

Appendix-66  
Resolution No. 14-1 (14-1-12)

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LIST OF SKILL ENHANCEMENT COURSES

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## Plant Tissue Culture

### CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Plant Tissue Culture	2	NIL	NIL	2	Class XII	NIL

### Learning Objectives

The learning objectives of this course are as follows:

- To discuss the principle of Plant Tissue Culture
- To understand the importance of Plant Tissue Culture and its applications
- To impart hands-on training on various aspects of Tissue Culture
- To understand the importance of aseptic culturing techniques
- To equip the learner to effectively utilize the techniques in various areas like basic research, genetic transformation studies, secondary metabolite production, pharmaceuticals etc

### Learning Outcomes

By the end of this course, students will

- Get familiarized with aseptic culture techniques
- Be able to prepare stock solutions and media for experimental purposes
- Comprehend different modes of regeneration
- Have understood the micro propagation mechanism and its intricacies.
- Be able to establish a regeneration protocol using different explant material
- Students will be able to appreciate the applications of plant tissue culture in various domains.
- An industrial visit will give them the required exposure for their holistic understanding of the commercial applications and entrepreneurship avenues in this field of plant tissue culture

### Skill development and job opportunities

After completion of this course students may be engaged in following opportunities:

- Entrepreneurship development: Students can start their own Tissue culture set-up
- Tissue culture industry: Individuals can work as researchers, technicians and support staff at tissue culture based industries
- Academia: Individuals can pursue higher education and research opportunities in the field of tissue culture and genetic transformation in universities and research institutions.

# SYLLABUS

60 hours

## Unit 1: Introduction to Plant tissue Culture

8 hours

Introduction to Plant Tissue culture, Terms and definitions, Historical background, laboratory organization: Design and layout for wash area, media preparation, methods of sterilization, transfer area for aseptic manipulations, Culture rooms, and observation/data collection areas.

### Practical:

1. Familiarization with the tissue culture laboratory set-up
2. Familiarization with basic equipment in tissue culture techniques- Autoclave, Laminar Air Flow
3. To understand history, theory and principles of plant tissue culture and concept of cellular totipotency.

## Unit 2: Tissue Culture Media

12 hours

Introduction, Types of Media and its importance; Preparation of stock solutions of macronutrients, micronutrients, PGRs and vitamins. pH and buffers- their significance in media. Plant Growth Regulators: Role of PGRs (auxins, cytokinins, abscissic acid, ethylene and Gibberellins) in plant development

### Practical:

4. Preparation of stock solutions- Macronutrients, Micronutrients and PGRs
5. Preparation of Murashige and Skoogs medium

## Unit 3: Aseptic Techniques

12 hours

Methods of sterilization of equipment's, culture media and explants:-Washing and preparation of glassware's, packing and sterilization, media sterilization, surface sterilization. Precautions to maintain aseptic conditions.

### Practical:

6. Study of methods of sterilization A) Moist heat sterilization B) Dry heat sterilization C) Filter sterilization
7. Sterilization of MS medium
8. Surface sterilization of Explant Material

## Unit 4: Initiation of Cultures

12 hours

Callus Induction and growth parameters, Callus subculture and maintenance, growth measurements, morphogenesis in callus culture – organogenesis, somatic embryogenesis

### Practical:

9. Establishment of callus cultures
10. Establishment of suspension cultures from callus
11. Characterization and sub-culturing of Callus cultures

## Unit 5: Micropopagation

12 hours

Micropopagation – stages, advantages, applications, Somatic embryogenesis-induction, factors, comparison with zygotic embryogenesis.

**Practical:**

12. Establishment of cultures using shoot tip and nodal explants (axillary proliferation)
13. Visit to a Tissue Culture Set-up/ Industry

**Unit 6: *Agrobacterium*-mediated genetic transformation****4 hours**

*Agrobacterium*-the natural plant genetic engineer, understanding the Ti plasmid, selection of recombinants by selectable marker and reporter genes (GUS, luciferase, GFP). Applications.

**Recommended Books:**

1. Bhojwani, S. S., & Razdan, M. K. (1986). *Plant tissue culture: theory and practice*. Elsevier.
2. Razdan, M. K. (2002). *Introduction To Plant Tissue Culture, 2/E*. Oxford and IBH publishing.
3. Gamborg, O., & Phillips, G. C. (Eds.). (2013). *Plant cell, tissue and organ culture: fundamental methods*. Springer Science & Business Media.
4. Taji, A., Dodd, W. A., & Williams, R. R. (1992). *Plant tissue culture practice*. University of New England.
5. Smith, R. H. (2012). *Plant tissue culture: techniques and experiments*. Academic press.

**Examination scheme and mode:**

Evaluation scheme and mode will be as per the guidelines notified by the University of Delhi.

## Applications of Plant Tissue Culture

### CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
<b>Applications of Plant Tissue Culture</b>	<b>2</b>	<b>NIL</b>	<b>NIL</b>	<b>2</b>	<b>Class XII</b>	<b>NIL</b>

### Learning Objectives

The learning objectives of this course are as follows:

- To discuss the principle of Plant Tissue Culture
- To understand the importance of Plant Tissue Culture and its applications
- To impart hands-on training on various aspects of Tissue Culture
- To understand the importance of aseptic culturing techniques
- To equip the learner to effectively utilize the techniques in various areas like basic research, genetic transformation studies, secondary metabolite production, pharmaceuticals etc

### Learning Outcomes

By the end of this course, students will

- Get familiarized with aseptic culture techniques
- Be able to prepare stock solutions and media for experimental purposes
- Have understood the micro propagation mechanism and its intricacies.
- Be able to establish a regeneration protocol using different explant material
- Students will be able to appreciate the applications of plant tissue culture in various domains.
- Able to do mass propagation of true to type and disease free, quality medicinal plants/ornamental plants,/fruit and forest trees through tissue culture

### Skill development and job opportunities

After completion of this course students may be engaged in following opportunities:

- Entrepreneurship development: Students can start their own Tissue culture set-up and do mass propagation of true to type and disease free, quality medicinal plants/ornamental plants,/fruit and forest trees through tissue culture
- Tissue culture industry: Individuals can work as researchers, technicians and support staff at tissue culture based industries
- Academia: Individuals can pursue higher education and research opportunities in the field of tissue culture and genetic transformation in universities and research institutions.

**Micropropagation of medicinally/economically important plants****32 hours**

1. Preparation of stock solutions of macronutrients, micronutrients, vitamins, PGRs
2. Preparation of MS medium fortified with the appropriate PGR for explant culture
3. Preparation of the explant material (shoot tips/nodal segments/leaf discs etc.) - excising the material and surface sterilization
4. Culturing of the explant on MS medium
5. Sub-culturing on maintenance medium / rooting medium
6. Acclimatization of the micropropagated plantlets
7. Transfer of plantlets to pots

**Anther Culture for production of Androgenic haploids****28 hours**

8. Identification of unicellular microspore stage of the anther
9. Media Preparation
10. Anther culture (*Datura innoxia*)
11. Complete regeneration of Haploid Plants

**Recommended Books:**

1. Bhojwani, S. S., & Razdan, M. K. (1986). *Plant tissue culture: theory and practice*. Elsevier.
2. Razdan, M. K. (2002). *Introduction To Plant Tissue Culture, 2/E*. Oxford and IBH publishing.
3. Gamborg, O., & Phillips, G. C. (Eds.). (2013). *Plant cell, tissue and organ culture: fundamental methods*. Springer Science & Business Media.
4. Taji, A., Dodd, W. A., & Williams, R. R. (1992). *Plant tissue culture practice*. University of New England.
5. Smith, R. H. (2012). *Plant tissue culture: techniques and experiments*. Academic press.

**Examination scheme and mode:**

Evaluation scheme and mode will be as per the guidelines notified by the University of Delhi.

## Exploring Medicinal Plants: From Cultivation to Applications

### CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Exploring Medicinal Plants: From Cultivation to Applications	2	0	0	2	Class XII	NIL

#### Learning Objectives:

The learning objectives of this course are as follows:

- To learn various methods of propagating medicinal plants, such as seed germination, stem cuttings, and division.
- To develop the ability to observe and document macroscopic characteristics of herbal materials.
- To learn the microscopic techniques for examination of plant materials.
- To learn the different methods used in extracting bioactive compounds from medicinal plants and the factors to be considered in choosing the appropriate method.
- To conduct phytochemical screening tests to detect the presence of various compounds in medicinal plant extracts.
- To analyze the separated compounds from medicinal plant extracts using Thin Layer Chromatography (TLC).

#### Learning Outcomes:

By studying this course, students will be able to:

- acquire knowledge of proper care and maintenance of medicinal plants during cultivation.
- learn to identify and describe variations in size, color, odor, and surface texture among different plant specimens.
- acquire the skills to observe and count stomata, the tiny openings on leaf surfaces.
- perform commonly used phytochemical screening methods such as the alkaloid test, glycoside test, steroid and triterpenoid test, tannin test, flavonoid test, and phenol test and interpret the results
- use Thin Layer Chromatography (TLC) to separate compounds from a medicinal plant extract and analyze the separated compounds.
- evaluate the current research and developments in the field of medicinal plants.

## **PRACTICAL**

**(60 hours)**

1. Cultivate and monitor medicinal plants to learn propagation techniques.
2. Conduct macroscopic examination of herbal material based on their size, color, odor, and surface texture.
3. Perform microscopic examination to determine stomatal number and index.
4. Conduct microscopic examination to measure the size of calcium oxalate crystals.
5. Determine the moisture content of crude medicinal plant extract.
6. Determine the alcohol-soluble extractive value of medicinal plant extract.
7. Determine the water-soluble extractive value of medicinal plant extract.
8. Perform solvent extraction of bioactive compounds from medicinal plants.
9. Perform phytochemical screening tests for alkaloids, glycosides, tannins, flavonoids, and phenols.
10. Conduct fractionation and purification using chromatographic technique (TLC) to separate compounds from medicinal plant extracts.
11. Visit industries/institutes and prepare a report based on your observations and learning.

### **Essential/ Recommended Readings:**

1. Harborne J. B. (1998) *Phytochemical Methods: A guide to modern techniques for plant analysis*. Publisher: Chapman and Hall.
2. N. Raaman (2006) *Phytochemical Techniques*. Publisher: New India Publishing Agency. ISBN: 9788189422301, 8189422308.
3. Joseph Sherma, Monika Waksmundzka-Hajnos, Teresa Kowalska (2008) *Thin Layer Chromatography in Phytochemistry*. Publisher: CRC Press. ISBN: 9781420046786, 1420046780.
4. Alex Gardner (2014) *DIY Herbal Gardening*. Publisher: CreateSpace Independent Publishing Platform. ISBN: 9781505672473, 1505672473.
5. L. D. Kapoor (2001) *Handbook of Ayurvedic Medicinal Plants*. Publisher: Taylor & Francis. ISBN: 9780849329296, 0849329299.

6. Raphael and Ikan (2013) "Natural Products: A Laboratory Guide" by Publisher: Academic Press ISBN 978-0123705518.
7. Nava and Dayan (2011) Formulation, Development and Production of Herbal Personal Care Products. Publisher: John Wiley and Sons Inc. ISBN-10: 047048408X.
8. Sanjay Sharma (2015) Current status of herbal product: Regulatory overview. J Pharm Bioallied Sci. 7(4): 293–296. doi: 10.4103/0975-7406.168030
9. WHO (1998) Quality control methods for medicinal plant materials. WHO Library Cataloguing-in-Publication Data. ISBN 978 92 4 150073 9.

**Suggestive Reading:**

1. Mohar Singh, Nikhil Malhotra (2021) Himalayan Medicinal Plants: Advances in Botany, Production & Research. Publisher: Elsevier Science, ISBN: 9780128234303, 012823430X.
2. H. S. Puri (2003) Rasayana: Ayurvedic Herbs for Longevity and Rejuvenation (Traditional Herbal Medicines for Modern Times Book 2). Publisher: CRC Press. ISBN-13: 978-0415284899.

**Note:** Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

## DNA barcoding of medicinal/commercially important plants

### CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
DNA barcoding of medicinal/commercially important plants	2	NIL	NIL	2	Class XII	NIL

### Learning Objectives

The Learning Objectives of this course are as follows:

- To give laboratory based first-hand training in various steps involved in DNA barcoding.
- To gain computational laboratory (Bioinformatics) based hands-on-training for DNA barcoding.
- To understand the importance of medicinal/herbal plants in Ayurveda, Unani, Siddha and Homeopathy and other commercially important plants.
- To gather knowledge of the potential adulterants and their harmful effect in medicinal/herbal/commercially important plant formulations as well as herbal trade.
- To gain experience in the management for identifying herbal plant parts vs their potential adulterants.

### Learning Outcomes

By the end of the course, the students will be able to:

- Learn DNA barcoding technology.
- Apply DNA barcoding technique in identification of herbal plant/parts and commercially important plant/parts from their potential adulterants.
- Familiarize with the applications of medicinal/herbal plants in Ayurveda, Unani, Siddha and Homeopathy.
- Identify and understand about potential adulterants of medicinal/herbal plant formulations as well as in herbal trade.

### Skill development and job opportunities

After completion of this course students may be

- Employed in various herbal plant-based companies.
- Employed in various trade companies related to medicinal/herbal plants.
- Setup a laboratory for DNA barcoding and provide the DNA barcode for herbal plants/ commercially important plants and generate employments.

## SYLLABUS

60 hours

### Unit 1: Medicinal/Commercially important plant parts and their potential adulterants. 8 hours

Overview of Medicinal/herbal plants and other commercially important plants and their parts, applications of medicinal plants and plant parts such leaves, bark, flower, roots etc. in Ayurveda, Unani, Siddha and Homeopathy. Adulteration in the herbal formulations and herbal trade, applications of DNA barcoding in distinguishing plants/parts/powder from their potential adulterants.

#### Experiments:

1. Collection of selected medicinally important plant parts/commercially important plant parts and their potential adulterants for DNA isolation.
2. Visit a herbal garden/industry.

### Unit 2: DNA barcoding 36 hours

Overview of DNA barcoding, Plant, chloroplast and mitochondrial genomes and genes, structure of nucleic acids, DNA denaturation and renaturation kinetics, melting temperature ( $T_m$ ) of DNA, primer designing, potential loci for DNA barcoding, DNA sequencing methods.

#### Experiments:

3. DNA isolation of selected medicinal plant part and other commercially important plant parts and their potential adulterants using CTAB and other methods.
4. Qualitative analysis of isolated DNA using Gel electrophoresis.
5. Qualitative ( $A^{260}/A^{280}$ ) and quantitative analysis of DNA using UV-VIS Spectrophotometer.
6. PCR amplification of loci for plant DNA barcoding using specific primers.
7. Analysis of PCR product by Gel electrophoresis.
8. PCR amplified product sequencing.

### Unit 3: Bioinformatics for DNA barcoding 16 hours

Introduction of biological databases, The Barcode of Life Datasystems (BOLD), Medicinal Materials DNA Barcode Database (MMDBD) <https://rdccm.cuhk.edu.hk/mherbsdb/>, Primer designing tools, The Basic Local Alignment Search Tool (BLAST) and its application in DNA barcoding, Sequence alignment and construction of tree.

#### Experiments:

9. Biological databases including DNA barcode databases.
10. Primer designing for DNA barcode using primer 3 plus and other tools.
11. Analysis of DNA barcode sequence using The Basic Local Alignment Search Tool (BLAST).
12. Sequence alignment and construction of tree

#### Recommended Books:

1. W. John Kress and David L. Erickson (2012) DNA Barcodes: Methods and Protocols. Humana Totowa, NJ. <https://doi.org/10.1007/978-1-61779-591-6>.

2. Subrata Trivedi, Hasibur Rehman, Shalini Saggu, ChellasamyPanneerselvam, Sankar K. Ghosh (2020) DNA Barcoding and Molecular Phylogeny, Springer Nature Switzerland AG 2020, Springer Cham. <https://doi.org/10.1007/978-3-030-50075-7>
3. Shaheen, Shabnum/ Ramzan, Sehrish/ Khan, Farah/ Ahmad, Mushtaq (2020) Adulteration in Herbal Drugs: A Burning Issue. ISBN 10: 3030280365, ISBN 13: 9783030280369, Publisher: Springer Nature

**Examination scheme and mode:**

Evaluation scheme and mode will be as per the guidelines notified by the University of Delhi.

## Cultivation of Lac: An eco-friendly multiuse wonder product of nature

### CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
<b>Cultivation of Lac: An eco-friendly multiuse wonder product of nature</b>	<b>2</b>	<b>1</b>	<b>NIL</b>	<b>1</b>	<b>Class XII</b>	<b>NIL</b>

### Learning Objectives

The Learning Objectives of this course are as follows:

- Understanding the basic principles and concepts of lac cultivation, such as the life cycle of lac insects, methods of propagation, and cultivation techniques.
- Acquiring knowledge of the different species of lac insects, their characteristics, and their ecological requirements.
- Learning about the various methods of harvesting lac, including timing, collection, and processing techniques.
- Developing practical skills in the management of lac plantations, such as pest and disease control, irrigation, and fertilization.
- Understanding the ecological and environmental impacts of lac cultivation and its sustainability.

### Learning Outcomes

By the end of the course, the students will be able to:

- understand the basic principles and concepts of lac cultivation, including the life cycle of lac insects, methods of propagation, and cultivation techniques.
- distinguish the different species of lac insects, their characteristics, and their ecological requirements.
- demonstrate proficiency in the methods of harvesting lac, including timing, collection, and processing techniques.
- apply quality control and assurance measures in lac cultivation.
- attain practical skills in the management of lac plantations, such as pest and disease control, irrigation, and fertilization.
- communicate effectively with stakeholders such as farmers, policymakers, and researchers in the field of lac cultivation.
- analyse and evaluate the challenges and opportunities in lac cultivation and proposing innovative solutions.

## Skill development and job opportunities

After completion of this course students may be engaged in following job opportunities:

- Entrepreneurship development: Students can start their own entrepreneurship of scientific lac cultivation.
- Lac cultivation and processing industry: Individuals can work in the lac cultivation and processing industry as plantation managers, quality control supervisors, production supervisors, etc.
- NGOs and development agencies: Individuals can work with NGOs and development agencies to promote sustainable lac cultivation practices and provide technical support to small-scale lac farmers.
- Government agencies: Individuals can work with government agencies involved in the promotion and regulation of the lac cultivation industry.
- Academia: Individuals can pursue higher education and research opportunities in the field of lac cultivation in particular and economically important trans-kingdom interactions in general in universities and research institutions.

## SYLLABUS

### Unit 1: Lac: Composition and their applications 2 hours

Historical introduction of lac, Types of lac and its composition, industrial applications of lac viz. resin, dye, wax, various chemicals of lac cultivation, Socioeconomic aspects of lac.

### Unit 2: Lac production: multiple partners involved and their role 5 hours

Major and minor lac host plants, Raising major lac host plantations of *Schleichera oleosa*, *Butea monosperma* and *Ziziphus mauritiana*, Selection of suitable host plant, Raising plantations of bushy lac host taxa namely, *Flemingia* sp. and *Calliandra* sp. for intensive lac cultivation, Pruning management of host plants, Integrated nutrient management of host plants. Morphology and lifecycle of lac insect, Crop cycle on host plant, multiparter interactions involving plant host-lac insect- endosymbiont and their role, implications of endosymbionts in lac production.

### Practical: 12 hours

1. How to select suitable lac host plant
2. Scientific pruning techniques of lac host plants
3. Methods and techniques of nutrient management of host plants
4. Study of morphology and life stages of lac insect
5. Crop cycles of lac on different host plants

### Unit 3: Pests and diseases in lac ecosystem and their management 1 hours

Pests and diseases of lac host plants and lac insects; pest management in lac.

### Practical: 4 hours

6. Identification of lac insect pests and diseases
7. Techniques of pest management in lac

#### **Unit 4: Broodlac and inoculation management**

**2 hours**

Selection, procurement, storing and transport of brood lac, brood Lac Inoculation Methods and inoculation management.

#### **Practical:**

**4 hours**

8. Methods of determination of brood lac maturity
9. Scientific Brood Lac Inoculation Methods

#### **Unit 5: Scientific lac production methods**

**4 hours**

Rangini lac production on *Butea monosperma*, Rangini lac production on *Ziziphus mauritiana*, Kusmi lac production on *Schleichera oleosa*, Winter Kusmi lac production on *Ziziphus mauritiana*, Coupe system of lac cultivation, Utilizing multiple lac hosts through coupe system, Intensive lac production on bushy lac host *Flemingia* sp. and *Calliandra* sp., Lac integrated farming system, Alternation of conventional host for sustainable brood lac quality.

#### **Practical:**

**8 hours**

10. Designing of coupe system of lac cultivation
11. How to formulate lac integrated farming system
  - Students visit to an Institute/Field and Prepare a report.

#### **Unit 6: Harvesting and post-harvest management of lac**

**1 hours**

Harvesting of lac, harvest management of lac.

#### **Practical:**

**2 hours**

12. How to harvest lac and harvesting tools
13. Methods of post-harvest management of lac

#### **Recommended Books:**

1. Sharma, K.K. & Ramani, R. (Eds.). (2011). *Recent advances in lac culture*. ICAR-IINRG publications.
2. Mathur, P. N., & Lal, S. B. (1993). *Lac Production, Processing and Marketing*. Indian Council of Agricultural Research.
3. Agarwal, J. P., & Gupta, R. K. (2006). *Lac Culture in India*. Daya Publishing House.
4. Agrawal, K. C., & Bhatnagar, S. K. (2009). *Lac Insect and Lac Culture*. Westville Publishing House.
5. Mattu, V. K., & Mathur, P. C. (2005). *Handbook of Lac Production Technology*. Indian Lac Research Institute.
6. Roy, D., & Dasgupta, P. (Eds.). (2016). *Lac Insect (Kerria lacca) Cultivation, Processing and Uses*. CRC Press.

**Examination scheme and mode:**

Evaluation scheme and mode will be as per the guidelines notified by the University of Delhi.

## Lac Characterization and Processing

### CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
<b>Lac Characterization and Processing</b>	<b>2</b>	<b>NIL</b>	<b>NIL</b>	<b>2</b>	<b>Class XII</b>	<b>NIL</b>

### Learning Objectives

This course's Learning Objectives are as follows:

- To provide first-hand laboratory training in the various steps involved lac processing.
- To gain laboratory experience in characterization of various types of lac.
- To develop skills in isolating lac wax and lac dye.
- To acquire practical laboratory experience characterising these substances.
- To gain the knowledge of industrial applications lac.
- To give students hands-on experience in the lab isolating a high-value product, aleuritic acid.

### Learning Outcomes

By the end of this course, students will

- Be familiar with various steps of lac processing.
- Learn how to characterise different kinds of lac in the lab.
- Be trained in separation of lac wax and lac dye.
- Gain hands-on experience in characterising these compounds in the lab.
- Have real-world laboratory experience in separating a valuable compound (aleuritic acid).

### Skill development and job opportunities

Students who successfully complete this course may be qualified for the following positions:

- Students can enhance their entrepreneurial skills by starting their own scientific lac processing unit and lac export unit.
- Quality control supervisors, production supervisors, etc. are only few of the jobs available in the lac processing business.
- Students can collaborate with non-governmental organisations (NGOs) and development agencies (DAs) to disseminate information on sustainable lac farming practises and offer assistance to local lac farmers.

- Employment opportunities exist in government entities that promote and regulate the lac sector.

## SYLLABUS

### Practical

**60 hours**

1. Collection of lac stick from the host plants and scrapping of stick lac
2. Primary processing of stick lac to seed lac
3. Processing of stick lac to seed lac
4. Characterization of the seed lac
5. Processing of seed lac to button lac/ shellac
6. Characterization of button lac /shellac
7. Extraction and purification of lac dye
8. Estimation of lac dye content and its characterization
9. Extraction of lac wax and its characterization
10. Isolation of Aleuritic acid from lac, value added lac product.
11. Project: Applications, Industries, Export and Marketing strategies of lac
12. Industry/ Institute Visit and prepare a report.

### Recommended Books:

1. Bangali babu and D.N. Goswami (2010) Processing, chemistry and applications of lac. ICAR publication. ISBN 978-81-7164-065-2.
2. Natural material and products from insects: Chemistry and applications (2020) ed. Dhiraj Kumar and Mohammad Shahid. Springer. ISBN 978-3-030-36610-0
3. Y. Sankaranarayanan (1968) Shellac: Modifications and Compositions. Indian Lac Research Institute, Namkum, Ranchi, India.

### Examination scheme and mode:

Evaluation scheme and mode will be as per the guidelines notified by the University of Delhi.

## SKILL ENHANCEMENT ELECTIVE (SEC) COURSES

Drosophila and Zebrafish model organism in Biological Studies

(CREDITS: PRACTICAL-2)

Course Title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical / Practice		
Drosophila and Zebrafish model organism in Biological studies	2			2	12th pass with Biology	NIL

### LEARNING OBJECTIVES:

The course will help students to understand the skills required to work with model organisms. To learn the use of model organisms such as Drosophila and Zebrafish in understanding the Biological concepts and processes and its applications in biomedical and Pharma research and industry. The specific objectives of the course are:

- To learn basic requirements for setting up Drosophila and Zebrafish lab.
- To learn to handle, breed and maintain Drosophila and Zebrafish model organism.
- To learn more about biological processes, genetics, drug discovery, toxicology and human diseases using these model organisms.
- To learn to design experiments using these model organisms.

### COURSE OUTCOMES

Upon completion of this course students will be skill trained in Drosophila and Zebrafish model system and its applications in Bioscience education, research and Pharmacology and Biotechnology industry.

- Will be able to set up Drosophila and zebrafish lab.
- Will be skilled trained in maintenance of Drosophila stocks and propagation and zebrafish husbandary.

- Have knowledge of designing experiments in genetics, toxicology, behavioural and human disease modelling using these model systems.
- Analyze and interpret the data collected in the laboratory experiments.

**Practical (2 credits)**

**Total 15 weeks**

**Total hours: 60**

**Unit I: Introduction to Drosophila model system**

**(4 weeks)**

- Introduction to different model organisms, advantage and disadvantage of using various model organisms, animal ethics.
- Study of life cycle and developmental stages of *Drosophila melanogaster*
- Male female differentiation
- Study of various mutants
- TLC of eye pigments
- Study of polytene chromosome in *Drosophila*

**Unit II: Mendelian and non Mendelian Genetics**

**(3 weeks)**

*Drosophila* as a model organism to study different principles of genetics

- Collection of virgin fly
- Setting up of crosses in *Drosophila*
- Scoring of F1 and F2 population, chi-square test

**Unit III: Introduction to Zebrafish model system**

**(3 weeks)**

Advantages of zebrafish model organism. Basic requirement to set up zebrafish lab. Zebrafish husbandry. Study development stages and developmental phenotypic end points.

- Handling zebrafish, identify male and female zebrafish, and breeding setup.
- To prepare Zebrafish feed and culture Pramecium and Artemia.
- Egg collection and study of developmental stages starting from the zygote - cleavage - blastula - gastrula - segmentation, pharyngula, hatching and early larval development.

#### **Unit IV: Zebrafish as a research and education model (5 weeks)**

Importance of zebrafish as a versatile research and education model. Genetic and morphological homology with humans.

- Query based experimental design using zebrafish model system.
- Perform Toxicological assays.
- Perform Behavioral assays.
- Create Human disease models in zebrafish
- Use of transgenic reporter lines.

#### **Essential Reading**

- Lakhotia S. C. and Ranganath H. A. (2021) Experiments with Drosophila for Biology Courses, Indian Academy of Sciences, Bengaluru, India, ISBN: 978-81-950664-2-1
- Sunita Joshi, S. and Dhamija, N. (2016) Rediscovering Genetics, IK International, 1st edition, ISBN: 9789384588984
- Westerfield, M. (2000). The Zebrafish book. A guide for laboratory use of Zebrafish (Danio rerio). 4th ed., Univ. of Oregon Press, Eugene. USA
- Mudgal, P., Bhasin, C., Joshi A., Gupta, R. (2021) Zebrafish, a versatile learning tool. Resonance: Journal of science education, 26(11), 1499-1521

#### **Suggested Readings**

- Kimmel, C.B., Ballard, W.W., Kimmel, S.R., Ullmann, B. and Schilling, T.F. (1995), Stages of embryonic development of the zebrafish. Dev. Dyn., 203: 253-310. <https://doi.org/10.1002/aja.1002030302>
- zfin.org

## Isolation and characterisation of Plasmid DNA

### CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Isolation and characterisation of Plasmid DNA	2		NIL	2	Class XII	NIL

#### Learning Objectives:

Students of this course should be able to learn:

- Fundamentals of nucleic acid molecules.
- Handling and growing of non-pathogenic bacterial strains of E. coli for recombinant DNA work.
- Basics of Plasmids and its isolation from the culture using different methods.
- Basics of electrophoresis techniques employed for the separation of Nucleic acid molecules.

#### Learning Outcomes:

At the end of this course, students should be able to learn and perform in Hands-on mode:

- Fundamentals of operation of different types of centrifuges, Electrophoresis, Spectrophotometer and about Good Laboratory Practices and working environment of Genomic Laboratory.
- Use of micropipettes, preparation of solutions, media and sterilisation.
- Basics of different types of nucleic acids
- Handle bacterial strains of E. coli for the isolation of single colony and growth in liquid media.
- Isolate Plasmids using different methods and characterise by agarose gel electrophoresis.

#### Unit 1: Basic microbiological techniques for culturing and growth of bacteria (16 hours)

Information on general and molecular biology laboratory practices including Biosafety, Information about important strains E. coli used in recombinant DNA work; chemical composition of media used for growing E. coli both on solid surface and in liquid culture.

##### Practical:

- 1.1 Pipetting using macro and micro pipettes, macro and micro weighing, measurement of pH, preparation of buffers and other solutions.
- 1.2 Preparation of solid and liquid media for growing E. coli, sterilization using autoclave and use of Biosafety cabinet.

1.3 Pouring of Petri plates with solid agar media and streaking of E. coli to isolate single colonies.

1.4 Inoculation of E. coli from streaked plate to obtain grown culture.

## **Unit 2: Isolation of Plasmids and their characterisation**

**(32 hours)**

Definition and Features of a plasmid, Comparative description of different plasmids in respect of copy number, compatibility and antibiotics resistance markers, various plasmid isolation methods, Gel electrophoresis for nucleic acids.

### **Practical:**

2.1 Isolation of plasmid DNA using the available culture by alkaline lysis method

2.2 Preparation of agarose gel, electrophoresis and visualization of plasmid DNA on the gel using transilluminator, characterisation of different forms of plasmid DNA.

## **Unit 3: Isolation and characterization of plasmid DNA by use of column**

**(16 hours)**

Technology for isolation of nucleic acids using column, principle of binding and elution of DNA from column. Chromatographic techniques for isolation of nucleic acids.

### **Practical:**

3.1 Isolation of plasmid DNA using the self-grown culture by spin column method.

3.2 Preparation of agarose gel, electrophoresis and visualization of plasmid DNA on the gel, characterisation of different forms of plasmid DNA.

3.3 Documentation of the gel using gel documentation system.

### **Essential/ Recommended Readings:**

1. Sambrook J, Fritsch EF & Maniatis T. Molecular Cloning. A laboratory Manual. 3rd Edition. Cold Spring Harbor Laboratory Press. New York.

### **Suggestive Reading:**

1. Ausubel FM, Brent R, Kingston RE, Moore DD, Seidman JG, Smith JA, Struhl K. Current Protocols in Molecular Biology. (eds.) John Wiley & Sons, Inc. New York.

**Note:** Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

## Isolation, characterisation and Quality Check of Genomic DNA

### CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Isolation, characterisation and Quality Check of Genomic DNA	2	NIL	NIL	2	Class XII	NIL

#### Learning Objectives:

Students of this course should be able to learn:

- Basics of Genomic DNA, need for isolation of genomic DNA and different methods for its isolation.
- Problems due to RNA contamination in further use of genomic DNA and Methods for elimination of contaminating RNA.
- Use of electrophoresis and spectrophotometric techniques for the quantification and quality check of DNA

#### Learning Outcomes:

At the end of this course, students should be able to learn and perform in Hands-on mode:

- Different methods for isolation of genomic DNA from prokaryotic and eukaryotic cells.
- Handle prokaryotic and eukaryotic cell samples.
- Isolate Genomic DNA and characterise by agarose gel electrophoresis
- Remove RNA contamination from genomic DNA
- Quantify and check quality of DNA by spectrophotometric technique.

#### Unit 1: Isolation of Genomic DNA from prokaryotic cell

**(24 hours)**

Information on differences between eukaryotic and prokaryotic cells wrt lysis of cells and extraction of DNA, different methods used for isolation of genomic DNA; different kinds of samples as starting material for extraction of DNA.

#### Practical: Isolation of Genomic DNA

- 1.1 Composition and preparation of required reagents.
- 1.2 Isolation of genomic DNA from E. coli culture.

### 1.3. Gel electrophoresis for isolated genomic DNA

## **Unit 2: Isolation of Genomic DNA from eukaryotic cell**

**(24 hours)**

Different methods used for isolation of genomic DNA; different kinds of samples as starting material for extraction of DNA.

### **Practical: Isolation of Genomic DNA**

2.1 Composition and preparation of required reagents.

2.2 Isolation of genomic DNA from Blood sample etc.

2.3. Gel electrophoresis for isolated genomic DNA

## **Unit 3: Elimination of RNA contamination followed by quantitation and quality check (16 hours)**

Problems due to RNA contamination in further use of genomic DNA in different applications, various methods for removal of RNA from genomic DNA preparation, Gel electrophoresis and UV-visible spectrophotometry-based quantification and quality check of DNA. Other automated systems of quality check for nucleic acids.

### **Practical Session:**

3.1 Removal of RNA from genomic DNA preparation

3.2 Gel electrophoresis of the genomic DNA preparation

3.3 Spectrophotometry-based quantification and quality check of DNA

### **Essential/ Recommended Readings:**

1. Sambrook J, Fritsch EF & Maniatis T. Molecular Cloning. A laboratory Manual. 3rd Edition. Cold Spring Harbor Laboratory Press. New York.
2. Ausubel FM, Brent R, Kingston RE, Moore DD, Seidman JG, Smith JA, Struhl K. Current Protocols in Molecular Biology. (eds.) John Wiley & Sons, Inc. New York.

### **Suggestive Reading:**

1. Alberts, B., Bray, D, Lewis, J., et al. The Molecular Biology of the Cell. Garland Publishing, New York.

**Note:** Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

## Polymerase chain reaction (PCR) and its applications

### CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Polymerase chain reaction (PCR) and its applications	2	NIL	NIL	2	Class XII	NIL

#### Learning Objectives:

Students of this course should be able to learn:

- Concept of PCR and different types of PCR.
- Principles of oligonucleotide (primer) synthesis and purification
- Designing of Primers for PCR.
- Hands-on setting up of PCR reaction and analysis of the amplified product.
- Purification of PCR product

#### Learning Outcomes:

At the end of this course, students should be able to learn and perform:

- PCR and its application for research.
- Designing of Primers for PCR and obtaining Primers as synthetic oligonucleotides of appropriate quality from commercial sources.
- Designing conditions for setting up a PCR and perform analysis of amplified DNA.
- Purification of PCR-amplified DNA using columns for downstream application.

#### Unit 1 Concept of PCR and different types of PCR with some applications (12 hours)

Principle of Polymerase Chain reaction and amplification process, use of thermocycler and other equipment required to perform PCR and analysis of amplified DNA, use of synthetic oligonucleotide as primers in PCR.

#### Practical:

1.1 Demonstration of thermocycler, setting of conditions for a PCR for different types of templates and understanding the reagents used in PCR.

1.2 Chemistry of oligonucleotide synthesis and purification techniques, designing the Primer sequence for PCR through the use of online free software. Handling and storage of Primers for long term use.

## **Unit 2: PCR reaction for amplification and analysis of the amplified product (32 hours)**

Designing and Setting up PCR, understanding about different reaction components, use of different types of polymerases for different length of amplicons, concept of fidelity and processivity of polymerases.

### **Practical:**

2.1 Demonstration of a PCR to explain all the steps required for setting up the reaction and analysis of the amplified product.

2.2 Designing and setting up a PCR individually to amplify a 500 bp product and analysis of the amplified product using agarose gel electrophoresis.

2.3. Designing and setting up a PCR individually to amplify a 1500 bp product and analysis of the amplified product using agarose gel electrophoresis.

## **Unit 3: Purification of PCR-amplified DNA and downstream applications (20 hours)**

Purpose of purification of PCR product, methods for purification, downstream applications of PCR products.

### **Practical:**

3.1 Purification of PCR products by spin column method

3.2 Agarose gel electrophoresis and visualization of the product after purification.

### **Essential/ Recommended Readings:**

1. Sambrook J, Fritsch EF & Maniatis T. Molecular Cloning. A laboratory Manual. 3rd Edition. Cold Spring Harbor Laboratory Press. New York.
2. Ausubel FM, Brent R, Kingston RE, Moore DD, Seidman JG, Smith JA, Struhl K. Current Protocols in Molecular Biology. (eds.) John Wiley & Sons, Inc. New York.

### **Suggestive Reading:**

1. Alberts, B., Bray, D, Lewis, J., et al. The Molecular Biology of the Cell. Garland Publishing, New York.

**Note:** Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

## CAD (Computer aided Jewellery Design-I) Coral Draw

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
CAD (Computer aided Jewellery Design-I)	2	0	0	2	Class XII	NIL

### Learning Objective:

**This course will enable the students to -**

- Acquire proficiency in computer application in jewellery designing.
- Introduction about various tools used in coral draw.
- Prepare computer sketches on specified themes.

### Learning outcomes

The students will be able to –

- Demonstrate knowledge of technical. Specification using appropriate Coral Draw software
- Competency of modelling & product presentation on this Software.
- Creating Jewellery Designs using this software.
- Develop digital portfolio & show reel.

### UNIT 1

Introduction to Corel Draw, Basic Tools in Coral Draw, Various Shapes.

### UNIT 2

Drawing & Shaping Objects, Transforming Objects, Corel Draw Effects, Working with Layer, Design Development, Colour Fills and Outlines Tools, Gold Colour Creation.

### UNIT 3

Motif Development to Make jewellery, Interactive Blend Tool, Diamond with Measurement, Stone Setting, Creating Shapes & Painting

## **UNIT 4**

Theme Based Designing-Earrings, Bracelets, Pendants, Ring, Brooch, Necklace

## **UNIT 5**

Special Effects to Images-Backgrounds, Text Option, Detail Of jewellery Piece

## **TEXT BOOKS/WEBSITE**

- <http://product.corel.com/help/CorelDRAW/540229932/Main/EN/UserGuide/CorelDRAWX7.pdf>
- <http://howto.corel.com/>
- [http://www.insidegraphics.com/corel\\_basics/corel\\_draw\\_guidelines.asp](http://www.insidegraphics.com/corel_basics/corel_draw_guidelines.asp)
- An Introduction to computer aided design for jewellery casting by Lucian Taylor
- Corel Draw 11: the official guide dream tech publishers

## CAD (Computer aided Jewellery Design-II) Coral Draw

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
CAD (Computer aided Jewellery Design-II)	2	0	0	2	Class XII	NIL

### Learning Objectives:

This course will enable the students to –

- Learn how to convert Manual Design to Digital Form with Exact Measurements using Corel.
- Learn about creating variation and Orthography in this module.
- Additionally, learn how to apply the 3D rendering Effect in Photoshop

### Learning Outcomes:

Students will learn the basics of jewellery Design Software “Coral Draw”.

- Each section will include a thorough examination of 2D design research conducted with Coral Draw.
- By visiting PCSIR and PGJDC, students will gain knowledge of the CAM manufacturing process.
- Examining various perspectives regarding jewellery, including traditional and contemporary perspectives.
- Learning to create two-dimensional illustrations.

Each endeavor requires research and documentation.

- Submissions: PowerPoint presentation with digital prints.

### UNIT 1

Corel Draw, Photoshop, Creating & Editing 3-D Images.

## **UNIT 2**

Introduction to Corel Draw, Drawing & Shaping Objects, Transforming Objects, Corel Draw Effects.

## **UNIT 3**

Working with Layer, Creating Shapes & Painting, Concept of Orthography by Corel.

## **UNIT 4**

Gold Color Creation, Stone Setting.

## **UNIT 5**

Color & Element Variation, 3D Rendering.

## **TEXT BOOKS/WEBSITE**

- <http://product.corel.com/help/CorelDRAW/540229932/Main/EN/UserGuide/CorelDRAWX7.pdf>
- <http://howto.corel.com/>
- [http://www.insidegraphics.com/corel\\_basics/corel\\_draw\\_guidelines.asp](http://www.insidegraphics.com/corel_basics/corel_draw_guidelines.asp)
- An Introduction to computer aided design for jewellery casting by Lucian Taylor
- Corel Draw 11: the official guide dream tech publishers

## CAD (Computer aided Jewellery Design-III) RHINO

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
CAD (Computer aided Jewellery Design-III)  RHINO	2	0	0	2	Class XII	NIL

### Learning Objectives:

Students will learn the advance level of tools by learning Jewelry Design Software “RHINO”

- Each content will cover the meticulous research about the 3D design by using Rhino
- Students will learn the process of manufacturing through CAM by visiting PCSIR and PGJDC
- Investigating different perceptions about jewellery including traditional and contemporary
- Learning how to develop 3D perspectives and execution of CAD.
- Research and documentation of each project with the final 3D processing
- The Final outcome in result of CAM.

### Learning Outcomes:

#### At the end students will:

- Understand use of specialist 3D technology and processes in chosen pathway
- Be able to apply understanding of specialist processes to produce design work
- Be able to produce outcomes using specialist 3D technology and processes
- Be able to evaluate own work

## UNIT 1

Introduction To Rhino, Surfacing, Stone Setting, Texture

## **UNIT 2**

Text Surfacing, Scooping, Creating Gallery & J-Bag,

## **UNIT 3**

Gold Weight Controlling,

## **UNIT 4**

Creating Human Figure in Rhino

## **UNIT 5**

Converting In to Dye Format, Casting Through CAD-CAM Process.

## **TEXT BOOKS/WEBSITE**

- Rhino for Jewelry Paperback – 2 Jul 2010 by Dana Buscaglia (Author)

## CAD (Computer aided Jewellery Design-IV) RHINO

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre- requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
<b>CAD (Computer aided Jewellery Design-IV)  RHINO</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>Class XII</b>	<b>NIL</b>

### Learning Objectives:

Each content will cover the meticulous research about the 3D design by using “RHINO”

- Students will learn the process of manufacturing through CAM by visiting PCSIR and PGJDC
- Investigating different perceptions about jewellery including traditional and contemporary
- Learning how to develop 2D drawings in multiple 3D perspectives and execution of CAD
- Research and documentation of each project with the final 3D processing
- The Final outcome in result of CAM

### Learning Outcomes:

At the end students will be:

Able to develop 3D Design with Rendering.

Able to develop exact setting in Design.

Able to Gold Controlling.

Able to Create Master Model & Rubber Dye to Create Different Joints for flexibility.

## **UNIT 1**

Concept Of 3D & 3Design, Concept of Surfacing,

## **UNIT 2**

**Stone Setting, Texture Concept, Text Surfacing**

## **UNIT 3**

Stone Setting, Texture Concept, Text Surfacing, Concept of Scooping, Concept of Beezal Creating

## **UNIT 4**

Concept of Gold Weight Controlling, Concept of Human Design Creating by Shaper

## **UNIT 5**

Real 3D Rendering, Video Creating, Concept of Converting in Dye Formatting,  
Concept Of Casting Through CAD-CAM Process.

## **TEXT BOOKS**

- Cadd3designhelp/Guide/Tutorial



# **UNDERGRADUATE CURRICULUM FRAMEWORK – 2022**

**based on**

**NATIONAL EDUCATION POLICY 2020**

**B. A. (Hons.) I Music - Hindustani Music  
(Vocal/Instrumental -  
Sitar/Sarod/Guitar/Violin/Santoor)**

**FOUR-YEAR FULL TIME PROGRAMME**

**SEC Syllabus**

**Department of Music  
Faculty of Music &  
Fine Arts University  
of Delhi**

**B.A. (Hons.) I Music - Hindustani Music**  
**Vocal/Instrumental (Sitar/Sarod/Guitar/Violin/Santoor)**

**Syllabus for SEC Papers**

**SEMESTER - II**

**SEC – : HARMONIUM - II**

Course Title & Code	Credits	Credit distribution of the course			Eligibility Criteria	Pre-requisite of the course
		L	T	P		
Study of Harmonium (201)	2	1	0	1	Class XII Pass	Nil

**Learning Objectives:**

- To throw light on the structure, origin and parts of Harmonium.
- To discuss the notation system
- To understand the different ragas and talas.

**Learning Outcomes:**

- Students learn the origin and initial form of Harmonium.
- Students are able to demonstrate the various talas and their layakaries.
- Students are able to understand the notation system.

**Unit – I (4 weeks)**

Study of the origin of Harmonium.

**Unit – II (4 weeks)**

Study of the structure of the Harmonium.

**Unit – III (2 weeks)**

Use of Harmonium in various forms of Indian music.

#### **Unit – IV (2 weeks)**

Writing notation of compositions in prescribed ragas

#### **Unit V (2 weeks)**

Writing notation of Talas with Thah, Dugun, Tigun and Chaugun – Dadra

#### **Unit VI (2 weeks)**

Theoretical knowledge of the prescribed ragas

#### **Suggestive readings:**

1. Bhartiya Sangeet Ka Itihasa – Dr. Sharad Chandra Shridhar. Paranjape :- Madhye Pradesh Hindi Granth Academy , Bhopal, 2<sup>nd</sup> Edition: 1985
2. Bhartiye Sangeet Ka Itihasa – Dr. Thakur Jaidev Singh:- Sangeet Research, Kolkatta, Editor: Premlata Sharma, 1<sup>st</sup> Edition: 1994
3. Sangeet Bodh : Dr. Sharad Chandra Shridhar Paranjape, Madhye Pradesh, Hindi Academy, Bhopal, 1<sup>st</sup> Edition: 1972
4. Kramik Pustak Malika Part- II , III & IV: - V.N Bhatkhande, Sangeet Karyalaya, Hathras, Jan-2008, Editor: Dr. Laxminarayan Garg
5. Harmonium: Vividh Aayam: Dr. Vinay Kumar Mishra :- Akanksha Publication, New Delhi, 1<sup>st</sup> Editon: 2015
6. Taal Parichay Part III, Girish Chandra Srivastava, Rubi Prakashan , New Delhi, 2<sup>nd</sup> Editon: June-2002

## **SEC – Stage Performance and Viva Voce**

### **Learning Objectives:**

- To continue to focus on the basics of playing the Harmonium.
- To encourage the student to attempt to improvise while playing the instrument
- To focus on his learning of newer talas
- To further his training in performance, with other basic ragas as prescribed

### **Learning Outcomes:**

- The basics of the student will get further strengthened
- The student will start to gain self-belief and make attempts to improvise while performing a raga.
- The student will begin to gain some command over increasingly complex talas
- With other basic ragas, the student will understand how to use the flat and sharp notes in ragas with varied tonal phrases
- He will gain confidence of playing with the Tabla

### **Syllabus:**

#### **Prescribed ragas:**

1. Bhairav
2. Bhupali
3. Kafi

#### **Unit – I (2 weeks)**

Five alankars to be presented in the prescribed ragas.

#### **Unit -II (2 weeks)**

One Sargam Geet each in the prescribed ragas

#### **Unit -III (2 weeks)**

One Lakshan Geet each in the prescribed ragas

#### **Unit- IV (2 weeks)**

Two Drut Khyals with elaborations in any of the prescribed ragas

#### **Unit - V (2 weeks)**

Ability to play a Dhun in raga Kafi

#### **Unit - VI (2 weeks)**

In-depth knowledge of the prescribed ragas

#### **Unit - VII (2 weeks)**

Knowledge and demonstration of the following tala with dugun, tigan and chaugun - Dadra

#### **Unit- VIII (2 weeks)**

Basic knowledge of Harmonium and its various parts

#### **Suggestive readings:**

- Bhartiya Sangeet Ka Itihasa – Dr. Sharad Chandra Shridhar. Paranjape :- Madhye Pradesh Hindi Granth Acadamy, Bhopal, 2<sup>nd</sup> Edition: 1985
- Bhartiye Sangeet Ka Itihasa – Dr. Thakur Jaidev Singh:- Sangeet Research, Kolkatta, Editor: Premlata Sharma, 1<sup>st</sup> Edition: 1994
- Sangeet Bodh : Dr. Sharad Chandra Shridhar Paranjape, Madhye Pradesh, Hindi Academy, Bhopal, 1<sup>st</sup> Edition: 1972
- Kramik Pustak Malika Part- II , III & IV: - V.N Bhatkhande, Sangeet Karyalaya, Hathras, Jan-2008, Editor: Dr. Laxminarayan Garg
- Harmonium: Vividh Aayam: Dr. Vinay Kumar Mishra :- Akanksha Publication, New Delhi, 1<sup>st</sup> Editon: 2015
- Taal Parichay Part III, Girish Chandra Srivastava, Rubi Prakashan , New Delhi, 2<sup>nd</sup> Edition: June-2002

# Department of Sanskrit UNIVERSITY OF DELHI

## UNDERGRADUATE PROGRAMES OF STUDY

### SKILL ENHANCEMENT COURSES (SEC)

#### SEMESTER -III



## SEC-1: Reading & Writing Skills in Brahmi Scripts

### Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Prerequisite of the course
		Lecture	Tutorial	Practical/ Practice		
Reading & Writing Skills in Brahmi Scripts	02	1		1	Class XII Pass	Nil

### Learning Objectives

Course of Epigraphy & script is an inter-disciplinary course within Sanskrit. The Brahmi script used in Indian inscriptions was developed into all modern Indian scripts like Tamil, Malayalam, Oriya, Bangali, Gurmukhi, among others. Study of inscriptions written mostly in Sanskrit languages, helps in preparation of ancient history.

### Learning outcomes

This course is helpful for students to investigate how actually Brahmi script developed and transformed into a wide variety at a time when mode and means of transport and communication were extremely slow. After acquiring knowledge of its variation, it will certainly be helpful in ascertaining to understand period of an inscription whose date is uncertain. This course is highly helpful for the students willing to adopt archaeology as their occupation with a background of Sanskrit.

### Detailed Syllabus

#### Unit I

##### Introduction to Brahmi Script

Introduction to Brahmi Script (Origin and Development)  
Early Brahmi alphabet Asokan period

#### Unit II

##### Translation

Translation to variations up to 4th century C.E.  
Reading Asokan Inscriptions

### Essential/recommended readings

1. Dani, A.H.: Indian Paleography, 1963
2. Upasak, C.S.: History & Paleography of Mauryan Brahmi Script, 1960
3. Verma, T.P.: Paleography of Brahmi script in North India, 1971
4. ओझा, गौ. ही. भारतीय प्राचीन प्रमाला
5. पाण्डेय, राजबली अशोक के आभलेख 1967

**Examination scheme and mode: Subject to directions from the Examination Branch/University of Delhi from time to time**

## SEC-2: Acting Skills in Sanskrit Dramaturgy

### Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Prerequisite of the course
		Lecture	Tutorial	Practical/ Practice		
Acting Skills in Sanskrit Dramaturgy	02	1		1	Class XII Pass	Nil

### Learning Objectives

The idea of acting has its connection with the practical aspects of the play related literary works. This paper aims at teaching the fundamental notions that go with the performance of a play on the stage. The practice of performance of drama can further enhance performance's hidden and natural talent. This paper deals with the rules of performance of play (acting) and aims at sharpening the dramatic talent of the students.

### Learning outcomes

After the completion of this course the students will be able to know about the various aspects of performance of the dramatic arts in the Indian context. The course will make the students inspired and encouraged for performing the dramatic arts on the stage.

### Detailed Syllabus

#### Unit I

##### Some Theatrical rules

Competent person for Acting.

Nāṭya-prayoktās-gaṇa (Members of theatrical group) : sūtradhāra nāṭyakāra, naṭa, kuśīlava, bharata, nartaka, vidūṣaka etc.

General and particular rules of assigning the roles.

#### Unit II

##### Types of Abhinaya

Lokadharmī and Nāṭyadharmī Abhinaya.

Types of four Abhinayas with various forms.

Analysis of acting in the context of Abhijñānaśākuntalam

### Essential/recommended readings

1. Ghosh, M.M.: *Nāṭyaśāstra*, Bharata, vol-1, Manisha Granthalaya, Calcutta, 1967.  
Hass, *The Daśarūpaka : A Treatise on Hindu Dramaturgy*, Columbia University, New York, 1912.

2. Adyarangachrya, *Introduction to Bharata's Nāṭyaśāstra*, Popular Prakashan Bombay, 1966.
3. मीरा द्विवेदी, *संस्कृत नाट्य : अभिनय एवं पटकथा लेखन*, परिमल पब्लिकेशन्स, दिल्ली, 2018
4. द्विवेदी, हजारी प्रसाद, *नाट्यशास्त्र की भारतीय परम्परा और दशरूपक*, राजकमल प्रकाशन दिल्ली, 1963.

**Additional Resources:**

1. सीताराम, झा, *नाटक और रंगमंच*, बिहार राष्ट्रभाषा परिषद्, पटना, 1981.
  2. राधावल्लभ, त्रिपाठी, *भारतीय नाट्य: स्वरूप और परंपरा*, हरिसिंह गौर विश्वविद्यालय, सागर, 1988.
  3. वाचस्पति, गैरोला — *भारतीय नाट्यपरम्परा और अभिनयदर्पण*, इलाहाबाद, 1967.
- त्रिपाठी, राधावल्लभ, *भारतीय नाट्यशास्त्र की परम्परा और विश्व रंगमंच*, प्रतिभा प्रकाशन, दिल्ली, 1999.

**Examination scheme and mode: Subject to directions from the Examination Branch/University of Delhi from time to time**

## SEC-3: Script Writing Skills in Sanskrit Dramaturgy

### Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Prerequisite of the course
		Lecture	Tutorial	Practical/ Practice		
Script Writing Skills in Sanskrit Dramaturgy	02	1		1	Class XII Pass	Nil

### Learning Objectives

The script writing forms as essential point in developing a plot into play relates to the practical aspects of theatre skill. It has a close relationship with Acting. This paper aims at acquainting the learners with the basic notions and aspects of the performing art especially of Drama. The practice in composition of drama can enhance one's natural talent. This paper deals with the rules, skills and practices of dramatic composition (script writing) and aims at sharpening the dramatic talent of the students.

### Learning outcomes

After complete this course the students are supposed to be able in developing a plot into a dramatic composition in context to the Indian Dramaturgy. They will learn the skills of constructing a story or an incident into script of a play. The Students will also be inspired and encouraged to prepare the scripts for drama.

### Detailed Syllabus

#### Unit I

#### Some Components of Scripts

##### Development of plot

##### Types of dramatic production:

Sukumāra (Delicate), Āviddha (Energetic)

##### Various kinds of plot (Vastu):.

Dr̥sya (presentable) and Sūchya (Restricted scenes)

##### Starting of a play by using Pūrvaraṅga-

Raṅgadvāra, Nāndī, Prastāvanā and Prarocanā.

##### Sources and objectives of play:

Sources : Prakhyat (Historic), Utpaddya (Imaginary), Mishra

Objectives : Dharm, Artha & kaama

##### Steps of developing a Plot :

(i.)Elements for Developing a plot :

- Arthaprakṛtis (caustations),
- Kāryāvasthā (stages of the actions)

- Sandhi (junctures) and Arthopakṣepaka(interludes)- pravesaka etc.

## Unit II

### Dialogues and Three Unities

#### A. Kinds of saṁvāda( Dialogue):

- Sarvaśrāvya or Prakāśa,
- Aśrāvya or Svagata (aside)
- Niyataśrāvya :
  - Janāntika (personal address),
  - Apavārita (confidential),
  - Ākāśabhāṣita (conversation with imaginary person).

#### B. Arrangement of a play by Three Unities :

Time, Actions and place

#### C. Analysis of Script Writing in the context of Abhijñānaśākuntalam

### Essential/recommended readings

1. Ghosh, M.M.: *Nāṭyaśāstra* , Bharata, vol-1, Manisha Granthalaya, Calcutta, 1967.  
Hass, The Daśarūpaka : A Treatise on Hindu Dramaturgy, Columbia University, NewYork , 1912.
2. Adyarangachrya, *Introduction to Bharata's Nāṭyaśāstra*, Popular Prakashan Bombay, 1966.
3. मीरा द्विवेदी , संस्कृत नाट्य : अभिनय एवं पटकथा लेखन, परिमल पब्लिकेशन्स,दिल्ली,2018  
द्विवेदी,हजारी प्रसाद, नाट्यशास्त्र की भारतीय परंपरा और दशरूपक, राजकमल प्रकाशन दिल्ली,1963.

### Additional Resources:

1. सीताराम, झा, नाटक और रंगमंच, बिहार राष्ट्रभाषा परिषद्, पटना, 1981.
2. राधावल्लभ, त्रिपाठी, भारतीय नाट्य: स्वरूप और परंपरा, हरिसिंह गौर विश्वविद्यालय, सागर, 1988.
3. वाचस्पति, गैरोला — भारतीय नाट्यपरम्परा और अभिनयदर्पण, इलाहाबाद, 1967.
4. त्रिपाठी, राधावल्लभ, भारतीय नाट्यशास्त्र की परम्परा और विश्व रंगमंच, प्रतिभा प्रकाशन, दिल्ली,1999.

**Examination scheme and mode: Subject to directions from the Examination Branch/University of Delhi from time to time**

## SEC-4: Fundamentals of Indian Manuscriptology

### Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Prerequisite of the course
		Lecture	Tutorial	Practical/ Practice		
Fundamentals of Indian Manuscriptology	02	1		1	Class XII Pass	Nil

### Learning Objectives

The manuscript repository of India, having more than 10 million codices, is an embodiment of its knowledge tradition. In order to make India a knowledge driven society, it is inevitable that the new generation understand important aspects of manuscripts and by treating and preserving the same may exert to find out and publish hitherto unexplored wisdom lying therein

### Learning outcomes

- This course will enable the students to discern importance of the manuscripts and instant need of curating and editing the same.
- The student will be able to understand the process of treating the manuscripts of different nature.
- The student will be aware of the process of preserving the manuscripts for coming generations.

### Detailed Syllabus

#### Unit I

##### Some Components of Scripts

- Importance of manuscripts for unleashing India's greatness.
- Salient features of Indian manuscriptology.
- Sources for Indian Manuscripts – different catalogues and Reports.
- Important manuscript reservoirs in India and abroad and methodology of accessing them

#### Unit II

##### Dialogues and Three Unities

- Dirge and Instant need of treating Indian manuscripts.
- Process of treatment of Indian manuscripts and their preservation.
- Modes operandi of Mass awareness for preservation of the manuscripts.
- Basics of critical edition of a text- Identifying various corruptions and their removal.

### Essential/recommended readings

- Chaubey, B.B. *Manuscriptology: Past and Present*. Poona Orientalia, Vol. V, Pg.49

2. Katre, S.M. 1941. *Introduction to Indian textual Criticism*. Bombay : Karnataka Publishing House.
3. लक्ष्मीनरसिंहभट्टः, जा. रामकृष्णः, विरूपाक्ष वि. जङ्गीपालः (अनुवादकौ)  
*भारतीयग्रन्थसम्पादनशास्त्रप्रवेशिनी* ( आङ्ग्लमूलप्रणेता – आचार्य एस. एम. कत्रे ),  
 २००२. तिरुपति : राष्ट्रिय संस्कृत विद्यापीठम्.
4. Sankrityayana, Rahula.1938. “Search for Sanskrit MSS. In Tibet.” In *Journal of the Bihar and Orissa Research Society*.Vol.XXIV Part IV. 137-163.
5. सत्येन्द्र. १९७८. *पाण्डुलिपि विज्ञान*. जयपुर : राजस्थान हिन्दी ग्रन्थ अकादमी.
6. Sharma, K.V. 2007. *Manuscriptology of India* in “New Lights on Manuscriptology” Pg.2-4
7. Shasri, P.P.S. 1930. *A Descriptive Catalogue of Sanskrit Manuscripts in the Tanjore Maharaja Sarfoji’s Saraswati Mahal Library*. Shrirangam : Sri Vani Vilas Press.
8. Tripathi, Dipti. 2018. “Reflections on Manuscriptology: Forays into Indian Paradigms of Knowledge managemnet” in *Sambodhi* XLI : 1-10

#### **Additional Resources:**

[https://www.jainfoundation.in/JAINLIBRARY/books/sambodhi\\_2018\\_vol\\_41\\_520791\\_hr6.pdf](https://www.jainfoundation.in/JAINLIBRARY/books/sambodhi_2018_vol_41_520791_hr6.pdf)  
<https://www.aanandashram-sanstha.org/>  
<https://www.ssvv.ac.in/about-library>  
<https://www.namami.gov.in/manuscript-resource-centres>  
<http://ignca.gov.in/online-digital-resources/manuscripts/>  
<https://vedabase.io/en/library/sb/11/5/34/>

**Examination scheme and mode: Subject to directions from the Examination Branch/University of Delhi from time to time**

## SEC-5: Traditional Indian Gastronomy (Bhāratīya Pāka Śāstra)

### Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Prerequisite of the course
		Lecture	Tutorial	Practical/ Practice		
Traditional Indian Gastronomy (Bhāratīya Pāka Śāstra)	02	1		1	Class XII Pass	Nil

### Learning Objectives

To train and develop students in Indian Cuisine and Food Culture through Industry Interface and Culinary experts. To strengthen students' Knowledge and skills with instruction based on Indian tradition and culture. The course also aims at enhancing learning menu planning as per festival, quantity preparations and management of resources. To develop competencies to understand Ayurveda and wellness cooking.

### Learning outcomes

Acquire knowledge and skill in Indian culinary practices.  
Identify and apply contemporary food safety and sanitation practices along with traditional principles of wellness and Ayurveda.

### Detailed Syllabus

#### Unit I

##### *Pāka Kalā in Sanskrit Sāhitya*

**Pāka Kalā (The art of Indian Cuisine):** Ancient Indian food culture, Characteristics of Indian Cuisine and food commodities, Indian culinary terminology.

**Āhāra in Sanskrit Sāhitya (Food in Sanskrit Literature) :** Food divisions in Sanskrit literature, Food and Drinks in ancient India, diet in Vedic period , food and related art in the Vedic age, food in Sanskrit poetry.

**Swastha Āhāra (Food and Ayurveda) :** Fundamentals of Ayurveda, Identifying the various constituents of Ayurveda and their characteristics, Outline the Three Vital essence (Tridoṣa) of

Ayurveda, Prakriti and Vikriti, Identify the concept about Rasa, Virya, Vipakah and Prabha, Dietary recommendations for Vāta doṣa, Pitta doṣa, Kapha doṣa.

## Unit II

### Āhāra

1. **Prādesika Āhāra (Regional Food):** Cuisines of North India, Cuisines of East India, Cuisines of North India, Cuisines of South India.
2. **Pāka evam Paryāṭana (Travel and Food):** Culinary journey of India, various types of food travel.
3. **Prasād Paramparā (Ritual food tradition):** Tradition of prasād culture in Vaishnav, Shaiva and Shakt sects of Hindu religion.
4. **Pūrva tathā Pāścima (Cuisines of East and West):** Specialty cuisines, staple diets, festival and signature dishes of different regions, various cooking methods and techniques used in different regions, preparation, classic recipes.

## Essential/recommended readings

1. *Ayurvedic Science Of Food And Nutrition* by Sanjeev Rastogi , Springer (2014).
2. *Feast and Fasts: A History of Food in India* by Colleen Taylor Sen, (2016).
3. *Aahara : Ancient Secret of Diet in Ayurveda & Yoga* by Dr Pradipkumar R. Suryawanshi (2018).
4. *Indian food: A Historical Companion* by K.T.Achaya, Indian food: A Historical Companion, Oxford University Press, 1998.
5. *Food and Drinks in Ancient India* (Based on Original Sanskrit Sources) by R Mitra, [COSMO PUBLICATIONS, NEW DELHI](#), (2007).
6. *Prasāda, the Gracious Gift, in Contemporary and Classical South Asia* by Andrea Marion Pinkney. Journal of the American Academy of Religion, September 2013, Vol. 81, No. 3, pp. 734–756.
7. *From the God's Kitchen: The Mahāprasād In Shri Jagannāth Temple, Puri, India*, by Sili Rout, SHSS XXIX, NUMBER 1, Summer 2022.
8. *From the Earliest Times to the Sixth Century, B.C.* by Romesh Chunder Dutt, C.I.E.1906. (Chapter 4 – Food and Art in the Vedic age).
9. *Food and Love in Sanskrit Poetry: On the Margin of Desires* by Danielle Feller. Cracow Indological Studies Vol. XXI, No. 2 (2019), pp. 69–124.
10. पाकशास्त्र. यशोदा देवी. बनिता हितैषी प्रेस. प्रयागराज, १९१३
11. पाकशास्त्र. कान्ति पाण्डेय. बिहार हिन्दी ग्रन्थ अकादमी. २०१३
12. आहारशास्त्र. दामोदर वासुदेव. दत्तात्रेय कृष्ण साहू ब्रदर्स, आर्योषधि कारखाना. १८५६.
13. आहारशास्त्र. जयनारायण. जीवन दृष्टि प्रकाशन, आरोग्यमन्दिर, यवतमाल-वर्धा.

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**Examination scheme and mode: Subject to directions from the Examination Branch/University of Delhi from time to time**

## SEC-6: E-Learning Tools and Techniques for Sanskrit

### Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Prerequisite of the course
		Lecture	Tutorial	Practical/ Practice		
E-Learning Tools and Techniques for Sanskrit	02	1		1		Nil

### Learning Objectives

This course will introduce the current research and development in Sanskrit computing. Primary emphasis will be on tools and techniques developed under government and private funding and to explore new technologies for Sanskrit. Special focus will be on e-learning and interacting tools, web application for Sanskrit, Unicode Devanagari typing tools and language computing. HTML will be taught for web application.

### Learning outcomes

The course-level learning outcomes that a student of this course is required to demonstrate are indicated below:

- Learn the basic Interactive Sanskrit Teaching Learning Tools.
- Learn the Basics of Multimedia, Web based tools development.
- Working knowledge of HTML and web page development.
- Working with Unicode Typing in Devanagari Scripts.
- Learn the Various Typing Tools and Software for Devanagari Unicode.
- Learn the Text preservation techniques and web publishing.

### Detailed Syllabus

#### Unit I

##### Interactive Sanskrit Teaching Learning Tools and Typing Tools:

Basics of Multimedia, Web based tools development.

Basics of HTML and web technology

Standard for Indian Languages (Unicode)

Unicode Typing in Devanagari Scripts, Various Typing Tools and Software for Devanagari Script: Baraha, Google Input Tools, Google Assistant

#### Unit II

##### Survey of Various developed Computational Tools for Sanskrit:

Sanskrit Grammar Tools

Sanskrit Text Preservation and Search

Online Indexing Tools for Sanskrit Texts

**Essential/recommended readings**

1. Bharti A., R. Sangal, V. Chaitanya, “NL, Complexity Theory and Logic” in Foundations of Software Technology and Theoretical Computer Science, Springer, 1990.
2. E-Content suggested by Teacher
3. Tools developed by Computational Linguistics Group, Department of Sanskrit, University of Delhi, Delhi-110007 available at: <http://sanskrit.du.ac.in>
4. Basic concept and issues of multimedia:  
<http://www.newagepublishers.com/samplechapter/001697.pdf>
5. Content creation and E-learning in Indian languages: a model:  
[http://eprints.rclis.org/7189/1/vijayakumarjk\\_01.pdf](http://eprints.rclis.org/7189/1/vijayakumarjk_01.pdf)
6. HTML Tutorial - W3Schools: [www.w3schools.com/html](http://www.w3schools.com/html)
7. The Unicode Consortium: <http://unicode.org>
8. [http://baraha.com/v10/help/Keyboards/kan\\_phonetic.htm](http://baraha.com/v10/help/Keyboards/kan_phonetic.htm)
9. <https://www.google.co.in/inputtools/try/>

**Examination scheme and mode: Subject to directions from the Examination Branch/University of Delhi from time to time**

## SEC-7: Practices in Horoscope-I

### Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Prerequisite of the course
		Lecture	Tutorial	Practical/ Practice		
Practices in Horoscope-I	02	1		1		Nil

### Learning Objectives

The objective of this paper is to teach the students about basic principles for horoscope and develop the ability/skill for making Horoscope.

### Learning outcomes

After studying this course students:

Will be able to know the concept behind Panchanga.

Will be able to know the concept of Horoscope.

Will be able to get Knowledge about how to make a horoscope.

### Detailed Syllabus

#### Unit I

सौरपरिवार का सामान्य परिचय, काल के भेद, पञ्चाङ्ग परिचय, द्वादशभाव परिचय ।

ग्रहों का स्वरूप, ग्रहों की उच्च-नीच एवं मूलत्रिकोण राशियाँ, ग्रहदृष्टिविचार ।

ग्रहमैत्री विचार, चर एवं स्थिरकारक ग्रह, राशियों के गुणधर्म एवं स्वामी ।

#### Unit II

समयज्ञान, मानक, स्थानीय सूर्योदय, सूर्यास्त, दिनमान

इष्टकाल, चालन, भयात्-भभोग साधन, स्पष्टग्रहसाधन, चन्द्र स्पष्टीकरण

अयनांश साधन, पलभा ज्ञान, चर-खण्ड ज्ञान, लंकोदयमान, स्वोदयमान

लग्नसाधन, ससन्धिद्वादशभावसाधन

### Essential/recommended readings

1. भारतीयकुण्डलीविज्ञानम् – मीठालालहिम्मतराम ओझा, देवर्षिप्रकाशन, वाराणसी ।
2. भारतीयज्योतिषम् - शिवनाथझारखण्डी, उत्तरप्रदेशहिन्दीसंस्थान, लखनऊ, 2010
3. भारतीयज्योतिषम् – नेमिचंद्र शास्त्री, भारतीय ज्ञानपीठ प्रकाशन, दिल्ली, 1992

4. ज्योतिष सर्वस्व- सुरेश चन्द्र मिश्र, रंजन पब्लिकेशन, दिल्ली, 2022
5. भारतीय ज्योतिष का इतिहास-गोरखप्रसाद, उत्तरप्रदेशहिन्दीसंस्थान, लखनऊ, 2010

**Examination scheme and mode: Subject to directions from the Examination Branch/University of Delhi from time to time**