



HSNC UNIVERSITY, MUMBAI

HSNCU Syllabus

School of Applied Sciences

Syllabus of BSc Data Science and Business Analytics

Board of Faculty of Science & Technology

Board of Studies in the Subject of Data Science & Business Analytics:

1. Name of the Chairperson: Dr.Nandini Sengupta, Associate professor, Department of Economics
2. Name of the Co – Chairperson: Mrs. Shailaja. J. Rane, Co- Ordinators of Data Science and Business Analytics.

Teachers from the college:

3. Miss. Beenarani Karutharan, Assistant Professor, Department of Computer science
4. Mrs.Mrunal M Hardikar , Assistant Professor, Department of Mathematics
5. Mr. Sikandar Yadav , Assistant Professor , Department of Data Science and Business Analytics.

External Professors:

6. Rosemary Gosling, Director of External Studies(Retd) for the London School of Economics and Political Science (LSE)
7. Dr. Santosh Bothe, Founder and Director AiSense(Start up funded by BIRAC, Govt. of India), Principal, Saraswati College, Shegaon, Affiliated to SGBU Amravati University.

External experts:

8. Prof. Parag Mahulikar is Ex- Dean and Senior Professor of Marketing at IES Management College and Research Centre, Bandra, India and Management Consultant.

9. Dr. Alok Deepak Dabade, Assistant Professor, Department of Statistics, University of Mumbai.

10. Dr. Sujata Suvarnapathki, Assistant Professor, Department of Statistics, Ramnarayan Ruia Autonomous College, Matunga, Mumbai.

11. Mr. Subhash Kumar, Assistant Professor, MCA, MPHIL IT department, St.Xavier's college, Mumbai.

12. Industry Expert: Mr. Vinayak Deshpande, Managing Director, Sankhya Analytical Research Pvt. Ltd.

13. Industry Expert: Mr. Nishad Kapadia, MCA, Technical trainer, Data and Solution Architect Project Manager, TeraData, Mumbai.

14. Industry Expert: Miss. Praveena Premanand Menon, MSc in Big Data Analytics.

15. Industry Expert: Mr. Awesh Bhornya, Infinity Learning (Founder)

Alumni: Proposed names Sara kale, Pranit Kadam

Part –I

Outline of Choice Based Credit System as outlined by University Grants Commission:

R. ** : The Definitions Of The Key Terms Used In The Choice Based Credit System And Grading System Introduced From The Academic Year 2023-2024 Are As Under:**

1. **Core Course:** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a core course.

2. **Elective Course:** Generally, a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

2.1 **Discipline Specific Elective (DSE) Course:** Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The

University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

2.2 Dissertation/Project: An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project. A Project/Dissertation work would be of 6 credits. A Project/Dissertation work may be given in lieu of a discipline specific elective paper.

2.3 Generic Elective (GE) Course: An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.

P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective.

3. Choice Base Credit System: CBCS allows students to choose inter- disciplinary, intra-disciplinary courses, skill oriented papers (even from other disciplines according to their learning needs, interests and aptitude) and more flexibility for students.

4. Honours Program: To enhance employability and entrepreneurship abilities among the learners, through aligning Inter Disciplinary / Intra Disciplinary courses with Degree Program. Honours Program will have 40 additional credits to be undertaken by the learner across three years essentially in Inter / Intra Disciplinary course.

A learner who joins Regular Undergraduate Program will have to opt for Honours Program in the first year of the Program. However, the credits for honors, though divided across three years can be completed within three years to become eligible for award of honours Degree.

5. Program: A Program is a set of course that are linked together in an academically meaningful way and generally ends with the award of a Degree Certificate depending on the level of knowledge attained and the total duration of study, B.Sc. Programs.

6. Course: A 'course' is essentially a constituent of a 'program' and may be conceived of as a composite of several learning topics taken from a certain knowledge domain, at a certain level. All the learning topics included in a course must necessarily have academic coherence, i.e. there must be a common thread linking the various components of a course. A number of linked courses considered together are in practice, a 'program'.

7. Bridge Course: Bridge course is visualized as Pre semester preparation by the learner before commencement of regular lectures. For each semester the topics, whose knowledge is considered as essential for effective and seamless learning of topics of the Semester, will be specified. The Bridge Course can be conducted in online mode. The Online content can be created for the Bridge Course Topics.

8. Module and Unit: A course which is generally an independent entity having its own separate identity, is also often referred to as a 'Module' in today's parlance, especially when we refer to a 'modular curricular structure'. A module may be studied in conjunction with other learning modules or studied independently. A topic within a course is treated as a Unit. Each course should have exactly 3 Units.

9. Self-Learning: 20% of the topics will be marked for Self-Learning. Topics for Self Learning are to be learned independently by the student, in a time- bound manner, using online and offline resources including online lectures, videos, library, discussion forums, fieldwork, internships etc.

Evaluative sessions (physical/online), equivalent to the credit allocation of the Self Learning topics, shall be conducted, preferably, every week for each course.

Learners are to be evaluated real time during evaluative sessions. The purpose of evaluative sessions is to assess the level of the students' learning achieved in the topics earmarked for Self-Learning.

The teacher's role in these evaluative sessions will be that of a Moderator and Mentor, who will guide and navigate the discussions in the sessions, and offer concluding remarks, with proper reasoning on the aspects which may have been missed by the students, in the course of the Self-Learning process.

The modes to evaluate self-learning can be a combination of the various methods such as written reports, handouts with gaps and MCQs, objective tests, case studies and Peer learning. Groups can be formed to present self- learning topics to peer groups, followed by Question and Answer sessions and open discussion. The marking scheme for Self-Learning will be defined under Examination and Teaching.

The topics stipulated for self-learning can be increased or reduced as per the recommendations of the Board of Studies and Academic Council from time to time. All decisions regarding evaluation need to be taken and communicated to the stakeholders preferably before the commencement of a semester. Some exceptions may be made in exigencies, like the current situation arising from the lockdown, but such ad hoc decisions are to be kept to the minimum possible.

10. Credit Point: Credit Point refers to the 'Workload' of a learner and is an index of the number of learning hours deemed for a certain segment of learning. These learning hours may include a variety of learning activities like reading, reflecting, discussing, attending lectures / counseling sessions, watching especially prepared videos, writing assignments, preparing for examinations, etc. Credits assigned for a single course always pay attention to how many hours it would take for a learner to complete a single course successfully. A single course should have, by and large a course may be assigned anywhere between 2 to 8 credit points wherein 1 credit is construed as corresponding to approximately 30 to 40 learning hours.

11. Credit Completion and Credit Accumulation: Credit completion or Credit acquisition shall be considered to take place after the learner has successfully cleared all the evaluation criteria with respect to a single course. Thus, a learner who successfully completes a 4 CP (Credit Point) course may be considered to have collected or acquired 4 credits. Learner level of performance above the minimum prescribed level (viz. grades / marks obtained) has no bearing on the number of credits collected or acquired. A learner keeps on adding more and more credits as he completes successfully more and more courses. Thus, the learner 'accumulates' course wise credits.

12. **Credit Bank:** A Credit Bank in simple terms refers to stored and dynamically updated information regarding the number of Credits obtained by any given learner along with details regarding the course/s for which Credit has been given, the course-level, nature, etc. In addition, all the information regarding the number of Credits transferred to different programs or credit exemptions given may also be stored with the individual's history.

13. **Credit Transfer:** (performance transfer) When a learner successfully completes a program, he/she is allowed to transfer his/her past performance to another academic program having some common courses and Performance transfer is said to have taken place.

14. **Course Exemption:** Occasionally, when two academic programs offered by a single university or by more than one university, may have some common or equivalent course-content, the learner who has already completed one of these academic programs is allowed to skip these 'equivalent' courses while registering for the new program. The Learner is 'exempted' from 'relearning' the common or equivalent content area and from re-appearing for the concerned examinations. It is thus taken for granted that the learner has already collected in the past the credits corresponding to the exempted courses.

Part-II

The Scheme of Teaching and Examination:

The performance of the learners shall be evaluated in two components: Internal Assessment with 15 marks by way of continuous evaluation and by Semester End Examination with 60 marks by conducting the theory examination.

INTERNAL ASSESSMENT: - It is defined as the assessment of the learners on the basis of continuous evaluation as envisaged in the credit-based system by way of participation of learners in various academic and correlated activities in the given semester of the programme.

A). Internal Assessment – 10 marks of Practical (internal Components of the Practical Course)

1. For Theory Courses

Sr. No.	Particulars	Marks
1	Self-Learning Evaluation	15 Marks

2. For Courses with Practicals

Each practical course can be conducted out of 25 marks with 10 marks for internal and 15 marks for external

Practical's (Internal component of the Practical Course)

Sr. No	Evaluation type	Marks
1	Journal	05
2	Viva	05

The semester end examination (external component) of 60% for each course will be as follows:

i) **Duration – 2 Hours**

ii) **Theory Question**

Paper Pattern: -

1. There shall be four questions each of 15 marks. On each unit there will be one question and the fourth one will be based on entire syllabus.

2. All questions shall be compulsory with internal choice within the questions. (Each question will be of 25 marks with options.)

3. Question may be subdivided into sub-questions a, b, c... and the allocation of marks depend on the weightage of the topic.

The marks will be given for all examinations and they will be converted into grade (quality) points. The semester-end, final grade sheets and transcripts will have only credits, grades, grade points, SGPA and CGPA.

3. Project:

- Project which can in the following forms

- Case Studies
- Videos
- Blogs
- Research paper (Presented in Seminar/Conference)
- Field Visit Report
- Presentations related to the subject (Moot Court, Youth Parliament, etc.)
- Internships (Exposition of theory into practice)
- Open Book Test
- any other innovative methods adopted with the prior approval of Director Board of Examination and Evaluation.

4. Self-Learning Evaluation:

- 20% of the topics of curriculum are learned by the student through self learning using online / offline academic resource specified in the curriculum. hence 20% of the lectures shall be allocated for evaluation of students on self learning topics
- The identified topics in the syllabus shall be learnt independently by the students in a time bound manner preferably from online resources. evaluative sessions shall be conducted by the teachers and will carry 10 marks.
- Club the self-learning topics into 3-4 groups of topics only for evaluation.
- prescribe time duration (in days) for completion of each group of topic and earmark self learning evaluation lectures in the imetable. hence each group of topic can be assigned 3 regular lectures for this evaluation for the entire class

3 Sub Topics

Each evaluative session shall carry 5 Marks.

4 Sub Topics

Each evaluative session shall carry 5 Marks

EVALUATION OF SELF LEARNING TOPICS CAN COMMENCE IN REGULAR LECTURES ASSIGNED FOR SELF LEARNING EVALUATION IN THE TIMETABLE

3 Evaluative sessions

Each evaluative session shall carry 5 Marks

4 Evaluative sessions

Each evaluative session shall carry 5 Marks

Methods for Evaluation of Self-learning topics:

- Seminars/presentation (PPT or poster), followed by Q&A – Objective questions /Quiz / Framing of MCQ questions.
- Debates

- Group discussion
- You-Tube videos (Marks shall be based on the quality and viewership)
- Improvisation of videos
- Role Play followed by question-answers
- Viva Voce
- Any other innovative method

Teachers can frame other methods of evaluation also provided that the method, duly approved by the college examination committee, is notified to the students at least 7 days before the commencement of the evaluation session and is forwarded for information and necessary action atleast 3 days before the commencement of the evaluation session.

THE MARKS OF THE INTERNAL ASSESSMENT SHOULD NOT BE DISCLOSED TO THE STUDENTS TILL THE RESULTS OF THE CORRESPONDING SEMESTER IS DECLARED.

HSNC University, Mumbai

(2024-2025)

Ordinances and Regulations

With Respect to

Choice Based Credit System (CBCS)

For the Programmes Under

The Faculty of Science and Technology

For the Course

Data Science & Business Analytics

**Curriculum – Second Year Undergraduate
Programmes**

Semester-III and Semester -IV

2024-2025

Data Science & Business Analytics

Part 1- Preamble

B. Sc. Data Science and Business Analytics program is of minimum 140 credits cover six semesters. Data is the new oil. The analytics may be input for human decisions or may drive fully automated decisions. It helps decision maker in building strategies to perform deep-dive understanding and provide descriptive, predictive, and prescriptive analytics. It is used to run the business effectively and is instrumental in growing the business. It is the area for huge potential for corporate investments. Business Analytics include identifying KPIs, measurement strategy, data analysis, complex statistical model and analysis, data mining and deep understanding of cause-and-effect models. Business analytics can drive key decision making in the organization and help executive decision makers in building strategy, predictive analysis, forecasting, risk analysis, identify and prevent fraud, market analysis, etc. Data Scientists use these skills can provide insights into discrete data sets, build complex model and present them in Scorecard format and use the same in executive reviews to lead data-driven discussion and decisions. Some of the impactful use of this is in the areas of Management Information Systems, Financial Service, Marketing Research, Process Improvements, Six Sigma, Process Excellence, Scorecard, Dashboard, End-to-End Product Management, etc.

The program emphasizes both theory and modern applications of Data Science and Business analytics and is structured to provide knowledge and skills in depth necessary for the employability of students in industry, in academics and other government and non-government organizations. The program has some unique features like independent projects, number of elective courses and extensive computer training of statistical computations including standard software packages like C++, SQL, SPSS, SAS, MINITAB, R and PYTHON etc. Due to Cluster University, the department got the academic autonomy and it has been utilized to add the new and need based elective courses. The independent project work is one among the important components of this program. The syllabus has been framed to possess a decent balance of theory, methods, and applications of statistics. It is possible for the students to study basic courses from other disciplines like economics, life sciences, computer science and Information Technology in place of optional/electives. The thrust of the course is to prepare students to enter a promising career after graduation, as also provide to them a platform for pursuing higher studies resulting in postgraduation degrees.

2. Salient features, how it has been made more relevant.

- Syllabus is prepared by top most industry experts, eminent statisticians, Data Scientists and reputed faculties of HSNC University.
- Skills covered includes Statistics, Data Analytics, Business Analytics, Data Visualization, machine learning algorithm, Text Mining, Forecasting/ Predictive Analytics, Hypothesis Testing etc.
- Tools and Technology covered includes R, Python, My SQL, NO SQL, Tableau, Power BI, Machine Learning, Artificial Intelligence, SPSS, Minitab, Excel, and many more.
- Course includes several Assignments and Case Studies.
- Getting industrial experience by working on industry relevant live projects and internship.
- University has tie up with 100+ companies to provide job to many students.
- University has a dedicated placement cell for the participants who will complete course.
- Teaching Faculties will include good blend of Academicians and Industry Experts.
- Focus is to prepare Participants with clear, concise concept to experts in data Science field to add quality and value to institute they join.
- University/ College has well placed Alumni working at top position.

Program Outcomes:

1. Students will be proficient in data structure and algorithms, enabling them to efficiently organize and manipulate data.
2. Perform scientific and technical computing using the Python SciPy package and its sub packages Integrate, Optimize, Statistics, IO and Weave.
3. Understand and apply principles of database management systems (DBMS) to efficiently and securely store, retrieve, and manage data.
4. Apply knowledge of programming, data structures, calculus, and analytics tools to solve complex real-world problems and make data-driven decisions.
5. Provide hands-on training to students to develop and enhance the strong analytical, quantitative modelling skills for solving team based, real word business problems and to make students ready for the role of data Scientist
6. Provide opportunity to work on some real-life data/problems or simulated data through building the business intelligence reports, scorecard and dashboard
7. Understand and use linear and non-linear regression models and classification techniques for data analysis
8. Display effective communication skills to express knowledge and views in the areas of Data Science, Mathematics and Statistics
9. To provide a systematic understanding of the concepts and theories of mathematics and analyse the situations.
10. Interpret data findings effectively to any audience, orally, visually, and in written formats.
11. Entrepreneurial and Social competence: (i) Cater to/ provide solutions particular domain specific problems by having in depth domain knowledge (ii) Exposure to emerging trends and technologies to prepare students for industry (iii) Develop skills required for social interaction.

Course Structure

<u>Semester – III</u>			
Course Code	Course Type	Course Name	Credits
	Major	Data Structure and Algorithms	3
	Major	Python Programming	3
	Minor	Data Based Management System	3
	Multidisciplinary (MDS)	Visual representation using Tableau & PowerBI	3
	Skill Enhancement Course (SEC)	Predictive Analytics using SPSS	3
	Ability Enhancement Course (AEC)		2
	Discipline Specific practical	Data Structure and Algorithms Practical	1
		Python Programming Practical	1
		Data Based Management System Practical	1
Total Credits			20
<u>Semester – IV</u>			
Course Code	Course Type	Course Name	Credits
	Major	OOPS with JAVA	3
	Major	Business Analytics	3
	Minor	Multivariate calculus	3
	Multidisciplinary (MDS)	Predictive Analysis using SPSS	3
	Skill Enhancement Course (SEC)	Visual representation using Tableau and Power BI	3
	Ability Enhancement Course (AEC)		2
	Discipline Specific Practical	OOPS with JAVA Practical	1
		Business Analytics Practical	1
		Multivariate Calculus Practical	1
Total Credits			20

Detailed Syllabus

Semester III

Curriculum Topics along with Self-Learning topics

Course Name: Data Structures and Algorithms		Course Code:	
Session Per Week(1 session is 60 minutes)		3	
Credits		3	
		Hours	Marks
Evaluation System	Theory Examination	2	60
	Internal	-	15

Course outcome:

1. Understand the basic concepts and principles of data structures and algorithms
2. Implement and analyse various data structures, such as arrays, linked lists, stacks, queues, trees, and graphs
3. Design and implement efficient algorithms for searching, sorting, and manipulating data
4. Analyze the complexity of algorithms using Big-O notation and understand the principles of algorithmic analysis
5. Apply different data structures and algorithms to solve real-world problems
6. Understand the importance of choosing the right data structure and algorithm for a given problem
7. Develop problem-solving and algorithmic thinking skills
8. Understand the trade-offs between different data structures and algorithms in terms of time and space complexity
9. Apply various data structures and algorithms in programming languages such as C, C++, Java, or Python

Unit	Content	No. of lectures
1	<p>Introduction - Why we need data structure? Concepts of data structures: a) Data and data structure b) Abstract Data Type and Data Type. Algorithms and programs, basic idea of pseudo-code. Algorithm efficiency and analysis, time and space analysis of algorithms – order notations.</p> <p>Linear Data Structure Arrays: Single and Multi-dimensional Arrays, Sparse Matrices (Array and Linked Representation), Limitations of Array. Stacks: Implementing single / multiple stack/s in an Array; Prefix, Infix and Postfix expressions, Utility and conversion of these expressions from one to another; Applications of stack. Linked Lists: Singly, Doubly and Circular Lists (Array and Linked representation); Self Organizing Lists; Skip Lists. Queues: Array and Linked representation of Queue, De-queue, Priority Queues Principle of recursion: Developing Recursive Definition of Simple Problems and their implementation; Advantages and Limitations of</p>	15

	Recursion ; Understanding what goes behind Recursion (Internal Stack Implementation)	
2	Nonlinear Data Structures Tree- Definitions and Concepts, Representation of binary tree, Binary tree traversal (In order, post order, preorder) . Binary search trees - insertion, deletion, searching, AVL trees, Red-Black trees. Graph- Representation of graphs (adjacency matrix, adjacency list), Graph traversal algorithms: BFS, DFS , Shortest path algorithms: Dijkstra's algorithm, Bellman-Ford algorithm, Minimum spanning tree: Prim's algorithm, Kruskal's algorithm. Priority queues : definition and applications, Heaps: properties, heap operations (insertion, deletion, heapify), Implementation of priority queues using heaps	15
3	Algorithms - Lower Bounding Techniques, Decision Trees, Iterative techniques, Divide and Conquer, Dynamic Programming, Greedy Algorithms (Job Scheduling, Assign Mice to Holes) . Sorting and Searching Techniques : Elementary sorting techniques–Bubble Sort, Insertion Sort, Merge Sort, Advanced Sorting techniques - Heap Sort, Quick Sort, Sorting in Linear Time - Bucket Sort, Radix Sort and Count Sort . Linear Search, BinarySearch . Introduction to hashing - Hash functions and collision resolution techniques (chaining, open addressing)	15

Self – Learning Topics (Unit wise)

Sub Unit	Topics
1	Limitations of Array, Utility and conversion of these expressions from one to another; Applications of stack, Self-Organizing Lists, Skip Lists. Advantages and Limitations of Recursion.
2	Definitions and Concepts, Representation of binary tree, Binary tree traversal (In order, post order, preorder). Representation of graphs (adjacency matrix, adjacency list), Graph traversal algorithms: BFS, DFS.
3	Greedy Algorithms (Job Scheduling, Assign Mice to Holes), Count Sort, Binary Search.

Online Resources:

“NOC:2016: Programming, Data structures and Algorithms” by Prof. Hema A Murthy Dr. N S. Narayanaswamy, Prof. Shankar Balachandran, Computer Science and Engineering, IIT Madras, available on the NPTEL portal, https://nptel.ac.in/courses/106/106/106106127/
“Data Structures And Algorithms” by Prof. Naveen Garg from IIT Delhi available on the NPTEL portal, https://nptel.ac.in/courses/106102064

Course Name:Data Structure and Algorithms Practical	Course Code
Session Per Week(1 session is 60 minutes)	2
Credits	1

List of Practical: Data Structure and Algorithms Practical	
1	Practical to implement various operations of Single and Multi-dimensional Arrays, Sparse Matrices
2	Practical to demonstrate push and pop operations in stack.
2	Practical based on conversion of expressions from one to another using stacks.
3	Practical to implement various operations of singly linked list
4	Practical to implement various operations of doubly linked list
5	Practical to implement various operations of queue
6	Practical based on BST, AVL
7	Practical based on priority queue
8	Implementing sorting algorithms
9	Implementing searching algorithms
10	Practical based on Hash functions

Reference books:

1	“Introduction to Algorithms” by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein.
2	“Data Structures” by S. Lipschutz.
3	“An Introduction to Data Structures with Applications” by Jean-Paul Tremblay & Paul G. Sorenson Publisher-Tata McGraw Hill.
4	“Fundamentals of Data Structures in C++”-By Sartaj Sahani.

Course Name: Python Programming		Course Code:	
Session Per Week(1 session is 60 minutes)		3	
Credits		3	
		Hours	Marks
Evaluation System	Theory Examination	2	60
	Internal	-	15

Course outcome:

1. Understand the basics of Python programming language, including syntax, data types, and control structures.
2. Develop problem-solving skills using Python through hands-on programming exercises and projects.
3. Learn how to work with various data structures in Python, such as lists, dictionaries, and tuples.
4. Gain proficiency in writing functions and modules to create reusable code.
5. Learn how to handle exceptions and errors in Python programs.
6. Understand the concept of object-oriented programming in Python, including classes and inheritance.
7. Gain knowledge of how to work with files and databases using Python.
8. Learn how to use popular libraries and frameworks in Python, such as NumPy, Pandas, and Django.
9. Develop skills in web scraping, data analysis, and visualization using Python.
10. Gain practical experience in building and deploying Python applications.

Unit	Content	No. of lectures
1	Introduction to Python programming, key words and identifiers, basic data types, Variables, Lists, Tuples and Strings, Dictionaries and sets, operators. Numpy arrays: Creating arrays crating n-dimensional arrays using np.array and array operations(indexing and slicing, transpose, mathematical operations) , Control statements: if, if-else, if-else-if, while loop, for loop Functions: built in functions, user-defined functions, defining functions, Recursion Different searching & sorting algorithms.	15
2	Classes and objects, methods, constructors, inheritance, polymorphism, exceptional handling, file input/ output. Modules & packages Introducing Pandas Objects, Creating series and data frames and Operations on series and data frames Reading and writing data: From and to Excel and CSV files Data Indexing and Selection, Operating on Data in Pandas, Handling Missing Data, Hierarchical Indexing, Combining Datasets: Concat and Append, Combining Datasets: Merge and Join, Aggregation and Grouping, Pivot Tables, Vectorized String Operations, Working with Time Series, High-Performance Pandas: eval() and query().	15
3	Data Handling and Visualisation: Data Manipulation: Selecting random N rows, removing duplicate row(s), dropping a variable(s), Renaming variable(s), sub-setting data, creating a new variable(s), selecting of random fraction of row(s), appending of row(s) and column(s), simulation of variables.	15

	Data Processing: Data import and export, setting working directory, checking structure of Data, Changing type of variable, Data split into training and Test Data Visualization: Simple bar diagram, subdivided bar diagram, multiple bar diagram, pie diagram, Box plot for one and more variables, histogram, frequency polygon, scatter plot, correlation plot Time series, Relationship maps, Heat maps, Geo Maps, 3-D Plots, Higher Dimensional Plots, Word clouds using Matplotlib , Plotly , Seaborn , ggplot2 , Creating Dashboard, Comparison of Data Sets and Storytelling with using Panda Profiling, Sweetviz, Autoviz. Story telling on Data Sets Iris /Pigeons/Car Design Data Set.	
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Self – Learning Topics (Unit wise)

Sub Unit	Topics
1	Introduction to Python programming, key words and identifiers, basic data types, Variables, Lists, Tuples and Strings, Dictionaries and sets, operators.
2	Reading and writing data: From and to Excel and CSV files Data Indexing and Selection, Operating on Data in Pandas, Handling Missing Data
3	Simple bar diagram, subdivided bar diagram, multiple bar diagram, pie diagram, Box plot for one and more variables, histogram, frequency polygon, scatter plot using Matplotlib, Plotly, Seaborn, ggplot2

Online Resources:

https://nptel.ac.in/courses/106/107/106107220/
https://nptel.ac.in/courses/106/106/106106212/

Course Name:Python programming Practical	Course Code	
Session Per Week(1 session is 60 minutes)	2	
Credits	1	

List of Practical:Python programming Practical	
1	Practical based on basic python operators
2	Practical based on basic python functions
3	Practical based on creating an array
4	Practical based on array operators
5	Practical based on creating data frame
6	Practical based on data frame operators
7	Practical based on creating pivot table
8	Practical based on combining datasets
9	Practical based on data manipulation
10	Practical based on data visualization

Reference books:

1	Mark Lutz: Programming Python, O'Reilly Media, 4th Edition.
2	Wes McKinney: Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, O'Reilly Media, 2nd Edition.
3	Kenneth A. Lambert: The Fundamentals of Python: First Programs, 2011, Cengage Learning.

Course Name: Database Management System	Course Code:
Session Per Week(1 session is 60 minutes)	3

Credits		3	
		Hours	Marks
Evaluation System	Theory Examination	2	60
	Internal	-	15

Course outcome:

1. To define program-data independence, data models for database systems, database schema and database instances.
2. To recall Relational Algebra concepts, and use it to translate queries to Relational Algebra.
3. To classify the methodology of conceptual modeling through Entity Relationship model.
4. To identify the methodology of logical model and also identify the methodology of physical model.
5. To distinguish Structure Query Language statements used in creation and manipulation of database.

Unit	Content	No. of lectures
1	<p>1.1 Introduction to DBMS: Database, DBMS – Definition, Overview of DBMS, Advantages of DBMS, Levels of abstraction, Data independence, DBMS Architecture</p> <p>1.2 Data models: Client/Server Architecture, Object Based Logical Model, Record Based Logical Model (relational, hierarchical, network)</p> <p>1.3 Entity Relationship Model: Entities, attributes, entity sets, relations, relationship sets, Additional constraints (key constraints, participation constraints, weak entities, aggregation / generalization, Conceptual Design using ER (entities VS attributes, Entity Vs relationship, binary Vs ternary, constraints beyond ER)</p> <p>1.4 Relational data model: Domains, attributes, Tuples and Relations, Relational Model Notation, Characteristics of Relations, Relational Constraints - primary key, referential integrity, unique constraint, Null constraint, Check constraint</p> <p>1.5 ER to Table: Entity to Table, Relationship to tables with and without key constraints.</p>	15
2	<p>2.1 Schema refinement and Normal forms: Functional dependencies, first, second, third, and BCNF normal forms based on primary keys, lossless join decomposition.</p> <p>2.2 Relational Algebra: operations (selection, projection, set operations, union, intersection, difference, cross product, Joins – conditional, equijoin and natural joins, division)</p> <p>2.3 DDL Statements: Creating Databases, Using Databases, data types, Creating Tables (with integrity constraints – primary key, default, check, not null), Altering Tables, Renaming Tables, Dropping Tables, Truncating Tables, Backing Up and Restoring databases</p> <p>2.4 DML Statements: Viewing the structure of a table insert, update, delete, select all columns, specific columns, unique records, conditional select, in clause, between clause, limit, aggregate functions (count, min, max, avg, sum), group by clause, having clause</p> <p>2.5 Normalization Concepts: 1NF, 2NF, 3NF, BCNF, examples.</p>	15
3	<p>3.1 Functions: String Functions (concat, instr, left, right, mid, length, lcase/lower, ucase/upper, replace, strcmp, trim, ltrim, rtrim), Math Functions (abs, ceil, floor, mod, pow, sqrt, round, truncate) Date Functions (adddate, datediff, day, month, year, hour, min, sec, now,</p>	15

	reverse) 3.2 Joining Tables: inner join, outer join (left outer, right outer, full outer) 3.3 Sub queries: Sub queries with IN, EXISTS, sub queries restrictions, Nested sub queries, ANY/ALL clause, correlated sub queries 3.4 Database Protection: Security Issues, Threats to Databases, Security Mechanisms, Role of DBA, Discretionary Access Control 3.5 Views: Creating, altering dropping, renaming and manipulating views 3.6 DCL Statements: (creating/dropping users, privileges introduction, granting/revoking privileges, viewing privileges).	
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Self – Learning Topics (Unit wise)

Sub Unit	Topics
1	Entity Relationship Model: Entities, attributes, entity sets, relations, relationship sets, Additional constraints (key constraints, participation constraints, weak entities, aggregation / generalization, Conceptual Design using ER (entities VS attributes, Entity Vs relationship, binary Vs ternary, constraints beyond ER)
2	Relational Algebra: operations (selection, projection, set operations, union, intersection, difference, cross product, Joins –conditional, equijoin and natural joins, division)
3	DDL Statements: Creating Databases, Using Databases, data types, Creating Tables (with integrity constraints – primary key, default, check, not null), Altering Tables, Renaming Tables, Dropping Tables, Truncating Tables, Backing Up and Restoring databases

Online Resources:

Refer week 3 content from “Database Management System” available on Swayam portal. Link: https://swayam.gov.in/nd1_noc19_cs46/preview
Refer week 2 and week 3 content from “Database Management System” available on Swayam portal. Link: https://swayam.gov.in/nd1_noc19_cs46/preview

Course Name: Data Based Management System Practical	Course Code
Session Per Week(1 session is 60 minutes)	2
Credits	1

List of Practical: Data Based Management System Practical	
1	For given scenario, Draw E-R diagram and convert entities and relationships to table.
2	Write relational algebra queries on the tables created in Practical-1.
3	Perform queries for: Viewing all databases, creating a Database, viewing all Tables in a Database, Creating Tables (With and Without Constraints), Inserting/Updating/Deleting Records in a Table, Saving (Commit) and Undoing (rollback)
4	Perform queries for: Altering a Table, Dropping / Truncating / Renaming Tables, backing up / Restoring a Database
5	Perform queries for: Simple Queries, Simple Queries with Aggregate functions, Queries with Aggregate functions (group by and having clause)
6	Queries involving: Date Functions, String Functions, Math Functions
7	Join Queries: Inner Join, Outer Join, Full Outer Join
8	Sub queries: With IN clause, With EXISTS clause
9	Views: Creating Views (with and without check option), Dropping views, Selecting from a view
10	DCL statements: Granting and revoking permissions.

Reference books:

1.	Ramez Elmasri, Shamkant B. Navathe, Fundamentals of Database Systems, Pearson Education, Sixth Edition, 2010.
2.	Ramakrishnam Gehrke, Database Management Systems, McGraw-Hill, 2007.
3.	Joel Murach, Murach's MySQL, Murach, 2012.
4.	NoSQL databases, by Christof Strauch
5.	Enterprise NoSQL for Dummies, a Wiley brand, Charlie books
6.	Practical MongoDB by Shakuntala Gupta Edward Navin Sabharwal

Course Name: Visual representation using Tableau & PowerBI		Course Code:	
Session Per Week(1 session is 60 minutes)		3	
Credits		3	
		Hours	Marks
Evaluation System	Theory Examination	2	60
	Internal	-	15

Course outcome:

1. Ability to create visually appealing and interactive data visualizations using Power BI and Tableau tools.
2. Proficiency in connecting, importing, and transforming data from various sources to create insightful reports and dashboards.
3. Understanding of data analysis techniques and best practices for using Power BI and Tableau to interpret and communicate data effectively.
4. Knowledge of how to customize and format visualizations to present data in a clear and engaging manner.
5. Skills in collaborating and sharing reports with team members and stakeholders using Power BI and Tableau sharing features.
6. Understanding of how to leverage advanced features in Power BI and Tableau to perform complex data analysis and create dynamic visualizations.
7. Ability to use Power BI and Tableau to monitor and analyze key performance indicators (KPIs) and make data-driven decisions.
8. Confidence in applying Power BI and Tableau skills in real-world business scenarios to solve complex data visualization challenges.

Unit	Content	No. of Lectures
1	Introduction to Power Query <u>1.1 Introduction to Power Pivot:</u> Creating a connection to the data model, Loading the data to the power pivot data model, Adding new data to the power pivot data model, Understanding the use of power pivot, Creating relationships in the power pivot data model <u>1.2 Pivot Tables:</u> Creating pivot tables using power pivot, Creating charts using pivot tables. <u>1.3 Dashboard creation:</u> Assembling the dashboard with slicers, Adding new data and updating the dashboard	15

	<p><u>1.4 Introduction to Data Literacy:</u> Introduction & Exploring Data</p> <p><u>1.5 Recognizing Well-Structured Data:</u> Data Characteristics, Data Organization & Data Restructuring</p> <p><u>1.6 Exploring Variables and Field Types:</u> Understanding variable types and field types, View variables in visualizations, Discrete and continuous variables</p> <p><u>1.7 Exploring Aggregation and Granularity:</u> Exploring aggregation, Exploring granularity</p> <p><u>1.8 Understanding Distributions:</u> Distribution of discrete variables & Distributions of continuous variables—histograms, Distributions of continuous variables—box plots</p> <p><u>1.9 Discover data analysis</u> Introduction Overview of data analysis Roles in data Tasks of a data analyst Get started building with Power BI Introduction Use Power BI Building blocks of Power BI Tour and use of Power BI</p>	
2	<p><u>2.1 Get data power BI</u> Introduction Get data from files Get data relational data source Get data from a NoSQL database Get data from online services select a storage mode Get data from Azure Analysis Services Fix performance issues Resolve data import errors Exercise - Prepare data in Power BI Desktop</p> <p><u>2.2 Clean, transform, and load data in Power BI</u> Introduction Shape the initial data Simplify the data structure Evaluate and change column data types Combine multiple tables into a single table Profile data in Power BI Use Advanced Editor to modify M code Exercise - Load data in Power BI Desktop</p> <p><u>2.3 Design a semantic model in Power BI</u> Introduction Work with tables Create a date table Work with dimensions Define data granularity Work with relationships and cardinality Exercise - Model data in Power BI Desktop</p> <p><u>2.4 Add measures to Power BI Desktop models</u> Introduction to DAX and Measures Create simple measures Create compound measures Create quick measures</p>	15

	<p>Compare calculated columns with measures</p> <p><u>2.5 Add calculated tables and columns to Power BI Desktop models</u></p> <p>Introduction</p> <p>Create Calculated Columns</p> <p>Learn about row context</p> <p>Choose a technique to add a column</p> <p><u>2.6 Optimize a model for performance in Power BI</u></p> <p>Introduction to performance optimization</p> <p>Review performance of measures, relationships, and visuals</p> <p>Use variables to improve performance and troubleshooting</p> <p>Reduce cardinality</p> <p>Optimize DirectQuery models with table level storage</p> <p>Create and manage aggregations</p> <p><u>6.1 Design Power BI reports</u></p> <p>Introduction</p> <p>Design the analytical report layout</p> <p>Design visually appealing reports</p> <p>Report objects</p> <p>Select report visuals</p> <p>Select report visuals to suit the report layout</p> <p>Format and configure visualizations</p> <p>Work with key performance indicators</p> <p>Exercise - Design a report in Power BI desktop</p> <p><u>2.7 Configure Power BI report filters</u></p> <p>Introduction to designing reports for filtering</p> <p>Apply filters to the report structure</p> <p>Apply filters with slicers</p> <p>Design reports with advanced filtering techniques</p> <p>Consumption-time filtering</p> <p>Select report filter techniques</p> <p>Case study - Configure report filters based on feedback</p> <p><u>2.8 Enhance Power BI report designs for the user experience</u></p> <p>Design reports to show details</p> <p>Design reports to highlight values</p> <p>Design reports that behave like apps</p> <p>Work with bookmarks</p> <p>Design reports for navigation</p> <p>Work with visual headers</p> <p>Design reports with built-in assistance</p> <p>Tune report performance</p> <p>Optimize reports for mobile use</p> <p>Exercise - Enhance Power BI reports</p> <p>Introduction to Tableau</p> <p><u>2.9 Connect to and Customize Data</u></p> <p>Connecting to Data</p> <p>Customizing a Data Source</p> <p>Working with a Data Extract</p> <p><u>2.10 Organize Data and Create Filters</u></p> <p>Creating Groups in Your Data</p> <p>Creating Hierarchies in Your Data</p> <p>Understanding Filtering in Tableau</p> <p>Filtering Your Data</p> <p>Sorting Your Data</p> <p>Using Sets to Highlight Data</p>	
3	<p><u>3.1 Build Common Views</u></p> <p>Working with Dates to Visualize Time-Based Data</p> <p>Creating Custom Date Fields and Hierarchies</p>	15

	<p>Comparing Multiple Measures in Views</p> <p>Using Scatter Plots To Show Relationships Between Measures</p> <p>Creating Spreadsheet-like Views Using Text Tables</p> <p>Using a Highlight Table to Show Specific Values</p> <p>Showing Breakdowns of the Whole Using Pie Charts</p> <p>Showing Breakdowns of the Whole Using Tree Maps</p> <p>Using Bar-in-Bar Charts and Bullet Graphs to Compare Measures</p> <p><u>3.2 Map Geographic Data</u></p> <p>Creating Symbol and Filled Maps</p> <p>Creating a Density Map</p> <p><u>3.3 Create Calculated Fields</u></p> <p>Creating Calculated Fields for Deeper Analysis</p> <p>Working with String and Type Conversion Functions</p> <p>Working with Date Functions</p> <p>Working with Aggregate Functions</p> <p><u>3.4 Apply Table Calculations</u></p> <p>Using Quick Table Calculations to Analyze Data</p> <p><u>3.5 Apply Analytics</u></p> <p>Highlighting Values with Reference Lines and Bands</p> <p>Using Parameters to Control Data in the View</p> <p>Using Histograms and Box & Whisker Plots to Show Distribution</p> <p><u>3.6 Work with Multiple Data Sources</u></p> <p>Creating Relationships between Tables</p> <p>Joining Tables Using a Common Field</p> <p>Using Unions to Combine Data</p> <p>Blending Multiple Data Sources Using a Common Field</p> <p><u>3.7 Create Dashboards and Stories</u></p> <p>Building a Dashboard</p> <p>Creating Interactive Dashboards Using Actions</p> <p>Refining a Dashboard</p> <p>Telling Stories with Data</p>	
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Self-Learning topics (Unit wise)

Sub Unit	Topics
1	1.1 Pivot Tables: Creating pivot tables using power pivot, Creating charts using pivot tables, 1.2 Histograms, box plots
2	Get data from files, Work with tables, Apply filters with slicers, Filtering Your Data, Sorting Your Data
3	Scatter Plots, Working with Date Functions, Histograms and Box & Whisker Plots

Online Resources

1. Power BI documentation: https://docs.microsoft.com/en-us/power-bi/
2. Power BI community forums: https://community.powerbi.com/
3. Tableau online help: https://help.tableau.com/current/guides/get-started-tutorial/en-us/get-started-tutorial-home.htm
4. Tableau community forums: https://community.tableau.com/

Reference books

Power BI and Tableau: A Complete Guide for Beginners to Learn and Master Data Visualization with Power BI and Tableau by David Kelly
Tableau Your Data!: Fast and Easy Visual Analysis with Tableau Software" by Dan Murray
Practical Tableau: 100 Tips, Tutorials, and Strategies from a Tableau Zen Master" by Ryan Sleeper

Course Name: Predictive Analytics using SPSS		Course Code:	
Session Per Week(1 session is 60 minutes)		3	
Credits		3	
		Hours	Marks
Evaluation System	Theory Examination	2	60
	Internal	-	15

Course outcome:

1. Demonstrate an understanding of basic statistical concepts and the role of SPSS in data analysis.
2. Identify and use appropriate data types and formats in SPSS for various types of data analysis.
3. Generate and interpret descriptive statistics using SPSS, including measures of central tendency, variability, and distribution.
4. Conduct hypothesis testing and interpret the results using various statistical tests in SPSS.
5. Create and customize visual representations of data in SPSS, such as charts and graphs.
6. Understand and apply statistical techniques for comparing groups and analysing relationships between variables in SPSS.
7. Evaluate and interpret output from statistical analyses in SPSS to draw meaningful conclusions and make data-driven decisions.
8. Demonstrate proficiency in using SPSS software to perform a wide range of data analysis tasks effectively and efficiently.
9. Apply ethical standards and best practices in data analysis using SPSS to ensure the accuracy and validity of results.
10. Communicate findings from data analysis in SPSS to various audiences effectively, both verbally and in writing.

Unit	Content	No. of Lectures
1	Managing Data in SPSS 1.1 Creating and Editing Data File 1.2 Data Manipulation: Sorting Data, Merging and Appending Data/files, Aggregating/summarizing Data, Reshaping Data, Recording Variables, Sub setting Data, Data Type Conversions, Sampling, Renaming-formatting data, Handling duplicates/Missing values, computing new variables, Selecting cases 1.3 Visualization for Univariate, Bivariate and Multivariate Data	15

	<p>1.4 Diagram Vs Graphs, Creating available Graphs, Histograms & Density Plot:</p> <ul style="list-style-type: none"> • Dot Plots – Bar Plots(Column, Subdivided, Percentage) • Line Charts – Pie Charts –Boxplots – Scatterplots <p>Story telling on dataset Titanic dataset: (http://biostat.mc.vanderbilt.edu/wiki/pub/Main/DataSets/titani c3.csv)</p>	
2	<p>Multi-Dimensional Scaling (MDS) & Correspondence Analysis and Statistical Test:</p> <p>2.1 Multi-Dimensional Scaling (MDS) & Correspondence Analysis:</p> <ul style="list-style-type: none"> • Objective of MDS, Comparing MDS to other interdependence techniques, Research design, Assumption of MDS, Deriving MDS & assessing over fit, Validating MDS, Objective of correspondence analysis., Research design, • Assumptions of correspondence analysis, Deriving of CA & assessing overall fit. <p>2.2 Reliability Analysis: Coefficient alpha and split half reliability</p> <p>2.3 Cross tabulation and Chi Square Analyses, Cramer V, Phi, Fisher Exact Test, odds Ratio</p> <p>2.4 ANOVA: Introduction, Model specification, Assumptions,</p> <ul style="list-style-type: none"> • Post hoc Analysis for One Way and Two Way ANOVA <p>Story telling using grades.sav Post hoc Analysis for One Way and Two Way ANOVA Story telling using grades.sav</p>	15
3	<p>Statistical Modeling:</p> <p>3.1 Bivariate Correlations, partial correlations, Multiple Correlations:</p> <p>3.2 Introduction, Examples, Scatter Diagram, Computation for quantitative and qualitative Data. Story telling using grades.sav</p> <p>3.3 Simple Linear Regression: Introduction to linearity in parameters and variables, Linear Regression Vs Nonlinear Regression, Model and Assumptions, Residuals, R^2, adjusted R^2, Overall significance of model, Significance of Individual Coefficient, Confidence intervals for the regression coefficients.</p> <p>3.4 Multiple Linear Regression: Model and Assumptions, correlation matrix, Forward Selection Method, Backward Selection Methods, Stepwise Selection Method, Variable Selection and Model Building.</p> <ul style="list-style-type: none"> • First Order Test: Interpretation of output: Residuals, R^2, adjusted R^2, Overall significance of model, Significance of Individual Coefficient, Confidence intervals for the regression coefficients. • Second Order Test: Test for Autocorrelation detection and treatment, Multicollinearity detection and treatment, Heteroscedasticity detection and treatment, Outlier detection and treatment. <p>Story telling on dataset mtcars. Story telling on datasets a-year-of-pumpkin-prices data/ others (https://www.kaggle.com/usda/a-year-of-pumpkin-prices a)</p>	15

Teaching of the unit will be done through teaching mode and through self-learning mode. Evaluation of self-learning topics to be undertaken before the concluding lecture instructions of the respective UNIT.

Self-Learning topics (Unit wise)

Sub Unit	Topics
1	Formatting data, Handling duplicates/Missing values, Computing new variables, Selecting cases, Creating available Graphs, Histograms & Density Plot
2	Data Pre-processing, Chi Square Analyses, Cramer V, Phi, Fisher Exact Test, odds Ratio ANOVA: Introduction, Model specification, Assumptions, Post hoc Analysis for Two Way ANOVA

Online Resources

‘Marketing Research and Analysis-II’ by PROF. J. K. NAYAK, Department of Management Studies, IIT Roorkee, available on the NPTEL portal,
<https://nptel.ac.in/courses/110/107/110107080/>
<https://nptel.ac.in/courses/110/107/110107113/>

Reference books:

SPSS for Windows Step by Step A Simple Guide and Reference by Darren George and Paul Mallery, Pearson
 Field, A. (2013). Discovering statistics using IBM SPSS statistics (4th ed.). SAGE Publications.
 Brian C. Cronk, How to Use SPSS®: A Step-By-Step Guide to Analysis and Interpretation Paperback

Curriculum Topics along with Self-Learning topics

Course Name: Multivariate Calculus		Course Code:	
Session Per Week(1 session is 60 minutes)		3	
Credits		3	
		Hours	Marks
Evaluation System	Theory Examination	2	60
	Internal	-	15

Course outcome:

1. Determine the extreme values of functions of two variables.
2. To give the insight of calculus starting with continuity and derivatives.
3. To apply derivatives and integration to various domains
4. Apply the vector differential operator to scalar and vector functions
5. Applying different techniques to solve various optimization problems
6. Applying basic concepts of mathematics to formulate an optimization problem.

Unit	Content	No. of lectures
1	Partial Differentiation and Its Applications: 1.1 Continuity and Derivatives: Limits at infinity, Derivative and Rate of Changes, The Derivatives as a function. 1.2 Differentiation rules: Derivatives of Polynomials, Logarithmic and Exponential functions. The Product and Quotient Rules, The Chain rule. 1.3 Derivative for multivariate functions: Partial derivatives, Higher order partial derivatives, Total derivative 1.4 Differentiation of implicit functions & Jacobians 1.5 Taylor's expansion of functions of two variables 1.6 Maxima and minima of functions of two variables.	15
2	Vector Differential Calculus: 2.1 Vectors in two and three dimensions, Vectors and equations, dot products, cross product, coordinate systems 2.2 Scalar and vector point functions, vector operator Del, Gradient, 2.3 Directional derivative, Divergence, Curl, Del applied twice to point functions, Del applied to product of point functions (vector identities).	15

	2.4 Applications: Irrotational fields and Solenoidal fields 2.5 Integral: The Definite Integral, the Substitution rule, Integration by Parts, Integration of Rational function by partial fractions 2.6 Double and triple integrations	
3	Optimization: 3.1 Optimization using Gradient Descent, 3.2 Constrained Optimization and Lagrange Multipliers, 3.3 Convex Optimization. 3.4 Riemann integration, 3.5 Improper integrals. 3.6 Applications of Integrals.	15

Self – Learning Topics (Unit wise)

Sub Unit	Topics
1	Differentiation rules: Derivatives of Polynomials, Logarithmic and Exponential functions. The Product and Quotient Rules, The Chain rule.
2	Vectors in two and three dimensions, Vectors and equations, dot products, cross product, coordinate systems. Integral: The Definite Integral, the Substitution rule, Integration by Parts, Integration of Rational function by partial fractions.

Online Resources:

“Multivariate Calculus” by Prof. S. K. Gupta and Prof. Sanjeev Kumar from IIT Roorkee, https://onlinecourses.nptel.ac.in/noc21_ma10/preview
“Integral and Vector Calculus” by Prof. Hari S. Mahato from IIT Kharagpur, https://onlinecourses.nptel.ac.in/noc21_ma13/preview

Course Name:Multi Variate Calculus Practical	Course Code
Session Per Week(1 session is 60 minutes)	2
Credits	1

List of Practical:	
1.	6 tutorials based on Calculus should be conducted.
2.	4 practical based on Multivariate calculus using MATLAB.

Reference books:

1.	Susan J. Colley, Vector Calculus, fourth edition, by, 2012
2.	E. Kreyszig, Advanced Engineering Mathematics, 9th edition, John Wiley and Sons, Inc., U.K. (2011)
3.	H.K. Dass, Er. Rajnish Verma ,Higher Engineering Mathematics, S.Chand Technical.
4.	R.K. Jain and S.R.K. Iyenger, Advanced Engineering Mathematics, 2nd Edition, Narosa Publishing House (2005)

Course Name: Essential Programming	Course Code:	
Session Per Week(1 session is 60 minutes)	3	
Credits	3	
	Hours	Marks

Evaluation System	Theory Examination	2	60
	Internal	-	15

Course outcome:

1. Understand the basics of Java programming language, including syntax, data types, control structures, and object-oriented programming concepts.
2. Design and implement Java programs that demonstrate proficiency in using loops, arrays, and classes.
3. Demonstrate knowledge of file handling in Java, including reading and writing data to files.
4. Utilize Java libraries and APIs to access external resources and services.
5. Apply best practices for coding, debugging, and testing Java programs.
6. Scala is a general-purpose, high-level, multi-paradigm programming language. It is a pure object-oriented programming language which also provides support to the functional programming approach. To make familiar with scala programming language.

Unit	Content	No. of lectures
1	<p>Introduction: History, architecture and its components, Java Class File, Java Runtime Environment, The Java Virtual Machine, JVM Components, The Java API, java platform, java development kit, , Methods References, setting the path environment variable, Java Compiler And Interpreter, java programs, java applications, main(), public, static, void, string[] args,</p> <p>Control Flow Statements: The If...Else If...Else Statement, The Switch...Case Statement Iterations: The While Loop, The Do ... While Loop, The For Loop, The Foreach Loop, Labeled Statements, The Break And Continue Statements, The Return Statement</p> <p>Classes: Types of Classes, Scope Rules, Access Modifier, Instantiating Objects From A Class, Initializing The Class Object And Its Attributes, Class Methods, Accessing A Method, Method Returning A Value, Method's Arguments, Inner Classes</p> <p>String Handling: String class and its methods, Tokenizing a String, Creating Strings using StringBuffer</p>	15
2	<p>Classes and its concepts: Method Overloading, Variable Arguments [Varargs], Constructors, this Instance, super Instance, Characteristics Of Members Of A Class, constants, this instance, static fields of a class, static methods of a class, garbage collection</p> <p>Inheritance: Derived Class Objects, Inheritance and Access Control, Default Base Class Constructors, this and super keywords. Abstract Classes And Interfaces, Abstract Classes, Abstract Methods</p> <p>Interfaces: What Is An Interface? How Is An Interface Different From An Abstract Class?, Multiple Inheritance, Default Implementation, Adding New Functionality, Method Implementation, Classes V/s Interfaces, Defining An Interface, Implementing Interfaces</p> <p>Packages: Creating Packages, Default Package, Importing Packages, Using A Package.</p>	15

	Byte streams: reading console input, writing console output, reading file, writing file, writing binary data, reading binary data, getting started with character streams, writing file, reading file.	
3	What is Scala? where to use Scala? Scala Keywords, identifiers, datatypes, variables Control statements: if-else, while, nested loops, for loop Scala Constructors, scala OOPS concept, lambda expression Scala Packages, File handling in scala. Scala Array, Scala collections-Seq, Set, List, Vector, Maps, Tuples. Scala Multithreading-Scala Thread Life cycle, Thread methods, examples. Programming examples with scala.	15

Self – Learning Topics (Unit wise)

Sub Unit	Topics
1	History, architecture and its components, String Handling: String class and its methods, tokenizing a String, Creating Strings using StringBuffer
2	Byte streams: reading console input, writing console output, reading file, writing file, writing binary data, reading binary data, getting started with character streams, writing file, reading file.
3	Scala Multithreading-Scala Thread Life cycle, Thread methods, examples.

Online Resources:

https://nptel.ac.in/courses/106105191
https://www.javatpoint.com/
https://www.javatpoint.com/scala-tutorial
https://docs.oracle.com/javase/tutorial/

Course Name Essential Programming Practicals	Course Code
Session Per Week(1 session is 60 minutes)	2

Credits	1	
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List of Practical: OOPs with JAVA Practicals	
1.	OOPs concepts in Java – 1
a.	Write a program to create a class and implement a default, overloaded and copy Constructor.
b.	Write a program to create a class and implement the concepts of Method Overloading
c.	Write a program to create a class and implement the concepts of Static methods
2.	OOPs concepts in Java – 2
a.	Write a program to implement the concepts of Inheritance and Method overriding
b.	Write a program to implement the concepts of Abstract classes and methods
c.	Write a program to implement the concept of interfaces
3.	Exceptions
a.	Write a program to raise built-in exceptions and raise them as per the requirements
b.	Write a program to define user defined exceptions and raise them as per the requirements
4.	Multithreading: Write a java application to demonstrate 5 bouncing balls of different colors using threads.
5.	Demonstrate the use of Scala Programming with multithreading

Reference books:

1.	Core Java 8 for Beginners
2.	Java: The Complete Reference
3.	Murach's beginning Java with Net Beans
4.	Core Java, Volume I: Fundamentals
5.	Core Java, Volume II: Advanced Features
6.	Programming Scala O'Reilly Publication

Course Name: Business Analytics	Course Code:
Session Per Week(1 session is 60 minutes)	3

Credits		3	
		Hours	Marks
Evaluation System	Theory Examination	2	60
	Internal	-	15

Course outcome:

1. Understand the importance of data-driven decision making in a business context
2. Develop skills to collect, clean, and analyze data using various tools and techniques
3. Apply statistical methods and models to interpret and make predictions based on data
4. Communicate results effectively through data visualization and storytelling
5. Identify key performance indicators and metrics relevant to different business functions
6. Use data to uncover insights, trends, and patterns that can drive business strategy
7. Develop a strategic mindset to leverage data for competitive advantage
8. Gain hands-on experience with real-world business analytics projects
9. Collaborate with team members to solve complex business problems using data
10. Stay current on emerging trends and technologies in the field of business analytics.

Unit	Content	No. of lectures
1	Business Analytics Landscape 1.1 Overview of Startup Landscape 1.2 Product Lifecycle Management 1.3 Details of Business Analytics 1.4 Competing on Analytics 1.5 Getting started with Business Analytics	15
2	Introduction to Data Mining 2.1 Introduction: Basic concept of Data mining, need, challenges and application of Data mining. 2.2 Discussion of Some case studies of data mining. 2.3 On-line Analytical Processing. 2.4 Major Issues in data mining. 2.5 Getting to know your data: data objects and attribute types, basic statistical descriptions of Data, Data Visualization, Measuring Data Similarity and dissimilarity.	15
3	Data Preparation & Basic Mining tools 3.1 Data Pre-processing: An Overview, Data Cleaning, Data Integration, Data Reduction, Data transformation and data discretization, Normalization and Smoothing of data. Associations and Correlations: Basic Concepts and methods. 3.2 Classification: Basic concepts decision Tree 3.3 Induction, Rule-Based Classification, Model Evaluation and Selection.	15

Sub Unit	Topics
1	Data Pre-processing: An Overview, Data Cleaning, Data Integration, Data Reduction, Data transformation and data discretization, Normalization and Smoothing of data. Associations and Correlations: Basic Concepts and methods.
2	Classification: Basic concepts decision Tree

Online Resources:

‘Data Mining’ by Prof. Pabitra Mitra from IIT Kharagpur available on the Swayam portal https://nptel.ac.in/courses/106/105/106105174/ for unit II.
‘Data Mining’ by Mr. L. Abraham David from St.John’s College, Palayamkottai Tirunelveli available on the Swayam portal http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/31
‘Business Analytics and Data Mining Modelling using R Part II’ by Dr. Gaurav Dixit from IIT Roorkee available on the Swayam portal https://nptel.ac.in/courses/110/107/110107095/
‘Business Analytics and Data Mining Modelling using R’ by Dr. Gaurav Dixit from IIT Roorkee available on the Swayam portal https://nptel.ac.in/courses/110/107/110107092/

Course Name:Business Analytics Practical	Course Code
Session Per Week(1 session is 60 minutes)	2
Credits	1

List of Practical:Buisness Analytics Practical
1 10 practicals based on Unit 1,2 and 3

Reference books:

1	Dunham, Margaret H, Data Mining: Introductory and Advanced Topics, Prentice Hall.
2	Witten, Ian and Eibe Frank, Data Mining: Practical Machine Learning Tools and Techniques, Second Edition, Morgan Kaufmann.
3	Han, J., Kamber, M., & Pei, J. Data mining: Concepts and techniques (3rd ed.). Waltham: Morgan Kaufmann, 2011.
4	Baeza and Yates, Modern Information Retrieval, Addison Wesley.
5	Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, McGraw – Hill.
6	Ramez elmasri and shamkant b.Navathe,“fundamental data base systems”, third edition, Pearson Education,2008.

Multi-Disciplinary

Course Name: Predictive Analytics using SPSS		Course Code:	
Session Per Week(1 session is 60 minutes)		3	
Credits		3	
		Hours	Marks
Evaluation System	Theory Examination	2	60
	Internal	-	15

Course outcome:

1. Demonstrate an understanding of basic statistical concepts and the role of SPSS in data analysis.
2. Identify and use appropriate data types and formats in SPSS for various types of data analysis.
3. Generate and interpret descriptive statistics using SPSS, including measures of central tendency, variability, and distribution.
4. Conduct hypothesis testing and interpret the results using various statistical tests in SPSS.
5. Create and customize visual representations of data in SPSS, such as charts and graphs.
6. Understand and apply statistical techniques for comparing groups and analyzing relationships between variables in SPSS.
7. Evaluate and interpret output from statistical analyses in SPSS to draw meaningful conclusions and make data-driven decisions.
8. Demonstrate proficiency in using SPSS software to perform a wide range of data analysis tasks effectively and efficiently.
9. Apply ethical standards and best practices in data analysis using SPSS to ensure the accuracy and validity of results.
10. Communicate findings from data analysis in SPSS to various audiences effectively, both verbally and in writing.

Unit	Content	No. of Lectures
1	Managing Data in SPSS 1.5 Creating and Editing Data File 1.6 Data Manipulation: Sorting Data, Merging and Appending Data/files, Aggregating/summarizing Data, Reshaping Data, Recording Variables, Sub setting Data, Data Type Conversions, Sampling, Renaming-formatting data, Handling duplicates/Missing values, computing new variables, Selecting cases 1.7 Visualization for Univariate, Bivariate and Multivariate Data 1.8 Diagram Vs Graphs, Creating available Graphs, Histograms & Density Plot: <ul style="list-style-type: none"> • Dot Plots – Bar Plots(Column, Subdivided, Percentage) 	15

	<ul style="list-style-type: none"> Line Charts – Pie Charts –Boxplots – Scatterplots <p>Story telling on dataset Titanic dataset: (http://biostat.mc.vanderbilt.edu/wiki/pub/Main/DataSets/titanic3.csv)</p>	
2	<p>Multi-Dimensional Scaling (MDS) & Correspondence Analysis and Statistical Test:</p> <p>2.1 Multi-Dimensional Scaling (MDS) & Correspondence Analysis:</p> <ul style="list-style-type: none"> Objective of MDS, Comparing MDS to other interdependence techniques, Research design, Assumption of MDS, Deriving MDS & assessing over fit, Validating MDS, Objective of correspondence analysis., Research design, Assumptions of correspondence analysis, Deriving of CA & assessing overall fit. <p>2.2 Reliability Analysis: Coefficient alpha and split half reliability</p> <p>2.3 Cross tabulation and Chi Square Analyses, Cramer V, Phi, Fisher Exact Test, odds Ratio</p> <p>2.4 ANOVA: Introduction, Model specification, Assumptions,</p> <ul style="list-style-type: none"> Post hoc Analysis for One Way and Two Way ANOVA <p>Story telling using grades.sav Post hoc Analysis for One Way and Two Way ANOVA Story telling using grades.sav</p>	15
3	<p>Statistical Modeling:</p> <p>3.5 Bivariate Correlations, partial correlations, Multiple Correlations:</p> <p>3.6 Introduction, Examples, Scatter Diagram, Computation for quantitative and qualitative Data. Story telling using grades.sav</p> <p>3.7 Simple Linear Regression: Introduction to linearity in parameters and variables, Linear Regression Vs Nonlinear Regression, Model and Assumptions, Residuals, R^2, adjusted R^2, Overall significance of model, Significance of Individual Coefficient, Confidence intervals for the regression coefficients.</p> <p>3.8 Multiple Linear Regression: Model and Assumptions, correlation matrix, Forward Selection Method, Backward Selection Methods, Stepwise Selection Method, Variable Selection and Model Building.</p> <ul style="list-style-type: none"> First Order Test: Interpretation of output: Residuals, R^2, adjusted R^2, Overall significance of model, Significance of Individual Coefficient, Confidence intervals for the regression coefficients. Second Order Test: Test for Autocorrelation detection and treatment, Multicollinearity detection and treatment, Heteroscedasticity detection and treatment, Outlier detection and treatment. <p>Story telling on dataset mtcars.</p> <p>Story telling on datasets a-year-of-pumpkin-prices data/ others (https://www.kaggle.com/usda/a-year-of-pumpkin-prices-a)</p>	15

Sub Unit	Topics
1	Formatting data, Handling duplicates/Missing values, Computing new variables, Selecting cases, Creating available Graphs, Histograms & Density Plot
2	Data Pre-processing, Chi Square Analyses, Cramer V, Phi, Fisher Exact Test, odds Ratio ANOVA: Introduction, Model specification, Assumptions, Post hoc Analysis for Two Way ANOVA

Online Resources

‘Marketing Research and Analysis-II’ by PROF. J. K. NAYAK, Department of Management

Studies, IIT Roorkee, available on the NPTEL portal,

<https://nptel.ac.in/courses/110/107/110107080/>

<https://nptel.ac.in/courses/110/107/110107113/>

Reference books:

SPSS for Windows Step by Step A Simple Guide and Reference by Darren George and Paul Mallery, Pearson

Field, A. (2013). Discovering statistics using IBM SPSS statistics (4th ed.). SAGE Publications.

Brian C. Cronk, How to Use SPSS®: A Step-By-Step Guide to Analysis and Interpretation Paperback

Course Name: Visual representation using Tableau & PowerBI		Course Code:	
Session Per Week(1 session is 60 minutes)		3	
Credits		3	
		Hours	Marks
Evaluation System	Theory Examination	2	60
	Internal	-	15

Course outcome:

1. Ability to create visually appealing and interactive data visualizations using Power BI and Tableau tools.
2. Proficiency in connecting, importing, and transforming data from various sources to create insightful reports and dashboards.
3. Understanding of data analysis techniques and best practices for using Power BI and Tableau to interpret and communicate data effectively.
4. Knowledge of how to customize and format visualizations to present data in a clear and engaging manner.
5. Skills in collaborating and sharing reports with team members and stakeholders using Power BI and Tableau sharing features.
6. Understanding of how to leverage advanced features in Power BI and Tableau to perform complex data analysis and create dynamic visualizations.
7. Ability to use Power BI and Tableau to monitor and analyze key performance indicators (KPIs) and make data-driven decisions.
8. Confidence in applying Power BI and Tableau skills in real-world business scenarios to solve complex data visualization challenges.

Unit	Content	No. of Lectures
1	Introduction to Power Query <u>1.1 Introduction to Power Pivot:</u> Creating a connection to the data model, Loading the data to the power pivot data model, Adding new data to the power pivot data model, Understanding the use of power pivot, Creating relationships in the power pivot data model <u>1.2 Pivot Tables:</u> Creating pivot tables using power pivot, Creating charts using pivot tables. <u>1.3 Dashboard creation:</u> Assembling the dashboard with slicers, Adding new data and updating the dashboard <u>1.4 Introduction to Data Literacy:</u> Introduction & Exploring Data <u>1.5 Recognizing Well-Structured Data:</u> Data Characteristics, Data Organization & Data Restructuring <u>1.6 Exploring Variables and Field Types:</u>	15

	<p>Understanding variable types and field types, View variables in visualizations, Discrete and continuous variables</p> <p><u>1.7 Exploring Aggregation and Granularity:</u> Exploring aggregation, Exploring granularity</p> <p><u>1.8 Understanding Distributions:</u> Distribution of discrete variables & Distributions of continuous variables—histograms, Distributions of continuous variables—box plots</p> <p><u>1.9 Discover data analysis</u> Introduction Overview of data analysis Roles in data Tasks of a data analyst Get started building with Power BI Introduction Use Power BI Building blocks of Power BI Tour and use of Power BI</p>	
2	<p><u>2.1 Get data power BI</u> Introduction Get data from files Get data relational data source Get data from a NoSQL database Get data from online services select a storage mode Get data from Azure Analysis Services Fix performance issues Resolve data import errors Exercise - Prepare data in Power BI Desktop</p> <p><u>2.2 Clean, transform, and load data in Power BI</u> Introduction Shape the initial data Simplify the data structure Evaluate and change column data types Combine multiple tables into a single table Profile data in Power BI Use Advanced Editor to modify M code Exercise - Load data in Power BI Desktop</p> <p><u>2.3 Design a semantic model in Power BI</u> Introduction Work with tables Create a date table Work with dimensions Define data granularity Work with relationships and cardinality Exercise - Model data in Power BI Desktop</p> <p><u>2.4 Add measures to Power BI Desktop models</u> Introduction to DAX and Measures Create simple measures Create compound measures Create quick measures Compare calculated columns with measures</p> <p><u>2.5 Add calculated tables and columns to Power BI Desktop models</u> Introduction Create Calculated Columns Learn about row context Choose a technique to add a column</p>	15

	<p><u>2.6 Optimize a model for performance in Power BI</u></p> <p>Introduction to performance optimization</p> <p>Review performance of measures, relationships, and visuals</p> <p>Use variables to improve performance and troubleshooting</p> <p>Reduce cardinality</p> <p>Optimize DirectQuery models with table level storage</p> <p>Create and manage aggregations</p> <p><u>6.1 Design Power BI reports</u></p> <p>Introduction</p> <p>Design the analytical report layout</p> <p>Design visually appealing reports</p> <p>Report objects</p> <p>Select report visuals</p> <p>Select report visuals to suit the report layout</p> <p>Format and configure visualizations</p> <p>Work with key performance indicators</p> <p>Exercise - Design a report in Power BI desktop</p> <p><u>2.7 Configure Power BI report filters</u></p> <p>Introduction to designing reports for filtering</p> <p>Apply filters to the report structure</p> <p>Apply filters with slicers</p> <p>Design reports with advanced filtering techniques</p> <p>Consumption-time filtering</p> <p>Select report filter techniques</p> <p>Case study - Configure report filters based on feedback</p> <p><u>2.8 Enhance Power BI report designs for the user experience</u></p> <p>Design reports to show details</p> <p>Design reports to highlight values</p> <p>Design reports that behave like apps</p> <p>Work with bookmarks</p> <p>Design reports for navigation</p> <p>Work with visual headers</p> <p>Design reports with built-in assistance</p> <p>Tune report performance</p> <p>Optimize reports for mobile use</p> <p>Exercise - Enhance Power BI reports</p> <p>Introduction to Tableau</p> <p><u>2.9 Connect to and Customize Data</u></p> <p>Connecting to Data</p> <p>Customizing a Data Source</p> <p>Working with a Data Extract</p> <p><u>2.10 Organize Data and Create Filters</u></p> <p>Creating Groups in Your Data</p> <p>Creating Hierarchies in Your Data</p> <p>Understanding Filtering in Tableau</p> <p>Filtering Your Data</p> <p>Sorting Your Data</p> <p>Using Sets to Highlight Data</p>	
3	<p><u>3.1 Build Common Views</u></p> <p>Working with Dates to Visualize Time-Based Data</p> <p>Creating Custom Date Fields and Hierarchies</p> <p>Comparing Multiple Measures in Views</p> <p>Using Scatter Plots To Show Relationships Between Measures</p> <p>Creating Spreadsheet-like Views Using Text Tables</p> <p>Using a Highlight Table to Show Specific Values</p> <p>Showing Breakdowns of the Whole Using Pie Charts</p> <p>Showing Breakdowns of the Whole Using Tree Maps</p>	15

	Using Bar-in-Bar Charts and Bullet Graphs to Compare Measures <u>3.2 Map Geographic Data</u> Creating Symbol and Filled Maps Creating a Density Map <u>3.3 Create Calculated Fields</u> Creating Calculated Fields for Deeper Analysis Working with String and Type Conversion Functions Working with Date Functions Working with Aggregate Functions <u>3.4 Apply Table Calculations</u> Using Quick Table Calculations to Analyze Data <u>3.5 Apply Analytics</u> Highlighting Values with Reference Lines and Bands Using Parameters to Control Data in the View Using Histograms and Box & Whisker Plots to Show Distribution <u>3.6 Work with Multiple Data Sources</u> Creating Relationships between Tables Joining Tables Using a Common Field Using Unions to Combine Data Blending Multiple Data Sources Using a Common Field <u>3.7 Create Dashboards and Stories</u> Building a Dashboard Creating Interactive Dashboards Using Actions Refining a Dashboard Telling Stories with Data	
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Self-Learning topics (Unit wise)

Sub Unit	Topics
1	1.1 Pivot Tables: Creating pivot tables using power pivot, Creating charts using pivot tables, 1.2 Histograms, box plots
2	Get data from files, Work with tables, Apply filters with slicers, Filtering Your Data, Sorting Your Data
3	Scatter Plots, Working with Date Functions, Histograms and Box & Whisker Plots

Online Resources

1. Power BI documentation: https://docs.microsoft.com/en-us/power-bi/
2. Power BI community forums: https://community.powerbi.com/
3. Tableau online help: https://help.tableau.com/current/guides/get-started-tutorial/en-us/get-started-tutorial-home.htm
4. Tableau community forums: https://community.tableau.com/

Reference books

Power BI and Tableau: A Complete Guide for Beginners to Learn and Master Data Visualization with Power BI and Tableau by David Kelly
Tableau Your Data! Fast and Easy Visual Analysis with Tableau Software" by Dan Murray
Practical Tableau: 100 Tips, Tutorials, and Strategies from a Tableau Zen Master" by Ryan Sleeper