UNIVERSITY OF DELHI

CNC-II/093/1(23)/2022-23/
Dated: 09.03.2023

N O T I F I C A T I O N

Sub: Amendment to Ordinance V

[E.C Resolution No. 38-1/ (38-1-16) dated 08.12.2022]

Following addition be made to Appendix-II-A to the Ordinance V (2-A) of the Ordinances of the University;

Add the following:

Skill Enhancement Courses (SECs)
Under
UGCF-2022
Listed under Appendix-II-A to the Ordinance V (2-A) of the Ordinances of the University
(with effect from Academic Year 2022-23)

A student who pursues any undergraduate programme in the University and its Colleges is offered a pool of Skill Enhancement Courses. A list of such courses as passed by the Executive Council in its meeting dated 08.12.2022 is as below:

Sl.No.	Course Title	Total Credits:2
1.	Apiculture	
2.	Bioinoculants for Agriculture and Sustainable Development	
3.	Early Child Care and Education Settings	
4.	Healthy and Sustainable Food Choices	
5.	Image Styling	
6.	Content development and Media for Children	
7.	Small Scale Catering	
8.	Radiation Safety	
9.	Chemistry Lab Operations and Safety Measures	
10.	Chemistry of Cosmetics and Hygiene Products	
11.	Basic Analytical Techniques	
12.	Essential Food Nutrients	
13.	Forensic Chemistry	
14.	Green Methods in Chemistry	

15. Lab Testing and Quality Assurance
16. Chemistry of Food Flavors and Colourants
17. PCB Designing and Fabrication
18. Electronic Product Testing
19. Culinary Science
20. Chocolate Crafts
21. Pasta and Patisserie Technology
22. Frozen Dessert Technology
23. Indian Snack Industry
24. Dairy Processing
25. Fruits and Vegetable Processing
26. Food Waste and By-Product Utilisation
27. Minimal Food Processing
28. Working with People
29. Life Skill Education
30. Participatory Learning and Action
31. Programme Media
32. Environmental impact and Risk Assessment
33. Sustainably Reporting
34. Environmental Auditing
35. Document Preparation & Presentation Software
36. Innovation and Entrepreneurship
37. IT Skills and Data Analysis – I
38. IT Skills and Data Analysis- II
39. R Programming for Business Analytics
40. Yoga in Practice
41. Floriculture
42. Mushroom Culture and Technology-I
43. Hydroponic and Aeroponic Farming
44. Viewing and Capturing Diversity in Nature
45. Plant Aromatics and Perfumery

46. Nursery Gardening and Landscaping
47. Horticulture
48. Mushroom Culture and Technology – II
49. Biofertilizers
50. Organic Farming
51. Green Belt Development for Smart Cities
52. Big Data Analytics-I
53. Big Data Analytics-II
54. Social Media Marketing
55. Design Thinking
56. Aquaculture Entrepreneurship
57. Bio-floc Technology
58. Fish Breeding and Larviculture
59. Formulation of Fish Feed
60. Ornamental Fish Culture: Opportunity and Scope
61. Pearl Culture
62. Sericulture-I: Mulberry Silkworm Rearing
63. Sericulture-II: Eri Silkworm Rearing
64. Sericulture-III: Silk Technology
65. Sericulture-IV: Application of Sericulture in Therapeutic and Cosmetic Industry

Apiculture

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		
Apiculture	2	0	0	2	Class XII	NIL

Learning Objectives

The Learning Objectives of this course are as follows:

- To help the student to become familiar with the significance of beekeeping as an economically viable industry.
- To help the student to understand the different species of honeybees, their biology, behaviour and role in pollination.
- To train the students to learn the techniques of honey bee rearing, optimization of techniques based on climate and geographical regions, and various measures to be taken to maximize the benefits.
- To understand the significance of beekeeping in the diversification of agriculture for the rural communities to increase their income and create employment opportunities and at the same time to develop entrepreneurial skills required for self-employment in the beekeeping sector.

Learning Outcomes

After studying this course, the students will be able to:

- Comprehend the various species of honey bees in India, their social organization and its importance.
- Appreciate the opportunities and employment in apiculture – in public, private and government sector.
- Gain thorough knowledge about the techniques involved in bee keeping and honey production.
- Make various products and by-products obtained from beekeeping sector and their importance.
- Develop entrepreneurial skills necessary for self-employment in beekeeping sector.
- Enhance collaborative learning and communication skills through practical sessions, teamwork, group discussions, assignments and projects.

Skill development and job opportunities

- After completion of this course students would obtain the training in collection, identification, and various ways/aspects of bee rearing.
- The students can also take a job as an apiary worker, often called a beekeeper, manage colonies of honeybees for the production of honey as well as pollination services.
- The course would also provide a basic training to enable the students to construct hives and replace combs.
- Enhance entrepreneurial skills by collecting and packaging hive products including honey, beeswax and pollen.
- Make decisions on yards, treatment, splits, honey harvesting and all other beekeeping decisions.

- Identify and report hive health concerns.

SYLLABUS (Practical)

Unit 1: Biology of Bees **16 hours**

Historical background of apiculture, classification and biology of honey bees, Social organization of bee colony, behavioral patterns (bee dance, swarming).

Practical Exercises:

1. Study of the life history of honey bees: *Apiscerana indica*, *Apis mellifera*, *Apis dorsata*, *Apis florea*, *Melipona* sp. from specimen/ photographs - Egg, larva, pupa, adult (queen, drone, worker).
2. Study of morphological structures of honey bees through permanent slides/photographs– mouthparts, antenna, wings, sting apparatus and temporary mount of legs (antenna cleaner, mid leg, pollen basket).
3. Study of natural beehive and identification of queen cells, drone cells and brood.

Unit 2: Rearing of Bees **18 hours**

Artificial Bee rearing (Apiary), Beehives – Newton and Langstroth; Bee Pasturage; Selection of bee species for apiculture –*Apiscerana indica*, *Apis mellifera*; Bee keeping equipment methods of extraction of honey (Indigenous and Modern) & processing; Apiary management - Honey flow period and lean period, effects of pollutants on honeybees**.**

Practical Exercises:

1. Distinguishing characters of workers of three bee species.
2. Importance of site selection for bee keeping.
3. Study of an artificial hive (Langstroth/Newton), its various parts and beekeeping equipment: draw diagrams of bee boxes proportionate to the body size and measure the body length and wing size.
4. Preparation of mount of pollen grains from flowers.

Unit 3: Diseases and Enemies **10 hours**

Bee diseases control and preventive measures: enemies of bees and their control.

Practical Exercises:

1. Diagnosis of honeybee diseases: Protozoan diseases, Bacterial diseases, Viral diseases (one each)- symptoms, nature of damage and control.
2. Identification of honeybee enemies: Predators-Insects and non-insects.

Unit 4: Bee Economy **8 hours**

Products of apiculture industry (Honey, Bees Wax, Propolis, Royal jelly, Pollen etc.) and their uses; Modern methods in employing artificial Beehives for cross pollination in horticultural gardens-stationary and migratory bee keeping.

Practical Exercises:

1. Video demonstration of wax extraction and preparation of comb foundation sheets.
2. Analysis of honey – purity, physical and biochemical parameters (any two constituents).
3. Study of bee pasturage – visit to fields/gardens/orchards for studying the bee activity (role in pollination, nectar collection, videography of honeybee activity) and preparation of herbarium of nectar and pollen yielding flowering plants (floral mapping).

Unit 5: Entrepreneurship in Apiculture **8 hours**

Bee keeping industries – Recent advancements, employment opportunities, economics in small and large-scale beekeeping, scope for women entrepreneurs in beekeeping sector, study of development

programs and organizations involved in beekeeping in India.

Exercise:

1. Visit to an apiary/honey processing unit/institute and submission of a report.

Essential/Recommended readings

Singh, S. (1962). Beekeeping in India, Indian Council of Agricultural Research, New Delhi.
Mishra, R.C. (1995). Honeybees and their management in India. Indian Council of Agricultural Research, New Delhi.
Prost, P. J. (1962). Apiculture. Oxford and IBH, New Delhi.
Rahman, A. (2017). Beekeeping in India. Indian Council of Agricultural Research, New Delhi.
Gupta, J.K. (2016). Apiculture, Indian Council of Agricultural Research, New Delhi.

Examination scheme and mode:

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

BIOINOCULANTS FOR AGRICULTURE AND SUSTAINABLE DEVELOPMENT

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
		Lecture	Tutorial	Practical/ Practice		
BIOINOCULANTS FOR AGRICULTURE AND SUSTAINABLE DEVELOPMENT	2	0	0	2	Class XII	NIL

Learning Objectives

The Learning Objectives of this course are as follows:

- To make students aware of the role of microorganisms in sustainable development and remediation.
- To develop their own biofertilizers and other kinds of bio-inoculants for use in agriculture and environment.
- Skill development in initiating a bioinoculant-based low cost startup.

Learning outcomes

After studying this course, the students will be:

- Able to identify the role of microbes in sustainable development and how microbes can be used in remediation of damaged environments.
- Skilled in isolating microorganisms from a variety of different sites. Will learn Selection, purification and preservation of useful cultures.
- Skilled in formulating bioinoculants and test its efficacy.

SYLLABUS

Practical

Unit 1 **20 hours**

Introduction and scope of bioinoculants: Biofertilizers: success story – biofertilizer production under ICAR - How Biofertilizers for Corn Went Commercial. Biopesticides: success story of using biopesticides for nematode management in horticultural crops. Bioinoculants as a solution to the problem of parali (stubble) burning: case study of "PUSA Decomposer". Bioinoculants for reforestation. Bioinoculants for the reclamation of waste lands having alkaline, acidic, heavy metal-contaminated soils. Bioinoculants for clearance of oil spills. Mycorrhizal inoculants. Some important commercially available bioinoculants.

Unit 2 **28 hours**

Isolation of microorganisms for the preparation of bioinoculants: Isolation of phosphate solubilizers, free-living nitrogen fixers, heavy metal-accumulating microbes, alkalophiles, acidophiles from suitable soil samples. Observation of colony morphology and microscopic structure of selected microbes and preservation of these cultures in slants and glycerol stocks.

Unit 3 **12 hours**

Formulation of bioinoculant using selected microbes (student group project): Culturing of selected microbes from those isolated, and formulating them into a bioinoculant. Preparation of workflow for evaluating efficacy in potted plants and in fields, for determining shelf life, and stability.

Essential/Recommended readings

1. Microbiology: A Lab Manual by J. G. Cappuccino and C. T. Welson. 12th edition.
2. Pearson. 2020.
3. Bio-inoculants as prospective inputs for achieving sustainability: Indian Story by C. Gupta et al. Economic Affairs. Vol. 65, No. 1, pp. 31-41. 2020.
4. Bioinoculants for bioremediation applications and disease resistance: Innovative Perspectives by T. Chaudhary and P. Shukla. Indian J Microbiol. 59 (2): 129–136. 2019.
5. Remediation of metalliferous soils through the heavy metal resistant plant growth promoting bacteria: paradigms and prospects by M. Ahemad. Arabian Journal of Chemistry, 12 (7);1365-1377. 2019.
6. Laboratory manual of Microbiology and Biotechnology by K.R. Aneja. 2nd edition. Scientific International Pvt. Ltd., Delhi. 2018.
7. Online resource: https://www.jaivikkheti.in/DMS/Waste-Decomposer%20Book-Eng.pdf
8. Online resource: https://www.iihr.res.in/success-story-using-biopesticides-nematode-management-horticultural-crops.
9. Biofertilizer Production under ICAR All India Network Project on Soil Biodiversity Biofertilizers DOI: 10.13140/RG.2.2.26840.42244
10. Online resource: https://blog.teamtrade.cz/the-story-of-how-biofertilizers-for-corn-went-commercial-part-one/
11. Online resource: https://en.wikipedia.org/wiki/Microbial_inoculant

Examination scheme and mode:

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

Early Child Care and Education Settings

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisiteof the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Early Child Care and Education Settings	**2**	**0**	**0**	**2**	**Class XII**	**NIL**

Learning Objectives

The Learning Objectives of this course are as follows:

- To understand the significance of early childhood years and the importance of ECCE
- To understand developmental milestones and delays in development
- To plan, organize and create care facilities and developmentally appropriate material for infants and young children.
- To be acquainted with the ECCE centre, its daily routine, requirements, functioning and evaluation of the programme.
- To trace the progression of children in early childhood setting

Learning outcomes

After studying this course, the student will be able to:

- Explain the significance of early childhood development andECCE
- Become familiar with developmental milestones and learn to assesschildren in early years.
- Understand, plan and organize care activities for youngchildren
- Prepare activities and aids for fostering development in theearly years
- Learn about evaluation of an ECCE programme

SYLLABUS

Unit 1: Importance of early years and significance of ECCE **20 hours**

The unit will help to develop an understanding on the concept and importance of ECCE

- Meaning and objectives of ECCE and importance of early years

- Norms and developmental milestones of infants and young children
- Observations, developmental checklists and developmental delays
- Nurturing care framework and early childcare practices
- Review of existing ECCE programmes and policies in India

Unit 2: Developmentally appropriate activities for young children 20 hours

The unit will focus on ways to promote development during early years through play and exploratory activities.

- Care and stimulation activities for infants and young children
- Plan and prepare multi-sensory materials and activities to promote development across domains: Physical motor, socio-emotional, cognitive and language development
- Use of music, dance, drama, storytelling, puppetry, rhymes/poems and art and craft
- Importance of- Indoor and outdoor activities; individual and group activities; free play and guided play; circle time
- Activities for school readiness

Unit 3: Components of ECCE Programme 20 hours

The unit will focus on the understanding of infrastructure, materials and equipment, curriculum development and assessing the development of children.

- Daily routines in child care and preschool centres
- Creating safe spaces for children: Organizing indoor and outdoor material and equipment
- Understanding the ECCE curriculum: Developing daily, weekly and monthly plans
- Assessing children's development across domains
- Indicators of a quality ECCE centre

Essential/Recommended Readings

- ECCE National Curriculum Framework- https://wcd.nic.in/sites/default/files/national_ecce_curr_framework_final_03022014%20%282%29.pdf
- Managing Children's Programmes: Some Perspectives. Indira Gandhi National Open University DECE Study Material. http://www.ignouhelp.in/ignou-dece-study-material/
- Morrison, G. S. (2018). Early Childhood Education Today. Pearson
- National Education Policy 2020- education.gov.in/sites/upload_files/mhrd/files/NEP_Final_English_0.pdf
- Organizing a Child Care Centre. Indira Gandhi National Open University DECE Study Material
- Soni, R. (2015). Theme Based Early Childhood Care and Education Programme: A Resource Book. National Council of Educational Research and Training.
- Swaminathan, M. (1998). The First Five Years. Sage Publications

Suggestive Readings

- Aggarwal, J. C. (2007). Early Childhood Care and Education: Principles and Practices.

Shipra: New Delhi.

- Arni, K. and Wolf G. (1999). Child Art with Everyday Materials. TARA Publishing.
- Mohanty, J. Mohanty, B. (1996). Early childhood care and Education. Deep and Deep Publication, New Delhi.
- Morrison, G. S. (2003). Fundamentals of early childhood education. Merrill/Prentice Hall:
- Play Activities for Preschoolers – 1 and 2. Indira Gandhi National Open University DECE Study Material
- Virginia Singh, A. (1995). Playing to Learn: A training manual for Early Childhood Education. M. S. Swaminathan Research Foundation.

Note: Learners are advised to use the latest edition of readings

Examination scheme and mode:

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

Healthy and Sustainable Food Choices

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		
Healthy and Sustainable Food Choices	**2**	**0**	**0**	**2**	**Class XII**	**NIL**

Learning Objectives

The Learning Objectives of this course are as follows:

- To identify healthier food options
- To understand portion control for foods
- To demonstrate skill for preparing healthy and nutritious dishes
- To link sustainability with healthy food choices

Learning Outcomes

After studying this course, the student will be able to:

- Select and prepare healthier food options
- Relate the influence of food environment on food choices
- Comprehend the importance of sustainable food choices

SYLLABUS

Unit 1: Healthy food choices **12 hours**

Identification of healthy and unhealthy foods and Understanding the immediate food environment

- Food labels and basics of nutrient profiling models to classify foods as HFSS
- Nutrient profiling of commonly consumed food items
- Exploring the food environment by mapping the food outlets and food available near home andcollege

Unit 2: Food portion sizes and related factors **12 hours**

Understanding food portion sizes and its relation to nutrient density

- The concept of portion/serving sizes and portion control
- Estimation of energy and nutrient density of selected food products using nutrient composition database

Unit 3: Basics of food preparation **20 hours**

Planning and preparation of healthy and nutritious dishes

- Planning and preparation of the following:
    - Snacks
    - Soups and Salads
    - Desserts
    - Meal combinations

Unit 4: Sustainability and healthy food **16 hours**

Linking the concept of healthy eating with sustainability

- Identification of nutritious food sources which have minimal impact on the environment
- Case study on understanding food supply chain and carbon footprints of any commonly consumed foods

Essential/Recommended readings

- Chadha R and Mathur P (2015). Nutrition - A Lifecycle Approach. New Delhi: Orient Blackswan Pvt Ltd.
- Longvah T, Ananthan R, Bhaskarachary K and Venkaiah K (2017). Indian Food Composition Tables. National Institute of Nutrition, Indian Council of Medical Research, Department of Health Research, Ministry of Health and Family Welfare, Government of India, Hyderabad.
- Khanna K, Gupta S, Seth R, Mahna R, Rekhi T (2004). The Art and Science of Cooking: A Practical Manual, Revised Edition. New Delhi: Elite Publishing House Pvt Ltd.
- Raina U, Kashyap S, Narula V, Thomas S, Suvira, Vir S, Chopra S (2010). Basic Food Preparation: A Complete Manual, Fourth Edition. Hyderabad: Orient Black Swan.

Suggestive readings

- HLPE. 2017. Nutrition and food systems. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome. https://www.fao.org/3/i7846e/i7846e.pdf

- Agarwal P and Mathur P (2021). Eat Right - A Food Systems Approach . New Delhi: Food Future Foundation

- NIN-ICMR. Food Based Dietary Guidelines for Indians

Note: Learners are advised to use the latest edition of readings.

Examination scheme and mode:

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

Image Styling

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		
Image Styling	2	0	0	2	Class XII	NIL

Learning Objectives

The Learning Objectives of this course are as follows:

- To strengthen the student's hands on experience in using different tools of improving the visual and non-visual appearance
- To train the students with technical and professional ways of understanding wardrobe needs and their development
- To develop skills in understanding fashion trends for planning personal shopping .

Learning Outcomes

After studying this course the student will be able to:

- Demonstrate the practical ways to strengthen physical image based on body type, face shape and personal style analysis.
- Understand the effect of elements and principles of design on visual appearance.
- Explain the fashion trends of apparel and accessories.
- Identify wardrobe elements and the processes of planning and organization.
- Plan personal shopping of apparel and accessories based on physical traits, personal style and budget.

SYLLABUS
Practical

Unit 1: Physical traits and analysis **16 hours**

Learning the first step in styling by developing skills to analyze individual characteristics such as body type, proportions, face shapes etc.

Subtopics:

- Body types
- Body proportion
- Face shapes
- Personal colour analysis

Unit 2: **Application of elements and principles of design for image styling** **16 hours**

Understanding the basics of design by learning about the various elements and principles of design, their role in the success of a design, and their importance in personal styling.
Subtopics:

- Effects of design elements and principles on clothing and visual appearance
- Effect of garment components on visual appearance

Unit 3: Wardrobe planning **12 hours**

Learning the skills of wardrobe planning, analysis and management as per apparel and accessory needs.
Subtopics:

- Wardrobe analysis
- Wardrobe essentials
- Organization and categorization of wardrobe
- Elements of a basic wardrobe
- Optimising wardrobe and budgeting

Unit 4: The business of styling **16 hours**

Understand the working of styling business. Developing the art of styling. Analyzing the present market trends.

Subtopics:

- Dress vs Style
- Analysis of trends of apparels and accessories
- Survey of apparel and accessory stores/ brands with respect to style, size and price.
- Types of stylists: Freelance stylists, Celebrity stylists, Editorial stylists
- Marketing your business
- Forms and Contracts

Essential Readings

- Constantine, S. & Woodall, T. *The Body Shape Bible: Forget Your Size Discover Your Shape Transform Yourself*, published by Weidenfeld & Nicolson (1877), ASIN: B01K14NWB8
- Funder, D.C. 2001, The Personality *Puzzle (2nd ed),* New York: W.W. Norton
- Phares, J.E. 1991, *Introduction to Personality (3rd ed),* New York: Harper Collins
- Rasband, J. *Wardrobe Strategies for Women*, published by Fairchild Books; Student edition (September 18, 2001), ISBN-10: 1563672596

Suggested Readings

- Baumgartner, J. *You are What You Wear*, Da Capo Press (2012)
- Mc Call, *Sewing in Color*, Hamlyn Publishing Group 11th edition (1975)
- Romano, C. *Plan your Wardrobe*, New Holland Publishers (1998)

  Vega, L. *The Image of Success*, American Management Association (2010)

Note: Learners are advised to use the latest edition of readings.

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

Content Development and Media for Children

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		
Content development and Media for Children	**2**	**0**	0	**2**	**Class XII**	**NIL**

Learning Objectives

The Learning Objectives of this course are as follows:

- To explore and review current trends in media and content for children
- To plan developmentally appropriate media and content for children
- To create culturally appropriate content for learning

Learning Outcomes

After studying this course, the student will be able to:

- Identify forms of content and media available for children
- Understand the impact of content and media on thoughts, attitudes and values of children
- Create age-appropriate content and media for children

SYLLABUS

Unit 1: Content for children: Relationship and interaction **20 hours**

This unit will cover the different forms of content available to children and will create a linkage between children, content and context

- Exploring different forms of content for children (exposure to history and folk forms)
- Children's usage and significance of print, audio visual content
- Review and analysis of available content for children
- Enabling parents/caregivers to be able to use content appropriately with children

Unit 2: Media for Children **20 hours**

This unit will discuss the different forms of media available to children in the contemporary context and also focus on advances in media technology

- Different media forms available for children

- Children's use and significance of media forms
- Assessing the portrayal of children in media; assessing the quality of Print, App or TV program, website, film
- Media literacy for children, parents and caregivers

Unit 3: Developing content and media for children **20 hours**

This unit will enable students in developing content and media for children.

- Scripting for children: content and structure; Literature for and by children; Writing stories/poems for children (significance of humour, wonder, logic)
- Music/ Dance/Theatre/puppetry as sources for content development and dissemination
- Creating age-appropriate content for:
  - Developmental and domain specific needs
  - Children activity box/ Preschool Kit
  - Interactive Mobile applications/Digital content

Essential readings

- Condry, J. (1989). *The Psychology of Television.* Lawrence Erlbaum, Associates, Inc.
- Daniel,A.K. (2012). *Storytelling across the Primary Curriculum.* London: Routledge.
- Engel, S. (1999). *The Stories Children Tell: Making Sense of the Narratives of Childhood.* USA: W.H.. Freeman and Company.
- Honig, A. (1983). *Television and young children*. Young children 38(4).
- Joshi, P. & Shukla, S. (2019). *Child development and education in the twenty-first century.* Singapore: Springer International.
- Livingstone, S. (2002). *Young People and New Media.* New Delhi: Sage
- Prakash, S. &Mathur, P. (2000). *Children and TV.* NCERT,
- Real, M. R. (1996). *Exploring Media Culture.* New Delhi: Sage
- Singer D.G. & Jerome L. (2012). *Handbook of Children and Media.* California: Sage.

Suggestive Readings:

- Calvert, S.L. & Wilson, B.J. (2008). *The Handbook of Children, media and Development.* United Kingdom: Blackwell Publishing.
- Jordan, A.B. & Romer, D. (2014). *Media and the Well-Being of Children andAdolescents.* New York: Oxford University Press.

Note: Learners are advised to use the latest edition of readings.

Examination scheme and mode:

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

Small Scale Catering

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		
Small Scale Catering	2	0	0	2	Class XII	NIL

Learning Objectives

The Learning Objectives of this course are as follows:

- To comprehend fundamentals of menu planning through management of resources in a food service establishment.
- To develop insight for recipe standardization and to apply acquired skills in menu planning and quantity food production.
- To use knowledge of preliminary steps for starting a small-scale catering unit.

Learning Outcomes

After studying this course, the student will be able to:

- Comprehend fundamentals of menu planning throughmanagement of resources in a food service establishment.
- Develop insight for recipe standardization.
- Apply acquired skills in menu planning and quantity foodproduction
- Use the knowledge of preliminary steps for starting a small-scalecatering unit.

SYLLABUS

Unit 1: Introduction to Food Service **12 hours**

Kinds of food service establishments, kinds of food service outlets

- Market survey of various food products raw and processed in different kinds of markets.
- Survey of a nearby small-scale catering unit

Unit 2: Food Production **32 hours**

- Menu planning: Importance of menu, factors affecting menu planning, types of menus, menu planning for different kinds of food service units, features of good menu card
- Basics of food purchase, receiving and storage
- Quantity food production: standardization of recipes, quantity food preparation techniques, recipe adjustments and portion control
- Hygiene and Sanitation

□ Planning menus within specified budget for the following:

- Menu for a birthday party/ nursery school.
- Packed tiffin lunch for MNC employees.
- Cyclic menu for catering breakfast, lunch and dinner for PG/ hostel girls.

- □ Evaluation of menu card
- □ Visit to a small-scale catering unit
- □ Use of computers in inventory and billing
- □ Standardization of a recipe
- □ Scaling up of recipe for large number of customers (75)
- □ Food stall/ event catering
- □ Demonstration of specific dishes for entrepreneurial set up
- □ Use of checklist to assess implementation of good hygiene and sanitation practices in a small-scale catering unit

Unit 3: Planning of a Food Service Unit **16 hours**

- Preliminary planning: survey of types of units, identifying clientele, menu, operations and delivery
- Planning the set up:
- Identifying resources (money, manpower, time, facilities, equipment, utilities, types of kitchen areas, flow of work and work area relationship), types of services and delivery system, business registration
- Basics of Finance (Components of cost and factors affecting them, determining the selling price)

- Market survey/visit for equipment
- Development of a business plan

Essential/Recommended Readings

- Desai V. (2011) The Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House Pvt. Ltd., Mumbai.
- Mohini, S. (2005) Institution Food Management New Age International Publishers.
- West, B.B.& Wood, L. (1988) Food Service in Institutions 6th Edition Revised By Hargar FV, Shuggart SG, &Palgne Palacio June, Macmillan Publishing Company New York.

Suggested Readings

- Knight, J.B. & Kotschevar, L.H. (2000) Quantity Food Production Planning & Management 3rd edition John Wiley & Sons.
- Payne-Palacio, J. & Theis, M. (2011) Foodservice Management: Principles and Practice 12th edition.
- Taneja, S. & Gupta, S. L. Entrepreneur Development- New Venture Creation. GalgotiaPublishing Company

Note: Learners are advised to use the latest edition of readings.

Examination scheme and mode:

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

RADIATION SAFETY

Course Title and Code	Credits	Credit distribution of the course			Eligibility Criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical		
Radiation Safety	2	1	0	1	Class XII pass with Physics and Mathematics as main subjects	NIL

Learning Objectives
The Learning Objectives of this course are as follows:

- To focus on the applications of nuclear techniques and radiation protection.
- To not only enhance the skills towards the basic understanding of the radiation but also provide the knowledge about the protective measures against radiation exposure.
- To impart all the skills required by a radiation safety officer or any job dealing with radiation such as X-ray operators, jobs dealing with nuclear medicine: chemotherapists, operators of PET, MRI, CT scan, gamma camera etc.

Learning Outcomes:
After studying this course, the student will be able to:

- Understand and use the applications of nuclear techniques and radiation protection to guard against nuclear radiation hazards.
- Understand and use the units of radiations and their safety limits, the devices to detect and measure radiation.
- Understand and use radiation safety management, biological effects of ionizing radiation, operational limits and basics of radiation hazards evaluation and control, radiation protection standards,
- Use the devices which apply radiations in medical sciences, such as X - r a y, MRI, PET, CT-scan with the required safety measures.

SYLLABUS

THEORY COMPONENT

Unit 1: **6 hours**
Radiation and its interaction with matter: Basic idea of different types of radiation electromagnetic (X-ray, gamma rays, cosmic rays etc.), nuclear radiation and their origin.
Nuclear Radiation: Basic idea of Alpha, Beta, Gamma neutron radiation and their sources (sealed and unsealed sources).
Interaction of Charged Particles (including alpha particles): Heavy charged particles (e.g. accelerated ions) - Beth-Bloch Formula, Scaling laws, Mass Stopping Power, Range, Straggling.
Interaction of Beta Particles: Collision and Radiation loss (Bremsstrahlung).
Interaction of Photons: Linear and Mass Attenuation Coefficients.
Interaction of Neutrons: Collision, slowing down and Moderation.

Unit 2: **4 hours**

Radiation detection and monitoring devices: Basic concepts and working principle of gas detectors, Scintillation Detectors, Solid State Detectors and Neutron Detectors, Thermo- luminescent Dosimetry.

Radiation Quantities and Units: Basic idea of different units of activity, KERMA, exposure, absorbed dose, equivalent dose, effective dose, collective equivalent dose, annual limit of intake (ALI) and derived air concentration (DAC).

Unit 3: **2 hours**

Radiation Units, dosage and safety management: Basic idea of different units of activity, KERMA, exposure, absorbed dose, equivalent dose, effective dose, collective equivalent dose, annual limit of intake (ALI) and Derived air concentration (DAC).

Radiation safety management: Biological effects of ionizing radiation, Operational limits and basics of radiation hazards, its evaluation and control: radiation protection standards.

Unit 4: **3 hours**

Application of radiation as a technique: Application in medical science (e.g., basic principles of X-rays, MRI, PET, CT scan, Projection Imaging Gamma Camera, Radiation therapy), Archaeology, Art, Crime detection, Mining and oil. Industrial Uses: Tracing, Gauging, Material Modification, Sterilization, Food preservation.

PRACTICAL **30 hours**

Minimum five experiments need to be performed from the following, graphs to be plotted using any graphical plotting software

1) Estimate the energy loss of different projectiles/ions in Water and carbon, using SRIM/TRIM etc. simulation software, (different projectiles/ions to be used by different students).
2) Simulation study (using SRIM/TRIM or any other software) of radiation depth in materials (Carbon, Silver, Gold, Lead) using H as projectile/ion.
3) Comparison of interaction of projectiles with Z_P = 1 to 92 (where Z_P is atomic number of projectile/ion) in a given medium (Mylar, Carbon, Water) using simulation software (SRIM etc).
4) SRIM/TRIM based experiments to study ion-matter interaction of heavy projectiles on heavy atoms. The range of investigations will be Z_P = 6 to 92 on Z_A = 16 to 92 (where Z_P and Z_A are atomic numbers of projectile and atoms respectively). Draw and infer appropriate Bragg Curves.
5) Calculation of absorption/transmission of X-rays, γ-rays through Mylar, Be, C, Al, Fe and Z_A = 47 to 92 (where Z_A is atomic number of atoms to be investigated as targets) using XCOM, NIST (https://physics.nist.gov/PhysRefData/Xcom/html/xcom1.html).
6) Study the background radiation in different places and identify the source material from gamma ray energy spectrum. (Gamma ray energies are available in the website http://www.nndc.bnl.gov/nudat2/).
7) Study the background radiation levels using Radiation meter.
8) Study of characteristics of GM tube and determination of operating voltage and plateau length using background radiation as source (without commercial source).
9) Study of counting statistics using background radiation using GM counter.
10) Study of radiation in various materials (e.g. KSO_4 etc.). Investigation of possible radiation in different routine materials by operating GM counter at operating voltage.
11) Study of absorption of beta particles in Aluminum using GM counter.
12) Measurement of gamma ray attenuation co-efficient of aluminium using GM counter.
13) Estimation of half thickness for aluminium using GM Counter.

Essential Readings:

- Basic ideas and concepts in Nuclear Physics: An introductory approach by K Heyde, third edition, IOP Publication, 1999.
- Nuclear Physics by S N Ghoshal, First edition, S. Chand Publication, 2010.
- Nuclear Physics: Principles and Applications by J Lilley, Wiley Publication, 2006.
- Fundamental Physics of Radiology by W J Meredith and B Massey, John Wright and Sons, UK, 1989.
- An Introduction to Radiation Protection by A Martin and S A Harbisor , John Willey and Sons, Inc. NewYork, 1981.

Suggestive Readings:

- Radiation detection and measurement by G F Knoll, 4th Edition, Wiley Publications, 2010.
- Techniques for Nuclear and Particle Physics experiments by W R Leo, Springer, 1994.
- Thermoluminescence dosimetry by A F Mcknlay, Bristol, Adam Hilger (Medical Physics Hand book 5
- Medical Radiation Physics by W R Hendee, Year book Medical Publishers, Inc., London, 1981.
- Physics and Engineering of Radiation Detection by S N Ahmed, Academic Press Elsevier, 2007.
- IAEA Publications: (a) General safety requirements Part 1, No. GSR Part 1 (2010), Part 3 No. GSR Part 3 (Interium) (2010); (b) Safety Standards Series No. RS-G-1.5 (2002), Rs-G-1.9 (2005), Safety Series No. 120 (1996); (c) Safety Guide GS-G-2.1 (2007).

References (for Laboratory Work):

- Schaum's Outline of Modern Physics, McGraw-Hill, 1999.
- Schaum's Outline of College Physics, by E. Hecht, 11th edition, McGraw Hill, 2009.
- Modern Physics by K Sivaprasath and R Murugeshan, S Chand Publication, 2010.
- AERB Safety Guide (Guide No. AERB/RF-RS/SG-1), Security of radioactive sources in radiation facilities, 2011
- AERB Safety Standard No. AERB/SS/3 (Rev. 1), Testing and Classification of sealed Radioactivity Sources., 2007.

Examination scheme and mode:

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

Chemistry Lab Standard Operations and Safety Measures

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		
Chemistry Lab Operations and Safety Measures	2	0	0	2	XIIth Pass with Science	NIL

Learning Objectives

- To cultivate efficient working skills among the students to work in a chemistry laboratory
- To create a trained workforce which can responsibly learn imbibe and explore verticals on structured knowledge safely.
- To make students aware of different chemicals and their properties being used in the chemistry laboratory.

Learning outcomes

After studying this course, the student will be:

- Able to design and implement safe working practices in chemistry laboratory.
- Able to safely handle different glass apparatus
- Able to handle the chemicals and equipment safely and properly.
- Able to design working protocols related to various methods and instruments in chemistry laboratory.

SYLLABUS

Practicals/ Hands-on Training: (60 hours)

Part A: Safety Measures

1) Design an illustrative chart exhibiting creativity at transaction of Do's and Don'ts instructions for working in a chemistry laboratory.
2) i. Carry out Classification and labeling of the given set of chemicals based upon Globally Harmonized System.
   ii. Carry out detailed survey of the Chemical Abstract Service (CAS) Registry Number and identify the given set of CAS RN and explain the different sections of CAS RN.
3) Carry out preparation of the indicative MSDS (Material Safety Data Sheet) of given set of chemicals as per Standard MSDS format.
4) Design an illustrative chart exhibiting creativity at transaction of Common Safety Symbols along with its description. Associate appropriate safety symbol with each of the given set of chemicals.

5) Draw and elucidate the National Fire Protection Association Hazard Labels.

6) i. Identify and enlist the Incompatible Chemicals from a given set of chemicals available in the laboratory.
   ii. Carry out investigations on Labeling and storage of Chemical in laboratory.

7) i. On the basis of MSDS analysis, identify the required storage conditions for the given set of chemicals.
   ii. Describe procedure for the storage, maintenance and handling of compressed gas cylinders.

   iii. Explore guidelines for the Storage of shelf chemicals and reagents.

8) i. Carry out a brief review of common pathways by which working Chemicals can enter the Body.
   ii. Carry out a detailed study of the Limits of Exposure of given Chemicals.

9) i. Classify the Hazard based on storage, handling, and disposal of chemicals.
   ii. Identification and describe handling protocols for Substances with Greater Hazardous Nature.

10) Carry out detailed investigations on procedural protocols for safe Disposal of Chemicals.
11) i. Carry out study on recommended Safety and Emergency Equipment essential for the safe practices in a Chemistry Laboratory.
   ii. Study the guidelines in the Event of a Chemical Accident or Spill.

12) i. Write detailed description on Fire Safety in the laboratory.
   ii. Carry out investigations of the data regarding Institute Safety Policies: Safety Audits / Inspections.

Part B: Chemistry Lab Standard Operations

1) Carry out exploration on Holding, Handling and use of Common Laboratory Apparatus as per given list of laboratory apparatus (Appendix A).
2) Carry out investigations of various types of apparatus in labs based on material they are made of such as Pyrex Glass (borosilicate Glass) Apparatus, Fused Silica Apparatus: Corning Vycor Glass, Porcelain apparatus, Plastic Apparatus, Metal Apparatus.
3) Understanding the protocol of Cleaning and drying and polishing of Glassware apparatus.
4) Carry out detailed investigations on Identification, diagrammatic representation, set up of Apparatus assemblies and details exploration on operational procedural protocols for glassware apparatus with Interchangeable ground glass joints: Typical Assemblies.
5) i. Carry out calibration of Volumetric/ Graduated Glassware Apparatus along with description on Temperature Standards.
   ii. Carry out Calibration of thermometers.

6) i. Carry out exploration and investigations of working protocol for various heating equipment in laboratory: Burners, Hot Plates, Electrical Heating Mantles, Electric Oven,

Microwave Oven, Muffle Furnace, Infrared lamps, Crucible and Beaker Tongs and Emersion heaters.

ii. Carry out exploration and investigations of working protocol for various Stirring apparatus in laboratory: Stirring rods; Policeman, Boiling rods, Use of Mechanical agitation-Magnetic Stirrer and Mechanical Shaker.

iii. Carefully analyze the Glass, Cork and Rubber Stoppers and investigate their preparation and appropriate applications.

7) i. Carry out detailed investigations of Heating and Cooling Bath, and determine their working ranges and working protocols.
ii. Explore and differentiate between different forms of water for Laboratory Use: Distilled (Grade I to III), De-ionized and tap water, and carry out conductance measurement /other analytical investigations for the differentiation purpose.

8) i. Differentiate among Various types of Filter Paper and explore their applications.
ii. Preparation of a fluted filter paper and its advantages.

iii. Classification of reagents as AR/ GR grade.

9) i. Care and Use of Analytical Balance: Mass and Weight, Two-Pan Balance and Electronic Balance.
ii. Carry out Calibration of weighing balances and accuracy in measurement.

10) Introduction to Chromatographic adsorption: Paper and Thin Layer Chromatography. Preparation of Thin Layer Chromatography (TLC) Plates.

11) i. Use of melting point apparatus. Experimental determination of the melting point using various methods.
ii. Experimental determination of the boiling point using various methods.

12) To Purify given organic solvents.
13) i. Hand on training for working with typical assemblies of apparatus for distillation and refluxing.
ii. Assessment of Fire hazards attending the distillation of inflammable solvents.

14) i. Purification of given solid organic compounds by crystallisation method.
ii. Recrystallization of given non-volatile organic solids and outline the Difficulties encountered in recrystallization process.

15) Removal of traces of colouring matter and use of decolourising carbon.
16) i. Carry out exploration and investigations of working and working protocol for Filtration Apparatus: Filtration with suction.
ii. Explore and imbibe knowledge about types of Vacuum Pump; Water and Oil Pump and their applications.

17) Investigate Conventions for Drying of the recrystallized material.
18) i. Introduction to Gas absorption traps and their importance.
ii. Recrystallization in an atmosphere of inert gas.

19) i. Performing Evaporation of the solvent in the laboratory.
ii. Preparation of anhydrous liquids or solutions of organic compounds in organic solvents.

20) i. Various procedures for the precipitation and washing of the precipitates.
ii. Application of various methods and instruments for drying of solid organic compounds.

21) i. Incineration of Filter paper with precipitate.
ii. Differentiate between various types of centrifugation methods, principle, uses and application of centrifugation method.

iii. Calculation of yields for different chemical processes.

22) In-depth Understanding and Preparation of Chemical Laboratory Reagents.
23) Explore methodologies of Preparation and Storage of Standard Solutions.

Important Instruction Note on working approach:

A minimum of 5 exercises from Part A and 10 exercises from Part B is required to be discussed/performed/investigate. Moreover, exercises related to MSDS, CASRN safety symbols identification is required to be performed mandatorily.

Mandatory exercises:

Part A Exercise No.: 2, 3, 4, 5 and 9

Part B Exercise No.: 1 to 10.

The exercises mentioned above will be performed by the student strictly in accordance with the instructions received and only under the supervision of the teacher concerned.

Essential Readings:

1. Skoog D.A., West D.M., Holler F.J., Stanley R.C., **Fundamentals of analytical chemistry**, 9th Edition, Cengage Learning.
2. Mendham, J.; Denney, R.C.; Barnes, J.D.; Thomas, M.J.K. (2007), **Vogel's Quantitative Chemical Analysis**, 6th Edition, Prentice Hall.
3. Furniss, B. S; Hannaford, A. J.; Smith, Peter W. G.; Tatchell, A. R; **Vogel's Text Book of Practical Organic Chemistry**, 5th Edition, Longman Scientific and Technical, Longman Group Ltd.
4. Garland, C. W.; Nibler, J. W.; Shoemaker, D. P. (2003), **Experiments in Physical Chemistry**, 8th Edition, McGraw-Hill, New York.
5. https://iupac.org/
6. https://edu.rsc.org/resources/practical/experiments

Examination scheme and mode:

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

Chemistry of Cosmetics and Hygiene Products

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		
Chemistry of Cosmetics and Hygiene Products	2	0	0	2	XIIth Pass with Science	NIL

Learning Objectives

- To introduce the concept of cosmetics in terms of chemistry and their formulation.
- To make students understand the role of each ingredients in the preparation of the cosmetic products.
- To give an idea about the role of herbal ingredients in the making of any cosmetic product.

Learning Outcomes

After studying this course, the student will:

- Be familiar with the basic principles of various cosmetic formulations
- Be aware of different ingredients and their roles in cosmetic products.
- Appreciate the role of herbal ingredients in various cosmetic products
- Use safe, economic and body-friendly cosmetics
- Prepare new innovative formulations to achieve the aimed efficacies and effects

SYLLABUS

Practicals/Hands-on-training **60 hours**

1. Definition, History and Classification of cosmetic & cosmeceutical products.

Skin Care Products: Basic structure and function of skin. Principles of formulation of skin care products. Role of herbs in Skin Care: Aloe and turmeric. General Ingredients and preparation of

(a) Preparation of Talcum powder (chemical based and herbal)

(b) Face cream/ vanishing cream/ cold cream/ suntan cream/lather shaving cream (any two)

(c) Body lotion

2. **Hair Care Products**: Basic structure of hair and classification of hair. Principles of formulation of Hair care products. Types of shampoo and conditioners. Role of herbs in Hair care: Henna and amla. Role of primary and secondary surfactants in shampoo. General Ingredients and preparation of

(a) Shampoo (chemical based and herbal)

(b) Conditioners

3. **Hand Care and hygiene Products**: Principles of formulation of hand sanitizers and hand wash. General Ingredients and preparation of:

(a) Hand wash

(b) Hand sanitizer

4. **Nail preparation**: Structure of nail, Nail lacquers, Nail polish remover. General Ingredients and preparation of:

(a) Nail polish and nail polish remover

5. **Personal hygiene products**: Total fatty matter, alkali content and pH of soaps. Bathing soap and toilet soap. Antiperspirants and deodorants. General Ingredients and preparation of

(a) Soaps

(b) Cream Soaps

6. **Oral hygiene products**: **Common problem associated with teeth and gums.Role of herbs in oral care: Neem and clove.** Principles of formulation of Oral hygiene products. Flavours and essential oils. General Ingredients and preparation of

(a) Tooth powder (chemical based and herbal)

(b) Tooth paste

Essential Readings

- Barel, A.O.; Paye, M.; Maibach, H.I. (2014), **Handbook of Cosmetic Science and Technology,** CRC Press.
- Garud, A.; Sharma, P.K.; Garud, N. (2012), **Text Book of Cosmetics**, Pragati Prakashan.
- Gupta, P.K.; Gupta, S.K. (2011), **Pharmaceutics and Cosmetics**, Pragati Prakashan
- Butler, H. (2000), **Poucher's Perfumes, Cosmetic and Soap**, Springer

Suggestive Readings:

- Flick, E.W. (1990), **Cosmetic and toiletry formulations,** Noyes Publications / William Andrew Publishing.
- Natural Ingredients for Cosmetics; EU Survey 2005
- Formulation Guide for cosmetics; The Nisshin OilliO Group, Ltd.

- Functional Ingredients & Formulated Products for Cosmetics & Pharmaceuticals; NOF Corporation

Examination scheme and mode:

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

Basic Analytical Techniques

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		
Basic Analytical Techniques	2	0	0	2	XIIth Pass with Science	NIL

Learning Objectives

- To make students aware of the importance and the concepts of chemical analysis of water and soil samples collected from different sources
- To make them learn few techniques like chromatography, analytical techniques and instrumentation techniques, for example: spectrophotometry and flame photometry.

Learning Outcomes

After studying this course, the student will able to:

- Handle analytical data
- Determine the pH and conductance of soil samples, which can be useful in agriculture sector
- Do quantitative analysis of metal ions in water samples
- Separate ions using chromatographic techniques
- Estimate macronutrients using Flame photometry.

SYLLABUS

Practical: **60 hours**

1. Determination of pH of soil samples collected from college nursery, sports ground and the soil collected from Yamuna River Bank.
2. Determination of conductance of soil samples collected from college nursery and sports ground.
3. Determination of pH of different types of aerated drinks and fruit juices.
4. Estimation of Calcium and Magnesium ions as Calcium carbonate (total hardness) by complexometric titration.
5. Determination of pH, acidity, and alkalinity of water samples collected from different water body/supply sources like Yamuna water, MCD supply water, Groundwater, water samples collected from water sewage treatment plants (Delhi /NCR).
6. Determination of dissolved oxygen (DO) of a water sample collected from different sources (at least two sources).
7. Determination of BOD of water sample collected from different water sources.

8. Paper chromatographic separation (*ascending and circular both*) of the mixture of metal ion (Ni^{2+} and Co^{2+}) and (Cu^{2+} and Cd^{2+}).
9. To study the use of phenolphthalein in trap cases.
10. Estimation of macro-nutrients: Potassium, calcium and magnesium in soil samples by flame photometry.
11. Spectrophotometric determination of Iron in vitamin / dietary tablets / different solutions of iron.
12. Spectrophotometric identification and determination of caffeine and benzoic acid in soft drink.
13. Spectrophotometric determination of cadmium and chromium in the given water sample.
14. Determination of ion exchange capacity of anion / cation exchange resin (using batch procedure if use of column is not feasible).
15. Visit STP plants and different chemical industries.

Essential Readings:

- Svehla, G. (1996), **Vogel's Qualitative Inorganic Analysis**, Prentice Hall.
- Mendham, J.; Denney, R.C.; Barnes, J.D.; Thomas, M.J.K. (2007), **Vogel's Quantitative Chemical Analysis**, 6th Edition, Prentice Hall.
- De, A. K. (2021), **Environmental Chemistry**, 10th edition. New Age International Pvt. Ltd.

Note: Learners are advised to use the latest edition of readings.

Examination scheme and mode:

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

Essential Food Nutrients

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		
Essential Food Nutrients	2	1	0	1	XIIth Pass with Science	NIL

Learning Objectives

- To develop a basic understanding of the components of food, their source, properties and interactions as well as changes that occur during processing, storage, and utilization

Learning Outcomes

After studying this course, the student will be able to:

- Account for chemistry of foods: composition of food, role of each component
- Recognize some of the reactions and changes in individual food components which occur during processing, handling and storage

SYLLABUS

Theory:

Unit 1: Carbohydrates **3 hours**

Introduction, sources, functions, deficiencies, Structures of monosaccharides and disaccharides: glucose, fructose, galactose; lactose, maltose, sucrose, maltitol, concept of reducing and non-reducing sugars; role of carbohydrates as sweeteners in food; lactose intolerance, galactosemia, dental plaque, overview of carbohydrate metabolism.

Unit 2: Lipids **5 hours**

Introduction, sources, functions, deficiencies, classification (fatty acids, phospholipids, fats & oils, waxes), common fatty acids present in oils and fats, Omega- 3,6,9 fatty acids, trans fats, chemical properties: iodine value, saponification value, effect of frying on fats, changes in fats and oils-rancidity, lipolysis, flavor reversion, auto-oxidation and its prevention.

Unit 3: Proteins **5 hours**

Introduction, sources, functions, deficiencies, protein structure (primary, secondary and tertiary), physico-chemical & functional properties of proteins, food proteins: animal and plant proteins.

Unit 4: Vitamins & Minerals **2 hours**

Vitamins: Introduction, classification: fat-soluble vitamins & water-soluble vitamins.
Minerals: Introduction, classification: macrominerals (Ca, P, Mg) & microminerals (Se, Fe, I, Co, Zn, Cu, Se, Cr).
Role of vitamins and minerals in food chemistry.

Practicals/Hands-on Training **30 hours**

1. Determination of moisture in food products by hot air oven-drying method.
2. Colorimetric determination of iron in vitamin/dietary tablets.
3. Estimation of Vitamin C in a given solution/lemon juice/chillies by 2, 6 Dichlorophenol indophenol method.
4. Estimation of total soluble sugar content by ferricyanide method (volumetric analysis).
5. Determination of saponification value of the given fat/oil.
6. Determination of iodine value of the given fat/oil.
7. Qualitative tests for proteins and carbohydrates.
8. Qualitative Estimation of cholesterol by Liebermann Burchard method.

Essential Readings:

Theory:

- deMan, J.M., Finley, J.W., Hurst, W.J., Lee, C.Y. (2018), **Principles of Food Chemistry**, 4th Edition, Springer.
- Msagati, T.A.M. (2013), **Chemistry of Food Additives and Preservatives**, Wiley-Blackwell.
- Fennema, O.R. (2017), **Food Chemistry**, 5th Edition, CRC Press.
- Attokaran, M. (2017), **Natural Food Flavors and Colorants**, 2nd Ed., Wiley-Blackwell.
- Potter, N.N., Hotchkiss, J.H, (1995) **Food Science,** 5th Ed., Chapman & Hall.
- Brannen, D., Davidsin, P.M., Salminen, T. Thorngate III, J.H. (2002), **Food Additives**, 2nd Edition, CRC Press.
- Coultate, T. (2016), **Food: The Chemistry of its Components**, 6thEdn., Royal Society of Chemistry.
- Belitz, H. D.; Grosch, W. (2009), **Food Chemistry**, Springer.
- Course: FOOD CHEMISTRY (iasri.res.in)

Practicals:

- Ranganna, S. (2017). **Handbook of analysis and quality control for fruits and vegetable products**, 2ndEdn., McGraw Hill Education
- Sawhney, S.K., Singh, R. (2001), **Introductory Practical Biochemistry**, Narosa Publishing House

Examination scheme and mode:

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

Forensic Chemistry

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		
Forensic Chemistry	2	1	0	1	XIIth Pass with Science	NIL

Learning Objectives

- To introduce students to this fascinating branch of science and familiarize them with important concepts like fingerprints, explosives/arson, drugs and their detection.

Learning outcomes

After studying this course, the student will be able to:

- Describe latent fingerprints, various methods of detection of latent fingerprints, explosive analysis in forensic science, collection and preservation of evidence from crime scene etc

SYLLABUS
Theory:

Unit 1: History of Development of Forensic Science in India **2 hours**
Definitions, Scope and Need of forensic science, Ethics in forensic science, History of forensic science, Basic principles of forensic science, Organizational structure of forensic science laboratories, Different branches in forensic science

Unit 2: Fingerprints **5 hours**
Definition, History of fingerprint identification, Fingerprint as forensic evidence, Visible Finger marks, Latent Finger marks, ten-digit classification, Methods of Development of latent fingerprints using conventional methods–Powdering (Black and grey, fluorescent and magnetic), Methods of development of latent fingerprint using chemical method (iodine fuming, silver nitrate, Ninhydrin, Vacuum metal deposition), Automated Fingerprint identification system (AFIS), Poroscopy and Edgescopy

Unit 3: Forensic Chemistry **8 hours**
Scope & significance of Forensic Chemistry, Types of cases/exhibits received for analysis. Trap Cases: Collection, and Preliminary analysis of evidence in trap cases.
Alcoholic Beverages: Types of alcohols, country made liquor, illicit liquor, denatured spirits, Indian made foreign alcoholic and non-alcoholic beverages.
Dyes: Scope & Significance of dyes in crime investigation, analysis of ink by TLC and UV visible spectrophotometry. Petroleum products and their adulterations: Chemical composition of various

fractions of Petroleum Products, Analysis of petrol, kerosene, diesel.
Fire/Arson and Explosives Fire: Introduction to Fire & Arson, origin of fire, Chemistry of Fire, Fire tetrahedron,Firefighting operations, preservation of fire scene, collection of evidences, Seat of fire, cause of fire, motives, Analysis of fire debris, Case studies related to fire and Arson. Explosive and Explosion: Scope & significance of explosive analysis in forensic science, Types of explosives, deflagration and detonation, explosive trains, collection, preservation and forwarding of exhibits, preliminary analysis of explosives. Dos and Don'ts. Case studies related to explosives.
Drugs of abuse: Classification, including designer drugs. Ill effects of drugs of abuse, Preliminary and conformatory tests.

Practicals/ Hands-on Training **30 hours**

1. Development of fingerprint through conventional powder method.
2. Development of fingerprint through chemical methods.
3. To check the alcohol presence in different liquor.
4. Phenolphthalein test for trap cases.
5. Identification of Handwriting Individual Characteristics.
6. Study of Disguise in handwriting.
7. TLC of amino acids

Essential/recommended readings

- Saferstein, R. (1990) Criminalistics, Prentice Hall, New York.
- Basic Principles of Forensic Chemistry by JaVed I. Khan • Thomas J. Kennedy Donnell R. Christian, Jr.
- Fundamentals of FINGERPRINT ANALYSIS Hillary Moses Daluz
- Clarke's Analysis of Drugs and Poisons 3rd Ed.

Examination scheme and mode:

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

Green Methods in Chemistry

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		
Green Methods in Chemistry	**2**	**0**	**0**	**2**	**XIIth Pass with Science**	NIL

Learning Objectives:

The learning objectives of this course are as follows:

- To create awareness about the chemistry that is good for human health and the environment.
- To provide thorough knowledge of the green chemistry principles, and new remediation technologies for the cleaning up of hazardous substances.
- To develop basic skills to be able to design, develop and run chemical processes in a sustainable way.

Learning Outcomes:

After studying this course, the student will be able to:

- Design and develop materials/ processes that reduce the use and generation of hazardous substances in industry.
- Describe how injudicious use of chemicals can have an adverse/potentially damaging effect on humans and the environment.
- Propose ideas for innovative approaches to environmental and societal challenges.
- Critically analyse the existing traditional chemical pathways/processes and creatively think about bringing environmentally benign reformations in these protocols.
- Convert biomass into valuable chemicals through green technologies.

SYLLABUS

Practicals/Hands-on Training **60 hours**

1. Definition and Importance of green chemistry. Introduction to the prevention of waste/ by products and waste/ pollution prevention hierarchy. Provide the scheme for the traditional as well as green method for the synthesis of ibuprofen and ask students to compare the amount and hazards of waste generated in both the processes.

2. Principle and calculation of atom economy. Use of molecular model kit to stimulate the reaction

to investigate how the atom economy can illustrate Green Chemistry.

Preparation of propene by two methods can be studied

(I) Hoffman elimination

(II) Dehydration of propanol

The other types of reactions, like addition, elimination, substitution and rearrangement should also be studied for the calculation of atom economy

3. Prevention/ minimization of hazardous/ toxic products reducing toxicity. Risk = (function) hazard x exposure.

(a) Nitration of salicylic acid using green method $Ca(NO_3)_2$

(b) Preparation and characterization of nanoparticles of gold using tea leaves/silver nanoparticles using plant extracts.

(c) Preparation of dibenzalacetone by cross aldol condensation reaction using base catalysed green method

(d) Acetylation of primary aromatic amine using the green method.

4. Use of Green solvents and comparison of greenness of solvents:

(a) Explain about supercritical fluids with special reference to carbon dioxide. Extraction of D-limonene from orange peel using liquid CO_2 prepared from dry ice

(b) Introduction to water as a solvent for chemical reactions. preparation of Manganese (III) acetylacetonate using green method

(c) Advantages and application of solventless processes in organic reactions.

(i) Benzil- Benzilic acid rearrangement in solid State under solvent-free Condition.

(ii) Mechanochemical solvent free, solid–solid synthesis of azomethine using *p*- toluidine and *o*-vanillin/*p*-vanillin

5. Energy requirements for reactions – alternative sources of energy: use of microwaves and photochemical energy.

(a) Photoreduction of benzophenone to benzopinacol in the presence of sunlight.

(b) Microwave assisted ammonium formate-mediated Knoevenagel reaction: *p*-anisaldehyde, ethyl cyanoacetate, ammonium formate.

6. Selection of renewable starting material rather than depleting, Illustrate with few examples such as biodiesel and polymers from renewable resources (such as green plastic). Preparation of biodiesel from waste cooking oil and characterization.

7. Importance of using catalytic reagents in preference to stoichiometric reagents; catalysis and green chemistry, comparison of heterogeneous and homogeneous catalysis, biocatalysis, asymmetric catalysis and photocatalysis.

(a) Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide

(b) Rearrangement of diazoamino benzene to *p*-aminoazo benzene using K10 montmorillonite clay

8. Students should be asked to prepare a presentation/project based on any of the following topics:

- Bhopal Gas Tragedy and safer route to carbaryl synthesis
- Flixiborough accident and safer route to cyclohexanol
- Use of Surfactants for SC-CO_2 for precision cleaning and dry cleaning of garments replacing PERC.
- A brief study of Green Chemistry Challenge Awards (Introduction, award categories and study about five last recent awards
- Healthier Fats and oils by Green Chemistry: Enzymatic Interesterification for production of No Trans-Fats and Oils.
- Synthesis of anti-tuberculosis drug Paramycin from waste water stream
- Syntheses of vitamin D_3 using photochemical energy
- Greener Manufacturing of Sitagliptin Enabled by an Evolved Transaminase
- Microwave assisted solvent free synthesis of aspirin
- Synthesis of 6-Aminopenicillanic Acid (6-APA) from penicillin G using biocatalyst.

Essential Readings:
Theory:

- Anastas, P.T., Warner, J.C. (2014), Green Chemistry, Theory and Practice, Oxford University Press.
- Lancaster, M. (2016), Green Chemistry: An Introductory Text, 3rd Ed., RSC Publishing.
- Cann, M.C., Connely, M. E. (2000), Real-World cases in Green Chemistry, American Chemical Society, Washington.
- Matlack, A.S. (2010), Introduction to Green Chemistry, 2nd Ed., CRC Press.
- Alhuwalia, V.K.; Kidwai, M.R. (2012), New Trends in Green chemistry, Kluwer Academic Publishers, Springer.
- Sidhwani, I.T; Sharma, R.K. (2020), An Introductory Text on Green Chemistry, Wiley India Pvt Ltd.
- Etzkorn, F. A . (2019), Green Chemistry: Principles and Case Studies, Royal Society of Chemistry.

Practicals:

- Kirchoff, M., Ryan, M.A. (2002), **Greener approaches to undergraduate chemistry experiment**, American Chemical Society, Washington DC.
- Sharma, R.K., Sidhwani, I.T., Chaudhari, M.K. (2013), **Green Chemistry Experiments: A monograph**, I.K. International Publishing House Pvt Ltd. New Delhi.
- Pavia, D.L., Lamponam, G.H., Kriz, G.S.W. (2006), **Introduction to organic Laboratory Technique- A Microscale approach**, 4th Edition, Brooks-Cole Laboratory Series for Organic chemistry.
- Sidhwani, I.T. ; Saini, G.; Chowdhury, S. **Wealth from Waste: A green method to produce biodiesel from waste cooking oil and generation of useful products from**

waste further generated. University of Delhi, Journal of Undergraduate Research and Innovation, Volume 1, Issue 1, February 2015, ISSN: 2395-2334.

- Sharma, R. K., Gulati, S., Mehta, S. (2012), **Preparation of Gold Nanoparticles Using Tea: A Green Chemistry Experiment,** Journal of Chemical Education, 89 (10), 1316-1318.

Examination scheme and mode:

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

Lab Testing and Quality Assurance

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		
Lab Testing and Quality Assurance	2	1	0	1	XIIth Pass with Science	NIL

Learning Objectives:

The objective of this course is :

- To introduce the concept of quality check and quality control in chemical industries.

Learning Outcomes:

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

- Describe role of quality control chemist
- Discuss and demonstrate analytical and separation techniques
- Carry out sample preparation
- Illustrate fundamentals of quality check
- Describe and use safety procedures

SYLLABUS

Unit 1: Introduction **2 hours**

Industry and sub-sectors, standards for manufacturing in life-sciences, drug regulatory agencies, role of quality control chemist, quality management systems

Unit 2: Modern Analytical methods and separation techniques **5 hours**

Gravimetric methods, volumetric methods, electroanalytical methods, spectroscopic methods, chromatographic techniques

Unit 3: Sample preparation **2 hours**

Basics of sample preparation, preservation and storage, standards and guidelines for sample handling, good storage practices

Unit 4: Quality check **6 hours**

Overview, productivity concept, statistical analysis of laboratory data, measurements, calibrations, validation, reference standards and materials, requirements of a calibration lab, fundamentals of advanced QC approaches, Trouble shooting in QC, documentation, audit/ process related query, Quality certifications, Government regulations in industries like pharmaceuticals, food supplements, cosmetics.

Practicals/Hands-on-Training **30 hours**

1. Calibration of glassware
2. Weighing of samples, accuracy of measurements
3. Preparation of TLC plates and separation of amino acids
4. Working protocols of various laboratory instruments-oven, pH-meter, conductivity meter, water baths, muffle furnace, spectrophotometer.
5. Calibration of instruments like colourimeter, pH-meter, conductivity meter, spectrophotometer using reference standards or reference materials.

Suggested exercise: Visit some industries to study the validation of simple procedures.

Essential readings:

- Skoog D.A., West D.M., Holler, F.J., Crouch S.R., **Fundamentals of Analytical Chemistry**, 9th Edition, Cengage learning.
- **Quality control chemist participant manual** prepared by LSSSDC in collaboration with NSDC India.
- iso.org

Examination scheme and mode:

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

Chemistry of Food Flavors and Colourants

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		
Chemistry of Food Flavors and Colourants	**2**	**1**	**0**	**1**	**XIIth Pass with Science**	NIL

Learning Objectives:

The learning objectives of this course are as follows:

- To provide introduction to quality attributes of food such as appearance and flavour.
- To impart an understanding of the chemistry of the flavour as well as colour constituents of foods.

Learning Outcomes:

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

- Describe mechanisms of flavor perception
- Demonstrate various mechanisms of flavor formation
- Discuss the chemical dimension of flavour.
- Recognize off-flavor defects in foods and strategies to control it.

SYLLABUS

Unit 1: Flavors **9 hours**

Introduction and importance of flavors in food.
Taste & Odour: Structure and physiology of taste organs- tongue, papillae, taste buds, salivary glands, Mechanism of taste and odour perception
Basic Types of taste : Salty, Sweet, Bitter, Sour, Umami taste, Chemical dimensions of basic tastes (sweet, salt, sour, bitter and umami), odour and other sensations (like astringency, coolness, pungency/pungency), Non-nutritive and nutritive sweeteners (including structures of aspartame, saccharin, sucralose, Stevioside), Molecular Theory of Sweetness, Taste Inhibition and enhancement, Chemical dimension of Flavors (peppers, peppermint, coriander, cinnamon, onion), Chemistry of food flavorings: Maillard browning, enzymic browning reactions, caramelisation browning, Off-Flavour in Food (Rancidity in Fats/Oils, Non Enzymic Browning), Control of enzymic browning (acidulants, chelating agents, heat treatment etc)

Unit 2: Food Colours **6 hours**

Introduction, importance, classification: Natural food colourants (Anthocyanins, Carotenoids, Chlorophyll), Examples of Pigments in common food (turmeric, tomato, carrot, orange); Nature-identical colourants (β-Carotene, Canthaxanthin and Riboflavin); Artificial/synthetic colourants: Azo dyes (e.g. amaranth dye, tatrazine, citrous red); Quinoline (e.g. quinoline yellow); Phthalein (e.g. erythrosine); Triarylmethanes and indigoid (e.g. indigo carmine), FD&C Dyes and Lakes.

Practicals/Hands-on-Training **30 hours**

1. Determination of the taste threshold for the different sensations – sweet, salty, sour.
2. Extraction of limonene from orange peels using supercritical carbon dioxide.
3. Quantitative determination of food dyes in powdered drink mixes by spectrophotometric method.
4. Extraction and separation of pigments present in spinach by Thin Layer Chromatography (TLC).
5. Experiment to demonstrate the enzymic browning and its prevention.
6. Determination of rancidity of edible oils by Kriess Test.
7. Estimation of carotenoids in sample by colorimetric method.

Essential readings:

Theory:

- DeMan, J.M., Finley, J.W., Hurst, W.J., Lee, C.Y. (2018), **Principles of Food Chemistry**, 4th Edition, Springer.
- Msagati, T.A.M. (2013), **Chemistry of Food Additives and Preservatives**, Wiley-Blackwell.
- Fennema, O.R. (2017), **Food Chemistry**, 5th Edition, CRC Press.
- Attokaran, M. (2017), **Natural Food Flavors and Colorants**, 2nd Ed., Wiley-Blackwell.
- Potter, N.N., Hotchkiss, J.H, (1995) **Food Science,** 5th Ed., Chapman & Hall.
- Brannen, D., Davidsin, P.M., Salminen, T. Thorngate III, J.H. (2002), **Food Additives**, 2nd Edition, CRC Press.
- Coultate, T. (2016), **Food: The Chemistry of its Components**, 6th Edn., Royal Society of Chemistry.
- Belitz, H. D.; Grosch, W. (2009), **Food Chemistry**, Springer.
- Course: FOOD CHEMISTRY (iasri.res.in)

Practicals:

- Ranganna, S. (2017). **Handbook of analysis and quality control for fruits and vegetable products**, 2nd Edn., McGraw Hill Education
- Sawhney, S.K., Singh, R. (2001), **Introductory Practical Biochemistry**, Narosa Publishing House

Examination scheme and mode:

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

PCB Designing and Fabrication

CREDIT DISTRIBUTION, ELIGIBILITY AND PREREQUISITES 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		
PCB Designing and Fabrication	2	0	0	2	Class XII	NIL

Learning Objectives

The Learning Objectives of the course are as follows:

- To give a comprehensive understanding and hands-on exposure to the various processes, industrial tools, protocols, and design specifics which are involved in PCB Designing
- To enable the students to design an electronic printed circuit board for a specific application using industry-standard software after going through the complete procedural steps of developing circuit schematic, board files, image transferring, assembly, soldering, and testing.

Learning Outcomes

After Studying this course, the student will be able to:

- Identify the various types of devices/components that may be mounted on PCB
- Understand the PCB layout techniques for optimized component density and power saving.
- Perform design and printing of PCB with the help of various image transfer and soldering techniques
- Understand the current trends and scope of the PCB industry

Syllabus

Practical

Unit 1: PCB Fundamentals **12 hours**

PCB Advantages, components of PCB, Electronic components, Microprocessors and Microcontrollers, IC‘s, Surface Mount Devices (SMD). Classification of PCB - single, double, multilayer, and flexible boards, Manufacturing of PCB, PCB standards.

Unit 2 : Schematic & Layout Design **16 hours**

Schematic diagram, General, Mechanical, and Electrical design considerations, Placing and Mounting of components, Conductor spacing, routing guidelines, heat sinks and package density, Net list, creating components for a library, Tracks, Pads, Vias, power plane, grounding.

Unit 3: PCB Design Processes **20 hours**

Design automation, Design Rule Checking; Exporting Drill and Gerber Files; Drills; Footprints and Libraries Adding and Editing Pins, copper-clad laminates materials of copper-clad laminates, properties of laminates (electrical & physical), types of laminates, soldering

techniques. Film master preparation, Image transfer, photo printing, Screen Printing, Plating techniques, Etching techniques, Mechanical Machining operations, Lead cutting and Soldering Techniques, Testing, and quality controls.

Unit 4 : PCB Technology **12 hours**

Introduction of PCB prototyping machines, Schematic Entry, PCB Parts creation, Auto Routing, Post Design, Brief overview of various models available, Recent Trends, and environmental concerns in the PCB industry.

Exercises

PCB Designing, Fabrication, Component Mounting and Testing using Standard Procedures (Hardware)

A. Analog Electronic Circuits

1. Verification of Thevenin theorem
2. Designing of RC Low Pass Filter and High Pass Filter circuits
3. To study current-Voltage characteristics of a p-n junction diode (forward bias and reverse bias)
4. Designing of Centre tapped full wave rectifier – without and with shunt capacitance filter.
5. Simple circuit to glow an LED
6. Design, fabrication, and testing of a 9 V power supply with Zener regulator
7. Design and study of voltage divider biasing.
8. Designing of a CE based amplifier of given gain

B. Digital Electronic Circuits

1. To verify and design AND, OR, NOT and XOR using NAND gates
2. Design a Half adder and Full Adder
3. Design a Half Subtractor and Full Subtractor

PCB Design Softwares recommended

- KiCAD (Open Source Electronics Design Automation Suite) https://www.kicad.org/
- EasyEDA (Online PCB Design Tool) https://easyeda.com/
- PADS - Siemens EDA (PCB Design Software) https://eda.sw.siemens.com/en-US/pcb/pads/
- Any other similar PCB designing software

Essential/recommended readings

- Printed Circuit Board – Design & Technology, Walter C. Bosshart, Tata McGraw Hill, 2008.
- Printed Circuit Board –Design, Fabrication, Assembly & Testing, R.S. Khandpur, First Edition, Tata Mcgraw-Hill Education Pvt. Ltd., 2005.
- Printed Circuit Board Design Using Autocad, Chris Schroeder, Newnes Publisher, 1998.
- Printed Circuits Handbook, Clyde F. Coombs, Jr, Happy T. Holden, Sixth Edition, Publisher: McGraw-Hill Education, 2016.

Examination scheme and mode:

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

Electronic Product Testing

CREDIT DISTRIBUTION, ELIGIBILITY AND PREREQUISITES 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		
Electronic Product Testing	2	0	0	2	Class XII	NIL

Course Learning Objectives

The Learning Objectives of the course are as follows:

- To enable students for testing of various electronic and electrical components and instruments such as diode, transistor, transformer, switches, fuses, cables, CRO, multimeters, voltmeter, ammeters etc.
- To give an insight upon the SMD and its soldering and de-soldering, EDS.
- To help students to have insight knowledge of SMPS, UPS and batteries along with maintenance of consumer electronics gadgets like computers, Audio Amplifiers, Induction Top, Solar Panel etc.
- To enhance their capabilities of assembling, fault diagnosis and rectification in a systematic way. To enrich students about reliability and quality control standards of equipment.

Course Learning Outcomes

After studying this course, the student will be able to:

- Test different types of electronic and electrical components and instruments.
- Practice soldering and de-soldering processes with correct methods.
- Testing of SMPS, UPS, Inverters and batteries.
- Identify faults in consumer electronics gadgets such as audio amplifiers, computers, Induction top, Microwave, solar panel.

Syllabus

Practical

Unit 1 : Introduction **16 hours**

Overview of Basic Measuring Instruments: CROs, Multimeter, Power supplies, LCR meter, Signal Generator and Power Analyzer.

Testing of various Devices: a) Semiconductor Devices: Single and Two junction Devices, Thyristor b) Electrical Devices: Transformers, relays, switches and fuses, cables and connectors, Batteries, Idea about ICs, PCBs, Sensors.

Unit II : Soldering and Power Sources **16 hours**

Basics of soldering: Soldering tools and materials (solder, flux), Types of soldering irons (Wattage, temperature, Tips), Soldering/ disordering station. Concept of ESD (Electrostatic discharge). The SMD (surface mounted Devices) and its soldering and de-soldering

Basics of SMPS (Switch Mode Power Supply), UPS (Uninterrupted power supply), batteries and Inverters along with their block diagram and Pin configuration of some important ICs used in it. Touch current and touch voltage.

Unit III : Appliance Testing and Computer Assembling **12 hours**

Testing of Induction cook Top, microwave, Solar panel; Installation and Requirements, stand alone and Grid connected PV system.
Basics of computer assembling and testing. Brief description about its specifications and costing Factors.

Unit IV : Reliability and Quality Standards **16 hours**
Concept of Reliability: Scope, objectives and factors influencing equipment effectiveness, Acceptance Testing, Type Testing , Safety Testing, Identification of legends, symbols, color codes, Safety, safety standards, safety certificates (CE, UL and VDE), General awareness of quality standards, quality management systems &documentation, Idea of ISO 17025, ISO 9001,Calibration and Uncertainty of measurements, Effect of environmental testing(refer to IEC60068-1 for guidance), Awareness on disposal of Electronic waste

Exercises

1. An overview of testing of basic electronic / electrical components (BNC cable, switches and fuses, Capacitors, Inductors, Transformers, Relays, diodes, transistor, Thyristor, IC, Potentiometer etc.); Design a curve tracer on CRO for component testing.
2. Control the intensity and color of bi-Color LED with the help of POT, SPDT switch and 9V battery.
3. Soldering and De-soldering processes; SMD
4. Safety testing of SMPS (Applicable Standard: IS 14886.
    a. Safety Testing (Earth Leakage current Test, Dielectric Test, Short Circuit Protection)
    b. Performance Testing (Line Regulation, Load Regulation for a variation of Load Min to Max load and vice versa, Efficiency at nominal input and rated load)
5. Tubular Batteries (Applicable standard: IS 1651) Test for Capacity, Test for voltage during discharge
6. Personal Computer (Applicable Standard: IS 14896)
    a. Safety Testing (Earth Leakage current Test, Dielectric Test) Performance Testing (Microprocessor used,
    b. RAM expansion Capacity, Clock Rate and RAM Capacity, Effect of Power Supply variations)
7. Invertor (Applicable Standard: IS 13314)
    a. Visual Inspection, High Voltage Test, Insulation Resistance Test, No –Load Test, Output Test

8. UPS (Applicable Standard: IEC 62040-3)
    a. Steady State Input Voltage Tolerance, Output-Normal Mode – No Load, Output-Normal Mode – Full Load, Output-Stored Energy Mode – No Load, Output- Stored Energy Mode – Full Load, Output-Normal Mode – Over Load, Output-Stored Energy Mode – Over Load Output-Normal Mode – Short Circuit, Output- Stored Energy Mode – Short Circuit, Efficiency and Input Power factor
9. Audio Amplifier (Applicable Standard: IEC 60065)
    a. Audio frequency response at various power levels, Response to various inputs sources like DVD player, IPOD, CD player, etc., audio output power, Power Consumption, Voltage range
10. Solar Panel system: Testing and Efficiency

Suggested Readings

- Nutan Kala Joshi and Swati Nagpal, Basic Electronics with Simulations and Experiments, Khanna Publishers (2021)
- Jesting Yong, Testing Electronic Components (2007)
- Mark de Vinck, Make Getting Started with Soldering; A Hands-on Guide to Making Electrical and Mechanical Connections, Maker Media (2017)
- Mike Judd and Keith Brindley, Soldering in Electronics Assembly, Second Edition, Elsevier (1999)
- Jestine Yong, Troubleshooting Repairing Switch Mode Power Supplies (1995)
- David Griffith, Uninterruptible Power Supplies, CRC Press (1989)
- Thomas Reddy, Lindens Handbook of Batteries, 4th Edition, McGraw Hill
- Kevin Wilson, Essentials Computer Hardware; The Illustrated Guide to Understanding Computer Hardware, Elluminet Press (2018)
- N.S. Reddy, PC Hardware Maintenance and Troubleshooting, NEO Publishing House (2016)
- Handbook of Induction Heating Second Edition Valery Rudnev, Don Loveless, Raymond L. Cook, CRC Press Taylor & Francis Group (2017)
- R. G. Gupta, Audio and Video systems, Tata McGraw Hill (2004)
- A.R. Jha, Solar Cell Technology and Applications, CRC Press (2009)
- Statistical Applications in Process Control (Quality and Reliability), J. Bert Keats, Douglas C. Montgomery, CRC Press (1996)
- Reliability and Quality Management , Ankitsandilya (Author), R.C.Mishra , New Age International Private Limited. (2009)
- E-Waste Management Challenges and Opportunities in India, Varsha Bhaga Ganguly, Routledge India (2021)

Examination scheme and mode:

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

CULINARY SCIENCE

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		
Culinary Science	2	1	0	1	Class XII	NIL

Learning Objectives:

Culinary science skill paper is about the cuisine arts of food preparation, cooking, and presentation of food. Students will be equipped with knowledge of various tools and equipments used for cooking, different cooking techniques, working in establishments such as restaurants and relatively large institutions such as hotels and hospitals, standardized cooking practices and recipes.

The learning objectives of the course are:

- To develop cuisine arts of food preparation, cooking, and presentation of food.
- The practical exercises aim to provide hands-on training to develop the skill of various cooking techniques and knowledge about various tools and equipment used for cooking

Learning Outcomes

After studying this course, the student will be able to:

- Develop different cooking and presentation skills.
- Get hands-on training to develop the skill to prepare Indian traditional and nutritious recipes.
- Develop the ability to work in establishments such as restaurants, food courts, kiosks, fast food centers large institutions such as hotels and hospitals.

SKILL DEVELOPMENT AND JOB OPPORTUNITIES':

Employment Opportunities:

- Apprentice in Small Catering units/ Kiosk/ Restaurant
- Food Supplier
- Food Storekeeper
- Food Stylist / Designer

SYLLABUS

Credits: 2 **Total lectures (45): 45 Hours/ 15 weeks**
Theory: 30%, Credit – 1 (Lectures – 15)
Practical/ Field work/ Hands on learning: 70%, Credit – 1 (Lectures – 30)

Unit 1: Basic Culinary Concepts **(8 hours)**

Description: This unit is an introductory unit about the culinary science and basic food ingredients, importance of hygiene to serve safe food.

Subtopics:

- Culinary Terms
- Basic Safety and Hygiene
- Basic food ingredients
- Recipe Evaluation: Sensory evaluation scales

Unit 2: Kitchen Techniques and Technology **(7 hours)**

Description: This unit is about methods of cooking, storage and organizing the storage and imparting knowledge about various kitchen equipment and accessories.

Subtopics:

- Methods: Moist heat, Dry heat, Frying, Microwave Cooking
- Basic Equipment: Gas stove/Cooking range, Refrigerator, Oven, Microwave, Electrical Blenders, Air Fryer
- Kitchen Aids: Cooking Equipment, Measuring Equipment, Baking Equipment, Assorted Knives, Assorted tools, Service Equipment.
- Storage and organization of work area

PRACTICALS **30 hours**

1. General Instructions: Working in Food Lab/ Kitchen, Weight of edible portion, Temperature, Abbreviations used in recipes **(2 hours)**
2. Basic Indian Gravies: White, Makhani, Salan, Red gravies, Kadi **(2 hours)**
3. Beverages: Tea, Coffee, Cold Coffee, Smoothies, Milk Shakes, Fruit Punch, Iced Tea, Panna, Mojito. **(2 hours)**
4. Indian Breads: Chapatti, Paratha, Naan, Kulcha, Bhatura, Bedmi Puri, Sandwich (open, grilled, rolled), Puranpoli, Kathi roll. **(2 hours)**
5. Indian Rice Cooking: Boiled, Curd, Tomato, Lemon, Fried, Pulao, Tamarind, Biryani, Poha **(2 hours)**
6. Soups: Stock, Clear soups, Cream soups **(2 hours)**
7. Salads and Salad cuts/ craft: Coleslaw, Quinoa salad, Corn &Walnut, Exotic seeds salad, Salad vegetable cuts and crafts **(2 hours)**
8. Vegetables Preparations: Dry veg, Koftas, Stuffed veg, Baked veg preparations. **(2 hours)**
9. Indian Dry Snacks with Dips: Dhokla, Idli, Uttapam, Kachori, Khandvi, Chilla, Dumplings, (Momos/Dim sums/ wontons) **(4 hours)**
10. Indian Savory Snacks: Assorted Pakoras, Dahi Bhalla, Cutlets, Samosa, Tikki, Paneer Tikka **(4 hours)**
11. Traditional Deserts 1: Halwa, Kulfi, Kheer, Gulab Jamun **(2 hours)**
12. Traditional Deserts 2: Rasmali, Ladoo, Burfi, Jalebi, Gujia, Rasgulla **(2 hours)**
13. Baking: Tea cake, Muffins **(2 hours)**

ESSENTIAL READINGS

- Raina, U., Kashyap, S., Narula,V., Thomas, S., Suvira, Vir, S., & Chopra, S. (2005). Basic Food Preparation – A Complete Manual. Delhi: Orient Longman.
- Khanna, K., Gupta, S., Seth, R., Mahana, R., & Rekhi, T. (2004). The Art and Science of Cooking. Delhi: Phoenix Publishing House Private Limited.
- Arora, K. (2011). New Delhi: Theory of Cooking. Frank Bros & Co.

SUGGESTED READINGS:

- Kumar, B. (2021). Theory of Culinary Arts. Rudra Publications
- Sethi, P. & Lakra, P. (2015). Aahar Vigyan, Poshan Evam Suraksha. Delhi: Elite Publishing House Pvt. Ltd.
- Suri, S. & Malhotra, A. (2014). Food Science Nutrition and Safety. Delhi: Pearson India Ltd.

Examination scheme and mode:

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

CHOCOLATE CRAFTS

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		
Chocolate Crafts	2	1	0	1	Class XII	NIL

LEARNING OBJECTIVES:

This Skill Enhancement Course enables student to understand the basic principles, hygiene and precautions of chocolate cookery. The emphasis of this will be to develop the skill required for preparation of various chocolates and its packaging and marketing.

The learning objectives of the course are:

- To learn the skill to craft different types of chocolates
- To learn the basic principles, hygiene and precautions of chocolate crafting and entrepreneurship in chocolate industry.

LEARNING OUTCOMES

After studying this course, the student will be able to:

- Have the understanding of different chocolates and acquire the skill to handle them.
- Develop the abilities and showcase skills for preparation of molded, center filled, free hand cluster, chocolate accessories, garnishes and ancillary chocolate recipes
- Get acquainted with techniques of packaging, costing and marketing of chocolates.
- Gain knowledge and skill to start small scale chocolate enterprise

SKILL DEVELOPMENT AND JOB OPPORTUNITIES':

Employment Opportunities:

- Apprentice in Small Catering units/ Kiosk/ Restaurant
- Entrepreneurship in chocolate industry
- Food Stylist / Designer

SYLLABUS

Credits: 2 **Total lectures (45): 45 Hours/ 15 weeks**
Theory: 30%, Credit – 1 (Lectures – 15)
Practical/ Field work/ Hands on learning: 70%, Credit – 1 (Lectures – 30)

THEORY

Unit 1: Introduction to Chocolates **(7 hours)**

Description: The focus of this unit is on chocolates, various aspects of chocolate processing and learning the precautions to make good chocolates.

Subtopics:

- Chocolates: history and types of compound and couverture chocolates.
- Processing of cocoa bean to manufacture chocolate liquor, cocoa butter, cocoa powder, chocolate and chocolate chips.
- Precautions and hygiene practices while handling chocolate.

Unit 2: Applications of Chocolates **(8 hours)**

Description: The focus of this unit is on using the chocolates to make different products, understanding and rectifying the faults.

Subtopics:

- Molded, center filled, free hand clusters, garnishes and accessories.
- Recipe development, costing and packaging of chocolates.
- Faults in chocolates like sugar bloom and fat bloom, their reasons and correction. temperature and moisture control while handling chocolate.

PRACTICALS

1. Introduction to different kinds of chocolates: Compound and Couverture; their sensory analysis and mouth feel. **(2 hours)**
2. Market survey of Indian and Internationally made chocolates with respect to label reading (ingredients). **(2 hours)**
3. Equipment's (molds, scrapers, piping bags, nozzles, cooking thermometers, microwave, double boiler) and precautions to be used in handling chocolate. **(2 hours)**
4. Making molded compound chocolate. **(2 hours)**
5. Variations of molded chocolates. **(2 hours)**
6. Making center filled chocolate. **(2 hours)**
7. Variations of center filled chocolate **(2 hours)**
8. Making free hand chocolate clusters. **(2 hours)**
9. Making chocolate accessories and garnish. **(4 hours)**
10. Ancillary chocolate recipes like chocolate sauce, ganache and hand **(2 hours)**

rolled truffles.

11. Tempering of couverture chocolate. **(2 hours)**
12. Packaging and labeling of chocolates. **(2 hours)**
13. Visit to chocolate factory or chocolate exhibition and sale trial. **(4 hours)**

ESSENTIAL READINGS

- Afoakwa E.O. (2013). Chocolate Science and Technology, Wiley India Pvt Ltd, 978-8126545735.
- Beckette S.T. (2018). The Science of Chocolate, Royal Society of Chemistry, 978-1788012355.
- Minifie B.W. (1999). Chocolate, Cocoa and Confectionary, Aspen Publication. 978-0834213012.
- Manay, S. & Shadaksharaswamy, M. (2020). Foods: Facts and Principles, New Age Publishers. 978-8122422153.
- Panda, H. (2012). Technology of Confectionery, Chocolates, Toffee, Candy, Chewing & Bubble Gums, Lollipop and Jelly Products with Formulations, Engineers India Research Institute publisher. 978-9380772165.

SUGGESTED READINGS:

- Hodge N. (2018). The Art and Craft of Chocolate, Quarry Books, 978-1631594663.
- Perry S. (2008). Deep Dark Chocolate, Chronicle Books. 978-0811860895.
- Panda, H. (2017). Start Your Own Confectionery and Chocolate Products with Manufacturing and Formulations Hand Book, Bio-Green Books publisher. 978-9380772844.
- Greweling, P.P. (2012). Chocolates and Confections: Formula, Theory, and Technique for the Artisan Confectioner, The Culinary Institute of America (CIA), Wiley; 2nd edition, 978-0470424414.
- Shaffer, K. (2019). Chocolate for Beginners: Techniques and Recipes for Making Chocolate Candy, Confections, Cakes and More, Rockridge Press Publishers, 978-1641528887.

Examination scheme and mode:

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

PASTA AND PATISSERIE TECHNOLOGY

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		
Pasta And Patisserie Technology	**2**	**1**	**0**	**1**	**Class XII**	**NIL**

Learning Objectives

This Skill Enhancement Course is about developing an understanding and skill about the types, role of ingredients, processing/production, innovations, sensory attributes and quality assessment of Pasta and Patisserie. The student can also study SEC on Bakery Enterprise, Food Business and Cafeteria Management to enhance scope of work opportunities.

The learning objectives of the course are:

- To provide students with basic knowledge of pasta technology.
- To familiarize students with patisserie technology/ skill.

Learning Outcomes

After studying this course, the student will be able to:

- Develop understanding of the pasta and patisserie technology.
- Acquire skill to prepare different pasta and patisserie.
- Work in specialized pasta and patisserie outlets such as restaurants, food courts, kiosks, fast food centers as well as in large institutions such as hotels, hospitals and food processing units.

SKILL DEVELOPMENT AND JOB OPPORTUNITIES':

Employment Opportunities:

- Apprentice in Small Catering units/ Kiosk/ Restaurant
- Entrepreneurship in pasta and patisserie technology
- Food Stylist / Designer for pasta and patisserie

SYLLABUS

Credits: 2 **Total lectures (45): 45 Hours/ 15 weeks**
Theory: 30%, Credit – 1 (Lectures – 15)
Practical/Field work/Hands on learning: 70%, Credit – 1 (Lectures – 30)

THEORY

Unit 1: Introduction to Pasta **(7 hours)**

Description: This unit will include history of pasta , types of pasta, pasta making tools and equipment and understanding different sauces for preparing pasta dishes

Subtopics:

- History and types of pasta: packaged and handmade.
- Types: names and shapes of pasta.
- Tools and equipment commonly used for manufacturing pasta and preparing pasta dishes.
- Different types of sauces used for preparing pasta dishes: Tomato sauce, Béchamel, Bolognese, pesto and aglio olio.

Unit 2: Introduction to Patisserie **(8 hours)**

Description: This unit is about different types of Patisserie like short crust pastry, choux pastry, puff pastry, sponge cake, shortened travel cakes, cheese cakes, cookies, brownies and biscotti.

Subtopics:

- Short crust Pastry: Tarts and Pies
- Choux Pastry: Eclairs, Profiteroles.
- Puff Pastry: Patties, French Hearts, Vol au vents.
- Sponge cake and its decoration techniques.
- Shortened travel cakes and its variations.
- Cheesecakes with different toppings.
- Cookies, Brownies and Biscotti.

PRACTICALS **30 hours**

1. Market survey of Packaged Pasta and patisserie. **(2 hours)**
2. Orientation and handling of the tools and equipment used in Pasta making (mechanical pasta roller and cutter, rolling pins, serrated knives, ravioli cutters, drying rack and drying trays, stock pots, pans). **(2 hours)**
3. Making the Pasta dough, shaping Pasta (Fettuccine, Farfalle, Macaroni, Noodles, Spaghetti, Vermicelli), drying and storage. **(4 hours)**
4. Making Stuffed Pasta: Ravioli with fillings like spinach and Ricotta Cheese; herbed cream cheese. **(2 hours)**
5. Making Sauces: Tomato, Bechamel, Pesto and preparing Pasta dishes with them. **(2 hours)**

6. Making Baked Pasta: Mac n cheese and Lasagna. **(2 hours)**
7. Preparation of short crust pastry: Tarts or Pies **(2 hours)**
8. Preparation of Choux pastry: Eclairs or Profiteroles. **(2 hours)**
9. Preparation of Puff pastry: Patties/ Vol au vents/ French Hearts **(4 hours)**
10. Preparation of cakes (sponge cake/shortened cake) and their variations/decoration with whipped cream frosting. **(4 hours)**
11. Preparation of Cheesecake with fruit compote topping. **(2 hours)**
12. Preparations of Brownies or biscotti **(2 hours)**

ESSENTIAL READINGS:

- Karr, N. (2016).Handmade Pasta Workshop & Cookbook: Recipes, Tips & Tricks for Making Pasta by Hand, with Perfectly Paired Sauces. US : Page Street Publishing .https://amzn.eu/d/6skTmuM(ISBN 10-1624143229, ISBN 13-978-1624143229)
- Donnelly,K. (2021). The Artisan Pasta Cookbook: The Step by Step Guide with Flavorful Recipes for Mastering Handmade Pasta, Noodles, Gnocchi and Risotto at Home.Oksana Alieksandrova . https://amzn.eu/d/dFir9Zx(ISBN 10-195460503X , 13-978-1954605039)
- Juillet, C. (1998). Classic Patisserie: An A-Z handbook. CBS publishers and distributors pvt. Ltd.https://amzn.eu/d/5RC7hja(ISBN 10-075063815X, ISBN 13-978-0750638159)
- Rippington, N. Baker, C. Burke, M (2013). Professional Patisserie: For Levels 2, 3 and Professional Chefs. Hodder Education; UK https://amzn.eu/d/352HVZy

  (ISBN-10: 1444196448, ISBN-13: 978-1444196443)

SUGGESTED READINGS:

- Dubey, S. C. (2016). Basic Baking - Science and Craft. Delhi: Society of Indian Bakers.
- Dubey, S. C. (2009). Bakery Vigyan. Delhi: Society of Indian Bakers
- Ketrapaul, N., Grewal, R.B., & Jood, S. (2005). Bakery Science and Cereal Technology. Delhi: Daya Publishing House.
- Edward, W. P. (2007). The Science of Bakery Products. Cambridge: RSC Publishing.

Examination scheme and mode:

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

FROZEN DESSERT TECHNOLOGY

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		
Frozen Dessert Technology	**2**	**1**	**0**	**1**	**Class XII**	**NIL**

LEARNING OBJECTIVES

This course will help learners be equipped with the skills of developing, packaging, innovating and marketing of frozen desserts like ice creams, sorbets, ice popsicles, yoghurts, traditional *kulfi*, etc. During the past decade, the frozen food industry has grown, with an array of innovations in ice-creams, frozen yogurt, gelato and traditional desserts such as *shrikhand*. There is vast scope for the development of lower-fat, reduced-sugar products which may lead to increased sales. This course will equip the students with knowledge and skills necessary to work in the frozen food industry.

The learning objectives of the course are:

- To learn basic concepts on processing, distribution and storage of frozen desserts
- To develop the skill of preparing various types of frozen desserts

LEARNING OUTCOMES

After studying this course, the student will be able to:

- Prepare/ process/pack/handle/sell different types of frozen desserts
- Work in frozen food industry or start own business – manufacturing, distribution and retail.

SKILL DEVELOPMENT AND JOB OPPORTUNITIES':

Employment Opportunities:

- Apprentice, supervisor, processor in frozen food manufacturing units/ distribution and retail outlets
- Entrepreneurship in frozen food industry
- Food Stylist / Designer for frozen desserts

SYLLABUS

Credits: 2 **Total lectures (45): 45 Hours/ 15 weeks**
Theory: 30%, Credit – 1 (Lectures – 15)
Practical/Field work/Hands on learning: 70%, Credit – 1 (Lectures – 30)

THEORY

Unit 1: Food Freezing **(7 hours)**

Description: This unit will give an introduction to the concept of frozen foods/industry, their properties. It will also include the various equipments, freezing systems/methods which can be used to process, store and maintain cold chain during distribution.

Subtopics:

- Background, description and properties of frozen foods
- Freezing time
- Equipment and Freezing systems (direct and indirect contact)
- Act, regulations and standards

Unit 2: Frozen Desserts **(8 hours)**

Description: This unit will focus on salient types of frozen desserts; both milk based as well as water based. It will include the composition, physical properties, processing, storage, freezing, common defects, packaging.

Subtopics:

Subtopics:

- Definitions and important terminology
- Ice-cream – composition, physical properties, processing, storage, freezing, common defects, packaging
- Ice based sherbets, sorbets, ice candies, popsicles
- Other frozen desserts – frozen yogurt, *shrikhnad*, mellorine, parevine, ice-cream sandwiches
- Future trends (novelties)

PRACTICALS

1. Market survey of frozen desserts and accessories and basics of working in food lab. **(2 hours)**
2. Preparation, packaging, labeling and sensory evaluation of vanilla ice cream **(4 hours)**
3. Preparation, packaging, labeling and sensory evaluation of any fruit based ice cream (mango, strawberry, pineapple etc.) **(4 hours)**
4. Preparation, packaging, labeling and sensory evaluation of Kulfi or nuts and fruit ice cream **(4 hours)**
5. Preparation, packaging, labeling and sensory evaluation of ice cream with egg or gelato or frozen custard **(4 hours)**
6. Preparation, packaging, labeling and sensory evaluation of ice cream sandwich or novelties **(4 hours)**
7. Preparation, packaging, labeling and sensory evaluation of ice-lolly/ popsicles/ ice-candies **(4 hours)**
8. Preparation, packaging, labeling and sensory evaluation of *Shrikhand* or frozen yogurt **(4 hours)**

ESSENTIAL READINGS

- Raina, U., Kashyap, S., Narula,V., Thomas, S., Suvira, Vir, S., & Chopra, S. (2005). Basic Food Preparation – A Complete Manual. Delhi: OrientLongman.
- Khanna, K., Gupta, S., Seth, R., Mahana, R., & Rekhi, T. (2004). The Art and Science of Cooking. Delhi: Phoenix Publishing House Private Limited.
- Migoya, MJ. (2008). Frozen Desserts. First Edition. John Wiley and Sons Inc.
- Food Safety and Standards Authority of India (FSSAI). (2011). Food Safety and Standards (Food Products Standards and Food Additives) Regulations, 2011. Compendium on Food Additives Regulations. Elite Publishers. Pgs. 877.
- Food Safety and Standards Authority of India (FSSAI). (2019). FSSAI regulations on frozen desserts. Website: https://www.fssai.gov.in/upload/media/FSSAI_News_Ice_FNB_22_05_2019.pdf.

SUGGESTED READINGS:

- Clarke, C. (2004). The Science of Ice Cream. The Royal Society of Chemists.
- De, S. (2001). Outlines of Dairy Technology. First Edition. Oxford Publishing House.
- Francis, F.J. (2010). Encyclopedia of Food Science and Technology. Volume 2. Second Edition. John Wiley & Sons.
- Goff, H.D. & Hartel, R.W. (2008). Ice Cream. Seventh Edition. Springer.
- Himadari, P. (2010). Handbook on Frozen Food Processing and Freeze Drying Technology. First Edition. Engineers India Research Institute.
- Jana, A., Pinto, S. & Moorthy, P.R.S. (2016). Ice Cream and Frozen Desserts. AgriMoon.com Publishing. Website: https://www.agrimoon.com/wp-content/uploads/Ice-cream-Frozen-Dessrt.pdf.
- Rorer, S.T. (2005). Ice Creams, Water Ices, Frozen Puddings Together with Refreshments for All Social Affairs. First Edition. Project Gutenberg. Website: https://www.gutenberg.org/ebooks/8501.
- Stogo, M. (2018). Ice Cream and Frozen Desserts: A Commercial Guide to Production and Marketing. John Wiley & Sons.
- Tharp, B.W. & Young, L.S. (2012). Tharp and Young on Ice Cream: An Encyclopedic Guide to Ice Cream Science and Technology. First Edition. DEStech Publications Inc.
- Weinstein, B. (2010). The Ultimate Ice Cream Book. First Edition. Perfect Bound Publishing House. Website: https://www.pdfdrive.com/the-ultimate-ice-cream-book-over-500-ice-creams-sorbets-granitas-drinks-and-more-e184459836.html.

Examination scheme and mode:

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

INDIAN SNACK INDUSTRY

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		
Indian Snack Industry	2	1	0	1	Class XII	NIL

LEARNING OBJECTIVES

With changing lifestyles and rising income levels, the processed Indian Snack industry has grown exponentially in recent years due to a massive upsurge in the demand for snack (ready to eat/ ready to cook) products in India. This course will equip our students with knowledge and skills necessary to work in the snack industry, contribute to the growth and after gaining some experience start-up their own micro/macro enterprises.

The learning objectives of the course are:

- To provide students with the basic knowledge of Indian snack industry.
- To familiarize students with different types of Indian snacks.

LEARNING OUTCOMES

After Studying this course, the student will be able to

- Describe various aspects of Indian snacks industry and regional snacks.
- Identify various types of snacks and their processing
- Prepare traditional, regional and healthy snacks.

SKILL DEVELOPMENT AND JOB OPPORTUNITIES':

Employment Opportunities:

- Apprentice in Small Catering units/ Kiosk/ Restaurant
- Start-up of micro/macro enterprises
- Able to set up home based/ small scale food catering units
- Work in Cloud Kitchen
- Food Stylist / Designer

SYLLABUS

Credits: 2 **Total lectures (45): 45 Hours/ 15 weeks**
Theory: 30%, Credit – 1 (Lectures – 15)
Practical/ Field work/ Hands on learning: 70%, Credit – 1 (Lectures – 30)

THEORY

Unit 1: Indian Snack Industry Current Scenario **(6 hours)**

Description: This unit is an introductory unit about what is a snack food, the history and current trends of snacks industry and regional snacks of India.

Subtopics:

- Definition and history of snack foods in India.
- Current scenario of Indian snack industry.
- Indian regional snacks and their salient features.

Unit 2: Processing of Snacks **(9 hours)**

Description: This unit is about different types of Indian snacks and common packaging materials and techniques used in snack industry.

Subtopics:

- Packed Snacks of India: Classification of packaged snacks, common packaging materials and techniques
- Ready to cook (RTC) snacks, Instant snacks, Freshly prepared snacks, Extruded snacks.
- Usage of oils for frying and various seasonings
- Healthy snacks preparations (innovations in snack preparation)
- FSSAI License and regulations

PRACTICALS **30 hours**

1. Weights, Measures and Food hygiene practices **(2 hours)**
2. Basic cooking terminologies and techniques of preparation **(2 hours)**
3. Pakoras/ fritters: Assorted pakoras, Bondas and its variations **(2 hours)**
4. Cutlets and Tikkis – Mixed Veg cutlets,Sago cutlets, Aloo tikki, Vegetable tikki, **(2 hours)**
5. Dough snacks: Kachori, Samosa, Spring rolls, Mathri, Kathi rolls, Pani puri **(4 hours)**
6. Vadas: Dahi vada, Masala vadas, Medu vada and accompaniments **(2 hours)**
7. Dips (Accompaniments): Mint chutney, Imli chutney, coconut chutney, Salsa sauce, Hummus, Hung curd dips, Guacamole etc. **(4 hours)**
8. Marinates: Curd marinates, Green marinates, Pickled marinate etc. **(2 hours)**
9. Tikkas and Kababs: Paneer tikka, Soya chaaps, Seekh kabab, Hara kabab **(2 hours)**

10. Healthy snacks 1: Sprouts, Cheela, Roasted snacks, Bhel, Fruit chat **(2 hours)**

11. Healthy Snacks 2: Fermented snacks (Idli (variations), Dhokla) **(2 hours)**

12. Extruded snacks: Bhujia, Chakli, Fafda, Gathiya **(2 hours)**

13. Packaging materials and techniques of packaging snacks **(2 hours)**

ESSENTIAL READINGS:

- Raina, U., Kashyap, S., Narula,V., Thomas, S., Suvira, Vir, S., & Chopra, S. (2005). Basic Food Preparation – A Complete Manual. Delhi: OrientLongman.
- Khanna, K., Gupta, S., Seth, R., Mahana, R., &Rekhi, T. (2004). The Art and Science of Cooking. Delhi: Phoenix Publishing House PrivateLimited.

SUGGESTED READINGS:

- Kumar, B. (2021). Theory of Culinary Arts Delhi: RudraPublications
- Arora, K. (2011).Theory of Cooking. New Delhi Frank Bros &Co.
- Lusas E.W., Rooney, L.W. (2002). Snack Food Processing: Delhi, CRC Press LLC.

Examination scheme and mode:

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

DAIRY 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		
Dairy Processing	**2**	**0**	**0**	**2**	**XII (PCM/PCB)**	**NIL**

Learning Objectives

The Learning Objectives of this course are as follows:

- To study the processing of milk products

Learning Outcomes

After studying this course, the student will be able to:

- Gain skills in dairy product development and hands-on training forthe processing of different milk products.
- Establish a food industry/start up based on their learnings in thesubject.
- Start providing 3rd party manufacturing to premier dairy-based industries.
- Work in any dairy based industry.

Syllabus

Practical Exercises: **60 hours**

The learners are required to perform the following:

- Processing of Flavoured milk
- Preparation of Dahi
- Preparation of Ghee
- Preparation of milk based traditional Indian sweet
- Preparation of Ice cream
- Preparation of milk based instant mix
- Preparation of whey based drink
- Milk based new product development
- How to plan a startup, budgeting, marketing / case study/ entrepreneur (anyone of the above)
- Regulations, Licensing and registration of a startup

Essential/recommended readings

- De, Sukumar. (2007). Outlines of dairy technology. Oxford University Press.
- Webb B.H. & Alford (2005). Fundamentals of dairy chemistry. CBS Publisher
- P.F. Fox, T. Uniacke-Lowe and J.A.O' Mahony (2005). Dairy Science and Technology. Taylor & Francis.
- P. Walstra, Jan T.M. Wouters and Tom J. Geurts (2015). Dairy chemistry and Biochemistry. Springer

Note: Learners are advised to use the latest edition of readings.

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

Skill progression
India is indisputably the largest milk producer in the world. Overall, dairy industry in India engages about 80 million households in rural area. The course 'Skills in Dairy Processing' provides valuable skills to the candidates required to be in a dairy industry. The course is planned to provide a hands-on training experience to the students in relevance to the dairy product preparation and setting up an enterprise. The other courses like Technology of Milk and milk products, Food Quality Management, Agri-business management, Sensory science, Food standards and regulations in the upcoming semesters will provide a deeper insight to thesubject and will help students to improve their skill set.

FRUITS & VEGETABLE 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		
Fruits and Vegetable Processing	2	0	0	2	XII (PCM/PCB)	NIL

Learning Objectives

- To provide hands-on training to students for the entire process of selection, preparation, packaging, & presentation of variety of fruits & vegetable products.
- To impart skills of scale-up production of fruits & vegetable products & by products for setting their own enterprise.

Learning Outcomes

After studying this course, the student will be able to:

- Create variety of value-added products of consumer's choice & need.
- Enhance the level of processing, level of valueaddition, share in global food trade & employability.

Skill Development and Job Opportunities: Justification

The food processing sector is one of the largest sectors in India in terms of production, growth, consumption, and export. however, there exists a definite lack in processing and storage infrastructure and skilled manpower, which are essential to reducing the waste and enhancingthe value addition and shelf life of the farm products. The government has ambitious plans to increase the level of processing, value addition and share in global food trade. This will have a spike in the requirement for qualified and trained fruits & vegetable processing professionals. The main objective of having this paper is to impart knowledge of processing various value addedfruits & vegetable products which is ultimately used to enhance the employability of anycandidatestudying the paper including food technology graduates.

Syllabus

Practical **60 hours**

Practicals based on different processing/ preservation techniques.

1. Preparation of canned fruits /vegetables
2. Preparation of chips from potato/bittergourd/apples etc.
3. In bottle pasteurization of fruit juices, nectars, purees etc.
4. Preparation of fruit squashes

5. Preparation of fruit cordials
6. Preparation of fruit jams/jellies
7. Preparation of fruit nectars
8. Preparation of mango/chilli/ lime pickle
9. Preparation of Tomato puree & product
10. How to plan a startup, budgeting, marketing / case study/ entrepreneur (anyone of the above)
11. To study the Regulation, Licensing & registration of particular

Essential Readings

- Girdharilal., Siddappaa, G.S and Tandon, G.L.(2009). Preservation of fruits & vegetables. ICAR, New Delhi.
- Thompson, A.K., (2003). Fruits and vegetables; Harvesting, handling and storage. Blackwell Publishing.

Suggested Readings:

- Crusess, W.B. (2004). Commercial Unit and Vegetable Products. W.V. Special Indian Edition. Agrobios India.
- Manay, S. and Shadaksharaswami, M. (2004). Foods: Facts and Principles. New Age Publishers.
- Ranganna S.(2007). Handbook of analysis and quality control for fruits and vegetable products. Tata Mc Graw-Hill publishing company limited, Second edition.
- Srivastava, R.P. and Kumar, S. (2006). Fruits and Vegetables Preservation-Principles and Practices. 3rd Ed. International Book Distributing Co.
- Somogyi, L.P., Ramaswamy, H.S. and Hui, Y.H. (1996). Biology, Principles and Applications. Volume 1. Technomic Publishing Company, Inc.

Examination scheme and mode:

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

Food Waste and By-product Utilisation

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		
Food Waste and By-product Utilisation	**2**	**0**	**0**	**2**	XII (PCM/PCB)	NIL

Learning Objectives

Environment sustainability is a key area of interest to government, scientist, environmentalist, researchers, and students. The present course is designed to address the issues of food waste and further their utilization into value added products. It's a multidisciplinary subject which can be taken by students of varied background. The objectives of the course are as follow:

- To improve students' understanding of basic food industry waste and by-product.
- To provide students an opportunity in understanding the significance of treating and utilizing food waste and by-products.
- To study effluent treatment plant.
- The practicals provide hands-on training in different type of food waste and by-products, further their utilization.
- After completion of course students can apply for courses specific to any category of food waste and further specialize in it.

Eligibility: Being interdisciplinary in its nature and scope, the course will be equally engaging and beneficial for students of all subject streams.

Learning Outcomes

After Studying this course, the student will be able to:

- Identify waste produced from different sectors of the food industry.
- Utilise waste from the food industry.
- Understand waste water treatment.

Skill Development and Job Opportunities:

- Students are eligible to handle the processing and operations at effluent treatment plant running in food and chemical-based industries.
- Students can provide consultancy to waste industries.
- Students can also start with hands-on training to students and industrialist on handling and utilizing the waste from industries.
- Students can work with Ministry of Agriculture to devise ways of utilizing the food waste.

- Students can start his/her own start-up by providing waste water treatment services to food industries.
- The course will provide basic training enabling students to apply to advanced food waste management courses.

Syllabus

Practical **60 hours**

1. Identification of waste from agriculture and food processing (Dairy/ Meat/ Fruits Vegetables / Alcoholic beverages/ cereals)
2. Study and layout of waste water treatment system (ETP)
3. Identification of co-products from F&V industry, estimation and utilization to develop value added products (pectin, banana fibre, lycopene from tomato waste, watermelon/ pumpkin rind).
4. Identification of waste from animal industry and utilisation to develop value added products (gelatin, egg shell).
5. Identification of various co-products from dairy industry, estimation and utilization to develop value added products (utilisation of ghee residue, buttermilk beverage, whey).
6. Identification of co-products from cereal industry, estimation and utilization to develop value added products (cereal husk, wheat fibre).
7. Determination of physico-chemical properties of wastewater.
8. Production of alcohol/ acetic acid from waste material.

Essential readings

- Marriott, N. G., Gravani, R. B., & Schilling, M. W. (2006). Principles of food sanitation(Vol. 22). New York: Springer.
- Sadasivam, A, & Manickam, A. (2021). Biochemical Methods. New Age InternationalPublishers.
- Green, J. H., & Kramer, A. (1979). Food Processing. Waste Management. Avi PublishingCompany, 629.
- Herzka, A. and Booth, R.G. Food Industry and Trade: Recycling Waste. Applied SciencePublishers, 1981.
- Tegge, G., Green, J. H., and A. Kramer. Food Processing Waste Management; AVIPublishing, 1979

Examination scheme and mode:

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

Paper and Skill Progression

The paper provides understanding a huge untapped sector if food wastage. This waste across globe is an environment concern. Students will be able to deeper understanding to the huge market of food wastage from industries. The course is designed to provide exclusive hands on training to students so that they can contribute the same to industries in search of food waste management.

MINIMAL FOOD 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		
Minimal Food Processing	**2**	**1**	**0**	**1**	XII (PCM/PCB)	NIL

Learning Objectives

- To provide the best combination of health, nutrition and convenience based on minimal food processing
- To impart skills in food processing for extending the shelf life with minimal processing that results in minimum changes to sensory characteristics and nutritional qualities, yet imparting convenience to the consumer.
- To make students aware of the various novel technologies being developed and used for minimal processing across the world.

Learning Outcomes

After studying this course, the student will be able to:

- Have skills and knowledge of methods of preservation by minimal processing of food.
- Do minimal processing of different food samples.

Job/Employment Opportunities:

- Students can establish his/her start-up specialized in minimal food processing of foods.
- Students can help in Research and Development in food industries to explore various novel technologies for minimal processing.
- Students can either collaborate or join with any Food Industry and help in developing various thermal and non-thermal techniques in food processing.

Syllabus

THEORY **Total Lecture (Nos): 15 Hours**

Unit 1: Basic minimal processing **(8 Hours)**

Introduction and importance of minimal processing, Preparation and pre-treatments, Minimal processing of foods by thermal, refrigeration and freezing methods, MAP (Modified Atmosphere Packaging) and CAP (Controlled Atmosphere Packaging). Physiological responses and biochemical changes during minimal processing of fruits and vegetables, Meat, Fish, poultry and Dairy products. Role of minimal processing in economic creation.

Unit 2: Advanced technologies in minimal processing of foods (7 Hours)

Principle and applications of; irradiation, pulsed electric field processing, high pressure processing, pulsed light, ultrasound, ohmic heating, sous vide.

PRACTICALS (30 Hours)

1. To study basic hygiene and sanitation requirements for minimal processing
2. Preparation and pre-treatment method for minimal processing of fruits and vegetables.
3. Minimal processing of Meat products.
4. Minimal Processing of fish and Poultry.
5. Minimal processing by Vacuum/ MAP/CAP/ edible coating.
6. Minimal Processing of Dairy Products.
7. To study the shelf life and quality characteristics of minimally processed foods available in the market
8. To study the effect of packaging material on shelf life of different minimally processed foods.
9. To determine the cost of minimally processed food.

Essential Readings:

- Fellows, P. J. (2009). Food processing technology: principles and practice. Elsevier Rahman, M. S. (Ed.). (2007). *Handbook of food preservation*. CRC press.
- Tewari, G., & Juneja, V. (Eds.). (2008). *Advances in thermal and non-thermal food preservation*. John Wiley & Sons.

Suggestive Readings:

- Barbosa-Canovas, G. V., Tapia, M. S., & Cano, M. P. (Eds.). (2004). *Novel food processing technologies*. CRC press.
- Bansal, V., Siddiqui, M. W., & Rahman, M. S. (2015). Minimally processed foods: overview. *Minimally processed foods*, 1-15.

Examination scheme and mode:

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

WORKING WITH PEOPLE

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		
WORKING WITH PEOPLE	**2**	**1**	**0**	**1**	**Class XII**	**NIL**

Learning Objectives

The learning objectives of this course are as follows:

- To inculcate values in strengthening knowledge and skills in field work practice learning
- To develop aptitude and attitude to work in the field
- To enhance skills of self-awareness, self-development, goal setting and time management

Learning outcomes

At the end of the semester the students will be able to

- Develop a practical understanding of using different skills while working with individuals and groups
- Develop skills and competencies to work effectively in field settings
- Acquire understanding about self, goal setting, networking, and communication

SYLLABUS

Course Content

Unit I: Developing Personal and Professional Self **Unit Description:** This unit will provide a conceptual understanding of Self-awareness and sensitivity. The students will learn about goal setting, time management and ethics in social work practice.	**(No. of hours)** **3** **Weeks: I-III**
Subtopics: ● Understanding personal self and professional self.	

● Professional Ethics: Responsibility, accountability, loyalty, commitment, cultural sensitivity and competence. ● Goal setting and time management	
Unit II: Planning for Field Work Practice **Unit Description:** This unit will introduce the students to strategic learning plans required for field work, thematic modules for different target groups and importance of rapport building and communication while working in community.	**(No. of hours)** **4** **Weeks: IV-VII**
Subtopics: ● Preparation of Field work learning plans and strategies. ● Rapport building, initiating dialogues and sustaining communication. ● Thematic learning modules for targeted populations: Children, adolescent, youth and elderly.	
Unit III: Documentation in Field Work **Unit Description:** This unit will focus on documentation and maintaining records while working with individuals, groups and communities. The students will also learn to develop community profile.	**(No. of hours)** **4** **Weeks: VIII-XI**
Subtopics: ● Case records ● Group work records ● Community profile	
Unit IV: Application of Skills and Techniques **Unit Description:** This unit will introduce various skills and techniques required in understanding self and mobilising support.	**(No. of hours)** **4** **Weeks: XII-XV**
Subtopics: ● Understanding Self: Johari Window ● Strength and Weakness- SWOT Analysis ● Mobilising Community Support: Networking, Advocacy and Public Relation	

Practical component (if any) – Unit III & IV application based **(30 hours)**

Essential readings

- Datar,S. et al. (2010). Skill Training for Social Workers: A Manual. New Delhi: Sage Publications
- Kumar, S. (2002).Methods for Community Participation: A Complete Guide for Practitioners. London: ITDG Publishing.
- Nair,R., Juvya,S., & Nadkarni,V. (2020). Field Instructions in Social Work Education, The Indian Experience. Routledge India.
- Subhedar, I. S. (2001). Field Work Training in Social Work. New Delhi: Rawat Publications.

- Trevithik, P. (2000). Social Work Skills: A Practice Handbook. Buckingham, Philadelphia: Open University Press.
- Verma, R.B.S. & Singh, A.P. (2013).Standard Manual for Field Work Practicum in Social Work. Lucknow: New Royal Book Company.

Suggested readings

- NAPSWI. (2016). NAPSWI's Code of Ethics for Professional Social Workers in India. New Delhi: National Association of Professional Social Workers in India

Examination scheme and mode:

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

LIFE SKILL EDUCATION

Credit distribution, Eligibility and Prerequisites 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		
LIFE SKILL EDUCATION	**2**	**1**	**0**	**1**	**Class XII**	**NIL**

Learning Objectives

The Learning Objectives of this course are as follows:

- To impart life skills education in field work practice
- To strengthen life skills for career building, critical thinking, attitudinal base for innovate leadership
- To learn the application of life skills in diverse field work settings

Learning outcomes

At the end of the semester the students will be able to

- Focus on development of values in strengthening knowledge and life skills, bringing high quality standards in field work practice-learning
- Understand the strength-based life skill development, team work, innovate leadership, design thinking and career building skills
- Develop universal human values while utilizing life skills in field work

SYLLABUS

Unit I: Life Skills Introduction **Unit Description**: To introduce students to the basic concepts of life skill management.	**(No. of hours)** **3** **Weeks: I-III**

Subtopics: ● Basic Life Skills: Concept, Components and Significance ● Life Skills Development: National Perspective ● Universal Human Values – Love, Compassion, Truth, Non-violence, Peace, Gratitude, Patience and Tolerance	
Unit II: Basic Life Skills **Unit Description**: To learn the set of essential life skills that can lead to high employability and good work culture.	**(No. of hours)** **4** **Weeks: IV-VII**
Subtopics: ● Team Work Skills: Social Etiquettes, Democratic Decision, and Collaboration ● Innovative Leadership: Initiative taking, Time Management, Capacity building, Life Coaching ● Career Building Skills: Exploring Career Opportunities, Mentoring, Resume Preparation, facing Interview & Group Discussion, Presentation Skills, Creating social media profile	
Unit III: Significant Life skills and Techniques **Unit Description**: To understand potential changes that can be brought about by employing essential life skills	**(No. of hours)** **4** **Weeks: VIII-XI**
Subtopics: ● Developing Strategies for enhancing Life Skills ● Life Skills (Cognitive based): Critical Thinking, Knowledge construction, Evaluating reasoning, Solution Focused Thinking, ● Life Skills (Behavioural Based): Ethics, Integrity, Problem Solving, Decision making	
Unit IV: Application of life skills in Field Work **Unit Description**: To learn the application of essential life skills in diverse settings through case studies about interventions	**(No. of hours)** **4** **Weeks: XII-XV**
Subtopics: Developing specific life skills intervention plan for ● Stress Management and Coping strategies ● Simulation exercises: Brainstorming, Role plays for Team building ● Case Management	

Practical component (if any) – Unit III & IV application based **(30 hours)**

Essential readings

- Bandyopadhyay and Subrahmanian (2008), Gender Equity in Education: A Review of Trends and Factors

- Brinkman, F. J. (2016). Environment, Religion and Culture in the Context of the 2030 Agenda for Sustainable Development, (April).
- Brown, T. (2012). Change by Design. Harper Business
- Care, E., Kim, H., Anderson, K., & Gustafsson-Wright, E. (2017). Skills for a Changing World: National
- Census of India. (2011), Registrar General of India
- Clarke, D., Bundy, D., Lee, S., Maier, C., Mckee, N., Becker, A., Paris, F. (n.d.). Skills for Health Skills-based health education including life skills: An important component of a Child-Friendly/Health-
- Dewan S, Sarkar U (2017) From education to employability: Preparing South Asian Youth for the world of work, UNICEF ROSA
- International Youth Foundation. (2014). Strengthening life skills for youth : A practical guide to quality programming.
- Kwauk C & Braga. (2017) Life skills education is more than teaching skills, Brookings institution Washington DC
- LIFESKILLS EDUCATION. (n.d.). Retrieved from, http://www.cbse.nic.in/cce/life_skills_cce.pdf
- Perspectives and the Global Movement. Retrieved from https://www.brookings.edu/wp-content/uploads/2017/03/global-20170324-skills-for-a-changing-world.pdf

Suggested readings

- Martin, R. (2007). How Successful Leaders Think. Harvard Business Review, 85(6): 60.
- Govt. of India. (2014 & 2016) Educational Statistics at a glance, MHRD,
- Murphy-Graham (2012), Opening Minds, Improving Lives: Education and Women's Empowerment in Honduras
- Sen Madhucchanda (2010), An Introduction to Critical Thinking, Pearson, Delhi
- South, T., Life, A., & Forum, E. (2005). Life Skills-Based Education in South Asia.
- Street, C. (2012). Global Life Skills Education Evaluation, (February).
- WHO (1997). Life Skills Education for Children and Adolescents in Schools. Geneva: WHO.

Examination scheme and mode:

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

PARTICIPATORY LEARNING AND ACTION

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		
PARTICIPATORY LEARNING AND ACTION	2	1	0	1	Class XII	NIL

Learning Objectives

The Learning Objectives of this course are as follows:

- To understand the basic principles and process of using Participatory Learning in field work settings
- To learn various techniques of Participatory Learning for working in rural and urban communities
- To learn the skills involved in application of participatory learning techniques

Learning outcomes

At the end of the semester the students will be able to

- Identify the situations where participatory learning techniques can be applied
- Demonstrate the process of various techniques and skills of participatory learning in field setting
- Analyse PLA data and reflect the same in report writing

SYLLABUS

Course Content

Unit I: Introduction to Participatory Learning and Action **Unit Description**: This unit introduces the students to the concept of	**(No. of hours)** **4**

Participatory Learning and Action (PLA). The students will also learn the advantages of PLA and its use over other similar techniques.	**Weeks: I-IV**
Subtopics: ● Participatory learning Action (PLA): Meaning, origin and principles ● Participatory learning: Basic rules and phases ● Preparations for PLA	
Unit II: PLA : Tools and Techniques **Unit description:** This unit aims to familiarize students with various tools and techniques of PLA which can be applied in community setting.	**(No. of hours)** **4** **Weeks: V-VIII**
Subtopics: ● PLA techniques I: Community mapping (social & resource mapping), ● PLA Techniques II: livelihood analysis, Venn(chapati) diagram, Time line analysis, Vector scoring, (preference ranking, issue prioritization, wealth ranking), Calendars (Seasonal calendar, Daily routine diagram), Transect walk ● Roles and responsibilities of PLA teams	
Unit III: Practical Application of Participatory Learning techniques **Unit Description:** The students will be engaged in hands on learning for practical application of PLA techniques through workshops and group exercises.	**(No. of hours)** **3** **Weeks: IX-XI**
Subtopics: ● Project work: Community Mapping, ● Project work: Need assessment (Calender/Seasonal Analysis/Transect Walk/Vector scoring) ● Project work: Resource identification & Utilization	
Unit IV: Analysis of data through PLA Techniques **Unit description:** The students will learn to analyse the information collected through PLA tools.	**(No. of hours)** **4** **Weeks: XII-XV**
Subtopics: ● Use of PLA for research and community action ● Processing, analysis and interpretation of data generated through participatory learning tools ● Report writing: Tips and techniques	

Practical component (if any) – Unit III & IV application based **(30 hours)**

Essential readings

- Chambers, R (1983) Rural Development: Putting the last first. Longman inc., USA, 1983.

- Chambers, R (2008). Revolutions in Development Inquiry. Institute of Development Studies, 2008, Earthscan, London.
- Mikkelsen, B (1995). Methods for Development Work and Research: A guide for practitioners. London, Sage.
- N. Narayansamy (2009): Participatory Rural Appraisal-Principles, Methods and Application, first edition. Gandhigram Rural University, Tamil Nadu, India
- Ramesh, R (2020):Participatory Rural Appraisal :PRA Application in Rural Development Planning. National Institute of Rural Development and Panchayati Raj Ministry of Rural Development, Government of India.
- Slocum, R; Wichhart, D; Rocheleau, D and Thomas-Slayter, B (eds.) (1995). Power, Process and Participation – Tools for change. London, IT Publications

Suggested readings

- Jules N. Pretty, Irene Guijt, Ian Scoones, & John Thompson (1995): A Trainer's Guide for Participatory learning and Action. International Institute for Environment and Development, London.
- Gosling, L and Edwards, M (2003). Toolkits: A practical guide to assessment, monitoring, review and evaluation. Second edition. Save the Children, UK
- The Leprosy Mission Trust India TLMTI (2015): Participatory Learning Approach Training Manual, New Delhi.
- Mukherjee, N. (1993): Participatory rural appraisal: Methodology and applications (Studies in rural participation). Concept publications,India.
- Mascarenhas, J (1991): Participatory Rural Appraisal and Participatory Learning methods: recent experiences from Myrada and South India, RRA Notes, Issue 13, pp.26–32, IIED, London.

Examination scheme and mode:

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

PROGRAMME MEDIA

Credit distribution, Eligibility and Prerequisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-Hospital Front Office Operations I requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
PROGRAMME MEDIA	**2**	**1**	**0**	**1**	**Class XII**	**NIL**

Learning Objectives

The Learning Objectives of this course are as follows:

- To understand the concept of programme media and its importance in field work practice
- To learn about various types of programme media and their effective use in field work
- To learn to demonstrate creative ideas and tools in field settings

Learning outcomes

At the end of the semester the students will be able to

- Learn the concept of programme media in social work
- Develop various programme media tools to be used in field settings
- Demonstrate the skills essential for using programme media in the field work

SYLLABUS

Unit I: Understanding Programme Media **Unit Description:** This unit will give an opportunity to the students to understand the concept of programme media in social work.	**(No. of hours)** **4** **Weeks: I-IV**
Subtopics: • Programme media: Concept, characteristics, purpose and significance • Communication in programme media	

• Role of programme media: propaganda and public opinion	
Unit II: Mediums and Methods of Programme Media **Unit Description:** Student will learn different types of programme media to be used for diagnostic, problem-solving and therapeutic purposes.	**(No. of hours)** **4** **Weeks: V-VIII**
Subtopics: • Types of programme media: Talk, public meeting & hearing, group discussion, press conference, movement, advertisement, campaign, storytelling and entertainment/games • Information and digital literacy: Concept, importance and components • People's participation in programme: Film screening, discussion and review	
Unit III: Handmade Creations and Creative Writings in Social Work **Unit Description:** This unit will give an opportunity to the students to learn various handmade creations and creative writings of programme media to interact with client groups.	**(No. of hours)** **3** **Weeks: IX-XI**
Subtopics: • Handmade creations: Collage, poster making, wall paintings • Creative writings: short story writing, slogans writing and preparing brochures, hand-outs & pamphlets, FAQs • IEC materials: Flip chart, flash cards, flyers, leaflets, banners, hoardings and standee	
Unit IV: Programme Media for Masses **Unit Description:** The students will be engaged in various learning activities related to application of programme media in field settings.	**(No. of hours)** **4** **Weeks: XII-XV**
Subtopics: • Tools preparation: Puppet shows & folk songs, • Performing arts: street plays, drama & theatre &, mime, skit and role plays • Significance of digital media: TV, community radio broadcast and various social media platforms	

Practical component (if any) – Unit III & IV application based **(30 hours)**

Essential readings

- Balwant, G. (1991). Folk Theatre in India. Bombay: Rupa & Co.
- Chen, H. T. (2005). Practical Programme Evaluation: Assessing and Improving Planning, Implementation and Effectiveness. California: Sage Publication.
- Cortright, R. & Hinds, G. (1959). Creative Discussion. New York: The Macmillian Company.
- Dev, M. P. (2009). Creative Writing: A Beginner's Manual. New Delhi: Pearson Longman.
- Mathur, D. (2003). AASHAA, Short Stories by Indian Women, Odyssey II. London: Indian Bookshelf and New Delhi: Star Publishing.
- Menon, M. & Gandhi, V.P. (1997.) Media and Communications - Vol. I. (New Information Order). New Delhi: Kanishka Publishers/Distributors.

Suggested readings

- National School of Drama. (2006). Nukkad Natak Rachnaaur Prastuti. Delhi: NSD.
- Mohan, K. &Banerji, M. (1990). Developing Communication Skills. Pilani: Birla Institute of Technology and Science.

Examination scheme and mode:

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

ENVIRONMENTAL IMPACT AND RISK ASSESSMENT

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
		Lecture	Tutorial	Practical/ Practice		
ENVIRONMENTAL IMPACT AND RISK ASSESSMENT	02	0	0	02	Class XII with Science	NIL

Learning Objectives

- To gain insights into the concepts of environmental impact assessment (EIA) and its relevance for sustainable development
- To acquire knowledge of the socio-ecological and economic perspectives of any developmental project.
- To evaluate methodologies to conduct and analyze EIA acceptable per prevalent regulations

Learning outcomes

The Learning Outcomes of this course are as follows.
After studying the course, the students will be able to:

- Conduct EIA of any developmental project and analyze its environmental and other implications
- Serve as consultant to different agencies working on EIA and a developmental plan
- Evolve strategies to ensure development and conservation hand-in-hand
- Formulate sustainable development strategies for any development plan varying in scale
- Identify and classify different development projects based on their sales and impacts on the environment

SYLLABUS: ENVIRONMENTAL IMPACT AND RISK ASSESSMENT

Practicals/Hands-on Exercises (02 Credits: 60 hours)

1. Based on the given project details, classify them as Category A and Category B1 and B2 projects.
2. Prepare the scope of any recent developmental project of Category A which received Environmental Clearance.

3. To prepare a questionnaire and compilation of primary data to study the scope of the project based on public participation.
4. Identify the impacts due to a Mining Project using the checklist method.
5. Based on the impacts identified in Activity 4, formulate mitigating measures for the project.
6. Determine the impacts due to a large-scale hydropower project in a given state using the matrix method and geo-spatial data,
7. Prepare an environmental management plan for a mining project.
8. To conduct a public hearing for any project and prepare a draft for the process.
9. Prepare a brief life cycle assessment of a smartphone.
10. Prepare a brief EIA report of a River Valley Project.

Teaching learning interface for practical skills

To impart training on technical and analytical skills related to the course objectives, a wide range of learning methods will be used, including (a) laboratory practicals; (b) field-work exercises; (c) customized exercises based on available data; (d) survey analyses; and (e) developing case studies; (f) demonstration and critical analyses; and (h) experiential learning individually and collectively.

Prospective Sectors:

As per the Ministry of Environment, Forests, & Climate Change (MoEF&CC), Govt. of India, ~30 sectors require EIA for Environmental Clearance before any project activity. Some of them include Mining, Oil and gas exploration, development & production, River valley, hydel, drainage and irrigation projects, thermal Power plants, Nuclear power projects, Coal washeries, Mineral, Metallurgical industries, Cement plants, Petroleum industry, Coke oven plants, Asbestos milling, Chlor-alkali industry, Soda ash Industry, Chemical fertilizers, Pesticides industry, Synthetic organic chemicals industry, Distilleries, Integrated paint industry, Pulp & paper industry, Induction/arc furnaces, Air ports, All ship breaking yards, Industrial estates, Common hazardous waste treatment, storage and disposal facilities, Highways, railways, transport terminals, mass rapid transport systems, Building and large construction projects, Townships, and area development projects.

Essential/recommended readings

- EIA 2020. Ministry of Environment, Forest and Climate Change, Draft Environment Impact Assessment Notification, 2020, <http://environmentclearance.nic.in/writereaddata/om/6998FGGHOI_Gaztte_EIA2020_Comments.pdf>.
- Glasson, J. and Therivel, R., 2013. Introduction to Environmental Impact Assessment. Routledge.
- MacKinnon, A.J., Duinker, P.N. and Walker, T.R., 2018. The Application of Science in Environmental Impact Assessment. Routledge.
- Mareddy, A.R. (2017) Environmental Impact Assessment Theory and Practices, Butterworth Heinemann.

Suggested readings

- Judith, P. 1999. Handbook of Environmental Impact Assessment. Blackwell Science.
- Lawrence, D.P., 2013. Impact assessment: practical solutions to recurrent problems and contemporary challenges. John Wiley & Sons.
- Marriott, B. 1997. Environmental Impact Assessment: A Practical Guide. McGraw-Hill, New York, USA.
- Petts, J. (1999). Handbook of Environmental Impact Assessment. Vol. 1, Blackwell Science.

Examination scheme and mode:

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

SUSTAINABILITY REPORTING

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
		Lecture	Tutorial	Practical/ Practice		
SUSTAINABILITY REPORTING	02	0	0	02	Class XII	NIL

Learning Objectives

- To gain insights into the step-by-step process of writing a sustainability report using internationally acceptable standards.
- To evolve a holistic view of sustainability and understand the carrying capacity of ecosystems for human needs.
- To acquire skills to address sustainability challenges in a global context.
- To evaluate industrial/organizational processes/programmes based on the interconnections among economic, environmental, and social activities

Learning outcomes

The Learning Outcomes of this course are as follows.
After studying the course, the students will be able to:

- Develop a multi-disciplinary and holistic perspective of sustainability and identify key factors determining sustainability and associated benefits
- Write sustainability reports using universal, sector, and topic standards
- Explain sustainability challenges and effective methods to communicate it to different stakeholders
- Apply sustainability concepts, and GRI Standards for sustainable industries
- Serve as environmental consultants to different industries
- Advise governments on sustainable environmental polices

SYLLABUS: SUSTAINABILITY REPORTING

Practicals/Hands-on Exercises (02 Credits: 60 hours)

1. Investigate the framework for sustainability reporting outlined by global reporting initiatives (GRI)
2. Analyse universal, sector, and topic standards given by GRI

3. Develop sustainability reporting of your institute
4. Examine and report the sustainability of your residential society or residential area around your College
5. Compare and contrast sustainability reporting of the market in your neighbourhood and the selected mining industry
6. Visit a thermal power plant in and around your city and write its sustainability report
7. Using appropriate standards, evaluate the sustainability of a Cement Factory in your city
8. Field survey of a waste treatment facility in your city, assess their sustainability and give recommendations if required.
9. Analyze the potential and limitations of certified tools and software recommended by the GRI for sustainability reporting
10. Examine and evaluate sustainability reports available on different sectors and topics worldwide and give appropriate recommendations, if any.

Teaching learning interface for practical skills

To impart training on technical and analytical skills related to the course objectives, a wide range of learning methods will be used, including (a) laboratory practicals; (b) field-work exercises; (c) customized exercises based on available data; (d) survey analyses; and (e) developing case studies; (f) demonstration and critical analyses; and (h) experiential learning individually and collectively.

Prospective Sectors:

All Multi-National Companies, (b) Environmental and Sustainability Consultancies, (c) Environmental NGOs, (d) World Bank, and (e) UNDP

Essential/recommended readings

- Bini, L. and Bellucci, M., 2020. Integrated Sustainability Reporting: Linking Environmental and Social Information to Value Creation Processes. Springer.
- A Short-Introduction to GRI Standards. https://www.globalreporting.org/media/wtaf14tw/a-short-introduction-to-the-gri-standards.pdf
- Evaluating National Policies on Corporate Sustainability Reporting https://wedocs.unep.org/handle/20.500.11822/9435
- Gutterman, A.S., 2021. Sustainability Reporting and Communications. Business Expert Press.
- Sustainability Reporting in the Financial Sector: A Governmental Approach https://wedocs.unep.org/handle/20.500.11822/17375
- United Nations Environment Program (UNEP), 2015. Raising the bar: Advancing environmental disclosure in sustainability reporting.

Suggested readings

- Greiling, D., Traxler, A.A. and Stötzer, S., 2015. Sustainability reporting in the Austrian, German and Swiss public sector. International Journal of Public Sector Management.
- https://www.globalreporting.org/reporting-support/reporting-tools/certified-software-and-tools/

Examination scheme and mode:

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

ENVIRONMENTAL AUDITING

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
		Lecture	Tutorial	Practical/ Practice		
ENVIRONMENTAL AUDITING	02	0	0	02	Class XII	NIL

Learning Objectives

- To gain an understanding of the fundamental principles and components of environmental auditing
- To train in conducting an environmental audit in any organization/ institution
- To implement critical thinking toward environmental problems and formulate local solutions for their mitigation

Learning outcomes

After studying the course, the students will be able to:

- Conduct an environmental audit in a scientific manner
- Recommend organizations to adopt specific sustainable strategies
- Serve as catalyst to evolve sense of ownership and responsibility among organizations/industries towards solving local environmental problems.
- Pursue environmental auditing for higher studies and a future career.

SYLLABUS: ENVIRONMENTAL AUDITING

Practicals/Hands-on Exercises (02 Credits: 60 hours)

1. Prepare a working plan (in the form of a flowchart/ graphical abstract) for the environmental audit of any organization/ institution focusing on pre-audit, on-site and post-audit objectives and activities
2. Prepare a brief profile of any selected organization/ institution (Area, land use, green cover, organizational setup, demography etc.) and discuss its environmental policy and the environmental management systems
3. Prepare an interpretive electricity consumption report of the organization/ institution over a five-year period (both actual or arbitrary data can be used).

4. Prepare an interpretive water consumption report of the organization/ institution over a five-year period (both actual or arbitrary data can be used). Also, identify the sources of wastewater discharge and its management, if any.
5. Survey the campus and prepare a list of the plant/ animal (or both) diversity, highlighting its importance and threats faced.
6. Prepare a monthly air quality level dataset nearest to the institution's location, extracting data from the National Air Quality Index (CPCB) website. Prepare a report on causes of variation and measures taken by an organization to improve air quality levels
7. Prepare a comprehensive assessment report of Solid Waste Management at the organization/ institution highlighting compliance to Solid Waste Management Rules, 2016.
8. Formulate a scientifically sound protocol for identifying and disposing of e-waste and hazardous waste at any organization based on E-waste (management) rules, 2016 and Hazardous waste (management) rules, 2016.
9. Examine various environment-related practices and activities of the organization/ institution that have impacted the neighbouring communities and prepare a social audit questionnaire for studying the impact.
10. Compile the data, results, and analysis of all previous practicals and prepare a detailed environmental audit report of your selected organization/ institution.

Teaching learning interface for practical skills

To impart training on technical and analytical skills related to the course objectives, a wide range of learning methods will be used, including (a) laboratory practicals; (b) field-work exercises; (c) customized exercises based on available data; (d) survey analyses; and (e) developing case studies; (f) demonstration and critical analyses; and (h) experiential learning individually and collectively.

Prospective Sectors:

(a) Universities/Colleges, (b) Environmental Consultancies, (c) Environmental NGOs, and (d) Indian Audit & Revenue Departments

Essential/recommended readings

- Cahill, L.B (2017). Environmental Health and Safety Audits: A Compendium of Thoughts and Trends, 2nd Edition, Bernan Press.
- Council, N.C., Britain, G. and Unit, E.F., 2011. Handbook for Phase 1 Habitat Survey: A Technique for Environmental Audit. Nature Conservancy Council.
- Ho G, Anda, M., Brennan, J., 2015. Water Auditing and Water Conservation. IWA Publishing
- Pain, S.W., 2010. Safety, Health, and Environmental Auditing: A Practical Guide. CRC Press.
- Thuman, A., Niehus, T., Younger, W.J., 2012. Handbook of Energy Audits, 9th ed. Routledge, Taylor and Francis
- Van Guilder, C.V., 2014. Environmental Audits. Mercury Learning & Information.

Suggested readings

- Barton, H., and Bruder N., 1993. A Guide to Local Environmental Auditing. Routledge, Taylor and Francis

Examination scheme and mode:

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

DOCUMENT PREPARATION & PRESENTATION SOFTWARE

Credit distribution, Eligibility and Prerequisites 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		
Document Preparation & Presentation Software	**2**	**0**	**0**	**2**	**Class XII**	**NIL**

Learning Objectives:

- To develop proficiency in the use of document preparation software such as document LaTeX, LibreOffice.
- To make a presentation using LaTeX, LibreOffice.
- To serve as a tool for conveying/communicating one's ideas, views, and observations.

Learning Outcomes

On completion of the course, a student will be able to

- Create a text document using LaTeX using a standard template.
- Incorporate well-formatted mathematical equations, algorithms, figures, tables and references in a document.
- Use Zotero for reference management.
- Format text, including alignment, emphasis and fonts.
- Handle basic aspects of document structure, including sections, subsections, paragraphs, and bulleted and enumerated lists.
- Page set a document including header, footer, and page numbering.
- Make a presentation.

Syllabus

Practical

Unit 1: Introduction **(4 Hours)**

1. Create a LaTeX/ LibreOffice document having several paragraphs, including comments in LaTeX.
2. Organize content into sections, including preface/abstract. Using the article and book class of LaTeX. Handling errors.

Unit 2: Styling Pages (6 Hours)

1. Loading and using packages, setting margins, header and footer, and page orientation.
2. Organizing the document into multiple columns

Unit 3: Formatting Content (10 Hours)

1. Formatting text (styles, size, alignment)
2. Adding colours to a block of text/ page
3. Adding ordered and unordered lists
4. Inserting mathematical expressions – subscripts, superscripts, fractions, binomials, aligning equations, operators, Greek and mathematical symbols, and mathematical fonts.

Unit 4: Tables and Figures (10 Hours)

1. Create basic tables
2. Adding different types of borders to a table
3. Merging rows and columns
4. Splitting tables across multiple pages.
5. Incorporating figures and subfigures, explore different properties like rotation and scaling.

Unit 5: Algorithms and Equations (12 hours)

1. Incorporating algorithms, body typesetting, organizing algorithms across multiple pages.
2. Incorporating equations, indentation, and captioning.

Unit 6: Referencing and Indexing (6 hours)

1. Insert captions, labels, and references
2. Incorporate cross-referencing (refer to sections, table, and images)
3. Incorporate a bibliography
4. Create a back index.

Unit 7: Making Presentations (12 hours)

1. Create a slideshow
2. Incorporate logo
3. Highlight important points
4. Create a title page
5. Make a table of contents
6. Incorporate special effects in a slideshow.

Exercises:

For the following figures, create LaTex documents using concepts from above:

1.

Hello World!

Prof. Naveen Kumar

November 15, 2022

Hello World! Today I am learning LaTeX. LaTeX is a great program for writing math. I can write in line math such as $a^2 + b^2 = c^2$. I can also give equations their own space:

$$\gamma^2 + \theta^2 = \omega^2$$

2.

Integrals, Sums and Limits

Dr. Neeraj Kumar Sharma

1 Integrals

Integral $\int_a^b x^2 dx$ inside text.

The same integral on display:

$$\int_a^b x^2\,dx$$

and multiple integrals:

$$\iint_V \mu(u,v)\,du\,dv$$

$$\iiint_V \mu(u,v,w)\,du\,dv\,dw$$

$$\oint_V f(s)\,ds$$

2 Sums and products

Sum $\sum_{n=1}^{\infty} 2^{-n} = 1$ inside text.

The same sum on display:

$$\sum_{n=1}^{\infty} 2^{-n} = 1$$

Product $\prod_{i=a}^{b} f(i)$ inside text.

The same product on display:

$$\prod_{i=a}^{b} f(i)$$

3 Limits

Limit $\lim_{x\to\infty} f(x)$ inside text.

The same limit on display:

$$\lim_{x\to\infty} f(x)$$

3.

Equations

Prof. Naveen Kumar[1], Dr. Neeraj Kumar Sharma[2], and Sakeena Shahid[3]

[1]Department of Computer Science, University of Delhi
[2]Ram Lal Anand College, University of Delhi
[3]SGTB Khalsa College, University of Delhi

November 15, 2022

1 Maxwell's Equations

"Maxwell's equations" are named for James Clark Maxwell and are as follow:

$$\vec{\nabla} \cdot \vec{E} = \frac{\rho}{\epsilon_0} \quad \text{Gauss's Law} \tag{1}$$

$$\vec{\nabla} \cdot \vec{B} = 0 \quad \text{Gauss's Law for Magnetism} \tag{2}$$

$$\vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t} \quad \text{Faraday's Law of Induction} \tag{3}$$

$$\vec{\nabla} \times \vec{B} = \mu_0 \left(\epsilon_0 \frac{\partial \vec{E}}{\partial t} + \vec{J} \right) \quad \text{Ampere's Circuital Law} \tag{4}$$

Equations 1, 2, 3, and 4 are some of the most important in Physics.

2 Matrix Equations

$$\begin{pmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \dots & a_{nn} \end{pmatrix} \begin{bmatrix} v_1 \\ v_2 \\ \vdots \\ v_n \end{bmatrix} = \begin{matrix} w_1 \\ w_2 \\ \vdots \\ w_n \end{matrix}$$

4.

List of mathematical functions:

- Trigonometric functions
  - sine
  - cosine
  - tangent
- Special functions
  - Beta function
  - Gamma function
  - Riemann zeta function

5. Add the following algorithm to the document.

Algorithm 1: Example code

Input: Your Input
Output: Your output
Data: Testing set x

```
1  ∑_{i=1}^{∞} := 0                                   // this is a comment
   /* Now this is an if...else conditional loop                          */
2  if Condition 1 then
3  |  Do something                                   // this is another comment
4  |  if sub-Condition then
5  |  |  Do a lot
6  else if Condition 2 then
7  |  Do Otherwise
   |  /* Now this is a for loop                                         */
8  |  for sequence do
9  |  |  loop instructions
10 else
11 |  Do the rest
   /* Now this is a While loop                                          */
12 while Condition do
13 |  Do something
```

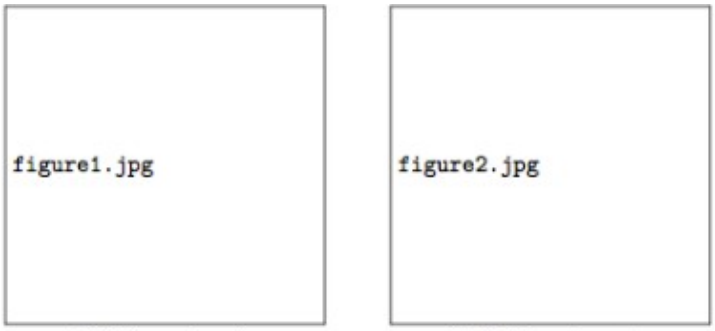
6.

col1	col2	col3
Multiple row	cell2 cell5 cell8	cell3 cell6 cell9

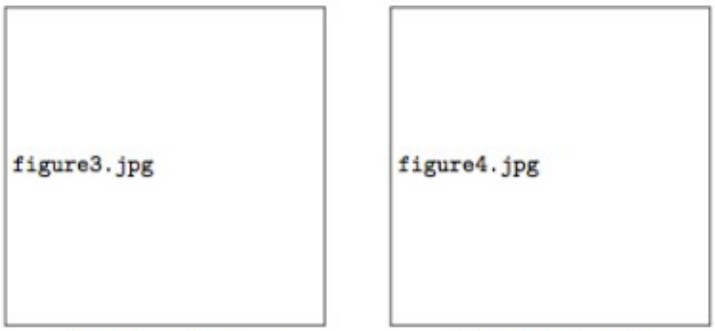
7.

Country List		
Country Name or Area Name	ISO ALPHA 2 Code	ISO ALPHA 3
Afghanistan	AF	AFG
Aland Islands	AX	ALA
Albania	AL	ALB
Algeria	DZ	DZA
American Samoa	AS	ASM
Andorra	AD	AND
Angola	AO	AGO

8. Insert four sub-figures as given below, and add captions. Also, refer to these sub-figures in the text.



(a) Subfigure 1 caption (b) Subfigure 2 caption



(c) Subfigure 3 caption (d) Subfigure 4 caption

Figure 1: This is a figure containing several subfigures.

In the text, you can refer to subfigures of figure 1 as 1a, 1b, 1c and 1d and to the sub-index as (a), (b), (c) and (d).

9. Add a table of contents, a list of figures, and a list of tables in the document as given below.

Contents

List of Tables

List of Figures

10. Add a list of references in the document as given below and cite them in the text.

This document is an example of `natbib` package using in bibliography management. Three items are cited: *The LaTeX Companion* book [2], the Einstein journal paper Einstein [1], and the Donald Knuth's website [3]. The LaTeX related items are [2, 3].

References

[1] A. Einstein. Zur Elektrodynamik bewegter Körper. (German) [On the electrodynamics of moving bodies]. *Annalen der Physik*, 322(10):891–921, 1905. doi: http://dx.doi.org/10.1002/andp.19053221004.

[2] M. Goossens, F. Mittelbach, and A. Samarin. *The LaTeX Companion*. Addison-Wesley, Reading, Massachusetts, 1993.

[3] D. Knuth. Knuth: Computers and typesetting. URL `http://www-cs-faculty.stanford.edu/~uno/abcde.html`.

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

Innovation and Entrepreneurship

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		
Innovation and Entrepreneurship	**2**	0	0	**2**	Class XII	NIL

Learning Objectives

The primary objectives of the course will be to:

- Encourage the process of creative thinking and innovation
- Build an entrepreneurial perspective to identify and tackle problems and explore new opportunities
- Gain insight into building business models and plans
- Identify tools and strategies that entrepreneurs may use for start-up, innovation and reinvention
- Understand how to go from an idea to product and scale it up for sustainability
- Develop skills to work in teams and build connections, collaborations and social networks .

Learning Outcomes

By the end of the course students should be able to:

- Identify and comprehend the concepts of creativity, innovation and invention in various contexts.
- Enrich their theoretical and conceptual foundations in entrepreneurship.
- Gain hands-on experience that shall empower them to identify business and social opportunities and venture in the entrepreneurial landscape.
- Prepare themselves to take informed decisions in establishing start-ups and ongoing innovation in organisations.

PEDAGOGY

While suitable concepts and theory will be utilized, the emphasis of the course will be on inquiry driven hands-on activities and experiential learning in a team setting. As this is essentially a group activity based course, the two lectures scheduled for each week shall be held together. The class to be split up ideally in groups of 5 – 7 students each, who will work

together for the rest of the semester on identifying a specific problem and by semester-end present a feasible innovative prototype capable of being funded as a start-up.

SYLLABUS

Unit I: Understanding Creativity

- Understanding the concept and process of creativity; students exploring within themselves the nature of the creative process; approaches to understanding creativity (Ref. B1)
- Differentiate between invention and innovation (Ref. OR1)
- Understanding entrepreneurial mindset and skills (creativity, decision making, risktaking behaviour, networking) and entrepreneurship in different contexts (eg. Social, Cooperative, Commercial, Public, Not for Profit organisations) (Ref. B1)
- Case studies of some successful innovations/start-ups – Different group can be given a different Case Study and the groups can have a discussion on same (Ref. Suggestive Case Studies A)

(15 practical hours)

Unit II: Ideation

- Identifying a specific problem through observation, contemplation, networking and research (Ref. B2)
- Generating ideas for problem solving using mind mapping, brainstorming, focus groups, idea generation tool kit (SCAMPER) (Ref. B1)
- Learning through failures of others – case studies of some ventures that could not sustain – Different group can be given a different Case Study and the groups can have a discussion on same (Ref. Suggestive Case Studies B)

(**15 practical hours)**

Unit III: Understanding the business

- Building a business plan using the lean canvas model (Ref. OR2)
- Understanding customers/stakeholders and evaluating the business plan through survey/questionnaire/interview/secondary research (Ref. B1 and B2)
- Designing, prototyping and iteration (Ref. B2)
- Networking and growth strategies (Ref. B3)
- Building and managing organisations (Ref. B3)
- Role of leadership and team based culture (Ref. B3 and OR4)

(**20 practical hours)**

Unit IV: Venturing Forth

- Financing the innovation: pitching and communicating the idea
- Sources of finance: crowdfunding, venture capital, equity funds, angel investing, borrowing (including government initiatives, bank and public funded schemes) (Ref. OR5 and OR6)
- Various forms of IPR (patent, copyright, trademark, geographical indication, industrial design) (Ref. OR7 and OR8)
- Setting and scaling up (Ref. B3)
- Entrepreneurial resilience and ongoing creativity (Ref. B1)

(**10 practical hours)**

Suggested Readings: Books

B1.The Innovator's DNA: Mastering the Five Skills of Disruptive Innovators, Jeff Dyer, Hal Gregersen, C.M. Christensen, Harvard Business Review Press, 2011

B2. Design Thinking: Business Innovation, Maurício Vianna, Ysmar Vianna, Isabel K. Adler, Brenda Lucena, Beatriz Russo, MJV Press, 1st Electronic Edition, 2011
(also available at https://cdn2.hubspot.net/hubfs/1701231/Documents/Design_Thinking_-_The_Book/Design_Thinking_The_Book.pdf)

B3. Contemporary Strategy Analysis: Text and Cases, Robert M Grant, Wiley, 9th Edition,2016 (Chapter 6 and Chapter 9)

Online Resources

OR1. Discovery, Innovation and Invention
https://www.laits.utexas.edu/~anorman/long/DII.html

OR2. How to create your lean canvas
https://leancanvas_production.s3.amazonaws.com/cms/LeanCanvas.pdf

OR3. Organisational behaviour and human relations, Module 12, Creativity in decision making
https://courses.lumenlearning.com/wm-organizationalbehavior/

OR4. Organisational behaviour and human relations, Module 13, Leadership
https://courses.lumenlearning.com/wm-organizationalbehavior/

OR5. Sources of Funding Innovation and Entrepreneurship
https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2020-chapter4.pdf

OR6. Government Schemes for Startups
https://www.startupindia.gov.in/content/sih/en/government-schemes.html

OR7. Intellectual Property Rights in India
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/627956/IP-Rights-in-India.pdf

OR8. What is Intellectual Property? WIPO 2020 doi:10.34667/tind.42176
https://www.wipo.int/publications/en/details.jsp?id=4528

Suggestive Case Studies A
1. Amul
2. Goonj
3. Aravind Eye care systems
4. Apple
5. Pixar
6. ISRO
7. Khan Academy
8. Nyka
9. Swiggy

10. Sulabh International
11. OYO
12. Mumbai's Dabbawalas
13. Lijjat Papad
14. Jaipur Rugs
15. WOW! Momo
16. Biryani by Kilo

Suggestive Case Studies B

1. Nokia
2. Cafe Coffee Day
3. HMT watches
4. Atlas Cycles
5. Jet Airways
6. Kodak
7. Stayzilla
8. SKS Microfinance IPO
9. Satyam Computers
10. Groupon Inc.

Weekly Plan:

Week I: Understanding the concept and process of creativity; Approaches to understanding creativity; differentiate between invention and innovation.

Week II: Activity week - Students exploring within themselves the nature of the creative process in groups (eg. exploring the surroundings for possible problems and challenges that may have innovative solutions).

Week III: Understanding entrepreneurial mindset and skills (creativity, decision making, risk taking behaviour, networking) in different contexts through discussion of a case study (may select one case study from Suggestive Case Studies A).

Weeks IV - IX: Activity Weeks - The class to be split up ideally in groups of 5 – 7 students each, who will work together for the rest of the semester on identifying a specific problem and by semester-end present a feasible innovative prototype capable of being funded as a start-up.

Week IV: To begin with, each group shall identify a problem through observation,contemplation, brainstorming, networking and research.

Week V: Each group to generate ideas for solving their identified problem using mind mapping, focus groups, idea generation tool kit (SCAMPER).

Week VI: Each group to critically assess the feasibility of the proposed ideas by learning through the failures of others – case studies of some ventures that could not sustain (may use a case study from Suggestive Case Studies B).

Week VII: Each group to build a business plan using the lean canvas model and survey/questionnaire/interview/secondary research.

Week VIII: Each group to design and prototype their proposed business solution/model/product.

Week IX: The groups evaluate their proposed business plan/model using feedback from networking. Submission of formal business plan (written) by each group.

Week X: Formulating growth/scaling up strategies*;* building and managing organisations*;* role of leadership and team based culture, *e*ntrepreneurial resilience and ongoing creativity.

Week XI: Financing the innovation: pitching and communicating the idea. Sources of finance: crowdfunding, venture capital, equity funds, angel investing, borrowing (including government initiatives, bank and public funded schemes)

Week XII: Various forms of IPR (patent, copyright, trademark, geographical indication, industrial design)

Week XIII, XIV and XV: Activity weeks - Submission of final project report (written) and presentation (oral) by each group, Viva.

Examination scheme and mode:

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

IT Skills and Data Analysis - I

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		
IT Skills and Data Analysis - I	**2**	0	0	**2**	Class XII	NIL

Learning Objectives

The primary objectives of the course will be to:

- Familiarise the student with the quantitative skills required for representing and interpreting data for the purpose of decision making.
- Equip the student with some fundamental concepts, which play a critical role in understanding and visualizing real world data.
- Enable the student to analyze data and problem situations using relevant IT tools.

Learning Outcomes

By the end of the course students will be able to

- Represent and interpret data in tabular and graphical forms
- Understand and interpret the measures of central tendency and dispersion.
- Use IT tools such as spreadsheets to visualise and analyse data.

PEDAGOGY

Relevant concepts and theory will be introduced which will be supplemented by hands-on activities enabled by the use of spreadsheets. This is a two credit course and will comprise two lecture periods per week. As this is essentially an activity-based course, it will involve two consecutive lecture periods, once in a week.

SYLLABUS
Practical

Unit I : What is Statistics ? (24 hours)

This unit provides an introduction to the fundamentals of datasets, sources of data, frequency distributions and graphical representations of data. The aim is to give students a hands-on experience of initiating data analysis through a spreadsheet.

- Concept of datasets (Variables, Observations)
  Reference 1, Chapter 2
- Different types of variables (Quantitative and Qualitative)
  Reference 1, Chapter 2
- Distinction between primary and secondary sources of data
  Reference 1, Chapter 2
- Basic idea of using questionnaire to collect primary data for analysis
  Reference 2, Chapter 1 [Section 1.6]
- How to construct a questionnaire
  Reference 1, Chapter 1
- Concept of frequency distribution: cumulative and relative frequencies
  Reference 2, Chapter 2
- Introduction to spreadsheet
  Reference 2, Chapter 2
  - Tabular and graphical presentation of data: data tables, frequency curve, histogram,bar graphs, pie charts (through the use of spreadsheets)
    Reference 2, Chapter 2

Unit II: Measures of Central Tendency and Dispersion (36 hours)

The focus of this unit will be to familiarise the student with summary statistics to describe datasets. In particular, two important characteristics of data, viz., central tendency anddispersion, will be used to summarise datasets using a spreadsheet. The concept of the Normal distribution and its characteristics will be discussed to highlight its relevance in modelling real life phenomenon.

- Measures of central tendency: mean, median, mode
  Reference 2, Chapter 3
- Examples of situations where it is appropriate to use the mean, median and mode asa measure of central tendency
  Reference 2, Chapter 3
- Weighted mean
  Reference 2, Chapter 3
- Measures of dispersion: range, variance, standard deviation
  Reference 2, Chapter 3

- Quartiles, deciles and percentiles
  Reference 2, Chapter 3
- Visualize the measures of central tendency and dispersion through frequency curveand histogram
  Reference 2, Chapter 3
- Skewness and kurtosis
  Reference 2, Chapter 3
- Normal curve and its basic properties : visual representation of population characteristics (height, weight, IQ etc.)
  Reference 2, Chapter 5 [Section 5.6]

References (Readings and Resources)

1. Rowntree, D., Statistics without tears - A primer for non-mathematicians, Allyn and Bacon, 2018.
2. Levin, Rubin, Rastogi and Siddiqui, Statistics for Management, 7th Edn, 2014

Suggested Data Sources

The following data sets are suggested to carry out the activities

1. https://data.worldbank.org/
2. https://www.statista.com/
3. https://data.gov.in/
4. https://censusindia.gov.in/
5. https://www.kaggle.com/
6. http://data.un.org/

Weekly Plan

Weeks I and II: Students learn about the concept of datasets (Variables, Observations) ; Different type of Variables (Quantitative and Qualitative); Distinction between primary and secondary sources of data

Weeks III and IV: Basic idea of using questionnaire and how to construct a it; Concept of frequency distribution - cumulative and relative frequencies; Introduction to spreadsheet

Weeks V and VI: Tabular and graphical presentation of data: data tables, frequency curve, histogram, bar graphs, pie charts. Students to explore various representations on spreadsheet using datasets

Weeks VII and VIII: Introduction of Measures of Central Tendency: Mean, Median, Mode through appropriate examples explaining the use of each one of them in various situations. Understanding the concept of Weighted mean;

Weeks IX and X: Measures of dispersion: Range, Variance, Standard deviation; Visualizingthe measures of central tendency and dispersion through frequency curve and histogram. Understanding Quartiles, deciles and percentiles numerically.

Weeks XI and XII: Representation of population characteristics using the basic propertiesof a Normal Curve, skewness and kurtosis.

Weeks XIII and XIV: Assignments based on Units 1 and 2 using spreadsheets to consolidate the learning of concepts covered.

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

IT Skills and Data Analysis - II

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		
IT Skills and Data Analysis - II	**2**	0	0	**2**	Class XII	IT Skills and Data Analysis - I

Learning Objectives

The primary objectives of the course will be to

- Familiarise the student with the quantitative skills required for corelating the datafor the purpose of decision making.
- Equip the student to visualise functions which play a critical role in understandingand visualizing real world data.
- Enable the student to analyze data and problem situations using relevant IT tools.

Learning Outcomes

By the end of the course students will be able to

- Establish relationships between variables using correlation and regression analysis.
- Visualize functions and differentiate between linear and nonlinear functions.
- Use IT tools such as spreadsheets to visualise and analyse data.

PEDAGOGY

Relevant concepts and theory will be introduced which will be supplemented by hands-on activities enabled by the use of spreadsheets. This is a two credit course and will comprise two lecture periods per week. As this is essentially an activity-based course, it will involve two consecutive lecture periods, once in a week.

SYLLABUS

Unit I: Functions and their graphical representations (16 hours)

This unit introduces the graphical visualisation of functions to understand the relationship between two variables.

- Definition and graphical representation of a function, vertical line test
  Reference 3
- Polynomial functions: linear, quadratic and cubic functions
  Reference 3
- Reciprocal, exponential and logarithmic functions
  Reference 3
- Concept of slope of a function through graphical representation
  Reference 3

Unit II: Relationship between Variables (28 hours)

Students will learn about scatter diagrams and correlation analysis as a means to describe the nature and strength of association between two variables. The concept of regression analysis will be introduced as a method for quantifying the relationship between two variables. Further, multiple linear regression will be discussed for situations where more than one independent variable is needed to estimate the dependent variable. The focus will be mainly on interpreting estimated regression coefficients.

- Scatter diagrams
  Reference 2, Chapter 12
- Correlation analysis : measure and interpretation of correlation coefficient andcoefficient of determination
  Reference 2, Chapter 12
- Hypotheses, model specification and testing
  Reference 2, Chapter 12
- Bi-variate regression analysis: method of least squares, curve of best fit as a modelfor prediction
  Reference 2,
  Chapter 12
- Multiple Linear Regression
  Reference 2,
  Chapter 13

Weeks 12 – 14: Project Presentations and Viva (16 hours)

References (Readings and Resources)

1. Rowntree, D., Statistics without tears - A primer for non-mathematicians, Allyn andBacon, 2018.

2. Levin, Rubin, Rastogi and Siddiqui, Statistics for Management, 7th Edn, 2014
3. Boundless Algebra : https://courses.lumenlearning.com/boundless-algebra/

Suggested Data Sources

The following data sets are suggested to carry out the activities

1. https://data.worldbank.org/
2. https://www.statista.com/
3. https://data.gov.in/
4. https://censusindia.gov.in/
5. https://www.kaggle.com/
6. http://data.un.org/

Weekly Plan

Weeks I and II: Understanding the definition of a function; graphical representation of a function and vertical line test; visualising various kinds of functions (Linear, quadratic and cubic functions)

Weeks III and IV: Reciprocal, exponential and logarithmic functions; Interpreting andvisualising the concept of slope of a function through graphical representations.

Weeks V and VI: Scatter Diagrams; Correlation analysis - measure and interpretation ofcorrelation coefficient and coefficient of determination.

Weeks VII to IX: Hypotheses, model specification and testing; Understanding Bi-variateRegression analysis: Method of Least Squares; Curve of best fit as a model for prediction.

Weeks X and XI: Multiple Regression Analysis

Weeks XII to XIV: Project Presentations and Viva

Examination scheme and mode:

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

R Programming for Business Analytics

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THECOURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
R Programming for Business Analytics	**2**	**0**	0	**2**	XII pass	NIL

Learning Objectives

- To introduce the basic concepts in R programming.
- To equip the students with the popular statistical programming language R.
- To familiarize the students with utility of 'R' for managerial decision making.

Learning outcomes

Upon successful completion of this course the student will be able to:

- Learn Syntax and Semantics of R Programming
- Understand the file system and data handling in R.
- Visualize and analyse the data using statistical methods.
- Apply best practice model design methodologies to real problems using R

SYLLABUS

Unit I: Introduction to R, Data Handling and Data Visualizatio (16 hours)
Introduction to R and familiarization of R Studio, Basic components in R Studio. R Syntax andprogramming , Understanding *tidyverse*, *tibble*, *dplyr*, *ggplot2*, *tidyr*, *purrr*, *readr*, *forcats*, *stringr* for tidying, manipulating and plotting data,

Unit II: Optimization Models using R (12 hours)
Linear Programming Models, Optimization models, understanding *optim()*,

Unit III: Machine Learning with R - Introduction to Supervised Learning (16 hours)
Classification based on similarities with k-nearest neighbours, odds with logistic regression, maximizing separation with discriminant analysis, classifying with decision tress, regression with kNN, random forest, XGBoost, Understanding *mlr, classif.* , regr.
,

Unit IV: Machine Learning with R - Introduction to Unsupervised Learning
(16 hours)

Dimension Reduction- Maximizing variance with Principal Component Analysis; k-mean cluster, understanding *cluster.* .

Essential/recommended readings

- Boehmke, B. & Brandon, G.(2020). Handson Machine Learning with R, CRC Press.

- Horton, N.J. & Kleinman, K.(2015) Using R & R Studio for Data Management, StatisticalAnalysis , and Graphics, CRC Press.
- Peng, R. D. (2016). *R programming for data science* (pp. 86-181). Victoria, BC,Canada: Leanpub.
- Lander, J. P. (2014). *R for everyone: Advanced analytics and graphics*. Pearson Education.
- Teetor, P. (2011). *R cookbook: Proven recipes for data analysis, statistics, and graphics*. " O'Reilly Media, Inc.".
- Zhao, Y., & Cen, Y. (2013). *Data mining applications with R*. Academic Press.

Note: Learners are advised to use the latest edition of readings.

Examination scheme and mode:

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

YOGA IN PRACTICE

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
		Lecture	Tutorial	Practical/ Practice		
Yoga in Practice	**2**	0	0	2	**Class XII Pass**	**NIL**

Total Credits: 02

Learning Objectives:

Students will be able to discern real significance of yogic oprations from original sources and will be prone to practicing in their day to day life.

Learning Outcomes:

(i) Student will form an understanding of the concept of yoga.
(ii) Students will learn various aspects of the science of yoga.
(iii) Theoretical and practical knowledge of Aasanas and pranayams to lead a balanced life.

SYLLABUS OF YOGA IN PRACTICE

Practical
Unit: I

30 hours

(i) Definition and types of yoga:

Karma yoga, Gyana yoga, Bhakti yoga, Laya yoga, Raja yoga, Hatha yoga, Mantra yoga,
Kundalini yoga. (योग एवं 4ोIv – अ◌ोाय -१)

(ii) Ashtanga Yoga:
Yam- Ahinsa, Satya, Asteya, Brahmacharya, Aparigrah.
Niyam- Sauch,Santosha,Tapa, Swadhyaya, Ishwarpranidhana
Asan, Pranayam- (the types of Pranayaama: Puraka, rechak & Kumbhaka), Pratyahara, Dharana, Dhyana & Samadhi etc.

(iii) Shat Chakra,s:
Mooladhara, Swadhishthana, Manipur, Anahata, Vishudha, Aagya, Sahasrara-(Sahasradhara chakra). (योग एवं 4ोIv - अ◌ोाय – २-३)

Unit: II **30 hours**

Asana,s and their advanteges:-

(i) Asana in standing position:

Surya Namaskara,Tadasana, Padahastasana, Garudasana, Natarajasana, Cakrasana.

(ii) Asana in sitting position:

Padmasana, Vajrasana, Siddhasana, Bhadrasana, Gomukhasana, Shashankasana, Mandukasana, Kukkutasana.

(iii) Asana in stomach side position:

Dhanurasana, Bhujangasana, Mayurasana, Marjarasana, Makrasana.

(iv) Asana in backbone side position:

Uttanapadasana, Naukasana,Sarvangasana, Sheershasana, Savasana etc.

(v) Practice of pranayama- Purak, Rechak and Kumbhaka. (योग एवं 4oIv - अ◌ाय – ३ -४,६)

Essential Readings:

1. योग दश◌न – महि◌ष पतंजलि, टीकाकार-हरिकृ ◌दास गोय◌का, गीता प्रेस, गोरखपुर, उKर प्रदेश,
४० वां पुनमुद्रण 1
2. योग एवं 4oTv – डॉ० विजय कुमार, चौख◌ा वि◌व◌भारती, वाराणसी, उKर प्रदेश, प्र ० सं◌रण – २०२१ 1

3. प्राणायाम रह4 –(वैyानिक त◌ोंं के साथ)– 4ामी रामदेव, दिD प्रकाशन, दिD योग म◌◌र ◌◌, पतंजिल योगपीठ ,

कनखल, ह◌र◌ार 1

4. योग साधना एवं योग चिकिTा रह4- 4ामी रामदेव, दिD प्रकाशन, दिD योग म◌◌र ◌◌, पतंजिल योगपीठ ,

कनखल, ह◌र◌ार 1

5. शतयुव◌ पु◌ष – 4ामी रामे◌रान◌ सर4ती, आ◌ प्रकाशन, कुं डे वालान, दिWी-सं० २०६२ 1 (ईवैदिक पु◌कालय, मु◌ई)

Suggestive Readings:

1. योग थिरपी – 4ामी अ◌ै तान◌ सर4ती, गु◌कुल वृ◌ावन Wातक शोध सं◌ान, आसफ अली रोड,नई दिWी -२००६ 1
2. Dायाम का मह◌ – 4ामी ओमान◌ सर4ती, हरयाणा साहिw सं◌ान, गु◌कुल झ◌र, हरयाणा - २००६ 1
3. आयुव◌दीय पUकम◌ चिकिTा- आचाय विhाधर शु4, भारतीय के◌ीय चिकिTा प◌रषद्, नई दिWी
1
4. रोग और योग- 4ामी कमान◌ सर4ती, योग प◌◌के शन, मुंगेर , बिहार , सं◌रण- २०१३ 1
5. स◌ू◌ योग विhा - राजीव जैन त्रिलोक, मंजुल प◌◌शंग हाउस, भोपाल, म◌ प्रदेश, सं◌रण -
२००५ 1

Examination scheme and mode:

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

Floriculture

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		
Floriculture	**2**	**0**	0	**2**	Class XII	NIL

Learning Objectives

- To acquaint students with the basic principles and importance of Floriculture.
- To teach students about flowering plants that can be grown in different seasons in Delhi-NCR.
- To make students aware about exotic flowering plants of ornamental value and their propagation in laboratories and greenhouses.
- To provide information about employment, business opportunities and other avenues in the Floriculture sector (Floriculturist).

Learning Outcomes

After completion of this course learners will be able to:

- identify and describe the ornamental flowering plants in Delhi-NCR.
- practice the methods of preparing soil and water, cultivation and propagation methods.
- design, prepare and apply appropriate combinations of plants and methods of cultivation for commercial setup.
- adapt to the job role of Floriculturist (employment/ entrepreneurship)

SYLLABUS

Practicals: 60 hours

1. Introduction to floriculture, tools and equipments. 4 hours
2. Study of diversity in shape, size, and colour of flowers (including basic botany, nomenclature, common name and general uses). 4 hours

3. Identification and preparation of an inventory of herbaceous flowering plants, climbers, shrubs, and trees around the campus. 4 hours
4. Study the various physico-chemical soil properties for understanding different soils/soil-types. 8 hours

5. Methods of preparation of floral beds, soil preparation, greenhouse design and

fumigation methods. 8 hours

6. Methods of seed sowing and raising flowering plants through seeds, bulbs and through vegetative methods in planters, containers and in outdoor environments. Role of light, plant growth regulators and nutrients in blooming and flowering. 8 hours

7. Bacterial and fungal diseases and pests of ornamental flowers and their management. 4 hours

8. Interior decoration methods, flower arrangements (Japanese, Western and Indian). 4 hours
9. Harvesting, methods to increase the shelf life of flowers, post-harvest care and marketing platforms for the floriculture industry. 8 hours
10. Field visit to nearby nursery/garden to understand basic aspects of Garden design. 4 hours
11. Project Report on any five flowering plants that are grown commercially, their share in the global market, methods used for selling the products and importance of the floriculture industry in job creation. 4 hours

Essential Readings:

1. Randhawa, G.S., Mukhopadhyay, A. (1986). Floriculture in India. New York, NY: Allied Publishers.
2. Larson, R. A. (Ed.). (2012). Introduction to floriculture. Elsevier.

Suggestive Readings:

1. Pal, S. L. (2019). Role of plant growth regulators in floriculture: An overview. J. Pharmacogn. Phytochem, 8, 789-796.

Examination scheme and mode:

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

Mushroom Culture and Technology I

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		
Mushroom Culture and Technology I	**2**	**0**	0	**2**	Class XII	NIL

Learning objectives

To make students aware about

- mushroom growing techniques.
- medicinal and nutritional value of mushrooms.

Learning Outcomes

After successful completion of the course, students will be able to:

- practice the techniques for cultivation of various edible mushrooms
- setup entrepreneurial small scale units for self-employment
- apply the skills as Mushroom Grower in large scale industries.

SYLLABUS

Practical: 60 hours**

** Specimens and examples studied may vary depending on seasonal factors and availability

1. To study the principle and operation of Autoclave, Incubator, Laminar Air Flow/ BSL 2 facility. 4 hours
2. To study edible mushrooms (*Agaricus, Pleurotus, Boletus, Lentinula, Calocybe, Volvariella, Morchella*). 4 hours
3. To study poisonous mushrooms *(Amanita, Cortinarius, Psilocybe, Coprinopsis*). 4 hours
4. To study medicinal mushrooms (*Ganoderma, Ophiocordyceps, Chaga, Hericium*).

4 hours

5. Preparation of various types of compost and media which can be used for cultivation of mushroom. 4 hours
6. To study the common fungal, bacterial, viral, and insect borne diseases of mushrooms (any 2 from each). 4 hours
7. To study the cultivation technique of *Agaricus* mushroom. 4 hours
8. To study the cultivation technique of *Pleurotus* mushroom. 4 hours
9. To study the cultivation technique of *Calocybe/ Volvariella* mushroom. 4 hours
10. To study the cultivation technique of *Ganoderma* mushroom. 4 hours
11. To study the nutritional value and market value of mushrooms, and post-harvest technologies like packaging and preservation. 4 hours
12. Various requirements for setting up a mushroom cultivation unit ("kuccha" or cemented house). 4 hours
13. Entrepreneurship in cultivation of mushrooms. 4 hours
14. Government policies related to the promotion of mushroom cultivation. 4 hours
15. Visit to an Institute or Center conducting mushroom cultivation (Report to be submitted). 4 hours

Essential Readings:

1. Bahl, N. (2015). Hand Book on Mushroom. Page no. 1-166. Oxford &IBH Publishing Company.
2. Russell, S. (2014). The Essential Guide To Cultivating Mushroom. Storey Publishing. North Adams, M.A. 01247.
3. Zied, D. C., Gimenez, A. P. (017) Edible and Medicinal Mushroom page no. 1-585.John Wiley & Sons Ltd.UK.
4. Chang, S.T., Miles, P.G. (2004) Mushrooms Cultivation, Nutritional Value, Medicinal effect and Environmental Impact, CRC Press.
5. Fletcher, J.T., Gaze, R.H. (2007). Mushroom Pest and Disease Control. CRC Press.
6. Ahlawat, O.P., Tewari , R.P. (2007) .Cultivation Technology Of Paddy Straw Mushroom (*Volvariella volvacea*). Pages 1-44 National Research Center for Mushroom (Indian Council of Agricultural Research) Chambaghat, Solan (HP).
7. Rai, R.D., Arumuganathan, Y. (2008). Post Harvest Technology of Mushrooms. National Research Center for Mushroom (Indian Council of Agricultural Research) Chambaghat, Solan (HP)

8. Singh, M., Vijay, B., Kamal, S., Wakchaure, G.C. (2011) . Mushrooms Cultivation, Marketing and Consumption., Publishers Directorate of Mushroom Research (ICAR) Chambaghat, Solan.

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

Hydroponic and Aeroponic Farming

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		
Hydroponic and Aeroponic Farming	**2**	**0**	0	**2**	Class XII	NIL

Learning objectives:

- The objective of the course is to provide hands-on experience to students on various aspects of hydroponics and aeroponics.
- To make students self-reliant and employable by providing the necessary knowledge and experience to establish hydroponic and aeroponic systems.

Learning Outcomes:

After completing the course, learners will be able to:

- develop basic hydroponics and aeroponics facilities at any given location (pilot scale and/or industrial scale).
- devise and implement a strategy for marketing of the product.
- apply the knowledge to fulfill certification rules and various government policies.
- establish themselves as entrepreneurs (Hydroponic cultivator).

Syllabus

Practical:

1. Study of techniques used in hydroponics (Circulating methods such as Nutrient Film Technique (NFT), Deep Flow Technique (DFT), Dutch bucket; Non circulating methods such as Root dipping, Floating, Capillary action; Aeroponics such as root mist and fog feed techniques). 8 hours
2. Study of various instruments used in hydroponics (Pressure gauge, Filters, PVC Tanks, Venturi/Reciprocating Pump/Mixing tank, EC meter, pH meter, TDS meter, water pump, net cups, air pump, thermometer, lux meter, drip irrigation system. 8 hours

3. Construction of sustainable hydroponic and aeroponic units (including greenhouse facilities) 8 hours
4. Preparation of growth media for Hydroponics. 4 hours
5. Estimation of NPK, DO, TDS, pH of growth media. 4 hours
6. Study of suitable conditions for Hydroponics-quality, light intensity, photoperiod and temperature. 4 hours
7. Growing a leafy vegetable/fruity vegetable/medicinal herb /aromatic plant in Hydroponics /Aeroponic solution. 16 hours
8. Study of safety measures, certification standards and government policies. 4 hours
9. Visit to Hydroponic/Aquaculture/Aeroponic farm/Institute. 4 hours

Essential Readings:

1. Meier Schwarz. (1995). Soilless Culture Management. Advanced Series in Agricultural Sciences, vol 24.Springer, Berlin.

2. Hasan, M.; Sabir, N.; Singh, A.K.; Singh, M.C.; Patel, N.; Khanna, M.; Rai, T.; and Pragnya, P. (2018). Hydroponics Technology for Horticultural Crops, Tech. Bull. TB-ICN 188/2018.Publ. by I.A.R.I., New Delhi.

3. Misra, R.L., Misra S. (2017). Soilless Crop production. Daya Publishing House, Astral

Suggestive Readings:

1. Goddek, S., Joyce, A., Kotzen, B., Burnell, G.M. (2019). Aquaponics Food Production Systems.Springer, Cham.

Examination scheme and mode:

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

Viewing and Capturing Diversity in 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		
Viewing and Capturing Diversity in Nature	**2**	**0**	0	**2**	Class XII	NIL

Learning objectives

- Understand fundamentals of digital cameras and smartphone photography technology.
- Develop a working knowledge of digital image analysis and processing.
- Understand the importance and use of Nature photography in business and as career goal.
- Enhance appreciation for the tremendous aesthetics inherent in nature.

Learning Outcomes

On successful completion of this course, a student will be able to:

- Describe and use the digital camera and smartphone camera functions and their applications
- employ different photographic equipment to enhance their photographic skills and create digital resources.
- discriminate between the photographic variables with reference to weather and season.
- employ the photographic skills in various professions and for entrepreneurship.

Syllabus

Practicals: 60 hours

1. To study the parts of a digital camera. 4 hours
2. To study the principle and working of digital camera/ smartphone camera. 4 hours
3. Working and handling of light microscopes (Dissection and Compound). 4 hours
4. Study of plant forms through microscopic lens (Single-celled, colonial forms, filamentous forms, multicellular and complex forms). 8 hours

5. To study techniques of capturing shots (using light and lenses effectively, macro and micro photography, wide angle and close-ups). 4 hours
6. Study of plant adaptations through photographs (Aquatic and desert plants). 4 hours
7. To capture and understand the Ecological Interactions. 8 hours
8. Identification of different plant life forms through online available tools/ search engines. 8 hours
9. Outdoor/ Campus Photography: Plants, Environment, Landscapes and Cityscape. 4 hours
10. Foldscope: The domestic microscope. Use the Foldscope to explore microscopic organisms in pond water. 4 hours
11. Project Work: To make a portfolio of diverse landscaping patterns/ selected themes through outdoor visits. 8 hours

Essential Readings:

1. Ang., T. (2008). Fundamentals of modern Photography. London, Mitchell.
2. Freeman Patterson "The Art of Seeing" by Key Porter Books.
3. Tim Fitzharris "Landscape Photography" Firefly Books.
4. Kelby, S. (2012). The digital photography book. Peachpit Press.
5. Langford, M., Fox, A., and Smith, R.S. (2013). Langford basic photography:the guide for serious photographers. Amsterdam: Focal Press/Elsevier.
6. Peterson, B. (2016). Understanding exposure: how to shoot great photographs with any camera. AmPhoto Books.

Suggestive readings:

1. Sharma P.D. (2008) Ecology and Environment. Rastogi Publishers.

Examination scheme and mode:

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

Plant Aromatics and Perfumery

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 Aromatics and Perfumery	**2**	**0**	0	**2**	Class XII	NIL

Learning objectives

- Provide the basic understanding of aromatic and medicinal plants including classification and methods of extracting essential oils.
- Practical demonstration of extraction and quality assessment of the product obtained.

Learning Outcomes

After completion of the course, learners will be able to:

- extract essential oils from a variety of plants and plant parts.
- develop strategy for promotion and marketing of the aromatic and essential oils.
- establish their own startup, become self-reliant and/or adapt to job roles in beauty and wellness sector.

Syllabus

Practicals: 60 hours

1. Classification of essential oils on the basis of chemical composition, aroma and extraction methods. 4 hours
2. Principles, processing and techniques of extraction of essential oils. 4 hours
3. Cultivation practices of the common aromatic crops (any five) - Rose, Lavender, Peppermint, Spearmint, Basil, Citronella, Vetiver, Palmrosa, Lemongrass. 8 hours

4. Extraction process of essential oil from fruit/ fruit peel by steam distillation (e.g. orange, lemon). 4 hours
5. Extraction of essential oil from bark by steam distillation (e.g. cinnamon). 4 hours
6. Extraction of essential oils from flower by steam distillation (e.g. clove, rose, jasmine, lavender, rosemary). 4 hours
7. Extraction of essential oil from leaves and stems by steam distillation (e.g. lemongrass, eucalyptus, citronella, bottlebrush). 4 hours
8. Extraction of essential oil from seeds by steam distillation (e.g. fennel, nutmeg). 4 hours
9. Extraction of essential oil from root (e.g. vetiver) and rhizome (e.g. ginger, curcuma) by steam distillation 4 hours
10. Determination of oil content in aromatic crop/material by Clevenger's method. 4 hours
11. Quality assessment of essential oils through s*ensory evaluation* (odour, colour), physical tests (specific gravity, refractive index, optical rotation, solubility), chemical tests (determination of acid value, ester value). 8 hours
12. Demonstration/Illustration of Instruments and techniques quality assessment of Gas chromatography (GC) and Thin layer chromatography (TLC). 4 hours
13. Field Visit to essential oils and perfumery Institute/Industry. 4 hours

Essential Readings:

1. EIRI BOARD. (2008). Handbook of Essential Oils Manufacturing and Aromatic Plants5/E edition, Engineers India Research Institute (India), New Delhi.
2. Kochhar, S.L. (2016). Economic Botany – A Comprehensive Study, 5th Edition. New Delhi, India: Cambridge University Press.

Suggestive Readings:

1. Başer, K.H.C., Buchbauer, G. (2020). Handbook of Essential Oils: Science, Technology, and Applications, 3rd edition, CRC Press.

Examination scheme and mode:

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

Nursery, Gardening and Landscaping

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		
Nursery, Gardening and Landscaping	**2**	**0**	0	**2**	Class XII	NIL

Learning objectives

The program is aimed to teach students the basic knowledge required to develop entrepreneurship skills in the development of Nursery, Gardening and Landscaping. This course would train students to initiate a remunerative enterprise owing to a high demand of skilled professionals in this field.

Learning Outcomes

After completing this course, the learners will be able to:

- describe and differentiate between the types of gardens.
- practice different methods for propagation of plants.
- execute several nursery and gardening operations.
- assess growing conditions of different horticultural plants, their general requirements and understand their role in landscaping.

Syllabus

Practical: 60 hours

1. Methods of preparation of nursery beds and sowing of seeds. Media for propagation of plants in Nursery Beds, Pots and Mist chamber. 12 hours
2. Study and practice of different propagation methods *viz*., cutting, layering, division, grafting and budding. 4 hours
3. Introduction and practicing Bonsai training, pruning and wiring. 4 hours

4. Study of different types of gardens (indoor and outdoor) and key features of gardens (Paths & Avenues, Hedges & Edges, Lawn, Flowerbeds, Arches & Pergolas, Fencing, Water bodies, Rock garden). 8 hours
5. Methods for selection and enlisting of suitable plants for different locations and in different types of gardens. 4 hours
6. Identification of key horticultural plants, Herbs including different types of grasses – foliage and flowering, Shrubs including hedge plants - foliage and flowering, Avenue trees – foliage and flowering, Climbers, Lianas, Epiphytes, Creepers, Trailers, Aquatic plants, Succulents, Weeds. 8 hours
7. Study of important gardens of India (any five). 4 hours
8. Methods of Landscape designing of Residential areas and Public Gardens, Aquatic Garden, Rock Garden, Industrial gardens. 4 hours
9. Concept and Application of Computer aided Designing (CAD) for landscape designing/ Preparation of landscape designs for school and college using CAD technology. 8 hours
10. Demonstration of different composting methods for Biofertilizers. 4 hours

Essential Readings:

1. A handbook of Landscape: CPWD
2. Gopalaswamiengar, K. S., Parthasarathy, G., Mukundan, P. (1991). Complete Gardening in India. India: Gopalaswamy Parthasarathy, 'Srinivasa'.
3. Hartmann, H. T., Kester, D. E., Hartmann, H. T., Kester, D. E. (1975). Plant Propagation: Principles and Practices. India: Prentice-Hall.
4. Roy, R. K., Roy, R. K. (2013). Fundamentals of Garden Designing: A Colour Encyclopedia. India: New India Publishing Agency.
5. Littlepage, R., Littlepage, R. (2017). Fundamentals of Garden Design: An Introduction to Landscape Design. (n.p.): CreateSpace Independent Publishing Platform.

Suggestive reading:

1. Hodge, G., Hodge, G. (2014). Practical Botany for Gardeners: Over 3,000 Botanical Terms Explained and Explored. United Kingdom: University of Chicago Press.
2. The Royal Horticultural Society Gardening Manual. (2000). United Kingdom: Dorling Kindersley.

Examination scheme and mode:

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

Horticulture

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		
Horticulture	**2**	**0**	0	**2**	Class XII	NIL

Learning objectives

- To acquaint students with the basic, principles, concepts and importance of Horticulture
- To train students in lawn designing, species selection for lawns, parks, home gardens and terrace gardens.
- To provide information about the employment and business opportunities and other avenues in the horticulture sector

Learning Outcomes

After completion of the course, learners will be able to:

- design gardens and learn the art of landscape design.
- describe and implement methods of preparing soil, cultivation and propagation for growing hedges, climbers, vegetables, and fruit yielding plants
- create and maintain nurseries, green houses and implement innovative practices in maintenance, harvesting and storage of horticultural produce.
- apply the skills for enhancing the job opportunities (Horticulturist) as well as self-employment.

Syllabus

Practical: 60 hours

1. Introduction to Horticulture; Garden tools and safety. 4 hours
2. Lawn making and lawn care: recognizing soils and drainage systems, types of grasses. 4 hours
3. Choosing the appropriate plants (species selection) for plantation in different seasons and locations (Outdoor, roof-top, balcony, rock gardens); Flowering annuals, herbaceous

perennials, vines and climbers, ornamental trees, bulbous and foliage plants, cacti and succulents. 4 hours

4. Vegetable Garden: Sowing, raising seedlings, transplantation methods; choosing the right vegetables for the season. 4 hours
5. Seed germination, viability tests and comparison of other parameters of seeds (stored from different years/different temperatures). 4 hours
6. Weeding, manuring, and irrigation methods used in lawns, parks, and vegetable gardens. 4 hours
7. Propagation and plant care: propagation by layering, cutting and other methods. 4 hours
8. Pruning: pruning roses, shrubs, and trees. 4 hours
9. Supporting plants: bamboos, strings, and enclosures. 4 hours
10. Maintenance and care of lawns and gardens: understanding diseases caused by pests and pathogens; protecting garden plants from infections, treating the plants with organic and biopesticides. 4 hours
11. Bonsais: Art and craft. 4 hours
12. One week internship on field or in a company/organisation (Landscape Design) that shall be facilitated by the college and report to be submitted. 8 hours
13. Methods and plantation approaches in various garden designs: Japanese, Mughal, Buddhist, English and Indian Gardens. 4 hours
14. Enhancing beauty of a garden using flowering plants, Garden walls, Fencing, Steps, Hedge, Edging, Lawn, Flower beds, Borders, aquatic garden with flowers; Case studies: Some selected gardens of India. 4 hours

Essential Readings:

1. Edmondson, J.L., Cunningham, H., Densley Tingley, D.O. et al. (2020). The hidden potential of urban horticulture. Nat Food **1,** 155–159.
2. Musser E., Andres. (2005). Fundamentals of Horticulture. New Delhi, Delhi: McGraw Hill Book Co. 2.
3. Sandhu, M.K. (1989). Plant Propagation. Madras, Bangalore: Wile Eastern Ltd.
4. Bird, C. (Ed.). (2014). The fundamentals of horticulture: Theory and practice. Cambridge University Press.
5. The Practical Gardener (1994). Reader's Digest Special Volume.

Examination scheme and mode:

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

Mushroom Culture and Technology-II

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		
Mushroom Culture and Technology-II	**2**	**0**	0	**2**	Class XII	NIL

Cultivation of Button mushroom and King oyster mushroom

Prerequisites:

Compost preparation for button mushroom would start around October-November and further cultivation steps will take place from January. Compost and spawn should be prepared before going to the next step.

Learning objectives:

- To develop skills for growing button and king oyster mushroom

Learning Outcomes:

After completion of this course, the learner will be able to:

- prepare casing soil and apply over spawn-run compost bags.
- implement harvesting, packaging and marketing of produce as per FSSAI standards.

Syllabus

Practical: 60 hours**

** Specimens and examples studied may vary depending on seasonal factors and availability

1. To add and mix spawn of button mushroom to pre-prepared compost (Spawning). 4 hours
2. To set up ideal mushroom house for cultivation of button mushroom. 8 hours
3. To maintain ideal environmental conditions for spawn run. 4 hours
4. Preparation and sterilization of casing soil. 4 hours

5. To apply casing soil over the spawn run compost bags and incubating for case run. 4 hours
6. To maintain appropriate conditions for pin head formation and fruiting of button mushroom. 8 hours
7. Harvesting of first flush of button mushrooms. 4 hours
8. Post-harvest packaging and storage of button mushrooms. 4 hours
9. Maintaining the environmental conditions for the second flush of button mushroom. 4 hours
10. To prepare and sterilize substrate bags for cultivation of king oyster mushroom. 4 hours
11. To add the spawn of king oyster mushroom in the substrate bags under aseptic conditions and incubator under appropriate conditions. 4 hours
12. To induce fruiting of king oyster mushroom by scraping the mycelium from the edges and surface of spawn run bags. 4 hours
13. Harvesting, post-harvest packaging and storage of king oyster mushrooms. 4 hours

Essential Readings:

1. Aggarwal, A., Sharma, Y.P., Angra, E. (2021). A textbook on mushroom cultivation, Theory and Practices. Newrays Publishing House, 2021.
2. Tiwari, S.C. Kapoor, P. (2018). Mushroom Cultivation. Mittal Publications. ISBN - 978-8183249232.
3. Bahl, N. (2015). Hand Book on Mushroom. Page no. 1-166. Oxford &IBH Publishing Company. ISBN- 13:978-8120413993.
4. Russell, S. (2014). The Essential Guide To Cultivating Mushroom. Storey Publishing. North Adams, MA 01247 page no. 1-233. ISBN 978-1-61212-146-8.
5. Chang, S.T. Miles, P.G. (2004). Mushrooms Cultivation, Nutritional Value, Medicinal effect and Environmental Impact. Page no. 1-477, CRC Press.
6. Fletcher, J.T., Gaze, R.G. (2007). Mushroom Pest and Disease Control. CRC Press.
7. Rai, R.D., Arumuganathan, Y. (2008). Post harvest technology of mushrooms. Pages 1-72. National Research Center for Mushroom (Indian Council of Agricultural Research) Chambaghat, Solan-173 213 (HP)

Examination scheme and mode:

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

Biofertilizers

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		
Biofertilizers	**2**	**0**	0	**2**	Class XII	NIL

Learning objectives:

To help the students understand:

- the concept of biofertilizers and develop the skills for handling microbial inoculants.
- the growth and multiplication conditions of useful microbes and their role in mineral cycling and nutrition to plants.
- various methods of decomposition of biodegradable waste and their conversion to compost.

Learning outcomes:

After completion of this course, the learners will be able to:

- describe the different methods of composting.
- assess quality of compost and its role in soil nutrition.
- apply methods of bio-control
- develop a composting unit for production of biofertilizers (generate employment)

Syllabus

Practical: 60 hours

1. Introduction to rhizobial symbiosis - Study of *Rhizobium* and its isolation from root nodules of leguminous plants by Gram staining method. 4 hours
2. Study of different bio-composting methods (microbes and earthworm). 8 hours
3. Compost quality assessment and its role in soil nutrition - Test for pH, NO^{3-}, $SO4^{2-}$, Cl^{-} and organic matter of different composts. 8 hours

4. Introduction to Arbuscular mycorrhiza - Study of arbuscular mycorrhizal fungi from plant roots by staining methods. 4 hours
5. Isolation of arbuscular mycorrhizal spores from rhizosphere soil. 4 hours
6. Study structure of *Anabaena and Azolla* structure - Isolation of *Anabaena* from *Azolla* leaf. 4 hours
7. Study various biocontrol methods and their application Pheromone trap, *Trichoderma*, *Pseudomonas*, Neem etc. 4 hours
8. Projects on any one of the following topics: *Rhizobium* technology, AMF technology, Organic farming, Bio composting, Vermicomposting, *Azolla* culture etc. The design of the project should be such that it includes a continuous work of at least 6 weeks and a dissertation submission/ presentation/ CE - continuous evaluation. 24 hours

Essential Readings:

1. Kumaresan, V. (2005). *Biotechnology.* New Delhi, Delhi: Saras Publication.
2. Sathe, T.V. (2004). *Vermiculture and Organic Farming.* New Delhi, Delhi: Daya publishers.
3. Subha Rao, N.S. (2000). *Soil Microbiology.* New Delhi, Delhi: Oxford & IBH Publishers.
4. Khosla, R. (2017). Biofertilizers and Biocontrol Agents for Organic Farming Kojo Press.

Suggestive Readings:

1. Azotobacter - Isolation and characterization -- https://youtu.be/1Z1VhgJ2h6U
2. Rhizobium -- Identification and characterization - https://youtu.be/jELlo-pMvc4.
3. 3-Days Online Workshop On Arbuscular Mycorrhizal Fungi_ Biodiversity, Taxonomy and Propagation 19-2 (2022-01-20 at 02_27 GMT-8) – https://youtu.be/LKzK4IuSRc4
4. Vayas,S.C, Vayas, S., Modi, H.A. (1998). Bio-fertilizers and organic Farming. Nadiad, Gujarat: Akta Prakashan.

Examination scheme and mode:

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

Organic Farming

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		
Organic Farming	**2**	**0**	0	**2**	Class XII	NIL

Learning objectives:

- To create awareness among the students about organic farming and its importance in sustainable agriculture.
- To provide a skill set of Organic farming to students to help them become self-reliant.

Learning Outcomes:

After completion of this course the learners will be able to:

- practice organic farming along with application of indigenous knowledge.
- establish entrepreneurial ventures and generate employment (Organic Grower).
- evaluate the organic produce as per FSSAI standards (Government rules).

Syllabus

Practical: 60 hours

1. Study of Organic Farming as an integrated approach. 4 hours
2. Soil analysis-physical testing and assessment of soil types, weighment, water movement, soil conditioners, etc. 8 hours
3. Manure preparation and introduction to compost, composting and its value addition quality test. 4 hours
4. Study of Indigenous Technology Knowledge (ITK) for nutrient, insect, pest disease and weed management. 8 hours
5. Study of various agriculturally useful Biofertilizers. 4 hours
6. Biocontrol agents including Integrated Pest Management. 4 hours

7. Study of traditional organic input preparation/formulation of Biofertilizer, biopesticides, plant health promoters like *Panchgavya, Beejamrut* etc. 8 hours
8. Study of the system of organic certification and inspection. 4 hours
9. Branding of rural products, FSSAI, marketing, packaging and handling of organic produce. 4 hours
10. Current Government schemes related to organic farming. 4 hours
11. Visit organic farms to study the various components and their utilization. 8 hours

Essential Readings:

1. Dhama, A.K. (2014). Organic Farming for Sustainable Agriculture (2nd edition), Agrobios (India), Jodhpur.
2. Sharma, Arun K. (2013). A Handbook of Organic Farming, Agrobios (India), Jodhpur
3. Palaniappan, S.P. and Anandurai, K. (1999). Organic Farming – Theory and Practice. Scientific Pub. Jodhpur
4. Thapa, U and Tripathy, P. (2006). Organic Farming in India, Problems and prospects, Agritech, Publising Academy, Udaipur.
5. Jaivik Kheti Sahayak Pustika- National Centre for Organic and Natural Farming, Department of Agriculture & Farmers Welfare, GoI.

Suggestive Readings:

1. National Program for Organic Production-APEDA, Ministry of Commerce & Industry, GoI.

Examination scheme and mode:

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

Green Belt Development for Smart Cities

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		
Green Belt Development for Smart Cities	**2**	**0**	0	**2**	Class XII	NIL

Learning objectives:

- To introduce students with one of the key green skill development programs under the Skill India mission by the Government of India.
- To acquaint students with various methods and techniques used in development of green infrastructure for smart cities

Learning Outcomes:

After completion of the course, students will be able to:

- measure factors (biotic and abiotic) contributing to sustainable, healthy environment.
- Assess, describe and use the appropriate plants for restoring polluted environment.
- use their skills enhancing for green infrastructure development (UN-SDG).

Syllabus

Practical:

1. Methods of vegetation sampling and calculation of importance value index 4 hours
2. Measuring Tree Basal Area, Height and Canopy Cover to estimate green cover of an area. 8 hours
3. Understanding of Instruments for measuring microclimatic variables *viz*., light, wind, temperature, humidity and precipitation 4 hours
4. Estimation of Total Carbon stock of an area. 8 hours
5. Understanding methods for selection of plants according to pollutant load of both air and water (includes field survey) 4 hours

6. Assessing air pollution tolerance of plant species using APTI (Air pollution tolerance index). 8 hours
7. Use Open Source Softwares for mapping the GPS points and generating a cover map. 4 hours
8. Measurement of Dissolved Oxygen (DO) from treated wastewater. 8 hours
9. Measurement of BOD and TDS from tank and treated pond. 8 hours
10. Determination of total dissolved and suspended solids in water. 4 hours

Essential Readings:

1. Bell, J. R., Wheater, C. P., Cook, P. A., Bell, J. R., Wheater, C. P., Cook, P. A. (2011). Practical Field Ecology: A Project Guide. United Kingdom: Wiley.
2. Singh J.S., Singh S.P. & Gupta S.R. · 2014. Ecology, Environmental Science & Conservation. (2014). India: S. Chand Pvt. Limited.
3. Measurements for Estimation of Carbon Stocksin Afforestation and Reforestation Project Activities under the Clean Development Mechanism, Afield Manual UNFCCC.
4. Slingsby, D., Cook, C., Slingsby, D., Cook, C. (2016). Practical Ecology. United Kingdom: Macmillan Education UK.
5. Mukerji, K. G. (2013). Laboratory Manual of Food Microbiology. India: I.K. International Publishing House Pvt. Limited.

Examination scheme and mode:

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

BIG DATA ANALYTICS-I

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		
Big Data Analytics-I	2	1	0	1	12th Pass	NIL

Learning Objectives

The Learning Objectives of this course are as follows:

- To understand the Big Data platform and its uses.
- Provide an overview of Apache Hadoop.
- Provide HDFS concepts and Interfacing with HDFS.
- Provide an overview of Map Reduce Programming.

Learning Outcomes

The Learning Outcomes of this course are as follows:

- After studying this course, students will be able to identify Big Data and its Business Implications.
- After studying this course, students will be able to list the components of Hadoop and Hadoop Eco-Systems.
- After studying this course, students will be able to access and process data on distributed file system.
- After studying this course, students will be able to manage job execution in Hadoop environment.

Syllabus:

Unit-1: Understanding Big Data **2 hours**

Data Storage and Analysis-The process of data analysis, Characteristics of Big Data, Big Data Analytics, Typical Analytical Architecture, Requirement for new analytical architecture, Challenges in Big Data Analytics – Need of big data frameworks

Unit-2: Foundations of Big Data Systems **4 hours**

Getting started with Hadoop, Requirement of Hadoop Framework, Design principle of Hadoop –Comparison with other system, Understanding Hadoop Ecosystem: Hadoop Components – Hadoop 1 vs Hadoop 2

Unit-3: HDFS (Hadoop Distributed File System) **4 hours**

The Design of HDFS, Hadoop Daemon's – HDFS Commands, HDFS Concepts,

Command Line Interface, Hadoop file system interfaces-Loading data into HDFS, read/write process to HDFS

Unit-4: Introduction to Parallel Programming with Map Reduce 5 hours

Map Reduce Programming: I/O formats, Map side join, Reduce Side Join, Secondary sorting, Pipelining Map Reduce jobs (Map Reduce Execution Pipeline)- Map, Shuffle and Sort, Reduce

Practical Exercises 30 hours

- Downloading and installing Hadoop.
- Understanding different Hadoop modes. Startup scripts, Configuration files.
- Hadoop Implementation of file management tasks, such as Adding files and directories, retrieving files and Deleting files.
- Run a basic word count Map reduce program to understand map reduce paradigm: To count words in a given file, to view the output file, and to calculate the execution time.
- Map Reduce Program to analyse time-temperature statistics and generate report with max/min temperature.

Essential/recommended readings

- Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.
- Tom White, "Hadoop: The Defective Guide", O'Reilly, 4thEdition, 2015.
- Donald Miner, Adam Shook, "Map Reduce Design Pattern", O'Reilly, 2012.

Examination scheme and mode:

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

BIG DATA ANALYTICS-II

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		
Big Data Analytics-II	**2**	**1**	**0**	**1**	**12th Pass**	**Big Data Analytics-I**

Learning Objectives

The Learning Objectives of this course are as follows:

- Provide hands on Hadoop Eco System.
- Provide an overview of Apache Spark.
- To understand Machine Learning with Big Data.
- Provide an overview of GPU Computing.

Learning Outcomes

The Learning Outcomes of this course are as follows:

- After studying this course, students will be able to develop Big Data Solutions using Hadoop Eco System.
- After studying this course, students will be able to use Spark for the effective analysis of the Big Data.
- After studying this course, students will be able to use Machine Learning Techniques with Big Data.
- After studying this course, students will be able to use GPU Computing for parallel computations.

Syllabus:

Practical

Unit-1: Big Data Systems- The Advances **(3 hours)**

Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures.

Unit-2: Introduction to Apache Spark **(3 hours)**

Introduction, Architecture of Spark, Resilient Distributed Datasets, Spark Transformations, Writing Spark Application - Spark Programming in Scala, Python, R, Java - Application Execution

Unit-3: Machine Learning with Big Data **(3 hours)**

Introduction to machine learning, Supervised vs Unsupervised learning, Cluster

analysis, understanding k means clustering, Implementation of k means clustering with Map Reduce.

Unit-4: Introduction to GPU Computing (6 hours)

Introduction to GPU Computing, CUDA Programming Model, CUDA API, Simple Matrix, Multiplication in CUDA, CUDA Memory Model, Shared Memory Matrix Multiplication, Additional CUDA API Features.

Practical Exercises 30 hours

- Implementation of Matrix Multiplication with Hadoop Map Reduce.
- Implementation of K-means clustering using Map Reduce.
- To study and implement basic functions and commands in R/Python programming.
- To build Word cloud, a text mining method using R/Python for easy to understand and visualization than a table data.
- To implement clustering program using R/Python programming

Essential/recommended readings

- Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.
- Mike Frampton, "Mastering Apache Spark", Packt Publishing, 2015.
- Tom White, "Hadoop: The Defective Guide", O'Reilly, 4thEdition, 2015.
- Nick Pentreath, Machine Learning with Spark, Packt Publishing, 2015.
- Mohammed Guller, Big Data Analytics with Spark, Apress, 2015.
- Donald Miner, Adam Shook, "Map Reduce Design Pattern", O'Reilly, 2012.

Examination scheme and mode:

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

Social Media Marketing

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		
Social Media Marketing	**2**	**1**	**0**	**1**	**Pass in XII**	**Pass in 'Digital Marketing' (SEC-Sem 1)**

Learning Objectives

- To provide basic knowledge of social media marketing concepts
- To enhance skills as social media marketer and start a career in social media marketing.

Learning Outcomes

After completion of the course, learners will be able to:
1. Evaluate the role of social media in marketing, advertising and public relations.
2. Assess the optimal use of various social media platforms for social media marketing.
3. Analyse the importance of social media for developing an effective marketing plan, and assess ways to measure its performance.
4. Describe practical skills required for creating and sharing content through online communities and social networks.
5. Demonstrate and appreciate social media ethics to use social media spaces effectively.

SYLLABUS:

Unit 1: Introduction to Social Media Marketing: (4 hours)

Social Media Marketing- Concept and Importance.

Social Media Platforms- Online communities and Forums; Blogs and Microblogs, Social Networks, other contemporary social media platforms: Goals, Role in Marketing and Use as listening tools. Trends in SMM. Social Media Influencers.

Unit 2: Social media marketing Plan and Performance Measurement: (6 hours)

SMM Plan- Setting Goals, Determining Strategies, Identifying Target Market, Selecting Tools, Selecting Platforms, Implementation: Measuring Effectiveness - Conversion rate, amplification rate, applause rate: on page and on post level.

Unit 3: Content Creation and Sharing using Case Campaigns: (5 hours)

Blogging, Streaming Video and Podcasting: Criteria and approach-70/20/10 with risk variants, 50-50 content, Brand Mnemonic, Brand story. Contextualising content creation. Social Media Ethics.

Practical Exercises: 30 hours

The learners are required to:

1. Discuss the importance of social media in marketing, advertising and public relations by analysing relevant case studies.

2. Examine the use of social media by your institution to improve alumni engagement.
3. Identify social media platforms for marketing a good, a service, an institution, an event and a person.
4. Promote any college event of your choice using social media. Measure the effectiveness of your campaign.
5. Create a blog/ vlog on any topic of your interest. Measure performance of your blog post.
6. Prepare a social media marketing plan for any product of your choice.
7. Prepare a calendar for scheduling various posts/campaigns via buffer or tweet deck. Find out the conversion rate, amplification rate, and the applause rate. Calculate the engagement rate and economic value/per visitor of the concerned campaigns.
8. Observe the engagement rate in twitter campaigns of your college and suggest improvements, if needed.
9. Assess the reviews/ratings, comments, likes, and dislikes of blog posts in the categories of health and nutrition, or yoga counselling, or family therapy.
10. Examine the twitter handles of Delhi Government or of Delhi University and find out how consistent they are in their reaction checks?
11. Design a social media plan for sensitising citizens for timely tax payments (Assuming that you are an honest tax-payer and feel that everyone should be like you).

Essengtial Readings

- Ahuja V(2015).Digital Marketing.Oxford University Press.
- Blanchard, O. (2011). Social Media ROI: Managing and Measuring Social Media Efforts in Your Organization. United Kingdom: Pearson Education.
- Charlesworth, A. (2014). An Introduction to Social Media Marketing. United Kingdom: Taylor & Francis.
- Gupta, S. (2020). Digital Marketing. India: McGraw Hill Education (India) Private Limited.
- Johnson, S. (2020). Social Media Marketing: Secret Strategies for Advertising Your Business and Personal Brand on Instagram, YouTube, Twitter, And Facebook. A Guide to being an Influencer of Millions. Italy: AndreaAstemio.
- Keller, K. L., Kotler, P. (2016). Marketing Management. India: Pearson Education.
- Maity M(2022). Digital Marketing.Oxford University Press.
- Mamoria C.B, Bhatacahrya A,Marketing Management. Kitab Mahal, Delhi
- Mathur,V. & Arora,S. Digital Marketing PHI Learning
- McDonald, J. (2016). Social Media Marketing Workbook: How to Use Social Media for Business. United States: CreateSpace Independent Publishing Platform.
- Parker, J., Roberts, M. L., Zahay, D., Barker, D. I., Barker, M. (2022). Social Media Marketing: A Strategic Approach. United States: Cengage Learning.
- Quesenberry, K. A. (2015). Social Media Strategy: Marketing and Advertising in the Consumer Revolution. United States: Rowman & Littlefield Publishers.
- Rishi, B., Tuten, T.L., (2020) Social Media Marketing, 3ed., Sage Textbook
- Setiawan, I., Kartajaya, H., Kotler, P. (2016). Marketing 4.0: Moving from Traditional to Digital. Germany: Wiley.

Examination scheme and mode:

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

Design Thinking

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		
Design Thinking	**2**	**0**	0	**2**	Class XII	NIL

Learning Objectives

To provide basic understanding of problem search, design process, design thinking and ability to convert an innovative product idea to a prototype.

Learning Outcomes

After studying the course, the student will be able to:

- Understand innovation process
- Do product designing
- Empathy research.
- Do designing brief and proof of concept.
- Do prototyping. product testing and validation

SYLLABUS:

Unit I: Design thinking and innovation in product or process designing. Identifying user needs. Human Centered Design. **(8 hours)**

Unit II: Innovation Opportunities. Problem space exploration. Ideation. Empathy Research **(13 hours)**

Unit III: Novel product or process Opportunities. Solution space exploration. Design brief. Concept generation. User validation **(13 hours)**

Unit IV: Converting ideas to product. Developing Prototypes. Iterative improvement. Proof of concept - Product testing and validation **(18 hours)**

Unit V: Disruptive design innovations – case studies **(8 hours)**

Teaching Plan

Week 1: Design thinking and innovation in product or process designing
Week 2: Identifying user needs. Human Centered Design

Week 3: Innovation Opportunities.
Week 4: Problem space exploration. Ideation.
Week 5: Empathy Research
Week 6: Novel product or process Opportunities.
Week 7: Solution space exploration. Design brief.
Week 8: Concept generation. User validation
Week 9: Converting ideas to product.
Week 10: Developing Prototypes.
Week 11: Iterative improvement.
Week 12: Proof of concept - Product testing and validation
Week 13, 14 & 15: Disruptive design innovations – case studies

Essential Readings:

1. *Creative Confidence: Unleashing the creative potential within us all* by Tom Kelley & David Kelley, Crown Business (New York, 2013)
2. *The Design of everyday things* by Don Norman, Basic Books (2013)
3. *Design Thinking: Understanding how designers think and work* by Nigel Cross, Bloomsbury Visual Arts (2019)

Examination scheme and mode:

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

Aquaculture Entrepreneurship

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		
Aquaculture Entrepreneurship	2	0	0	2	Class XII	NIL

Learning Objectives

The Learning Objectives of this course are as follows:

- To give first-hand training on traditional and technology-based Aquaculture.
- To understand the importance of different types of ponds required for aquaculture.
- To understand the requirement of advanced technology for sustainable development of aquaculture in India.
- To gain experience in the management of optimum water quality in the fish production systems.
- To enhance the quality of aquacrops and increase the production.

Learning Outcomes

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

- Identify the useful aquaculture systems for sustainable aquaculture development.
- Recognize the suitable and economically important aquacultural species.
- Understand the importance of aquaculture in nutrition security, poverty elevation and employment generation.

Skill development and job opportunities

After completion of this course students may be

- Employed in various aquaculture related business including prawn and fish farms.
- Fully equipped to start own entrepreneurships in fish farming.

SYLLABUS:

Practical

Unit I: Pond-based Traditional Aquaculture **20 Hours**

Introduction to indigenous pond-based fish culture systems and identification of economically important cultivable finfishes and shellfishes. The impact of aquatic organisms in the production of aquacrops.

Exercises:

1. Designing (layout) and drawing of a self-sustainable Aquaculture farm showing different ponds.

2. Selection and identification of cultivable finfishes and shellfishes (prawns, mussels, crabs).

3. Collection and identification of various freshwater aquatic plants. Understanding of the role of different aquatic plants in aquaculture.

4. Identification of harmful aquatic insects and their remedial measures.

5. The study of diurnal fluctuations of major water quality parameters (*viz*., temperature, pH, dissolved oxygen, ammonia etc.) in a pond.

Unit II: Recirculating Aquaculture System (RAS) 20 Hours

Application of advance technology like, Recirculating Aquaculture System (RAS) for the sustainable development of Aquaculture in India.

Exercises:

1. Designing of a land-based Recirculating Aquaculture System (RAS).

2. Evaluation of various types of filters like, mechanical, chemical and biological filters in the maintenance of water quality in the RAS.

3. The study of role of flow rate and duration of circulation in the maintenance of water quality in the RAS.

4. The monitoring of temperature, pH, dissolved oxygen, ammonia, nitrite, nitrate, phosphate etc. at different hours of water circulation.

5. Culture of various fishes and prawns in the RAS.

6. Visit to a Recirculating Aquaculture System.

Unit III: Aquaponics System 20 Hours

Application of Aquaponics System to grow multiple crops simultaneously and thereby, increases the production of aquacrops in per unit area in a sustainable manner. Thus, enhances the earning of Fish farmers.

Exercises:

1. Designing of an Aquaponics System.

2. Evaluation of role of various types of edible (lettuce, tomato, water spinach etc.) and ornamental plants in the maintenance of ammonia levels in the fish culture units.

4. Identification of microorganisms functioning in the Aquaponics System.

5. Culture of various fishes and prawns in the Aquaponics System.

6. The monitoring of temperature, pH, dissolved oxygen, ammonia, nitrite, nitrate, phosphate etc. in the fish culture units.

7. Visit to an Aquaponics System.

Recommended Readings:

- AOAC, Association of Official Analytical Chemists. 2019. Official Methods of Analysis. Washington, DC: Association of Official Analytical Chemists Inc.

- APHA, American Public Health Association. 2017. Standard Methods for the

Examination of Water and Wastewater. 23rd ed. Washington DC, USA: American Public Health Association, American Water Works Association, Water Environment Federation.

- Chakrabarti, R. and Sharma, J. G. 2008. Aquahouse. New Dimension of Sustainable Aquaculture. DIPAS, Indian Council of Agricultural Research, New Delhi, India.

- Holt, G. J. 2021. Larval Fish Nutrition. Willey-Blackwell, UK.

- ICAR, Indian Council of Agricultural Research. 2013. Handbook of Fisheries and Aquaculture. Directorate of Knowledge Management in Agriculture, Indian Council of Agricultural Research, New Delhi, India.

- Pillay, T. V. R. 2005. Aquaculture. Principles and Practices. Blackwell Publishing, New Delhi, India.

Examination scheme and mode:

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

Bio-floc Technology

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		
Bio-floc Technology	**2**	**0**	**0**	**2**	Class XII	NIL

Learning Objectives

The Learning Objectives of this course are as follows:

- To learn about the basics of Bio-floc technology and it's important as a skill for self-sustainable and self-employment
- To learn production of fish in the larger scale with minimum use of water source and land to help in the total production of fish for human consumption in India.
- To learn about how to set-up the technology looking into the different conditions and availability of space and training.
- To teach fundamental concept of running this system with the biological knowledge of bacteria culture, water quality management
- To learn the types of fish species, types of feed and feeding, density of fish to be maintain in the particular volume of water etc.

Learning Outcomes

The Learning Outcomes of this course are as follows:

- After studying this course, students will be able to gain insight into fish culture using minimum amount of water, land, fish feed and with high biosecurity.
- After studying this course, students will be able to learn and explain about the bio-floc technology and they can set up bio-floc tanks for themselves and for others in the form of industries and entrepreneurship as well as for stat-up with the help of existing Government funding and self funding.
- After studying this course, students will be able to understand and implement bio-floc system and this can be an alternative skill for earning, self-employment, job generation and contribute in large scale fish production which are hygienic, organic and good protein source for human health.

SYLLABUS:

Practical

Unit-I **12 Hours**

Introduction to basics of Bio-floc technology and its applications in aquaculture industry, Standard operating procedure, Microbial Role in Bio-floc System, Design Set-up and installation of Bio-floc system, Biosecurity , Advance over pond aquaculture, basic equipment's and necessary items .

Exercises

1. Inoculation of bacteria and its role in Bio-floc technology.
2. Plankton and microbial analysis of bio-floc.
3. Set-up and Installation of Bio-floc system.

Unit-II **12 Hours**

Optimum water quality parameters and its management. Floc water preparation and floc volume measurement. Monitoring and management of dissolved oxygen, pH, conductivity, temperature, salinity, ammonia, nitrate, nitrite, TDS. Measurement of floc volume and its control. Role of bacteria in management of water quality.

Exercises

1. Analysis of following water quality parameters in Bio-floc culture tanks using kits: temperature, pH, conductivity , salinity, TDS, ammonia, nitrate, nitrite.
2. Water preparation for Bio-floc system.
3. Measurement of floc volume using imhoff cone.

Unit-III **12 Hours**

Suitable species selection, Pre-stocking and post stocking management, Food and feeding management, Production performance, Nursery rearing days, Survival (%), Average body weight at harvest, feed conversion ratio.

Exercise

1. Identification of suitable fish, feeding habits, stocking capacity, growth rate and duration of culture.
2. The study of Feed Conversion Ratio (FCR) and Feed Conversion Efficiency (FCE).

Unit-IV **12 Hours**

C: N ratio management , Nutritional requirements and protein levels in the food.
Source of carbon, calculation of carbon and nitrogen ratio, suitable C:N ration management in the initial floc preparation and during culture days. Selection of species-specific food with optimum protein level, food size, quantity of feed according to per cent body weight, feeding rate.

Exercise

1. Calculation of C: N ratio and its management from the TAN content in the floc water.
2. Mouth size and food size and growth study.

Unit-V **12 Hours**

Disease management and prophylactic treatment, Economics values of fish and its marketing strategies. Common disease in bio-floc, identification of disease its causes, species-specific disease, stress management and treatment. Steps for prevention and protections of possible disease, possible control measures with setup systems by controlling light, temperature etc. Sludge management. Economics values of fish and its marketing strategies. Production capacity and requirements, start-up and entrepreneurship opportunities, funding and grants for setting up from Government.

Exercise

1. Fungal, bacterial, parasitic and viral disease commonly found in bio-floc fish culture system.
2. Identification and economically important fish species for culture in bio-floc system like prawn, other new economic species etc.

3. Write a Project for start-up or entrepreneurship and governmental grants.
4. Visit to hatcheries with super-intensive models.

Recommended Readings:

- Avnimelech, Y. 2015. Bio-floc Technology- a Practical Guidebook. 3rd ed. World Aquaculture Society, USA.

Examination scheme and mode:

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

Fish Breeding and Larviculture

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		
Fish Breeding and Larviculture	2	0	0	2	Class XII	NIL

Learning Objectives

The Learning Objectives of this course are as follows:

- To give first-hand training on various aspects of brood stock maintenance of carps and air breathing fishes.
- To understand the breeding techniques for carps and air breathing fishes.
- To understand the larviculture techniques for carps.
- To gain experience on the larviculture techniques of air breathing fishes.
- To gather knowledge in the management of optimum water quality for larviculture.
- To gather knowledge on the nutritional requirements of the cultivable species.
- To gain knowledge on the impact of live food in larviculture.

Learning Outcomes

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

- Produce seeds of carps and air breathing fishes.
- Start the Fish hatchery business.
- Start fish-food production.
- Initiate entrepreneurship in fish seeds production.

Skill development and job opportunities

After completion of this course students may be

- Employed in various aquaculture related business including prawn and fish farms.
- Fully equipped to start own entrepreneurships in fish farming.

SYLLABUS:

Practical

Unit I: Breeding of Economically Important Fishes **20 Hours**

Breeding of various fishes in the captivity and production of quality fish seeds for aquaculture.

Exercises:

1. Management of brood stock units and breeding of carps.

2. Maintenance of brood stock units and breeding of air breathing fishes.

3. Estimation of major water quality parameters *viz*., temperature, pH, dissolved oxygen, conductivity etc. in the fish breeding units.

Unit II: Culture of Important Live Food Organisms **15 Hours**

Culture of various live food organisms using organic manures and feeding of different fish larvae produced.

Exercises:

1. Culture of live food organisms *viz*., rotifers, cladocerans, copepods, chironomid larva etc. using organic manures (like cattle manure, poultry wastes and mustard oil-cake).

2. Evaluation of major water quality parameters *viz*., temperature, pH, dissolved oxygen, ammonia etc. in the live food culture units.

3. The enrichment of live food organisms (with vitamin C, DHA, EPA etc.) to enhance the nutritional value of the live food for fish larvae.

Unit II: Larviculture **25 Hours**

Culture of larvae of carps and air breathing fishes and production of healthy seeds for stocking ponds.

Exercises:

1. Culture of fish larvae in the static water/ Recirculating Aquaculture Systems (RAS).

2. Measurement of water quality parameters (*viz*., temperature, pH, dissolved oxygen, ammonia etc.) in the larvae culture unit regularly.

3. Feeding of fish larvae with live food thrice daily.

4. The study of morphological and physiological changes in the larvae during ontogenic development.

5. Visit to a fish farm.

Recommended Readings:

- AOAC, Association of Official Analytical Chemists. 2017. Official Methods of Analysis. Washington, DC: Association of Official Analytical Chemists Inc.

- APHA, American Public Health Association. 2017. Standard Methods for the Examination of Water and Wastewater. 23rd ed. Washington DC, USA: American Public Health Association, American Water Works Association, Water Environment Federation.
- Chakrabarti, R. and Sharma, J. G. 2008. Aquahouse. New Dimension of Sustainable Aquaculture. DIPAS, Indian Council of Agricultural Research, New Delhi, India.

- Holt, G. J. 2021. Larval Fish Nutrition. Willey-Blackwell, UK.

- ICAR, Indian Council of Agricultural Research. 2013. Handbook of Fisheries and Aquaculture. Directorate of Knowledge Management in Agriculture, Indian Council of Agricultural Research, New Delhi, India.

- Pillay, T. V. R. 2005. Aquaculture. Principles and Practices. Blackwell Publishing, New Delhi, India.

Examination scheme and mode:

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

Formulation of Fish Feed

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		
Formulation of Fish Feed	2	0	0	2	Class XII	NIL

Learning Objectives

The Learning Objectives of this course are as follows:

- To give first-hand training on identification of various indigenous ingredients for formulation of fish feed.
- To gather knowledge on the nutritional requirements of the cultivable species.
- To gain knowledge on the impact of formulated feeds on fish growth.
- To enhance the quality of aquacrops and increase the production.

Learning Outcomes

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

- Identify the useful ingredients for fish feed formulation.
- Learn to prepare fish feed using locally available ingredients.
- Start the Fish feed production industry.
- Initiate entrepreneurship on Fish feed production.

Skill development and job opportunities

After completion of this course students may be

- Employed in various aquaculture related business including prawn and fish farms.
- Fully equipped to start own fish feed production industry.

SYLLABUS:

Practical

Unit I: Selection of ingredients **20 Hours**

Identification of various types of non-conventional ingredients for fish feed formulation. Evaluation of their nutritional quality. Preparation of fish feed and feeding of the prepared feeds to the cultivable fishes and prawns. The study of impact of the prepared feeds on the performances of fishes and prawns.

Exercises:

1. Identification of various types of locally available ingredients (*viz*. macrophytes, oil-cakes, plants etc.) for fish feed formulation.
2. Evaluation of the nutritional values (*viz*. protein, lipid, carbohydrates, ash, amino acids, fatty acids) of these ingredients.
3. Assay of presence of anti-nutritional factors (*viz*. tannin, saponin, phytic acid, oxalic acid etc.) in these ingredient

Unit II: Formulation of Fish Feed **20 Hours**

Preparation of fish feed using traditional method and computerized soft ware. Evaluation of quality of prepared feed for the cultivable species.

Exercises:

1. Formulation of fish feed using "Pearson Square" method.
2. Formulation of fish feed using computerized soft ware.
3. The assay of biochemical composition of formulated feed: protein, lipid, carbohydrate, ash, amino acids, fatty acids.

Unit III: Feeding of Fish **20 Hours**

The feeding of the prepared feeds to the cultivable fishes and prawns. The study of impact of the prepared feeds on the performances of fishes and prawns. Evaluation of nutritional value of fishes for human consumption.

Exercises:

1. The feeding of the prepared feeds to the cultivable fishes and prawns.
2. Evaluation of impact of the prepared feeds on the survival, growth and production of fishes and prawns.
3. Assessment of Feed Conversion Ratio (FCR) and Feed Conversion Efficiency (FCE) of the feed.
4. Assay of nutritional value of the produced fishes/ prawns for human consumption.
5. Evaluation of impact of prepared feed on the water quality of the culture system.
6. Visit to a Fish feed preparation facility/ industry.

Recommended Readings:

- AOAC, Association of Official Analytical Chemists. 2017. Official Methods of Analysis. Washington, DC: Association of Official Analytical Chemists Inc.

- APHA, American Public Health Association. 2017. Standard Methods for the Examination of Water and Wastewater. 23rd ed. Washington DC, USA: American Public Health Association, American Water Works Association, Water Environment Federation.

- Chakrabarti, R. and Sharma, J. G. 2008. Aquahouse. New Dimension of Sustainable Aquaculture. DIPAS, Indian Council of Agricultural Research, New Delhi, India.

- Holt, G. J. 2021. Larval Fish Nutrition. Willey-Blackwell, UK.

- ICAR, Indian Council of Agricultural Research. 2013. Handbook of Fisheries and Aquaculture. Directorate of Knowledge Management in Agriculture, Indian Council of Agricultural Research, New Delhi, India.

Examination scheme and mode:

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

Ornamental Fish Culture: Opportunity and Scope

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		
Ornamental Fish Culture: Opportunity and Scope	2	0	0	2	Class XII	NIL

Learning Objectives

The Learning Objectives of this course are as follows:

- To give first-hand training on Aquarium preparation and decoration.
- To gain hands-on training on breeding and culture of various Ornamental fishes.
- To gain experience in the management of optimum water quality in the fish aquarium.
- To gather knowledge on the nutritional requirements of the cultivable species.

Learning Outcomes

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

- Prepare and decorate ornamental fish aquarium.
- Identify the suitable and economically important Ornamental fish species.
- Initiate entrepreneurship on Aquarium making and Ornamental fish production.

Skill development and job opportunities

After completion of this course students will be

- Fully equipped to start own entrepreneurship in **aquarium making and its decoration.**
- Aware about the requirements to start their own **Ornamental fish industry**.

SYLLABUS:

Practical

Unit I: Preparation of Aquarium and Its Decoration **20 Hours**

Preparation of glass aquaria of various shapes and their decoration using locally available materials. The impact of aquatic plants in the maintenance of healthy environment in the aquarium.

Exercises:

1. Construction of glass aquaria of various shapes (rectangular, square, round etc.).
2. Identification and culture of useful aquatic plants for the decoration of fish aquarium.
3. Decoration of aquarium with plants and locally available materials.

Unit II: Breeding of Ornamental Fishes and Culture of Plants **20 Hours**

Identification of economically important cultivable Ornamental plants and fishes for culture.

Exercises:

1. Identification of economically important Ornamental fishes and their breeding.
2. Culture of young larvae and feeding them live food.
3. Regular monitoring of water quality parameters viz. temperature, pH, conductivity, dissolved oxygen, ammonia etc. in the fish aquarium.
4. Culture of zooplankton (rotifers, cladocerans, copepods etc.) using organic manures for the feeding of fish larvae.
5. Production of plants for the decoration of aquarium.

Unit III: Production of Marketable Ornamental Fishes **20 Hours**

Culture of compatible fishes together and feeding them with live food and prepared diets. Keep them ready for local market.

Exercises:

1. Maintenance of aquarium.
2. Feeding of ornamental fishes with various natural foods and prepared diets.
3. Evaluation of their growth rate and colour development.
4. Development of marketing strategy for the produced ornamental fishes in well decorated aquaria.
5. Visit to any Aquarium Facility.

Recommended Readings:

- AOAC, Association of Official Analytical Chemists. 2019. Official Methods of Analysis. Washington, DC: Association of Official Analytical Chemists Inc.

- APHA, American Public Health Association. 2017. Standard Methods for the Examination of Water and Wastewater. 23rd ed. Washington DC, USA: American Public Health Association, American Water Works Association, Water Environment Federation.

- Chakrabarti, R. and Sharma, J. G. 2008. Aquahouse. New Dimension of Sustainable Aquaculture. DIPAS, Indian Council of Agricultural Research, New Delhi, India.

- Holt, G. J. 2021. Larval Fish Nutrition. Willey-Blackwell, UK.

- ICAR, Indian Council of Agricultural Research. 2013. Handbook of Fisheries and Aquaculture. Directorate of Knowledge Management in Agriculture, Indian Council of Agricultural Research, New Delhi, India.

- Pillay, T. V. R. 2005. Aquaculture. Principles and Practices. Blackwell Publishing, New Delhi, India.

- Swain, S. K., Sarangi, N. and Ayyapan, S. 2010. Ornamental Fish Farming. DIPAS, Indian Council of Agricultural Research, New Delhi, India.

Examination scheme and mode:

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

Pearl 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		
Pearl Culture	**2**	**0**	**0**	**2**	XII	NIL

Learning Objectives

The Learning Objectives of this course are as follows:

- To learn the basics of Pearl culture and it's important as a skill for self-sustainable and self-employment.
- To impart a comprehensive knowledge regarding morphology, anatomy, physiology, food and feeding behaviour, related diseases and its control measures of the mother Pearl Oyster.
- To gather a comprehensive knowledge of various types of implantations in Oyster and also the technique of insertion of beads for the formation of Pearl.
- To gather experience of post-operative care.
- To learn the techniques of harvesting, processing, sorting and marketing of the Pearl produced.

The Learning Outcomes:

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

- Gain overall idea about Pearl oyster - its biology, morphology especially the histology of mantle, pearl formation etc.
- Recognize the suitable species of oyster for pearl culture in India.
- Set up a pearl culture system in pond/ tanks.
- Start entrepreneurship on Pearl culture.
- Start-up with the help of existing Government funding.

Skill development and job opportunities

After completion of this course students may be

- Employed in various pearl farming related businesses.
- Fully equipped to start own entrepreneurship in **pearl farming**.
- Completely aware about the requirements to start their own **Pear processing industry**.

SYLLABUS:

Practical

Unit-I **20 Hours**

Introduction to pearl culture. Morphology and anatomy of pearl culture. Structure andhistology of mantle. Origin of pearls, mussels producing pearls. Identification of species capable of producing pearl.

Exercises:

1. Set-up and Installation of culture system (sac culture, raft culture) for sustainable production.

2. Identification of suitable species capable to produce pearl.
3. The study of morphology and growth rate of the pearl oyster.
4. Measurement of major water quality parameters.
5. Feeding of the pearly oyster.

Unit-II **20 Hours**

Implantation of foreign particles for pearl formation and post operation care.

Exercise:

1. Preparation of the graft tissue for insertion.
2. Pearl oyster surgery and insertion technique of bead.
3. Post-operational care.
4. Culture of the pearl oyster using natural food .
5. Regular monitoring of the water quality parameters.

Unit-III **20 Hours**

Harvesting of Pearl and its processing. Sorting of Pearl. Marketing and economics concerned.

Exercises:

1. Bleaching and collection of pearls.
2. Cleaning of pearls.
3. Sorting of pearls.
4. Marketing of pearl.
5. Visit to a pear production site.

Recommended Readings:

- Srivastava, C.B.L. 2014. Fishery Science and Indian Fisheries.
- Far, A. E. 1986. Pearls. Butterworth Heinemann publications.
- Beveridge, M.C.M. 1987. Cage aquaculture. Fishing News.
- Bardach, J.E.W . 1972. Aquaculture farming and husbandry of freshwater and Sorting of Pearl. Marketing and economics concerned with Pearl Culture. Generation marine organisms
- Dobilet, D. 199. Pearl Farming. Australia: Nat Geographic Mag publication.

Examination scheme and mode:

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

Sericulture I: Mulberry Silkworm Rearing

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		
Sericulture I: Mulberry Silkworm Rearing	2	0	0	2	Class XII	NIL

Learning Objectives

The Learning Objectives of this course are as follows:

1. To make the students aware about the significance of sericulture as a profit-making enterprise.
2. To help the students to understand the biology of silkworms and its nutritional requirement to secrete quality silk.
3. To give an understanding about the techniques of silkworm rearing, reeling of silk and various measures to be taken to maximize the benefits.
4. To help the students to know about various uses of silk and develop entrepreneurial skills required for self-employment in sericulture and silk production sector.

Learning Outcomes

Upon completion of the course, students should be able to:

1. Learn about the history of sericulture and silk route.
2. Recognize various species of silk moths in India, and exotic and indigenous races.
3. Be aware about the opportunities and employment in sericulture industry- in public, private and government sector.
4. Gain thorough knowledge about the techniques involved in silkworm rearing and silk reeling.
5. Develop entrepreneurial skills necessary for self-employment in mulberry and seed production and be apprised about practicing sericulture as a profit-making enterprise.
6. Enhance collaborative learning and communication skills through practical sessions, team work, group discussions, assignments and projects.

Skill Development and Job Opportunities

1. Sericulture is multi-disciplinary activity consists of mulberry leaf production, silkworm rearing (cocoon production), silkworm egg production, silk reeling (yarn production), twisting, Warp and weft making, printing and dyeing, weaving, finishing, garment designing, marketing etc.
2. The demand for silk is bound to increase in the coming years This course will therefore help in generating employment, economic development and improvement in the quality of life of unemployed youth.

3. This course will generate entrepreneurs in this field. Sericulture offers gainful employment not only the rural masses but also for the educated youth in semi-urban and urban areas.
4. Effective utilization of waste generated in the industry will help in making the sericulture sector more viable, stable and create more employment opportunities.
5. Sericulturists fall under the category of primary activities. They usually find employment in sectors like government and research development centres.

SYLLABUS:

Introduction to sericulture. Life cycle of silkworm and its characteristic features, Rearing of mulberry silk worm **(60 hours)**

Practical

1. Study of models of rearing houses, appliances used in silkworm rearing
2. Preparation and application of disinfectants in rearing house and appliances
3. Technique for hot and cold acid treatment of silkworm eggs, its advantages and disadvantages
4. Rearing Techniques: Harvesting and preservation technique; leaf selecting for different instants; mulberry leaf estimation; Identification of moulting larva, care during moulting, mounting and mounting density, types of mountages; Harvesting of cocoons, assessment of cocoons.
5. Selection of moth, pairing and despairing, preparation of eggs (loose and sheet, surface sterilization of eggs
6. Visit to seed cocoon markets, commercial grainage and cold storage centre to know activities of cocoon markets, preparation of laying and cold storage of eggs.
7. Mulberry Crop Cultivation: Preparation of nursery beds, Different propagation methods – grafting and layering, Planting System and Intercultural Operations: - pit and row system, mulching, irrigation.
8. Visit to Sericulture research institute

Essential Readings

- Manual on Sericulture (1976); Food and Agriculture Organisation, Rome Ullal, S.R. and Narasimhanna M.N. (1987) Handbook of Practical Sericulture; 3rd Edition, CSB, Bangalore

Suggested Readings

- Yonemura, M. and Rama Rao, N. (1951) A Handbook of Sericulture. I. Rearing of silk-worms. Government Branch Press, Mysore.
- Ananthanarayanan, S. K. (2008) Silkworm Rearing. Daya Publishing House Aruga, H. (1994). Principles of Sericulture. CRC Press
- Sathe, T. V. and Jadhav, A. (2002) Sericulture and Pest Management. Daya Publishing House Yup-Lian, L. (1991) Silkworm Diseases. Food and Agricultural Organization.

Examination scheme and mode:

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

Sericulture II: Eri Silkworm Rearing

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		
Sericulture II: Eri Silkworm Rearing	**2**	**0**	**0**	**2**	**Class XII**	**NIL**

Learning Objectives

The Learning Objectives of this course are as follows:

1. To make the students aware about the significance of sericulture as a profit-making enterprise.
2. To help the students to understand the biology of silkworms and its nutritional requirement to secrete quality silk.
3. To give an understanding about the techniques of silkworm rearing, reeling of silk and various measures to be taken to maximize the benefits.
4. To help the students to know about various uses of silk and develop entrepreneurial skills required for self-employment in sericulture and silk production sector.

Learning Outcomes

Upon completion of the course, students should be able to:

1. Learn about the history of sericulture and silk route.
2. Recognize various species of silk moths in India, and exotic and indigenous races.
3. Be aware about the opportunities and employment in sericulture industry- in public, private and government sector.
4. Gain thorough knowledge about the techniques involved in silkworm rearing and silk reeling.
5. Develop entrepreneurial skills necessary for self-employment in mulberry and seed production and be apprised about practicing sericulture as a profit-making enterprise.
6. Enhance collaborative learning and communication skills through practical sessions, team work, group discussions, assignments and projects.

Skill Development and Job Opportunities

Sericulture mainly focuses on silkworms rearing with the main aim of silk production. There are several applications of this:

1. The demand for silk is bound to increase in the coming years This course will therefore help in generating employment, economic development and improvement in the quality of life of unemployed youth. This course will generate entrepreneurs in this field.
2. . Sericulture by-products have remarkable application in the preparation of compost. Sericulture waste upon enrichment can be converted to high value manures.
3. Silk consists of two types of proteins, silk fibroin and sericin.
    a. Sericin contributes about 20-30 per cent of total cocoon weight. It is characterized by its high content of serine and 18 amino acids, including essential amino acids. Sericin has wide applications in pharmaceuticals and cosmetics such as, wound healing, bioadhesive moisturizing, antiwrinkle and antiaging properties.
    b. Silk fibroin, has a variety of applications in pharmaceutical, food, and fodder industries. Silk fibroin is used for bone formation, silk thread in surgery, and drug delivery system . Silk fibroin has unique properties including good adherence with flexibility to wound bed, absorption of exudates, biocompatibility, biodegradability, minimal inflammatory reaction and in skin grafting due to its outstanding mechanical properties.
    4. Mulberry, the sole food plant of silkworm has also the potential to be used in pharmaceutical and food industry.

Syllabus:

Introduction to non-mulberry sericulture (Eri, Tassar, Muga). Morphology of Eri silkworm, Propagation of host plant. **(60 hours)**

Practical

1. Propagation of castor food plant
2. Study of models of rearing houses, appliances used in Eri silkworm rearing
3. Preparation and application of disinfectants in rearing house and appliances
4. Rearing techniques of Eri silkworm, Eri mother moth examination, mounting method and storage of cocoons.
5. Incubation of eri eggs and its egg hatching ratio

Essential Readings

- Manual on Sericulture (1976); Food and Agriculture Organisation, Rome Ullal, S.R. and Narasimhanna M.N. (1987) Handbook of Practical Sericulture; 3rd Edition, CSB, Bangalore

Suggested Readings

- Yonemura, M. and Rama Rao, N. (1951) A Handbook of Sericulture. I. Rearing of silk-worms. Government Branch Press, Mysore.
- Ananthanarayanan, S. K. (2008) Silkworm Rearing. Daya Publishing House Aruga, H. (1994). Principles of Sericulture. CRC Press

- Sathe, T. V. and Jadhav, A. (2002) Sericulture and Pest Management. Daya Publishing House Yup-Lian, L. (1991) Silkworm Diseases. Food and Agricultural Organization.

- Hisao Aruga, Principles of Sericulture, Oxford & IBH Publications
- Eikichi Hiratsuka, Silkworm Breeding, Oxford & IBH Publications
- P.K. Pandey, S.K. Sharan, Silk Culture, APH Publishing Corp.
- Dr. P.K. Rajan, Silkworm Rearing Technology, Central Silk Board
- R.K. Goel, Laboratory Techniques in Sericulture, APH Publishing Corp.

Examination scheme and mode:

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

Sericulture III: Silk Technology

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		
Sericulture III: Silk Technology	**2**	**0**	**0**	**2**	**Class XII**	**NIL**

Learning Objectives

The Learning Objectives of this course are as follows:

1. To make the students aware about the significance of sericulture as a profit-making enterprise.
2. To help the students to understand the biology of silkworms and its nutritional requirement to secrete quality silk.
3. To give an understanding about the techniques of silkworm rearing, reeling of silk and various measures to be taken to maximize the benefits.
4. To help the students to know about various uses of silk and develop entrepreneurial skills required for self-employment in sericulture and silk production sector.

Learning Outcomes

Upon completion of the course, students should be able to:

1. Learn about the history of sericulture and silk route.
2. Recognize various species of silk moths in India, and exotic and indigenous races.
3. Be aware about the opportunities and employment in sericulture industry- in public, private and government sector.
4. Gain thorough knowledge about the techniques involved in silkworm rearing and silk reeling.
5. Develop entrepreneurial skills necessary for self-employment in mulberry and seed production and be apprised about practicing sericulture as a profit-making enterprise.
6. Enhance collaborative learning and communication skills through practical sessions, team work, group discussions, assignments and projects.

Skill Development and Job Opportunities

Sericulture mainly focuses on silkworms rearing with the main aim of silk production. There are several applications of this:

1. The demand for silk is bound to increase in the coming years This course will therefore help in generating employment, economic development and improvement in the quality of life of unemployed youth. This course will generate entrepreneurs in this field.
2. . Sericulture by-products have remarkable application in the preparation of compost. Sericulture waste upon enrichment can be converted to high value manures.
3. Silk consists of two types of proteins, silk fibroin and sericin.
   a. Sericin contributes about 20-30 per cent of total cocoon weight. It is characterized by its high content of serine and 18 amino acids, including essential amino acids.

Sericin has wide applications in pharmaceuticals and cosmetics such as, wound healing, bioadhesive moisturizing, antiwrinkle and antiaging properties.

b. Silk fibroin, has a variety of applications in pharmaceutical, food, and fodder industries. Silk fibroin is used for bone formation, silk thread in surgery, and drug delivery system . Silk fibroin has unique properties including good adherence with flexibility to wound bed, absorption of exudates, biocompatibility, biodegradability, minimal inflammatory reaction and in skin grafting due to its outstanding mechanical properties.

4. Mulberry, the sole food plant of silkworm has also the potential to be used in pharmaceutical and food industry.

Syllabus:

Introduction to Silk Technology (**60 hours)**

Practical

Introduction to different textile fibres.
Cocoon stifling- different methods and determination of degree of drying.
Determination of commercial characters of cocoon: average cocoon weight, shell weight, shell percentage, average filament length, reelibility, raw silk recovery percentage, renditta and denier.
Identification of silk, cotton, wool and synthetic fibres by various tests.
Raw silk testing and grading by mechanical tests like winding test, seriplane test and cohesion test.
Study of silk manufacturing unit.

Essential Readings

- Manual on Sericulture (1976); Food and Agriculture Organisation, Rome Ullal, S.R. and Narasimhanna M.N. (1987) Handbook of Practical Sericulture; 3rd Edition, CSB, Bangalore

Suggested Readings

- Yonemura, M. and Rama Rao, N. (1951) A Handbook of Sericulture. I. Rearing of silk-worms. Government Branch Press, Mysore.
- Ananthanarayanan, S. K. (2008) Silkworm Rearing. Daya Publishing HouseAruga, H. (1994). Principles of Sericulture. CRC Press
- Sathe, T. V. and Jadhav, A. (2002) Sericulture and Pest Management. Daya Publishing House Yup-Lian, L. (1991) Silkworm Diseases. Food and Agricultural Organization.
- Hisao Aruga, Principles of Sericulture, Oxford & IBH Publications
- Eikichi Hiratsuka, Silkworm Breeding, Oxford & IBH Publications
- P.K. Pandey, S.K. Sharan, Silk Culture, APH Publishing Corp.
- Dr. P.K. Rajan, Silkworm Rearing Technology, Central Silk Board
- R.K. Goel, Laboratory Techniques in Sericulture, APH Publishing Corp.

Examination scheme and mode:

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

Sericulture IV: APPLICATION OF SERICULTURE IN THERAPEUTIC AND COSMETIC INDUSTRY

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		
Sericulture IV: Application of Sericulture in Therapeutic and Cosmetic Industry	**2**	**0**	**0**	**2**	**Class XII**	**NIL**

Learning Objectives

The Learning Objectives of this course are as follows:

1. To make the students aware about the significance of sericulture as a profit-making enterprise.
2. To help the students to understand the biology of silkworms and its nutritional requirement to secrete quality silk.
3. To give an understanding about the techniques of silkworm rearing, reeling of silk and various measures to be taken to maximize the benefits.
4. To help the students to know about various uses of silk and develop entrepreneurial skills required for self-employment in sericulture and silk production sector.

Learning Outcomes

Upon completion of the course, students should be able to:

1. Learn about the history of sericulture and silk route.
2. Recognize various species of silk moths in India, and exotic and indigenous races.
3. Be aware about the opportunities and employment in sericulture industry- in public, private and government sector.
4. Gain thorough knowledge about the techniques involved in silkworm rearing and silk reeling.
5. Develop entrepreneurial skills necessary for self-employment in mulberry and seed production and be apprised about practicing sericulture as a profit-making enterprise.
6. Enhance collaborative learning and communication skills through practical sessions, team work, group discussions, assignments and projects.

Skill Development and Job Opportunities

1. Sericulture is multi-disciplinary activity consists of mulberry leaf production, silkworm rearing (cocoon production), silkworm egg production, silk reeling (yarn production), twisting, Warp and weft making, printing and dyeing, weaving, finishing, garment designing, marketing etc.

2. The demand for silk is bound to increase in the coming years This course will therefore help in generating employment, economic development and improvement in the quality of life of unemployed youth.
3. This course will generate entrepreneurs in this field. Sericulture offers gainful employment not only the rural masses but also for the educated youth in semi-urban and urban areas.
4. Effective utilization of waste generated in the industry will help in making the sericulture sector more viable, stable and create more employment opportunities.
5. Sericulturists fall under the category of primary activities. They usually find employment in sectors like government and research development centres.

Syllabus:

Sericulture as a tool for rural development. Uses of different by-products of sericulture in pharmaceuticals and Cosmetics **(60 hours)**

Practical

1. Identify and collection of different waste materials of mulberry, silkworm rearing and silk reeling
2. Prepare different useful products of mulberry leaf waste and sticks.
3. Silkworm sericin in- medical textiles, regenerative drugs, and tissue engineering, cosmeceuticals, food additives, and manufacturing of valuable biomaterials.
4. Silkworm pupa in the field of therapeutics, cosmetics, animal feed, fertilizer, etc.
5. Sericulture wastes in sustainable applications for biofuels generation.
6. Entrepreneurial ideas to convert waste material of sericulture into raw material for other industries.
7. IT/ non IT based projects of sericulture.

Essential Readings

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Suggested Readings

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Examination scheme and mode:

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REGISTRAR