S.Y.B.Sc (DATA SCIENCE) 2025-26

	Semester III Subjects	Credits		Semester IV Subjects	Credits
Major **BDD301** **BDS302** **BDDP303** **BDSP304**	 Data warehousing and Mining Data structure and Algorithm using Python Programming Data warehousing and Mining Practical Data structure and Algorithm using Python Programming Practical	 2 2 2 2	**Major** **BDB401** **BDA402** **BDBP403** **BDAP404**	 Big Data Artificial Intelligence Big Data Practical Artificial Intelligence Practical	 2 2 2 2
Minor **BDR305** **BDRP306**	 Research Methodology Research Methodology Practical.	2 2	**Minor** **BDT405** **BDTP406**	 Testing of Hypothesis Testing of Hypothesis Practical	 2 2
OE **BDL307** **BDF307** **BDE307**	Linear Algebra Fundamental of Stock Market. Econometrics-I	2	**OE** **BDN407** **BDM407** **BDE407**	Numerical Methods Basics of Marketing Econometrics-II	2
VSC **BDW308** **BDO308**	Web Technology Operating System	2	**SEC** **BDS408** **BDC408**	Search Engine Optimization Computer Graphics	2
AEC **BDH309/BDM309**	Hindi/Marathi	2	**AEC** **BDH409/BDM409**	Hindi/Marathi	2
FP **BDFP310**	FP	2	**CEP** **BDCP410**	CEP	2
CC **BDN311/BDY311**	NSS/ Sports/ Cultural/ Yoga	2	**CC** **BDN411/BDY411**	NSS/ Sports/ Cultural/ Yoga	2
	Total	**22**			**22**

SEMESTER IV

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Programme Name: **S.Y.B.Sc(Data Science)**	**Semester:IV**
Course Category: Major	
Name of the Dept: **Science and Technology**	
Course Title: **Big Data**	
Course Code: **BDB401** Course Level: 5.0	
Type: Theory	
Course Credit: 02	
Hours Allotted: 30 Hours	
Marks Allotted: 50 Marks	
Course Objectives: 1. Overview of an exciting growing field of big data analytics 2. To provide a sound understanding of Big Data Processing Systems, platforms, management, Big Data Replay on Multicore	
Course Outcomes: After the completion of the course, the learners would be able to: CO1: To introduce the tools required to manage and analyze big data like Hadoop, NoSql MapReduce. CO2: To teach the fundamental techniques and principles in achieving big data analytics with scalability, streaming capability and Big Data Replay on Multicore.	
Description the course:	Introduction, relevance, Usefulness, Application, interest, connection with other courses, demand in the industry, job prospects etc.

Syllabus: NEP 2020 w.e.f 2025-26

Unit No.	Content	Hours
I	**Big Data Science:** Introduction and Historical Interpretation of Big Data, From 3Vs to 3^2Vs , Big Data Analytics and Machine Learning, Big Data Analytics and Cloud Computing, Hadoop, HDFS, MapReduce, Spark, and Flink **Real-Time Analytics:** Computing Abstractions for Real-Time Analytics, Real-Time Processing for Big Data, Data Stream Processing Platforms, Data Stream Analytics Platforms, Data Analysis and Analytic Techniques, Finance Domain Requirements **Database Techniques for Big Data:** Background, NoSQL Movement, NoSQL Solutions for Big Data Management, NoSQL Data Models	15
II	Resource Management, Big Data Processing Systems and Platforms, Single-Resource Management in the Cloud, Multi resource Management in the Cloud, Related Work on Resource Management. **Local Resource Consumption Shaping:** A Case for MapReduce: Local Resource Shaper, Evaluation System Optimization for Big Data Processing: Basic Framework of the **Hadoop Ecosystem, Parallel Computation Framework :** MapReduce, Job Scheduling of Hadoop, Performance Optimization of HDFS and HBase. **Packing Algorithms for Big Data Replay on Multicore:** Performance Bottlenecks, The Replay Method, Packing Algorithms	15
	Total Hours	**30**

Books and References:

1. Big Data Principles and Paradigms, Rajkumar Buyya, Rodrigo N. Calheiros, Amir Vahid Dastjerdi, Publisher: Morgan Kaufmann
2. Big Data: Principles and best practices of scalable real-time data systems By Nathan Marz and James Warren Publisher: Manning Publications
3. Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph By David Loshin Publisher: Morgan Kaufmann

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<table>
<tr><td colspan="2">Programme Name: SY B.Sc. Data Science Semester: IV</td></tr>
<tr><td colspan="2">Course Category: Major</td></tr>
<tr><td colspan="2">Name of the Dept: Science and technology</td></tr>
<tr><td colspan="2">Course Title: Artificial Intelligence</td></tr>
<tr><td colspan="2">Course Code: BDA402 Course Level: 5.0</td></tr>
<tr><td colspan="2">Type: Theory</td></tr>
<tr><td colspan="2">Course Credit: 2 Total Marks: 50 Marks</td></tr>
<tr><td colspan="2">Hours Allotted: 30</td></tr>
<tr><td colspan="2">Course Objectives:
1. Comprehensive understanding of intelligent systems, AI problem-solving techniques, search algorithms, and the development of intelligent agents using various search methods and reasoning strategies.
2. To explore uncertainty reasoning, probabilistic models like Bayesian networks, and machine learning techniques, including supervised learning, decision trees, neural networks, and deep learning for solving real-world problems</td></tr>
<tr><td colspan="2">Course Outcomes:
CO1: Students will be able to design and implement intelligent agents, apply various search techniques, and formulate AI problems effectively to solve complex challenges using both uninformed and informed search strategies.
CO2: Students will be able to effectively apply uncertainty reasoning and advanced machine learning techniques, including probabilistic models, decision trees, neural networks, and deep learning, to solve complex real-world problems.</td></tr>
<tr><td>Description the course:</td><td>This course introduces the fundamentals of Artificial Intelligence (AI), focusing on intelligent agents, problem-solving techniques, and search algorithms. It covers uninformed and informed search methods, uncertainty reasoning using Bayesian networks, and key machine learning concepts like decision trees, neural networks, and support vector machines. Students will learn to apply these techniques in real-world AI applications. The course emphasizes both theoretical understanding and practical implementation.</td></tr>
</table>

Syllabus: NEP 2020 w.e.f 2025-26

Unit No.	Content	Hours
I	**Intelligent Systems and Intelligent Agents**: Introduction to AI, AI Problems and AI techniques, Solving problems by searching, Problem Formulation. State Space Representation Structure of Intelligent agents, Types of Agents, Agent Environments PEAS representation for an Agent. **Searching Techniques**: Uninformed Search: DFS, BFS, Uniform cost search, Depth Limited Search, Iterative Deepening. Informed Search: Heuristic functions, Hill Climbing, Simulated Annealing, Best First Search, A*	15
II	**Uncertainity and Reasoning**: Uncertainly, Representing Knowledge in an Uncertain Domain, Bayesian Network, Conditional Probability, Joint Probability, Bayes' theorem, Belief Networks **Machine Learning:** Forms of Learning, Supervised Learning, Learning Decision Trees, Evaluating and Choosing the Best Hypothesis, Theory of Learning, Regression and Classification with Linear Models, Artificial Neural Networks, Support Vector Machines, Introduction to deep learning.	15
	Total Hours	**30**

References:

Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year**
1.	Artificial Intelligence: A Modern Approach	Stuart J. Russell and Peter Norvig	Pearson	Fourth Edition	2020
2.	Artificial Intelligence: Foundations of Computational Agents	David L Poole, Alan K. Mackworth	Cambridge University Press	Second Edition	

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<table>
<tr><td colspan="2">Programme Name: S.Y.B.Sc(Data Science) Semester:IV</td></tr>
<tr><td colspan="2">Course Category: Major</td></tr>
<tr><td colspan="2">Name of the Dept: Science and Technology</td></tr>
<tr><td colspan="2">Course Title: Big data Practical</td></tr>
<tr><td colspan="2">Course Code: BDBP403 Course Level: 5.0</td></tr>
<tr><td colspan="2">Type: Practical</td></tr>
<tr><td colspan="2">Course Credit: 02</td></tr>
<tr><td colspan="2">Hours Allotted: 60 Hours</td></tr>
<tr><td colspan="2">Marks Allotted: 50 Marks</td></tr>
<tr><td colspan="2">Course Objectives:
1. Learners must understand tools required to manage and analyze big data like Hadoop, NoSQL, MapReduce.
2. Understanding of techniques and principles in achieving big data analytics with scalability and streaming capability.</td></tr>
<tr><td colspan="2">Course Outcomes:
After the completion of the course, the learners would be able to:
CO1: To introduce the tools required to manage and analyze big data like Hadoop, NoSQL, MapReduce.
CO2: To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.</td></tr>
<tr><td>Description the course:</td><td>Introduction, relevance, Usefulness, Application, interest, connection with other courses, demand in the industry, job prospects etc.</td></tr>
</table>

Syllabus: NEP 2020 w.e.f 2025-26

	List of Practical's	Hours
1	a. Install, configure and run Hadoop and HDFS b. Implement word count/ frequency program using MapReduce Hadoop/R	
2	Implement an Mapreduce program that process a weather dataset	
3	Exploring Hadoop Distributed File System (HDFS)	
4	Implement an application that store big data in Hbase/ Mongodb/ Pig using Hadoop/R	
5	Implement a program in Pig	
6	Configure the Hive and implement the application in Hive	
7	Illustrate the working of Jaql	
8	a. Implement Decision tree classification technique b. Implement SVM Classification technique	
9	Regression Model: a. Import a data from web storage. Name the dataset and do Logistic Regression to find out relation between variables that are affecting the admission of a student in an institute based on his or her GRE score, GPA obtained and rank of the student. Also check the model is fit or not require (foreign), require (Mass) b. b MULTIPLE REGRESSION MODEL: Apply multiple regressions, if data have a continuous independent variable. Apply on above dataset.	
10	CLASSIFICATION MODEL: a. Install relevant package for classification. b. Choose classifier for classification problem. c. Evaluate the performance of classifier.	
	CLUSTERING MODEL a. Clustering algorithms for unsupervised classification. b. Plot the cluster data using R visualizations.	
	Total Hours	**60**

Books and References:

1. VigneshPrajapati, "Big Data Analytics with R and Hadoop", Packt Publishing House.
2. Bart Baesens, Analytics in a Big Data World: The Essential Guide to Data Science and its Applications (Wiley and SAS Business Series), Wiley

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Programme Name: **S.Y. B.Sc (Data Science)**	**Semester: IV**
Course Category: Major	
Name of the Dept: **Science and Technology**	
Course Title: **Artificial Intelligence Practical**	
Course Code: **BDAP404**	Course Level: 5.0
Course Credit: **02**	Total Marks: **50**
Type- Practical	
Hours Allotted: 60 Hrs	

Course Objectives:

1. To teach students how to implement search algorithms and AI techniques to solve problems like the Water Jug Problem, N-Queen, and machine learning tasks such as decision trees and classification.
2. To provide practical experience in applying AI algorithms and creating PL/SQL triggers and packages for efficient problem-solving and database management.

Course Outcomes: Learners will be able to,

CO1: Students will gain hands-on experience in implementing and applying both uninformed and informed search algorithms, including Depth First Search, Breadth First Search, Hill Climbing, Simulated Annealing, and A*, to solve real-world problems like the Water Jug Problem, Number Puzzle, and N-Queens.

CO2: Students will acquire the skills to implement machine learning algorithms such as linear regression and classification, along with decision tree models for both binary and multi-class classification tasks, enabling them to tackle complex data-driven problems effectively.

Course Description:	This course focuses on advanced AI techniques and algorithms, emphasizing search strategies, problem-solving, and decision-making. Students will learn and implement both uninformed and informed search algorithms like DFS, BFS, Hill Climbing, and A*. The course also covers machine learning techniques, including linear regression, classification, and decision trees, along with game theory concepts like Alpha-Beta pruning. Practical applications include solving classic AI problems like the N-Queens, map coloring, and the water jug problem. By the end, students will be equipped with the tools to apply AI in real-world scenarios and optimization problems.

Syllabus: NEP 2020 w.e.f 2025-26

Sr No.	Content	Hours
1	**Generate the state-space possibilities for the following problems** a. Water jug problem b. Number puzzle	
2	**Write the program to compute the following Uninformed Search Algorithms for suitable problem** a. Depth First Search b. Breadth First Search	
3	**Write the program to compute the following Informed Search Algorithms for suitable problem** **a.** Hill Climbing b. Simulated Annealing **c.** A* algorithm	
4	**Write the program to compute the following Algorithms for suitable problem** a. Simulate solution for 4-Queen / N-Queen problem **b.** Constraint satisfaction problem: Map Coloring	
5	**Write the program to compute the following Search Algorithms for suitable problem** a. Alpha Beta Pruning **b.** Water jug problem	
6	**Write the program to compute the following Algorithms for suitable problem** **a.** Simple Inferencing	
7	**Write the program to compute the following Algorithms for suitable problem** a. Linear Regression **b.** Classification problem	
8	**Write the program to implement decision tree for suitable problem.** a. Two Class decision **b.** Multi Class decision	
	Total Hours	**60**

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<table>
<tr><td colspan="2">Programme Name: S.Y.B.Sc(Data Science) Semester:IV</td></tr>
<tr><td colspan="2">Course Category: Minor</td></tr>
<tr><td colspan="2">Name of the Dept: Science & Technology</td></tr>
<tr><td colspan="2">Course Title: Testing of Hypothesis</td></tr>
<tr><td colspan="2">Course Code: BDT405 Course Level: 5.0</td></tr>
<tr><td colspan="2">Type: Theory</td></tr>
<tr><td colspan="2">Course Credit: 02</td></tr>
<tr><td colspan="2">Hours Allotted: 30 Hours</td></tr>
<tr><td colspan="2">Marks Allotted: 50 Marks</td></tr>
<tr><td colspan="2">Course Objectives:
1. Understand the Fundamentals of Data Collection Process
2. Develop Skills to Formulate Research Problems and apply scientific process to test it</td></tr>
<tr><td colspan="2">Course Outcomes:
After the completion of the course, the learners would be able to:
CO 1: Ability to Critical Thinking and apply analytical tools to interpret results effectively.
CO 2: Ability to critically evaluate existing research, assess evidence, and make data-driven decisions.</td></tr>
<tr><td>Description the course:</td><td>Hypothesis testing are crucial for data analysts. Accurate data collection ensures reliable insights, while hypothesis testing helps validate assumptions with statistical evidence. This process supports data-driven decisions, reduces bias, and quantifies uncertainty. By combining clean data and rigorous analysis, data analysts provide businesses with trusted recommendations, driving smarter strategies and improving overall decision-making effectiveness in competitive environments.</td></tr>
</table>

Syllabus: NEP 2020 w.e.f 2025-26

Unit No.	Content	Hours
I	**Introduction to Hypothesis Testing:** Hypothesis Tests, Stating a Hypothesis, Types of Errors and Level of Significance, Statistical Tests and P-Values, Making a Decision and Interpreting the Decision, Strategies for Hypothesis Testing, Characteristics of a good hypothesis, Steps for hypothesis testing **Hypothesis Testing for the Mean (σ Known):** Using P-Values to Make Decisions, Using P-Values for a z-Test, Rejection Regions and Critical Values, Using Rejection Regions for a z-Test, Critical Values in a t- Distribution, The t-Test for a Mean μ, Using P-Values with t-Tests, Sums and case studies **Goodness of fit tests:** Anderson-Darling, Chi-square test, Kolmogorov-Smirnov, Ryan-Joiner,Shapiro-Wilk, Jarque-Bera, Lilliefors **Variance tests:** Chi-square test of a single variance, F-tests of two variances,Tests of homogeneity **Wilcoxon rank-sum/Mann-Whitney U test,Sign test** **Contingency tables:** Chi-square contingency table test, G contingency table test, Fisher's exact test, Measures of association, McNemar's test	15
II	**Analysis of variance and covariance:**ANOVA**,** Single factor or oneway ANOVA, Two factor or two-way and higher-way ANOVA , MANOVA, ANCOVA **Non-Parametric ANOVA:** Kruskal-Wallis ANOVA, Friedman ANOVA test, Mood's Median **Regression and smoothing:**Least squares, Ridge regression, Simple and multiple linear regression, Polynomial regression, Generalized Linear Models (GLIM), Logistic regression for proportion data, Poisson regression for count data, Non-linear regression, Smoothing and Generalized Additive Models (GAM), Geographically weighted regression (GWR), Spatial series and spatial autoregression- SAR models, CAR models, Spatial filtering models **Time series analysis and temporal autoregression:** Moving averages, Trend Analysis, ARMA and ARIMA (Box-Jenkins) models, Spectral analysis	15
	Total Hours	**30**

Books and References:

Sr. No	Title	Author/s	Publisher	Edition	Year
1.	Hypothesis Testing	---	Pearson Higher Education	---	---
2.	Statistical Analysis Handbook	Dr. Michael J de Smith	The Winchelsea Press, Drumlin Security Ltd,	2018 Ed	2018
3.	An Introduction to Statistical Methods and Data Analysis	R. Lyman Ott& Michael Longnecker	Thomson Learning	---	---
4.	Research Methodology – Methods and techniques	C. R. Kothari	New Age International (P) Ltd., Publishers	---	---

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Programme Name: S.Y.B.Sc(Data Science)	Semester:IV
Course Category/Vertical: Minor	
Name of the Dept: **Science and Technology**	
Course Title: **Testing of Hypothesis Practical**	
Course Code: **BDTP406**	Course Level: 5.0
Type: Practical	
Course Credit: 2	
Hours Allotted: 60 Hours	
Marks Allotted: 50 Marks	

Course Objectives:

1. To enable students to apply hypothesis testing techniques using real-life and sample data.
2. To develop the ability to formulate null and alternative hypotheses for different statistical problems.
3. To enhance skills in using statistical tables and software tools (like Excel, R, SPSS, Python, etc.) for hypothesis testing.
4. To cultivate the ability to interpret test results and draw meaningful conclusions for decision-making.
5. To promote problem-solving and **critical thinking through data-driven experiments** in hypothesis testing.

Course Outcomes:

CO1: Formulate null and alternative hypotheses for different statistical problems and Apply appropriate hypothesis testing methods (Z-test, t-test, Chi-square test, F-test, ANOVA) to real-life data.
CO2: Use statistical tools/software (Excel, R, SPSS, Python, etc.) for performing hypothesis tests and Interpret the results of hypothesis testing and draw valid statistical inferences.
CO3: Demonstrate critical thinking and analytical ability in solving practical data-driven problems.

Description the course:	The course provides hands-on experience in applying the concepts of hypothesis testing to real-life datasets. It focuses on formulating null and alternative hypotheses, selecting suitable statistical tests, and interpreting results for informed decision-making. Students will conduct experiments using **Z-test, t-test, Chi-square test, F-test, and ANOVA**, and gain exposure to **statistical software tools** such as Excel, R, SPSS, or Python. The practical sessions emphasize understanding the role of significance levels, p-values, and types of errors (Type I & Type II), thereby strengthening analytical and critical thinking skills. By the end of the course, learners will be able to practically validate statistical assumptions and apply hypothesis testing techniques in academic, research, and industry contexts.

Syllabus: NEP 2020 w.e.f 2025-26

Unit No.	Content	Hours
1	**Hypothesis Testing for the Mean**	
a.	Perform testing of hypothesis using one sample t-test.	
b.	Perform testing of hypothesis using two sample t-test	
c.	Perform testing of hypothesis using paired t-test.	
d.	Perform testing of hypothesis using Z-test.	
2.	**Goodness-of-fit test**	
a.	Perform goodness-of-fit test using chi-squared test.	
b.	Perform goodness-of-fit test using KS-test.	
c.	Perform testing of hypothesis using chi-squared Test of Independence	
3.	**Variance Testing**	
a.	Using Chi-square test of a single variance	
b.	Using F-tests of two variances	
c.	Testing of homogeneity	
4.	**Analysis of variance and covariance**	
a.	Perform testing of hypothesis using one-way ANOVA.	
b.	Perform testing of hypothesis using two-way ANOVA.	
c.	Perform testing of hypothesis using one-way ANOVA.	
5.	**Regression**	
a.	Perform simple linear regression	
b.	Perform multiple linear regression	
c.	Perform polynomial regression	
6.	**Perform spatial series and spatial auto-regression**	
7.	**Perform time series analysis using Moving averages**	
8.	Perform time series analysis using Trend Analysis	
9.	Perform Spectral analysis	
10.	Creating ―Infographics‖ using secondary data available on internet. (Use Canva /Adobe Spark / Prezi / Vennage	
Note- **Practical can be performed using R / Python / scilab / matlab / SPSS / MS Excel**		

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<table>
<tr><td colspan="2">Programme Name: S.Y. B.Sc.(Data Science) Semester: IV</td></tr>
<tr><td colspan="2">Course Category: Open Electives</td></tr>
<tr><td colspan="2">Name of the Dept: Science and technology</td></tr>
<tr><td colspan="2">Course Title: Numerical Methods</td></tr>
<tr><td colspan="2">Course Code: BDN407 Course Level: 5.0</td></tr>
<tr><td colspan="2">Type: Theory</td></tr>
<tr><td colspan="2">Course Credit: 02 Total Marks: 50</td></tr>
<tr><td colspan="2">Hours Allotted: 30 Hrs</td></tr>
<tr><td colspan="2">Course Objectives:
1. To be able to precisely solve problems using mathematical modeling & find solution for a solvable to unsolvable problems.
2. To find an answer or solution close to answer, without even knowing what the answer is</td></tr>
<tr><td colspan="2">Course Outcomes: Learners will be able to,
CO 1: understand the numerical technique to find the roots of non linear equation & difference operator with use of interpolation
CO2: Understand the numerical differentiation & integration.</td></tr>
<tr><td>Description the course:</td><td>As a Data Science student, learning numerical methods gives you a strong foundation in mathematical modeling and computational approaches, which are useful in a variety of fields and occupations.</td></tr>
</table>

Syllabus: NEP 2020 w.e.f 2025-26

Unit No.	Content	Hours
I	**Introduction**: Errors and Approximations, Iterative Methods, Truncation error, Taylor's series. **Numerical Solution of Equations of a Single Variable:** Numerical Solution of Equations, Bisection Method, Regular Falsi Method, Fixed Point Method, Newton's raphson Method, Secant Method **Numerical Solution of Systems of Equations:** Linear Systems of Equations, Numerical Solution of Linear Systems, Gauss Elimination Method. **Interpolation**: forward difference, Backward difference, Newton's forward difference interpolation, Newton's Backward difference Interpolation, Polynomial Regression, and Polynomial Interpolation.	15
II	**Numerical Differentiation and Integration:** Numerical Differentiation, Numerical Integration: Trapezoidal, Simpson $1/3^{rd}$ rule, Simpsons $3/8^{th}$ rule. **Numerical solution of 1^{st} & 2^{nd} Order differential equation:** Euler's method, Modified Euler's method, Runge-katta method for 1^{st} and 2^{nd} order differential equation	15
	Total Hours	**30**

Books and References:

Sr.No	Title	Authors	Publisher	Edition	Year
1	Numerical Methods for Engineers and Scientists Using MATLAB	Ramin S. Esfandiar	CRC Press	2^{nd}	2017
2	Introductory Methods of Numerical Method	S. S. Sastry	PHI	5^{th}	2012
3.	Numerical methods	T Veerarajun T Ramachadran	Tata Mc Graw Hill	7^{th}	2011

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<tr><td colspan="2">Programme Name: S.Y. B.Sc. (Data Science) Semester: IV</td></tr>
<tr><td colspan="2">Course Category/Vertical: Open Elective</td></tr>
<tr><td colspan="2">Name of the Dept: B.Com (Management Studies)</td></tr>
<tr><td colspan="2">Course Title: Basics of Marketing</td></tr>
<tr><td colspan="2">Course Code: BDM407 Course Level: 5.0</td></tr>
<tr><td colspan="2">Type: Theory</td></tr>
<tr><td colspan="2">Course Credit: 02</td></tr>
<tr><td colspan="2">Hours Allotted: 30 Hours</td></tr>
<tr><td colspan="2">Marks Allotted: 50 Marks</td></tr>
<tr><td colspan="2">Course Objectives:
1. To make learners aware of the basic concepts of marketing
2. Make learners aware about the importance of marketing research</td></tr>
<tr><td colspan="2">Course Outcomes:
CO1.Gain knowledge about the concepts of marketing and its implications in the business
CO2. Understand the importance of marketing research and its contribution in analysing the market and decision making</td></tr>
<tr><td>Description the course:</td><td>The course introduces the learners to the concept of marketing and its practical application in the current competitive world. The learners could upgrade their current understanding of marketing and get themselves ready for the workforce.
Students would be able to explore new areas of marketing, such as executive MIS, marketing research, and much more, which are in high demand right now in the business world.</td></tr>
</table>

Syllabus: NEP 2020 w.e.f 2025-26

Unit No.	Content	Hours
I	**Introduction to Marketing** **Introduction to Marketing**: Definition, features, advantages and scope of marketing. The 4P's and 4C's of marketing. Marketing v/s Selling, functions of marketing **Concepts of Marketing**: Needs, wants and demands, transactions, transfer and exchanges **Orientations of a firm:** Production concept; Product concept; selling concept and marketing concept, social relationship, Holistic marketing	15
II	**Marketing Environment, Research and Consumer Behaviour** **The micro environment of business:** Management structure; Marketing Channels; Markets in which a firm operates; competitors and stakeholders. **Macro environment:** Political Factors; Economic Factors; Socio-Cultural Factors , Technological Factors (PEST Analysis) **Marketing research**: Meaning, features, Importance of marketing research. Types of marketing research: Product research; Sales research; consumer/customer research; production research **MIS:** Meaning, features and Importance **Consumer Behaviour:** Meaning, feature, importance, factors affecting Consumer Behaviour	15
	Total Hours	**30**

References:

1. Saxena, Rajan. Marketing Management. Fourth edition, Tata McGraw Hill Publishing Co., New Delhi
2. Ramaswamy V.S. and Namakumari S. Marketing Management – Planning, Implementation and Control. Fourth edition, Macmillan
3. Kumar Arun & N Meenakshi. Marketing Management. Second Edition; Vikas Publications
4. Michael Vaz – Manan Prakashan
5. Kale – Vipul Publication

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Programme Name: **S. Y. B. Sc (Data Science)**	**Semester: IV**
Course Category/Vertical: Open Electives (OE)	
Name of the Dept: **Economics**	
Course Title**: Econometrics II**	
Course Code: **BDE407**	Course Level: 5.0
Type: Theory	
Course Credit: 2 credits	
Hours Allotted: 30 Hours	
Marks Allotted: 50 Marks	

Course Objectives:

1. To provide students with a basic understanding of different types of distributions.

2. To understand the basic regression concepts, including the purpose, assumptions, and types of regression models.

Course Outcomes:

CO1. Students will learn the different distribution functions to help analyze.

CO2. Students will be able to understand various techniques of regression analysis.

Description the course:	The objective of this course is to impart a basic understanding of econometrics. The student will be able to appreciate the theoretical basis of the subject. At the same time, it will enhance the student's ability to apply the theoretical techniques to the problems of the real world. Topics like forecasting have been introduced to impart this practical orientation

Syllabus: NEP 2020 w. e. f 2025-26

Unit No.	Content	Hours
I	**MODULE I: Statistical Inference** • Point and interval estimation • The Z distribution • The Null and Alternate hypotheses and significance testing for mean using Z distribution when population variance is known • The chi-square distribution and testing for sample variance with known population variance • The F distribution and comparing sample variances • The t distribution and hypothesis tests when population variance in unknown	15
II	**UNIT - II: Regression Analysis** • Two variable regression model • The concept of the PRF • Classical assumptions of regression • Derivation of the OLS estimators and their variance • Properties of OLS estimators under classical assumptions, Gauss-Markov Theorem (without proof) • Tests of Hypothesis, confidence intervals for OLS estimators • Measures of goodness of fit: R square and its limitations, adjusted R square and its limitations	15
	Total Hours	**30**

References:

1. Gujarati Damodar : Basic Econometrics,
2. Hatekar Neeraj (2009), Econometrics: The First Principles A Friendly Introduction
3. Kapoor V. k. (2011), Operations Research Problems & Solutions, sultan chand & sons
4. Lipschutz (Schaum Series) Theory and Problems of Statistics 5. Loomba Paul : An Introduction to linear programming.

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Programme Name: **S.Y.B.Sc(Data Science)**	**Semester:IV**
Course Category: SEC	
Name of the Dept: **Science and Technology**	
Course Title: **Search Engine Optimization**	
Course Code: **BDS408**	Course Level: 5.0
Type : Theory	
Course Credit: 02	
Hours Allotted: 30 Hours	
Marks Allotted: 50 Marks	
Course Objectives: 1. Understand the core principles of search engines, including their functionality, crawling, indexing, ranking mechanisms and apply keyword research methods 2. SEO-friendly web development techniques to design and build optimized websites and Analyze website performance using SEO analytics tools and recommend strategies for improvement based on data insights	
Course Outcomes: After the completion of the course, the learners would be able to: CO1: Describe how search engines work and explain the factors that influence webpage ranking, Use technical tools for keyword research CO2: Develop websites that are optimized for search engines, considering accessibility, content structuring, and URL hierarchy, Diagnose SEO issues using tools like Google Search Console, identify technical bottlenecks and implement solutions for improved site performance	
Description the course:	Introduction to Search Engines and their Fundamentals, Keyword Research and SEO-Friendly Web Design, SEO Optimization and Analytics

Syllabus: NEP 2020 w. e. f 2025-26

Unit No.	Content	Hours
I	**Introduction to Search Engines and their Fundamentals** Putting Search Engines in Context and Meeting Them Identifying Search Engine Users, Understanding the Search Engines: They're a Community, Finding the Common Threads among the Engines, Getting to Know the Major Engines, Understanding Metasearch Engines **Search Fundamentals** Deconstructing Search, The Language of Search, Crawling, The Index, The Search Engine Results Page, Ranking Factors **Keyword Research and SEO-Friendly Web Design** **Keyword Strategy :**Researching Client Niche Keywords, Checking Out Seasonal Keyword Trends, The Words and Phrases That Define Business, Internal Resources for Keyword Research, External Resources for Keyword Research, Keyword Valuation, Acting on Keyword Plan, Periodic Keyword Reviews	15
II	**Developing SEO Friendly Website** Making Site Accessible to Search Engines, Creating Optimal Information Architecture, Root Domains, Subdomains, and Microsites, Optimization of Domain Names/URLs, Keyword Targeting, Content Optimization and Duplicate Issues, Controlling Content with Cookies and Session IDs, Content Delivery and Search Spider Control, Best Practices for Multilingual/Multicountry Targeting, Google's EEAT and YMYL, Domain Changes, Content Moves, and Redesigns **SEO Optimization and Analytics** **Optimizing the Foundations :**Meeting the Servers, Health and Fast Servers, Excluding Pages and Sites from the Search Engines, Creating 404 Error Pages, Dirty IPs , Serving Your Site to Different Devices, Selecting Domain Name, Discovering the Types of Redirects, Reconciling www and Non-www URLs, 301 Redirects, Inviting Spiders to Your Site, 302 Hijacks, Handling Secure Server Problems **SEO Analytics and Measurement** Why Measurement Is Essential in SEO, Analytics Tools for Measuring Search Traffic, Connecting SEO and Conversions, Diagnostic Search Metrics, Free SEO Specific Analytics Tools from Google and Bing, Auditing Websites for SEO Improvements, AI in Search Engine	15
	Total Hours	**30**

Books and References:

1. Eric Enge, Stephen Spencer, Jessie Stricchiola, “The Art of SEO”, 4th Edition, O’Reilly Media Inc,September 2023
2. Bruce Clay, Kristopher B. Jones, “Search Engine Optimization All-in-One For Dummies”, 4th Edition, For Dummies, February 2022 (9 Books in One)

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Programme Name: **S.Y.B.Sc(Data Science)**	**Semester:IV**
Course Category: SEC	
Name of the Dept: **Science and Technology**	
Course Title: **Computer Graphics**	
Course Code: **BDC408**	Course Level:5.0
Type: Theory	
Course Credit: 02	
Hours Allotted: 30 Hours	
Marks Allotted: 50 Marks	
Course Objectives: 1. The course introduces the basic concepts of computer graphics & animations. 2. It provides the necessary theoretical background and demonstrates the application of computer science to graphics.	
Course Outcomes: After the completion of the course, the learners would be able to: CO1. Understand the basics of computer graphics, different graphics systems and applications of computer graphics, various scan conversion algorithms, Use of geometric transformations on graphics object. CO2 . Understand the basics of 3D viewing, hidden surface removal algorithms, basics of curve representations. (the core concepts of computer animations & image manipulations)	
Description of the course:	This course introduces fundamental concepts and techniques in computer graphics, including 2D and 3D transformations, scan conversion algorithms, and visible-surface determination. Students will learn about key algorithms like DDA, Bresenham's, and Midpoint methods, as well as advanced topics such as curve and surface representation, computer animation, and image manipulation. The course also covers the principles of 3D viewing, including the Canonical View Volume and techniques like the z-buffer and painter's algorithms for efficient rendering. Practical applications in animation and image processing, including compression and enhancement, will be explored.

Syllabus: NEP 2020 w.e.f 2025-26

Unit No.	Content	Hours
I	**Introduction to Computer Graphics:** Overview of Computer Graphics, Computer Graphics Application and Software. Active and Passive Graphics Devices, Raster-Scan and Random-Scan Displays . **Scan conversion :** Digital Differential Analyzer (DDA) algorithm, Bresenhams' Line drawing algorithm. Bresenhams' method of Circle drawing, Midpoint Circle Algorithm, Midpoint Ellipse Algorithm. **Two-Dimensional Transformations:** Transformations and Matrices, Transformation Conventions, 2D Transformations, Homogeneous Coordinates and Matrix Representation of 2D Transformations, Translations and Homogeneous Coordinates, Rotation, Reflection, Scaling, Combined Transformation, Rotation About an Arbitrary Point.	15
II	**Viewing in 3D :** Stages in 3D viewing, Canonical View Volume (CVV), Specifying an Arbitrary 3D View, Examples of 3D Viewing. **Visible-Surface Determination:** Techniques for efficient Visible-Surface Algorithms, Categories of algorithms, Back face removal, The z-Buffer Algorithm, Scan-line method, Painter's algorithms (depth sorting). **Computer Animation:** Principles of Animation, Key framing, Deformations, Character Animation, Physics-Based Animation, Procedural Techniques, Groups of Objects. **Image Manipulation and Storage:** What is an Image? Digital image file formats, Image compression standard – JPEG, Image Processing - Digital image enhancement, contrast stretching, Histogram Equalization, smoothing and median Filtering.	15
	Total Hours	**30**

Books and References:

Sr. No	Title	Author/s	Publisher	Edition	Year
1.	Principles of Interactive computer Graphics	William M. Newman and Robert F. Sproull	TMH	2nd	
2.	Computer Graphics - Principles and Practice	J. D. Foley, A. Van Dam, S. K. Feiner and J. F. Hughes	Pearson	2nd	
3.	Fundamentals of Computer Graphics	Steve Marschner, Peter Shirley	CRC press	4th	2016

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Programme Name: **S.Y. B.Sc. (Data Science)** **Semester:IV**
Course Category: CC
Name of the Department: **Sociology**
Course Title: **National Integration and Communal Harmony**
Course Code: **BDN411** Course Level: 5
Type: Theory / Practical
Course Credit: 2 credits
Hours Allotted: 30 Hours
Marks Allotted: 50 Marks
Course Objectives: 1. To develop an understanding of the significance of National Integration and Communal Harmony. 2. To enable students to appreciate the role of youth in fostering unity and peace in society.
Course Outcomes: CO1. Understand the principles of National Integration and Communal Harmony. CO2. Develop leadership and teamwork skills through NSS activities focused on unity and peace.
Introduction: National Integration and Communal Harmony are essential for a diverse country like India. This course introduces students to the importance of unity in diversity and the role of NSS in promoting peace, social justice, and inclusive development. Students will engage in activities and discussions to strengthen their commitment to harmony and national unity. Relevance and Usefulness: Given the challenges of communal tensions and social divisions, fostering National Integration is crucial. This course empowers students with the knowledge and skills to actively participate in building a more inclusive and peaceful society. Interest and Connection with Other Courses:This course complements subjects such as Sociology, Political Science, and Social Work, reinforcing the importance of civic responsibility, human rights, and peacebuilding in a democratic society.

Syllabus: NEP 2020 w.e.f 2024-25

Unit No.	Content	Hours
I	**UNIT I: Concept and Importance of National Integration and Communal Harmony** A. Meaning and Significance of National Integration B. Factors Affecting National Integration in India C. Challenges to Communal Harmony	15
II	UNIT II: Role of NSS in Promoting National Integration and Communal Harmony A. NSS and Its Role in Community Development B. Social Service as a Tool for Unity C. Case Studies of Successful NSS Interventions for National Integration	15
	Total Hours	**30**

References:

1. National Service Scheme Manual (Revised) 2006, Government of India, Ministry of Youth Affairs and Sports, New Delhi.
2. University of Mumbai National Service Scheme Manual 2009.
3. http://nss.nic.in
4. https://www.rccmindore.com/wp-content/uploads/2023/04/NSS-Notes-II.pdf

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Programme Name: S.Y. B.Sc. (Data Science)	**Semester: IV**
Course Category/Vertical: **Co-Curricular (CC)**	
Name of the Dept: **Psychology**	
Course Title: **Yoga**	
Course Code: **BDY411**	Course Level: 5.0
Type: Theory / Practical	
Course Credit: 2 credits	
Hours Allotted: 30 Hours	
Marks Allotted: 50 Marks	

Learning Objectives:

1. To impart to the students the knowledge of teachings and philosophy of yoga tradition.
2. To provide the knowledge of various Yoga therapy practices like asana (posture), pranayama (voluntarily regulated breathing techniques).

Course Outcomes:

CO1. Students will be able to understand the basic principles and applications of Yoga.
CO2. Students will be able to use the Practical knowledge in their day to day life.

Description the course:	Yoga practices will be important for the upcoming lifestyle hence students can seek a career in the same. Students will understand the importance of yoga in life. Students will be having practical exposure. Hence, practicing yoga will help students to maintain their health.

Syllabus: NEP 2020 w.e.f 2024-25

Unit No.	Content	Hours
I	**Theory of Yoga** A) Yogic Sanchalan (Yogic Movements), Kapalbhati (Cleansing Breath Technique), Suryanamaskar (Sun Salutation) B) Anulom-Vilom (Alternate Nostril Breathing), Dirgha Shwasan (Deep Breathing), Bhramari (Humming Bee Breath)	**15**
II	**Practical** A) Vajrasana (Thunderbolt Pose), Paschimottanasana (Seated Forward Bend), Parivritta Janushirasana (Revolved Head-to-Knee Pose), Vakrasana (Twisting Pose), Marjarasana (Cat Pose), Naukasana (Boat Pose) B) Shalabhasana (Locust Pose), Dronasana (Warrior Boat Pose), Pavanmuktasana (Wind-Relieving Pose), Bramha Mudra (Sacred Gesture for Neck Strength), Utthita Dwipadasana (Raised Two-Leg Pose), Netra Sanchalan - 1 (Eye Movement Exercise - 1), Netra Sanchalan - 2 (Eye Movement Exercise - 2)	**15**
	Total Hours	**30**

References:

1. G. V Kadam - Yoga Life Sutra, Girish Vasant Kadam (2012)
2. ajayoga - Swami Vivekananda - Ramakrishna Ashrama Publications
3. C.D. Sharma: Critical Survey of Indian Philosophy, Motilal Banarsidass Publications 2003

Scheme of Examination

Course with Credit	External Examination	Internal Examination	Total
Credit 4	**60 marks**	**40 marks**	**100 marks**
Credit 2	**30 marks**	**20 marks**	**50 marks**

Internal Examination Structure(Theory)

Internal examination	**40 marks**	**20 marks**
Project Presentation/Case Study /Quiz/Group Discussion	10 marks	5 marks
Assignment /Active class Participation/Attendance	10 marks	5 marks
Class test	20 marks	10 marks
Total	40 marks	20 marks

Structure for Class Test

For 10 marks	
Q1. Fill in the blank (5 Marks) **a.** **b.** **c.** **d.** **e.** **Q2. Answer in one or two lines (5 Marks)** **a.** **b.** **c.** **d.** **e.**	**10 Marks**

External Examination (For 60 Marks)

Q. No.	External	Marks: 60
Q .1 (From Module 1)	Answer the following questions (Any 3) A B C D E F	15 Marks
Q. 2 (From Module 2)	Answer the following questions (Any 3) A B C D E F	15 Marks
Q. 3 (From Module 3)	Answer the following questions (Any 3) A B C D E F	15 Marks
Q. 4 (From Module 4)	Answer the following questions (Any 3) A B C D E F	15 Marks

External Examination (For 30 Marks)

Q. No.	External	Marks: 30
Q .1 (From Module 1)	Answer the following questions (Any 3) A B C D E F	15 Marks
Q. 2 (From Module 2)	Answer the following questions (Any 3) A B C D	15 Marks

	E F	

Practical Exam Evaluation: 50 marks

A Certified copy journal is essential to appear for the practical examination.

1	Practical Question 1	20
2	Practical Question 1	20
3	Journal	5
4	Viva Voce	5

OR

1	Practical Question 1	40
2	Journal	5
3	Viva Voce	5