodhana and Marana procedures
1.2. Importance of purification and incineration in Ayurvedic pharmaceutical manufacturing
1.3. Principles of Shodhana and Marana procedures
1.4. Applications of Shodhan and Maran procedures in Ayurvedic pharmaceutical manufacturing

References: 1,2,7,9

3A	3B	3C	3D	3E	3F	3G
CO 1	Discuss Shodhana and Marana procedures	1	Lecture	CC	Knows-how	DIS,FC,L &PPT
CO 1,CO 7	Discuss the importance of purification and incineration in Ayurvedic pharmaceutical manufacturing	1	Lecture	CC	Knows-how	DIS,L&PPT

CO 1,CO 2,CO 7,CO 8	Analyse principles of Shodhana and Marana procedures with their application in Ayurvedic pharmaceutical manufacturing	1	Lecture	CAN	Knows-how	DIS,L&PPT

Unit 2 SOP of Shodhana Processes

2.1. Types of Shodhana procedures (physical, chemical, biological)
2.2. Methods of Shodhana (filtration, sedimentation, distillation, etc.)
2.3. SOPs for Shodhana procedures

References: 122,123

3A	3B	3C	3D	3E	3F	3G
CO 1,CO 7	Describe types of Shodhana procedures (physical, chemical, biological)	1	Lecture	CK	Knows-how	DIS,FC,L&PPT ,PL
CO 1,CO 8	Discuss methods of Shodhana (filtration, sedimentation, distillation, etc.) and its SOPs	1	Lecture	CC	Knows-how	DIS,FC,L&PPT
CO 1,CO 7	Demonstrate Shodhana procedure of Rasadravyas using various methods	10	Practical Training 4.1	PSY-GUD	Does	D,DIS
CO 1,CO 7	Perform Shodhana of Rasadravyas with various methods	10	Experiential-Learning 4.1	PSY-ADT	Shows-how	PT,PrBL

Unit 3 SOP of Marana process

3.1. Types of Marana procedures (incineration, calcination, etc.)
3.2. Methods of Marana (oxidation, thermal decomposition, etc.)
3.3. SOPs for Marana procedures

References: 124

3A	3B	3C	3D	3E	3F	3G
CO 1,CO 7	Describe types of Marana procedures (incineration, calcination, etc.)	1	Lecture	CC	Knows-how	FC,L&PPT
CO 1,CO 7	Discuss methods of Marana (oxidation, thermal decomposition, etc.) and its SOPs	1	Lecture	CC	Knows-how	DIS,L&PPT ,PAL
CO 1,CO 7	Demonstrate Marana procedure of Rasadravyas with different methods	10	Practical Training 4.2	PSY-GUD	Shows-how	D,DIS,PT
CO 1,CO 7	Perform Marana procedure of Rasadravyas with different methods	10	Experiential-Learning 4.2	PSY-MEC	Shows-how	DIS,PT,PBL

Unit 4 Chemical Changes involved in Shodhana and Marana processes

4.1. Chemical changes involved in Shodhan procedures
4.2. Chemical Changes involved in Marana procedures

References: 125,182

3A	3B	3C	3D	3E	3F	3G
CO 1,CO 7	Discuss chemical changes involved in Shodhana and Marana procedures	1	Lecture	CC	Knows-how	DIS,JC,L&PPT ,PAL

Unit 5 Shodhana and Marana- Case Studies, troubleshooting and emerging trends

5.1. Case studies of Shodhana and Marana procedures in Ayurvedic pharmaceutical manufacturing
5.2. Troubleshooting and optimization of Shodhana and Marana procedures
5.3. Future directions and emerging trends in Shodhana and Marana procedures

References: 183,184

3A	3B	3C	3D	3E	3F	3G
CO 1,CO 7,CO 8	Describe Troubleshooting and optimization of Shodhana and Marana procedures	1	Lecture	CC	Knows-how	BS,DIS,FC,L&GD
CO 8	Discuss future directions and emerging trends in Shodhana and Marana procedures	1	Lecture	CC	Knows-how	DIS,L&PPT
CO 1,CO 7,CO 8	Analyse and write Shodhana and Marana procedures in Ayurvedic pharmaceutical manufacturing through case studies	6	Experiential-Learning 4.3	CS	Knows-how	CBL,DIS,JC

Practical Training Activity

Practical No	Name	Activity details
Practical Training 4.1	Demonstration of the Shodhana procedure of Rasadravyas using various methods	The teacher will demonstrate a set of SOPs of Various Shodhana procedures like Nimajjana (Immersion), Bhavana (Levegation), Swedana (heating under a liquid bath), Pachana(Boiling),Patana(Sublimation/distillation),Nirvapa(Quenching),Dhalana (Melting and pouring), Bharjana(Roasting/frying), Nirjaleekarana(Dehydration) etc. with a selected suitable drug, explain scientifically applying different theories, and discuss the rationale behind the procedure and Shodhana Dravya used
Practical Training 4.2	Demonstration of the Marana procedure of Rasadravyas with different methods	The teacher will demonstrate any three Marana procedures along with SOPs for each procedure with a selected suitable drug and type of Puta, analyzing each step of the Marana scientifically applying different theories and discussing the rationale behind Marana Dravya used in the procedure.

Experiential learning Activity

Experiential learning No	Name	Activity details
Experiential-Learning 4.1	Performing Shodhana of Rasadravyas with various methods	Each Student will be allotted different drugs for each procedure to perform and experience the process. Students will present their observations, followed by critical appraisal/summarization by the teacher for comprehensive understanding. Each student may be allotted a set of processes, such as: 1. Swedana, Dhalana, and Nirvapa

		2. Bhavana 3. Bharjana and Patana 4. Nimajjana, Pachana, and Nirjaleekarana 5. Bhavana, Swedana, and Nirvapa 6. Dhalana, Bharjana, and Nirjaleekarana 7. Nimajjana, Pachana, and Patana
Experiential-Learning 4.2	Performing Marana procedure of Rasadravyas with different methods	Each student will be allotted different drugs and asked to carry out Marana as per the SOP laid down in classical texts/published literature and experience the procedure. Each student will present their observations. This will be followed by critical appraisal/summarisation by the teacher for a comprehensive understanding
Experiential-Learning 4.3	Analysis of Shodhana and Marana procedures in Ayurvedic pharmaceutical manufacturing through case studies	Each student will be allotted different articles published in peer-reviewed journals on Shodhana and Marana procedures and asked to analyze the contents and present their observations. Presentation of observation by each student will be followed by critical appraisal/summarisation by the teacher for a comprehensive understanding

Modular Assessment

Assessment method	**Hour**
Instructions: Conduct a structured Modular assessment. Assessment will be for 50 marks for this module. Keep a structured marking pattern. Use different assessment methods in each module for the semester. Keep a record of the structured pattern used for assessment. Calculate the Modular grade point as per Table 6C. Select any two activities for 25 marks each (2x25=50 Marks) 1. Develop a detailed chart comparing the effectiveness of various media used in the Shodhana process of Rasa Dravyas, including their chemical composition, pharmacological properties, and therapeutic application. 2. Make a study on the effect of temperature and pressure on Shodhana and Marana, including the rate of reaction and the yield of product. 3. Conduct a comparative analysis of Shodhana and Marana, highlighting their similarities and differences at the physical and chemical levels. OR Any practical in converted form can be taken for assessment(25 Marks) AND	4

Any experiential learning method in converted form can be taken for assessment (25 marks)	

Module 5 : Principles, specification, SOPs of handling of classical and advanced instruments

Module Learning Objectives
(At the end of the module, the students should be able to)

1. Describe the principles, specifications, and SOPs for handling classical instruments like Puta and Musha, and their modern aspects.
2.Discuss the principles, types, and applications of chromatography, spectroscopy, and microscopy in the standardization of Ayurvedic formulations.
3. Demonstrate the use of advanced characterization instruments, such as PSA, XRD, XRF, SEM-EDAX, TEM, TGA, DTA, and VSM analysis.
4. Develop SOPs for calibration, troubleshooting, and maintenance of various instruments.
5. Integrate the knowledge of instrumental analysis for the standardization and quality control of Ayurvedic medicines

Unit 1 Puta and its modern aspects

1.1. Introduction, principles, and specifications of Puta
1.2. SOPs for handling Puta
1.3. Modern aspects of Puta (automation, computerization, etc.)
1.4. Troubleshooting and maintenance of Puta

References: 1,2,10

3A	3B	3C	3D	3E	3F	3G
CO 1,CO 2	Discuss the principles and specifications of Puta	1	Lecture	CC	Knows-how	DIS,FC,L&PPT
CO 2,CO 7,CO 8	Analyse modern aspects of Puta	1	Lecture	CAN	Knows-how	DIS,L&GD,L&PPT

CO 1,CO 7	Demonstrate selected Puta to give the knowledge of Standard Operative Procedure	4	Practical Training 5.1	PSY-GUD	Does	D,DIS,PT
CO 1,CO 7	Develop Standard Operative Procedures (SOPs)for given Puta	8	Experiential-Learning 5.1	CS	Does	PAL,PT,PrBL

Unit 2 Musha and its modern aspects

2.1. Introduction, principles, and specifications of Puta.
2.2. SOPs for handling Musha
2.3. Modern aspects of Musha (automation, computerization, etc.)
2.4. Troubleshooting and maintenance of Musha

References: 1,2,3

3A	3B	3C	3D	3E	3F	3G
CO 1	Discuss the principles and specifications of Musha	1	Lecture	CC	Knows-how	DIS,L&PPT
CO 2,CO 8	Analyse modern aspects of Musha with special reference to crucibles	1	Lecture	CAN	Knows-how	BS,DIS,L&PPT
CO 1,CO 7	Demonstrate the handling of Musha following the Standard Operating Procedure (SOP).	4	Practical Training 5.2	PSY-GUD	Shows-how	D,DIS,PT
CO 1,CO 7	Develop Standard Operative Procedure for handling Musha	8	Experiential-Learning 5.2	PSY-MEC	Shows-how	DIS,PT,PrBL

Unit 3 Chromatography

3.1. Scope and applications of chromatography in herbal drug standardization (identification of active compounds, adulterant detection, phytochemical analysis, and quality a
3.2. Principle and types of chromatography, including TLC, HPTLC, HPLC, LC-MS, and GC-MS.

3.3. Instrumentation of chromatography, including equipment and tools used in different types of chromatography.
3.4. Data analysis in chromatography, including interpretation of chromatograms and spectra.
3.5. Chromatography's Limitations, challenges, and prospects in pharmaceutical and phytochemical research

References: 129,130,131,132,133,134

3A	3B	3C	3D	3E	3F	3G
CO 4,CO 8	Discuss the scope and applications of chromatography in herbal drug standardization	1	Lecture	CAP	Knows-how	L&PPT
CO 4,CO 8	Describe the instrumentation of chromatography, including equipment and tools used in different types of chromatography	1	Lecture	CC	Knows-how	L&PPT ,L_VC,PER
CO 7,CO 8	Discuss chromatography's Limitations, challenges, and prospects in pharmaceutical and phytochemical research.	1	Lecture	CC	Knows-how	DIS,L&PPT
CO 4,CO 7,CO 8	Demonstrate chromatography techniques to separate, and identify components and interpretation of results.	6	Practical Training 5.3	PSY-SET	Does	DL
CO 4,CO 8	Perform chromatography to separate and identify components and interpret the results.	8	Experiential-Learning 5.3	PSY-MEC	Shows-how	DIS,PrBL

Unit 4 Spectroscopy

4.1. Introduction, principles, and types (IR, UV, NMR, AAS, ICP, etc.) of spectroscopy.
4.2. Specifications of spectroscopy instruments
4.3. SOPs for handling spectroscopy instruments
4.4. Troubleshooting and maintenance of spectroscopy instruments

References: 11,12,13,14,15,16,135,136,137

3A	3B	3C	3D	3E	3F	3G
CO 4,CO 8	Discuss spectroscopy's principles and types (IR, UV, NMR, AAS, ICP, etc.).	1	Lecture	CC	Knows-how	DIS,L&PPT ,L_VC
CO 4,CO 8	Describe the specifications of spectroscopy instruments	1	Lecture	CAP	Know	L&PPT ,L_VC
CO 4,CO 8	Demonstration of spectroscopic instruments through Audiovisual aids	3	Practical Training 5.4	PSY-SET	Knows-how	BL,DL,DIS,PL
CO 4,CO 8	Explore and analyze published articles on spectroscopic instruments	4	Experiential-Learning 5.4	CAN	Knows-how	DIS,JC,PAL,PER

Unit 5 Microscopy

5.1. Introduction, principles, and types of microscopy (optical, petrological, electron, etc.)
5.2. Specifications of microscopy instruments
5.3. SOPs for handling microscopy instruments
5.4. Use of micrometer in microscopy

References: 138,139,140,141,142

3A	3B	3C	3D	3E	3F	3G
CO 4	Describe the principles, types, and specifications of microscopy instruments	1	Lecture	CC	Knows-how	DIS,L&PPT
CO 4,CO 8	Describe the Specifications of microscopy instruments	1	Lecture	CC	Knows-how	DIS,L&PPT
CO 4,CO 8	Demonstrate handling of petrological and trinocular microscopes	6	Practical Training 5.5	PSY-GUD	Shows-how	D,DL,DIS,PT

CO 4	Perform hands-on practice on the trinocular microscope	4	Experiential-Learning 5.5	PSY-MEC	Shows-how	DIS,PT,PrBL

Unit 6 Calibration techniques

6.1. Introduction, principles, and types of calibration (instrument calibration, method calibration, etc.)
6.2. SOPs for calibration
6.3. Troubleshooting and maintenance of calibration instruments

References: 143,144,145

3A	3B	3C	3D	3E	3F	3G
CO 4,CO 7,CO 8	Discuss principles and types of calibration	1	Lecture	CC	Knows-how	DIS,L&PPT
CO 4,CO 8	Demonstrate calibration of various instruments present in the department	3	Practical Training 5.6	PSY-SET	Shows-how	DL,DIS
CO 4,CO 8	Analyse articles related to challenges in the calibration of equipment	3	Experiential-Learning 5.6	CAN	Does	DIS,JC,PAL,PL,PER

Unit 7 Overview of characterization instruments

7.1. Overview of advanced characterization instruments and their significance in the standardization of Ayurvedic medicines.
7.2. Principles and applications of working mechanism and Applications of instrumental methods: PSA, XRD, XRF, SEM-E-Dax, TEM, TGA, DTA, VSM analysis

References: 14,15,17,18,20,26

3A	3B	3C	3D	3E	3F	3G

CO 4,CO 8	Discuss overview of Advanced Characterization Instruments and their significance in the standardization of Ayurvedic medicines	1	Lecture	CC	Knows-how	DIS,FC,LRI,L_VC
CO 4,CO 8	Discuss principles and Applications of Spectroscopic and X-ray techniques (PSA,XRD, and XRF techniques)	1	Lecture	CC	Knows-how	BL,DIS,FC,L&PPT
CO 4,CO 8	Describe the Principles and Applications of Microscopic and Thermal Techniques(SEM-EDAX, TEM, TGA, DTA, and VSM)	1	Lecture	CAP	Knows-how	FC,L&PPT
CO 4,CO 8	Demonstrate characterization instruments with Audiovisual aids	4	Practical Training 5.7	CAP	Knows-how	DL,L_VC
CO 4,CO 7,CO 8	Analyse published articles on advanced instruments used for characterization	4	Experiential-Learning 5.7	CAN	Knows-how	DIS,JC,PL,PER,PBL

Practical Training Activity

Practical No	Name	Activity details
Practical Training 5.1	Demonstration of selected Puta to give the knowledge of Standard Operative Procedure	The teacher will select any one Puta and one type of fuel and demonstrate the Standard Operative Procedure of the selected Puta and explain the recording and documentation of the temperature pattern, and time frame. Different Puta/fuel should be selected for every batch to avoid repetition of the Puta/fuel.
Practical Training 5.2	Demonstration of the handling of Musha following the Standard Operating Procedure (SOP).	The teacher will demonstrate the use of a Musha/crucible for determining the ash value of a selected drug, describing the required temperature, time frame, and confirmatory test. A different drug will be selected for each batch to avoid repetition.
Practical Training 5.3	Demonstration of the chromatography techniques to separate,	The teacher will demonstrate the TLC of a selected herb and any formulation (Kwatha, Churna, Sneha, Avaleha, Asava arishta, tablet) containing that herb as one of the ingredients. HPTLC of the same drug and formulations can be demonstrated wherever facilities are available.

	identify components and interpret the results.	
Practical Training 5.4	Demonstration of spectroscopic instruments through Audiovisual aids	The teacher will show Audio-Visual Content related to the instrumentation and functioning of various spectroscopy instruments. After the demonstrations, the students will discuss the key points they observed. The teacher will summarize the contents. Further students are advised to observe the working of these instruments during their visit to the characterization lab as a part of module 8
Practical Training 5.5	Demonstration of handling of petrological and trinocular microscopes	The teacher will select any mineral and demonstrate the method of identifying rocks/minerals based on optical characters. For every batch different sample will be selected for demonstration (avoiding repetition).The teacher will select a suitable sample and demonstrate the microscopic characteristics of the sample like morphology and particle size with the help of projection and discuss the findings. For every batch different sample will be selected for demonstration (avoiding repetition)
Practical Training 5.6	Demonstration of calibration of various instruments present in the department	The concerned expert will demonstrate the methods of calibration of various equipment present in the department.
Practical Training 5.7	Demonstration of characterization instruments with Audiovisual aids	Each student will be instructed to search and collect articles related to specific instruments used for the characterization of Ayurvedic formulations like, PSA, XRD, XRF, SEM-EDAX, TEM, TGA, DTA, and VSM. Articles published in peer-reviewed journals will be selected. Findings in the articles will be presented and discussed (Collected articles should be unique and different for each student and the same will not be accepted in the next sessions)

Experiential learning Activity

Experiential learning No	**Name**	**Activity details**
Experiential-Learning 5.1	Developing Standard Operative Procedures (SOPs)for given Puta	The teacher will allot any one Puta and one type of fuel to each student to develop the Standard Operative Procedure of the given Puta and the student will gain experiential learning by carrying out this practical and documenting the temperature required, and time frame. Different Puta/fuel will be allotted for each student (repetition of the Puta/fuel should be avoided in the next session)
Experiential-Learning 5.2	Developing Standard Operative Procedure for handling Musha	The teacher will allot a different drug to each student to determine its ash value using a Musha/ following a Standard Operative Procedure. The student will gain experiential learning by carrying out this practical and documenting the temperature required, time frame, and confirmatory test. Different drugs will be allotted for each student (repetition of the drug should be avoided in the

		next session)
Experiential-Learning 5.3	Performance of chromatography to separate, and identify components and interpretation of results.	Each student will be allotted an herb/formulation for Thin-Layered Chromatography to develop a Standard Operational Procedure. After performing TLC, visualization/derivatization will be carried out, and the Rf value will be calculated and compared with the standards. The results will be interpreted.
Experiential-Learning 5.4	Analysis of published articles on spectroscopic instruments	Each student will be instructed to search and collect articles related to specific spectroscopic instruments used for the characterization of Ayurvedic formulations. Articles published in peer-reviewed journals will be selected. Findings in the articles will be presented and discussed (Collected articles should be unique and different for each student and the same will not be accepted in the next sessions)
Experiential-Learning 5.5	Hands-on practice on the trinocular microscope	The teacher will allot separate samples to each student and the student will examine the given sample using the trinocular microscope and experience the microscopic characteristics of the given sample like morphology and particle size with the help of projection and discuss the findings.
Experiential-Learning 5.6	Analysis of articles related to challenges in the calibration of equipment	Each student will be instructed to search and collect articles related to the challenges in the calibration of equipment. Findings in the articles will be presented and discussed (Collected articles should be unique and different for each student and the same will not be accepted in the next sessions). The teacher will encourage the students to develop a Standard Operative Procedure for the calibration of classical instruments
Experiential-Learning 5.7	Analysis of published articles on advanced instruments used for characterization	Each student will be instructed to search and collect articles related to specific instruments used for the characterization of Ayurvedic formulations like, PSA, XRD, XRF, SEM-EDAX, TEM, TGA, DTA, and VSM. Articles published in peer-reviewed journals will be selected. Findings in the articles will be presented and discussed (Collected articles should be unique and different for each student and the same will not be accepted in the next sessions)

Modular Assessment

Assessment method	**Hour**
Instructions: Conduct a structured Modular assessment. Assessment will be for 75 marks. Keep a structured marking pattern. Use different assessment methods in each module for the semester. Keep a record of the structured pattern used for assessment. Calculate the Modular grade point as per Table 6C. 1. Design a quality control protocol for Ayurvedic formulation using chromatography. 20 Marks AND	6

Make a chart on the dimensions of putas and temperature given for Rasa dravyas. - 20 Marks OR Approach to conduct a comparative study of different analytical methods for standardization of Ayurvedic medicine.- 20 Marks AND Investigate the application of calibration techniques in emerging technologies, such as nanotechnology. - 20 marks 2. Create a presentation that explores advanced microscopy techniques, such as super-resolution microscopy and single-molecule microscopy. 35 Marks Or 1. Any practical in converted form can be taken for assessment.(40 Marks) AND 2. Any experiential learning method in converted form can be taken for assessment (35 marks)	

Module 6 : Animal house and Animal handling technique

Module Learning Objectives
(At the end of the module, the students should be able to)

1. Describe the principles of animal care and welfare, and apply them to animal house management.
2. Demonstrate handling techniques for various animal species, including small and large animals.
3. Identify and prevent common diseases in laboratory animals, and implement disease control measures.
4. Apply advanced animal handling techniques and promote animal welfare and ethics in research.
5. Develop skills in animal behavior observation, enrichment techniques, and humane endpoints and euthanasia methods.

Unit 1 Introduction to animal house management

1.1. Overview of animal house management
1.2. Animal house design and layout
1.3. Record-keeping and documentation

References: 28,29

3A	3B	3C	3D	3E	3F	3G
CO 7,CO 8	Describe the principles of Animal House Management with its design and layout	1	Lecture	CC	Knows-how	L&PPT ,L_VC
CO 7,CO 8	Design and Set Up an Animal House	2	Practical Training 6.1	PSY-GUD	Shows-how	D,DIS,PL
CO 7,CO 8	Present structure and functioning of an animal house	4	Experiential-Learning 6.1	PSY-MEC	Does	DIS,FV,PL

Unit 2 Study of animal behaviour

2.1. Introduction to Animal Behaviour
2.2. Types of Animal behaviour.
2.3 Animal communication and their body language

References: 146,147,148

3A	3B	3C	3D	3E	3F	3G
CO 7,CO 8	Identify behavioral patterns and body language in animals	1	Lecture	CAN	Knows-how	L&PPT ,L_VC
CO 7,CO 8	Observe and Interpret Animal Body Language through demonstration	2	Practical Training 6.2	CS	Shows-how	DL,FV,PL,PT
CO 7,CO 8	Develop critical thinking and research skills by analyzing online resources and studies on experimental animal behavior.	5	Experiential-Learning 6.2	PSY-MEC	Does	BS,CBL,DIS,JC,PAL,PER

Unit 3 Species-specific handling techniques

\3.1. Rodents (mice, rats, etc.)
3.2. Non-human primates
3.3. Aquatic animals
3.4. Other specialized species (e.g., birds, reptiles)

References: 30,31

3A	3B	3C	3D	3E	3F	3G
CO 7,CO 8	Discuss the handling techniques for various laboratory animal species, ensuring handler	1	Lecture	CC	Know	DIS,L&P

	safety.					PT ,L_VC
CO 7,CO 8	Demonstrate Species-Specific Handling Techniques for Laboratory Animals	2	Practical Training 6.3	PSY-GUD	Does	D,DL,FV, PT,RLE

Unit 4 Animal health and disease prevention

4.1. Common diseases in laboratory animals
4.2. Vaccination and immunization programs
4.3. Parasite control and management

References: 149,150,151

3A	3B	3C	3D	3E	3F	3G
CO 7,CO 8	Describe Common diseases in laboratory animals and their management.	1	Lecture	CC	Knows-how	L&PPT ,L_VC
CO 7,CO 8	Demonstrate microscopic Examination of Faecal Samples for Parasites	2	Practical Training 6.4	PSY-GUD	Does	D,DL,DIS
CO 7,CO 8	Prepare and present a parasite Control in Laboratory Animals	4	Experiential-Learning 6.3	PSY-MEC	Knows-how	L_VC,PAL,PrBL,TUT

Unit 5 Animal welfare and ethics

5.1. Animal welfare principles and ethics
5.2. Humane endpoints and euthanasia methods
5.3. Case studies and group discussions on animal welfare and ethics

References: 152,185

3A	3B	3C	3D	3E	3F	3G
CO 7,CO 8	Discuss Animal Welfare Principles, Ethics, Humane Endpoints, Euthanasia Methods, and Case Studies in Animal Research	1	Lecture	CC	Knows-how	CD,DIS,L &PPT ,L_VC
CO 7,CO 8	Evaluate Animal Welfare and Ethics in a Research Setting.	2	Practical Training 6.5	CE	Does	CD,DIS,PAL,PER,PBL

Practical Training Activity

Practical No	Name	Activity details
Practical Training 6.1	Demonstration of animal house model	The teacher will demonstrate an animal house model and describe its compartments considering space requirements, ventilation, temperature control, lighting, noise levels, sanitation, and hygiene including record-keeping and documentation.
Practical Training 6.2	Demonstration of Animal Body Language	Teacher will assign each student a small laboratory animal group. They will be provided a checklist of behavioural patterns and body language cues to observe, including posture, facial expressions, and vocalizations. They will be instructed to observe the animals for 30 minutes, recording their observations on the checklist. After the observation period, students will discuss and interpret their findings. Encourage students to present their findings to the class, facilitating a discussion on the importance of recognizing animal behaviour and body language. Note: Before visiting virtual observation using Computer Assisted Learning using dedicated soft ware – Ex Pharm may be carried out
Practical Training 6.3	Demonstration of Species-Specific Handling Techniques for Laboratory Animals	Under the guidance of experienced instructors, students will engage in hands-on handling sessions with various small laboratory animal species, including rodents, rabbits, and guinea pigs. Students will learn and practice species-specific handling techniques, focusing on animal behavior, body language, and welfare considerations. The session will conclude with a debriefing discussion, addressing challenges, best practices, and future applications.
Practical Training 6.4	Demonstration of microscopic Examination of Faecal Samples for Parasites	Under the supervision of the teacher or animal house in-charge, students will collect and label fecal samples from laboratory animals, wearing gloves and lab coats. They will prepare slides with staining solution and examine them under the microscope, starting at 40x and increasing to 100x. They will record parasite presence, morphology, and size. They will compare their findings with reference materials and participate in a debriefing discussion

Practical Training 6.5	Evaluation of Animal Welfare and Ethics in a Research Setting.	The teacher will prepare case study scenarios, and students will be asked to evaluate Ethical and animal welfare issues, using an animal welfare and ethics checklist. Students will present their findings and discuss with the teacher highlighting concerns and recommendations.
Experiential learning Activity		
Experiential learning No	**Name**	**Activity details**
Experiential-Learning 6.1	Visit to an Animal House	Students will visit a local animal house, with prior permission from the concerned authority, to critically observe and thoughtfully learn about animal house management practices. Beforehand, they will research and review relevant principles, prepare insightful questions, and create a comprehensive observation checklist. During the visit, students will carefully observe animal enclosures, feeding, and care practices. They will interact collaboratively with staff, take detailed notes and photographs, and reflect deeply on their observations and learning. After the visit, students will discuss their experiences empathetically with peers and the facilitator. They will then develop a well-informed action plan for improving animal house management practices.
Experiential-Learning 6.2	Analysis of online resources to develop critical thinking and research skills, and the analysis of studies on experimental animal behavior.	Students will be instructed to conduct an online search for peer-reviewed articles (at least five) and studies on experimental animal behavior, focusing on a specific topic such as stress, social behavior, or learning. Students will analyze the studies, identifying the research design, methods, results, and conclusions. They will also evaluate the strengths and limitations of each study, considering factors such as sample size, data collection methods, and statistical analysis. Students will be asked to create a comparative table or graph to summarize the findings, and write a reflective report discussing the implications of the research for understanding animal behavior.
Experiential-Learning 6.3	Preparation and presentation of a parasite Control in Laboratory Animals	Students will be instructed to search video programs that provide an overview of parasite control in laboratory animals, covering common parasites, best practices, and preventions. Best practices for parasite control are then presented, including sanitation and hygiene protocols, fecal examination and testing, and treatment and prevention strategies.

Modular Assessment	
Assessment method	**Hour**

Instructions: Conduct a structured Modular assessment. Assessment will be for 25 marks. Keep a structured marking pattern. Use different assessment methods in each module for the semester. Keep a record of the structured pattern used for assessment. Calculate the Modular grade point as per Table 6C. 25 marks may be allotted to any one of the following assessment methods: 1. Students are advised to select different animal species and conduct a study on the behaviour of a specific animal species, including their habitat, diet, and social structure. 2. Develop an SOP for laboratory animal care and management, including information on animal handling and restraint, housing and enrichment, and health monitoring. 3. Investigate a case of animal cruelty and analyze the factors that contributed to cruelty, make a critical evaluation on existing animal welfare policies, and recommend improvements. OR Any practical in converted form can be taken for assessment.(25 Marks) OR Any experiential learning method in converted form can be taken for assessment (25 marks)	2

Module 7 : Classical and Advanced quality control techniques for Ayurveda Formulations

Module Learning Objectives
(At the end of the module, the students should be able to)

1. Describe the importance of quality control and quality assurance in Ayurveda product manufacturing.
2. Describe classical quality control parameters for Ayurvedic formulations, including Mana, Avaleha Siddhi Lakshan, and Bhasma Pariksha.
3. Apply quality control parameters for various Ayurvedic dosage forms, including solid, semi-solid, and liquid.
4. Identify regulatory requirements for quality control and ensure documentation and record-keeping compliance.
5. Integrate classical and advanced quality control techniques to ensure the quality and safety of Ayurvedic formulations.

Unit 1 Quality Control and Quality Assurance

1.1. Importance of quality control in Ayurveda
1.2. Quality Assurance of Ayurveda Products
1.3. Quality control parameters (identity, purity, etc.)
1.4. Regulatory requirements for quality control
1.5. Documentation and record-keeping

References: 153,154,155,156

3A	3B	3C	3D	3E	3F	3G
CO 4	Describe the importance of Quality Control and Quality Assurance in Ayurveda	1	Lecture	CC	Knows-how	L&PPT
CO 4,CO 5	Discuss Quality Control Parameters, Regulatory Requirements, and Documentation	1	Lecture	CC	Knows-how	DIS,L&PPT

CO 4	Demonstrate documentation and record-keeping processes in the quality control section	2	Practical Training 7.1	PSY-ADT	Shows-how	D,IBL,PT, TBL
CO 4	Practice documentation and record-keeping processes in the quality control section	2	Experiential-Learning 7.1	PSY-MEC	Does	PT,PER,PSM,PrBL, RLE

Unit 2 Classical aspects of the quality control parameter for Ayurvedic formulations

2.1 Mana and their application in quality control
2.2 Avaleha siddhi Lakshana
2.3 Sneha paka Siddhi Lakshana
2.4 Sandhana Siddhi Lakshana
2.5 Guggulu paka lakshana
2.6 Bhasma/Pishti pariksha

References: 14,15,157,158,159,160,161,162,181

3A	3B	3C	3D	3E	3F	3G
CO 1,CO 4	Discuss Mana and their application in quality control and Bhasma/Pishti pariksha	1	Lecture	CAP	Knows-how	DIS,FC,L &PPT
CO 1,CO 2,CO 4	Discuss Siddhi Lakshana of Avaleha, Snehapaka, Sandhana and Guggulu Paka	1	Lecture	CC	Knows-how	DIS,FC
CO 1,CO 2,CO 4	Demonstrate assessment of Bhasma Siddhi Lakshana (Quality tests to confirm the perfect preparation of Bhasma)	2	Practical Training 7.2	PSY-GUD	Shows-how	DL,DIS,DA,PT
CO 1,CO 2,CO 4	Assess Bhasma Siddhi Lakshana (Quality tests to confirm the perfect preparation of Bhasma)	2	Experiential-Learning 7.2	PSY-MEC	Does	DA,LRI,PT,PSM

Unit 3 Quality Control parameter for solid dosage forms

3.1 Churn, kwatha churna, lepa
3.2 Kshara, Lavana, Satva
3.3 Tablets, pills, and Varti
3.4 Khalveeya, Parpati, and Kupipakwa Rasayana
3.5 Lauha/Mandura

References: 161,162,163,164,165,166,167,181

3A	3B	3C	3D	3E	3F	3G
CO 4	Discuss quality control parameters for powder dosage forms like Churna (including Kwatha Churna and Lepa Churna), Kshara, Lavana, Satva	1	Lecture	CC	Know	DIS,FC,L &PPT
CO 4	Discuss Quality control parameters for solid dosage forms like tablets, pills, and Varti	1	Lecture	CC	Knows-how	DIS,FC,L &PPT ,L_VC
CO 4	Discuss Quality control parameters for Khalveeya, Parpati and Kupipakwa Rasayana, Lauha/Mandura	1	Lecture	CC	Knows-how	DIS,FC,L &PPT
CO 4	Demonstrate Quality control parameters for powder dosage forms like Churna (including Kwatha Churna and Lepa Churna), Kshara, Lavana, Satva	3	Practical Training 7.3	CE	Shows-how	DL,DA,L RI,PT
CO 4	Demonstrate quality control parameters for solid dosage forms like tablets, pills, and Varti	3	Practical Training 7.4	PSY-GUD	Does	D,DIS,PT
CO 4	Demonstrate quality control parameters for Khalveeya, Parpati and Kupipakwa Rasayana, Lauha/Mandura	4	Practical Training 7.5	CE	Shows-how	DL,DIS,D A,LRI,PT
CO 4	Perform Quality control procedures for powder dosage forms like Churna (including Kwatha Churna and Lepa Churna), Kshara, Lavana, Satva	4	Experiential-Learning 7.3	PSY-MEC	Does	DIS,DA,L RI,PT,PrB L,SDL
CO 4	Perform quality control procedures for solid dosage forms	4	Experiential-	PSY-	Does	DL,DIS,L

			Learning 7.4	MEC		RI,PT,PrBL,SDL
CO 4	Perform quality control procedures for Rasoushadhi	5	Experiential-Learning 7.5	PSY-MEC	Does	DL,DIS,DA,LRI,PT,PrBL

Unit 4 Quality Control parameter for semi-solid dosage forms

4.1. Rasakriya/Avaleha/Paka
4.2. Anjana

References: 161,162,163,166,167,168,169,186

3A	3B	3C	3D	3E	3F	3G
CO 4	Describe Quality control parameters for semisolid dosage forms like Rasakriya/Avaleha/Paka/Anjana as per Pharmacopeial standards	1	Lecture	CC	Knows-how	DIS,L&PPT
CO 4	Demonstration of Quality control parameters for semisolid dosage forms like Rasakriya/Avaleha/Paka/Anjana as per Pharmacopeial standards	2	Practical Training 7.6	CE	Shows-how	DL,DA,LRI,PT
CO 4	Perform quality control tests for semisolid dosage forms	3	Experiential-Learning 7.6	PSY-MEC	Does	DL,DIS,LRI,PT,PrBL

Unit 5 Quality Control parameter for liquid and gaseous dosage forms

5.1. Kashaya
5.2. Arka
5.3. Sharkara
5.4. Asava-arishta
5.5. Netra Bindu/Karna Bindu

5.6. Aerosols/sprays

References: 161,162,163,170,171,172,181

3A	3B	3C	3D	3E	3F	3G
CO 1,CO 4	Discuss Quality control parameters for liquid dosage forms like Kashaya, Arka, Sharakara, Asava-arishta	1	Lecture	CC	Knows-how	DIS,FC,L &GD
CO 4	Discuss Quality control parameters for Netra Bindu/Karna Bindu and aerosols/sprays	1	Lecture	CC	Knows-how	DIS,L&P PT ,L_VC
CO 4	Demonstrate quality control parameters for liquid dosage forms like Kashaya, Arka, Sharakara, Asava-arishta	2	Practical Training 7.7	CE	Shows-how	DL,DIS,D A,FC,LRI
CO 4	Demonstrate quality control parameters for Netra Bindu/Karna Bindu and aerosols/sprays	2	Practical Training 7.8	PSY-GUD	Does	D,PT
CO 4	Perform quality control tests for liquid dosage forms	3	Experiential-Learning 7.7	PSY-ADT	Does	DIS,DA,L RI,PT,PB L,PrBL
CO 4	Perform quality control tests for Netra Bindu/Karna Bindu and aerosols/sprays.	3	Experiential-Learning 7.8	PSY-ADT	Does	DA,LRI,P rBL,SDL

Practical Training Activity

Practical No	Name	Activity details
Practical Training 7.1	Demonstration of documentation and record-keeping processes in the quality control section	The teacher will take the students to the quality control section and demonstrate the documentation and record-keeping processes for different dosage forms, from input materials to finished products.

Practical Training 7.2	Demonstration of assessment of Bhasma Siddhi Lakshana (Quality tests to confirm the perfect preparation of Bhasma)	The teacher will select at least one Bhasma from each category (ore/mineral, metal, and Sudha Varga) and demonstrate classical Bhasma Pareeksha. Additionally, special Bhasma Pareeksha tests for Rasadravyas (such as Amla Pareeksha for copper-containing compounds) will be performed. The scientific basis of these tests will be discussed. To illustrate the application of each test, the teacher will demonstrate Bhasma Pareeksha using both positive and negative samples.
Practical Training 7.3	Demonstration of Quality control parameters for powder dosage forms like Churna (including Kwatha Churna and Lepa Churna), Kshara, Lavana, Satva	The teacher will select at least one formulation from each category of powder dosage form and will demonstrate the quality testing methods as per the parameters prescribed in Pharmacopoeia.
Practical Training 7.4	Demonstrate quality control parameters for solid dosage forms like tablets, pills, and Varti	The teacher will select at least one formulation from each category of solid dosage form and will demonstrate the quality testing methods as per the parameters prescribed in Pharmacopoeia.
Practical Training 7.5	Demonstration of quality control parameters for Khalveeya, Parpati and Kupipakwa Rasayana, Lauha/Mandura	The teacher will select at least one formulation from each category of Rasoushadhi (Chaturvidha Rasayana, Louha/Mandura) and will demonstrate the quality testing methods as per the parameters prescribed in Pharmacopoeia.
Practical Training 7.6	Demonstrate Quality control parameters for semisolid dosage forms like Rasakriya/Avaleha/ Paka/Anjana as per	The teacher will select at least one formulation from each category of semisolid dosage form and will demonstrate the quality testing methods as per the parameters prescribed in Pharmacopoeia.

	Pharmacopeial standards	
Practical Training 7.7	Demonstration of quality control parameters for liquid dosage forms like Kashaya, Arka, Sharakara, Asava-arishta	The teacher will select at least one formulation from each category of liquid dosage form and will demonstrate the quality testing methods as per the parameters prescribed in Pharmacopoeia.
Practical Training 7.8	Demonstration of quality control parameters for Netra Bindu/Karna Bindu and aerosols/sprays	The teacher will select at least one formulation from aerosols/sprays and will demonstrate the quality testing methods as per the parameters prescribed in Pharmacopoeia.
Experiential learning Activity		
Experiential learning No	**Name**	**Activity details**
Experiential-Learning 7.1	Practice of documentation and record-keeping processes in the quality control section	Each student will be allotted a different dosage form and tasked with developing documentation and record-keeping processes according to an established proforma. Students will then present their work and engage in peer discussion.
Experiential-Learning 7.2	Assessment of Bhasma Siddhi Lakshana (Quality tests to confirm the perfect preparation of Bhasma)	The teacher will allot different samples of Bhasma from the categories of ore/mineral, metal, and Sudha Varga to each student. Students will then conduct Bhasma Pareeksha according to classical guidelines. To facilitate a comprehensive understanding, the teacher may provide both positive and negative samples for testing.

Experiential-Learning 7.3	Performance of Quality control procedures for powder dosage forms like Churna (including Kwatha Churna and Lepa Churna), Kshara, Lavana, Satva	The teacher will allot different powder dosage form samples to each student. Students will then conduct quality testing on their assigned samples according to standard pharmacopoeial protocols. The results obtained will be compared to pharmacopoeial standards and discussed.
Experiential-Learning 7.4	Performance of quality control procedures for solid dosage forms	The teacher will allot different solid dosage form samples like tablets, pills, and Varti to each student. Students will then conduct quality testing on their assigned samples following standard pharmacopoeial protocols. The results obtained will be compared to pharmacopoeial standards and discussed.
Experiential-Learning 7.5	Performance of quality control procedures for Rasoushadhi	The teacher will allot different samples of Rasoushadhi (representing Chaturvidha Rasayana, Loha, and Mandura categories) to each student. Students will then conduct quality testing on their assigned samples following standard pharmacopoeial protocols. The results obtained will be compared to pharmacopoeial standards and discussed.
Experiential-Learning 7.6	Performance of quality control tests for semisolid dosage forms	The teacher will select at least one formulation from each category of semisolid dosage form(like Rasakriya/Avaleha/Paka/Anjana) and will demonstrate the quality testing methods as per the parameters prescribed in the Pharmacopoeia. The students will then conduct quality testing on their assigned samples as per the standard pharmacopoeial protocol. The results obtained will be compared to pharmacopoeial standards and discussed.
Experiential-Learning 7.7	Performance of quality control tests for liquid dosage forms	The teacher will allot different liquid dosage form samples like Kashaya, Arka, Sharakara, Asava-arishta to each student. Students will then conduct quality testing on their assigned samples following standard pharmacopoeial protocols. The results obtained will be compared to pharmacopoeial standards and discussed.
Experiential-Learning 7.8	Performance of quality control tests for Netra Bindu/Karna Bindu and aerosols/sprays.	The teacher will allot different samples of Netrabindu/ Karnabindu/ aerosols/ sprays to each student. Students will then conduct quality testing on their assigned samples following standard pharmacopoeial protocols. The results obtained will be compared to pharmacopoeial standards and discussed.

Modular Assessment	
Assessment method	**Hour**
Instructions: Conduct a structured Modular assessment. Assessment will be for 50 marks. Keep a structured marking pattern. Use different assessment	4

methods in each module for the semester. Keep a record of the structured pattern used for assessment. Calculate the Modular grade point as per Table 6C. Select any two activities for 25 marks each (2x25=50 Marks) 1. Discuss the importance of quality assurance in Ayurveda products, including the role of Good Manufacturing Practices (GMP) and quality control parameters. 2. Investigate the classical methods used for microbiological analysis of Ayurvedic formulations and make a comparison with the modern parameters. 3. Enlist the quality control parameters of every dosage form and try to prepare a comparative chart showing the differences and similarities among the parameters. 4. Attempt to assess the aerodynamic properties of a gaseous dosage form OR Any practical in converted form can be taken for assessment.(25 Marks) AND Any experiential learning method in converted form can be taken for assessment (25 marks)	

Module 8 : Nano-science, nano-technology and its application in Ayurveda

Module Learning Objectives
(At the end of the module, the students should be able to)

1. Define nanotechnology, its history, principles, and applications.
2. Describe Ayurveda Formulations with respect to Nanotechnology
3. Discuss the potential of nanotechnology in Ayurvedic formulations.
4. Identify and describe various types of nanocarriers for Ayurvedic formulations.
5. Discuss the regulatory frameworks, safety concerns, and toxicity issues related to nanotechnology-based Ayurvedic formulations.
6. Describe recent advances and future directions in nanotechnology-based Ayurvedic formulations.

Unit 1 Introduction to Nanotechnology

1.1.Definition and history of nanotechnology
1.2. Basic principles and applications of nanotechnology
1.3. Understanding Nanoscale

References: 173,174

3A	3B	3C	3D	3E	3F	3G
CO 8	Define nanotechnology and describe the history of nanotechnology	1	Lecture	CK	Know	L&PPT
CO 4,CO 8	Describe the basic principles and applications of nanotechnology	1	Lecture	CAP	Knows-how	DIS,L&PPT
CO 4,CO 8	Demonstrate the measurement of micro-particles using relevant equipment	4	Practical Training 8.1	PSY-GUD	Shows-how	DL,DIS

Unit 2 Ayurvedic Formulations and Nanotechnology

2.1.Overview of Ayurvedic formulations and their limitations
2.2.Potential of nanotechnology in Ayurvedic formulations
2.3.Characterization micro/nanoparticles in Bhasma
2.4. Characterization micro/nanoparticles in Kupipakwa Rasayana and Pottali
2.5. Characterization of micro-nano sized particles generated during Bhavana
2.6. Synthesize silver nanoparticles (AgNPs) using the chemical precipitation method and grasp the fundamental principles underlying nanoparticle synthesis
2.7. Market Survey of Nano-Based Herbal Formulations

References: 175

3A	3B	3C	3D	3E	3F	3G
CO 4,CO 5,CO 8	Discuss an overview of Ayurvedic Nano formulations and their limitations	1	Lecture	CC	Knows-how	DIS,L&PPT
CO 4,CO 5,CO 8	Identify the potential of nanotechnology in Ayurvedic formulations	1	Lecture	CC	Knows-how	BS,DIS,L&PPT
CO 4,CO 5,CO 8	Demonstrate particle size of Bhasma prepared with different numbers of Puta	4	Practical Training 8.2	PSY-GUD	Shows-how	DL,DIS,PT
CO 4,CO 8	Demonstrate particle size of various Kupipakwa Rasayana samples	4	Practical Training 8.3	PSY-GUD	Shows-how	DL,DIS,PT
CO 4,CO 5,CO 8	Synthesize silver nanoparticles (AgNPs) using the chemical precipitation method	4	Practical Training 8.4	PSY-GUD	Shows-how	D,DIS,TBL
CO 4	Measure particle size of Bhasma prepared with different numbers of Puta	4	Experiential-Learning 8.1	PSY-MEC	Shows-how	DIS,PL,PrBL
CO 4,CO 8	Measure particle size of various Kupipakwa Rasayana samples	4	Experiential-	PSY-	Shows-	DIS,DA,P

			Learning 8.2	MEC	how	T,PBL,PrBL
CO 4,CO 8	Review articles regarding the green synthesis of metallic nanoparticles	2	Experiential-Learning 8.3	PSY-MEC	Know	DIS,DA,JC,PAL,PBL
CO 4,CO 5,CO 8	Analyze the impact of Bhavana by measuring the particle size of samples	4	Experiential-Learning 8.4	PSY-MEC	Does	DIS,PT,PBL
CO 5,CO 8	Conduct a market Survey of Nano-Based Ayurvedic Formulations	6	Experiential-Learning 8.5	PSY-MEC	Does	FV,PER

Unit 3 Nanocarriers for Ayurvedic Formulations

3.1.Types of nanocarriers (liposomes, nanoparticles, etc.)
3.2. Advantages and limitations of nanocarriers in Ayurvedic formulations
3.3. Conversion of Taila into Oil in water nano emulsion and its characterization

References: 179,180

3A	3B	3C	3D	3E	3F	3G
CO 4,CO 5,CO 8	Discuss types of nanocarriers (liposomes, nanoparticles, etc.)	1	Lecture	CC	Knows-how	DIS,L&PPT ,L_VC
CO 4,CO 5,CO 8	Discuss the advantages and limitations of nanocarriers in Ayurvedic formulations	1	Lecture	CC	Knows-how	DIS,FC,L&PPT ,PT
CO 4,CO 5,CO 8	Demonstrate converting Taila into an oil-in-water nanoemulsion and its characterization.	4	Practical Training 8.5	PSY-GUD	Shows-how	DL,DIS,PT

Unit 4 Regulatory Aspects and Safety Concerns

4.1. Regulatory frameworks for nanotechnology-based Ayurvedic formulations
4.2. Safety concerns and toxicity issues related to nanotechnology-based Ayurvedic formulations

References: 176,177

3A	3B	3C	3D	3E	3F	3G
CO 5	Discuss regulatory frameworks for nanotechnology-based Ayurvedic formulations	1	Lecture	CC	Know	BS,DIS,L &PPT
CO 5,CO 8	Discuss safety concerns and toxicity issues related to nanotechnology-based Ayurvedic formulations	1	Lecture	CC	Know	BS,DIS,L &PPT

Unit 5 Recent Advances and Future Directions

5.1. Recent advances in nanotechnology-based Ayurvedic formulations
5.2. Future directions and potential applications
5.3. Exploring the Future of Nanomedicine with Ayurvedic Formulations

References: 178

3A	3B	3C	3D	3E	3F	3G
CO 8	Discuss recent advances in nanotechnology-based Ayurvedic formulations	1	Lecture	CK	Know	FC,L&G D
CO 8	Discuss future directions and potential applications of nanotechnology in Ayurvedic formulations	1	Lecture	CC	Knows-how	DIS,IBL, L&PPT ,PER
CO 5,CO 8	Integrate nanomedicine with Ayurvedic formulations and their prospects.	6	Experiential-Learning 8.6	PSY-MEC	Knows-how	BL,DL,DI S,LS

Practical Training Activity		
Practical No	**Name**	**Activity details**
Practical Training 8.1	Demonstration of the measurement of micro-particles using relevant equipment	The teacher will demonstrate the application of microscale measurement using relevant equipment. Various samples of differing dimensions, ranging from micro to centimeter levels, will be selected and measured using equipment like micrometers and vernier calipers. Under the teacher's guidance, students will identify microparticles from the selected samples.
Practical Training 8.2	Demonstration of particle size of Bhasma prepared with different numbers of Puta	The teacher will select Bhasma samples prepared with varying numbers of Puta and demonstrate the particle size measurement in these samples using a relevant microscope.
Practical Training 8.3	Demonstration of particle size of various Kupipakwa Rasayana samples	The teacher will select Kupipakwa Rasayana samples and demonstrate the measurable particle size in the samples using a relevant microscope.
Practical Training 8.4	Synthesiis of silver nano particles (AgNPs) using the chemical precipitatio n method	The teacher will demonstrate the synthesis of silver nanoparticles using the chemical method in the laboratory, utilizing silver nitrate solution, and compare the results with those of Rajata Bhasma
Practical Training 8.5	Conversion of Taila into oil-in-water nanoemulsion and its characterization.	The teacher will select a taila kalpa and demonstrate its conversion into nanoemulsion by sonication method using an appropriate surfactant. Students will repeat the procedure following the instructions of the teacher. An intermediate sample will be collected. Prepared nanoemulsion and intermediate samples will be characterized and compared for particle size with the help of a High-resolution microscope
Experiential learning Activity		
Experiential learning No	**Name**	**Activity details**
Experiential-	Measurement of particle	The teacher will allot different Bhasma samples prepared with different numbers of Puta and instruct students to measure the size

Learning 8.1	size of Bhasma prepared with different numbers of Puta	of particles measurable in the samples using the relevant microscope.
Experiential-Learning 8.2	Measurement of particle size of various Kupipakwa Rasayana samples	The teacher will allot different samples of Kupipakwa Rasayana to students and instruct them to measure the size of particles measurable in the samples using the relevant microscope
Experiential-Learning 8.3	Review of articles regarding the green synthesis of metallic nanoparticles	Students will be instructed to explore relevant articles related to the green synthesis of metallic nanoparticles, analyze the contents, and discuss with peer
Experiential-Learning 8.4	Experiencing the impact of Bhavana	The teacher will instruct students to collect samples prepared at different numbers/duration of Bhavana and they will be instructed to analyze the particle size of the samples.
Experiential-Learning 8.5	Market Survey of Nano-Based Ayurvedic Formulations	The teacher will instruct students to conduct a market survey of nano-based Ayurvedic formulations and present the summary of their observations in the departmental seminar
Experiential-Learning 8.6	Integration of nanomedicine with Ayurvedic formulations and its prospects.	The department will arrange a visit to the characterization laboratory to provide hands-on experience with advanced instruments used for nanoparticle characterization. Alternatively, if an on-site visit is not feasible, an online virtual tour using audio-visual aids will be arranged.

Modular Assessment

Assessment method	**Hour**
Instructions: Conduct a structured Modular assessment. Assessment will be for 50 marks. Keep a structured marking pattern. Use different assessment methods in each module for the semester. Keep a record of the structured pattern used for assessment. Calculate the Modular grade point as per Table 6C. Select any two activities for 25 marks each (2x25=50 Marks) 1. Make a comparison over the particle size of nanoparticles present in different formulations such as Asavarista, Bhasma, and pottali. 2. Conduct a risk assessment of nanotechnology-based Ayurvedic formulations and develop a safety protocol for the handling and use of nano-based	4

Ayurvedic formulations, including guidelines for health care professionals and patients. 3. Conduct a case study of successful nanotechnology-based Ayurvedic formulations, including their development, testing and marketing. 4. Select a specific Ayurvedic drug and discuss how nanotechnology can improve its efficacy and bioavailability. OR Any practical in converted form can be taken for assessment.(25 Marks) AND Any experiential learning method in converted form can be taken for assessment (25 marks)	

Table 4 : Practical Training Activity

Practical No	Practical name	Hours
1.1	Demonstration of regulatory frameworks (FDA,etc.)	2
1.2	Demonstration of pharmaceutical product development process	2
1.3	Identify and categorise Classical Ayurvedic dosage forms	2
1.4	Identification and categorisation of modified Ayurvedic dosage forms	2
1.5	Formulation of Solid Dosage Forms selecting appropriate excipients	4
1.6	Formulation of liquid Dosage Forms selecting appropriate excipients	4
1.7	GMP audit and compliance evaluation	2
1.8	Demonstration, designing, and evaluation of pharmaceutical packaging and labelling	2
2.1	Demonstration of various searching techniques for databases	2
2.2	Demonstration of Modelling, Querying, and Analytics of Data	2
2.3	Demonstration of techniques to search and extract data from the USGS Mineral Database	2
2.4	Analyse and integrate Web mineral Database	3
2.5	Search and explore Metal Database and Applications	3
2.6	Demonstration of techniques to explore Plant Databases	4
2.7	Analysis of case studies of Database Applications in Metal, Mineral, or Plant Research	4

3.1	Analysis of chemical bonding types, principles, and isomerism	5
3.2	Demonstration of the essential fundamental principles of crystallography and organometallic principles with special reference to Rasashastra procedures	5
3.3	Demonstration of different types of extraction methods including solvent selection	4
3.4	Demonstration of qualitative identification of phytoconstituents in single herbs and herbal formulations	3
3.5	Demonstration of different types of metals and their properties.	3
4.1	Demonstration of the Shodhana procedure of Rasadravyas using various methods	10
4.2	Demonstration of the Marana procedure of Rasadravyas with different methods	10
5.1	Demonstration of selected Puta to give the knowledge of Standard Operative Procedure	4
5.2	Demonstration of the handling of Musha following the Standard Operating Procedure (SOP).	4
5.3	Demonstration of the chromatography techniques to separate, identify components and interpret the results.	6
5.4	Demonstration of spectroscopic instruments through Audiovisual aids	3
5.5	Demonstration of handling of petrological and trinocular microscopes	6
5.6	Demonstration of calibration of various instruments present in the department	3
5.7	Demonstration of characterization instruments with Audiovisual aids	4
6.1	Demonstration of animal house model	2
6.2	Demonstration of Animal Body Language	2
6.3	Demonstration of Species-Specific Handling Techniques for Laboratory Animals	2
6.4	Demonstration of microscopic Examination of Faecal Samples for Parasites	2
6.5	Evaluation of Animal Welfare and Ethics in a Research Setting.	2
7.1	Demonstration of documentation and record-keeping processes in the quality control section	2

7.2	Demonstration of assessment of Bhasma Siddhi Lakshana (Quality tests to confirm the perfect preparation of Bhasma)	2
7.3	Demonstration of Quality control parameters for powder dosage forms like Churna (including Kwatha Churna and Lepa Churna), Kshara, Lavana, Satva	3
7.4	Demonstrate quality control parameters for solid dosage forms like tablets, pills, and Varti	3
7.5	Demonstration of quality control parameters for Khalveeya, Parpati and Kupipakwa Rasayana, Lauha/Mandura	4
7.6	Demonstrate Quality control parameters for semisolid dosage forms like Rasakriya/Avaleha/Paka/Anjana as per Pharmacopeial standards	2
7.7	Demonstration of quality control parameters for liquid dosage forms like Kashaya, Arka, Sharakara, Asava-arishta	2
7.8	Demonstration of quality control parameters for Netra Bindu/Karna Bindu and aerosols/sprays	2
8.1	Demonstration of the measurement of micro-particles using relevant equipment	4
8.2	Demonstration of particle size of Bhasma prepared with different numbers of Puta	4
8.3	Demonstration of particle size of various Kupipakwa Rasayana samples	4
8.4	Synthesiis of silver nanoparticles (AgNPs) using the chemical precipitation method	4
8.5	Conversion of Taila into oil-in-water nanoemulsion and its characterization.	4

Table 5 : Experiential learning Activity

Experiential learning No	Experiential name	Hours
1.1	Recognising applications suiting various regulatory frameworks	3
1.2	Listing out challenges and solutions in the pharmaceutical product development process	3
1.3	Exploration, identification and collection of various classical and modified pharmaceutical dosage forms	3
1.4	Selection of an Appropriate Excipient According to Solid and Liquid Dosage Form	6
1.5	Designing and development of Pharmaceutical Packaging systems and labelling	4
1.6	Optimization of Pharmaceutical Formulation for Enhanced Bioavailability	7
2.1	Design and Implement a Simple Database for a Plant Nursery	6
2.2	Analyse Web mineral Database and Metal Database	6
2.3	Exploration and analysis of plant database	6
2.4	Apply and justify case studies of Database Applications in Metal, Mineral, or Plant Research	6
2.5	Perform a role play related to the challenges and limitations of databases	2
3.1	Exploration of the Periodic Table: Chemical Properties of Main Group and Transition Metals	6
3.2	Exploration and identification of different functional groups and discuss their influence on molecular interactions and therapeutic efficacy.	6
3.3	Extraction Techniques in Herbal Formulations: A Hands-on Approach	3
3.4	Identification of phytoconstituents in Herbs and Herbal Formulations: A Practical Approach	3
3.5	Test different types of metals for their properties.	4
3.6	Hands-on experience with basic metal identification techniques	4
4.1	Performing Shodhana of Rasadravyas with various methods	10

4.2	Performing Marana procedure of Rasadravyas with different methods	10
4.3	Analysis of Shodhana and Marana procedures in Ayurvedic pharmaceutical manufacturing through case studies	6
5.1	Developing Standard Operative Procedures (SOPs)for given Puta	8
5.2	Developing Standard Operative Procedure for handling Musha	8
5.3	Performance of chromatography to separate, and identify components and interpretation of results.	8
5.4	Analysis of published articles on spectroscopic instruments	4
5.5	Hands-on practice on the trinocular microscope	4
5.6	Analysis of articles related to challenges in the calibration of equipment	3
5.7	Analysis of published articles on advanced instruments used for characterization	4
6.1	Visit to an Animal House	4
6.2	Analysis of online resources to develop critical thinking and research skills, and the analysis of studies on experimental animal behavior.	5
6.3	Preparation and presentation of a parasite Control in Laboratory Animals	4
7.1	Practice of documentation and record-keeping processes in the quality control section	2
7.2	Assessment of Bhasma Siddhi Lakshana (Quality tests to confirm the perfect preparation of Bhasma)	2
7.3	Performance of Quality control procedures for powder dosage forms like Churna (including Kwatha Churna and Lepa Churna), Kshara, Lavana, Satva	4
7.4	Performance of quality control procedures for solid dosage forms	4
7.5	Performance of quality control procedures for Rasoushadhi	5
7.6	Performance of quality control tests for semisolid dosage forms	3
7.7	Performance of quality control tests for liquid dosage forms	3

7.8	Performance of quality control tests for Netra Bindu/Karna Bindu and aerosols/sprays.	3
8.1	Measurement of particle size of Bhasma prepared with different numbers of Puta	4
8.2	Measurement of particle size of various Kupipakwa Rasayana samples	4
8.3	Review of articles regarding the green synthesis of metallic nanoparticles	2
8.4	Experiencing the impact of Bhavana	4
8.5	Market Survey of Nano-Based Ayurvedic Formulations	6
8.6	Integration of nanomedicine with Ayurvedic formulations and its prospects.	6

Table 6 : Assessment Summary: Assessment is subdivided in A to H points

6 A : Number of Papers and Marks Distribution

Subject Code	Paper	Theory	Practical	Total
AYPG-AB-RB	1	100	200	300

6 B : Scheme of Assessment (Formative and Summative Assessment)

Credit frame work

AYPG-AB-RB consists of 8 modules totaling 16 credits, which correspond to 480 Notional Learning Hours. Each credit comprises 30 Hours of learner engagement, distributed across teaching, practical, and experiential learning in the ratio of 1:2:3. Accordingly, one credit includes 5 hours of teaching, 10 hours of practical training, 13 hours of experiential learning, and 2 hours allocated for modular assessment, which carries 25 marks.

Formative Assessment : Module wise Assessment:will be done at the end of each module. Evaluation includes learners active participation to get Credits and Marks. Each Module may contain one or more credits.
Summative Assessment: Summative Assessment (University examination) will be carried out at the end of Semester II.

6 C : Semester 2 Calculation Method for Modular Grade Points (MGP)

Module Number & Name (a)	Credits (b)	Actual No. of Notional Learning Hours (c)	Attended Number of notional Learning hours (d)	Maximum Marks of assessment of modules (e)	Obtained Marks per module (f)	MGP =d* f/c*e*100
M1. Pharmaceutics and Pharmaceutical Technology	2	60		50		
M2. Databases and Information Systems for Metal, Mineral, and Plant Research	2	60		50		
M3. Essential Chemistry :- Unlocking the Rasashastra Techniques	2	60		50		
M4. Concept, understanding, application, SOPs and chemical changes of Shodhana and Marana procedures	2	60		50		
M5. Principles, specification, SOPs of handling of classical and advanced instruments	3	90		75		
M6. Animal house and Animal handling technique	1	30		25		
M7. Classical and Advanced quality control techniques for Ayurveda Formulations	2	60		50		

M8. Nano-science, nano-technology and its application in Ayurveda	2	60		50		
MGP = ((Number of Notional learning hours attended in a module) X (Marks obtained in the modular assessment) / (Total number of Notional learning hours in the module) X (Maximum marks of the module)) X 100						

6 D : Semester Evaluation Methods for Semester Grade point Average (SGPA)

SGPA will be calculated at the end of the semester as an average of all Module MGPs. Average of MGPS of the Semester For becoming eligible for Summative assessment of the semester, student should get minimum of 60% of SGPA

SGPA = Average of MGP of all modules of all papers = add all MGPs in the semester/ no. of modules in the semester

Evaluation Methods for Modular Assessment

A S.No	B Module number and Name	C MGP
1	M1.Pharmaceutics and Pharmaceutical Technology	C1
2	M2.Databases and Information Systems for Metal, Mineral, and Plant Research	C2
3	M3.Essential Chemistry :- Unlocking the Rasashastra Techniques	C3
4	M4.Concept, understanding, application, SOPs and chemical changes of Shodhana and Marana procedures	C4
5	M5.Principles, specification, SOPs of handling of classical and advanced instruments	C5
6	M6.Animal house and Animal handling technique	C6
7	M7.Classical and Advanced quality control techniques for Ayurveda Formulations	C7
8	M8.Nano-science, nano-technology and its application in Ayurveda	C8
	Semester Grade point Average (SGPA)	(C1+C2+C3+C4+C5 +C6+C7+C8) / Number of modules(8)

S. No	Evaluation Methods
1.	Method explained in the Assessment of the module or similar to the objectives of the module.

6 E : Question Paper Pattern

MD/MS Ayurveda Examination

AYPG-AB-RB

Sem II

Time: 3 Hours ,**Maximum Marks:** 100

INSTRUCTIONS: All questions compulsory

		Number of Questions	Marks per question	Total Marks
Q 1	Application-based Questions (ABQ)	1	20	20
Q 2	Short answer questions (SAQ)	8	5	40
Q 3	Analytical based structured Long answer question (LAQ)	4	10	40

				100

6 F : Distribution for summative assessment (University examination)

S.No	List of Module/Unit	ABQ	SAQ	LAQ
(M-1)Pharmaceutics and Pharmaceutical Technology (Marks: Range 5-20)				
1	**(U-1)** Introduction to Pharmaceutics	No	Yes	Yes
2	**(U-2)** Pharmaceutical Dosage Forms	No	Yes	No
3	**(U-3)** Pharmaceutical Formulation	Yes	Yes	Yes
4	**(U-4)** Pharmaceutical Manufacturing and Quality Control	No	Yes	No
5	**(U-5)** Biopharmaceutics	No	Yes	Yes
(M-2)Databases and Information Systems for Metal, Mineral, and Plant Research (Marks: Range 5-15)				
1	**(U-1)** Introduction to Databases and Information Systems	No	Yes	No
2	**(U-2)** Metal and Mineral Databases	No	No	Yes
3	**(U-3)** Plant Databases	No	Yes	No
4	**(U-4)** Database application	No	Yes	No
5	**(U-5)** Challenges and limitation of Databases	No	Yes	No
(M-3)Essential Chemistry :- Unlocking the Rasashastra Techniques (Marks: Range 5-20)				
1	**(U-1)** Atomic, Molecular Structure, and Periodic Table Elements	Yes	Yes	No
2	**(U-2)** Specialized Chemistry Fields-An Outline	Yes	Yes	No
3	**(U-3)** Organic Chemistry	Yes	Yes	No
4	**(U-4)** Phytochemistry	No	Yes	Yes
5	**(U-5)** Metallurgy	No	Yes	Yes
(M-4)Concept, understanding, application, SOPs and chemical changes of Shodhana and Marana procedures (Marks: Range 5-20)				
1	**(U-1)** Shodhana and Marana Procedures	Yes	Yes	No
2	**(U-2)** SOP of Shodhana Processes	No	Yes	Yes
3	**(U-3)** SOP of Marana process	No	Yes	Yes
4	**(U-4)** Chemical Changes involved in Shodhana and Marana processes	Yes	Yes	No
5	**(U-5)** Shodhana and Marana- Case Studies, troubleshooting and emerging trends	No	Yes	No
(M-5)Principles, specification, SOPs of handling of classical and advanced instruments (Marks: Range 5-20)				
1	**(U-1)** Puta and its modern aspects	No	Yes	Yes
2	**(U-2)** Musha and its modern aspects	No	Yes	No

3	**(U-3)** Chromatography	Yes	Yes	Yes
4	**(U-4)** Spectroscopy	Yes	Yes	Yes
5	**(U-5)** Microscopy	Yes	Yes	No
6	**(U-6)** Calibration techniques	Yes	Yes	No
7	**(U-7)** Overview of characterization instruments	Yes	Yes	Yes
(M-6)Animal house and Animal handling technique (Marks: Range 5-15)				
1	**(U-1)** Introduction to animal house management	No	Yes	No
2	**(U-2)** Study of animal behaviour	No	Yes	No
3	**(U-3)** Species-specific handling techniques	No	Yes	No
4	**(U-4)** Animal health and disease prevention	No	Yes	Yes
5	**(U-5)** Animal welfare and ethics	No	Yes	No
(M-7)Classical and Advanced quality control techniques for Ayurveda Formulations (Marks: Range 5-20)				
1	**(U-1)** Quality Control and Quality Assurance	Yes	No	Yes
2	**(U-2)** Classical aspects of the quality control parameter for Ayurvedic formulations	No	Yes	No
3	**(U-3)** Quality Control parameter for solid dosage forms	Yes	Yes	No
4	**(U-4)** Quality Control parameter for semi-solid dosage forms	Yes	Yes	No
5	**(U-5)** Quality Control parameter for liquid and gaseous dosage forms	Yes	Yes	No
(M-8)Nano-science, nano-technology and its application in Ayurveda (Marks: Range 5-20)				
1	**(U-1)** Introduction to Nanotechnology	No	Yes	Yes
2	**(U-2)** Ayurvedic Formulations and Nanotechnology	Yes	Yes	No
3	**(U-3)** Nanocarriers for Ayurvedic Formulations	No	Yes	No
4	**(U-4)** Regulatory Aspects and Safety Concerns	Yes	Yes	No
5	**(U-5)** Recent Advances and Future Directions	No	Yes	No

6 G : Instruction for the paper setting & Blue Print for Summative assessment (University Examination)

Instructions for the paper setting.

1. 100 marks question paper shall contain:-
• Application Based Question: 1 No (carries 20 marks)
• Short Answer Questions: 8 Nos (each question carries 05 marks)
• Long Answer Questions: 4 Nos (each question carries 10 marks)
2. Questions should be drawn based on the table 6F.
3. Marks assigned for the module in 6F should be considered as the maximum marks. No question shall be asked beyond the maximum marks.
4. Refer table 6F before setting the questions. Questions should not be framed on the particular unit if indicated “NO”.
5. There will be a single application-based question (ABQ) worth 20 marks. No other questions should be asked from the same module where the ABQ is framed.
6. Except the module on which ABQ is framed, at least one Short Answer Question should be framed from each module.
7. Long Answer Question should be analytical based structured questions assessing the higher cognitive ability.
8. Use the Blueprint provided in 6G or similar Blueprint created based on instructions 1 to 7

6 H : Distribution of Practical Exam (University Examination)

S.No	Heads	Marks
1	**Major practical** **1) Pharmaceutical preparation (40 Marks)** Pharmaceutical preparation that takes 60-90 minutes. **2) Analytical practical (40 Marks)** An analytical practical that takes 60-90 minutes to perform	80
2	**A) Minor Practical:** **1)** Pharmaceutical preparation that takes less than 30 minutes (25 Marks) **2)** Analytical (Minor analytical practical that takes less than 30 minutes to perform) (25 Marks) **B) Spotting and Identifications** A total of 10 samples are to be identified (Live sample/PowerPoint pictures)-10 marks • Raw materials (metals, minerals, Visha Dravya): 02 • Finished products: 02 (one Rasoushadhi, one Kshthoushadhi) • Manufacturing equipment:02 (end runner, edge runner, granulator, pulverizer, tableting machine etc.) • Analytical equipment: 02 (Tablet hardness tester, tablet disintegration apparatus, tablet friability testing apparatus, digital pH meter, Abbe's refractometer, brix meter, TLC developer, microscopes etc.) • Analytical study reports: 02 (XRD graphs, TLC plates to calculate Rf values, petrological microscopy slides)	60
3	**Viva Exams: General and Structured Viva**	40
4	Practical record book containing 25 practical entries 15 Pharmaceutical (Rasashastra and Bhaishajya Kalpana-10 major and 5 minor practicals) and 10 analytical practicals (5 major and 5 minor practicals) need to be entered into the record book. Practical works are to be selected from each module	10
5	Log book	10
Total Marks		**200**

Reference Books/ Resources

05_Rasashastra

Click here to access References and Resources

Abbreviations

Domain		T L Method		Level	
CK	Cognitive/Knowledge	L	Lecture	K	Know
CC	Cognitive/Comprehension	L&PPT	Lecture with PowerPoint presentation	KH	Knows how
CAP	Cognitive/Application	L&GD	Lecture & Group Discussion	SH	Shows how
CAN	Cognitive/Analysis	L_VC	Lecture with Video clips	D	Does
CS	Cognitive/Synthesis	REC	Recitation		
CE	Cognitive/Evaluation	SY	Symposium		
PSY-SET	Psychomotor/Set	TUT	Tutorial		
PSY-GUD	Psychomotor/Guided response	DIS	Discussions		
PSY-MEC	Psychomotor/Mechanism	BS	Brainstorming		
PSY-ADT	Psychomotor Adaptation	IBL	Inquiry-Based Learning		
PSY-ORG	Psychomotor/Origination	PBL	Problem-Based Learning		
AFT-REC	Affective/ Receiving	CBL	Case-Based Learning		
AFT-RES	Affective/Responding	PrBL	Project-Based Learning		
AFT-VAL	Affective/Valuing	TBL	Team-Based Learning		
AFT-SET	Affective/Organization	TPW	Team Project Work		
AFT-CHR	Affective/ characterization	FC	Flipped Classroom		
		BL	Blended Learning		
		EDU	Edutainment		
		ML	Mobile Learning		
		ECE	Early Clinical Exposure		
		SIM	Simulation		
		RP	Role Plays		
		SDL	Self-directed learning		
		PSM	Problem-Solving Method		
		KL	Kinaesthetic Learning		
		W	Workshops		
		GBL	Game-Based Learning		
		LS	Library Session		
		PL	Peer Learning		
		RLE	Real-Life Experience		
		PER	Presentations		
		D-M	Demonstration on Model		
		PT	Practical		
		X-Ray	X-ray Identification		
		CD	Case Diagnosis		
		LRI	Lab Report Interpretation		

		DA	Drug Analysis		
		D	Demonstration		
		D-BED	Demonstration Bedside		
		DL	Demonstration Lab		
		DG	Demonstration Garden		
		FV	Field Visit		
		JC	Journal Club		
		Mnt	Mentoring		
		PAL	Peer Assisted Learning		
		C_L	Co Learning		
		DSN	Dissection		
		PSN	Prosection		

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