Nirmala Memorial Foundation College of Commerce and Science

(Autonomous)

Re-accredited by NAAC with B++, ISO 9001-2015 Certified, Recognised under section 2(f) & 12(B) of the UGC Act 1956

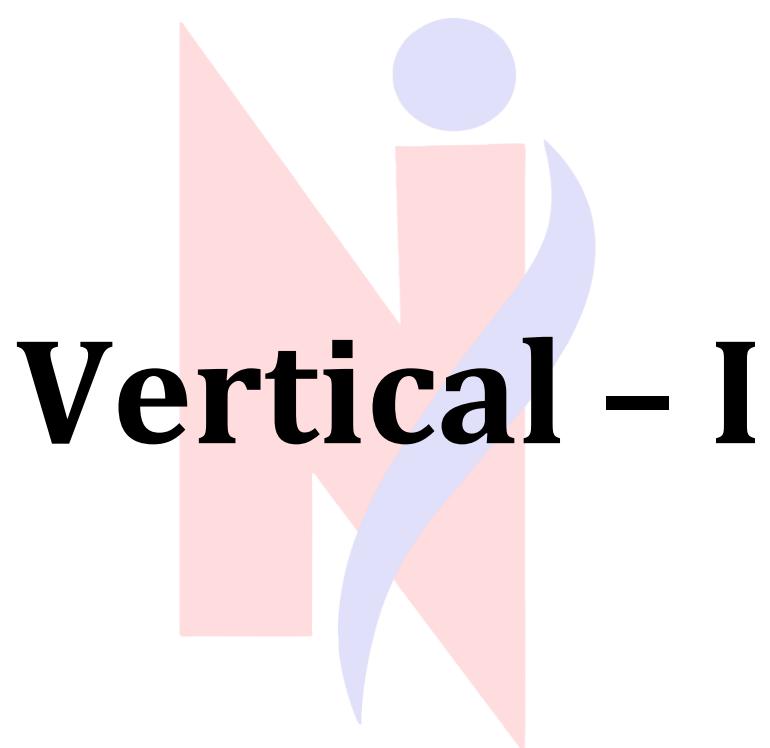*Permanently Affiliated to the University of Mumbai,*

Syllabus

Bachelor of Science in Information Technology

(B.Sc. Information Technology)

(Programme Code: UGIT01)

As Per New Education Policy (NEP) 2020

(To be implemented from the Academic Year 2025-2026)
Approved in the Academic Council Meeting held on **5**th **July 2025**

Vertical – I

Semester- IV

Name of the Course: Core Java Techniques

Sr. No.	Heading	Particulars
1	**Description the course:**	Core Java course focuses on teaching students how to design, develop, and maintain software applications using the Java programming language. The course covers fundamental to advanced concepts of Java, enabling students to understand object- oriented programming (OOP) principles, data structures, algorithms, and real-world application development
2	**Vertical:**	Major
3	**Type:**	Theory
4	**Credits:**	2 credits (1 credit = 15 Hours for Theory in a semester, Total 30 hours)
5	**Hours Allotted:**	30 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives:**	

7. **Course Objectives:**

1. Understand and Apply Object-Oriented Programming (OOP) Concepts.
2. Identify the key components of a class and object in Java, including attributes (fields), methods, and constructors.
3. Apply sound software engineering principles in Java by organizing code into classes and methods with proper access control identifiers
4. Use tools and techniques like unit testing, as well as IDE debugging tools to find and fix issues within Java programs.
5. Effectively use Java's collection framework (e.g., Lists, Sets, Maps) to manage and process groups of related objects.
6. Use OOP concepts in designing and building solutions to real-world problems, ensuring the application is modular, maintainable, and reusable.

8. **Course Outcomes:**

CO1. Understand the basics of Java and its runtime environment.
CO2. Be proficient in using Java's data types, control flow statements, and OOP principles such as classes, inheritance, and exception handling.
CO3. Creating own classes and objects
CO4. Develop mini projects using Class, Interface and exception handling

9. **Modules:-**

Module 1 (15 hours):

Introduction to Java Programming : History of Java and its Evolution, Features of Java (Platform Independence, Object Oriented), Data Types and Variables, Operators Constants and Literals, Type Casting
Decision Making and Loops : If-else Statements, Switch Statement, Loops (For, While, Do-While), Break and Continue Statements
Classes and Objects : Array, Arrays String class and String methods, String Buffer and StringBuilder, Object-Oriented Programming Concepts, Defining Classes and Creating

	Objects, Instance Variables and Methods, Constructors, this Keyword, super keyword, Types of Classes, Scope Rules, Access Modifier, constants, static members of a class, garbage collection. **Inheritance:** Its types, Superclass and Subclass, Final classes and methods **Polymorphism:** Compile-time and Runtime Polymorphism **Interfaces:** Defining and Implementing Interfaces, Abstract Classes and Methods, Multiple Interface Implementation
	Module 2 (15 hours):
	Packages: Introduction to predefined packages, User Defined Packages, Access specifier, Java Built-in packages **Exception handling :** Try, Catch, and Finally Blocks, Throw and Throws Keywords **Introduction to Threads:** Creating and Running Threads, Thread Lifecycle **Introduction to JFC and Swing :** Features of the Java Foundation Classes, Swing API Components, JComponent Class, Containers and Panels, Labels, Buttons, RadioButton, Check Boxes, Text-Entry Components, Menus **Layouts:** Flow Layout, Grid Layout, Border Layout **Event Handling:** Delegation Event Model, Events, Event classes, Event listener interfaces, Using delegation event model, adapter classes
10	**Text Books** 1. Cay S. Horstmann. *Core Java: Fundamentals, Volume I* (Oracle Press Java). 12th Ed., Pearson/Oracle Press, 2022. ISBN-13: 978-0-13-767362-9. 2. Cay S. Horstmann. *Core Java: Advanced Features, Volume II* (Oracle Press). 12th Ed., Pearson/Oracle Press, 15 Apr 2022. Print ISBN-13: 978-0-13-787107-0 (ISBN-10: 0137871074)
11	**Reference Books** 1. Java: The Complete Reference Herbert Schildt MC-Graw HILL 12th EDITION 2022 2. Core Java, Volume I: Fundamentals Hortsman Pearson 9th 2013 3. Core Java, Volume II: Advanced FeaturesGary Cornell and Hortsman Pearson 8th 2008 4. Core Java: An Integrated Approach R. Nageswara Rao DreamTech 1st 2008

12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Class test: 15 marks Quizzes/ Presentations/ Assignments: 5 marks Total: 20 marks	**Format of Question Paper: External Examination (30 Marks)– 1 hr duration**
14	**Format of Question Paper: (Semester End Examination : 30 Marks. Duration:1 hour)** Q1: Attempt any three (out of five) from Module 1 (15 marks) Q2: Attempt any three (out of five) from Module 2 (15 marks)	

Name of the Course: Software Engineering

Sr. No.	Heading	Particulars
1	**Description the course:**	This course introduces core concepts of software engineering and the Software Development Life Cycle (SDLC), including requirements analysis and documentation. It covers key development models—Waterfall, Prototyping, Iterative, and Agile—with a focus on Scrum. Topics also include verification, validation, software testing, test design, and COTS product reuse.
2	**Vertical:**	Major
3	**Type:**	Theory
4	**Credits:**	2 credits (1 credit = 15 Hours for Theory in a semester, Total 30 hours)
5	**Hours Allotted:**	30 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives:**	

7. **Course Objectives:**

1. Explain the principles of software engineering and the stages of the Software Development Life Cycle (SDLC).
2. Identify, classify, and document functional and non-functional software requirements.
3. Compare and apply various software development models, including Waterfall, Prototyping, Iterative, and Agile methodologies.
4. Demonstrate understanding of Agile principles, Scrum framework, and sprint management practices.
5. Plan and implement verification and validation strategies during software development.
6. Apply different software testing techniques, including test case design, system testing, and COTS product integration.

8. **Course Outcomes :**

CO1. Describe the fundamentals of software engineering and explain each phase of the Software Development Life Cycle (SDLC).
CO2. Analyze and document software requirements, distinguishing between functional and non-functional requirements.
CO3. Evaluate and select appropriate software development process models for given project scenarios.
CO4. Apply Agile methodologies, including Scrum practices such as sprint planning, roles, workflow, and retrospectives, in software projects.
CO5. Develop and implement verification and validation plans to ensure software quality and compliance.
CO6. Design effective test cases and apply suitable testing strategies and levels, including system testing and COTS reuse.

9. **Modules:-**

Module 1 (15 hours):

Software and Software Engineering, Software Development Life Cycle, Software Requirements: Functional and Non-functional requirements, Documentation of the software requirements, Software Development Process Models: • Waterfall Model. • Prototyping. • Iterative Development, Agile Software Development, Agile Software Development Process, Principles of Agile Software Development, Scrum in Software Development, Sprint Planning, Sprint Roles, Sprint workflow and process, Sprint Retrospectives

Module 2 (15 hours):

Verification and Validation: Planning Verification and Validation,Software testing: Types of Software Testing ,Types of System Testing Test Case Design , Levels of testing, COTS product reuse**.**

10	**Text Books** 1. Roger S. Pressman & Bruce R. Maxwell. *Software Engineering: A Practitioner's Approach*. 9th Ed., McGraw-Hill Education, 2020. ISBN-13: 978-1263948423. 2. Philip A. Laplante. *What Every Engineer Should Know About Software Engineering*. 1st Ed., CRC Press, 2012. ISBN-13: 978-1439841722
11	**Reference Books** 1. "Software in 30 Days" by Ken Schwaber and Jeff Sutherland, Wiley, 1st edition (2012). 2. "Scrum Insights for Practitioners: The Scrum Guide Companion" by Hiren Doshi, PracticeAgile Solutions, 1st edition (2016). 3. "A Scrum Book: The Spirit of the Game" by Jeff Sutherland and James O. Coplien, Pragmatic Bookshelf, 1st edition (2019).

12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Class test: 15 marks Quizzes/ Presentations/ Assignments: 5 marks Total: 20 marks	**Format of Question Paper: External Examination (30 Marks)– 1 hr duration**
14	**Format of Question Paper:** (**Semester End Examination: 30 Marks. Duration:1 hour)** Q1: Attempt any three (out of five) from Module 1 (15 marks) Q2: Attempt any three (out of five) from Module 2 (15 marks)	

Name of the Course: Computer Networks

Sr. No.	Heading	Particulars
1	**Description the course:**	This course provides students knowledge and skills to understand and implement the Networking skills. It will help them to implement Virtual networks to understand and resolve real-world network problem.
2	**Vertical:**	Major
3	**Type:**	Theory
4	**Credits:**	2 credits (1 credit = 15 Hours for Theory in a semester, Total 30 hours)
5	**Hours Allotted:**	30 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives:** 1. To understand the basic concepts of networks 2. Understand basic concepts in OSI Model , distinguishing Factors in TCP/IP ,IP addressing Schemes 3. Understand How the communication happens across the network 4. Understanding of various Routing protocol and their implementation	
8	**Course Outcomes :** **CO1** .Understanding the Transport layer protocols and their utilities **CO2** .Various application layer protocols and their implementation **CO3 .**Mailing Services and web services implementation	
9	**Modules:-** **Module 1 (15 hours):**	
	Introduction: Network Definition , components of data communication , Data flow , Characteristics of data communication , Analog and digital Signals and their characteristics , Conversions from one form to another form. Layered architecture , OSI reference Model, TCP/IP Protocol Suite, IPV 4 Addressing classfull , classless , Subnet mask and Protocol and IPV6 Addresses and Protocol. Address Resolution Protocol (ARP), Internet Control. Message Protocol Version 4 (ICMPv4), Mobile IP, Unicast Routing Protocols (RIP, OSPF and BGP)	
	Module 2 (15 hours):	
	Flow control protocols : Stop and wait protocols , sliding window protocols (selective repeat ARQ , go back n ARQ) User Datagram Protocol (UDP), Transmission Control Protocol (TCP) **Host Configuration:** DHCP, Domain Name System (DNS) **Remote Login**: TELNET and SSH, File Transfer: FTP and TFTP ; World Wide Web and HTTP, **Electronic Mail:** SMTP, POP, IMAP and MIME.	

10	**Text Books**
	1. Larry L. Peterson & Bruce S. Davie. *Computer Networks: A Systems Approach*. 6th Ed., Morgan Kaufmann, 2021. ISBN-13: 978-0-12-813431-9.
	2. William Stallings. *Data and Computer Communications*. 11th Ed., Pearson, 2020. ISBN-13: 978-0-13-687665-8

11	**Books and References:**
	1. Data communication and Networking : Behrouz Forouzan
	2. Computer Network : Tanenbaum
	3. Computer Network a Top down approach: James F.Kurose , Keith W. Ross

12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Class test : 15 marks Quizzes/ Presentations/ Assignments: 5 marks Total: 20 marks	**External Examination (30 Marks)– 1 hr duration**

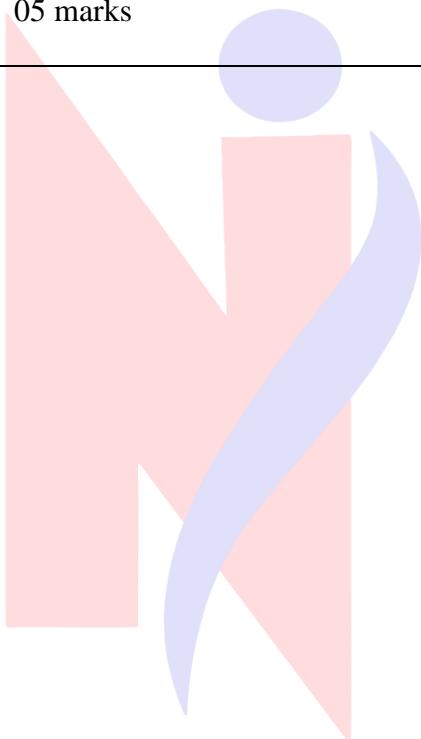| 14	**Format of Question Paper:** (**Semester End Examination : 30 Marks. Duration:1 hour**) Q1: Attempt any three (out of five) from Module 1 (15 marks) Q2: Attempt any three (out of five) from Module 2 (15 marks)

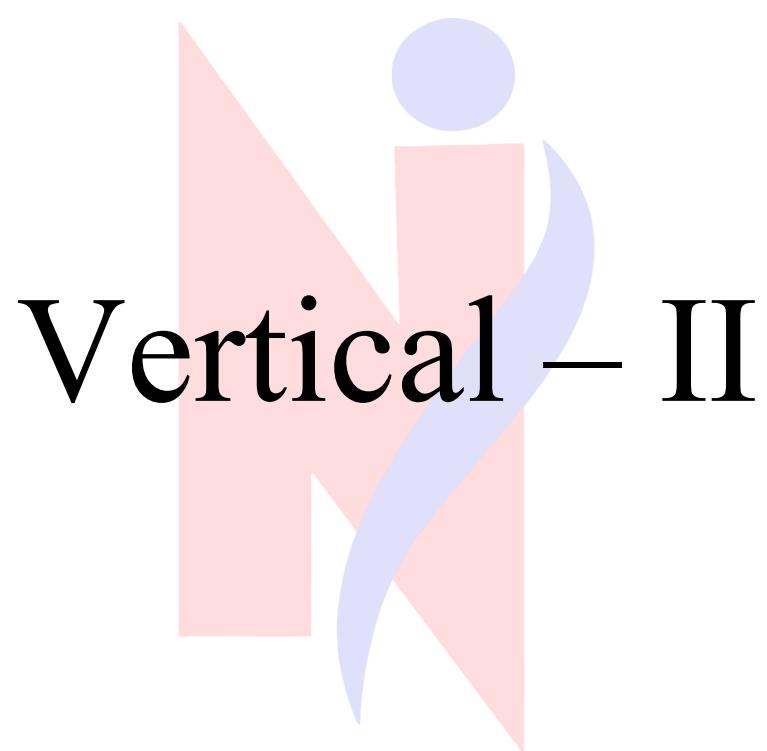# Name of the Course: Core Java Techniques + Computer Networks Practical

Sr. No.	Heading	Particulars
1	**Description the course:**	**Core Java Techniques Practical** This course is a stepping stone to learn other languages. This course provides students hands-on experiences of coding exercises and projects. **Database Management System's practical** approach is useful to gain the knowledge for software backend development. It benefits to user by providing data definition, data access, reduced data redundancy, data integrity, data sharing, data organizing, data consistency, data accuracy, and security.
2	**Vertical:**	Major
3	**Type:**	Practical
4	**Credits:**	2 credits
5	**Hours Allotted:**	60 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives:** 1. Understand core Java programming concepts, including data types, control structures, and object-oriented programming principles. 2. Develop the ability to implement inheritance, polymorphism, interfaces, and abstract classes effectively. 3. Gain hands-on experience with exception handling, multithreading, and dynamic initialization. 4. Learn to apply Java programming to solve real-world problems, such as matrix 5. operations and finding areas/volumes. 6. Enhance debugging and problem-solving skills using Java's rich standard libraries and features. 7. Basic foundation of LAN 8. various command line utilities to be tested 9. Practical implementation of IP Subnetting 10. Testing of various Routing Protocols	
8	**Course Outcomes :** **CO1**. Write efficient Java programs to perform arithmetic operations, manage control flow, and manipulate strings. **CO2**. Demonstrate knowledge of object-oriented concepts by implementing inheritance, polymorphism, and interfaces. **CO3**. Apply exception handling mechanisms to create robust Java applications. **CO4**.1Implement multithreading and explore dynamic initialization for advanced Java programming. **CO5**. Solve computational problems, such as matrix operations and factorial calculation, using packages and Java constructs. **CO6**. Implementation of utility protocols **CO7**. Understanding Basic Security features **CO8**. Network Traffic and Packet Analysis **CO9**. Basic Understanding of Wireless Network	

9	**Modules:-**
	Module 1:

Practical

a. Write a program in Java to demonstrate Boolean value by checking whether the age is appropriate to vote. The age must **greater than or equal to** 18. Otherwise output "Not old enough to vote."

b. Write a program in Java to print a string 10 times using a for loop.

Practical 2:

a. Write a program in Java to check the grade of marks using a switch case.

b. Write a program in Java to find the biggest element among three numbers using if else.

Practical 3:

a. Write a program in Java to create a class and access all data members and methods using the object and compute the area and perimeter of a circle.

b. Write a program in Java to access member variables using the constructor.

Practical 4:

a. Write a program in Java to multiply two matrices.

b. Write a program in Java to calculate the area of a rectangle using single inheritance.

c. Write a program in Java to demonstrate multilevel inheritance.

Practical 5:

a. Write a program in Java to demonstrate hierarchical inheritance.

b. Write a program in Java to find the area and perimeter of a circle using an abstract class.

Practical 6:

a. Write a program in Java to find the average of three numbers using the method overloading.

b. Write a program in Java to find average of three numbers using method overriding.

Practical 7:

a. Write a program in Java to create an interface area. Find the area of a circle.

b. Write a program in Java to find the sum and average of three numbers using the super keyword.

Practical 8:

a. Write a program in Java to find the volume of a box using constructor overloading.

b. Write a program in Java to demonstrate exception handling in case of variable/constant divided by zero.

Practical 9:

a. Write a program in Java to implement multiple inheritance using the interface.

b. Write a program in Java to implement thread.

Practical 10:

a. Write a program in Java to find the factorial of a number using the package.

b. Write a program in Java to import the package.

c. Write a program to implement Flow, Grid and Border Layout using swing.

d. Write program to demonstrate following events Action Mouse Key

	Module 2 :
	Practical 1:- Configuring LAN setup a. Planning and Setting IP networks b. Configuring subnet c. Using, linux-terminal or Windows-cmd, execute following networking commands and note the output: ping, traceroute, netstat, arp, ipconfig, Getmac, hostname, NSLookUp, pathping, SystemInfo **Practical 2:-**IPv4 Addressing and Subnetting a. Given an IP address and network mask, determine other information about the IP address such as: a. Network address , Network broadcast address , Total b. number of host bits , Number of hosts. b. Given an IP address and network mask, determine other information about the IP address such as: c. The subnet address of this subnet d. The broadcast address of this subnet e. The range of host addresses for this subnet f. The maximum number of subnets for this subnet mask g. The number of hosts for each subnet h. The number of subnet bits ,The number of this subnet **Practical 3:-**Configure Static IP routing using. **Practical 4:-**Configure IP routing using RIP. **Practical 5:-**Configuring Simple and multi-area OSPF **Practical 6:-**Configuring BGP protocol (Multi-Autonomous) **Practical 7:-**Configuring server and client. a. Configure DHCP b. Configure DNS c. Configure HTTP d. Configure Telnet e. Configure FTP **Practical 8:-**Configure basic security features for networks **Practical 9:-**Using Wireshark, network analyzer, set the filter for ICMP, TCP, HTTP, UDP, FTP and perform respective protocol transactions to show/prove that the network analyzer is working **Practical 10:-**create a wireless network of multiple PCs using appropriate access point. **Practical 11:-**IPV6 Addressing Basics
10	**Text Books** 1. Sanjay Silakari, Shashank Jain, Mahesh Motwani. *Core Java and Computer Networks: Concepts, Techniques & Practicals*. 1st Ed., McGraw-Hill Education, 2021. ISBN-13: 978-9354600164. 2. Elliotte Rusty Harold. *Java Network Programming: Developing Networked Applications*. 4th Ed., O'Reilly Media, Jan 2014. Print ISBN-13: 978-1-4493-5767-2.
11	**Books and References:** 1. Core Java 8 for Beginners Vaishali Shah, Sharnam Shah SPD 1st 2015 2. Java: The Complete Reference Herbert Schildt McGraw Hill 9th 2014 3. Murach's beginning Java with Net Beans Joel Murach , Michael Urban SPD 1st 2016 4. Core Java, Volume I: Fundamentals Hortsman Pearson 9th 2013 5. Core Java, Volume II: Advanced Features Gary Cornell and Hortsman Pearson 8th

	2008
	6. Core Java: An Integrated Approach R. Nageswara Rao DreamTech 1st 2008
	7. TCP/IP Protocol Suite Behrouz A. Forouzan Tata McGraw Hill 2010
	8. Data Communication and Networking Behrouz A. Forouzan Tata McGraw Hill Computer Networks Andrew Tanenbaum Pearson Fifth 2013

12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Performance and write-up submission of 20 marks.	**30 marks practical exam of 2 hours duration**
14	**Format of Question Paper: Duration 2 hours. Certified copy of Journal is compulsory to appear for the practical examination Practical Slip:** Q1. From Module 1 13 marks Q2. From Module 2 12marks Q3. Journal and Viva 05 marks	

Vertical – II

Minor Courses

Name of the Course: Advance Python for Data Science

Sr. No.	Heading	Particulars
1	**Description the course:**	Advanced Python for Data Science is designed to equip learners with essential data manipulation, analysis, and visualization skills using Python's powerful libraries – Pandas, NumPy, and Seaborn. The course focuses on efficiently handling large datasets, performing complex data transformations, statistical analysis, and creating insightful visualizations. Learners will gain practical experience through hands-on labs, enabling them to apply these techniques to real-world data science problems.
2	**Vertical:**	**Minor**
3	**Type:**	**Practical**
4	**Credits:**	**2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)**
5	**Hours Allotted:**	**30 Hours**
6	**Marks Allotted:**	**50 Marks**
7	**Course Objectives:**	

1. To introduce students to data manipulation and analysis using Pandas and NumPy, including data loading, transformation, and filtering techniques.

2. To equip students with the ability to perform statistical computations, matrix operations, and time-series analysis using Pandas and NumPy.

3. To develop proficiency in data visualization using Seaborn, enabling students to create meaningful visual representations of datasets.

4. To train students in using Seaborn for advanced plotting techniques, including heatmaps, pairplots, and time-series visualizations for data-driven insights.

| 8 | **Course Outcomes:** | |

After successful completion of this course, students would be able to -

CO1. Students will be able to manipulate and preprocess datasets using Pandas and NumPy, including handling missing values, filtering data, and performing statistical analysis.

CO2. Students will perform matrix operations, generate random datasets, execute Boolean indexing, and apply time-series analysis using NumPy and Pandas.

CO3. Students will create and customize various Seaborn plots, including histograms, boxplots, scatter plots, and violin plots for effective data visualization.

CO4. Students will apply advanced Seaborn visualization techniques such as heatmaps, facet grids, and time-series plots to extract and present meaningful insights from data.

| 9 | **Modules:-** | |

Module 1 (15 hours):

Practical 1: Data Loading, Inspection, and Cleaning with Pandas
· Load a CSV dataset into a Pandas DataFrame.

· Display the first few rows, check data types.

· Handle missing values, remove duplicates.

· Rename columns, change data types, drop unnecessary columns.

Practical 2: Advanced Data Manipulation with Pandas

· Add a new calculated column.

· Filter rows using .loc and .query() (e.g., sales above a threshold, region = "North")

· Merge two DataFrames using inner, outer, left, right joins (e.g., customers + orders).

Practical 3: Statistical Analysis with NumPy

· Generate a random dataset of 1000 values (or a 1D array of 100 random integers between 1 and 1000).

· Calculate mean, median, variance, standard deviation, min, max.

· Apply Boolean indexing (filter values > 500 and < 800, compute mean of filtered).

Practical 4: Matrix Operations with NumPy

· Create two 3x3 matrices of random integers.

· Perform matrix addition, subtraction, multiplication, element-wise division.

· Calculate determinant and inverse of a matrix.

Practical 5: Grouping, Pivoting, and Time Series Analysis with Pandas

· Group dataset by one or more categorical columns and calculate count, mean, std.

· Create a pivot table showing product-wise sales for each region.

Perform time series analysis: extract year, month, day, weekday; group data by month, calculate monthly sales.

Note : Create a mini assignment for students that covers the above concepts in a single question

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Module 2 (15 hours):

Practical 6: Histogram, Boxplot, and Barplot Visualization with Seaborn

· Load a dataset into Pandas.

· Plot a histogram showing the distribution of a numerical column. Customize bin size, color, and title.

· Plot a boxplot of a numerical column grouped by a categorical column (e.g., salary by department).

· Create a barplot comparing average values of a numerical column for categories of a categorical column. Customize axes labels and title.

Practical 7: Pairwise and Faceted Visualizations with Seaborn

· Create a Seaborn pairplot to visualize pairwise relationships between numerical columns. Add hue for categories.

· Create a Seaborn facet grid of scatter plots showing relationships between two numerical columns for different values of a third categorical column.

Practical 8: Correlation Heatmap and Violin Plot

· Generate a correlation matrix from a DataFrame and create a Seaborn heatmap. Customize color palette, annotations, and title.

· Create a violin plot showing the distribution of multiple numerical columns grouped by a categorical column.

Practical 9: Scatter Plot and Count Plot

· Create a Seaborn scatter plot between two numerical columns, add hue to differentiate categories, customize markers and plot size.

· Create a count plot for a categorical column, customize colors, orientation, and add value labels.

Practical 10:

Concept: Line Plot for Time Series

· Create a Seaborn line plot to visualize trends in a time series dataset.

· Customize with appropriate labels, grid lines, and title.

Note : Create a mini assignment for students that covers the above concepts in a single

	question	
10	**Text Books** 1. Python for Data Analysis by Wes McKinney 2nd Edition Publisher: O'Reilly Media	
11	**Reference Books** 1. Python Data Science Handbook by Jake VanderPlas 1st Edition Publisher: O'Reilly Media 2. Hands-On Data Analysis with Pandas by Stefanie Molin 2nd Edition Publisher: Packt Publishing	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Practical journal submission, viva, assignments • Journal Submission : 10 Marks • Assignments: 10 Marks Total: 20 marks	**A semester end practical examination of 2 hours duration for 30 marks as the paper pattern given below.** *Its compulsory to carry certified journal at the time of practical exam*
14	Format of Question Paper: (Semester End Practical Examination : 30 Marks. Duration:2 hours) Q1: Module 1 (12 marks) Q2: Module 2 (12 marks) Q.3 Viva (06 Marks)	

Name of the Course: Data Analysis with SAS / SPSS /R

Sr. No.	Heading	Particulars
1	**Description the course:**	Data Analysis with SAS / SPSS /R course provides hands-on training in data analysis techniques using industry-standard tools — SAS, SPSS, or R. It covers essential skills such as data importing, cleaning, transformation, and visualization, along with performing statistical analysis like t-tests, ANOVA, chi-square tests, and regression. Learners will gain practical experience in managing datasets, applying statistical methods, and generating professional reports, preparing them for real-world data analysis tasks across various domains.
2	**Vertical:**	**Minor**
3	**Type:**	**Practical**
4	**Credits:**	**2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)**
5	**Hours Allotted:**	**30 Hours**
6	**Marks Allotted:**	**50 Marks**
7	**Course Objectives:** 1. To understand the SAS/SPSS/R as a tool to data analysis. 2. Understand different techniques of data manipulation. 3. Use different functions for descriptive statistics. 4. To generate the reports after data manipulation.	
8	**Course Outcomes:** After successful completion of this course, students would be able to - CO1. To understand the basis of data analytics using a software tool. CO2. To use data from multiple sources relevant for Data Analytics. CO3. To Categorize and utilize data for inferential data analytics. CO4. To integrate the statistical tool with an analytical problem to bring the proficiency.	
9	**Modules:-** **Module 1 (15 hours):**	
	Data Handling, Preparation and Transformation (using SAS or SPSS or R) 1. Introduction to the SAS, SPSS and R environments – installation, interface overview, and loading data files. 2. Creating datasets from raw data (text files, CSV files, Excel sheets) and importing data into SAS/SPSS/R. 3. Exploring data: Displaying datasets using PROC PRINT (SAS), Data Viewer (SPSS), and View() or print() (R). 4. Applying conditional filters using IF, WHERE, and IF-THEN in SAS;Select Cases in SPSS; and subset() or filter() in R.	

5. Sorting data using PROC SORT in SAS, Sort Cases in SPSS, and arrange() in R.

6. Combining and appending datasets using MERGE in SAS, Merge Files in SPSS, and merge() or bind_rows() in R.

7. Selecting and dropping variables using KEEP, DROP in SAS,Variable View in SPSS, and select() in R.

8. Applying basic data cleaning functions: handling missing values using MISSING (SAS), Define Missing Values (SPSS), and na.omit()/replace_na() in R.

9. Performing text manipulation using substr, scan (SAS), String functions (SPSS), and str_sub(), str_split() (R).

10. Creating new variables using transformations and calculations (all three software).

11. Reshaping data using PROC TRANSPOSE (SAS), Restructure Data Wizard (SPSS), and pivot_longer()/pivot_wider() (R).

12. Combining datasets vertically (concatenation) using SET statement (SAS), Merge Files - Add Cases (SPSS), and rbind() (R).

13. Identifying and handling duplicates using PROC SORT NODUPKEY (SAS), Identify Duplicate Cases (SPSS), and distinct() (R).

14. Extracting date components using DATE functions (SAS), Date & Time Wizard (SPSS), and lubridate:: functions (R).

15. Generating basic summaries using PROC CONTENTS (SAS), Variable View (SPSS), and str() or summary() (R).

Module 2 (15 hours):

Statistical Analysis and Reporting (using SAS or SPSS or R)

1. Generating descriptive statistics using PROC MEANS (SAS), Descriptive Statistics (SPSS), and summary() or describe() (R).

2. Generating frequency tables using PROC FREQ (SAS), Frequencies (SPSS), and table() or count() (R).

3. Creating cross-tabulations and two-way tables using PROC FREQ (SAS), Crosstabs (SPSS), and table() (R).

4. Performing one-sample t-tests using PROC TTEST (SAS), T-Test (SPSS), and t.test() (R).

5. Performing independent two-sample t-tests using PROC TTEST (SAS), T-Test (SPSS), and t.test() with grouping (R).

6. Performing paired t-tests using PROC TTEST (SAS), Paired Samples T-Test (SPSS), and t.test(paired=TRUE) (R).

7. Performing one-way ANOVA using PROC ANOVA (SAS), One-Way ANOVA (SPSS), and aov() (R).

8. Performing two-way ANOVA using PROC GLM (SAS), Univariate Analysis (SPSS), and aov() (R).

9. Conducting Chi-square tests using PROC FREQ (SAS), Crosstabs with Chi Square (SPSS), and chisq.test() (R).

10. Creating graphical reports using PROC REPORT (SAS), Chart Builder (SPSS), and ggplot2 (R).

11. Generating histograms and box plots using PROC SGPLOT (SAS), Graphs (SPSS), and

	ggplot2 (R).
	12. Generating correlation matrices using PROC CORR (SAS), Correlation (SPSS), and cor() (R).
	13. Performing linear regression analysis using PROC REG (SAS), Regression (SPSS), and lm() (R).
	14. Performing logistic regression using PROC LOGISTIC (SAS), Binary Logistic Regression (SPSS), and glm() (R).
	15. Exporting results into external files (Excel, CSV,PDF) using ODS (SAS), Export Wizard (SPSS), and write.csv()/writexl (R).
	Note : Create a mini assignment for students that covers the above concepts in a single question
10	**Text Books**
	1. The Little SAS Book: A Primer – Lora D. Delwiche & Susan J. Slaughter
	2. Learning SAS by Example: A Programmer's Guide – Ron Cody
	3. Discovering Statistics Using IBM SPSS Statistics – Andy Field
	4. IBM SPSS for Introductory Statistics: Use and Interpretation – George A. Morgan, Nancy L. Leech,
	5. R for Data Science – Hadley Wickham & Garrett Grolemund
	6. The Book of R: A First Course in Programming and Statistics – Tilman M. Davies
11	**Reference Books**
	1. Applied Statistics and the SAS Programming Language – Ron P. Cody & Jeffrey K. Smith
	2. Data Analysis with IBM SPSS Statistics – Kenneth Stehlik-Barry & Anthony J. Babinec
	3. Hands-On Programming with R – Garrett Grolemund

12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Practical journal submission, viva, assignments • Journal Submission : 10 Marks • Assignments: 10 Marks Total: 20 marks	**A semester end practical examination of 2 hours duration for 30 marks as the paper pattern given below.** *Its compulsory to carry certified journal at the time of practical exam*
14	Format of Question Paper: (Semester End Practical Examination : 30 Marks. Duration:2 hours) Q1: Module 1 (12 marks) Q2: Module 2 (12 marks) Q.3 Viva (06 Marks)	

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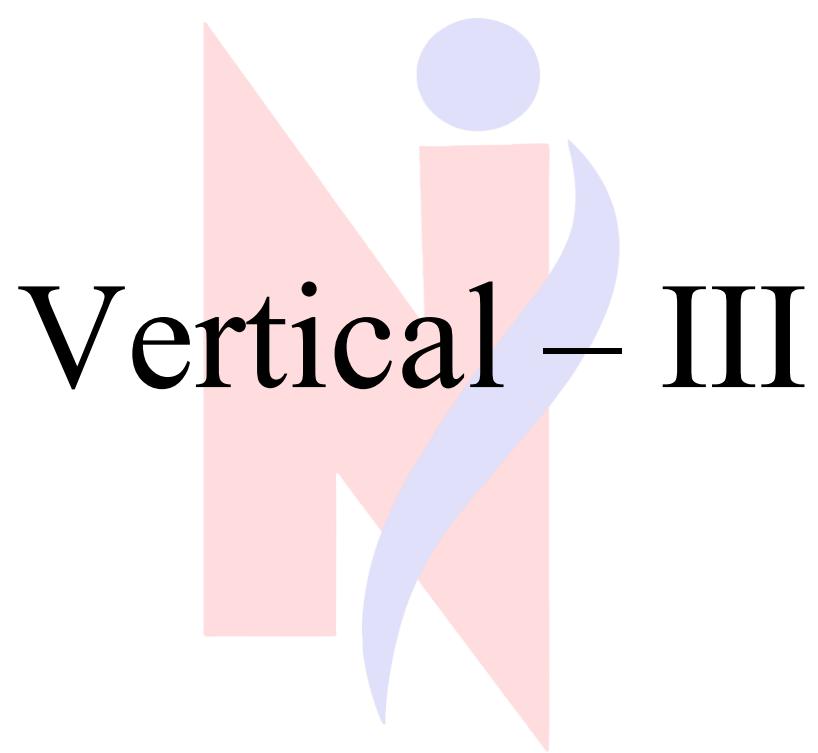*Permanently Affiliated to the University of Mumbai,*

Syllabus

Open Electives (OE)

As Per New Education Policy (NEP) 2020

Vertical – III - Semester IV

(To be implemented from the Academic Year 2025-2026)
*Approved in the Academic Council Meeting held on **5th July 2025***

Vertical – III

Name of the Course:Environmental Systems and Management-II

Sr. No.	Heading	Particulars
1	**Description of the course :**	This course introduces students to the vital link between the environment and the world of commerce. It offers an essential understanding of how ecological systems interact with economic activities, preparing future professionals to make informed, responsible decisions in business and society. **What They Will Learn**: Ecosystems and Biodiversity: Understand the balance of natural systems and the economic value of biodiversity in sectors like agriculture, tourism, and healthcare. Human Impact on the Environment: Analyze how industries, trade, and consumer behavior contribute to environmental challenges such as resource depletion, pollution, and climate change. Sustainability and Commerce: Explore sustainable business practices and how commerce can play a role in achieving long- term environmental and economic goals. **Why It Matters for First Year Undergraduate Students:** In any specialization, environmental awareness is essential in today's global business environment. This course empowers students to: Become socially responsible citizens: Make ethical decisions that consider environmental impact and sustainability. Understand environmental challenges in business contexts: Gain insight into how issues like climate change, waste management, and pollution affect business operations, supply chains, and policy. Explore emerging green career paths: Discover opportunities in environmental consulting, sustainable business strategy, and green entrepreneurship.
2	**Vertical :**	**VEC**
3	**Type :**	**Theory**
4	**Credit**:	**2 credits**
5	**Hours Allotted :**	**30 Hours**
6	**Marks Allotted**:	**50 Marks**
7	**Course Objectives**: 1. To provide knowledge on types of disasters and their impact on human life and the economy. 2. To equip students with the principles of disaster management and waste management strategies. 3. To promote understanding of sustainable development models and eco-friendly innovations. 4. To introduce key environmental movements, ethics, and legal frameworks relevant to environmental conservation.	

8	**Course Outcomes:**
	After studying this course students will be in position to :
	CO1. To describe different types of disasters and outline the phases of disaster management.
	CO2. To apply concepts of waste reduction, reuse, and recycling in real-life scenarios.
	CO3. To evaluate sustainable development initiatives and propose eco-friendly business strategies.
	CO4. To critically assess environmental movements, laws, and policies, and their role in conservation and management.
9	**Modules**:-

Module I: Dealing with Environmental Concerns

- Concept and Classification of Disaster (Natural, Man-made and Hybrid Disaster). General effects of Disaster on Human Life- Physical, Psychological, Economic and Social
- Disaster Management: Meaning and Phases of Disaster Management (Prevention, Mitigation, Preparedness, Response, and Recovery)
- Waste Management: Meaning and Types of Waste (biodegradable, non-biodegradable, hazardous, e-waste, etc).
- Waste Management- Reduce, Reuse, and Recycle Strategies in Daily Life

Module II: Sustainable Development and Environmental Conservation

- Introduction to Sustainable Development: Meaning and Importance. Sustainable Development Goals (SDGs). Case Studies
- Environmental Movements and Ethics: Chipko, Silent Valley, Bishnoi of Rajasthan. Role of Religion and Culture in Environmental Conservation.
- Innovative Models: Eco Tourism, Green Marketing, Organic Farming, and Eco-Friendly Packaging
- • Environmental Legislation and Policies: Major environmental laws and policies at national and international levels, and their effectiveness in environmental conservation

10	**References:**

1. Ahluwalia, V. K. (2015). Environmental Pollution, and Health. The Energy and Resources Institute (TERI).

2. Central Pollution Control Board Web page for various pollution standards. https://cpcb.nic.in/standards/

3. Masters, G. M., & Ela, W. P. (2008). Introduction to environmental engineering and science (No. 60457). Englewood Cliffs, NJ: Prentice Hall.

4. Jørgensen, Sven Marques, Erik João Carlos and Nielsen, Søren Nors (2016) Integrated Environmental Management, A transdisciplinary Approach. CRC Press.

5. Barrow, C. J. (1999). Environmental management: Principles and practice. Routledge.

6. Theodore, M. K. and Theodore, Louis (2021) Introduction to Environmental Management, 2nd Edition. CRC Press.

7. Richard A. Marcantonio, Marc Lame (2022). Environmental Management: Concepts and Practical Skills. Cambridge University Press.

8. UNEP (2007) Multilateral Environmental Agreement Negotiator's Handbook, University of Joensuu, ISBN 978-952-458-992-5

9. Ministry of Environment, Forest and Climate Change (2019) A Handbook on International Environment Conventions & Programmes. https://moef.gov.in/wp content/uploads/2020/02/convention-V-16-CURVE-web.pdf

10. Ministry of Environment, Forest and Climate Change (2019) A Handbook on International Environment Conventions & Programmes. https://moef.gov.in/wp content/uploads/2020/02/convention-V-16-CURVE-web.pdf 11. India Code – Digital repository of all Central and State Acts: https://www.indiacode.nic.in/ 12. University Grants Commission, D.O.No.F. 14-5/2015(CPP-II) dated 2nd August1 2019.

11	Internal Continuous Assessment: 40%	Semester End Examination: 60%
12	Project Work 15 Marks Attendance and Participation in Seminar, Workshop, and Activity, etc. 05 Marks	Report Submission based on Suggested Practical Activities by Faculty Members for 30 Marks.
13	Suggested Practical Activities: • A field visit to observe and identify different environmental components (e.g., land, water bodies, air, flora, fauna) in a local park or urban green space. • Develop a mini-awareness campaign (e.g., posters, short video, etc.) on a chosen environmental issue for their college or local community. • Report on an endangered species in India and the conservation efforts being undertaken. • Hands-on experiment involving simple water quality testing (e.g., pH, turbidity) of different water samples (e.g., tap water, pond water). • A debate or discussion on the role of individual actions vs. governmental policies in combating climate change. • Beach Cleaning Activity • Tree Plantation (One Student – One Plant) • Environment Conservation Activity	

Course Outcomes (CO)	PO 1	PO 2	PO 3	PO 4	PO 5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1: Acquire proficiency in English for media-specific platforms and forums	2	3	0	2	2	2	2	2	1	2
CO2: Speak and write effectively for diverse media platforms	2	3	0	2	2	2	3	2	2	2
CO3: Enhance critical abilities to present effective social media content	2	2	0	3	3	3	3	3	3	3
CO4: Understand the roles and functions of English in global media framework	3	2	0	3	2	2	2	0	2	3
CO5: To attain proficiency in understanding media trends at a global level	3	2	0	3	3	2	3	0	3	3
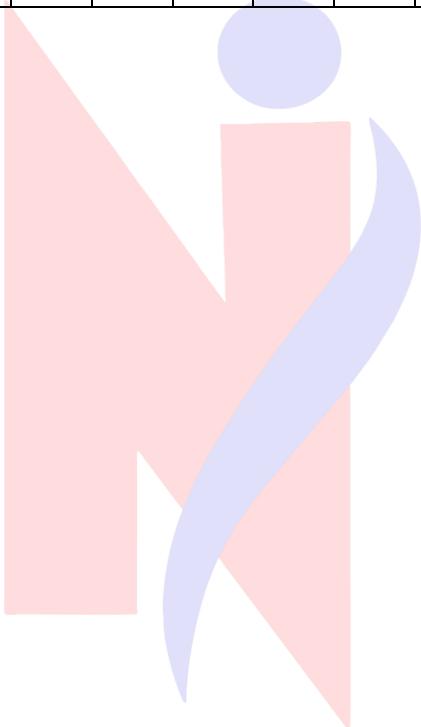
Nirmala Memorial Foundation College of Commerce and Science

Syllabus

Bachelor of Science in Information Technology

(B.Sc. Information Technology)

(Programme Code: UGIT01)

As Per New Education Policy (NEP) 2020

Vertical – IV

Skill Enhancement Course (SEC)

Name of the Course: Arduino Programming

Sr. No.	Heading	Particulars
1	**Description the course:**	This course covers the basics of programming and building electronic projects using the Arduino microcontroller. Students will learn to design circuits on breadboards and write code to interact with various sensors and actuators. Practical sessions include working with LEDs, light, temperature, humidity, gas, motion sensors, servo motors, and input devices like joysticks. The course emphasizes hands-on learning to help students develop skills in embedded systems and sensor integration for real-world applications.
2	**Vertical:**	Major
3	**Type:**	Practical
4	**Credits:**	2 credits
5	**Hours Allotted:**	30 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives:**	1. To understand the basics of Arduino hardware, circuits, and programming. 2. To learn to use breadboards for building electronic circuits. 3. To write Arduino programs that interface with different sensors and actuators. 4. To collect and process data from sensors like light, temperature, humidity, and gas sensors. 5. To control motors and other output devices using Arduino. 6. To develop problem-solving skills by creating embedded systems and automation projects.
8	**Course Outcomes:**	**CO1**: Build and program Arduino-based circuits using breadboards. **CO2:** Interface and use various sensors including light, temperature, humidity, and gas sensors. **CO3:** Control output devices like LEDs, servo motors, and joysticks through Arduino code. **CO4:** Collect, process, and respond to sensor data in embedded systems. **CO5:** Troubleshoot and debug Arduino circuits and programs. **CO6:** Design and implement basic automation and sensor-driven projects.
9	**Modules:-**	**Practical 1:-** Introduction to Arduino circuits and bread boarding Blinking of LEDs **Practical 2:-** Program using Light Sensitive Sensors **Practical 3:-** Program using temperature sensors **Practical 4:-** Programs using humidity sensors **Practical 5:-** Programs using Line tracking sensors **Practical 6:-** Programs using Ultrasonic Sensors **Practical 7:-** Programs using digital infrared motion sensors **Practical 8:-** Programs using gas sensors

	Practical 9:- Programs using servo motors **Practical 10:-** Programs making Joystick with Arduino
10	**Textbooks:** 1. Getting Started with Arduino by Massimo Banzi and Michael Shiloh 2. Exploring Arduino by Jeremy Blum
11	**Reference Books** 1. Arduino Cookbook by Michael Margolis 2. Programming Arduino: Getting Started with Sketches by Simon Monk 3. Practical Electronics for Inventors by Paul Scherz and Simon Monk

12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Performance and write-up submission of 20 marks.	**30 marks practical exam of 2 hours duration**

14	**Format of Question Paper: Duration 2 hours. Certified copy of Journal is compulsory to appear for the practical examination** **Practical Slip:** Q1. From Module 1 13 marks Q2. From Module 2 12marks Q3. Journal and Viva 05 marks

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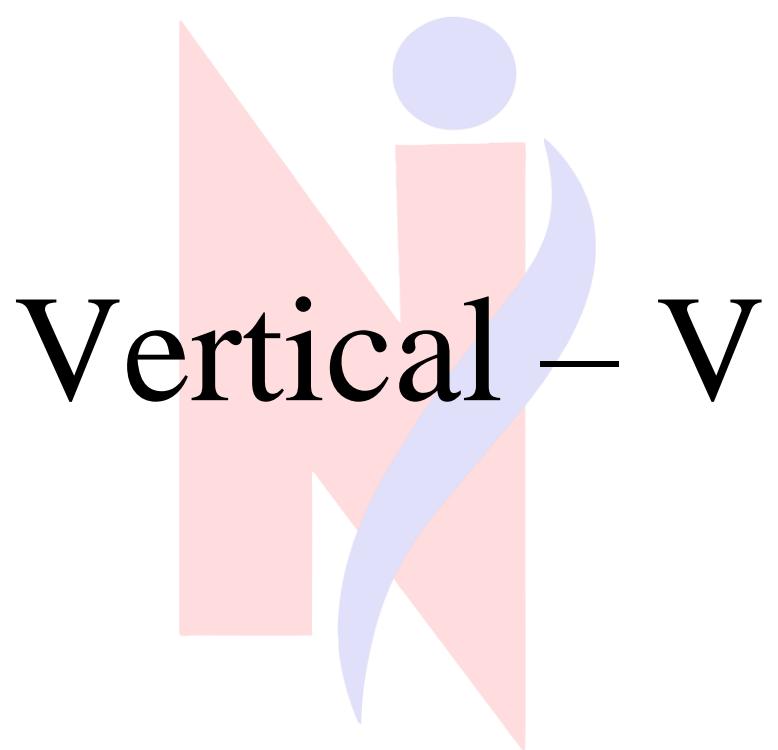
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Syllabus

Ability Enhancement Courses (AEC)

(To be implemented from the Academic Year 2025-2026)
Approved in the Academic Council Meeting held on 5th July 2025

Vertical – V

Technical Writing in English

Sr. No.	Heading	Particulars
1	**Description of the course :**	This course introduces students to the essential principles and practices of technical writing. It aims to develop students' ability to communicate complex technical information clearly and effectively through various written formats such as reports, memos, emails, manuals, and proposals. Emphasis is placed on understanding the target audience, organizing content logically, and using appropriate tone and style. The course also covers the use of visual aids like charts and graphs to enhance comprehension. Additionally, students will learn basics of digital communication and oral presentation skills necessary for professional environments. This course prepares students for effective documentation and communication in technical and business settings.
2	**Vertical :**	AEC (Ability Enhancement Course)
3	**Type :**	**Theory**
4	**Credit**:	**2 credits**
5	**Hours Allotted :**	**30 Hours**
6	**Marks Allotted**:	**50 Marks**
7	**Course Objectives**: 1. Understand the fundamentals and importance of technical writing in professional communication. 2. Analyze the audience to tailor technical documents effectively. 3. Prepare various technical documents including reports, emails, memos, and manuals with clarity and accuracy. 4. Use visual elements such as charts and tables to enhance technical communication. 5. Develop skills for writing on digital platforms and delivering basic oral presentations confidently.	
8	**Course Outcomes:** **CO1:** Explain the principles and importance of technical writing in professional contexts. **CO2:** Identify and analyze the needs of different audiences for effective communication. **CO3:** Write various types of technical documents such as reports, emails, memos, and manuals with clarity and precision. **CO4:** Utilize visual elements like charts, graphs, and tables to support and clarify written content. **CO5:** Prepare and deliver effective oral presentations using appropriate tools and communication techniques.	

9	**Modules**:-	

Module 1: Basics of Technical Writing
- Introduction to technical writing: definition, scope, importance
- Types of technical documents: reports, emails, memos, manuals
- Audience analysis and writing style
- Clarity, conciseness, tone, and structure

Module 2: Practical applications

- Writing formal letters, proposals, and process documentation
- Use of visuals: charts, graphs, tables
- Writing for digital platforms: blogs, websites, social media
- Basics of oral presentation (slides, speech, delivery)

10	**References:**

- Raman, M., & Sharma, S. (2015). Technical communication: Principles and practice (3rd ed.). Oxford University Press.
- Rizvi, A. (2017). Effective technical communication (2nd ed.). McGraw Hill Education.
- Gupta, R. (2020). Professional communication. S. Chand Publishing.
- Bansal, R. K., & Harrison, J. B. (2013). Spoken English: A manual of speech and phonetics (10th ed.). Orient BlackSwan.
- Mehrotra, R. (2019). Content writing: A handbook for beginners. Bharat Book Bureau.

11	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
12	**Continuous Evaluation through:** Activity: 10 marks Quizzes/ Presentations/ Assignments: 10 marks Total: 20 marks	**A semester end written examination of 1 hour duration for 30 marks as the paper pattern given below.**
13	**Format of Question Paper: (Semester End Examination : 30 Marks. Duration : 1 hour)** **Q.1 Answer the following Questions (Attempt Any 2 out of 3) (15 Marks Each)**	

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Co-Curricular Courses
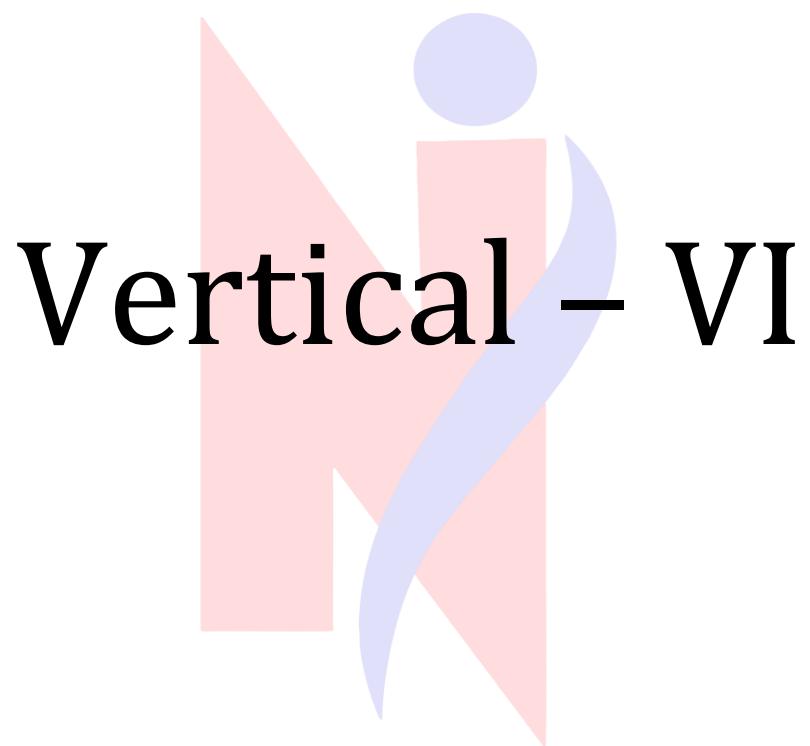
Sports

As Per New Education Policy (NEP) 2020

(To be implemented from the Academic Year 2025-2026)
Approved in the Academic Council Meeting held on **5th July 2025**

Semester IV

Yoga and Wellness II

Vertical – VI

Name of the Course: Yoga and Wellness II

Sr. No.	Heading	Particulars
1	**Description the course :** **Including but Not limited to :**	India is growing rapidly as a global super-power. To face the challenges of the century and to keep up with the pace of the world, maintaining health is of prime importance. Giving thrust to healthy society, Physical Education, Sports, Health & fitness and Yoga are of great significance in today's world. The Government of India insists on Physical Fitness, Mental Health and Overall Development of Personality for every citizen. However, creating efficient and skilled human resource in the field of Physical Education, Sports and Yoga is identified as the need of the hour. Thus, the Governments of India and Government of Maharashtra have included Physical Education, Sports and Yoga as a key area under the NEP 2020.
2	**Vertical :**	Co-Curricular
3	**Type :**	Activity Based
4	**Credit:**	2 credits
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives:** The student should be able to: • **To create awareness about the negative effects of a sedentary lifestyle** and highlight the importance of exercise in preventing lifestyle diseases. • **To encourage the development of time management skills** for incorporating regular fitness activities into daily life across all age groups and genders. • **To introduce advanced yoga practices and meditation techniques** for enhancing physical health and managing stress, anxiety, and related conditions.	
8	**Course Outcomes:** **CO1:** Identify the effects of a sedentary lifestyle and explain the role of regular exercise in preventing lifestyle-related diseases. **CO2:** Apply time management strategies to incorporate fitness into daily routines across different age groups and genders.	

	CO3: Demonstrate proficiency in advanced yoga techniques, including pranayama, meditation, and therapeutic asanas for mental and physical well-being.
9	**Module :** This course focuses on the impact of a sedentary lifestyle and the importance of exercise in preventing lifestyle diseases like diabetes, obesity, and hypertension. It emphasizes time management and integrating fitness into daily routines for all age groups and genders. The module also introduces advanced yoga practices including pranayama, mindfulness meditation, and complex asanas. Students will explore the therapeutic use of yoga for stress, anxiety, and back pain. Overall, the course promotes holistic health through physical activity and mental well-being.
10	**Reference Books:** 1. McCall, T. (2007). Yoga as Medicine: The Yogic Prescription for Health and Healing. New York: Bantam Books. 2. 5. Brown, D. & Gerbarg, P.L. (2012). The Healing Power of the Breath. Boston: Shambhala Publications.
11	**Internal Continuous Assessment: 40 %(20 Marks)** • Yoga Report/Assignment
12	**External Assessment: 60% : (30 Marks)** • Scanned copy of the Advanced Yoga participation certificate. • A short report on Yogasana (handwritten or typed). *Note: Students participating in sports competitions conducted by University at State or National Level, students who have represented Mumbai University or College at Intercollegiate / Inter Zonal / West Zone Inter University / All India Inter University/ International tournament are exempt from submission of report.*

Letter Grades and Grade Points:

Semester GPA/ Program CGPA Semester/ Program	% of Marks	Alpha-Sign / Letter Grade	Result	Grade Points
9.00-10.00	90.0-100	O	(Outstanding)	10
8.00-<9.00	80.0-<90.0	A+	(Excellent)	9
7.00-<8.00	70.0-<80.0	A	(Very Good)	8
6.00-<7.00	60.0-<70.0	B+	(Good)	7
5.50-<6.00	55.0-<60.0	B	(Above Average)	6
5.00-<5.50	50.0-<55.0	C	(Average)	5
4.00-<5.00	40.0-<50.0	P	(Pass)	4
Below 4.00	Below 40	F	(Fail)	0
Ab (Absent)	-	AB	(Absent)	0

Signature of BOS Chairman
Ms. Vaishali Mishra
BOS (Information Technology)

Signature of Faculty Member
Dr. Aparna Panigrahy
(Information Technology)

Signature of I/C Principal
Dr. Swiddle D'Cunha