Vivekanand Education Society's College of Arts, Science & Commerce(Autonomous)

Proposed Syllabus

Program: S.Y.B.Sc. Sem - III &
IV CBCS Course:
BSc DATA SCIENCE & DATA ANALYTICS

(Choice Based and Credit System with
effect from the academic year 2023-24)

Second Year (Semester III)

Title of the Course	Number of Lectures/ Practicals	(Theory) per week	(Practical) per week	Credits
Algorithms and Data Structures	60	4	-	3
Introduction to Data Science	60	4	-	3
Data Warehousing and Data Mining	60	4	-	3
IoT	60	4	-	3
Elective Subjects (Any one Elective from the below list)				
Financial Literacy and Investment Analysis	60	4	-	3
Strategic Management and Entrepreneurship Development	60	4	-	3
Practical				
Practical of Algorithms and DataStructures	45	-	3	1
Practical of Introduction to DataScience	45	-	3	1
Practical of Data Warehousing and Data Mining	45	-	3	1
Practical of IoT	45	-	3	1
Internship	45	-	3	1
Total Credits				20

Second Year (Semester IV)

Title of the Course	Number of Lectures/ Practicals	(Theory) per week	(Practical) per week	Credits
Object Oriented Programming using Java	60	4	-	3
AI & Machine Learning	60	4	-	3
Software Engineering	60	4	-	3
Cloud Computing	60	4	-	3
Elective Subjects (Any one Elective from the below list)				
Universal Human Values	60	4	-	3
Green Technologies	60	4	-	3
Practical				
Practical of Object Oriented Programming using Java	45	-	3	1
Practical of AI & Machine Learning	45	-	3	1
Practical of Software Engineering	45	-	3	1
Practical of Cloud Computing	45	-	3	1
Capstone Project	45	-	3	1
Total Credits				20

S.Y.B.Sc

DSDA

Semester III

CourseCode	Course Title	Credits	Lecture/Week
VESUDS301	**Algorithms and Data Structures**	**3**	**4**

About the course

The course covers the concepts of –

(i) Calculating complexity of algorithms

(ii) The essential operations like searching, sorting, selection, pattern matching & recursion

(iii)Various algorithmic strategies like greedy, divide-n-conquer, dynamic programming, backtracking and implementations of all these on basic data structures like array, list and stack.

(iv) Data structures like trees and graphs, how to create them and various algorithms on it

Course Objectives
The objectives of this course are:

The objectives of this course are:

- To make students understand the basic principles of algorithm design.
- To give idea to students about the theoretical background of the basic data structures
- To familiarize the students with fundamental problem-solving strategies like searching, sorting, selection, recursion and help them to evaluate efficiencies of various algorithms.
- To teach students the important algorithm design paradigms and how they can be used to solve various real world problems.

Learning Outcomes

After successful completion of this course -

- Students should be able to understand and evaluate efficiency of the programs that they write based on performance of the algorithms used.
- Students should be able to appreciate the use of various data structures as per need
- To select, decide and apply appropriate design principle by understanding the requirements of any real life problems.

Unit	Topic	No. of lectures
I	Introduction to algorithms - What is algorithm, analysis of algorithm, Types of complexity, Running time analysis, How to Compare Algorithms, Rate of Growth, Types of Analysis, Asymptotic Notation, Big-O Notation, Omega-Ω Notation, Theta-Θ Notation, Asymptotic Analysis, Performance characteristics of algorithms, Estimating running time / number of steps of executions on paper, Idea of Computability Introduction to Data Structures - What is data structure, types, Introduction to Array(1-d & 2-d), Stack and List data structures, operations on these data structures, advantages disadvantages and applications of these data structures like solving linear equations, Polynomial Representation, Infix-to-Postfix conversion.	12
II	Recursion - What is recursion, Recursion vs Iteration, recursion applications like Factorial of a number, Fibonacci series & their comparative analysis with respect to iterative version, Tower of hanoi problem. Basic Sorting Techniques - Bubble, Selection and Insertion Sort & their comparative analysis. Searching Techniques - Linear Search and its types, Binary Search and their comparative analysis Selection Techniques - Selection by Sorting, Partition-based Selection Algorithm, Finding the Kth Smallest Elements in Sorted Order & their comparative analysis.	12
III	Algorithm Design Techniques - Introduction to various types of classifications/design criteria and design techniques Greedy Technique - Concept, Advantages & Disadvantages, Applications, Implementation using problems like - file merging problem .Divide-n-Conquer - Concept, Advantages & Disadvantages, Applications, Implementation using problems like - merge sort, Strassen's Matrix Multiplication. Dynamic Programming - Concept, Advantages & Disadvantages, Applications, Implementation using problems like - Fibonacci series, Factorial of a number, Longest Common subsequence.	12

IV	Backtracking Programming - Concept, Advantages & Disadvantages, Applications, Implementation using problems like N-Queen Problem Abstract Data Types: Introduction, The Date Abstract Data Type, Collection, Linked Structures: Introduction, Singly Linked List-Traversing, Searching, Prepending and Removing Nodes, Bag ADT-Linked List Implementation. Stacks: Stack ADT, Implementing Stacks-Using Python List, Using Linked List, Stack Applications-Balanced Delimiters, Evaluating Postfix Expressions	12
V	Binary Trees: Tree Structure, Binary Tree-Properties, Implementation and Traversals, Binary Search Tree, Balanced BST,Threaded Binary Trees, AVL Trees, Graph : Introduction, Applications of Graphs, Graph Representation, Graph Traversals, Shortest Path Algorithms, Minimal Spanning Tree Graph basics, Terminologies, Matrix and Adjacency List Representation of Graphs, Elementary Graph operations – Shortest-Path Algorithms–Un weighted Shortest Paths–Minimum Spanning Tree– Applications of Depth First Search, Breadth First Search.	12

TextBooks :
1. "Data Structure and AlgorithmUsing Python", Rance D. Necaise, Wiley India Edition, 2016.
2. "Data Structures and Algorithms Made Easy", Narasimha Karumanchi, CareerMonk Publications, 2016.
3. "Introduction to Algorithms", Thomas H. Cormen, 3rd Edition, PHI.

Additional References:
1. "Introduction to the Design and Analysis of Algorithms", Anany Levitin, Pearson, 3rd Edition, 2011.
2. "Design and Analysis of Algorithms", S. Sridhar, Oxford University Press, 2014.

Course Code	Course Title	Credits	Practical/ Tutorials Per Week
VESUDSP301	**Practical of Algorithms and Data Structures**	**1**	**3**
1	a) Programs on 1-d arrays like - sum of elements of array, searching an element in array, finding minimum and maximum element in array, count the number of even and odd numbers in array. For all such programs, also find the time complexity, compare if there are multiple methods. b) Programs on 2-d arrays like row-sum, column-sum, sum of diagonal elements, addition of two matrices , multiplication of two matrices. For all such programs, also find the time complexity, compare if there are multiple methods.		
2	Program to create a list-based stack and perform various stack operations		
3	Program to perform linear search and binary search on list of elements. Compare the algorithms by calculating time required in milliseconds using readymade libraries.		
4	Programs to sort elements of list by using various algorithms like bubble, selection sort, and insertion sort. Compare the efficiency of algorithms.		
5	Programs to select the Nth Max/Min element in a list by using various algorithms. Compare the efficiency of algorithms.		
6	Programs on recursion like factorial, Fibonacci, tower of hanoi. Compare algorithms to find factorial/Fibonacci using iterative and recursive approaches.		
7	Program to implement file merging, coin change problems using Greedy Algorithm and to understand time complexity. Program to implement merge sort, Straseen's Matrix Multiplication using D-n-C Algorithm and to understand time complexity.		
8	Program to implement Fibonacci series, Longest Common Subsequence using dynamic programming and to understand time complexity. Compare it with the general recursive algorithm. Program to implement N-Queen Problem, Binary String generation using Backtracking Strategy and to understand time complexity.		

Course Code	Course Title	Credits	Lecture / Week
VESUDS 302	**Introduction to Data Science**	**3**	**5**

About the course

The course aims to introduce the basic concepts of data science from how to get the data till howto get actionable insights on the data.

Course Objectives
The objectives of this course are:
- Provide insights how to analyze data.
- Learn techniques and tools to process and transform data.
- Students should be able to understand organization's data, analyze and give valuable information to clients.

Learning Outcomes

After successful completion of this course -

- Students will know relevant programming tools/technologies.
- Students will demonstrate proficiency with processing of data.
- Students will demonstrate skill in data management.
- Students will apply data science concepts and methods to solve problems inreal-world contexts and will communicate these solutions effectively

Unit	Topic	No. of lectures
I	Introduction to Data Science - What is Data Science, Concepts, Process and tools/technologies used for Data Science, Data Science as compared. to other fields like BI, AI, ML, DW-DM, Applications of Data Science, Various roles in data science, What is Data, Different kinds of data, Types of Data, Data Sources.	**12**
II	Data Preprocessing - Data Cleaning, Transforming, Selecting columns/fields, Merging data, Handling missing values, outliers, Data aggregation, Data Wrangling, Feature Engineering & its types, Domification, Feature Scaling, Use of popular libraries like - Pandas, NumPy, Sci-kit Learn etc.	**12**

III	Data Analysis - Exploratory Data Analysis (EDA), Types of Data analysis, Tools used for data analysis, Techniques to analyze data like Hypothesis Testing, ANOVA	12
	Machine Learning : What is machine learning, Types of machine learning, Supervised, Unsupervised Methods, Classification, Bias variance Tradeoff, Underfitting, Overfitting	

IV	Regression and its types(Simple, Multiple, Stepwise, Logistic), Cross-Validation, Issues like multicollinearity, heteroscedasticity, Decision Tree Technique, K-Means Technique, PCA	12
	Model Selection and Model Evaluation - Model Evaluation and its techniques like accuracy, confusion matrix, f-score, AUC for various machine learning techniques.	
V	Data Visualization & Communication - What is data visualization, types of data visualization, Benefits, Visualization Tools, Data Storytelling	12
	Data Management - Introduction, Activities under data management, Data Pipeline.	

Textbooks :

1. Introduction to Data Science: Practical Approach with R and Python by B. Uma Maheswari and R. Sujatha
2. Data Science Fundamentals And Practical Approaches: Understand Why Data Science Is The Next: Understand Why Data Science Is the Next (English Edition) – 1 January 2020, by Dr Gypsy Anand/ Dr Rupam Sharma
3. Data Science and Analytics Paperback – 1 January 2018 by V. K. Jain

Additional References:

1. The Power of Data Storytelling by Sejal Vora

2. Advanced Analytics With Excel 2019: Perform Data Analysis Using Excel's Most Popular Features (English Editions) by Manisha Nigam.

Course Code	Course Title	Credits	Practical/ Tutorials Per Week
VESUDSP3 02	**Practical of Introduction to Data Science**	**1**	**3**
	(Using various softwares like Python/Google Collab/Tableau)		

1	Introduction to Excel and various functions like conditional formatting, pivot tables, lookup, what-if analysis, lookup functions, goal-seek, charts etc.
2	Creating data frames from various types of files(csv/json etc) and performing various basic data pre-processing functions
3	Practical on feature scaling & Feature Dummification
4	Practical on Hypothesis Testing & ANOVA

5	Practical on Regression & its types
6	Practical on Decision Tree
7	Practical on K-Means, PCA
8	Practical on Data Visualization and Storytelling

Course Code	Course Title	Credits	Lectures / Week
VESUSDS303	**Data Warehousing and Data Mining**	**3**	**4**

About the course

To help learners learn data warehousing and mining architecture , understanding classification and prediction of data.

Course Objectives
The objectives of this course are:

- To understand the principles of Data warehousing and Data Mining.
- To be familiar with the Data warehouse architecture and its Implementation.
- To know the Architecture of a Data Mining system.
- To understand the various Data preprocessing Methods.
- To perform classification and prediction of data.

Learning Outcomes

After successful completion of this course -

- Learners will be able to understand the importance of advanced database concepts.
- earners will develop skills for implementation of mining the data.
- Learners will be able to understand the implementation of various data preprocessing methods

Unit	Topic	No. of lectures
I	Introduction to data warehousing and concepts, definitions, and applications, Definition of Data warehouse, Logical architecture of Data Warehouse, Data Warehouse model- Enterprise warehouse; Data Marts; Virtual warehouse.	**12**

	Data warehousing architecture and design: dimensional modelling, star schema, snowflake schema, and data marts, Data warehousing tools and technologies: ETL (Extract, Transform, Load) tools. Data warehousing platforms.	
II	Data-Information-Knowledge-Decision making-Action cycle. Business Intelligence: Data warehousing, Business Intelligence architecture, Use and benefits of Business Intelligence. Knowledge Discovery in Databases: KDD process model, Data Pre-processing: Cleaning: Missing Values; Noisy Values; Inconsistent values; redundant values. Data pre-processing: Principles of dimensional modelling, Data cubes, Data cube operations, data cube schemas. Data cleaning, data integration, data transformation, and data reduction. Designing Business Data Warehouse: OLTP and OLAP systems, Designing business information warehouse.	**12**

III	The Data Warehouse Environment: The Structure of the Data Warehouse, Granularity- The Benefits of Granularity, An Example of Granularity, Dual Levels of Granularity, Living Sample Database, partitioning as a Design Approach, Partitioning of Data, Structuring Data in the Data Warehouse, Data Homogeneity and Heterogeneity, Purging Warehouse Data, Incorrect Data in the Data Warehouse. The Data Warehouse and Design: Beginning with Operational Data, Process and Data Models and the architected environment, The Data Warehouse and Data Models- Midlevel Data Model, Physical Data Model. Metadata: Managing Reference Tables in a Data Warehouse, Cyclicity of Data — The Wrinkle of Time Complexity of Transformation and Integration, Triggering the Data Warehouse Record, Events Components of the Snapshot with Examples.	12
IV	The Data Warehouse and Technology: Managing Large Amounts of Data, Managing Multiple Media, Indexing and Monitoring Data, Interfaces to Many Technologies, Parallel Storage and Management of Data, Metadata Management, Multidimensional DBMS and the Data Warehouse, Data Warehousing across Multiple Storage Media. The Distributed Data Warehouse: Types of Distributed Data Warehouses, Local and Global Data Warehouses, Intersection of Global and Local Data, Redundancy , Access of Local and Global Data The Technologically Distributed Data Warehouse The Independently Evolving Distributed Data Warehouse, Distributed Data Warehouse Development.	12

V	Introductions to Data Mining, What Kinds of Data Can Be Mined? What Kinds of Patterns Can Be Mined, Data Mining Engine. Data mining techniques: association rule mining, clustering, classification, and prediction. Big data analytics tools, such as Hadoop, Pig, Hive, and Impala. Importance of data governance, security, and privacy in data warehousing and data mining with big data.	12

TextBooks :

1. Jiawei Han, Micheline Kamber and Jian Pei"Data Mining Concepts and Techniques", Third Edition, Elsevier, 2011.
2. Alex Berson and Stephen J. Smith "Data Warehousing, Data Mining & OLAP", Tata McGraw – Hill Edition, Tenth Reprint 2007.

Additional References:

1.K.P. Soman, Shyam Diwakar and V. Ajay "Insight into Data mining Theory and Practice", Easter Economy Edition, Prentice Hall of India, 2006.
2.Building the Data Warehouse, Inmon: Wiley (1993).
3.Data Mining: Introductory and Advanced Topics, Dunham, Margaret H, Prentice Hall (2006)

Course Code	Course Title	Credits	Practical/ Tutorials Per Week
VESUDSP30 3	**Practicals in Data Warehousing and Data Mining**	1	3
1	Basic of WEKA Installing WEKA , understanding WEKA data file format		
2	Data visualization in WEKA Data filtering Using the concepts of data mining with WEKA		
3	Create tables using different applications and to pre-process data imported from external sources .		

4	Develop an application to design a warehouse by importing various tables from external sources		
5	Execute K-Means Clustering using Weka.		
6	Pre-process the given data set and hence apply hierarchical algorithms And density based clustering techniques. Interpret the result.		
7	Develop an application to create a fact table and measures in a cube.		
8	Develop an application to create dimension tables in a cube and form star schema		

Course Code	Course Title	Credits	Lecture / Week
VESUDS3 04	IoT	3	4

About the course

The course aims to provide basic understanding of SoC architectures; IoT, different types of IoT platforms and different types of applications that can be built.

Course Objectives
The objectives of this course are:
- Introduce concepts of SoC and IoT
- Introduce various types of IoT platforms.
- Interfacing various types of devices using different protocols with IoT
- Understand practical applications of IoT in real life world

Learning Outcomes
After successful completion of this course -
- learners will be able to understand SoC and IoT
- Learners will be use different types of IoT Platforms and interfaces
- Learners will be able to use various types of sensors with IoT platforms.
- Learners will get an idea of various types of applications built using IoT

Unit	Topic	No. of lectures
I	Fundamentals of IoT: Introduction, Definitions & Characteristics of IoT,IoT Architectures, Physical & Logical Design of IoT, Enabling Technologies in IoT, History of IoT, About Things in IoT, The Identifiers in IoT, About the Internet in IoT, IoT frameworks, IoT and M2M. System on Chip: What is System on chip? Structure of System on Chip.SoC Elements: FPGA, GPU, APU, Compute Units. Different types of IoT/SoC Platforms: Introduction to Raspberry Pi,Arduino & NodeMCU, Introduction to SoC-ARM Architecture, atmega328 architecture.	12
II	Interfacing with IoT Platforms: Basic hardware components like LED, Button, Camera, 8X8 LED Grid, Motor etc. and interfacing them for input/output with IoT devices using PWM, UART, GPIO, I2C, SPI Using Sensor & Actuators: Overview of Sensors working, Analog and Digital Sensors, Interfacing of Temperature, Humidity, Motion, Light and Gas Sensor, Level Sensors, Ultrasonic sensors, Interfacing of Actuators, Interfacing of Relay Switch and Servo Motor.	12
III	IoT and Protocols IoT Security: HTTP, UPnP, CoAP, MQTT, XMPP,Privacy and Security Issues in IoT. IoT & Web: Web server for IoT, Sending/Receiving data between web server & IoT device, Cloud for IoT, Node RED, M2M vs IoT communication Protocols, Basics of WSNs, WSN architecture and types.	12
IV	IoT and Protocols IoT Security: HTTP, UPnP, CoAP, MQTT, XMPP,Privacy and Security Issues in IoT. IoT & Web: Web server for IoT, Sending/Receiving data between web server & IoT device, Cloud for IoT, Node RED, M2M vs IoT communication Protocols, IoT Applications: Modern IoT case studies / applications used in the areas of transportation, agriculture, health care etc.	12
V	Basics of WSNs, WSN architecture and types. SCADA, Bacnet Edge Computing: Edge computing purpose and definition, Edge computing use cases, Edge computing hardware architectures, Edge platforms, Edge vs Fog Computing, Communication Models - Edge, Fog and M2M. Introduction of Web of Things (WoT), IoT Data Analytics, IoT Data Analytics benefits and Challenges.	12

	CASE STUDIES/INDUSTRIAL APPLICATIONS: IoT applications in home, infrastructures, buildings, security, Industries, Home appliances, other IoT electronic equipments, Industry 4.0 concepts. Applications of IoT in industry.	

Textbooks:

1.Introduction to IoT Paperback by Sudip Misra , Anandarup Mukherjee , Arijit Roy Cambridge Press, 2022

2. Jain, Prof. Satish, Singh, Shashi, "Internet of Things and its Applications", 1ˢᵗ Edition, BPB,2020.

3. Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sundaram, Internet of
Things, Wiley, India,2019

4. IoT and Edge Computing for Architects - Second Edition, by Perry Lea, Publisher: Packt Publishing, 2020

Additional References:

1. https://mrcet.com/downloads/digital_notes/EEE/IoT%20&%20Applications%20Digital%20Notes.pdf

2.Internet of Things by Vinayak Shinde, SYBGEN Learning India Pvt. Ltd, 2020

3. Internet of things, Dr. Kamlesh Lakhwani, Dr. Hemant kumar Gianey, Josef Kofi Wireko, Kamalkant Hiran, BPB Publication, 2020

4. Arduino, Raspberry Pi, NodeMCU Simple projects in easy way by Anbazhagan k and Ambika Parameswari k, 2019.

4. IoT based Projects: Realization with Raspberry Pi, NodeMCU Paperback – February 2020, by Rajesh Singh Anita Gehlot, 2020

5. Mastering the Raspberry Pi, Warren Gay, Apress, 2014
6 Arduino, Raspberry Pi, NodeMCU Simple projects in easy way by Anbazhagan k and Ambika Parameswari k | 24 August 2019.

Course Code	Practical Title	Credits	Practical/ Tutorials Per Week
VESUDSP304	**IoT Practical**	**1**	**3**
1	Understanding of different parts of Raspberry Pi		
2	Preparing Raspberry Pi: Hardware preparation and Installation		
3	Demonstrate Arduino Uno and its pins interfacing with IDE.		
4	GPIO: Light the LED with Python with/without a button using either Uno/Raspberry Pi.		

5	SPI: Camera Connection and capturing Images/Videos using SPI	
6	Stepper Motor Control: PWM to manage stepper motor speed using Uno/Raspberry Pi.	
7	Node RED: Connect LED to Internet of Things	
8	Use different types of sensors (LDR, Temperature) with Raspberry Pi/Uno	

Course Code	Course Title	Credits	Lecture / Week
VESUDS3 05	Financial Literacy and Investment Analysis	**3**	**4**

About the course

The goal is to develop financial literacy and gain a strong fundamental understanding of the stock market.
Financial literacy involves knowing and using the basic concepts of financial literacy. As mentioned above, these include saving, investing, budgeting, and borrowing.

Course Objectives

The objectives of this course are:

1. Provide an in-depth view of the process in financial management of the firm
2. Develop knowledge on the allocation, management and funding of financial resources.
3. Improving students' understanding of the time value of money concept and the role of a financial management.

Learning Outcomes

On completion of this course, the students will be able to

CO1. Explain the concept of fundamental financial concepts, especially value of money.

CO2. Apply capital budgeting projects using traditional methods.

CO3. Analyze he main ways of raising capital and their respective advantages and disadvantages in different circumstances.

CO4 Integrate the concept and apply the financial concepts to calculate ratios and do the capital budgeting.

Unit	Topic	No. of lectures
I	Basic financial literacy terms : Budget, Saving, Credit, Interest ,Insurance and Asset. Investment: Meaning and scope - Investment V/s Speculation, Investment V/s Gambling - Types of Investors. Objectives of Investor - Characteristics of Investment: risk, return, safety. liquidity.	12
II	Non-marketable financial assets: Deposit with Banks, Instruments of Post offices, public provident fund, National saving certificate, preference shares, LIC, Real Assets etc. Marketable financial assets: Money Market Instruments - Bonds or Fixed Income Securities - Debentures- Equity Shares - Mutual Fund Schemes - Financial Derivatives.	12
III	Securities Market: Participants in the Securities Market- Primary Market, Role of Primary Market- Secondary Market: its functions and Operations, Stock Markets in India, Over the Counter Exchange of India (OTCEI) - Securities and Exchange Board of India: Objectives, Powers and Functions. Depositories - CDSL, NSDL- Role of depositories.	12

IV	Basics of Economics: macro and microeconomics, Supply and Demand: Product and Resource Markets, Macroeconomics: Theory and Policy. The Business Cycle in Market Economies, short-term vs. long-term growth trend Expansion, peak, decline, trough Emergence of modern-day macroeconomic policy to moderate effects of recessions. Macroeconomics Krugman and Wells, Eds. Worth Publishers, 3RD Edition 2012. Macroeconomics Leeds, Michael A. von Allmen, Peter and Schiming, Richard C Pearson Education 1st 2006	12
V	Unemployment and Inflation: How is the labor force defined? Who is in the labor force? Measuring employment and unemployment. Types of unemployment; cyclical unemployment and the business cycle. Unemployment and the changes in the global economy Measuring inflation the consumer price index Gross Domestic Product(GDP): Measuring the economy's output of goods and services; Government Sector: federal state and local government.	12

REFERENCES:

1. Hirschey, M. (2001), Investment Theory and Applications, Harcourt College Publisher, USA
2. Shalla V. K. (1983), Investment Management, Security Analysis and Portfo Management, S. Chand, New Delhi.
3. Chandra, Prasanna (2000) Investment Analysis and Portfolio, Management, Tata McGraw-Hill Publishing Company Ltd, New Delhi.
4. Chandra, Prasanna (1993) Finance Sense, Tata McGraw-Hill Publishing Company Ltd, New Delhi.

Course Code	Course Title	Credits	Lecture / Week
VESUDS306	**Strategic Management and Entrepreneurship Development**	3	4

About the course
The goals of this Programme are to inspire students and help them imbibe an entrepreneurial mind-set. The students will learn what entrepreneurship is and how it has impacted the world and their country. The Programme comprises several short courses, each focusing on a specific entrepreneurial knowledge or skill requirement such as creative thinking, Strategic Management, risk taking, and resilience and helping them become career ready, whether it is entrepreneurship or any other career.

Course Objectives

The objectives of this course are:

1. To understand the concept of entrepreneurship development, the theories of entrepreneurship and the relationship between theory and practice.
2. To create awareness of the role of entrepreneurs in the growth of Indian economy.
3. To comprehend the process of creating an entrepreneurial venture.
4. To develop analytical skills for evaluating new venture ideas and understanding both the opportunities and constraints faced by entrepreneurs.
5. To critically view the role of financial institutions, government bodies in promoting entrepreneurship in India.
6. To develop an entrepreneurial spirit and have feasible ideas for ventures.

Learning Outcomes

After successful completion of this course -

On completion of the syllabus, the student will :

1. Understand the issues involved in entrepreneurship development.
2. Able to evaluate opportunities for a new venture.
3. Demonstrate the ability to prepare a business plan for a venture.
4. Get insights into their creative, entrepreneurial and team skills.
5. To equip them with a platform to develop an entrepreneurial venture.

Unit	Topic	No. of lectures
I	Definition of Management – Science or Art – Manager Vs Entrepreneur – types of managers -managerial roles and skills – Evolution of Management- Scientific, human relations, system and contingency approaches – Types of Business organization – Sole proprietorship, partnership, company-public and private sector enterprises – Organization culture and Environment – Current trends and issues in Management.	12
II	Introduction to Strategic Management : Define strategy, strategic management process. Levels of strategies - Corporate, Business and Operational level, types of strategies - Functional Strategies, HR Strategy, Marketing strategy, Financial strategy, Operational strategy. Benefits and risks of strategic management.	12

III	Concept, meaning and definition of entrepreneur and entrepreneurship. Importance and significance of growth of entrepreneurial activity. Characteristics and qualities of entrepreneurs Classification and types of entrepreneurs. Women entrepreneurs. Factors influencing entrepreneurial development and motivation. Role of culture in entrepreneurial development. Entrepreneurship and Enterprise, Objectives of Entrepreneurship Development, Phases of Entrepreneurship Development, Role of Entrepreneurship.	**12**
IV	The Entrepreneurial Mindset, Characteristics of Entrepreneurship, Traits of Entrepreneurship, Skilled Entrepreneurship VS Startups Meaning of Entrepreneurship skill, Types of Entrepreneurship Skills: Business management skills, Teamwork and leadership skills, Communication and listening, Customer service skills, Financial skills.	**12**
V	Entrepreneurial Project Development : Idea generation – sources and methods Identification and classification of ideas. Environmental Scanning and SWOT analysis Preparation of project plan – points to be considered. Components of an ideal business plan – market plan, financial plans, operational plan, and HR plan. Project formulation – project report significance and contents. **Small and Medium Enterprises:** Meaning and definition (evolution) Role and importance. SME funding. Requirements of capital (fixed and working), Factors determining capital requirements, Importance of fixed and working capital, Working capital management, Sources of finance for SME'S.	**12**

 REFERENCES:

 TextBooks :

 1. Principles of Management | 7th Edition Paperback – 14 November 2021 by PC
 Tripathi (Author), PN Reddy (Author), Ashish Bajpai (Author)
2. Entrepreneurship | 11th Edition Paperback – 6 August 2020 by Robert D. Hisrich
   (Author), Michael P. Peters (Author), Dean A. Shepherd (Author)
3. Zero to One: Notes on Start Ups, or How to Build the Future by Peter Thiel and
   Blake Masters

 Additional References:

 1. Fundamentals of Entrepreneurship (Book Code:1087) by Dr. G.K. Vashney | 1
 January 2019
 2. Surviving a Startup: Practical Strategies for Starting a Business, Overcoming

Obstacles, and Coming Out on Top by Steven S. Hoffman | 20 April 2021
3. Principles of Management, Second Edition Paperback – 16 November 2019 by
Ramesh B Rudani (Author)
4. Small scale industries and entrepreneurship, Dr. Vasant Desai, Himalayan Publishing House
5. Management of small scale industries, J.C. Saboo Megha Biyani, Himalayan
Publishing House 6.Dynamics of entrepreneurial development and Management, Dr.
Vasant Desai, Himalayan Publishing.
7. Entrepreneurship development, Moharanas and Dash C.R., RBSA Publishing, Jaipure
8. Beyond entrepreneurship, Collins and Lazier W, Prentice Hall, New Jersey, 1992
9. Entrepreneurship, Hisrich Peters Sphephard, Tata McGraw Hill
10. Fundamentals of entrepreneurship, S.K. Mohanty, Prentice Hall of India
11. A Guide to Entrepreneurship, David Oates, Jaico Publishing House, Mumbai, Edn 2009

Course Code	Course Title	Credits	Lecture / Week
VESUDSP 305	Internship	1	

About the course

The course is designed so as to expose the students to industry environment and to take up on-site assignment as trainees or interns.

Course Objectives:

The objective of the course is to designed so as to expose the students to industry environment and to take up on-site assignment as trainees or interns.

Course Outcome:
At the end of this internship the student should be able to:
1. Provide to students the feel of the actual working environment and to gain practical knowledge and skills
2. Have an exposure to industrial practices and to work in team's environment.
3. Communicate effectively
4. Understand the impact of data science solutions in a global, economic, environmental and societal context.
5. Internship is also expected to provide the students the basis to identify their key operational area of interest
6. Develop the ability to engage in research and to involve in life-long learning

Guidelines for Internship

1. Minimum 45 Hours internship at college level organised by Global Gyan or any other industry
2. Internship can be related with data science, banking, finance and marketing
3. Internship can be in online or offline or hybrid mode.
4. Should be Supervised by an expert at the industry or trainer college level

Evaluation Method

- The student will give a presentation based on his training report, before an expert committee constituted by the concerned department as per norms of the institute.
- The evaluation will be based on the following criteria: Total Marks - 50
- ✓ Quality of content presented – 10 Marks
- ✓ Effectiveness of presentation. - 10 Marks
- ✓ Depth of knowledge and skills. 10 Marks
- ✓ Attendance record, daily diary, certificate with the Internship Report. - 20 Marks

S.Y.B.Sc

DSDA

Semester IV

Course Code	Course Title	Credits	Lecture/ Week
VESUDS 401	**Object Oriented Programming using Java**	**3**	**5**

About the course

The objective of this course is to teach the learner how to use Object Oriented paradigm to develop code and understand the concepts of Core Java.

Course Objectives
The objectives of this course are:

1. To understand Object oriented concepts like data abstraction, encapsulation, etc.
2. To solve the real world scenarios using top down approach.
3. To understand various Java programming concepts.

Learning Outcomes

CO1: Students will understand the need of object oriented programming, fundamental concepts and will be able to solve computational problems using basic constructs like if-else, control structures, array, strings. in Java   environment.

CO2: Student will understand how to model the real world scenario using class diagram and be able to exhibit communication between objects using sequence diagram.

CO3: Students will be able to implement relationships between class and objects.

Unit	Topic	No. of lectures
I	OOP concepts: Classes and objects, data abstraction, encapsulation, inheritance, benefits of inheritance, polymorphism, procedural and object oriented programming paradigm. Object oriented vs Procedure oriented Introduction to Java : Basics of Java programming, Data types, Variables, Operators, Control structures including selection, Looping, Java methods, Arrays in java.	12
II	Objects and Classes : Basics of objects, and classes in java, Constructors with types, Declaring Methods, Keyword-static,this,final.	12
III	Inheritance hierarchies, super and subclasses, member access rules, super keyword, preventing inheritance: final classes and methods, the object class and its methods; Constructors in Inheritance.	12

IV	Polymorphism: dynamic binding, method overriding, abstract classes and methods; Interface: Interfaces VS Abstract classes, defining an interface, implement interfaces, accessing implementations through interface references, extending interface.	12

V	Exception Handling: Introduction, Pre-Defined Exceptions, Try-Catch-Finally, Throws, throw, User Defined Exception examples. IO In Java – Different types of Streams – Byte Streams & Character Streams, Various classes of byte and character streams	12

TextBooks : Herbert Schildt, Java The Complete Reference, Ninth Edition, McGraw-Hill Education, 2014

Additional References:
1) E. Balagurusamy, Programming with Java, Tata McGraw-Hill Education India, 2014
2) Programming in JAVA, 2nd Ed, Sachin Malhotra & Saurabh Choudhary, Oxford Press .

Course Code	Course Title Credit	Practical/ Tutorials Per Week
VESUDSP401	**Practical of Object Oriented Programming using Java**	**3**
1	Program to define the data types, variable, operators, control structures and arrays	
2	Program to define class, methods and objects.	
3	Program to define class and constructors. Demonstrate constructors.	
4	Demonstrate method overloading	
5	Program to define inheritance and show method overriding	

6	Program to demonstrate Abstraction	
7	Program to demonstrate Exception Handling.	
8	Program to demonstrate IO streams	

CourseCode	Course Title	Credits	Lecture/ Week
VESUDS402	**AI & Machine Learning**	**3**	**4**

About the course:
- To understand the basic theory underlying machine learning.
- To be able to formulate machine learning problems corresponding to different applications.To understand a range of machine learning algorithms along with their strengths and weaknesses.
- To be able to apply machine learning algorithms to solve problems of moderate complexity.
- To apply the algorithms to a real-world problem, optimize the models learned and reporton the expected accuracy that can be achieved by applying the models

Course Objectives
The objectives of this course are:
- Appreciate the importance of visualization in data analytics solution.
- Apply structured thinking to unstructured problems.
- Understand a very broad collection of machine learning algorithms and problems.
- Learn algorithmic topics of machine learning and mathematically deep enough to introduce the required theory.
- Develop an appreciation for what is involved in learning from data.

Learning Outcomes
After successful completion of this course -
- Learner will be able to understand concepts of AI
- Learner will get to know different types of machines algorithms
- Learner will be able to solve different types of problems of this domain

Unit	Topic	No. of lectures
I	What Is AI: Foundations, History and State of the Art of AI. Intelligent Agents: Agents and Environments, Nature of Environments, Structure of Agents. Problem Solving by searching: Problem-Solving Agents, Uninformed Search Strategies, Informed (Heuristic) Search Strategies,	12
II	Knowledge Representation and its various forms like first order logic, semantic networks, frame etc. Reasoning, Planning, Uncertainty in Knowledge Foundations for Machine Learning- ML Techniques overview, Types of ML , Parametric & Non-Parametric Models, Regression, Classification, Clustering, Probabilistic Models.	12

Unit	Topic	No. of lectures
III	Supervised Models - Regression & its types, Regularization, Decision Trees, SVM, Time Series, Neural Network(Feed Forward), K-NN, Gradient Descent	12
IV	Probabilistic models: Logistic Regression, Naive Bayes Classifier, Learning with Hidden Variables: The EM Algorithm Ensemble Learning, Boosting.	12
V	Unsupervised Learning - Clustering, EM, Association Rule Learning, Apriori Algorithm, Anomaly Detection. Reinforcement learning: Concept of Reinforcement learning, Q-Learning, Hidden Markov Model	12

TextBooks :

1) Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig,3rd Edition, Pearson, 2010.

2) Artificial Intelligence | Third Edition | By Pearson: A Modern Approach by Russell

Additional References:

 1. The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani and Jerome Friedman, Springer, 2013

 2. Artificial Intelligence: Foundations of Computational Agents, David L Poole,Alan K. Mackworth, 2nd Edition, Cambridge University Press ,2017.

Course Code	Course Title	Credits	Practical/ Tutorials Per Week
VESUDSP4 01	**Practical of AI & Machine Learning (Using various softwares like Python/Google Collab)**	**1**	**3**
1	Implement Breadth first search & Iterative depth first search algorithm		
2	Implement A* search and recursive best-first search algorithm		
3	Implement decision tree learning algorithm		
4	Implement feed forward back propagation neural network learning algorithm		
5	Implement SVM Algorithm		
6	Implement Adaboost ensemble learning algorithm		

7	Implement Naive Bayes' learning algorithm
8	Implement K-NN Algorithm
9	Implement Association rule mining algorithm
10	Demo of OpenAI / TensorFlow tools

Course Code	Course Title	Credits	Lectures / Week
VESUS DS403	**Software Engineering**	**3**	**4**

About the course

This course covers a collection of methods which embody an "engineering" approach to the development of software. It discusses the nature of software and software projects, software development models, software process maturity, project planning, management, and estimations.

Course Objectives
The objectives of this course are:

- The basic objective of software engineering is to develop methods and procedures for software development that can scale up for large systems.
- It can be used consistently to produce high-quality software at low cost and with a small cycle of time.
- To understand the importance of Software Testing strategies and Quality Assurance during the software development process.

Learning Outcomes
After successful completion of this course -

- Apply use of knowledge of Software Life Cycle to successfully implement the projects in the corporate world
- Identify the Inputs, Tools and techniques to get the required Project deliverable and Product deliverable using knowledge areas of Project Management.
- Understand the concept and need of software testing.
- Understand the need and usage of software tools required for manual and automated testing

Unit	Topic	No. of lectures
I	Introduction: The Nature of Software, Software Engineering, The Software Process, Generic Process Model, The Waterfall Model, Incremental Process Models, Evolutionary Process Models, Concurrent Models, Component-Based Development, The Unified Process Phases, Agile Development- Agility, Agile Process, Extreme Programming. Introduction to Poker, Planning Poker. Software Requirement Analysis and Specification Requirement Engineering Process: Elicitation, Analysis, Documentation, Review and Management of User Needs, Feasibility Study, Entity Relationship Diagrams, SRS Document, IEEE Standards for SRS. Requirement Elicitation: Interviews, Questionnaire, Brainstorming, Facilitated Application Specification Technique (FAST).	
II	UML -Use Case Approach Sequence diagram, Collaboration diagram, State chart diagram, Activity diagram, Component diagram, Deployment diagram . SRS Case study. **Software Project Planning and Scheduling** Business Case, Project selection and Approval, Project charter, Project Scope management: Scope definition and Project Scope management, Creating the Work Breakdown Structures, Scope Verification, Scope Control. Staffing Level Estimation, Effect of schedule Change on Cost, Degree of Rigor & Task set selector, Project Schedule.	

III	**System Design:** System/Software Design, Architectural Design, Low-Level Design Coupling and Cohesion, Functional-Oriented Versus The Object-Oriented Approach, Design Specifications, Verification for Design, Monitoring and Control for Design Software Measurement and Metrics: Product Metrics – Measures, Metrics, and Indicators, Function-Based Metrics, Metrics for Object-Oriented Design, Operation-Oriented Metrics, User Interface Design Metrics, Metrics for Source Code, Halstead Metrics Applied to Testing, Metrics for Maintenance, Cyclomatic Complexity, Software Measurement - Size-Oriented, Function-Oriented Metrics, Metrics for Software Quality. **Estimation in Project Planning Process** –Software Scope And Feasibility, Resource Estimation, Empirical Estimation Models – COCOMO II, Estimation for Agile Development, The Make/Buy Decision, Project Scheduling - Basic Principles, Relationship Between People and Effort, Effort Distribution, Time-Line Charts.	

IV	**Software Testing and Quality Assurance** Testing Objectives, Unit Testing, Integration Testing, Acceptance Testing, Regression Testing, Testing for Functionality and Testing for Performance, Top Down and Bottom-Up Testing Strategies: Test Drivers and Test Stubs, Structural Testing (White Box Testing), Functional Testing (Black Box Testing), Test Data Suit Preparation, Alpha and Beta Testing of Products. Static Testing Strategies: Formal Technical Reviews (Peer Reviews), Walk Through, Code Inspection, Compliance with Design and Coding Standards Software Quality Assurance (SQA): Verification and Validation, SQA Plans, Software Quality Frameworks, ISO 9000 Models, SEI-CMM Model.	
V	**Software Maintenance and Software Project Management** Software as an Evolutionary Entity, Need for Maintenance, Categories of Maintenance: Preventive, Corrective and Perfective Maintenance, Cost of Maintenance, Software Re- Engineering, Reverse Engineering. Software Configuration Management Activities. **Risk Management** - Software Risks, Risk Identification, Risk Projection and Risk Refinement.	

TextBooks :

     1) Software Engineering, A Practitioner's Approach, Roger S, Pressman.(2014)

Additional Reference(s):

2) Software Engineering, Ian Sommerville, Pearson Education

3) Software Engineering: Principles and Practices",Deepak Jain,OXFORD UniversityPress

4) Fundamentals of Software Engineering, Fourth Edition, Rajib Mall, PHI

5) Software Engineering: Principles and Practices, Hans Van Vliet, John Wiley & Sons A Concise Introduction to Software Engineering, Pankaj Jalote, Springer

Course Code	Course Title	Credits	Practical/ Tutorials Per Week
VESUDSP403	Practical **of** Software Engineering	**1**	**3**
1	Develop a Use Case Diagram for the given case study.		
2	Develop an Activity Diagram for given the case study.		

3	Develop an E-R Diagram for the case study.
4	Develop a Class Diagram for the given case study.
5	State Chart Diagram for the given case study.
6	Develop a Sequence / Collaboration Diagram for the given case study.
7	Develop a Component and Deployment Diagram for the given case study.
8	Prepare a SRS document for the given case study.

Course Code	Course Title	Credits	Lecture/ Week
VESUDS40 4	**Cloud Computing**	3	4

About the course:

The purpose of this course is to provide an overview of Cloud Computing concepts ,architecture ,Virtualization, Data Storage, Services of Cloud, Types of Cloud.

Course Objectives
The objectives of this course are:
- To understand the concepts in Cloud Computing and its Security
- To understand the evolving computer model.
- To introduce the various levels of services that can be achieved by cloud

Learning Outcomes
After successful completion of this course students able to -
- Apply levels of services of cloud
- Able to describe the security aspects in the cloud.

Unit	Topic	No. of lectures
I	Cloud Computing Foundation: Introduction to Cloud Computing – Move to Cloud Computing – Types of Cloud – Working of Cloud Computing	12
II	Cloud Computing Architecture : Cloud Computing Technology – Cloud Architecture – Cloud Modeling and Design - Virtualization : Foundation – Grid,Elements of Parallel Computing. Elements of Distributed Computing. Cloud and Virtualization – Virtualization and Cloud Computing.	12

| III | Data Storage and Cloud Computing : Data Storage – Cloud Storage, Cloud Computing and Security : Risks in Cloud Computing – Data Security in Cloud – Cloud Security Services– Application Security – Virtual Machine Security - Identity Management and Access Control, Disaster Recovery in Clouds. | 12 |

IV	Introduction to OpenStack, OpenStack test-drive, Basic OpenStack operations, OpenStack CLI and APIs, Tenant model operations, Quotas, Private cloud building blocks, Controller deployment, Networking deployment, Block Storage deployment, Compute deployment, deploying and utilizing OpenStack in production environments, Building a production environment, Application orchestration using OpenStack Heat.	**12**	
V	Cloud Applications – Moving Applications to the Cloud – Microsoft Cloud Services – Google Cloud Applications – Amazon Cloud Services – Cloud Applications	**12**	

TextBooks :

1) A.Srinivasan and Suresh, "Cloud Computing – A Practical Approach for Learning and Implementation", Pearson India Publications 2014.

Additional References:

1. Rajkumar Buyya, James Broberg, Andrzej , "Cloud Computing: Principles and Paradigms", Wiley India Publications 2011.

2.Arshdeep Bahga and Vijay Madisetti ,"Cloud Computing – A Hands on Approach", Universities Press (India) Pvt Ltd. 2014.

Course Code	Course Title	Credits	Practical/ Tutorials Per Week
VESUDSP4 04	**Practical of Cloud Computing**	**1**	**3**
1	Working and Implementation of Infrastructure as a service.		
2	Manage users on azure (create user ,create group)assign roles and policies.		
3	Working and Implementation of identity management.		
4	Practical Implementation of cloud security		
5	Execute the step to Demonstrate and implementation of cloud on single sign on		

6	Write a program for web feed
7	Working and Implementation of Platform as a service.
8	Assign MFA on created Users
9	Working and Implementation of SAAS
10	Case study of Google cloud,AWS,Azure IBM etc

Course Code	Course Title	Credits	Lecture/ Week
VESUDS405	**Universal Human Values**	3	4

About the course:

The methodology of this course is universally adaptable, involving a systematic and rational study of the human being vis-à-vis the rest of existence. It is free from any dogma or value prescriptions

Course Objectives.

The objectives of this course are:

The objective of the course is fourfold:

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.

2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence

3. Strengthening of self-reflection.

4. Development of commitment and courage to act.

Learning Outcomes

After successful completion of this course students able to –

1. Understand the significance of value inputs in a classroom and start applying them in their life and profession
2. Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.
3. Understand the role of a human being in ensuring harmony in society and nature.
4. Distinguish between ethical and unethical practices and start working out the strategy

to actualize a harmonious environment wherever they work.

Unit	Topic
I	Human Values: Objectives, Morals Values, Service learning, Respect for others, Living peacefully, Valuing time, Commitment, Self-confidence , Challenges in the workplace. Honesty, trustworthiness, loyalty, adherence to the law doing good and avoiding harm to others accountability. Understanding Value Education ,Self-Exploration Process for Value Education, Human Aspirations Prosperity and Happiness, Understanding and Living in Harmony at Various Levels.

II	Harmony in Myself – Understanding Harmony in The Human Being, Understanding Human Being as a Co-Existence of The Sentient 'I' and the Material 'Body', Understanding the need of self (I) and body-Sukh and Suvidha,Understanding the Body as an Instrument of Self (I),Understanding the Characteristics and Activities of 'I' and Harmony in 'I' Understanding the Harmony of 'I' with Body. Understanding Harmony in Family Relations, Values in Human-Human Relations, Understanding Harmony in Society, Vision of Universal Harmonious Society.
III	Harmony in Nature and Existence–Whole Existence as Co-existence: Understanding Harmony in Nature, Understanding Existence as Co-existence and Harmony at all Levels of Existence. Implications of the holistic understanding of harmony on professional ethics: Natural acceptance of human values, Definitiveness of Ethical Human Conduct. Computer ethics: Engineers as managers, Consulting engineers, Engineers as expert witness, Engineers as advisors in planning and policy making, Moral leadership. Codes of ethics : Case study on industry (example - Codes of ethics for TATA group), Ethics and codes of business conduct in MNC.
IV	Self-Management: Self-confidence, peer pressure, anger, frustration, stress at workplace, Stress and Work performance: Role of communication in managing stress and work performance, Strategies of Stress Management. Foundational Principles of Time Management: Steps of Time Management, Keys for managing time effectively, Identifying your biggest 'time stealer', Setting up priorities Task Prioritization, Urgent tasks vs. Important tasks, implementing planning in your life, Balancing out your work and individual life.
V	Social Ethics The Basics for Ethical Human Conduct, Defects in Ethical Human Conduct. Holistic Alternative and Universal Order, Universal Human Order and Ethical Conduct. Human Rights violation and Social Disparities. Value based Life and Profession. Professional Ethics and Right Understanding. Competence in Professional Ethics. Issues in Professional Ethics – The Current Scenario. Vision for Holistic Technologies, Production System and Management Models. Preparing for the Future: Care of the Self: Nutrition and Other Lifestyle Issues. Stress reduction practices: Time management,Exercise,Relaxation techniques, yoga,meditation.

References:

1.A.N Tripathy, New Age International Publishers, 2003.
2.Bajpai. B. L , , New Royal Book Co, Lucknow, Reprinted,
2004 3.Bertrand Russell Human Society in Ethics & Politics
4 .Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books,
New Delhi, 2010 2.
5. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
6. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
7. AICTE Model Curriculum UHV Courses -
https://www.bitmesra.ac.in/UploadedDocuments/adminvec/files/02_AICTE%20Model%20Curri
culum%20UHV%20Courses.pdf
8. UNIVERSAL HUMAN VALUES guidelines by AICTE
   https://vvce.ac.in/wp-content/uploads/2021/04/Realising-Aspirations-of-NEP2020-UHV.pdf
 9. Baron .L & Feist.J (2000) Health Psychology 4th edition, USA Brooks/Cole
10. Barlow, Rapee, and Perini(2014), 10 Steps to Mastering Stress: A Lifestyle Approach,USA
11. Clayton,M, (2011).Brilliant stress management How to manage stress in any
situation's 1st edition, Great Britain Pearson Education

ADDITIONAL REFERENCE BOOKS:

1.Corliss Lamont, Philosophy of Humanism

2.Gaur. R.R. , Sangal. R, Bagaria. G.P, A Foundation Course in Value Education, Excel
Books, 2009.
3.Gaur. R.R. , Sangal. R , Bagaria. G.P, Teachers Manual Excel Books, 2009.
4.I.C. Sharma . Ethical Philosophy of India Nagin & co Julundhar
5.Mortimer. J. Adler, – Whatman has made of man
6.William Lilly Introduction to Ethic Allied Publisher

Course Code	Course Title	Credits	Lecture/ Week
VESUDS406	**Green Technology**	3	4

About the course:

Green Technologies is a highly interdisciplinary degree program that emphasizes green systems and the environment, energy technology and efficiency, and sustainability and society.

The objectives of this course are:

The objective of this course is to:

- Seek opportunities for alternative sourcing, conservation, efficiency and repurposing through

an understanding of product life cycles from origins to recycling or inevitable disposal.

- To design products, processes and complex infrastructure systems to promote sustainable attributes of importance to the environment and the global community.
- To combine technical and scientific skills with an understanding of the environment, renewable energy management, waste utilization, resource management and land based industries who can contribute to the national and global development.

Learning Outcomes

Course Outcomes:

After successful completion of this course students able to –

- Understand the principles of green technology and green engineering.
- Understand the strategies, frameworks, processes and management of green IT
- Learn about green IT can be achieved in and by hardware, software, network communication and data center operations.

Unit	Topic
I	Green IT: An Overview, Introduction, Environmental Concerns and Sustainable Development, OCED Green IT Framework, Green IT 1.0 and 2.0. Greening IT: Green PCs, Notebooks and Servers, Green Data Centers, Green Cloud Computing, Green Data Storage, Green Software, Green Networking and Communications. Applying IT for Enhancing Environmental Sustainability, Green IT Standards and Eco-Labelling of IT. Enterprise Green IT Strategy -Green Washing, Green IT: Burden or Opportunity?
II	Green Devices and Hardware: Introduction, Life Cycle of a Device or Hardware, Reuse, Recycle and Dispose. Green Software: Introduction, Processor Power States, Energy-Saving Software Techniques. Sustainable Software Development: Introduction, Current Practice, Sustainable Software, Software Sustainability Attributes. **Software Sustainability Metrics:** Modifiability and Reusability, Portability ,Supportability ,Performance Dependability ,Usability ,Accessibility ,Predictability,Efficiency,Project's Carbon Footprint.
III	**Green Data Centres**: Data Centres and Associated Energy Challenges, Data Centre IT Infrastructure, Data Centre Facility Infrastructure: Implications for Energy Efficiency, IT Infrastructure Management, Green Data Centre Metrics, Data Centre Management Strategies. Green Data Storage: Introduction, Storage Media Power Characteristics, System-Level Energy Management, RAID with Power Awareness, Hierarchical Storage Management, Storage Virtualization, Cloud Storage.

	Green Networks and Communication: Introduction, Green Network Communications and Management, The Challenge of Next-Generation Networks, Benefits of Energy-

IV	Efficient Networks, Objectives of Green Networking, Core Components in Green-Networking Technology. Green Network Protocols and Standards: Strategies to Reduce Carbon Emissions, Contributions from the EMAN Working Group, Contributions from Standardization Bodies. Enterprise Green IT Strategy: Approaching Green IT Strategies, Business Drivers of Green IT Strategy, Business Dimensions for Green IT Transformation.
V	Sustainable Information Systems and Green Metrics: Introduction, Multilevel Sustainable Information Enterprise Green IT Readiness: Development of the G-Readiness Framework, Green IT Attitude, Green IT Policy, Green IT Governance, Green IT Practice, Green IT Technology. Sustainable IT Services: Creating a Framework for Service Innovation, Factors Driving the Development of Sustainable IT, Sustainable IT Services (SITS). Ecosystem of Software Tools: MediaWiki,Semantic ,MediaWiki,SparqlExtension Semantic Web.

 REFERENCES
1. Harnessing green IT : principles and practices / San Murugesan, G. R.. Gangadharan,
2 Harnessing Green IT: Principles and Practices San Murugesan(Authorized licensed use limited to:
University of Pittsburgh. Downloaded on January 15, 2010 at 14:05 from IEEE Xplore.
3.Green Data Center: Steps for the Journey, Alvin Galea, Michael Schaefer, Mike
Ebbers, Shroff Publishers and Distributors, 2011
4. Green Computing and Green IT Best Practice, Jason Harris,Emereo, 2014
5. Green Computing Tools and Techniques for Saving Energy, Money and Resources,Bud E.
Smith ,CRC Press ,2014

Additional References:
1. Green IT, Deepak Shikarpur, Vishwakarma Publications, 2014
2. Green Communications: Principles, Concepts and Practice- Samdanis et al, J. Wiley
3. Green IT for Sustainable Business Practice: An ISEB Foundation Guide, Mark
G. O'Neill, The Chartered Institute for IT, 2010

Course Code	Course Title	Credits	Practical / Tutorials Per Week
VESUDSP4 05	**Project**	**1**	

Project Implementation Guidelines

    1. A learner can choose any topic which is covered in Semester I- semester III or any other

topic.

2 prior approval from head of the department/ project in charge is required to repeat the

topic

3. The Project has to be performed individually.

4. A learner is expected to devote around three months of efforts in the project.

5. The project can be application oriented/web-based/database/research based.

6. It has to be an implemented work; just theoretical study will not be acceptable.

7. A learner can choose any programming language, computational techniques

and tools which have been covered during course or any other with the prior

permission of

head of the department/ project guide.

8. A project guide should be assigned to a learner. He/she will assign a

schedule for the project and hand it over to a learner. The guide should oversee

the project progress on a weekly basis by considering the workload of 3

lectures as assigned.

9. The quality of the project will be evaluated based on the novelty of the topic,

scope of the work, relevance to the computer science, adoption of emerging

techniques/technologies

and its real-world application.

10. A learner has to maintain a project report with the following subsections

a) Title Page

b) Certificate

A certificate should contain the following information –

- The fact that the student has successfully completed the project as per

the syllabus and that it forms a part of the requirements for completing

the BSc degree in computer science of University of Mumbai.

- The name of the student and the project guide

- The academic year in which the project is done

- Date of submission,

- Signature of the project guide and the head of the department with date

along with the department stamp.

Space for signature of the university examiner and date on which the

project is evaluated.

c) Self-attested copy of Plagiarism Report from any open source tool.

d) Index Page detailing description of the following with their subsections:

- Title: A suitable title giving the idea about what work is proposed.

- Introduction: An introduction to the topic giving proper back ground of the topic.

- Requirement Specification: Specify Software/hardware/data requirements.

- System Design details : Methodology/Architecture/UML/DFD/Algorithms/protocols etc.

Project evaluation scheme
Project Evaluation Scheme:

Presentation   10 Marks
Working of the Project 10 Marks
Quality of the Project   10 Marks
Viva   10 Marks
Documentation   10 Marks
 (Certified Project Document is compulsory for appearing at the time of Project Presentation)

Modality of assessment

The performance of the learners shall be evaluated into two parts. The learner's performance shall be assessed by Internal Assessment with 25% marks in the first part & by conducting the Semester End Examinations with 75% marks in the second part. Practical Examination will consist of End Sem examination.

Students will have to score 40% of marks separately in each of the Internal Theory , ExternalTheory as well as External Practical Examination to pass the course.

I. Internal Evaluation for Theory Courses – 25 Marks

(i) Mid-Term Class Test – 15 Marks

It should be conducted using any learning management system such as Moodle (Modular object-oriented dynamic learning environment)

The test should have 15 MCQ's which should be solved in a time duration of 30 minutes.

<u>(ii) Assignment / Presentations – 10 Marks</u>

Assignment - Any subject-related work in soft copy format comprising of case study, solutions to multiple problems, study and review of published research paper from a reputed journal, technical paper written as white paper

Presentation - Any subject-related work (can be done in a group) comprising of mini-project , explaining topics beyond syllabus, converting any subject-related topic into innovative way

Proof of the assignment/presentation should be maintained.

II. External Examination for Theory Courses – 75 Marks

Duration: 2.5 Hour

Theory question paper pattern:

All questions are compulsory.			
Question	**Based on**	**Options**	**Marks**
Q.1	Unit I	*Any 3 out of 5*	15
Q.2	Unit II	*Any 3 out of 5*	15
Q.3	Unit III	*Any 3 out of 5*	15
Q.4	Unit IV	*Any 3 out of 5*	15
Q.5	Univ V	*Any 3 out of 5*	15

All questions shall be compulsory with internal choice within the questions. Each Question may be subdivided into sub questions as a, b, c, d, etc. & the allocation of Marks depends on the weightage of the topic.

III. Practical Examination
Each core subject carries 50 Marks
40 marks + 05 marks (journal) + 05 marks (viva)
Duration: 2 Hours for each practical course.
Minimum 80% practical from each core subject is required to be completed. Certified Journal is compulsory for appearing at the time of Practical Exam failing which the student will not be allowed to appear for the practical examination.