# SKILL ENHANCEMENT COURSES

SYLLABUS FOR THE

# SUBJECT: BIOINFORMATICS (VOCATIONAL)

for the award of the Degree in

**BACHELOR OF ARTS/ BACHELOR OF SCIENCE/ HONOURS**

(Offered under 4-year UG Degree Programme)

(Credit Based Grading System)
under NEP 2020

**Batch: 2025–29**

## GURU NANAK DEV UNIVERSITY AMRITSAR

# SCHEME

# BIOINFORMATICS (VOCATIONAL)

# SKILL ENHANCEMENT COURSES

## SEC-I

| Sr. No. | Course Code | Course Title | Credits L-T-P | Marks |
|---|---|---|---|---|
| 1. | | FUNDAMENTALS OF DATA ANALYTICS & VISUALIZATION (THEORY) | 2-0-0 | 50 |
| 2. | | FUNDAMENTALS OF DATA ANALYTICS & VISUALIZATION (PRACTICAL) | 0-0-1 | 25 |

## SEC-II

| Sr. No. | Course Code | Course Title | Credits L-T-P | Marks |
|---|---|---|---|---|
| 1. | | SKILL DEVELOPMENT IN BIOTECHNOLOGY-I (THEORY) | 2-0-0 | 50 |
| 2. | | SKILL DEVELOPMENT IN BIOTECHNOLOGY-I (PRACTICAL) | 0-0-1 | 25 |

## SEC-III

| Sr. No. | Course Code | Course Title | Credits L-T-P | Marks |
|---|---|---|---|---|
| 1. | | SKILL DEVELOPMENT IN BIOTECHNOLOGY-II (THEORY) | 2-0-0 | 50 |
| 2. | | SKILL DEVELOPMENT IN BIOTECHNOLOGY-II (PRACTICAL) | 0-0-1 | 25 |

**BIOINFORMATICS (VOCATIONAL)**

**SKILL ENHANCEMENT COURSE**

**(SEC-I)**

# FUNDAMENTALS OF DATA ANALYTICS & VISUALIZATION

**(THEORY)**

**Time: 3 Hrs.** **L-T-P**

**Credits: 2-0-0**

**Marks : 50**

**30 Hrs.**

**Instructions for the Paper Setters:**

Eight questions of equal marks (Specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions selecting at least one question from each Section. The fifth question may be attempted from any Section.

## SECTION–A

**Introduction to Data Analysis:** What is Data and Data Analysis?, Data Analysis Vs Data Science, Data Ecosystem & Life Cycle, Data Analysis Process, Key Terminologies in Data Analysis.

Types of Data Analysis: Quantitative & Qualitative data analysis, Components of Data Analysis (Text Analytics, Data Mining, Business Intelligence).

## SECTION–B

Understanding Data Types, Common Data Sources, Data Privacy & Ethics, Data Integrity.

**Data Cleaning & Preparation:** Understanding Data Quality, Data Cleaning Techniques, Data Integration & Preparation.

## SECTION–C

**Data Visualization:** Introduction to Data Visualization, Principles of Effective Data Visualization, Advantages of Data Analytics and Visualization, Different types of Data Visualization Techniques and their usage including Histograms, Graphs, Fever Charts, Heatmaps, Infographics, Dashboards and Geospatial.

## SECTION–D

**Introduction to Data Visualization using R:** Introduction to R and its features, Basic Syntax of R Programming (Data Types, Variables, Comments, Keywords, input, output, etc.), Common Data Structures in R (Vectors, Lists, Arrays, Strings, Matrices, Factors, Data Frames), File Handling in R.

**Introduction to Graphics Packages in R:** R Packages**,** Basic Graphics in R, Graphics using ggplot2 package.

***Course Learning Outcomes (CO):***
On completion of this course, students will be able to:

CO 1: Know Data and Data analysis
CO 2: Differentiate between various types of data
CO 3: Perform Data Cleaning and Preparation
CO 4: Know which type of visualization can be used to present a specific type of data
CO 5: Analyze data and Create a different types of Visualizations using R

**Books Recommended and Resources:**

1. Srinivasa, K. G., & Kurni, M. (2021). A beginner's guide to learning analytics. Berlin/Heidelberg, Germany: Springer.
2. Moreira, J., Carvalho, A., & Horvath, T. (2018). A general introduction to data analytics. John Wiley & Sons.
3. Healy, K. (2018). Data visualization: a practical introduction. Princeton University Press.
4. Hyman, J.A., Massaron, L., McFedries, P., Mueller, J.P., Pierson, L., Reichental, J., Schmuller, J., Simon, A. and Taylor, A.G., 2024. Data Analytics & Visualization All-in-one. John Wiley & Sons, Incorporated.
5. Data Visualization: Storytelling Using Data (2022), Sharada Sringeswara; Purvi Tiwari; U. Dinesh Kumar, Wiley.
6. Data Analytics Using R (2018), Seema Acharya, Mc Graw Hill.
7. Brown, D. S. (2021). Statistics and data visualization using R: the art and practice of data analysis. SAGE Publications. Grauer B. (2005). Exploring Microsoft Office 2003 (Volume 1). Prentice Hall, New Jersey.
8. Hartvigsen, G. (2014). A primer in biological data analysis and visualization using R. Columbia University Press.
9. Collins, R. (2018). Data Visualization: Introduction to Data Visualization with Python, R and Tableau. Create Space Independent Publishing Platform.
10. https://hevodata.com/learn/data-analytics-and-visualization/
11. https://businessanalyst.techcanvass.com/fundamentals-of-data-analytics/
12. https://www.geeksforgeeks.org/data-visualization-in-r/

**BIOINFORMATICS (VOCATIONAL)**

**SKILL ENHANCEMENT COURSE**

**(SEC-I)**

# FUNDAMENTALS OF DATA ANALYTICS & VISUALIZATION (PRACTICAL)

**Time: 3 Hrs.**

**L-T-P**
**Credits: 0-0-1**
**Marks: 25**
**30 Hrs.**

1. Downloading and installing R and understanding its various components
2. Downloading and installing R Studio and understanding its various components
3. Overview of basic syntax, commands, input, output operations
4. Creating various data structures in R
5. File handing in R
6. Control structures in R
7. Creating various types of visualizations using Basic R and ggplopt2 package
8. Case Studies on Data analytics using data from any of the Business, Sciences, Biological Sciences, Social Science or Clinical domains etc.

**BIOINFORMATICS (VOCATIONAL)**

**SKILL ENHANCEMENT COURSE**

**(SEC-II)**

**SKILL DEVELOPMENT IN BIOTECHNOLOGY-I**

**(THEORY)**

**Time : 3 Hrs.** **L-T-P**
**Credits : 2-0-0**
**Marks: 50**
**30 Hrs.**

**Instructions for the paper setters:**
Eight questions of equal marks (specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**SECTION-A** **(8 Hrs.)**

**Biofertilizers:** Introduction and types and importance of biofertilizers, Microorganisms used in biofertilizers production, Biological Nitrogen fixation VIZ: Rhizobium: Process of nodule formation , Role of Nif and Nod gene in, Enzyme nitrogenase and its component, Different methods of application of biofertilizers, Strategies of Mass production and packing, Registration of biofertilizers.

**SECTION-B** **(8 Hrs.)**

**Herbal Biotechnology:** Introduction to medicinal plants and their medicinal value, Phytochemicals, Essential oil:
definition, extraction and applications in domestic life, industry and other purposes (Eucalyptus, Levender, Rosa grass, Tulsi)

**SECTION-C** **(7 Hrs.)**

**Nutraceuticals and Functional Foods**: Introduction to Nutraceuticals as Science, Properties, structure and functions of various Nutraceuticals, Food as remedies, Anti-nutritional Factors present in Foods, Nutraceuticals and Functional, Functional Foods, Nutritional Genomics, Quality Control, Quality Assurance

**SECTION-D** **(7 Hrs.)**

**Bio Entrepreneurship**

Overview of bio industries, public/private funding opportunities; Innovation-focused thinking. Preparation of a business plan: socio-economic cost benefit analysis; Statutory and legal aspects. Business and market strategy: pricing, financing, market linkages, branding

**Course Outcome:**

Experimental or case study design, scientific data analysis, writing and communication, ethical practices, and effective team work. Students will be able to work safely and successfully in a biotechnology laboratory, both individually and as part of a team.

**Books Recommended:**

1. Fundamentals of Foods, Nutrition and Diet Therapy, (English, Mudambi Sumati R.), New Age International publication,
2. Clinical Dietetics and Nutrition, by Antia F P (Author), Oxford publication.
3. Alpers. D.H., Stenson W.F. and Bier. D. M., (2002). Manual of Nutritional Therapeutics, 4th edition, Lippincott Williams & Wilkins, Philadelphia, USA.
4. Research pare and e-notes.
5. F. Bakkali, S. Averbeck , D. Averbeck, M. Idaomar. (2008). Biological effects of essential oils – A review. Food and Chemical Toxicology 46: 446–475.
6. R. Amorati, M. C. Foti, L. Valgimigli. (2013). Antioxidant Activity of Essential Oils. Journal of Agriculture and Food Chemistry. 61:10835−10847.
7. A Sharma, D.S. Cannoo. (2016). Comparative evaluation of extraction solvents/techniques for antioxidant potential and phytochemical composition from roots of Nepeta leucophylla and quantification of polyphenolic constituents by RP-HPLC-DAD. Food Measure. Doi10.1007/s11694-016-9349-5
8. Sharma and D. S. Cannoo. (2013). Phytochemical composition of essential oils isolated from different species of genus NEPETA of Labiatae family: a review. Pharmacophore, 4(6): 181-211.
9. Sarikurkcu, B. Tepe, D. Daferera, M. Polissiou, Mansur Harmandar. (2008). Studies on the antioxidant activity of the essential oil and methanol extract of Marrubium globosumsubsp. globosum (lamiaceae) by three different chemical assays. Bio resource Technology, 99: 4239–4246.

**BIOINFORMATICS (VOCATIONAL)**
**SKILL ENHANCEMENT COURSE**

**(SEC-II)**

**SKILL DEVELOPMENT IN BIOTECHNOLOGY-I**

**(PRACTICAL)**

**Time : 2 Hrs.** **L-T-P**
**Credits : 0-0-1**
**Marks: 25**
**30 Hrs.**

Note. The question paper will be set by the examiner based on the syllabus.

1. Isolation of Rhizobium from root nodules
2. Production of commercial biofertilizers using Rhizobium.
3. Extraction of essential oils through oil distillation apparatus.
4. To measure total polyphenolic content of the essential oil.
5. Total flavanoid content of the essential oil.
6. Investigating the antioxidant potential of the oils by DPPH assay.
7. Antimicrobial activity of essential oils.
8. Estimation of BMR
9. Estimation of lipid profile
10. Estimation of blood glucose

**Course Outcome:**

Experimental or case study design, scientific data analysis, writing and communication, ethical practices, and effective teamwork. Students will be able to work safely and successfully in a biotechnology laboratory, both individually and as part of a team.

**Books Recommended:**

1. Fundamentals of Foods, Nutrition and Diet Therapy, (English, Mudambi Sumati R.), New Age International publication,
2. Clinical Dietetics and Nutrition, by Antia F P (Author), Oxford publication.
3. Alpers. D.H. , Stenson W.F. and Bier. D.M., (2002). Manual of Nutritional Therapeutics, 4th edition, Lippincott Williams & Wilkins, Philadelphia, USA.
4. Research pare and e-notes.
5. F. Bakkali, S. Averbeck , D. Averbeck, M. Idaomar. (2008). Biological effects of essential oils – A review. Food and Chemical Toxicology 46: 446–475.

**BIOINFORMATICS (VOCATIONAL)**

**SKILL ENHANCEMENT COURSE**

**(SEC-III)**

**SKILL DEVELOPMENT IN BIOTECHNOLOGY-II**

**(THEORY)**

**L-T-P**
**Time : 3 Hrs.** **Credits : 2-0-0**
**Marks: 50**
**30 Hrs.**

**Instructions for the paper setters:**
Eight questions of equal marks (specified in the syllabus) are to be set, two in each of the four Sections (A-D). Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any section.

**SECTION-A** **(8 Hrs.)**

**Phlebotomy:** Collection of blood samples, preparation and use of different anticoagulants, estimation of CBC, TLC, DLC, bleeding count, clotting time, Platelet count, Reticulocyte count, Morphology of red cells, ESR, PCV

**SECTION-B** **(8 Hrs.)**

**Diagnostic tests:** Principles of X-ray, MRI, ultrasonography, CT scan, PET Scan, ECG, ECHO, Biopsy , colonoscopy, Gastroscopy, Eye test, Hearing test

**SECTION-C** **(7 Hrs.)**

**Cancer, Tumor & Cancer Markers :** Carcinogens, Oncogene, Clinical applications of tumor markers, Overview of vector borne diseases: Dengue, Chickengunia, PCR based diagnosis of Bacterial, viral & fungal diseases (covid-19, Swine flu, Tuberculosis, Candidiasis)

**SECTION-D** **(7 Hrs.)**

**Bio-medical waste management:** Causative methods, transmission methods, investigation, prevention and control of biomedical Infection**,** Non-infectious waste, infected sharp waste disposal, infected non-sharp waste disposal.

**Course Outcome:**

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**Books Recommended:**

1. Godkar, PB and Godkar, DP (2008) Text Book of Medical Laboratory Technology, 2nd edition Bhalani Publishing House, Mumbai, India.
2. Martin R. Howard & Peter J Hamilton (2013) Text Book of Hematology, 4th edition, Churchill Livingstone.
3. Robert A. Weinberg (2023). The Biology of Cancer, 3rd Edition. W W Norton & Co Inc:.
4. Lauren Pecorino (2012). Molecular Biology of Cancer, 3rd Edition, Oxford.
5. Singh A., Bachheti P. (2017). Hematology & Blood Banking, 2nd Edition, Vayu Edition of India

## BIOINFORMATICS (VOCATIONAL)

## SKILL ENHANCEMENT COURSE

## (SEC-III)

## SKILL DEVELOPMENT IN BIOTECHNOLOGY-II (PRACTICAL)

**Time :2 Hrs.** **L-T-P**
**Credits : 0-0-1**
**Marks: 25**
**30 Hrs.**

Note. The question paper will be set by the examiner based on the syllabus.

1. Isolation of Rhizobium from root nodules
2. Production of commercial biofertilizers using Rhizobium.
3. Extraction of essential oils through oil distillation apparatus.
4. To measure total polyphenolic content of the essential oil.
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