M. G. Science Institute, Ahmedabad

Autonomous | Affiliated to Gujarat University, Ahmedabad

(Managed by The Ahmedabad Education Society)

Department of Computer and Data Science

Bachelor of Science (Hons.) in Data Science and Analytics

B.S. (Hons.) DSA

4 Year, 8 Semester Full-Time Programme

Choice-Based Credit System (CBCS) & Grading System

Outcome-Based Education Pattern

(Effective from Academic Year 2024-25)

Contents

1.0 Preamble

B.S. (Hons.) with DSA is a 4-year undergraduate programme spread over eight semesters. The course comes under the domain of computer science, Business Analytics and Artificial Intelligence. Data Science and Analytics is an interdisciplinary subject that includes Statistics, Big-Data Analytic, Machine Learning in order to understand the problem with respect to a set of real-world data. B.S. (Hons.) with DSA is intended to provide data analytics, machine learning techniques and their applications for effective decision making in improving the business processes.

2.0 Definitions

Bachelor Degree

Bachelor Degree is designed to offer the undergoing students a broad foundation necessary for a science-based career with a special focus on multidisciplinary learning.

Bachelor Degree (Hons.)

Bachelor Degree (Hons.) aims at providing advanced and specialized theoretical and research skills in the chosen science subject, along with the overall knowledge in the sciences, to provide the students a strong platform for an advanced academic or professional career.

Choice Based Credit System

The Choice Based Credit System (CBCS) provides an opportunity for the students to choose courses from the prescribed courses comprising Core, minor, multi-disciplinary, or skill-based courses.

Credit

Credits means the value assigned to a course which indicates the level of instruction:

1 hour lecture per week equals 1 credit

2 hours practical per week equals 1 credit

Credit for a practical could be proposed as part of a course or as a separate practical course.

SGPA

SGPA means Semester Grade Point Average calculated for individual semesters.

CGPA

CGPA means Cumulative Grade Point Average calculated for all courses completed by the students at any point of time. CGPA is calculated for each year for both semesters clubbed together.

Course

A course is a specific subject in the academic programme taught in a particular semester for the specifically assigned number of credits.

Course Announcement

The college shall announce the elective courses it proposes to offer to the students out of the wider course basket. It is not mandatory to offer all the electives. The decision of the principal shall be final in this case. However, in the spirit of Choice Based Credit System, the college should offer choices to the students for the elective courses and not offer only the minimum number of electives.

Course Registration

It is mandatory for every student, to register every semester, for the elective courses opted for that semester. Each student, on admission shall be assigned to a Faculty Advisor who shall advise him/her about the academic programs and counsel on the choice of courses considering the student's profile, career goals and courses taken in the earlier semesters. With the advice and consent of the Faculty Advisor, the student shall register for a set of courses he/she plans to take up for the Semester. Students shall have to register for the courses for the semester within first week of Semester I and immediately after conclusion of the preceding term for subsequent Semesters II, III, IV, V, VI, VII and VIII.

Course Outcomes

Course outcomes are the specific and measurable attributes defining the knowledge, skill and attitude of the learners are expected to demonstrate by the completion of the course.

Grading System

The Grading System is the 10-point standard scale system defined by the UGC comprising of the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA).

Letter Grade	Grade Point
O (Outstanding)	10
A+ (Excellent)	9
A (Very Good)	8
B+ (Good)	7
B (Above Average)	6
C (Average)	5
P (Pass)	4
F (Fail)	0
Ab (Absent)	0

Graduate Attributes

The Graduate Attributes are the generic abilities, attitudes and approaches expected to be demonstrated by the learner in the world around him/her in a longer period of the life time.

Learning Outcomes

Learning outcomes describe the measurable skills, abilities, knowledge, or values that students should be able to demonstrate as a result of completing a course.

Outcome Based Education (OBE) Approach

OBE is the approach focusing on the performance outcome comprising of the following:

a. The performer – the student (learner), not only the teacher.
b. The performable (thus demonstrable or assessable) to perform
c. The performance outcome, not the activity or task to be performed.

Outcome-Based Assessment

An assessment system that asks course teachers to first identify what it is that we expect students to be able to do once they have completed a course or program. It then asks course teachers to provide evidence that they are able to do so. In other words, how will each learning outcome be assessed? What **evidence of student learning** is most **relevant for each learning outcome** and **what standard or criteria** will be used to evaluate that evidence? Assessment is therefore a key part of outcome-based education and used to determine whether or not a qualification has been achieved.

Programme Educational Objectives

Programme Educational Objectives are a set of **broad future-focused student performance outcomes** that explicitly identify what students will be **able to do with what they have learned**, and what **they will be like** after they leave school and are **living full and productive lives**. Thus, PEOs are what the programme is preparing graduates for in their **career and professional life** (to attain within a **few years** after graduation).

Programme Outcomes

Programme Outcomes are a set of **narrow statements** that describe what learners of the programme are expected to know and be able to perform or attain by the time of graduation.

Programme Specific Outcomes

The PSOs are a set of narrow statements that describe what the learners of a particular specialization of the programme are expected to know and be able to perform or attain by the time of graduation. PSOs are also a function of the various course combinations offered by the college.

Semester

The Semester means the one half of the academic year comprising of the teaching days and examination & evaluation days as per the UGC/ University norms.

Teaching and Learning Activities

The set of **pedagogical tools and techniques** or the teaching and learning activities that aim to **help students to attain** the intended learning outcomes and engage them in these learning activities through the teaching process.

3.0 B.S. DSA Programme Focus

Programme Educational Objectives (PEOs)

a) Built strong foundations in core areas of data science with a focus on Data Science and Analytics so that learners can contribute significantly in the area of data analytics, research and innovation.
b) Develop professionals with high competency in recent tools and techniques related to Data Science and Analytics.
c) Inculcate strong human values and social, interpersonal and leadership skills required for professional success in evolving global professional environments

Programme outcomes (POs)

a) Apply the knowledge of data sciences and analytics to the solution of complex societal problems.
b) Acquire a rich basket of skill enhancement courses and soft skill courses instilling self-confidence and moral values.
c) Competence in programming languages commonly used in data science, such as Python or R.
d) Understanding of fundamental machine learning concepts and algorithms. Application of machine learning techniques to solve real-world problems and make predictions.
e) Experience working in collaborative environments, particularly on interdisciplinary teams. Ability to contribute to group projects and share knowledge with team members.
f) Build young minds with a research attitude concerning the needs of society.

g) Application of data science techniques to solve real-world problems through capstone projects or internships.

Graduate Attributes (GAs)

These attributes reflect the core competencies necessary for graduates to succeed in the field. The common graduate attributes for B.S. Data Science and Analytics courses are:

a) Ability to analyze complex real-world data sets and extract meaningful insight. Proficiency in statistical analysis and data interpretation.
b) Apply mathematical and statistical concepts, including linear algebra, calculus, basic statistics, probability, and statistical inference to Data Science and Machine Learning problems.
c) Demonstrate proficiency in programming languages commonly used in Data Science and Analytics, such as C, Python, Java, and R Programming)
d) Understanding of data collection, storage, retrieval, and management techniques. Familiarity with databases and data warehousing.
e) Implement effective strategies for data cleaning, transformation, and feature engineering.
f) Knowledge of machine learning algorithms and techniques. Ability to apply ML algorithms to solve real-world problems.
g) Proficiency in creating effective data visualization to communicate findings. Knowledge of visualization tools like ggplot2, matplotlib, and seaborn.
h) Effective communication and collaboration with colleagues from diverse backgrounds.
i) Evaluate and interpret the performance of machine learning models using appropriate metrics.

4.0 B.S. DSA Programme Course Types and Evaluation Pattern

Sr. No.	Course Type	Credits	Nature	CCE Marks	ECE Marks	Total Marks
1	Major Course	4	Compulsory	50	50	100
2	Minor Course	4	Compulsory	50	50	100
3	Multidisciplinary Course	4	Elective	50	50	100
4	Skill Enhancement Course	2	Elective	25	25	50
5	Ability Enhancement Course	2	Elective	25	25	50
6	Indian Knowledge System/ Value Added Courses	2	Elective	25	25	50

Courses Types Definitions:

1. **Major Course (DSC-C)**
   Discipline-specific course core is a course that a student admitted to a particular programme must successfully complete receiving the degree and which cannot be substituted by any other course.
2. **Minor Course (DSC-M)**
   A discipline Specific Minor Course refers to a set of academic courses that form a focused and specialized area of study within a particular discipline. Students have the option to pursue a minor alongside their major allowing them to gain additional expertise in a specific subject.
3. **Multidisciplinary Course (IDC)**
   A multidisciplinary course is a course chosen generally from a related discipline/subject, intending to seek exposure in the discipline relating to the core domain of the student.

4. **Skill Enhancement Course**
   Skill Enhancement Course is designed to provide students with specific skills or knowledge in addition to their primary academic pursuits. The main purpose of the SEC is to provide students with practical skills, life skills, soft skills, hands-on training, etc. to increase their employability.
5. **Ability Enhancement Course**
   The ability enhancement course is designed to improve students' communication, language, and personality development skills. The main purpose of the AEC is to introduce students to the theory, fundamentals, and tools of communication and to develop in them vital communication skills that should be integral to personal, social, and professional interactions.
6. **Indian Knowledge System**
   Indian Knowledge System refers to the rich and diverse heritage of knowledge, wisdom, and traditions that have evolved over millennia within the Indian subcontinent.

5.0 B.S. Programme Structure

B.S. (Hons.) DSA is a four-year programme divided into eight semesters. A student is required to complete 176 credits for the completion of the programme and the award of B.S. (Hons.) DSA degree.

The B.S. (Hons.) DSA programme is aligned with the NEP-2020 structure as given in below Table.

Courses	No. of Papers	Credits Each	Total Credits
1. DSC-Major	22	4	88
2. DSC-Minor	8	4	32
3. IDC-Multi	3	4	12
4. AEC	5	2	10
5. SEC	5	2	10
Internship	1	4	4
6. IKS/VAC	4	2	8
OJT/RP	2	6	12
		Total	**176**

Details of Programme

Year	Semester	Course Type (Credits)						
1st Year	Sem-I	Major-1 (4)	Major-2 (4)	Minor-1 (4)	MDC-1 (4)	AEC-1 (2)	SEC-1 (2)	IKS-1 (2)
	Sem-II	Major-3 (4)	Major-4 (4)	Minor-2 (4)	MDC-2 (4)	AEC-2 (2)	SEC-2 (2)	VAC-1 (2)
2nd Year	Sem-III	Major-5 (4)	Major-6 (4)	Major-7 (4)	MDC-3 (4)	AEC-3 (2)	SEC-3 (2)	IKS-2 (2)
	Sem-IV	Major-8 (4)	Major-9 (4)	Major-10 (4)	Minor-3 (4)	AEC-4 (2)	SEC-4 (2)	VAC-2 (2)
3rd Year	Sem-V	Major-11 (4)	Major-12 (4)	Major-13 (4)	Minor-4 (4)	Minor-5 (4)	SEC-5 (2)	-
	Sem-VI	Major-14 (4)	Major-15 (4)	Major-16 (4)	Minor-6 (4)	AEC-5 (2)	Internship (4)	-
4th Year	Sem-VII	Major-17 (4)	Major-18 (4)	Major-19 (4)	Minor-7 (4)	-	OJT/RP-1 (6)	-
	Sem-VIII	Major-20 (4)	Major-21 (4)	Major-22 (4)	Minor-8 (4)	-	OJT/RP-2 (6)	-

6.0 Multiple Entry-Exit Option

The B.S. DSA programme is fully compliant with the Curriculum and Credit Framework for Undergraduate Programmes issued by the UGC. Accordingly, the programme provides the exit option to the learners at the end of the first year with UG Certificate awarded, at the end of the second year with UG Diploma awarded, at the end of the third year with UG Degree awarded and at the end of the fourth year with UG Honors Degree awarded. The learners choosing to exit the programme at the end of the first year or at the end of the second year will be allowed to, subject to successful completion of the relevant portion of the curriculum, shall be allowed to re-enter within a period of three years and complete the degree programme within a period of maximum seven years from the year of the first admission. All the other details are as provided in Sec.3.2.3 of the Curriculum and Credit Framework for Undergraduate Programmes issued by the UGC in December 2022.

7.0 Internship Project

Every learner must undergo and complete the internships/apprenticeships in a firm/ industry/organization or training in labs with faculty or researchers in their own or other college/institute/research institution during the summer term. Completion of the Summer Internship shall be mandatory for every learner choosing to exit at the end of the first year with a UG Certificate or at the end of the second year with a UG Diploma. The Internship Project shall carry the weightage of 4 credits. Since the internship is categorized as Practice, every learner will have to actually produce the work for 120 hours during the internship.

Evaluation of the Internship Project:

It is mandatory for the student to seek advance written approval from the faculty guide and the HOD for the internship and organization before commencing the internship.

a. It is mandatory for the student to seek advance written approval from the faculty guide and the Director of the Institute about the topic and organization before commencing the SIP.
b. Students shall also seek a formal evaluation of their Internship Project from the external guide. The formal evaluation by the external guide shall be done for 50 marks and comment on the nature and quantum of work undertaken by the student, the effectiveness and overall professionalism. The learning outcomes of the Internship Project and utility of the project to the host organization must be specifically highlighted in the formal evaluation by the external guide. The Internship Project evaluation sheet duly signed and stamped by the external guide shall be included in the final Internship report.
c. The completion of the SIP shall be certified by the respective Faculty Guide & approved by the Director of the Institute.
d. The college level evaluation shall be for 50 marks through the Viva-Voce conducted by the faculty guide and HOD of the respective department.
e. Copies of SIP report and records of evaluation shall be maintained by the college for a period of 5 academic years.

8.0 Comprehensive Internal Evaluation (CIE)/Comprehensive Concurrent Evaluation (CCE)

1. The course teacher shall prepare the scheme of Comprehensive Concurrent Evaluation (Formative Assessment) before commencement of the term. The scheme of

Comprehensive Concurrent Evaluation shall explicitly state the linkages of each CCE with the Course Outcomes and define the targeted attainment levels for each CO.

2. The Head of the Department shall approve the scheme of Comprehensive Concurrent Evaluation with or without modifications.
3. The course teacher shall display, on the notice board/ ERP, the approved CCE scheme of the course and the same shall also be hosted on the website, not later than the first week of the term.
4. Each CCE item shall be of minimum 25 marks.
5. For a 4 Credit Course there shall be a MINIMUM of three CCE items. The final scores shall be converted to 50, using an average or best two out of three formulae.
6. For 2 Credit Course there shall be a MINIMUM of two CCE items. The final scores shall be converted to 50.
7. CCE shall be spread through the duration of course and shall be conceptualized, executed, assessed and documented by the course teacher along with student-wise and class-wise attainment levels of the COs and the attainment levels of the course.
8. The assessment outcome of each CCE shall be duly signed by the course teacher & the programme coordinator / HOD of the college.
9. A copy of the duly signed CCE outcome shall be displayed on the notice boards/ ERP, within a week of the assessment and course teachers shall guide the students on a need basis.
10. The college may conduct additional make up / remedial CCE items at its discretion.
11. At the end of the term aggregate CCE scores/grades shall be calculated and the CO attainment levels shall be calculated by the course teacher. The same shall be displayed on the notice board/ ERP.
12. Records of CCE shall be retained for 5 years from the completion of the Academic Year. i.e. Current Academic Year (CAY) + 4 years.

The comprehensive internal evaluation shall be conducted by the college once a semester. The maximum marks for 4 credit courses shall be 50 and for 2 credit courses shall be 25 marks.

9.0 End-Semester Evaluation

1. The End Semester Evaluation (Summative Evaluation) for all the courses shall be conducted by the Examination Department/Committee of the college headed by a full-time regular faculty member nominated by the Principal as Controller of the Examination.
2. The ESE for each course shall have the weightage as follows:
    - For a 4 Credit Course: 50 marks
    - For a 2 Credit Course: 25 marks
3. The ESE for each course shall have 5 questions each of 10 marks. In case of 2 Credit courses the aggregate marks out of 50 shall be converted to the level proportionate to 25 marks.
4. All questions shall be compulsory with internal choice within the questions.
5. The broad structure of the ESE question paper shall be as follows:

Question Number	COGNITIVE ABILITIES EVALUATED	Nature
Q.1	REMEMBERING	Answer any 5 out of 8 (2 marks each)
Q.2	UNDERSTANDING	Answer any 2 out of 3 (5 marks each)
Q.3	APPLYING	Answer 3 (a) or 3 (b) (10 marks)
Q.4	ANALYSING	Answer 4 (a) or 4 (b) (10 marks)
Q.5	EVALUATING	Answer 5 (a) or 5 (b) (10 marks)
	CREATING	

10.0 Passing Standard

A learner shall be said to have earned the credits for a course if he/she earns minimum 36% marks.

Formative Evaluation and Summative Evaluation shall be separate head of passing.

Grading System

The Indirect and Absolute Grading System shall be used, i.e. the assessment of individual Courses in the concerned examinations will be on the basis of marks. However, the marks shall later be converted into Grades by a defined mechanism wherein the overall performance of the learners can be reflected after considering the Credit Points for any given course. The overall evaluation shall be designated in terms of Grade. The 10-point standard scale mandated by UGC shall be used.

The performance of a student will be evaluated in terms of two indices, viz.

(a) Semester Grade Point Average (SGPA) which is the Grade Point Average for a semester

(b) Cumulative Grade Point Average (CGPA) which is the Grade Point Average for all the completed semesters at any point in time

Letter Grade	Grade Point
O (Outstanding)	10
A+ (Excellent)	9
A (Very Good)	8
B+ (Good)	7
B (Above Average)	6
C (Average)	5
P (Pass)	4
F (Fail)	0
Ab (Absent)	0

Grade Point (Gi) (10 points scale) = Marks of each paper out of 100 / 10

Marks out of 100	Grade Point Range (Gi)	Letter Grade	Classification
96.0-100	10	O	Outstanding
86.0-95.9	9	A+	Excellent
76.0-85.9	8	A	Very Good
66.0-75.9	7	B+	Good
56.0-65.9	6	B	Above Average
46.0-55.9	5	C	Average
36.0-45.9	4	P	Pass
Below 36.0	0	F	Fail
Absent	0	Ab	Absent

The Semester Grade Point Average (SGPA) is the ratio of the sum of the product of the number of credits with the grade point scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.,

$$SGPA\ (Si) = \Sigma\ (Ci \times Gi) / \Sigma\ Ci$$

where Ci is the number of credits of the i^{th} course and Gi is the grade point scored by the student in the i^{th} course.

The cumulative grade point average (CGPA) is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.,

$$CGPA = \Sigma\ (Ci \times Si) / \Sigma\ Ci$$

where Si is the SGPA of the i^{th} semester and Ci is the total number of credits in that i^{th} semester.

The SGPA and CGPA shall be rounded off to 2 decimal points.

Scaling Down of the CIE Score

The marks obtained by the student for the CCE shall be scaled down, to the required extent, if percentage of the marks of CCE exceeds the percentage of marks scored in the ESE (End Semester University Examination) by 25% for the respective course.

Degree Requirements

The degree requirements for the B.S. DSA programme are completion of minimum 136 credits and 180 credits in case of Honours degree.

Maximum Duration for Completion of the Programme

The program of the study is four years of eight semesters. A candidate shall complete his/her degree within **seven (7)** academic years from the date of his/her admission to the first semester.

Grade Improvement

There shall be a provision for candidates to reappear for the examination for the concerned course of theory papers only (subject) in which the candidate wishes for improvement of his/her grade point of SGPA in general and CGPA in a total of the program subject to the condition that:

a) The candidate shall be eligible to reappear for improvement of grade points only after successfully passing the program.
b) The candidate may opt for the examination for any number of courses (subject/paper) of the programme for improvement of grade points but not more than three times for each course (subject/paper) as per the prevailing syllabus of the examination conducted in the regular schedule of University examinations.
c) All such provisions are there within 04 years from successful completion of the programme, but not exceeding the period of 08 years of the duration of completion of the programme.
d) In all such cases grade points are considered if there is a progress in such improvements, otherwise, original grade points shall be retained.
e) No such candidates shall be eligible for the award of Rank, Gold Medal, Cash Prize, etc.

f) The validity of credits earned will be for a maximum period of seven years or as specified by the Academic Bank of Credits (ABC).

11.0 Attendance

The student must meet the requirement of 75% attendance per semester per course for grant of the term. The college may condone the shortage in attendance in exceptional circumstances, up to a maximum of 10%. The college shall have the right to withhold the student from appearing for examination of a specific course if the above requirement is not fulfilled.

12.0 Medium of Instruction

The medium of instruction and evaluation shall be English.

13.0 Detailed Course List (Annexure-1)

Detailed course list is available in Annexure-1

14.0 Detailed Syllabus for Each Course (Annexure-2)

Detailed syllabus for each course is available in Annexure-2

Annexure 1 Detailed Course List for B.S.(Hons.) DSA

Detailed Course List for B.S. (Hons.) DSA

Year	Sem	Course Type	Course Code	Course Title	Credits T	Credits P	Total
1	Sem-I	DSC-Core	DSM111	Statistics for Data Science	3	1	4
		DSC-Core	DSM112	Fundamentals of R Programming	3	1	4
		DSC-M	DSE113	Foundation Course in Mathematics I	3	1	4
		IDC/Multi	DSMDC114	Introduction to C Programming-I	3	1	4
		AEC	AEC115	Language Through Literature-I	2	-	2
		SEC	DSSEC116	Essential Excel Skills for Data Science	1	1	2
		VAC/IKS	IKS117	Indian Knowledge System	2	-	2
	Sem-II	DSC-Core	DSM121	Probability Theory & Prob. Distributions	3	1	4
		DSC-Core	DSM122	Fundamentals of Data Science	3	1	4
		DSC-M	DSE123	Foundation Course in Mathematics II	3	1	4
		IDC/Multi	DSMDC124	Introduction to C Programming-II	3	1	4
		AEC	AEC125	Language Through Literature-II	2	-	2
		SEC	DSSEC126	Advanced Excel Skills for Data Science	1	1	2
		VAC/IKS	VAC127	Interpersonal Skills	2	-	2

Exit Option: Students exiting the programme after securing **44** credits will be awarded an **Advanced UG Certificate in DSA** provided they secure **4** credits in work-based vocational courses offered by the institute during the summer term.

Year	Sem	Course Type	Course Code	Course Title	Credits T	Credits P	Total
2	Sem-III	DSC-Core	DSM231	Statistical Inference	3	1	4
		DSC-Core	DSM232	Data Structure and Algorithm	3	1	4
		DSC-Core	DSM233	Data Visualization and Story Telling	3	1	4
		IDC/Multi	DSMDC234	Fundamentals of Python Programming	3	1	4
		AEC	AEC235	Communicative English	2	-	2
		SEC	DSSEC236	***SEC-3 Choose any one from Table 1***	1	1	2
		VAC/IKS	IKS237	Environmental Studies	2	-	2
	Sem-IV	DSC-Core	DSM241	Sampling Techniques	3	1	4
		DSC-Core	DSM242	Introduction to Java Programming	3	1	4
		DSC-Core	DSM243	Data Warehousing and Multidimensional modeling	3	1	4
		DSC-M	DSE244	Optimization Techniques	3	1	4
		AEC	AEC245	Communicative English	2	-	2
		SEC	DSSEC246	***SEC-4 Choose any one from Table 1***	1	1	2
		VAC/IKS	IKS247	Understanding India	2	-	2

Exit Option: Students exiting the programme after securing **88** credits will be awarded a **UG Diploma in DSA** provided they secure **4** credits in skill-based courses offered by the institute during 1st year or 2nd-year summer term.

Year	Sem	Course Type	Course Code	Course Title	Credits T	Credits P	Total
3	Sem-V	DSC-Core	DSM351	Advanced topics in Machine Learning	3	1	4
		DSC-Core	DSM352	Non-parametric Tests and Survival Analysis	3	1	4
		DSC-Core	DSM353	Basic Econometrics	3	1	4
		DSC-M	DSE354	Data warehousing and Data Minning	3	1	4
		DSC-M	DSE355	Database Management System with SQL	3	1	4
		SEC	SEC356	***Choose any one from Table 1***	1	1	2
		IKS	-	-	-	-	-
	Sem-VI	DSC-Core	DSM361	Design of Experiments	3	1	4
		DSC-Core	DSM362	Multivariate Data Analysis	3	1	4
		DSC-Core	DSM363	Time Series Analysis & Forecasting	3	1	4
		DSC-M	DSE364	Operations Research	3	1	4
		AEC	AEC365	Business Communication	2	-	2
		SEC	DSSEC366	Internship	4	-	4
		IKS	-	-	-	-	-

Exit Option: Students exiting the programme after securing **132** credits will be awarded **UG Degree B.S. in DSA** provided they have satisfied the credit requirements.

Year	Sem	Course Type	Course Code	Course Title	Credits T	Credits P	Total
4	Sem-VII	DSC-Core	DSM471	Data Minning Using Python	3	1	4
		DSC-Core	DSM472	Statistical Simulation	3	1	4
		DSC-Core	DSM473	Big Data Analytics	3	1	4
		DSC-M	DSE474	***Choose any one from Table 1***	3	1	4
		AEC	-	-	-	-	-
		SEC	-	-	-	-	-
		OJT/RP	OJT/RP-1	On-Job Training/Research Project	6	-	6
	Sem-VIII	DSC-Core	DSM481	Deep Learning	3	1	4
		DSC-Core	DSM482	Natural Language Processing Using Python	3	1	4
		DSC-Core	DSM483	Microsoft Azure Cloud Fundamentals	3	1	4
		DSC-M	DSE484	***Choose any one from Table 1***	3	1	4
		AEC	-	-	-	-	-
		SEC	-	-	-	-	-
		OJT/RP	OJT/RP-2	On-Job Training/Research Project	6	-	6

Students after securing **176** credits will be awarded a **UG Degree B.S. (Hons.) in DSA** provided they have satisfied the credit requirements.

Table 1: List of Elective Courses

Year	Sem	Course Type	Course Code	Course Title	Credits T	Credits P	Total
2	Sem-III	SEC-3	DSSEC236	Numerical Methods	1	1	2
			DSSEC236	Basic Excel Modelling	1	1	2
			DSSEC236	Building Interactive Dashboard	1	1	2
	Sem-IV	SEC-4	DSSEC246	Digital Marketing	1	1	2
			DSSEC246	Cyber Security	1	1	2
			DSSEC246	Recommendation System	1	1	2
3	Sem-V	SEC-5	DSSEC356	Marketing and Retail Analytics	1	1	2
			DSSEC356	Financial Analytics	1	1	2
			DSSEC356	Healthcare Analytics	1	1	2
4	Sem-VII	DSC-M	DSE474	Artificial Intelligence	3	1	2
			DSE474	Image and Video Processing	3	1	2
			DSE474	Supply Chain and Logistic Analytics	3	1	2
	Sem-VIII	DSC-M	DSE484	Generative AI	3	1	2
			DSE484	Deep Learning Essentials	3	1	2
			DSE484	Basics of Reinforcement Learning	3	1	2

Annexure 2

Detailed Syllabus for Each Course B.S. (Hons.) DSA

DSM111 Statistics for Data Science

Semester: I	Course Title: Statistics for Data Science	Credits: 4
Course No.: DSM111		(3 T + 1 P)

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 1	REMEMBERING	Recall the types of data and when to use which type of data. Remember when to use which type of charts and graphs.
CO 2	UNDERSTANDING	Understand various measures of central tendency, dispersion, skewness, and kurtosis. Summarize the information in the data using different charts and summary measures. Understand the measures of correlation.
CO 3	APPLYING	Apply the theory of descriptive statistics and probability theory to various real-life situations. Apply various probability distributions to real-life situations.
CO 4	ANALYSING	Explain the definition of independence of events, the concept of conditional probability, and Bayes' theorem.
CO 5	EVALUATING	Evaluate the relationship between the variables and apply regression analysis to the real-life data.
CO 6	CREATING	Formulate univariate and bivariate probability distributions.

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	2	2	1
CO 2	2	3	3	2	1
CO 3	2	2	2	3	2
CO 4	2	3	2	2	1
CO 5	3	3	2	2	1
CO 6	3	3	2	3	1

Unit	Detailed Syllabus	Teaching Hours
I	**Descriptive Statistics** Classification of data: Qualitative, Quantitative: Discrete, Continuous; Chronological (Time series) data. Data Types: Nominal, Ordinal, Interval, and Ratio data. Frequency: grouped and ungrouped data; Construction of frequency and cumulative frequency distribution. Presentation of qualitative data: Tabulation (up to four attributes). Graphical representation of grouped data: Histogram, frequency curve, frequency polygon, ogives (cumulative frequency curves), Diagrammatic representation of data: Bar diagrams- simple Bar, multiple bars, sub-divided bar, and percentage bar diagrams. Pie diagrams. Stem - Leaf plot.	9

	Bivariate: Frequency distribution, Marginal and Conditional frequency distributions	
II	**Measures of Central Tendency** Concept of central tendency, various measures of central tendency, and their interrelationship. Their merits and demerits. The empirical relation between mean, median, and mode. Properties and applications of measures of central tendency. Partition values (quartiles, deciles and percentiles.) **Measures of Dispersion and Moments** Concept of variation/dispersion, quartile deviation, Absolute and relative measures of dispersion with their merits, demerits, and applications. Moments: raw moments, central moments, factorial moments, and their interrelationship. Skewness, Kurtosis and their measures.	9
III	**Correlation and Regression** Bivariate data, Scatter diagram, and interpretation. Concept of correlation between two variables, positive correlation, negative correlation, no correlation. Covariance between two variables: Definition, computation, effect of change of origin and scale. Karl Pearson's coefficient of correlation and its properties. Computation for ungrouped data and grouped frequency distributed data with interpretation. Correlation Ratio, Spearman's rank correlation coefficient, Kendall's Tau. Meaning of regression, the difference between correlation and regression. Concept of error in regression, error modeled as a continuous random variable. Simple linear regression model. Estimation of unknown constants by the method of least squares. Interpretation of parameters.	9
IV	**Curve fitting:** Fitting of second-degree curve ($Y = a + bX + cX^2$), Fitting of exponential and power curves of the type $Y = ae^{bx}$, $Y = ab^X$ and $Y = aX^b$. In all these curves, parameters are estimated by the method of least squares.	9
V	**Theory of Attributes:** Attributes: Classification, notion of manifold classification, dichotomy, class frequency, order of a class, positive class frequency, negative class frequency, ultimate class frequency, relationship among different class frequencies (up to three attributes), and dot operator to find the relation between frequencies, fundamental set of class frequencies. Consistency of data upto 3 attributes, Concepts of independence and association of two attributes. Yule's coefficient of association (Q), $-1 \leq Q \leq 1$, Interpretation.	9

Practical Component		
Sr. No.	**Title of the Practical**	**Teaching Hours**
1	Methods of Classification and Construction of Frequency Distribution. (One-way and Two-Way).	2
2	Present the data using various diagrams and graphs.	2
3	Computation of measures of central tendency, dispersion and partition values.	2
4	Computation of moments, coefficient of skewness and kurtosis.	2

5	Computation of correlation coefficient (Pearson's, Spearman's and Kendall's Tau) and its interpretation.	2
6	Fitting of a simple linear regression model.	2
7	Fitting of exponential and power curves.	2
8	Coefficient of associations and interpretation.	2

Suggested Reference Books:

1. Introduction to the Practice of Statistics, Moore, S. David; McCabe, P. George W. H. Freeman and Company, New York.
2. Basic Statistics, Agarwal, B. L., New Age International (P) Ltd.
3. Introduction to the theory of Statistics, Mood, A. M., Greybill, F.A., Boes, D.C., Mc Graw Hill.
4. Probability and Statistics for Engineers and Scientists. Devore, J.L. Cengage Learning, New Delhi 8th Edition, 2014.
5. Mathematical Statistics, P. Mukhopadhyay, New Central Book Agency (P) Ltd, Calcutta
6. An Introduction to Probability and Statistics, V. K. Rohatgi and A.K.Md. Ehsanes Saleh, Wiley Series.

DSM112 Fundamentals of R Programming

Semester: I	**Course Title: Fundamentals of R Programming**	**Credit: 4**
Course Code: DSM112		**(3 T + 1 P)**

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 1	REMEMBERING	Remember the syntax or R
CO 2	UNDERSTANDING	Understand the concept of data types and data structures.
CO 3	APPLYING	Understand control structures and apply them to real-world problems.
CO 4	ANALYSING	Import the data from various sources and analyze.
CO 5	EVALUATING	Evaluate the data and use of appropriate visualization charts.
CO 6	CREATING	Create exploratory data analysis report.

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	1	2	2	1	1
CO 2	1	1	1	2	-
CO 3	1	1	-	1	-
CO 4	1	2	1	1	-
CO 5	1	-	1	-	1
CO 6	1	1	1	1	1

Unit	Detailed Syllabus	No. of Hours of Teaching
I	Introduction of R Language: Data Types in R. Syntax of R Expressions. Data Structures in R: Vector, Matrix Array, List, and Dataframe. Factors. RStudio: An IDE for R.	9

	Operators in R: Assignment operators, Arithmetic Operators, Relational Operators, Logical Operators, Precedence of Operators	
II	Control flow Structures: Decision Making, if statement, if else statement, nested if else statement, ifelse statement, nested ifelse statement, for loop, while loop, repeat loop, return, break and next statements.	9
III	Functions in R: Built-in functions, User-defined functions, Function Components, and Scoping Rules for functions. Family of apply functions.	9
IV	Concept of Packages, Installation of packages, Data Importing in R (.txt, .csv, table format, etc.), data importing from other formats. Data aggregation and Data Wrangling (using tidyr, dplyr). Writing a data file.	9
V	Exploratory Data Analysis: Summarizing Data, Data Visualization using graphics, Lattice and ggplot2 packages.	9

Practical Component		
Sr. No.	**Title of the Practical**	**No. of Hours of Teaching**
1	Creating R Script and running R Script.	2
2	Practical based on loops.	2
3	Practical based on Functions.	2
4	Practical based on data importing and data Summarization.	2
5	Practical based on data wrangling with tidyverse and dplyr.	2
6	Practical based on data visualization.	2
7	Additional practicals	2

Suggested Reference Books:

1. Hadley Wickman and Garrett Grolemund. R For Data Science, O'Reilly Publication.
2. Andrie de Vries and Joris Meys, R For dummies.
3. Jared Lander, R For Everyone, Addison-Wesley Data and Analytics
4. Jared Lander, The Art of R Programming
5. Garrett Grolemund, Hands-on Programming with R, O'Reilly Publication.

DSE113 Foundation Course in Mathematics I

Semester: I	**Course Title: Foundation Course Mathematics I**	**Credit: 4**
Course Code: DSE113		**4 T**

Course Outcomes: On successful completion of the course the learner will be able to

CO	**COGNITIVE ABILITIES**	**COURSE OUTCOMES**
CO 1	REMEMBERING	Remember the concept of set theory and functional relationships.
CO 2	UNDERSTANDING	Understand the concept of functions and types of functions.
CO 3	APPLYING	Study the computational and mathematical context of Boolean Algebra.

CO 4	ANALYSING	Describe several practical applications of graph theory, matrix algebra,
CO 5	EVALUATING	Evaluate simultaneous equations using matrix algebra.

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	1	1	1	1	-
CO 2	1	2	1	1	1
CO 3	2	1	-	1	1
CO 4	1	2	1	-	1
CO 5	1	1	-	1	-
CO 6					

Unit	Detailed Syllabus	Teaching Hours
I	**Set Theory** • Introduction, Representation of sets, Types of sets • Venn Diagram, Operations on sets • Algebra of sets with proof • The cardinality of sets, Addition theorem, and its examples. • Examples on set theory	12
II	**Functions** • Introduction, Definition, Domain, Co-domain and Range of a Function • Types of Function: Into Function, On-To Function, One to One Function, Many to One Function, One to One Correspondence and its examples. • Classification of Function-Algebraic Functions, Composite, Identity and Inverse functions, • Transcendental Functions, exponential functions, and logarithmic functions	12
III	**Boolean Algebra** • Introduction, Basic Definitions • Duality, Basic Theorems • Boolean Algebras as lattices • Kinds of Lattices • Representation Theorem, Sum-of-product form for sets, Sum-of-products form for Boolean Algebras	12
IV	**Graph Theory** • Introduction and Data Structures, Kinds of graph, Degree of a vertex • Complete graph, Regular graph, Cycle, Pendant vertex • Definitions, Paths Connected Graphs, graph isomorphism, Subgraph, Walks • Trees, Spanning Trees, Directed graphs	12
V	**Matrix Algebra** • Determinant, Rules of determinant with examples • Meaning and Definition of Matrix, Types of Matrices • Addition and Subtraction of Matrices, Scalar Product of a Matrix with examples	12

	• Multiplication of two Matrices with Examples, Transpose of a matrix, Adjoint matrix • Inverse of a matrix, Solution of simultaneous equations using a matrix, Laws of Matrix Algebra, • Examples.	

Suggested Reference Books:

1. Advance Mathematics, Prof. H.R. Vyas and Others, B.S. Shah Prakashan
2. Advance Mathematics for F.Y.B.C.A., Dr. K.R. Kachot, Ramesh Kataria, Mahajan Publishing House.
3. Schaum's outlines Discrete Mathematics Graph Theory, Narsingh Deo
4. Fundamental Approach to Discrete Mathematics, D.P. Acharya Sreekkumar

DSMDC114 Introduction to Programming I

Semester: I	Course Title: Introduction to Programming I	Credit: 4
Course Code: DSMDC114		(3 T + 1 P)

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 1	REMEMBERING	Enumerate core concept of C Programming.
CO 2	UNDERSTANDING	Discuss programs using Array and String.
CO 3	APPLYING	Develop Functions for any problem.
CO 4	ANALYSING	Classify Union and Structure to write any program.
CO 5	EVALUATING	Implement the concept of Pointers.
CO 6	CREATING	Predict a real-world problem with the help of c programming.

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	2	2	3	2	2
CO 2	3	2	3	2	2
CO 3	2	2	3	2	2
CO 4	1	1	2	1	1
CO 5	2	3	3	2	2
CO 6	3	2	3	3	1

Unit	Detailed Syllabus	Teaching Hours
I	**Fundamental of Algorithms:** Introduction, Algorithm Development Method, Algorithms for basic human general activities focused on understanding basic steps, Basic number and arithmetic Operation, Looping & Control flow statements, Series computation, Introduction to flowchart, Symbols for input/output, Processes, Decision, Begin/End, Representation of algorithms by Flowchart.	9
II	**Overview of C:** Brief history of C, Importance of C, Features of 'C' language, Basic Structure of C Programs, Programming Style, Steps to execute 'C' Program, Understanding the terminologies: Source Program, Object Program, Executable Program, Linker, Loader, Debug, Compilation process, Interpreter. **Constants, Variables and Data Types:**	9

	Character set, C tokens, keywords and identifiers, constants, variables, data types, declaration of variables, assigning value to the variable, defining symbolic constants.	
III	**Operators and Expression:** Operators - arithmetic, relational, logical, assignment, increment-decrement, conditional, bit-wise and special, Arithmetic expressions, evaluation of expressions, precedence of arithmetic operators, type conversions in expressions, operator precedence and associativity, mathematical functions. **Managing Input and Output Operators:** Reading and writing a character formatted input-output.	9
IV	**Decision-Making and Branching:** Decision making with IF statement, simple IF statement, the IF-ELSE statement, nesting of IF … ELSE statements, the ELSE IF ladder, Switch statement, turnery (? :) operator, Go-To statement.	9
V	**Looping:** Looping statements – WHILE, DO-WHILE and FOR, Nesting and Jumps in loops, Break & Continue.	9

Practical Component		
Lab.	**Title of the Practical**	**Teaching Hours**
1	Write a program to find out the largest of three numbers by using if-else.	2
2	Write a program to find out the largest of three numbers by using the logical operators.	2
3	Write a program to find the roots of a quadratic equation using function and switch statements.	2
4	Write a program to multiply two matrices.	2
5	Write a program to find out the sum of the digits of a number.	2
6	Write a program to find out whether the entered no is Armstrong or not.	2
7	Write a program in which if and else both blocks get their execution.	2
8	Some additional programs.	2

Suggested Reference Books:

1. B.S. Gottfried - Programming with C - Schaum's Outline Series - Tata McGraw Hill 2nd Edition - 2004.
2. E. Balagurusamy - Programming in ANSI C - Second Edition - Tata McGraw Hill- 1999.
3. Kernighan, Brian, and Dennis Ritchie. The C Programming Language
4. Forouzan, B. A., & Gilberg, R. F. (2007). A Structured Programming Approach Using C (3rd ed.). Cengage Publication.
5. Kernighan, B. W., & Ritchie, D. M. (2015). The C Programming Language (2nd ed.). Prentice Hall of India.
6. Gottfried, B. (2017). Schaum's Outline of Programming with C (3rd ed.). McGraw Hill Book.

AEC115 Language Through Literature-I

Semester: I	Course Title: Language Through Literature-I	Credit: 2
Course Code: AEC115		Hours: 2/week

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 1	REMEMBERING	
CO 2	UNDERSTANDING	Students will develop an appreciation for diverse literary forms, demonstrating an ability to analyze and interpret stories and poems in English.
CO 3	APPLYING	Students will exhibit improved grammatical competence, applying correct grammar and syntax in written and spoken communication.
CO 4	ANALYSING	Students will acquire the ability to understand and critically evaluate scientific articles, research papers, and lab reports, demonstrating improved scientific literacy.
CO 5	EVALUATING	Students will showcase overall language proficiency, enabling effective communication in various contexts.

Unit	Content	Teaching Hours
I	Text: *Sparkles* (Macmillan Publication) Section – I	10
II	Text: *Sparkles* (Macmillan Publication) Section – II	10
III	Grammar **A)** BE, HAVE and DO as Lexical Verbs **B)** Tenses: • Simple Present Tense • Simple Past Tense • Simple Future Tense • Present Continuous Tense • Past Continuous Tense • Present Perfect Tense • Past Perfect Tense • Present Perfect Continuous Tense	5
IV	**A)** Comprehension of Scientific articles, scientific texts • The passage should be of 200-300 words. • The questions should measure the student's ability to comprehend the main ideas, relevant facts and arguments, and the logical relationship between various ideas and facts presented in the passage. • A total of four questions will be asked from the passage. B)Vocabulary(Textual Glossary)	5

V	PRACTICAL Speaking: To enable the students to • Greeting and formulae of everyday conversation • Introduce themselves • Making a request, saying no politely	10

References Books:

• *Oxford Practice Grammar (Advanced)* - George Yule – OUP
• *Advanced Grammar in Use* - Martin Hewings - Cambridge University Press
• *English Grammar for Students* - Anne Seaton and Y H Mew - Learner's Publishing
• *A Practical English Grammar* - A J Thomson and A V Martinet – OUP
• *Better English* - Betty Kirkpatrick - Geddes and Grosset
• *Contemporary English Grammar Structures and Composition* – David Green - Trinity Press

DSSEC116 Essential Excel Skills for Data Science

Semester: I	**Course Title: Essential Excel Skills for Data Science**	**Credit: 2**
Course Code: DSSEC116		**Hours: 2/week**

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 1	REMEMBERING	Remember Excel shortcuts
CO 2	UNDERSTANDING	Understand Excel formulas (relative and absolute). Understand the basic functions of Excel.
CO 3	APPLYING	Describe the sample data with suitable Excel functions like sum, average, median, var, stdev, etc.
CO 4	ANALYSING	Analyze the sample data from various domains using Excel.
CO 5	EVALUATING	Summarize the data using suitable charts and graphs. Summarize the data using Excel basic functions.
CO 6	CREATING	Students can visualize the data graphically and summarize the data numerically for real-life data analysis problems.

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	2	1	1	1	-
CO 2	2	1	-	1	-
CO 3	-	2	3	-	-
CO 4	1	1	2	2	1
CO 5	1	1	2	1	-
CO 6	1	1	2	3	1

Unit	Detailed Syllabus	Teaching Hours
I	**Introduction to MS Excel** • Importance of MS Excel. Understand workbooks and worksheets. Entering and editing data. Formatting cells. Creating and managing cell styles. Formatting numbers and labels.	15

	• Editing worksheet and cells. Add, edit, and delete comments. Lock and protect cells. • Enter basic formulas. Absolute and relative references. Basic functions. • Working with range names. • Create charts and graphs. Format charts and graphs. • Filtering, sorting, and conditional formatting • Calculations and functions: sum, average, min, max, and, or, not, if.	
II	**Practical Based on Unit-I** 1. Understanding spreadsheet elements. Data Entering and editing. 2. Basics of formulas in Excel. Relative and Absolute referencing. 3. Basic Functions in Excel. Working with range names. 4. Creating formatting Charts and graphs. 5. Use of various functions like sum, average, min, max, and, or, not, if 6. Filtering, sorting of the data 7. Use of conditional formatting.	30

Suggested Reference Books:

1. Microsoft Excel: Data Analysis and Business Model, PHI, Wayne, WL, 2019.
2. Microsoft Excel Formulas and Functions Dummies, Ken Bluttman, 2020.

IKS117 Indian Knowledge Systems

Semester: II	Course Title: Indian Knowledge Systems	Credit: 2
Course Code: IKS117		Hours: 2/week

Unit	Topic	Teaching Hours
I	**Introduction to IKS** o Introduction to IKS& Its importance ▪ Introduction &importance of IKS ▪ Various IKS Systems o Shashtra – Foundational Literature of Bharatvarsha ▪ What is Shashtra? ▪ Importance of Shashtra ▪ Classification of Shashtra – Vaidic & Avaidic (with examples of imp. Literature) o Base of IKS proliferation ▪ Bhartiya Education System and its philosophy ▪ History of BES from Ancient to Modern ▪ Domains of Education: Gurukul, Pathshala, Vidyalay, Vishva vidyalay	15

II	**Contribution of IKS to the World** ▪ Mathematics &Astronomy ▪ Number System ▪ Algebra & Arithmetic ▪ Geometry ▪ Trigonometry ▪ Planetary System ▪ Speed of Light ▪ Eclipse o Life sciences ▪ Physics ▪ Chemistry ▪ Botany o Metal Technology ▪ Mining Techniques ▪ Types of Metals ▪ Tools & Techniques for Metal Smelting with examples o Town planning &Temple Architecture ▪ Indigenous tools & technologies for town planning & Temple Architecture ▪ Science of Architecture ▪ Lothal, MohanJoDaro, Dholavira o Angkorvat, Lepakshi Temple,J agannath Puri Temple, Thanjavur Temple, Modhera and Konark Sun Temple, Hampi Temple Etc. o Ayurveda ▪ Introduction of Ayurveda- Definition, Branches of Ayurveda, Books and Pioneers ▪ Concept of Tri Dosh and the importance of its Balance in the body ▪ Indic Medical Science Achievement: Tools & Technology o Art &Traditions ▪ History and Origin ▪ SkillEnhancementwith64Kala ▪ Science behind our traditions and rituals	**15**

Reference Books:

- Introduction to Indian Knowledge System-Concept and Application by B. Mahadevan, Vinayak Rajat Bhat, Nagendra Pavan R.N.
- R.M.Pujari, Pradeep Kolhe, N.R. Kumar, 'Pride of India: AGlimpse into India's Scientific Heritage', Samskrita Bharati Publication.
- 'Indian Contribution to science', compiled by Vijnana Bharati.
- 'Knowledge Traditions and Practices of India', Kapil Kapoor, Michel Danino, CBSE, India.
- Dr. Subhash Kak, Computation in Ancient India, Mount, Meru Publishing (2016)
- Dharampal, Indian Science and Technology in the Eighteenth Century, Academy of Gandhian Studies, Hyderabad, 1971, republ. Other India Bookstore, Goa, 2000
- Robert Kanigel, The Man Who Knew Infinity: A Life of the Genius Ramanujan, Abacus, London, 1999
- Alok Kumar, Sciences of the Ancient Hindus: Unlocking Nature in the Pursuit of Salvation, CreateSpace Independent Publishing, 2014
- B.V. Subbarayappa, Science in India: A Historical Perspective, Rupa, New

Delhi, 2013
- S. Balachandra Rao, Indian Mathematics and Astronomy: Some Landmarks, Jnana Deep Publications, Bangalore, 3rd ed., 2004

DSM121 Probability Theory & Probability Distributions

Semester: II	Course Title: Probability Theory & Probability Distribution	Credit: 4
Course Code: DSM121		(3 T + 1 P)

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 1	REMEMBERING	Recall the principle of counting, and describe random and non-random experiments.
CO 2	UNDERSTANDING	Explain basic concepts of probability. Create sample space for some random experiments and identify the events and their types. Understand the types of random variables and their probability distributions.
CO 3	APPLYING	Apply the theory of probability to various real-life situations to find the probability of different types of events. Apply various probability distributions to real-life situations.
CO 4	ANALYSING	Explain the definition of independence of events, the concept of conditional probability, and Bayes' theorem.
CO 5	EVALUATING	Justify the random variables in a given situation and find the probability distribution.
CO 6	CREATING	Formulate univariate and bivariate probability distributions.

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	2	1	-	-
CO 2	1	1	-	2	-
CO 3	1	2	3	-	-
CO 4	2	1	2	2	1
CO 5	1	1	-	1	-
CO 6	1	1	2	3	1

Unit	Detailed Syllabus	Teaching Hours
I	**Introduction to Probability** Random Experiment, trial, sample point, sample space, definitions of equally likely, mutually exclusive, and exhaustive events. Definition of probability: classical, relative, and axiomatic approach and its properties. Conditional probability, multiplicative law of probability. Independence of events, law of total probability, Bayes theorem and its applications.	9
II	**Random Variables (Univariate & Bivariate)** Random Variable (rv) with its types, probability mass function (pmf), probability density function (pdf), cumulative distribution function (cdf) with illustrations. Concept of Joint Distributions, Joint probability mass function, and Joint probability density function. Marginal and conditional distributions, independence of random variables. **Mathematical Expectation and Generating Functions**	9

	The expectation of Random variables with properties, Expectation of a function of a random variable. Conditional expectation. Moments, moment generating function (mgf), cumulant generating function (cgf), probability generating function (pgf), characteristic function and their properties. Measures of location, dispersion, skewness, and kurtosis. Conditional expectation.	
III	**Distribution of Function of Random Variables** Distributions of functions of one- and two-dimensional random variables. Basic idea and concept of Jacobian of transformation in the derivation of distribution of function of random variables. Use of Jacobian of the transformation in distribution deriving distribution of a function of two random variables. The general form of distribution of the sum of two independent random variables, the difference between two independent random variables, the product of two independent random variables, quotient (ratio) of two independent random variables.	9
IV	**Discrete Probability Distributions** Discrete Uniform, Bernoulli's, Binomial, Poisson, Hypergeometric, Geometric and Negative Binomial distributions and their properties.	9
V	**Continuous Probability Distributions** Rectangular, Exponential, Gamma, Beta Type I, Beta Type II, Normal, Cauchy, Laplace and their properties.	9

Practical Component Based on R Programming		
Sr. No.	**Title of the Practical**	**Teaching Hours**
1	Computation of probability and conditional probability.	2
2	Applications of Bayes' Theorem	2
3	Construction of univariate and Bivariate probability distributions.	2
4	Construction of marginal and conditional probability distributions.	2
5	Model sampling from Binomial, Poisson, Geometric, and Negative-Binomial distributions.	2
6	Model sampling from rectangular, exponential, beta type-I, beta type-II, gamma, and normal distributions.	2
7	Fitting of Binomial distribution. Fitting of Poisson distribution.	2
8	Fitting of Exponential distribution. Fitting of Normal distribution.	2

Suggested Reference Books:

1. Introduction to the Practice of Statistics, Moore, S. David; McCabe, P. George W. H. Freeman and Company, New York.
2. Basic Statistics, Agarwal, B. L., New Age International (P) Ltd.
3. Introduction to the theory of Statistics, Mood, A. M., Greybill, F.A., Boes, D.C., Mc Graw Hill.
4. Fundamentals of Mathematical Statistics, S. C. Gupta and V. K. Kapoor, Sultan Chand and Sons, New Delhi.
5. Mathematical Statistics, P. Mukhopadhyay, New Central Book Agency (P) Ltd, Calcutta

6. An Introduction to Probability and Statistics, V. K. Rohatgi and A.K.Md. Ehsanes Saleh, Wiley Series.

DSM122 Fundamentals of Data Science

Semester: II	Course Title: Fundamentals of Data Science	Credit: 4
Course No.: DSM122		(3 T + 1 P)

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 1	REMEMBERING	Describe the significance of data science and understand the Data Science process.
CO 2	UNDERSTANDING	Understand the basics of data science and data scientist's role in the analysis process.
CO 3	APPLYING	Explain how data is collected, managed and stored for data science.
CO 4	ANALYSING	Analyze Data using various Visualization techniques.
CO 5	EVALUATING	Choose contemporary models, such as machine learning, AI, techniques to solve practical problems.
CO 6	CREATING	Build, and prepare data for use with a variety of statistical methods and models.

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1					
CO 2					
CO 3					
CO 4					
CO 5					
CO 6					

Unit	Detailed Syllabus	Teaching Hours
I	**Introduction To Data Science**: Definition, Big Data and Data Science Hype, Datafication, Data Science Profile, Meta-Definition, Data Scientist, Statistical Inference, Populations and Samples, Populations and Samples of Big Data, Big Data Can Mean Big Assumptions, Modeling, Philosophy of Exploratory Data Analysis, The Data Science Process, A Data Scientist's Role in this Process. Case Study: RealDirect.	9
II	**Data Munging:** Properties of Data, Languages for Data Science, Collecting Data, Cleaning Data, Crowdsourcing.	9
III	**Scores and Rankings:** Developing Scoring Systems, Z-scores and Normalization, Advanced Ranking Techniques **Statistical Analysis:** Sampling from Distributions, Statistical Distributions, Statistical Significance, Permutation Tests and P-values.	9
IV	**Visualizing Data:** Exploratory Data Analysis, Developing a Visualization Aesthetic, Chart Types, Great Visualizations	9

	Mathematical Models: Philosophies of Modeling, A Taxonomy of Models, Baseline Models, Evaluating Models, Evaluation Environment.	
V	**Supervised Learning:** Linear Regression, Better Regression Models, Regression as Parameter Fitting, Simplifying Models through Regularization Classification and Logistic Regression, Issues in Logistic Classification, Naive Bayes, Decision Trees Classifiers.	9

Practical Component		
Sr. No.	**Title of the Practical**	**Teaching Hours**
1		2
2		2
3		2
4		2
5		2
6		2
7		2
8		2
9		2

Suggested Reference Books:

1. Steven S. Skiena, "The Data Science Design Manual", Springer 2017.
2. Rachel Schutt & O'neil, "Doing Data Science", Straight Talk from The Frontline O'REILLY, ISBN:978-1-449-35865-5, 1st edition, October 2013.
3. Joel Grus," Data Science from Scratch" First Edition, April 2015
4. Gareth James, Daniela Witten, Trevor Hastie, Roberst Tibhirani, "An Introduction to Statistical Learning-with Applications in R", 2013
5. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press. 2 edition (30 September 2014)
6. R Programming for Data Science, Roger D. Peng, LeanPub, 2015

DSE123 Foundation Course in Mathematics II

Semester: II	**Course Title: Foundation Course in Mathematics II**	**Credit: 4**
Course No.: DSE123		**(3 T + 1 P)**

Course Outcomes: On successful completion of the course the learner will be able to

CO	**COGNITIVE ABILITIES**	**COURSE OUTCOMES**
CO 1	REMEMBERING	Describe the concept of the algebra of matrices and elementary row operations, calculate the rank of the matrix, and analyze the consistency of a linear system.
CO 2	UNDERSTANDING	Explain the concept of Eigenvalues and Eigenvectors; evaluate the diagonalization of matrices and quadratic & bilinear forms.
CO 3	APPLYING	Discuss the basics of Vector spaces.
CO 4	ANALYSING	Describe and use the linear transformation and evaluate nullity and kernel.

CO 5	EVALUATING	Explain the range and kernel and the basic introduction of Inner product spaces and orthogonal and orthonormal vectors.
CO 6	CREATING	Describe the application of rank, Eigenvalues, Eigenvectors, and Gram-Schmidt orthogonalization.

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	1	2	-	-	-
CO 2	-	1	1	-	-
CO 3	1	1	1	-	-
CO 4	-	-	-	1	-
CO 5	-	-	1	1	-
CO 6	-	-	-	-	-

Unit No.	Detailed Syllabus	Teaching Hours
I	**Matrix Analysis-I** Course introduction and properties of Matrices, Elementary row operations, and Echelon form of a matrix. Rank of a Matrix, Normal form of a Matrix, Gauss-Jordan Method: Inverse of a Matrix by elementary operations. Application of Rank: System of linear homogeneous and nonhomogeneous equations, Theorems on the consistency of a system of linear equations.	9
II	**Matrix Analysis-II** Eigenvalues, Eigenvectors, and characteristic equations of a matrix. Cayley Hamilton theorem and its application, Diagonalization. Quadratic forms, Matrix of quadratic forms, Bilinear forms, Matrix of bilinear forms.	9
III	**Vector space and Linear Transformations-I** Vector Space, Vector Subspaces and Linear Span, Linear Independence, and Linear Dependence, Basic Results on Linear Independence. Basis of a Finite Dimensional Vector Space, Linear Transformations, Results on Linear Transformation. Range and Kernel of a Linear Transformation, Rank and Nullity, Rank-Nullity Theorem.	9
IV	**Linear Transformations-II** Linear operators, Invertible Linear Transformations. Matrix of a Linear Transformation, Matrix of the sum and product of linear transformations. Linear transformation of a Quadratic Form and its theorems.	9
V	**Orthogonality** Inner Product Space (definition and examples), Cauchy- Schwartz inequality. Orthogonal and orthonormal vectors, Orthogonal and orthonormal bases Gram-Schmidt Process, Orthogonal, and positive definite matrices.	9

Practical Component		
Sr. No.	**Title of the practical**	**Teaching Hours**
1	Algebra of Matrices, Echelon form of a Matrix, Rank of a Matrix.	2
2	System of Equations, Eigenvalues, eigenvectors.	2
3	Matrix of a Quadratic form.	2
4	Matrix of a Bilinear form.	2
5	Cayley Hamilton Theorem.	2
6	Linear dependence and linear independence of vectors, Linear Transformation.	2
7	Inner Product Space Orthogonal Vectors.	2
8	Orthonormal Vectors, Gram-Schmidt Process.	2

Suggested Reference Books:

1. Strang G, Linear Algebra and its Applications, 3 Edition, Thomson.
2. Krishnamurthy V, Mainra V P, Arora J L, An introduction to Linear Algebra.
3. Lipshutz S, Lipson M, Linear Algebra, 3rd edition, Schaum's Outline series.
4. Kreyszig E, Advanced Engineering Mathematics, John Wiley & sons.

DSMDC124 Introduction to Programming II

Semester: II	**Course Title: Introduction to Programming II**	**Credit: 4**
Course No.: DSMDC124		**(3 T + 1 P)**

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 1	REMEMBERING	Remember the array syntax
CO 2	UNDERSTANDING	Understand concepts of array, strings and user-defined function
CO 3	APPLYING	Learn about structure and union
CO 4	ANALYSING	Understand about Pointers and file management functions
CO 5	EVALUATING	Evaluate the program using debugging and testing
CO 6	CREATING	Create computer programs for the real-world problems.

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	0	2	-	1
CO 2	2	1	1	-	1
CO 3	3	1	1	-	1
CO 4	2	1	-	1	1
CO 5	3	1	1	1	1
CO 6	3	1	1	-	-

Unit No.	Detailed Syllabus	Teaching Hours

I	**Array and Strings:** Introduction to Array, Concept of Dimensions in arrays, Initialization values in an array, Overflow and Underflow, Concepts of Multidimensional Array Introduction, Declaring and initializing string variables, Reading string from terminal, Writing string to screen, Arithmetic operations on characters, Putting string together, String Operations: String Copy, String Compare, String Concatenation and String Length, String Handling functions, Table of strings	**9**
II	**User Defined Functions:** Need for user-defined functions, the form of C function, return values and their types, calling a function, category of functions, no arguments and no return values, arguments with return values, handling of non-integer functions, nesting of functions, recursion, functions with arrays, the scope, visibility and lifetime of variables in functions	**9**
III	**Structures & Unions:** Structure definition, Assigning values into members, structure initialization, comparison of structures, arrays of structures, arrays within structures, structures within structures. Introduction of Union. Difference between Structure and Union	**9**
IV	**Pointers & File Management:** Introduction, Understanding pointers, Accessing the address of variable, Declaring and initializing pointers, Accessing a variable through its pointer, Pointer expressions, Pointer increments and scale factor, Pointers and arrays, Pointers and character strings, Pointers and Functions, Pointers and structures Introduction, Defining files and its Operations, Error handling during I/O operations, Random access files, Command line arguments	**9**
V	**Dynamic Memory Allocation, Preprocessor and Debugging** Introduction of Dynamic Memory Allocation, Dynamic Memory Allocation functions Introduction of Preprocessor, Macro Substitution, File Inclusion, Compiler Control Directives, ANSI additions Program design, Program coding, Common programming errors, Program testing and debugging, Program efficiency	**9**

Practical Component		
Sr. No.	**Title of the practical**	**Teaching Hours**
1	Programs on single dimensional array. Programs on two-dimensional array.	2
2	Programs on String operations (with and without library functions).	2
3	Programs on Functions (including searching and sorting). Programs on Recursive Functions.	2
4	Programs on Pointers. Programs on Dynamic Memory Allocation.	2
5	Programs on Structure & Union.	
6	Programs on File Handling.	
7	Programs on Searching and Sorting.	

Suggested Reference Books:

1. Programming in ANSI C by E Balagurusamy - TMH Publications
2. Programming in C by Pradip Dey and Manash Ghosh - Oxford University Press Publication
3. Let us 'C' by Yashwant Kanetkar –BPB Publications
4. Forouzan, B. A., & Gilberg, R. F. (2007). A Structured Programming Approach Using C (3rd ed.). Cengage Publication.
5. Kernighan, B. W., & Ritchie, D. M. (2015). The C Programming Language (2nd ed.). Prentice Hall of India.
6. Gottfried, B. (2017). Schaum's Outline of Programming with C (3rd ed.). McGraw Hill Book.

AEC125 Language Through Literature-II

Semester: II	**Course Title: Language Through Literature-II**	**Credit: 2**
Course No.: AEC125		**Hours: 2/week**

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 1	REMEMBERING	
CO 2	UNDERSTANDING	Students will demonstrate an increased interest in reading stories and poems in English, developing a habit of literary exploration.
CO 3	APPLYING	Students will exhibit proficiency in identifying and using different sentence types, articles, and question tags in written and spoken English
CO 4	ANALYSING	Students will apply learned grammatical concepts effectively in communication, showcasing improved language precision
CO 5	EVALUATING	Students will be adept at constructing grammatically correct sentences in English, and understanding and implementing English syntax principles.
CO 6	CREATING	Students will demonstrate the ability to choose and use appropriate words and expressions in various contexts, enhancing their communication skills in English

Unit	Content	Teaching Hours
I	Text: *Sparkles* (Macmillan Publication) Section – III	10
II	Text: *Sparkles* (Macmillan Publication) Section– IV	10
III	Grammar **A)** Articles **B)** Types of Sentences • Question Tags	10
IV	Practical **A)** Jumbled Sentences **B)** Cloze Test • The passage for the Cloze Test will contain a total of four blanks	10

	(one mark each) and for each blank three options will be given. Describing scientific processes/ experiments	

References Books:

• Oxford Practice Grammar (Advanced) - George Yule – OUP.
• Advanced Grammar in Use - Martin Hewings - Cambridge University Press.
• English Grammar for Students - Anne Seaton and Y H Mew - Learner's Publishing.
• A Practical English Grammar - A J Thomson and A V Martinet – OUP.
• Better English - Betty Kirkpatrick - Geddes and Grosset.
• Contemporary English Grammar Structures and Composition – David Green - Trinity Press.

DSSEC126 Advanced Excel Skills for Data Science

Semester: II	**Course Title: Advanced Excel Skills for Data Science**	**Credit: 2**
Course No.: DSSEC126		**Hours: 3/week**

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 1	REMEMBERING	Remember Excel functions, data validation tools.
CO 2	UNDERSTANDING	Understand Advanced Excel formula and other data validation tools.
CO 3	APPLYING	Apply pivoting technique to summarize the real-life data. Apply slicers to the data in excel. Applying page layout to excel worksheet.
CO 4	ANALYSING	Analysing data using advanced excel functions and techniques.
CO 5	EVALUATING	Summarize the data using suitable filtering and pivot table techniques.
CO 6	CREATING	Students can visualize the data using charts and slicers.

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	1	1	1	
CO 2	1	1	1	2	
CO 3	1	1	3	1	
CO 4	2	1	3	1	
CO 5	1	1	2	1	
CO 6	1	1	2	3	1

Unit	Detailed Syllabus	No. of Hours of Teaching
I	**Advanced MS Excel** • Advance functions: ifs, sumif, sumifs, averageif, averageifs, lookup, vlookup and hlookup • Data Validation • Create and modify pivot tables, value field settings, Sorting and filtering pivot tables. • Charts and Slicers.	15

	• Page layouts, and page setup.	
II	**Practical Based on Unit-I** 1. Use of advanced Excel functions: ifs, sumif, sumifs, averageif, averageifs. 2. Use of lookup, vlookup, hlookup functions 3. Creating and modifying pivot tables. 4. Use of data validations. 5. Charts and slicer	30

Suggested Reference Books:

1. Microsoft Excel: Data Analysis and Business Model, PHI, Wayne, WL, 2019.
2. Microsoft Excel Formulas and Functions Dummies, Ken Bluttman, 2020.

VAC127 Interpersonal Skills

Semester: II	**Course Title: Interpersonal Skills**	**Credit: 2**
Course Code: VAC127		**Hours: 2/week**

Course Outcomes: On successful completion of the course the learner will be able to

CO	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 1	REMEMBERING	Identify and analyze different communication styles and understand their strengthsand weaknesses
CO 2	UNDERSTANDING	Demonstrate active listening skills and questioning styles to explore issues andenhance understanding
CO 3	APPLYING	Identify conflict response styles; approach and effectively mediate workplaceconflicts.
CO 4	ANALYSING	Determine ways to build and maintain trust and increase your influence andeminence in the workplace
CO 5	EVALUATING	
CO 6	CREATING	

Unit	Topics	Teaching Hours

I	➢ Effective Communication 1. Art Of Listening • Introduction • What is listening? • Benefits of active listening • Factors that hamper listening • Common poor listening habits. 2. Art Of Speaking • Art of public speaking • Importance of public speaking • Public speaking tips • Overcoming fear of public speaking 3. Art Of Writing E -mail • Introduction • The mail magic • Use appropriate salutations • Make the subject matter significant • Reread before pressing the "send" button – Be polite,and reciprocate good deeds	15
II	➢ Team Building and Conflict Management 1. Body Language 2. Body language in building interpersonal relations – Body language in building industrial relations 3. Interpreting body language Developing confidence with correct body language. ➢ Skill needed for teamwork	15

Reference

1. Soft Skills Know Yourself And Know The World, Author: Dr. K. ALEX, Publication: S.CHAND, First Edition: 2009, Reprint: 2023
2. Barnlund, Dean C. "A Transactional Model of Communication," in Foundations of Communication Theory, eds. Kenneth K. Sereno and C. David Mortensen (New York, NY: Harper and Row, 1970), 83–92.
3. Burleson, Brant R. Sandra Metts, and Michael W. Kirch, "Communication in Close Relationships," in Close Relationships: A Sourcebook, eds. Clyde Hendrick and Susan S. Hendrick (Thousand Oaks, CA: Sage, 2000).
4. Dance, F. E. X. (1972). Speech Communication; Concepts and Behavior. New York:Holt, Rinehart, and Winston.
5. Frank E. X. Dance and Carl E. Larson, The Functions of Human Communication:A Theoretical Approach (New York, NY: Holt, Reinhart, and Winston, 1976)
6. Ellis, Richard and Ann McClintock, You Take My Meaning: Theory into Practice in Human Communication (London: Edward Arnold, 1990).
7. Robert H. Gass and John S. Seiter, Persuasion, Social Influence and ComplianceGaining (Boston, MA: Allyn and Bacon, 1999)
8. Erving Goffman, The Presentation of Self in Everyday Life (New York, NY: Anchor Books, 1959)
9. Greene, Kathryn, Valerian J. Derlega, and Alicia Mathews, "Self-

Disclosure in Personal Relationships," in The Cambridge Handbook of Personal Relationships, eds. Anita L. Vangelisti and Daniel Perlman (Cambridge: Cambridge University Press, 2006).
10. Hargie, Owen. Skilled Interpersonal Interaction: Research, Theory, and Practice (London: Routledge, 2011).
11. National Association of Colleges and Employers, Job Outlook 2011 (2010): 25.