UNIVERSITY OF DELHI

Bachelor of Vocation – Software Development

Ramanujan College

(Second Year Syllabus to Be Effective from Academic Year 2022-23)

Revised Syllabus as approved by

Academic Council

Date: No:

ExecutiveCouncil

Date: No:

1. Introduction to Programme – B.Voc SoftwareDevelopment

Ramanujan College under the umbrella of Deen Dayal Upadhyaya (DDU) Kaushal Kendra offers vocational course in software development i.e. B.Voc. (Software Development). The B.Voc. (Software Development) course comes under the purview of the IT/ITes sector.
Thesecourseswelcomeaspirantsfromallspheresofthecountryirrespectiveoftheireducational backgrounds and encourages them to learn the skills necessary for being employable in the dynamic IT industry. The curriculum in each of the years of the programme would be a suitable mix of general education and skill development components.
This program improves the skills of the candidates by concentrating on theoretical knowledge as well as practical training. The main aim of this course is to give out skills related to Computer Science and Software Development.

The course is a four year honors with research program designed to develop analytical skills in the field of software development. The program is structured with **multiple Entry/Exit schemes**. The certification levels will lead to **Diploma/Advanced Diploma/B. Voc. Degree/ B. Voc. Degree (Honors with research/academic/ industry project)** in one or more vocational areas and will be offered under the aegis of the University.

2. Description

2.1 Aims andobjectives

1. Develop theoretical understanding in information technology as per industry requirements.
2. Develop practical skills in programming based upon the most recent and mostly widely used programminglanguages.
3. Develop foundation in the ever-growing field of software development and services.
4. Develop analytical acumen, to pursue higher studies andresearch.
5. Develop ability to use state of art technologies and shape them effectively to understand and solve societal obligations.
6. To make students industry ready and enhance their ability to work in ateam.

2.2 Graduate Attributes

1. Ability to analyze, and solve real world computationalproblems.
2. Ability to design and suggest algorithms and models for givenproblems.
3. Ability to deal with growing need and requirements of software industry.
4. Ability to communicate effectively through oral and writtenmeans.
5. Ability to work in ateam.
6. Ability to become an entrepreneur and face the challenges associated withit.

3. ProgramStructure

The course will consist of combination of practice, theory and hands on skills in the IT/ITeS sector. The curriculum consists of skill based subjects which includes both theory as well as practical aspects of skill based training.

- The focus of skill components that shall be the core papers of this course to equip students with appropriate knowledge, practice and attitude, to become work ready. These components will be relevant to the industry as per its requirements.
- The curriculum will focus on work-readiness skills in each of the year of training.
- Adequate attention will be given in curriculum design to practical work, on the job training, development of student portfolios and project work.
- Adequate emphasis is given to language, communication skills, environment and ethical values.

3.1. Credit Distribution for B.Voc Software Development

SEM	**Core DSC**	**DSE**	**GE**	**AEC**	**SEC#**	**IAPC**	**VAC**	**Total Credits**
3	Data Structures (4) Web Design and Development (4) Operating Systems (4)	Programming using R/ Discrete Structures/ Digital Image Processing [Choose any 1 DSE (4)] OR Choose one from pool of GE courses (4)		Choose from pool of AEC (2)	Choose from pool of SEC OR Internship / apprenticeship / project /community outreach (IAPC) * (2)		Choose from pool of VAC (2)	22
4	Software Modelling (4) Full Stack Web Development -1 (4) Data Communication And Networks (4)	Big Data/ Advance DBMS/ Android Programming [Choose any 1 DSE (4)] OR Choose one from pool of GE courses (4)		Choose from pool of AEC (2)	Choose from pool of SEC OR Internship / apprenticeship / project /community outreach (IAPC) * (2)		Choose from pool of VAC (2)	22
5	Machine Learning (4) Full Stack	Distributed Systems/ Artificial	Choose one	--	Choose from pool		--	22

	Web Development -2 (4) Minor Project-1 (4)	Intelligence/ Advance Algorithms [Choose any 1 DSE (4)]	from pool of GE (4)		of SEC OR Internship / apprenticeship / project /community outreach (IAPC)* (2)		
6	Cloud Computing (4) Information Security (4) Minor Project – 2 (4)	Deep Learning/ Software Testing/ IOT/ Research Methodology [Choose any 1 DSE (4)]	Choose one from pool of GE (4)	--	Choose from pool of SEC OR Internship / apprenticeship / project /community outreach (IAPC) * (2)	--	22
7	Natural language Processing (4)	Data Analysis and Visualization/ Data Science and analytics using Python / Organizational Behavior/ Software Project Management/ Research Methodology/ Robotics [Choose any 3 DSE (3*4) OR Choose 2 DSE (2*4) and 1 GE (4) OR Choose 1 DSE (4) and 2 GE (2*4)]		--	--	--	Dissertation/ Academic Project/ Entrepreneurship (6) **	22
8	AdvancedAI Systems Design (4)	Optimization Techniques/ Soft Computing/Entrepreneurship/ SEO Optimization and Digital Marketing/ Quantum Computing/ Blockchain and its applications [Choose any 3 DSE (3*4) OR Choose 2 DSE (2*4) and 1 GE (4) OR Choose 1 DSE (4) and 2 GE (2*4)]		--	--	--	Dissertation/ Academic Project/ Entrepreneurship (6) **	22

SEM: Semester
DSC: Discipline Specific Core
SEC: Skill Enhancement Course
DSE: Discipline Specific Elective
GE: Generic Elective
AEC: Ability Enhancement Course
VAC: Value Addition Course
IAPC: Internship/ Apprenticeship/ Project/ Community Outreach

* As per University guidelines
** As per University guidelines; Dissertation/Academic Project/Entrepreneurship in the 4th year shall commence from VII semester and conclude in VIII semester. Detailed outcomes of each track chosen out of these three options shall be notified and assessment at the end of VII and VIII semesters shall be done accordingly.Dissertation may be written in the Major or Minor or Interdisciplinary (combination of Major and Minor) discipline.

3.2 DISCIPLINE SPECIFIC CORE (DSC) COURSES

Sem	S.No.	Core DSC
VII	1	DSC-19: Natural language Processing
VIII	2	DSC-20: AdvancedAI Systems Design

3.3 DISCIPLINE SPECIFIC ELECTIVE (DSE) COURSES

Semester	S. No.	DSE - Elective Subject
VII	1	DSE-13: Data Analysis and Visualization
	2	DSE-14: Data Science and Analytics using Python
	3	DSE-15: Organizational Behaviour
	4	DSE-16: Software Project Management
	5	DSE-17: Research Methodology
	6	DSE-18: Robotics
VIII	7	DSE-19: Optimization Techniques

	8	DSE-20: Soft Computing
	9	DSE-21: Entrepreneurship
	10	DSE-22: SEO and Digital Marketing
	11	DSE-23: Quantum Computing
	12	DSE-24: Blockchain and its Applications

3.4 CREDITS FOR DISCIPLINE SPECIFIC CORE (DSC) COURSES

Sem	S.No.	Core DSC	No. of Credits	Components of the Course		
				Lecture	Tutorial	Practical
VII	1	Natural language Processing	4	3	0	1
VIII	2	AdvancedAI Systems Design	4	3	0	1

3.5 CREDITS FOR DISCIPLINE SPECIFIC ELECTIVE (DSE) COURSES

Semester	S.No.	Core DSE	No. of Credits	Components of the Course		
				Lecture	Tutorial	Practical
VII	1	Data Analysis and Visualization	4	3	0	1
	2	Data Science and Analytics using Python	4	3	0	1
	3	Organizational Behaviour	4	3	1	0
	4	Software Project Management	4	3	0	1
	5	Research Methodology	4	3	0	1
	6	Robotics	4	3	0	1
VIII	7	Optimization Techniques	4	3	0	1
	8	Soft Computing	4	3	0	1
	9	Entrepreneurship	4	3	1	0
	10	SEO and Digital Marketing	4	3	0	1
	11	Quantum Computing	4	3	0	1
	12	Blockchain and its Applications	4	3	0	1

Annexure A
Detailed Syllabus – Discipline Specific Core

DISCIPLINE SPECIFIC CORE COURSE – 19: Natural Language Processing

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Natural Language Processing*	**4**	**3**	**0**	**1**	**Class XII pass with Mathematics**	Probability and Statistics, Machine Learning, Deep Learning

* This course is equivalent to the one offered by the Department of Computer Science, University of Delhi for the B.Sc (Hons.) Computer Science program.

***Learning objectives*:**

1. *To introduce foundational understanding in natural language*
2. *To understand the principles and methods of statistical natural language processing*
3. *To develop an in-depth understanding of the algorithms available for the processing and analysis of natural languages*
4. *To perform statistical analysis of textual data and find useful patterns from the data*

Learning Outcome:

1. *Grasp the significance of natural language processing in solving real-world problems*
2. *Preprocess and Analyze text using mathematical techniques.*
3. *Apply machine learning techniques used in NLP - HMM, RNN*
4. *Understand approaches to syntax and semantics analysis in NLP and gain practical experience of using NLP toolkits*

Unit I **(10 Hours)**

Introduction and Basic Text Processing: Knowledge in Speech and Language Processing, The problem of ambiguity, Typical NL Tasks, Tokenization, Stemming, Lemmatization, Stop-word removal, Regular Expressions, Text Normalization, Edit Distance

Unit II **(10 Hours)**

Statistical Language Modeling: Unigrams, Bigrams, N-grams, N-gram Language Models,

Smoothing and Entropy, Part-of-Speech Tagging, Named Entities and Named Entity Tagging/Recognition,
Hidden Markov Model (Forward and Viterbi algorithms and EM training)

Unit III **(15 Hours)**

Vector Semantics and Word Representations: Lexical Semantics, Vector Semantics, Words and Vectors,
TF-IDF: Weighing terms in the vector and its applications, Learning Word Embeddings - Word2vec and Gensim,
Vector Space Models

Unit IV **(10 Hours)**

Applications and Deep Learning in NLP: Text classification, Sentiment Analysis, Feedforward Neural Networks, Recurrent Neural Networks, and LSTM

References :

1. Daniel Jurafsky and James H. Martin Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, 3rd edition, Pearson, 2022.
2. Christopher D. Manning and Hinrich Schütze Foundations of Statistical Natural Language Processing, MIT Press, 1999.
Steven Bird, Ewan Klein, and Edward Loper Natural Language Processing with Python– Analyzing Text with the Natural Language Toolkit, 1st edition, O'Reilly Media, 2009.
4. Yoav Goldberg A Primer on Neural Network Models for Natural Language Processing, 2022.

Suggested Practical List :

Python Packages like Scikit (SKLearn), NLTK, spaCy, gensim, PyTorch, transformers (HuggingFace) etc. may be used for programming
1. Prepare/Pre-process a text corpus to make it more usable for NLP tasks using tokenization, filtration of stop words, removal of punctuation, stemming and lemmatization.
2. List the most common words (with their frequency) in a given text excluding stopwords.
3. Extract the usernames from the email addresses present in a given text. .
4. Perform POS tagging in a given text file. Extract all the nouns present in the text. Create and print a dictionary with frequency of parts of speech present in the document. Find the similarity between any two text documents
5. Perform dependency analysis of a text file and print the root word of every sentence.
6. Create the TF-IDF (Term Frequency-Inverse Document Frequency) Matrix for the given set of text documents
7. Extract all bigrams , trigrams using ngrams of nltk library
8. Identify and print the named entities using Name Entity Recognition (NER) for a collection of news headlines.
9. Find the latent topics in a document using any LDA and display top 5 terms that contribute to each topic along with their strength. Also visualize the distribution of terms contributing to the topics.

10. Classify movie reviews as positive or negative from the IMDB movie dataset of 50K movie reviews. (Link for dataset: https://www.kaggle.com/datasets/lakshmi25npathi/imdb-dataset-of-50k-movie-reviews)
11. Build and train a text classifier for the given data (using textbob or simpletransformers library)
12. Generate text using a character-based RNN using an appropriate dataset. Given a sequence of characters from a given data (eg "Shakespear"), train a model to predict the next character in the sequence ("e").

DISCIPLINE SPECIFIC CORE COURSE – 20: AdvancedAI Systems Design

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code		Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
			Lecture	Tutorial	Practical/ Practice		
AdvancedAI Systems Design		**4**	**3**	**0**	**1**	**Class XII pass with Mathematics**	**ML , DL , NLP**

Learning Objectives:

1. *To build AI systems by applying machine learning, deep learning, and NLP concepts learned previously.*
2. *To understand Artificial General Intelligence (AGI) and its relationship with current AI technologies.*
3. *To develop practical AI applications using Python, APIs, and integration frameworks.*

Learning Outcome:

After completing the course, students will be able to:

1. *Apply ML/DL/NLP knowledge to build intelligent AI systems.*
2. *Explain AGI concepts and current AI limitations.*
3. *Develop AI applications using APIs and multimodal capabilities.*
4. *Understand ethical, social, and safety implications of AI systems.*

UNIT-I **(10 hours)**

Introduction to AI and Intelligent Architectures: Definition of AI and AGI, narrow AI vs general AI, applying ML/DL models in AI systems, symbolic AI and expert systems, search algorithms (BFS, DFS, A*), knowledge representation, cognitive architectures (SOAR, ACT-R), intelligent agents and multi-agent systems, combining supervised/unsupervised learning with

reasoning systems.

UNIT-II **(15 hours)**

Building AI Applications using APIs and Frameworks: Architecture of AI systems, integrating pre-trained ML/DL models, using LLM APIs (OpenAI GPT, Claude, Gemini), computer vision APIs (YOLO, MediaPipe), applying NLP models in chatbots and virtual assistants, multimodal AI (text + image + speech), prompt engineering and API chaining, building intelligent workflows using LangChain, creating AI applications with Streamlit/Gradio.

UNIT-III **(10 hours)**

AI Ethics and Responsible AI: Bias in ML models and mitigation strategies, fairness in AI systems, explainable AI and model interpretability, privacy concerns in AI applications, ethical use of generative AI, AI safety and alignment, legal implications of automated decision-making, responsible AI development practices.

UNIT-IV **(10 hours)**

Current AI Trends and Applications: Overview of major AI companies and their products, generative AI applications (GPT, DALL-E, Stable Diffusion), AI in computer vision (object detection, face recognition), conversational AI and chatbots, AI in robotics and autonomous systems, reinforcement learning applications (gaming, robotics), future of AI in real-world applications and education.

References

1. Russell &Norvig – Artificial Intelligence: A Modern Approach
2. Melanie Mitchell – Artificial Intelligence: A Guide for Thinking Humans
3. Marcus & Davis – Rebooting AI
4. OpenAI, DeepMind, and SingularityNET research papers and blogs
5. Documentation from OpenCog, LangChain, GPT, and Hugging Face

List of Practicals:

1. Build a rule-based expert system using Python
2. Create an intelligent chatbot using LLM APIs
3. Develop a computer vision application using pre-trained models
4. Implement multi-agent system simulation
5. Build a multimodal AI application (text + image)
6. Create an AI web application using Streamlit
7. Test bias detection and mitigation in ML models
8. Develop a recommendation system using collaborative filtering

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DSE COURSES

OFFERED BY

DEPARTMENT OF VOCATION
Software Development

DSE – 13
Data Analysis and Visualization

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical / Practice		
Data Analysis and Visualization	**4**	**3**	**0**	**1**	**Class XII pass with Mathematics**	DSC-01(Programming using Python), Probability and Statistics, Linear Algebra

Learning Objectives:

1. *To introduce the students to real-world data analysis problems.*
2. *Students will be able to use statistics to get a deterministic view of data and interpret results in the field of exploratory data science using Python.*

Learning Outcome:

1. Apply descriptive statistics to obtain a deterministic view of data
2. Perform data handling using Numpy arrays
3. Load, clean, transform, merge and reshape data usingPandas
4. Visualize data using Pandas and matplotlibraries

UNIT-I **(5 hours)**

Introduction to basic statistics and analysis: Fundamentals of Data Analysis, Statistical foundations for Data Analysis, Typesof data, Descriptive Statistics, Correlation and covariance, Linear Regression, Statistical Hypothesis Generation and Testing, Python Libraries: NumPy, Pandas, Matplotlib

UNIT-II **(10 hours)**

Array manipulation using Numpy*:* Numpy array, Creating and various data types, indexing and slicing, swapping axes, transposing arrays, data processing using Numpy arrays.

UNIT-III **(15 hours)**

Data Manipulation using Pandas: Data Structures in Pandas: Series, Data Frame, Index objects, Loading data into Pandas data frame, Working with Data Frames: Arithmetics, Statistics, Binning, Indexing, Reindexing, Filtering, Handling missing data, Hierarchical indexing, Data wrangling: Data cleaning, transforming, merging and reshaping.

UNIT-IV **(15 hours)**

Plotting and Visualization: Using matplotlib to plot data: figures, subplots, markings, color and line styles, labels and legends, Plotting functions in Pandas: Line, bar, Scatter plots, histograms, stacked bars.

References

1. McKinney W. *Python for Data Analysis: Data Wrangling with Pandas, NumPy and IPython*. 2nd edition. O'Reilly Media, 2018.
2. Molin S. *Hands-On Data Analysis with Pandas*, Packt Publishing,2019.
3. Gupta S.C., Kapoor V.K., *Fundamentals of Mathematical Statistics*, Sultan Chand &Sons, 2020.
4. Chen D. Y, *Pandas for Everyone: Python Data Analysis*, Pearson,2018.
5. Miller J.D. *Statistics for Data Science*, Packt Publishing, 2017.

Practicals :

Use data set of your choice from Open Data Portal (https:// data.gov.in/) for the following exercises.

1. List of Practical based on NumPy
2. List of Practical based on Pandas
3. List of Practical based on Data Loading, Storage and File Formats
4. List of Practical based on Data Cleaning and Preparation
5. List of Practical based on DataWrangling
6. List of Practical based on Data Visualization usingmatplotlib

Use data set of your choice from Open Data Portal (https://data.gov.in/) for the following exercises.

Project students are encouraged to work on a good dataset in consultation with their faculty and apply the concepts learned in the course.

Practice Questions sample

1. Load a Pandas data frame from a database.tdentify and count the missing values in adata frame. Clean the data after removing noise as follows

a) Drop duplicate rows.
b) Detect the outliers and remove the rows having outliers
c) Identify the most correlated positively correlated attributes and negatively correlated attributes

2. Import iris data using sklearn library to

i. Computemean,mode,median,standarddeviation,confidenceintervaland standard error for eachfeature
ii. Compute correlation between length and width of sepalfeature
iii. Find covariance between length of sepal andpetal
iv. Build contingency table for classfeature

3. Load Titanic data from sklearn library, plot the following with proper legend and axis labels:

a. Plot bar chart to show the frequency of survivors and non-survivors for male and female passengers separately
b. Draw a scatter plot for any two selected features
c. Compare density distribution for features age and passenger fare
d. Use a pair plot to show pairwise bivariate distribution

4. Using Titanic dataset, do the following:

a. Find total number of passengers with age less than 30
b. Find total fare paid by passengers of first class
c. Compare number of survivors of each passenger class

5. Download any dataset and do the following
a. Count number of categorical and numeric features
b. Remove one correlated attribute (if any)
c. Display five-number summary of each attribute and show it visually

DSE – 14
Data Science and Analytics using Python

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Data Science and Analytics using Python	**4**	**3**	**0**	**1**	**Class XII pass with Mathematics**	DSC-01(Programming using Python)

Learning Objectives:

1. *To introduce the students to real-world data analysis problems.*
2. *To introduce students with concepts of data wrangling and aggregation.*
3. *To give students hands-on knowledge of Pandas.*

Learning Outcomes:

1. Use data analysis tools in the pandas library.
2. Load, clean, transform, merge and reshape data.
3. Create informative visualization and summarize data sets.
4. Analyse and manipulate time series data.

UNIT-I **(10 Hours)**

Introduction: Introduction to Data Science, Exploratory Data Analysis and Data Science Process. Motivation for using Python for Data Analysis, Introduction of Python shell iPython and Jupyter Notebook.

Essential Python Libraries: NumPy, pandas, matplotlib, SciPy, scikit-learn, statsmodels

UNIT-II **(10 Hours)**

Getting Started with Pandas: Arrays and vectorized computation, Introduction to pandas Data Structures, Essential Functionality, Summarizing and Computing Descriptive Statistics. Data Loading, Storage and File Formats.

Reading and Writing Data in Text Format, Web Scraping, Binary Data Formats, Interacting with Web APIs, Interacting with Databases Data Cleaning and Preparation. Handling Missing Data, Data Transformation, String Manipulation

UNIT-III **(10 Hours)**

Data Wrangling: Hierarchical Indexing, Combining and Merging Data Sets Reshaping and Pivoting.

Data Aggregation and Group operations: Group by Mechanics, Data aggregation, General split-apply-combine, Pivot tables and cross tabulation

UNIT-IV **(15 Hours)**

Time Series Data Analysis: Date and Time Data Types and Tools, Time series Basics, date Ranges, Frequencies and Shifting, Time Zone Handling, Periods and Periods Arithmetic, Resampling and Frequency conversion, Moving Window Functions.

Advanced Pandas: Categorical Data, Advanced Group by Use, Techniques for Method Chaining

References:

1. Dr. Anil Maheshwari, "Data Analytics", McGraw Hill Education (India) Private Limited.

Practicals :

Use data set of your choice from Open Data Portal (https://data.gov.in/) for the following exercises.

1. List of Practical based on NumPy ndarray
2. List of Practical based on Pandas Data Structures
3. List of Practical based on Data Loading, Storage and File Formats
4. List of Practical based on Interacting with Web APIs
5. List of Practical based on Data Cleaning and Preparation
6. List of Practical based on Data Wrangling
7. List of Practical based on Data Aggregation
8. List of Practical based on Time Series Data Analysis

DSE – 15
Organizational Behavior

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Organizational Behavior	**4**	**3**	**1**	**0**	**Class XII pass with Mathematics**	**NIL**

Learning Objectives:

1. *To deeply understand the role of individual, groups and structure in achieving organizational goals effectively and efficiently.*

2. *To critically evaluate and analyze various theories and models that contributes in the overall understanding of the discipline.*

Learning Outcomes:

1. To analyze and compare different models used to explain individual behavior related to motivation and rewards.
2. To identify the processes used in developing communication and resolving conflicts.
3. To explain group dynamics and demonstrate skills required for working in groups (team building)

UNIT-1 **(15 Hours)**

Basic forms of Business Ownership: Sole proprietorship, Partnerships, Corporations/Company, Cooperatives: Advantages and Disadvantages; An Introduction to Special forms of ownership: Franchising, Licensing, Leasing; choosing a form of Business ownership; Corporate Expansion: A brief introduction to mergers and acquisitions, diversification, forward and backward integration, joint ventures, and strategic alliance. Evolution of Management Theory: Classical, Behavioral, Systems and Contingency approaches to Management. Managerial functions and Roles (Henry Mintzberg).

UNIT-II **(15 Hours)**

Overview of Planning: Types of Plans, the planning process, making plans effective, MBO as a tool for planning; Decision making: Process, Types and Techniques. Control: Function, Process and types of Control; Principles of organizing: Common organizational structures- Functional product, Division, Customer, Geographic / Regional, Matrix, Hybrid, Networking organizational structures; Delegation and Decentralization: Factors affecting the extent of decentralization, Process and Principles of delegation.

UNIT-III **(15 Hours)**

Conceptual Foundations and Importance of organizational Behavior. Perception and Attribution: Concept, Nature, Process, And Personality: Concept, Types and Theories of Personality: Learning: Concept and Theories of Learning, reinforcement, Emotional Intelligence. Motivation:Concepts and their application, Need (Maslow and Herzberg), Content and Process theories, Expectancy theory, Equity theory, goal Setting theory. Leadership: Leaders and Leadership Process: Traits, Behavior, and Situational theories, Blake and Mouton's: Managerial grid, Hersey and Blanchards' situational Leadership Model, Likert's 4 system model, Fiedler's Leadership contingency theory, House's Path-goal theory, Contemporary Leadership issues: Charismatic, Transformational Leadership.

UNIT-IV **(15 Hours)**

Groups and Teams: Definition, Difference between Groups and teams; Stages of Group Development, Group Cohesiveness, Types of teams. Analysis of Interpersonal Relationship: Transactional Analysis, Johari Window. Organizational Power and Politics: Concept, Sources of Power, Tactics to gain power in Organizations. Nature of organizational politics. Conflict: Concept, Sources, Types, stages of conflict and Management of conflict, organizational Change: Concept, Resistance to change, managing resistance to change, Implementing Change, Kurt Lewin Theory of Change.

References:

1. Koontz and Heinz Weihrich: Essential of management McGraw Hill, 1999.

2. Kaul, Vijay kumar, Management- Text and Cases, Vikas Publishing, New Delhi, 2015.
3. Stoner and Wankel: Management

DSE – 16
Software Project Management

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Software Project Management	**4**	**3**	**0**	**1**	**Class XII pass with Mathematics**	**NIL**

Learning Objectives:

1. To use multiple techniques to estimate software tasks, projects and products.
2. To define, implement, analyze and use the metrics required to manage a software project.
3. To describe the strengths and weaknesses of software estimation and metrics techniques.

Learning Outcomes:

1. Apply project management concepts and techniques to an IT project.
2. Identify issues that could lead to IT project success or failure.
3. Explain project management in terms of the software development process.
4. Apply project management concepts through working in a group as team leader or active team member on an IT project

UNIT-I **(7 Hours)**

Introduction and Software Project Planning: Fundamentals of Software Project Management (SPM), Need Identification, Vision and Scope document, Project Management Cycle, SPM Objectives, Management Spectrum, SPM Framework, Software Project Planning, Planning Objectives, Project Plan, Types of project plan, Structure of a Software Project Management Plan, Software project estimation, Estimation methods, Estimation models, Decision process.

UNIT-II **(8 Hours)**

Project Organization and Scheduling Project Elements: Work Breakdown Structure (WBS), Types of WBS, Functions, Activities and Tasks, Project Life Cycle and Product Life Cycle, Ways to Organize Personnel, Project schedule, Scheduling Objectives, Building the project schedule, Scheduling terminology and techniques, Network Diagrams: PERT, CPM, Bar Charts: Milestone Charts, Gantt Charts. (SPI), Interpretation of Earned Value Indicators, Error Tracking, Software Reviews, Types of Review: Inspections, Deskchecks, Walkthroughs, Code Reviews, Pair Programming.

UNIT-III **(15 Hours)**

Project Monitoring ,Control and Management: Dimensions of Project Monitoring & Control, Earned Value Analysis, Earned Value Indicators: Budgeted Cost for Work Scheduled (BCWS), Cost Variance (CV), Schedule Variance (SV), Cost Performance Index (CPI), Schedule Performance Index (SPI), Interpretation of Earned Value Indicators, Error Tracking, Software Reviews, Types of Review: Inspections, Deskchecks, Walkthroughs, Code Reviews, Pair Programming. Risk Management. Tools: CASE Tools, Planning and Scheduling Tools, MS-Project. Software Configuration Items and tasks, Baselines, Plan for Change, Change Control, Change Requests Management, Version Control.

UNIT-IV **(15 Hours)**

Software Quality Assurance and Testing Objectives: Testing Principles, Test Plans, Test Cases, Types of Testing, Levels of Testing, Test Strategies, Program Correctness, Program Verification & validation, Testing Automation & Testing Tools, Concept of Software Quality, Software Quality Attributes, Software Quality Metrics and Indicators, The SEI Capability Maturity Model CMM), SQA Activities, Formal SQA Approaches: Proof of correctness, Statistical quality assurance, Cleanroom process.

References:

1. M. Cotterell, Software Project Management, Tata McGraw-Hill Publication.
2. Royce, Software Project Management, Pearson Education
3. Kieron Conway, Software Project Management, Dreamtech Press
4. S. A. Kelkar, Software Project Management, PHI Publication.
5. Harold R. Kerzner, Project Mangment "A Systems Approach to Planning, Scheduling, and Controlling" Wiley.
6. Mohapatra, Software Project Management, Cengage Learning.
7. P.K. Agarwal, SAM R., Software Project Management, Khanna Publishing House

Practicals:

1. Prepare a vision and scope document for a small software project (e.g., Online Food Ordering System) including business need, stakeholders, objectives, and deliverables.
2. Use the basic COCOMO model to calculate effort and development time for a project based on KLOC (e.g., 3 KLOC). (using Excel or online tools.)
3. Create a WBS for any software project using a hierarchical format in draw.io or MS Word. Include at least 3 levels (Phase → Task → Subtask).
4. List project tasks with start dates, durations, and dependencies, then create a Gantt chart to show scheduling and timelines.
5. Using sample data (BCWS, ACWP, BCWP), calculate CV, SV, CPI, and SPI in Excel, and interpret whether the project is on time/on budget.

DSE – 17
Research Methodology

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Research Methodology*	**4**	**3**	**0**	**1**	**Class XII pass with Mathematics**	**NIL**

* This course is equivalent to the one offered by the Department of Computer Science, University of Delhi for the B.Sc (Hons.) Computer Science program.

Learning Objective

This course allows the students to acquire the necessary skills to conduct research in computer science. It enables the students to understand the entire process of research from problem identification, literature review, designing the project to documenting the outcome.

Learning Outcomes

On the successful completion of the course, the student would be able to:

1. *Identify the problem after conduct of a literature survey.*
2. *Define goals, approach, and scope of the research.*
3. *Explore, download and interpret datasets.*
4. *Effectively record study findings in a research paper format.*

UNIT-I **(8 Hours)**

Research Fundamentals: Meaning and significance of research, requirements and characteristics of research, types of research - basic, applied analytical, conceptual, empirical, experimental, non-experimental, prospective, retrospective, exploratory / descriptive, qualitative, quantitative, mixed method. Research process, induction and deduction in research, introduction to research tools, qualities of a good researcher.

UNIT-II

(5 Hours)

Problem Identification: Choosing an appropriate problem area, identifying sources of research articles, literature review – stating and evaluating the research problem, techniques and methodologies, state of the art.

UNIT-III **(12 Hours)**

Data Analytics: Exploring and organizing data sets, pre-processing data, interpreting the data. Choosing appropriate statistics. Descriptive statistics - measures of central tendency and variability, measures of association. Inferential statistics – estimating population parameters, testing hypothesis.

UNIT-IV **(10 Hours)**

Presenting research outcomes: Essential elements of a research paper - explanation of the research problem, description of methods and data, data analysis and its interpretation, identification of possible weaknesses of the study, presenting and summarizing the research output, drawing conclusions.

UNIT-V **(5 Hours)**

Publication: Process of journal submission and review. Peer review process - single, blind and double blind. Professional research societies, scientometric analysis - citation index and analysis, plagiarism, plagiarism checker.

UNIT-VI **(5 Hours)**

Research Ethics: Ethical issues in research, protection from harm, voluntary and informed participation, right to privacy, conflict of interest, honesty with professional colleagues, professional code of ethics, intellectual property rights, fraud and misconduct in science.

Essential/recommended readings

1. Thomas, C. G. (2021). Research Methodology and Scientific Writing, 2nd Ed. Springer. 2. Leedy, P. D., & Ormrod, J. E. (2016). Practical Research: Planning and Design, 11th Ed. Pearson.

Additional References:

1. Ghezzi. C. *Being a Researcher: An Informatics Perspective.* Springer 2. Locharoenrat, K. (2018). *Research Methodologies for Beginners.* PAN Stanford Publication.
3. https://www.unesco.org/en/articles/what-you-need-know-about-unescos-new-ai competency-frameworks-students-and-teachers?hub=32618
4. Creswell, John W. Research design: Qualitative, quantitative, and mixed methods approaches. Sage publications, 2013

Suggested Practical List:

Capstone Project: Students must choose an area of interest for research, based on the curriculum (but not limited by it) covered in the program. They should identify a research problem to solve. During the semester the students must document the research journey in the form of a report, which will be evaluated at the end of the semester. The students are encouraged to write a research
paper based on the report, under the guidance of the teacher. The practical class for research methodology course should be utilized to perform the following tasks in the research process.

1. Search the research papers related to the chosen problem using academic search engines like Google Scholar, Scopus search, Web of Science database, etc.
   a. Evaluate the venue of the source of research paper - Journals using citation metrics like CiteScore, SCImago Journal Rank (SJR)), Source Normalized Impact per Paper (SNIP) etc., Conferences venues are evaluated using indexing information, Core Ranking etc.
   b. Summarize the reviewed papers in a tabular format with columns: Paper Title, Author(s), Year, Key Findings, and Citation Count.
   c. Explore reference management tools like Mendley / Zotero / EndNote to organize, store, and manage references.

2. Practice data analysis techniques taught in the class and identify a suitable technique required to solve the chosen research problem.

3. Write the research report and prepare to write the research paper.

a. Choose a document writing software and prepare the report as per the format given by the teacher.
b. Use the plagiarism check tool to assess the similarity index of the report and ensure that it is less than 10%.
c. Explore the journal finder tools available for the publishers and select a suitable journal to submit the manuscript

DSE – 18
Robotics

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Robotics	**4**	**3**	**0**	**1**	**Class XII pass with Mathematics**	DSC-03(Mathematics for Computing-I) ,DSC-06(Mathematics for Computing-II)

Learning Objectives:

1. *To teach students the fundamentals of creating and programming a robot to interact with its environment.*
2. *To perform basic tasks involving motion, sensor data and decision-making.*

Learning Outcomes:

1. *Explain the fundamentals of robotics and its components*

2. *Explain sensors and actuators in robotics*
3. *Know about various communication modes used in robotics*

UNIT-I **(7 Hours)**

Programming Environments: Integrated Development Environment (IDE) for AVR microcontrollers, free IDEs like AVR studio, win AVR. Installing and configuring For Robotic programming, In System Programmer (ISP), loading programs on Robot.

UNIT-II **(8 Hours)**

Actuators: DC Motors, Gearing and Efficiency, Servo Motors, Stepper motors, Motor control and its implementations.

UNIT-III **(15 Hours)**

Sensors and LCD interfacing: White line sensors, IR Range sensor of different range, Analog IR proximity sensors, Analog directional light intensity sensors, position encoder, Servo mounted sensor pod/camera pod, wireless color camera, Ultrasound scanner, Gyroscope and accelerometer, Magnetometer, GPS receiver, Battery voltage sensing, current sensing.
LCD interfacing with the robot (2 x 16 Characters LCD), other indicators: Indicator LEDs.

UNIT-IV **(15 Hours)**

Timer / counter operations: PWM generation, Motor velocity control, servo control, velocity calculation and motor position control, event scheduling.
Communication: Wired RS232 (SERIAL) communication, Wireless ZigBee Communication, USB communication, Simplex infrared communication (IR remote to robot).

References:

1. *Saha, S.K, Introduction to robotics, 2 nd edition, McGraw-Hill Education, New Delhi, 2014*
2. R.K Mittal, I.J Nagrath, -Robotics & Controll, Tata McGraw & Hills, 2015.

Practicals:

1. Blink an LED using AVR microcontroller.
2. Run a DC motor in forward and reverse directions using motor driver.
3. Detect obstacle using IR sensor and turn ON an LED.
4. Display IR sensor values on a 16x2 LCD.
5. Control the angle of a servo motor using PWM.
6. Measure the speed of a DC motor using an encoder and display it.

DSE – 19
Optimization Techniques

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical / Practice		
Optimization Techniques	**4**	**3**	**0**	**1**	**Class XII pass with Mathematics**	DSC-01(Programming using Python) , Linear Algebra and Vector Calculus

Learning Objectives:

1. *To apply the theory of optimization methods and algorithms to develop and for solving various types of optimization problems.*
2. *To go in research by applying optimization techniques in problems of Engineering and Technology.*

Learning Outcomes:

1. Be able to model engineering minima/maxima problems as optimization problems.
2. Be able to use Matlab to implement optimization algorithms

UNIT-I **(5 Hours)**

Linear Programming Problems (LPP) in the standard form: Mathematical formulation, LPP in canonical form, conversion of LPP in standard form to LPP in canonical form.

UNIT-II **(10 Hours)**

Simplex: Prevention of cyclic computation in Simplex and Tableau, Big-M method, Dual Simplex and Revised Simplex. Complexity of Simplex algorithms, Exponential behavior of Simplex.

UNIT-III **(15 Hours)**

Ellipsoid method and Karmakar's method for solving LPP: Solving simple LPPs through these methods etc. Assignment and Transportation Problems: Simple algorithms like Hungarian Method etc. Shortest Path Problems: Dijkestra and Moore's method

UNIT-IV **(15 Hours)**

Network Flow Problem: Formulation Max Flow, Mincut theorem, Ford and Fulkerson's algorithm, Malhotra, Pramod Kumar Maheshwari (MPM) Polynomial algorithm for solving network flow problem.

Non Linear Programming: Kuhn Tucker Conditions, Convex Functions and Convex region.

References:

1. An introduction to Optimization by Edwin P K Chong, Stainslaw Zak
2. Nonlinear Programming by Dimitri Bertsekas

Practicals:

1. Hands-on practice with optimization algorithms and tools.
2. A small project to apply optimization techniques to various problems.
3. A comprehensive project to formulate and solve a complex optimization problem. 4. Reviewing and analyzing optimization problems in real-world scenarios.

DSE – 20
Soft Computing

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Soft Computing	**4**	**3**	**0**	**1**	**Class XII pass with Mathematics**	**NIL**

Learning Objectives:

1. *To teach students the fundamentals of soft computing and its applications.*
2. *To give students knowledge of neural networks, fuzzy systems and hybrid systems.*

Learning Outcomes:

1. To Improve Data Analysis Solutions is to strengthen the dialogue between the statistics and soft computing research communities in order to cross-pollinate both fields and generate mutual improvement activities.
2. Soft Computing is a consortia of methodologies which collectively provide a body of concepts and techniques for designing intelligent systems.

UNIT-I **(5 Hours)**

Introduction: What is Soft Computing? Difference between Hard and Soft computing, Requirement of Soft computing, Major Areas of Soft Computing, Applications of Soft Computing.

UNIT-II **(10 Hours)**

Neural Networks: What is Neural Network, Learning rules and various activation functions, Single layer Perceptrons, Back Propagation networks, Architecture of Backpropagation(BP) Networks, Backpropagation Learning, Variation of Standard Back propagation Neural Network, Introduction to Associative Memory, Adaptive Resonance theory and Self Organizing Map, Recent Applications.

UNIT-III **(15 Hours)**

Fuzzy Systems: Fuzzy Set theory, Fuzzy versus Crisp set, Fuzzy Relation, Fuzzification, Minmax Composition, Defuzzification Method, Fuzzy Logic, Fuzzy Rule based systems, Predicate logic, Fuzzy Decision Making, Fuzzy Control Systems, Fuzzy Classification, Genetic Algorithm: History of Genetic Algorithms (GA), Working Principle, Various Encoding methods, Fitness function, GA Operators- Reproduction, Crossover, Mutation, Convergence of GA, Bit wise operation in GA, Multi-level Optimization.

UNIT-IV **(15 Hours)**

Hybrid Systems: Sequential Hybrid Systems, Auxiliary Hybrid Systems, Embedded Hybrid Systems, Neuro-Fuzzy Hybrid Systems, Neuro-Genetic Hybrid Systems, Fuzzy-Genetic Hybrid Systems. GA based Weight Determination, K - factor determination in Columns.

References:

1. Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications, S.Rajasekaran, G. A. Vijayalakshami, PHI.
2. Genetic Algorithms: Search and Optimization, E. Goldberg.
3. Neuro-Fuzzy Systems, Chin Teng Lin, C. S. George Lee, PHI.
4. Build_Neural_Network_With_MS_Excel_sample by Joe choong.

Practicals:

1. Train a simple perceptron or multilayer perceptron to learn the XOR logic gate using Python or MATLAB.
2. Use Python (TensorFlow or Keras) to implement a backpropagation neural network to classify simple data like digits or shapes.
3. Write a simple genetic algorithm in Python to find the maximum value of a mathematical function (e.g., `f(x) = x * sin(x)`).
4. Use scikit-fuzzy (Python) or MATLAB to cluster sample data (e.g., customer behavior data) using fuzzy C-means algorithm.
5. Use MATLAB's ANFIS editor to train and test a fuzzy-neural model for function approximation or prediction.

DSE – 21
Entrepreneurship

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical / Practice		
Entrepreneurship	4	3	1	0	Class XII pass with Mathematics	NIL

Learning Objectives:

1. *To understand the meaning and importance of entrepreneurship.*
2. *To understand the issues and problems faced by entrepreneurs.*
3. *To enable students to work effectively with colleagues with diverse skills, experiences and be able to critically reflect on own practice.*

Learning Outcomes:

1. Recognize the entrepreneurial potential within yourself and appreciate the role of entrepreneurship within society
2. Understand the process of entrepreneurship
3. Develop and appraise creative new business concepts that can be turned into sustainable business ventures
4. Identify the financial, marketing, legal, human resource, operations, and general management skills that are necessary to successfully launch and operate a new venture.

UNIT-I **(10 Hours)**

Introducing Entrepreneurship: Introduction: concept and definitions, entrepreneurship mindset, entrepreneurship process; factors impacting emergence of entrepreneurship; Evolution of entrepreneurship; role of entrepreneur: role of an entrepreneur in economic growth as an innovator; generation of employment opportunities; complementing and supplementing economic growth; bringing about social stability and balanced regional development of industries.

UNIT-II **(15 Hours)**

Building Blocks of Entrepreneurship: Classification and types of entrepreneurs; dimensions of entrepreneurship: intrapreneurship, social entrepreneurship, net entrepreneurship, technopreneurship, cultural entrepreneurship, ecopreneurship; women entrepreneurs; rural entrepreneurship; corporate entrepreneurs; characteristics of entrepreneur: leadership; risk taking; decision-making and business planning. Managerial versus entrepreneurial decision making; entrepreneurial attributes and characteristics; traits/qualities of entrepreneurs; creativity & innovation.

UNIT-III **(20 Hours)**

Creating and Running Entrepreneurial Ventures: Creating Entrepreneurial Venture,Generating Business idea - Sources of Innovation, generating ideas, Creativity and Entrepreneurship; Challenges in managing innovation; Entrepreneurial strategy, Business planning process; Business Model for start-up ventures; Drawing business plan; Business plan failures.

Mobilizing resources for start-up. Accommodation and utilities; Preliminary contracts with the vendors, suppliers, bankers, principal customers; Contract management: Basic start-up problems. Promotion of a Venture: External environmental analysis- economic, social and technological, Competitive factors: Legal requirements for establishment of new unit and raising of funds, venture capital sources and documentation required. Analyzing Business Opportunities: Market Analysis; demand-supply. Technical Analysis; assets analysis, Financial Analysis; sources of capital and its cost. Viable and feasible business Opportunity: Testing feasibility of business ideas by applying sensitivity analysis.

UNIT-IV **(15 Hours)**

New Frontiers in Entrepreneurship: Technology and Entrepreneurship: tech-enabled ventures; technology supporting entrepreneurship. Intrapreneurship: description, forms, levels and degrees of corporate entrepreneurship, corporate culture. Entrepreneurial climate within the organization: description, impact on intrapreneurship. Eco-friendly and climate conscious entrepreneur. Stimulating organizational creativity: creative teams; managing organizations for innovation and positive creativity.

References:

1. Hisrich, R.D., Manimala, M.J., Peters, M.P., Shepherd, D.A.Entrepreneurship, Tata McGraw Hill

2. Brandt, S. C. Entrepreneuring: The Ten Commandments for Building a Growth Company. MacMillan Business Books.

3. Holt, D. H. Entrepreneurship: New Venture Creation. New Delhi: Prentice Hall of India.

4. Panda, S. C. Entrepreneurship Development. New Delhi: Anmol Publications.

5. Taneja, S., & Gupta, S. L. Entrepreneurship Development-New Venture creation. New Delhi: Galgotia Publishing House.

6. Shankar, R., Entrepreneurship Theory and Practice, Tata McGraw Hill.

DSE – 22
SEO and Digital Marketing

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
SEO and Digital Marketing	4	3	0	1	Class XII pass with Mathematics	NIL

Learning Objectives:

1. *To launch a new, or evolve an existing, career path in Digital Marketing*
2. *To articulate the value of integrated marketing campaigns across SEO, Paid Search, Social, Mobile, Email, Display Media, and Marketing Analytics.*
3. *To recognize Key Performance Indicators tied to any digital marketing program.*

Learning Outcomes:

1. *To help students to succeed through online business.*
2. *To help Small, medium and large business owners*
3. *Anyone who want to dominate Google for their business keywords*
4. *Website designers and developers who want to offer SEO services*

UNIT-I **(10 Hours)**

Introduction to Digital Marketing: The impact of Digital Marketing and effective strategies, Marketing & data regulations such as GDPR ,Campaigns via your website and social media: LinkedIn, Facebook, Twitter etc. ,Capitalising on ROI (Return on Investment on Campaign strategies, Website overviews: HTML5 vs. WordPress and E-commerce sites ,Mobile marketing and analytics , Attracting and retaining customers via mobile ,Conversion rates, tracking, analytics and reporting ,Search engine optimisation ,Developing a content plan and Successful content strategies ,Social Media Platforms; LinkedIn, Facebook, Twitter, Instagram, YouTube, Snapchat and others ,The power of hashtags and search terms.

UNIT-II **(10 Hours)**

Basics for SEO:Domain Basic Knowledge of World Wide Web,Difference between Portal and Search Engines,Types of SEO Techniques,Black hat techniques, White Hat techniques Search Engine working, Page Speed ,Basics of search engine that includes crawling, indexing and caching.

UNIT-III **(10 Hours)**

Market Research, Keyword Research and Analysis: Keyword opportunity, Competitors Website Analysis, SWOT Analysis of Website .How to Choose Best Keywords, Tools available for Keyword Research, Search engine commands, Search engine algorithms.

UNIT-IV **(15 Hours)**

Content Research ,Content Guidelines, Content Optimization ,Design & Layout: XML Sitemap / URL List Sitemap ,Search engine friendly content development ,On-page Optimization, The Page Title, Meta Descriptions & Meta Keywords, Headings, Bold Text, Domain Names & Suggestions, Canonical Tag ,Meta Tags ,Images and Alt Text, Internal Link Building, The Sitemap ,Invisible Text ,Server and Hosting Check, 404 Error, Duplicate content ,PDF, PPT, MS-Word & Video Optimization, off page optimization.

SEO Tools: Keyword Density Analyzer Tools, Google Tools, Yahoo / Bing Tools, Rich Snippet Text Tools, Comparison Tools, Link Popularity Tools, Search Engines Tools Site Tools Miscellaneous Tools.

References:

1. SEO 2021 Learn Search Engine Optimization with Smart Internet Marketing Strategies: Learn SEO with smart internet marketing strategies by Adam Clarke.

2. Digital Marketing | Second Edition Paperback – 6 August 2020 by Seema Gupta

Practicals:

1. Design a small paid ad campaign (use a mock budget or real trial), track performance (clicks, leads), and calculate ROI based on results.
2. Use a tool like Ubersuggest, Ahrefs (free trial), or SEMRush (limited features) to analyze a competitor website's top-performing pages, backlinks, and keywords.
3. Build a sample product page using WordPress with a call-to-action (CTA), images, meta tags, and an inquiry/contact form.
4. Use any website and check whether it has a proper XML sitemap and robots.txt file using tools like Google Search Console or SEO Site Checkup.
5. Use Google PageSpeed Insights or GTmetrix to test any website's speed and get suggestions to improve performance on mobile and desktop.

DSE – 23
Quantum Computing

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical / Practice		
Quantum Computing	**4**	**3**	**0**	**1**	**Class XII pass with Mathematics**	DSC-01(Programming using Python) , Linear Algebra and Vector Calculus

Learning Objectives:

1. *To Study the structural units of quantum computers of the future, forming an understanding of the differences between quantum bits and classical bits*
2. *To Study of basic quantum logical operations and algorithms for processing quantum information.*

Learning Outcomes:

1. *Understand the basic implications of quantum computing*
2. *The fundamental differences between conventional computing and quantum computing.*
3. *Several basic quantum computing algorithms.*
4. *The classes of problems that can be expected to be solved well by quantum computers.*

Unit-I **(7 Hours)**

Overview of traditional computing, Turing machines, analysis of computational problems, quantum mechanics, Dirac notation and Hilbert Spaces, linear algebra for quantum mechanics, Pauli matrices, Hermitian operators, Tensor products. Qubit, Bloch Sphere, Quantum Computation,

UNIT II **(8 Hours)**

No-cloning theorem, Bell states, Entanglement, quantum teleportation, applications of teleportation, super dense coding, quantum key distribution
State of a quantum system, time evolution of a closed system, composite systems, measurement, mixed states.

UNIT-III **(15 Hours)**

Quantum circuit model, quantum gates, Hadamard gate, controlled operations, universal sets of quantum gates, unitary transformations, simulation of quantum systems. Introduction to the IBMQ,

UNIT-IV **(15 Hours)**

Probabilistic versus quantum algorithms, Quantum parallelism, Deutsch algorithm, Deutsch-Jozsa algorithm, Simon's algorithm, Shor's algorithm

References:

1. *Quantum Computation and Quantum Information, M A Nielsen and I L Chuang.*
2. *An Introduction to Quantum Computing, P Kaye, R Laflamme and M Mosca.*

Practicals:

1. Use Qiskit or IBMQ to create a qubit in superposition and visualize it on the Bloch Sphere.
2. Build a quantum circuit to generate an entangled Bell state and verify it using measurement results.
3. Simulate quantum teleportation of a qubit's state using a quantum circuit with entanglement and classical bits.
4. Create a quantum circuit for Deutsch's algorithm and run it to determine if a function is constant or balanced.
5. Use IBMQ or Qiskit to implement basic quantum gates (X, H, Z, CNOT) and observe their effect on quantum states.

DSE – 24
Blockchain and its Applications

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Blockchain and its Applications	**4**	**3**	**0**	**1**	**Class XII pass with Mathematics**	**NIL**

Learning Objectives:

1. *To cover the basic concepts behind blockchain and present Bitcoin and other cryptocurrencies as the motivation for blockchain technologies.*
2. *To provides a substantive discussion about different technologies behind blockchain and cryptocurrencies.*

Learning Outcomes:

1. *Understand the fundamental principles and structure of blockchain technology, including cryptographic components and decentralized systems.*
2. *Analyze and compare consensus mechanisms such as Proof of Work and Proof of Stake in real-world blockchain networks.*
3. *Demonstrate practical knowledge of cryptocurrencies, transactions, wallets, and major platforms like Bitcoin and Ethereum.*
4. *Design and deploy basic smart contracts using Ethereum and Solidity for decentralized applications.*

UNIT-I **(10 Hours)**

Introduction: History and evolution of money to digital currencies, Introduction to Blockchain: concept, purpose, key features, Cryptographic foundations: Hashing, Digital Signatures, Public vs Private vs Consortium Blockchains, Blockchain structure: Blocks, Hash functions, Block headers, Merkle Trees.

UNIT-II **(10 Hours)**

Consensus and Decentralized Systems: Peer-to-peer networks and decentralization principles, Consensus algorithms: Proof of Work (PoW), Proof of Stake (PoS), Delegated Proof of Stake (DPoS), Forks and governance in blockchain systems, Blockchain scalability and energy concerns.

UNIT-III **(10 Hours)**

Cryptocurrencies and Transactions: Bitcoin architecture: Addressing and UTXO model, Ethereum basics: Accounts, Gas and Ether, Transactions and Wallets, Overview of major cryptocurrencies: Bitcoin, Ethereum, Stablecoins (USDT, USDC).

UNIT-IV **(15 Hours)**

Smart Contracts and Applications: Smart Contracts: Concept and use-cases, Introduction to Ethereum and Solidity, DeFi overview: Lending, DEX, Staking, Real-world applications: Supply Chain, NFTs, Digital Identity, Legal and ethical considerations in smart contract deployment.

References:

1. Mastering blockchain Distributed ledger technology, decentralization, and smart contracts explained by Imran Bashir, 2nd edition (2018), Packt Publication.
2. Mastering Blockchain Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications by Lorne Lantz and Daniel Cawrey, 1 st Edition (2020), O'Reilly Publication.
3. Introducing Ethereum and Solidity Foundations of Cryptocurrency and Blockchain Programming for Beginners by Chris Dannen, 1st Edition (2017), Apress Publication.

Practicals:

1. Using SHA256, obtain the message digest of string "Blockchain Developer".

2. Write a program to encrypt and decrypt the message “Hello World” using
SHA256. 3. Implement a simple chain of 5 nodes using linked list.
4. Implement RSA cryptographic algorithm.
5. Create a simple blockchain using Proof of Work (PoW).
6. Demonstrate sending of a digitally signed document.
7. Create a hash table that has ‘8’ number of buckets and insert the keys 20, 1, 7, 15, 25,16, 8, 20 using hash function h(k) = k mod 3.
8. Create a blockchain having 5 nodes and print the hash values of each
block. 9. Create a blockchain having 5 nodes and check its validity.
10. Use flask to deploy blockchain.