

SARVAJANIK UNIVERSITY
FACULTY OF SCIENCE



Faculty of Science

B. Sc. (Honors)

Microbiology

DETAILED CURRICULUM

(W.E.F. 2024-25)

SARVAJANIK UNIVERSITY
FACULTY OF SCIENCE

Semester 3

B.Sc. (Hons) Microbiology Semester 3

Sr. No.	Category	Course Title	Course Type
1	Major	Prokaryotic and Eukaryotic Cell Structure	Compulsory
2		Nutrition and Growth of Bacteria	Compulsory
3		Biochemistry and Enzymology	Compulsory
4	SEC	Mushroom Cultivation Technology	Elective
		Economical Arthropods	
5	VAC	Indian Knowledge Systems (Temple Architecture and Design)	Elective
		Indian Knowledge Systems (Gananshastra)	
6	AEC	Communication Skills	Elective
		Mastering Google Drive	
7	Multidisciplinary	Entrepreneurship and Innovation- Indian Context	Elective
		Green Schools	
		Personal Finance and Investment Planning	
		Pharmaceutical Product	

Faculty: Science	Department: Microbiology
Program: B. Sc. (Hons)	Type: Major
Subject: Prokaryotic and Eukaryotic Cell Structure	
Credits: 4	Semester: 3
Course description: This course deals with the fundamental building blocks of life: cells. Student will explore structure, function, and diversity, of both prokaryotic (bacteria and archaea) and eukaryotic cells (animals, plants, fungi, and protists). The course also aims to make student aware some basic cellular processes. They will also learn the similarity and differences among various types of cells.	
Student learning outcome: By the end of this course, student will 1. Understand fundamental concepts regarding different types of cells. 2. Able to differentiate between procaryotic and eucaryotic cell structure 3. Know the structure and functions of cell organelles 4. Understand the cellular processes	

Reference Book:

1. Cooper, G. M., Hausman, R. E. (2007). The Cell: A Molecular Approach. United Kingdom: ASM Press.: Fourth Edition, ISBN: 9780878932191
2. Black, Jacquelyn G., Black, Laura J.(2015). Microbiology: Principles and Explorations. 9th Edition, United Kingdom : Wiley, ISBN: 9781118743164
3. Karp, G., Iwasa, J., Marshall, W. (2018). Karp's Cell Biology, Global Edition. Spain: Wiley.: Global Edition, ISBN: 9781119454175
4. Cowan, M. K., Talaro, K. P. (2005). Microbiology. United Kingdom: McGraw-Hill Higher Education. ISBN: 9780073048383
5. Lodish, H. F. (2007). Molecular Cell Biology. India: W. H. Freeman.: ISBN: 9780716776017
6. Sherwood, Linda., Woolverton, Christopher J., Willey, Joanne M.. (2017) Prescott's Microbiology, , Singapore: McGraw-Hill Education, 10th Edition , ISBN: 9789813151260
7. Verma, P. S. (2004). Cell Biology, Genetics, Molecular Biology: Evoloution and Ecology. India: S. Chand Limited. ISBN: 9788121924429

Further Reading:

1. Pollard, T. D., Earnshaw, W. C., Lippincott-Schwartz, J. (2007). Cell Biology E-Book. United Kingdom: Elsevier Health Sciences. ISBN: 9781437700633
2. Alberts, B., Bray, D., Hopkin, K., Johnson, A. D., Lewis, J., Raff, M., Roberts, K., Walter, P. (2013). Essential Cell Biology. United States: CRC Press. Fourth Edition ISBN: 9781317806271

3. Gunsalus, Robert P., Perry, Jerome J., Lory, Stephen., Staley, James T..
Microbial Life, 2nd Edition, United Kingdom: Sinauer Associates, 2007.
ISBN: 9780878936854

Unit-1: Foundations of Cell

(Duration: 07 Hrs)

- 1.1 Origin and Evolution of Cell
 - 1.1.1: The First Cell
 - 1.1.2: Endosymbiotic Theory
- 1.2 Cell Theory
- 1.3 Basic properties of Cell
- 1.4 Typical (General) Structure of Cell
 - 1.4.1: Bacterial Cell
 - 1.4.2: Eukaryotic Cells
- 1.5 Functions of Cells

Unit-2: Prokaryotic Cell Architecture: I

(Duration:08 Hrs)

- 2.1 Cell, Size and Shape and arrangement of cell
- 2.2 Structure and Function of Cell Wall
 - 2.2.1: Gram Positive Cell Wall
 - 2.2.2: Gram Negative Cell Wall
 - 2.2.3: Archaeal Cell Wall
- 2.3 Structure and Function of Prokaryotic Plasma Membrane
 - 2.3.1: Bacterial Cell Membrane
 - 2.3.2: Archaeal Cell Membrane

Unit-3: Prokaryotic Cell Architecture: II

(Duration: 08 Hrs)

- 3.1 Prokaryotic Internal Structure and their functions
 - 3.1.1: Cytoplasm
 - 3.1.2: Nucleoid
 - 3.1.3: Prokaryotic Ribosome
 - 3.1.4: Bacterial Cytoskeleton
 - 3.1.5: Inclusion Bodies
- 3.2 Prokaryotic External Structure and their Functions
 - 3.2.1: Bacterial Flagella

3.2.2: Glycocalyx

3.2.3: Bacterial Fimbriae and Pilli

3.2.4: Spore

Unit-4: Eukaryotic Cell Architecture

(Duration: 07 Hrs)

4.1 Size, Shape and organization of Eukaryotic Cell

4.2 Eukaryotic Cell Wall

4.3 Eukaryotic Cell Envelope

4.4 Cell Nucleus

4.5 Cytoplasm and cytoskeleton

Unit-5: Eukaryotic Cell Organelles: Structure and Function

(Duration: 07 Hrs)

5.1 Endoplasmic Reticulum

5.2 Mitochondria and Chloroplast

5.3 Golgi Complex

5.4 Eukaryotic Flagella, Cilia and Pseudopodia

5.5 Lysosomes

Unit-6: Cellular Landscape: Study and Comparison

(Duration: 08 Hrs)

6.1 Cell Cycle:

6.1.1: Bacterial Cell Cycle

6.1.2: Eukaryotic Cell Cycle, Mitosis and Meiosis

6.2 Comparison of Bacteria and Archaeal Cells

6.3 Comparison of Prokaryotic and Eukaryotic Cells

6.4 Comparison of Animal and Plant Cell

List of Practicals

- 1) Gram staining & Acidfast staining of Bacteria
- 2) Capsule staining of Bacteria
- 3) Endospore staining
- 4) Cell Wall staining
- 5) Metachromatic Granule staining
- 6) DNA staining by Schiff Reagent in Eucaryotic Cell
- 7) Study of mitosis in onion root tip

Program: B.Sc. (Hons.)	Type: Major
Subject: Biochemistry and Enzymology	Semester: 3
Credit: 04	Department: Chemistry
Course description: This course provides fundamental knowledge of biochemistry. It gives an overview of classification of enzyme and mechanism of enzyme action. This course also deals with types and properties of biomolecules important for life. It also give an idea regarding bio-energetics.	
Student learning outcome: Students will: 1. Get an idea about the basic concepts of biochemistry 2. Know about the importance of biochemistry 3. Understand mono, di and polysaccharides 4. Able to comprehend the structure, function and acid base properties of amino acids and protein 5. Learn the nature and importance of enzymes in living systems 6. Understand the basic tenets of bioenergetics	

Reference books:

1. Fundamentals of Biochemistry –Jain, J.L., Jain, S., Jain, N. S. Chand & Co.
2. Biochemistry – Satyanarayana. U and Chakrapani. U, Books & Allied Pvt. Lt
3. Nelson.D.L. and Cox.M..M -Lehninger's Principles of Biochemistry-Freeman & Co.- 7 th Edition
4. Voet, D.J., Voet, J.G., Pratt, C.W. (2008). Principles of Biochemistry (3rd ed.).

Unit: 1 Fundamentals of biochemistry (05 Hrs)

- 1.1 History, scope and avenues of biochemistry
- 1.2 Water as a biological solvent
- 1.3 Biological relevance of buffers
- 1.4 Outlines of surface tension, adsorption and osmosis and their biological relevance

Unit: 2 Carbohydrates (08 Hrs)

- 2.1 Classification
- 2.2 Monosaccharides, D and L designation, open chain and cyclic structures, epimers and anomers,
- 2.3 Structure and biological importance of disaccharides (sucrose, lactose, maltose, isomaltose, trehalose), trisaccharides (raffinose, melezitose)

2.4 Structural polysaccharides (cellulose, chitin, pectin) and storage polysaccharides (starch, inulin, glycogen).

Unit: 3 Lipids (08 Hrs)

3.1 Classification - neutral lipids, Phospho lipids (lecithines, cephalins, plasmalogens) and glycolipids

3.2 Fatty acids – saturated, unsaturated fatty acids, essential fatty acids

3.3 Properties – Hydrolysis-acid number, saponification number. Auto-oxidation (Rancidity), iodine value, Polenske number, Reichert-Meissl number, acetyl number.

3.4 General properties and structures of phospholipids, sphingolipid
Prostaglandins- structure, types and biological role

Unit-4 Amino acids and protein (08 Hrs)

4.1 Classification of all amino acids

4.2 General methods of preparation and properties of amino acids

4.3 Proteins: structure of protein

4.4 Qualitative and quantitative analysis of proteins

Unit: 5 Enzymes (08 Hrs)

5.1 Introduction, classification and nomenclature of enzymes

5.2 Specificity and mechanism of enzyme action (Fischer's lock and key hypothesis, Koshland's induced fit hypothesis.)

5.3 Factors affecting enzyme action

5.4 Enzyme inhibitors and their importance, phenomenon of inhibition.

Unit: 6 Concept of energy in biosystems (08 Hrs)

6.1 Introduction to metabolism (catabolism, anabolism)

6.2 ATP: The universal currency of cellular energy, hydrolysis and free energy

6.3 Agents for transfer of electrons in biological redox systems: NAD^+ , FAD

6.4 Outline of catabolic pathways of carbohydrate- glycolysis, fermentation, Krebs cycle

Practical (Minimum four):

1. Qualitative tests for carbohydrates
2. Estimation of sugar by Cole's method
3. Determination of Iodine number of an oil/ fat
4. Estimation of proteins by Lowry's method
5. Determination of enzyme activity
6. Separation of amino acids by paper chromatography

Reference books:

1. Mu P, Plummer DT. Introduction to practical biochemistry. Tata McGraw-Hill Education; 2001.
2. Sawhney, S. K. & Singh, R. (2008) Introductory Practical Biochemistry Narosa Publishing House Pvt. Ltd. New Delhi.
3. Sadasivam, S. & Manickam, A. (2006) Biochemical Methods New Age International (P) Limited, New Delhi.

Name of faculty: Science	Department: Microbiology
Program: B.Sc. (Hons)	Type: Major
Subject: Nutrition and Growth of Microorganisms	
Credits: 04	Semester: 3
Course description: This course will incline the student how microbes reproduce, determine the environmental conditions that promote or hinder their growth. It also helpful to understand how to measure the growth of microbial populations. It also comparative for microbial growth in natural environment as well in laboratory	
Student learning outcome: 1. Students will be benefited by understanding the basic concepts of microbial growth and growth curve 2. Students will be conceptualized with the examples of essential nutrients, and describe how they are used by cells 3. Students will learn to Distinguish macroelements (macronutrients) from micronutrients (trace elements) 4. Students will acquire the understanding about growth factors needed by some microorganisms	

Reference Book:

1. Cowan K. M. and Smith H. (2018). Microbiology - A Systems Approach 5th Ed. Mc Graw Hill Education (ISSN: 978-1-259-70661-5).
2. Willey J, Sherwood I and Woolverton (2014). Prescott's Microbiology 9th Ed. Mc Graw Hill Education (ISBN: 978-0-07-340240-6)
3. Elementary Microbiology Vol.1 (Fundamentals of Microbiology) By Dr. H. A. Modi. (Akta Prakashan)
4. Pelczar, Chan and Krieg (2001). Microbiology- Concepts and Applications 5th Ed. Tata Mc Graw Hill Publishing Company Ltd. (ISBN-13: 978-0-07-462320-6).

Further Reading:

1. Atlas R. M. (2004). Handbook of Microbiological Media. CRC Press. (ISBN:0-8493-1818-1).
2. Bauman R. W. (2012). Microbiology with Diseases by Body Systems 3rd Ed. Pearson. ISBN: (978-0-321-73267-5)
3. Madigan M. et al., (2015) Brock Biology of Microorganisms 14th Ed. Pearson Education Ltd. (ISBN 978-0-321-89739-8).
4. Brock biology of Microorganisms 14th Ed. By Madigan, Martinko, Bender, Buckley and Stahl. (Pearson) ISBN 978-0-321-89739-8.

Unit-1: The Basis of population growth**(Duration: 08 Hrs)**

- 1.1 Reproduction: Mode of Cell Division
- 1.1 Normal growth cycle of Bacteria
- 1.2 Synchronous culture and Continuous culture

Unit-2: Microbial growth: Role of Nutrients & Environmental factors**(Duration: 10 Hrs)**

- 2.1 Sources of Essential Nutrients
- 2.2 Nutritional Types of Bacteria
- 2.3 Environmental factors Affect Microbial Growth
 - 2.3.1 Solutes Affect Osmosis and Water Activity
 - 2.3.2 pH
 - 2.3.3 Temperature
 - 2.3.4 Oxygen Concentration
 - 2.3.5 Radiation

Unit-3: Transport of Nutrients**(Duration: 09 Hrs)**

- 3.1 The Movement of Nutrients: Diffusion and Transport
- 3.2 The Movement of Water: Osmosis
- 3.3 Transport of Nutrients by Bacteria
 - 3.3.1 Passive Transportation
 - 3.3.2 Facilitated Diffusion
 - 3.3.3 Group Translocation
 - 3.3.4 Active Diffusion

Unit 4: Culture Media: Ingredients and Types**(Duration: 05 Hrs)**

- 4.1 Media Ingredients
- 4.2 Media: Providing Nutrients in the Laboratory
 - 4.2.1 Types of Media
 - 4.2.2 Physical states of media
 - 4.2.3 Chemical content of media
 - 4.2.4 Media for different purposes

Unit-5: Cultivation of Bacteria & Pure culture techniques**(Duration: 07 Hrs)**

- 5.1 Methods of Culturing Microorganisms
- 5.2 Techniques of Isolation, Inoculation and Incubation of Bacteria
 - 5.2.1 Streak Plate
 - 5.2.2 Spread Plate
 - 5.2.3 Pour Plate and Enrichment
- 5.3 Cultivation of Aerobes and Anaerobes

- 5.4 Microbial growth on solid media
- 5.5 Quantitative Measurement of Bacterial Growth

Unit-6: Growth of Fungi and Protozoa

(Duration: 6 Hrs)

- 6.1 Fungal Nutrition
- 6.2 Fungal Identification and Cultivation
- 6.3 Biology of Protozoa
 - 6.3.1 Nutrition and Habitat Range
 - 6.3.2 Life Cycles and Reproduction

Practicals:

1. Preparation of Nutrient broth and Nutrient Agar slants and plates.
2. Isolation Techniques: Streak Plate, Spread Plate and Pour Plate methods.
3. Demonstration of selective and differential media: Mac Conkey Agar, EMB Agar and Mannitol Salt Agar
4. Enumeration of bacteria by Heterotrophic plate count method (HPC)
5. Effect of temperature on growth of microorganisms
6. Effect of pH of the medium on growth of microorganisms
7. Effect of osmotic pressure on growth of microorganisms
8. Demonstration of measurement of microorganisms by micrometry.

Sarvajanik University

Faculty of Science

B.Sc. (Hons)

Faculty: Science	Department: Microbiology
Program: B. Sc. (Hons)	Type: Skill Enhancement Course
Subject: Mushroom Cultivation Technology	Credits: 2
Semester: 3	
Learning Outcome: Upon finishing the Mushroom Cultivation Technology course, students will 1. Acquire diverse skills encompassing mushroom cultivation methods, substrate preparation, environmental management, and harvesting practices. Furthermore, they will gain insights into assessing market opportunities and crafting effective strategies for thriving mushroom cultivation enterprises. 2. Aligns with the SKILL INDIA MISSION ('Kaushal Bharat, Kushal Bharat') by fostering professional competency among students, nurturing their entrepreneurial capabilities for sustainable growth.	

Reference:

1. Participant Handbook by Agriculture Skill Council of India.
2. National Horticulture Board (NHB): Cultivation Technology and Technical Standards of Components of Integrated Button Mushroom Unit, Ministry of Agriculture and Farmers Welfare, Government of India.
3. ED, A. M., ED, S. S., & Thakur, M. P. (2016). Mushroom Training Manual. ICAR, India.

Unit 1: Introduction to Mushrooms

(8 hours)

- 1.1 Overview of mushrooms and their importance
- 1.2 Basic biology of mushrooms
- 1.3 Edible vs. non-edible mushrooms
- 1.4 Health benefits of edible mushrooms
- 1.5 Popular edible mushroom species available in India

Unit 2: Cultivation Techniques and Practices

(8 hours)

- 2.1 Overview of cultivation methods
- 2.2 Container selection
- 2.3 Substrate selection, preparation, and sterilization
- 2.4 Preparation of spawn and spawning
- 2.5 Controlling temperature, humidity, and light

Sarvajanik University

Faculty of Science

B.Sc. (Hons)

Unit 3: Harvesting and Post-Harvest Handling (7 hours)

- 3.1 Understanding the mushroom growth cycle
- 3.2 Harvesting techniques and timing
- 3.3 Storage

Unit 4: Market Potential of Mushrooms (7 hours)

- 4.1 Overview of the mushroom market and demand
- 4.2 Considerations for scaling up mushroom production
- 4.3 Funding and support options for mushroom cultivation businesses

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Faculty: Science	Department: Environmental Science
Program: B. Sc. (Hons)	Type of Subject: SEC
Subject: Economical Arthropods	
Semester: 3	
Credits: 2	

Student Learning Outcomes (SLOs):

After completing the course, students will be able to:

1. The paper will introduce students to insects economically useful to humans.
2. Students will also learn the classification, morphology and morphology of insects.
3. Students will also gain skilful knowledge regarding rearing, culturing, preservation and processing techniques of various products of selected insects.

References and Textbooks: (With Author, Edition, Publishers, ISBN)

1. Jordan and Verma (2015): Invertebrate Zoology, S.Chand Publication, New-Delhi.
2. Kotpal, R. L (2005): Arthropoda, Rastogi Publication, Meerut.
3. Kotpal, R.L (2011): Invertebrates, Rastogi Publication, Meerut.
4. Upadhyay and Shukla (2002): Economic Zoology, Rastogi Publication, Meerut.

Unit 1: Introduction to Arthropoda

7 Hours

- 1.1 Biological Success
- 1.2 Habits & Habitat
- 1.3 General Characters
- 1.4 Classification of Arthropoda

Unit 2: Apiculture

7 Hours

- 2.1 Species & Social Organization of Honey Bee
- 2.2 External Morphology & Selection of Bees
- 2.3 Appliances & Methods for Bee Keeping
- 2.4 Products & Economic importance of Bee Keeping

Unit 3: Prawn Culture

8 Hours

- 3.1 Types & Species of Prawn
- 3.2 Culturing of Fresh & Marine Water Prawn
- 3.3 Preparation & Methods of Farming
- 3.4 Preservation & Processing of Prawn

Unit 4: Lac Culture

8 Hours

- 4.1 Distribution & Life History
- 4.2 Selection of Host Plant
- 4.3 Cultivation & Processing of Lac
- 4.4 Threats & Economic importance of Lac Industry

SARVAJANIK UNIVERSITY
FACULTY OF SCIENCE

Faculty: Science	Department: Environmental Science
Program: B. Sc. (Hons)	Type of Subject: Value Added Course
Subject: IKS (Temple Architecture and Design)	
Credits: 2	
Semester: 3	

Student Learning Outcomes (SLOs):

After completing the course, students will be able to:

1. Understand architectural diversity of ancient and modern Hindu temples.
2. Learn different parts and styles of Hindu temples.
3. Gain knowledge about history and design of famous Indian temples.

References and Textbooks: (With Author, Edition, Publishers, ISBN)

1. Krishna Dev (1963): Temples of Northern India, National Book Trust of India, Delhi.
2. S. Krimirish (1946): Hindu Temples Part I and II, Calcutta.
3. Shri K.R. Nivason (2016): Dakshin Bharat Ke Mandir, National Book Trust of India, Delhi.
4. Surendra Sahai (2007): Indian Architecture-Hindu, Buddhist, and Jain, Prakash Books, India. ISBN: 9788172341299

Unit 1: Introduction and Fundamentals of Forest Mensuration System (07 hours)

- 1.1 Introduction and basic form of Hindu temple
- 1.2 Terminology of Hindu temple
- 1.3 Key features of Hindu temples

Unit 2: Styles of temple Architecture (07 hours)

- 2.1 Nagara (North Indian) Style
- 2.2 Vesara Style
- 2.3 Dravida (South Indian) Style

Unit 3: Features of temple architecture (08 hours)

- 3.1 Features of Nagara and Dravida Temple Style Architecture of India
- 3.2 Classification of Nagara Temple Style
- 3.3 Classification of Dravida Temple Style
- 3.4 Deccan, Buddhist and Jain temple architecture, Hill temples

Unit 4: Major Hindu temples of India (08 hours)

- 4.1 Meenakshi Amman Temple
- 4.2 Khajuraho Group of Temples
- 4.3 Brihadeeswarar Temple
- 4.4 Puri Jagannath Temple
- 4.5 Shri Somnath Temple

Sarvajanik University

Faculty of Science

Faculty: Science	Department: Computer Sci
Program: B.Sc. (Hons)	Type: Value Added Course (VAC)
Subject: Indian Knowledge System (Gananshastra)	Credits: 2
Semester: 3	

References:

1. Introduction to Indian Knowledge Systems - Concepts and Application, B. Mahadevan, Vinayak Rajat Bhat, Nagendra Pava R.N., PHI Publication
2. Sivananda S. All about hinduism. Sivananda literature research institute; 1988.
3. Dharampal G. Essential Writings of Dharampal. Publications Division Ministry of Information & Broadcasting; 2017 Nov 3.
4. Bajaj J, Śrīnivāsa MD. Sanatana Bharat, jagrita Bharat= Timeless India, resurgent India: a celebration of the land and people of India. (No Title).

Unit 1: Number System in IKS - Part 1

(07 hours)

- Number System in India - Historical Evidence
- Features of Indian Numeral System - Concept of zero and its importance, Large Number Representation, Place Value Numerals, Decimal System

Unit 2: Number System in IKS- Part 2

(07 hours)

- Unique Approaches to Represent Numbers
 - Bhuta Samkhya System,
 - Katapyadi system
- Pingala and Binary System
- Binary word system

Unit 3: Arithmetic

(08 hours)

- Square of Number,
- Square Root
- Square Root of Imperfect Squares
- Binary Mathematics and Combinatorial Problems in Chanda Shahstra of Pingala 300 BCE
- Magic Squares in India

Unit 4: Series and Progression

(08 hours)

- Series - upaciti
- Sum of Series of Squares and Cubes
- Repeated sum of series - Varasnkalita
- Pi approximation techniques
- Contribution of Indian Mathematicians

Name of Faculty: Science	Department: All
Program: B.Sc. (Hons)	Type: Ability Enhancement Course (AEC)
Subject: Communication Skills	Semester: 3

Credits: 02	Total Learning Hours: 30 Hours
Course Description: • Identify common communication problems that may be holding learners back • Perceive what the non-verbal messages are communicating to others • Understand the role of communication in the teaching-learning process • Learn to communicate through the digital media • Understand the importance of empathetic listening • Explore communication beyond language	
Student Learning Outcome: After completion of the course the student will be able to 1. Get a clear understanding of good communication skills 2. Know what they can do to improve their communication skills.	

Unit – 1 Listening & Speaking Skills

(08 Hours)

- 1.1. Techniques of Effective Listening
- 1.2. Listening and Comprehension
- 1.3. Probing Questions
- 1.4. Barriers to Listening
- 1.5. Pronunciation
- 1.6. Enunciation
- 1.7. Vocabulary
- 1.8. Common Errors

Unit – 2 Reading Skill

(06 Hours)

- 2.1. Techniques of Effective Reading
- 2.2. Gathering Ideas and Information from a Given Text
- 2.3. Evaluating these Ideas and Information
- 2.4. Interpreting the Text

Unit – 3 Writing and Different Modes of Writing

(08 Hours)

- 3.1. The Writing Process
- 3.2. Effective Writing Strategies
- 3.3. Different Modes of Writing
- 3.4. Types of Business Letters - Inquiry, Reply, Complaint
- 3.5. Email, Blogs

Unit – 4 Non – Verbal Communication

(08 Hours)

- 4.1. Meaning of Nonverbal Communication (NVC)
- 4.2. Advantages of Using Nonverbal Communication
- 4.3. Introduction to Modes of Nonverbal Communication
 - 4.3.1. Open and Closed Body Language
 - 4.3.2. Eye Contact and Facial Expression
 - 4.3.3. Hand Gestures
- 4.4. Do's and Don'ts in NVC
- 4.5. Learning from Experts
- 4.6. Activities-based Learning

Recommending Reading:

1. Kumar, S and Pushp Lata. Communication Skills. New Delhi, OUP, 2015.
2. Raman, Meenakshi and Sangeeta Sharma. Technical Communication: Principles and Practice. New Delhi, OUP, 201

Online Resources:

1. <https://www.thoughtco.com/what-is-nonverbal-communication-1691351>
2. <https://www.skillsyouneed.com/ips/nonverbal-communication.html>
3. <https://www.andrews.edu/~tidwell/bsad560/NonVerbal.html>
4. <https://artofeloquence.com/pages/the-importance-of-body-language>
5. https://www.tutorialspoint.com/body_language/body_language_open_closed.htm# Life Skills (Jeevan Kaushal) Facilitators' Manual 2022 39
6. <https://study.com/academy/lesson/facial-expressions-in-nonverbal-communicationimportance-lesson-quizz.html>
7. <https://www.sophia.org/tutorials/eye-contact-and-facial-expression>
8. <https://socialtriggers.com/21-hand-gestures-for-powerful-communication/>
9. <https://www.gqrgm.com/interview-dos-donts-importance-nonverbal-communication/> Video
10. <https://www.lifemasterygym.com/blog/power-of-non-verbal-communication>
11. <https://www.youtube.com/watch?v=vyrGNZ4Lzrw>
12. https://www.youtube.com/watch?v=FU0DkL184_4
13. <https://www.youtube.com/watch?v=qRnwdWXbwDY>
14. <https://www.youtube.com/watch?v=1zs-DRBWLmE>
15. Bailey, Stephen. 2010. Academic Writing: A handbook for International Learners. Routledge
16. Hogue, Ann. 1995. First Steps in Academic Writing. Pearson Longman.
17. Taylor, Shirley. 2006. Communication for Business. Pearson Education.
16. <https://learnenglishteachers.britishcouncil.org/skills/writing>
18. <http://www.sciedu.ca/journal/index.php/ijhe/article/view/9190>
19. <https://www.britishcouncil.in/>
20. <https://literarydevices.net/context/>
21. <https://courses.lumenlearning.com/waymaker-level3-english/chapter/text-inductivereasoning/>
22. <http://www.criticalreading.com/interpretation.htm>
23. <http://www.criticalreading.com/restatement.htm>
24. <http://www.criticalreading.com/description.htm>
25. https://www.britishcouncil.in/sites/default/files/day_3_-_sruti_akula.pptx
26. https://www.cs.kau.se/cs/education/courses/dvad07/Lectures/Critical_Reading.pdf

27. <https://www.youtube.com/watch?v=fOYtzoil2XI> 2.
<https://www.youtube.com/watch?v=VrD9-In6C1o>
28. <https://literarydevices.net/context>
<https://www.strategiesinlanguagelearning.com/how-to-improve-english-pronunciation/>
29. <http://giftarist.expertscolumn.com/article/speech-delivery-importance-enunciation-andpronunciation>
30. <https://www.wikihow.com/Enunciate>
31. <https://englishforeveryone.org/PDFs/Homonyms,%20Homographs,%20Homophones.pdf>
32. <https://learnenglishteens.britishcouncil.org/exams/speaking-exams/fluency>
33. <https://www.learnpick.in/blog/8-common-mistakes-make-speaking-english>
34. <https://www.fluentu.com/blog/english/common-mistakes-in-english>

Faculty: Science	Department: Microbiology
Program: B. Sc. (Hons)	Type: Ability Enhancement Course (AEC)
Semester: 3	
Subject: Mastering Google Drive	
Credit: 02	Total learning hours: 30 hr
Rationale: / Course description: In today's digital age, proficiency with online tools like Google Drive is essential. Google Drive provides a free and accessible platform for storing, sharing, and collaborating on documents. Google Drive is widely used in educational settings for assignments, collaboration among students and teachers, and managing course materials. Mastery of Google Drive can enhance one's professional skill set, making individuals more competitive in the job market and more valuable to employers.	
Students Learning Outcome: Upon completion of the course, students will be able to: 1. Understanding Google Drive Basics 2. Effective File Management Skills 3. Collaborative Editing and Real-Time Collaboration	

References:

1. **Steve, R. (2020).** Google Drive, Docs, and Sheets for Beginners 2021: Using Google Drive, Docs, and Sheets and Utilizing All Its Features. United States: RS Publishing House.
2. **Lamont, I. (2018).** Google Drive & Docs in 30 Minutes: The Unofficial Guide to Google Drive, Docs, Sheets & Slides. United States: I30 Media Corporation. ISBN: 9781641880107
3. **Darbyshire, P., Darbyshire, A. (2010).** Getting StartED with Google Apps. Netherlands: Apress.

Unit-1: Basics of Google drive		
	1.1	Use of Google Drive
	1.2	Interface of Google drive
	1.3	Navigating the main screen of google drive
	1.4	Making of folder, Management of folders
Unit-2: Use of Google Docs		
	2.1	Creating Google Doc, Naming the file
	2.2	Editing the file
	2.3	Understanding of Various Tabs and their function
	2.4	Import, Export and Sharing of Google Docs
Unit-3: Use of Google Sheet		
	3.1	Creating and naming the Google Sheet
	3.2	Importing the data
	3.3	Formatting the sheet
	3.4	Basic Functions in Google sheet and sharing
Unit-4: Use of Google Slide and Google forms		

	4.1	Creating and launching of Google slide
	4.2	Import the presentation and add slide to the presentation
	4.3	Editing the google slide
	4.4	Export, share and present the google slide
	4.5	Creating , editing and formatting google form and quiz
	4.6	Host control; Sharing and collecting the data by Google Form

Name of Faculty: Science	Department: Biotechnology
Program: B.Sc. (Hons)	Type: Theory
Subject: Entrepreneurship and Innovation- Indian Context	Semester: 03
Credit: 04	Total learning hours: 60
Type: Multidisciplinary course	
Course description: This multidisciplinary course is designed to provide students with a comprehensive understanding of entrepreneurship and innovation in the Indian context, equipping them with the knowledge, skills, and networks needed to succeed as entrepreneurs in India's diverse and dynamic market landscape.	
Student learning outcome: 1. Students will be able to demonstrate the ability to recognize market needs and gaps, generate innovative ideas and evaluate the feasibility and viability of entrepreneurial opportunities. 2. Students will be able to create well-structured and actionable business plans that outline the mission, vision, goals, strategies, and financial projections of a new venture, integrating market analysis, competitive positioning, and growth strategies. 3. Students will be able to get idea about to the entrepreneurial landscape in India, historical perspectives, and current trends 4. Students will understanding the Indian startup ecosystem, funding options, and support mechanisms for entrepreneurs 5. Students will developing comprehensive business plans and strategies tailored to the Indian market.	

References:

1. Startup India: Insight for Aspiring Entrepreneurs by Varun Aggarwal (2017) Publisher: Penguin Random House India
2. The lean Start Up: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Business by Eric Ries (2011) Publisher: Crown Business
3. India Startup Ecosystem: An Entrepreneur's Guide to Navigating the Indian Startup Landscape by Mukesh Bansal (2020) Publisher: Harper Collins India

Unit-1 Introduction to Entrepreneurship in India (8 hrs)

- 1.1 Overview of Indian entrepreneurial ecosystem: opportunities, challenges, and key players
- 1.2 Historical evolution of entrepreneurship in India
- 1.3 Role of government policies, regulatory environment and cultural factors in shaping entrepreneurship

Unit-2 Opportunity Recognition and Ideation (8 hrs)

- 2.1 Market research and analysis for identifying unmet needs in the Indian market
- 2.2 Idea generation methods tailored to the Indian context
- 2.3 Identifying opportunities in emerging sectors such as technology, agriculture, healthcare and renewable energy

Unit-3 Indian Startup Ecosystem and Funding Landscape (8 hrs)

- 3.1 Overview of Incubators, accelerators and start up support organization in India
- 3.2 Sources of funding for startups: angel investors, venture capital, government schemes
- 3.3 Case studies of successful Indian startups and their funding journeys

Unit-4 Business planning and strategy (8 hrs)

- 4.1 Component of business plan: market analysis, financial projections, marketing strategy
- 4.2 Adapting global business models to the Indian context
- 4.3 Strategies for navigating regulatory and bureaucratic hurdles in India

Unit-5 Marketing and Sales Strategies for Indian Markets (8 hrs)

- 5.1 Market segmentation and targeting strategies in diverse Indian demographics
- 5.2 Pricing, distribution and promotional strategies tailored to Indian consumer behavior
- 5.3 Digital marketing and e-commerce trends in India

Unit-6 Innovation and Technology in India (6 hrs)

- 6.1 Emerging technologies with potential for disruption in India
- 6.2 Startups leveraging technology to address Indian societal challenges
- 6.3 Government Initiative promoting innovation and technology entrepreneurship

Unit-7 Legal and Regulatory Environment in India (6 hrs)

- 7.1 Business registration, intellectual property protection and compliance requirement in India
- 7.2 Contract Law, employment regulation and taxation for startups
- 7.3 Challenges and opportunities in navigating the Indian legal system

Unit-8 Scaling and Growth Strategies for Indian Startups (8 hrs)

- 8.1 Scaling models and growth strategies for Indian start ups
- 8.2 Accessing international markets and global expansion strategies
- 8.3 Managing organizational growth and maintainin startup culture

Faculty: Science	Department: Environmental Science
Program: B. Sc. (Hons)	Type of Subject: Multidisciplinary
Subject: Green Schools	Semester: 3
Credits: 4	

Student Learning Outcomes (SLOs):

1. The course is designed to provide the basic understanding of teaching methodology for green education.
2. It will be helpful to students to develop teaching capacity to teach school students with understanding nature and sustainable goals to save energy and environment.

References and Textbooks:

1. Towards a Green School on Education for Sustainable Development for Elementary Schools by National Council of Educational Research and Training
2. Joy Palmer, Philip Neal, The handbook of Environmental Education, Routledge.

Unit 1: Green School Concept and Curriculum

1. Green School: Concept and Background
2. Green School and ESD
3. Essential Aspects
4. Towards Green School Curriculum
5. What is Greening of Curriculum?
6. Understanding Green Curriculum

Unit 2: Green Practices

1. The Classroom
2. Common Spaces
3. Conserving Water
4. Conserving Electricity
5. Managing Garbage
6. Plantation

Unit 3: Greening of School Activities

1. School Assembly
2. Occasions and Festivals
3. Safe School Environment
4. Infrastructure Safety Audit

Unit 4: Assessment

1. How Green is a School?
2. Profile of a Green School

Unit-5: Planning and Practices at Primary Level

1. Overall model for teaching and learning
2. Issue-Based themes and topics

Unit-6: Planning and Practices at Secondary Level

1. Lesson plan
2. Individual efforts- litter as an example
3. Concentric Approach
4. Blocking time-table

Unit-7: The Out Of school approach (The Field Work)

1. Out of classroom
2. Local action for a better environment
3. School case studies

Unit-8 Practicalities For Environmental Education

1. Developing policies
2. Implementation of School Policies

Faculty: Science	Department: Microbiology
Program: B. Sc. (Hons)	Type: Multidisciplinary
Subject: Personal Finance and Investment Planning	
Credits: 4	Semester: 3
Course description: The course is designed to provide basic financial literacy which is a prerequisite for the students to manage financial aspects of the life.	
Student learning outcome: 1. To familiarize students with the Financial System, Institutions & Market. 2. To expose students to the various avenues available for effective investment and risk management. 3. Acquire skill to protect assets by insurance planning. 4. Understanding of the Indian tax system. 5. Able to plan financially independent retirement.	

Reference Books:

1. Jeff Madura, Personal Finance, 7th edition, Pearson Education, 2020 (ISBN: 978-0-13-498996-9)
2. Shalu Garg, Personal Financial Planning, 1st Edition (2024) Sultan Chand & Sons, New Delhi (ISBN: 978-93-91820-90-9)
3. M.K. Sarva, Personal Financial Planning, LPU, Excel Books Pvt. Ltd., new Delhi
4. Arthur J. Keown: Personal Finance, Pearson India.
5. Eric Tyson: Personal Finance, 6th Edition Wiley publishing
6. Faith Glasgow: Personal Finance and investing, John Wiley and sons
7. Jack R. Kapoor, Les R. Dlabay, Robert J. Hughes, Melissa Hart: Personal Finance, Tata McGraw Hill India.
8. Lewis Altfest: Personal Financial Planning, Tata McGraw Hill.
9. Sinha. Madhu, Financial Planning: A Ready Reckoner July 2017 McGraw Hill.

Unit-1: Structure of Indian Financial System

(Duration: 08 Hrs)

- 3.1 Features of Indian financial system
- 3.2 Components of Indian financial system
 - 3.2.1 Financial Institutions
 - 3.2.2 Financial markets
 - 3.3.3 Financial Instruments/Assets/Securities
 - 3.3.4 Financial Services
- 3.3 Functions of Indian financial system
- 3.4 Regulators of Indian Financial markets.

Unit-2: Introduction to personal financial planning**(Duration: 07 Hrs)**

- 2.1 Meaning and concept of finance
- 2.2 Different definition of finance
- 2.3 Meaning and concept of financial planning
- 2.4 Importance of financial planning
- 2.5 Financial goals: Types of financial goals & SMART financial goals
- 2.6 Components of financial plan
- 2.7 Process of financial planning

Unit-3: Fundamentals of Investment**(Duration: 07 Hrs)**

- 3.1 Objective of investments
- 3.2 Types of investments
- 3.3 Managing Investment Risk – Types of risk, Measurement of risk
- 3.4 Return from Investment – Types of return and their calculations

Unit-4: Investment Instruments - I**(Duration: 08 Hrs)**

- 4.1 Government Securities & Small Saving Schemes
- 4.2 Fixed income Instruments
- 4.3 Bond
- 4.4 Precious metal
- 4.5 Real estate & REITs
- 4.6 Digital currency
- 4.7 International Investment Avenues

Unit-5: Investment Instruments - II**(Duration: 08 Hrs)**

5.1 Stocks: Stock exchanges, Stock Price Quotations, Purchasing and selling stocks – Selecting broker, Placing an order, Buying stocks on margin, Short selling stock, Analyzing stocks – Firm's Financial and economic condition, Industry condition, Limitation of stock analysis.

5.2 Mutual Fund: Introduction – NAV, Open-End V/s Closed-End fund, Load v/s No load fund, Expense ratio., Types of mutual funds: Stocks, Bonds., Exchange traded funds: Types, Advantage & Disadvantage., Return and risk of mutual fund, Reviewing a Mutual Fund's Prospectus.

Unit-6: Insurance Planning**(Duration: 07 Hrs)**

- 6.1 Need for insurance
- 6.2 Characteristics of Insurance
- 6.3 Rights of the Insurer
- 6.4 Rights of the Insured
- 6.5 Types of Insurance

Unit-7: Personal Tax Planning**(Duration: 07 Hrs)**

- 7.1 Concept of tax structure in India – Direct tax and Indirect tax
- 7.2 Need for tax planning
- 7.3 Objectives & Advantages of tax planning

7.4 Exemption and Deduction

7.5 Tax Saving Options

Unit-8: Retirement Planning

(Duration: 08 Hrs)

8.1 Why plan for retirement

8.2 Retirement assets

8.3 Retirement planning goals

8.4 Process of retirement planning

8.5 Pension plans available in India

8.6 Will

Name of Faculty: Science	Department: Biotechnology
Program: B.Sc. (Hons)	Type: Theory
Subject: Pharmaceutical Product	Semester: 04
Credit: 04	Total learning hours: 60
Type: Multidisciplinary course	Semester: 3
Course description: The objectives of this course are to provide students with a comprehensive understanding of the process involved in developing pharmaceutical products from conception to market launch. This course integrates principles from various fields including pharmacology, chemistry, biology, engineering and marketing to equip students with the necessary knowledge and skills to contribute effectively to the pharmaceutical industry.	
Student learning outcome: 1. Students will develop an understanding of pharmaceutical industry and its products. 2. Students will gain knowledge about techniques of drug formulation, dosage , drug delivery and along with excipients. 3. The units will also focus on and thus provides knowledge of drug stability and shelf life, along with pharmaceutical packaging and labelling. 4. At the end of the course, the students will have sufficient scientific understanding of the subject and have good knowledge of current trends and future direction in pharmaceutical product.	

References:

Pharmaceutical Analysis: A Textbook for Pharmacy Students and Pharmaceutical Chemists" by David G. Watson

Unit-1 Introduction to Pharmaceutical Products

(6 hr)

- 1.1 Overview of the pharmaceutical industry
- 1.2 Historical perspective
- 1.3 Milestone in drug development

Unit-2 Drug formulation and Dosage forms

(8 hr)

- 2.1 Types of drug dosage forms
 - 2.1.1 Solid
 - 2.1.2 liquid
 - 2.1.3 semi solid
 - 2.1.4 parenteral
- 2.2 Principle of drug dosage formulation and dosage form design
- 2.3 Manufacturing process and techniques for different dosage forms

Unit-3 Pharmaceutical Excipients

(6 hr)

- 3.1 Role of excipients in drug formulation
- 3.2 Common excipients used in pharmaceutical products and their fundtions

Unit-4 Drug delivery system

(8 hr)

- 4.1 Controlled release drug delivery system
- 4.2 Targeted drug delivery system

- 4.3 Novel drug delivery techniques – Nasal, Osmosis, RNAi
- 4.4 Personalize medicine and personalize drug target

Unit-5 Drug stability and Shelf life **(8 hr)**

- 5.1 Factors affecting drug stability
- 5.2 Method of assessing shelf life of pharmaceutical products
- 5.3 Method of extending shelf life of pharmaceutical products

Unit-6 Quality control and drug stability testing **(8 hr)**

- 6.1 Definition and importance of Quality control
- 6.2 Role of QC in pharmaceutical manufacturing
- 6.3 Types and Importance of drug stability testing
- 6.4 Factor affecting stability testing

Unit-7 Pharmaceutical packaging and labelling **(8 hr)**

- 7.1 Packaging materials for pharmaceutical products
- 7.2 Packaging techniques for pharmaceutical products
- 7.3 Labelling requirement and regulation

Unit-8 Case studies of popular pharmaceutical products **(8 hr)**

- 8.1 Aspirin
- 8.2 Viagra
- 8.3 Lipitor