KANNUR UNIVERSITY

Re-accredited by NAAC with 'B++' Grade

KUFYUGP

BACHELOR OF DATA SCIENCE AND LOGISTICS

CURRICULUM & SYLLABUS

Effective from 2026 Admission Onwards

PREFACE

Welcome to the Four-year Integrated UG Data Science and Logistics programme of Kannur University. The Board of Studies of the University has designed this programme on the basis of the National Education Policy 2023 which critically envisions a brand-new holistic education system for the country, hinging on the effective adoption of modern teaching and training methods, application of technology, and imparting practical and contemporary skills, to shape the overall personality of students. Our programme is designed to equip students with a strong foundation in Data Science and Logistics principles while also providing specialized training in Artificial Intelligence and Machine Learning. In today's digital age, these technologies are at the forefront of technological advancements, driving innovation across various industries including healthcare, finance, transportation, logistics and entertainment.

The programme in Data Science and Logistics is designed with the objective of equipping the students to cope with the emerging trends and challenges in the field of Data Science, Logistics and interrelated disciplines. This programme involves various courses such as value-added courses, skill enhancement courses, multi-disciplinary courses and ability enhancement courses with an attribution of discipline specific core, discipline specific electives and various scholastic and co scholastic domains. This programme aims at helping the students define and recharge their creative, analytical, problem-solving, and critical thinking abilities, topped by actively pursuing digital literacy.

The BSc Data Science and Logistics Honours program emphasizes a strong theoretical foundation complemented by extensive laboratory experience. Students will engage in hands-on experiments that reinforce classroom learning and develop critical technical skills. Through practical work, they will learn to design application programmes, softwares, and analyse data, thus bridging the gap between theory and practice.

For those opting for the BSc Data Science and Logistics Honours with Research track, the program offers an enriched experience with a significant focus on independent research. This track is designed for students who wish to delve deeper into specific areas of interest, culminating in a research thesis. Under the mentorship of faculty members, students will undertake original research projects, honing their ability to conduct

scientific inquiries, think critically, and contribute to the body of knowledge in Data Science and Logistics. This rigorous training prepares graduates for careers in academia, research institutions, and industry.

The successful revision of this curriculum would not have been possible without the collective efforts and inputs from the BOS members, Ad hoc committee members, Data Science and Logistics academic council member, resource persons and the unwavering support of Data Science and Logistics faculty members from the various colleges. Their dedication and expertise have played an instrumental role in shaping a curriculum that is relevant, up-to-date, and consistent with international scholarly criteria.

We wish you to have a motivating atmosphere to make use of your extreme potential and caliber to complete this programme and to serve the nation by enriching yourself.

INTRODUCTION

Kannur University - Four-Year Undergraduate Programme: Backdrop and Context

The implementation of the Four-Year Undergraduate Programme (FYUGP) has been driven by the pressing need to address contemporary challenges ensuring responsive changes to the evolving needs of students, industry, and society at large. Recognizing the curriculum as the cornerstone of any education system, it requires regular refinement to align with evolving socioeconomic factors. Higher education must provide students with practical and technical skills relevant to their fields of interest, necessitating the development of a job-oriented curriculum. Despite significant increases in access and expansion of higher education over the years, concerns persist regarding the quality and relevance of educational outcomes, particularly in terms of employability skills.

As the world becomes increasingly interconnected, our education system must evolve to instill 21st-century skills, enabling students not only to survive but to thrive in this dynamic environment. Moreover, there is a growing need for higher education institutions to embrace social responsibility and contribute to the development of a knowledge society capable of driving sustainable development through innovation. With the central objective of fostering a robust knowledge society to support a knowledge economy, the Government of Kerala has initiated steps to reform higher education. Accordingly, three commissions were established to suggest reforms in higher education policy, legal and regulatory mechanisms, and evaluation and examination systems. It is within this context that a comprehensive reform of the undergraduate curriculum has been proposed, leading to the restructuring of the Four-Year Undergraduate Programme (FYUGP).

VISION AND MISSION OF KANNUR UNIVERSITY

Vision:

To establish a teaching, residential and affiliating University and to provide equitable and just access to quality higher education involving the generation, dissemination and a critical application of knowledge with special focus on the development of higher education in Kasargod and Kannur Revenue Districts and the Mananthavady Taluk of Wayanad Revenue District.

Mission:

- To produce and disseminate new knowledge and to find novel avenues for application of such knowledge.
- To adopt critical pedagogic practices which uphold scientific temper, the uncompromised spirit of enquiry and the right to dissent.
- To uphold democratic, multicultural, secular, environmental and gender sensitive values as the foundational principles of higher education and to cater to the modern notions of equity, social justice, and merit in all educational endeavours.
- To affiliate colleges and other institutions of higher learning and to monitor academic, ethical, administrative, and infrastructural standards in such institutions.
- To build stronger community networks based on the values and principles of higher education and to ensure the region's intellectual integration with national vision and international standards.
- To associate with the local self-governing bodies and other statutory as well as nongovernmental organizations for continuing education and also for building public awareness on important social, cultural and other policy issues.

PROGRAMME OUTCOME

PO1	**Mathematical and Analytical Skills** Apply mathematical, statistical, and analytical techniques to solve data-driven problems.
PO2	**Programming and Technical Skills** Demonstrate proficiency in programming and use of modern data science tools and technologies.
PO3	**Data Analysis and Interpretation** Analyze, interpret, and derive meaningful insights from structured and unstructured data.
PO4	**Problem Solving and Critical Thinking** Identify real-world problems and develop effective data-driven solutions.
PO5	**Communication and Teamwork** Communicate technical information effectively and work collaboratively in multidisciplinary teams.
PO6	**Ethics and Lifelong Learning** Follow ethical practices in data handling and engage in continuous learning to adapt to emerging technologies.

PROGRAMME SPECIFIC OUTCOMES

PSO1	**Data Collection and Preprocessing** Collect, clean, and preprocess data from logistics, business, and real-world sources.
PSO2	**Statistical and Predictive Analysis** Apply statistical methods and predictive analytics for decision-making in logistics.
PSO3	**Machine Learning Applications** Develop machine learning models for demand forecasting, inventory control, and route optimization.
PSO4	**Data Visualization and Reporting** Create dashboards and visual reports for effective logistics and business decision support.
PSO5	**Database and Big Data Handling** Design and manage databases and handle large-scale logistics data using modern tools.
PSO6	**Supply Chain and Logistics Optimization** Apply analytical and optimization techniques to improve supply chain efficiency and operations.
PSO7	**Ethical and Sustainable Logistics Practices** Ensure ethical data usage and contribute to sustainable and efficient logistics systems.

STRUCTURE OF THE PROGRAMME

Title of the Programme: This DEGREE shall be called BACHELOR OF **DATA SCIENCE AND LOGISTICS.**

The programme of instruction shall consist of lecture courses, tutorial courses, practical courses, comprehensive viva-voce, seminars, internship/industrial visits, and project work**.**

a) **Lecture Courses:** These courses involve classroom teaching by a faculty member in a specific field or discipline.
b) **Tutorial Courses:** These courses involve problem-solving sessions and discussions related to a subject, conducted under the guidance of qualified personnel.
c) **Laboratory Work:** These courses require students to participate in practical/lab activities or projects that apply the theoretical concepts learned in the chosen field, under the supervision of an instructor.
d) **Comprehensive Viva-Voce:** This is an essential assessment component of the programme, aimed at evaluating the student's overall understanding of the subject and their ability to apply knowledge as defined in the course outcomes. It also provides an opportunity for academic interaction and expert feedback.
e) **Seminar:** A seminar involves structured discussions, presentations, or debates on assigned topics, current or historical issues, or shared academic experiences, guided by a faculty member or expert.
f) **Internship / Industrial Visit:** All students shall undergo a field trip, summer internship, or apprenticeship in a firm, industry, or organization; or receive training in laboratories under faculty, researchers, Higher Education Institutions (HEIs), or research organizations.
g) The department shall actively promote internships and institutional/industrial visits, as they enhance practical exposure and may lead to research project opportunities. Such activities enrich students' learning experiences and prepare them for careers in data science and logistics.
h) **Research Project:** Students opting for Honours with Research shall undertake a research project under the guidance of a faculty member from the University/College. They must

submit a research report and successfully defend it to earn 12 credits. The research shall be carried out in the major discipline.

Eligibility for Teachers: Master's Degree in Data Science, Computer Science, Information Technology, Computer Applications, Data Science and Logistics, or a related discipline with UGC-NET or Ph.D. in accordance with UGC regulations.

Eligibility for admission: A pass in Higher Secondary Examination of the state or an Examination accepted by the University as equivalent thereto with minimum 50% marks in aggregate. (Calculation of Index marks for Admission: Total marks of the qualifying examination + Marks secured for Computer Science/Mathematics/ Information Technology/ Statistics /Computer Applications/ Commerce)

Medium of Instruction: The medium of instruction and examination shall be English.

COURSE STRUCTURE

Course and Credit Structure for Different Pathways

Course Distribution for Students (Semesters I – VI)

1. **Single Major:**

   The six courses under categories **B and C** may be chosen from **different disciplines**, allowing interdisciplinary learning.

2. **Major with Multiple Disciplines:**

   Categories **B and C** represent **two different disciplines**, enabling students to gain knowledge in multiple subject areas alongside their major.

3. **Major with Minor:**

   Categories **B and C** represent the **same minor discipline**, allowing students to develop additional specialization in a chosen minor field.

I SEMESTER				
Sl. No.	**Course**	**Hours/Week**	**Credits**	**Total Marks**
1	AEC 1 (English)	4	3	75
2	AEC 2 (Additional Langauges)	4	3	75
3	MDC 1	3/4	3	75
4	DSC A1	5	4	100
5	DSC B1	4/5	4	100
6	DSC C1	4/5	4	100
	Total	**24/26**	**21**	**525**

II SEMESTER				
Sl. No.	**Course**	**Hours/Week**	**Credits**	**Total Marks**
1	AEC 3 (English)	4	3	75
2	AEC 4 (Additional Languages)	4	3	75
3	MDC 2	3/4	3	75
4	DSC A2	5	4	100
5	DSC B2	4/5	4	100
6	DSC C2	4/5	4	100
	Total	**24/26**	**21**	**525**

III SEMESTER				
Sl. No.	**Course**	**Hours/Week**	**Credits**	**Total Marks**
1	MDC 3 (Kerala Studies)	3/4	3	75
2	VAC 1	3/4	3	75
3	DSC A3	5	4	100
4	DSC A4	5	4	100
5	DSC B3	4/5	4	100
6	DSC C3	4/5	4	100
	Total	**24/26**	**22**	**550**

IV SEMESTER				
Sl. No.	**Course**	**Hours/Week**	**Credits**	**Total Marks**
1	SEC 1	4	3	75
2	VAC 2	3/4	3	75
3	VAC 3	3/4	3	75
4	DSC A5	5	4	100
5	DSC A6	5	4	100
6	DSC A7	4/5	4	100
	Internship		2	50
	Total	**24/25**	**23**	**575**

V SEMESTER				
Sl. No.	**Course**	**Hours/Week**	**Credits**	**Total Marks**
1	SEC 2	4	3	75
2	DSC A8	5	4	100
3	DSC A9	5	4	100
4	DSC A10	4/5	4	100
5	DSE A11	4/5	4	100
6	DSE A12	4/5	4	100
	Total	**26/29**	**23**	**575**

VI SEMESTER				
Sl. No.	**Course**	**Hours/Week**	**Credits**	**Total Marks**
1	SEC 3	4	3	75
2	DSC A13	5	4	100
3	DSC A14	5	4	100
4	DSC A15	4/5	4	100
5	DSE A16	4/5	4	100
6	DSE A17	4/5	4	100
	Total	**26/29**	**23**	**575**

4. ***Double major pathway****:* A and B represent the courses offered by the two departments. Students should choose one of the disciplines as their major 1 and the other as major 2.

I SEMESTER				
Sl. No.	**Course**	**Hours/Week**	**Credits**	**Total Marks**
1	AEC 1 (English)	4	3	75
2	AEC 2 (Additional Languages)	4	3	75
3	MDC A/B	3/4	3	75
4	DSC A1	5	4	100
5	DSC A2	5	4	100
6	DSC B1	4/5	4	100
	Total	**25/26**	**21**	**525**

II SEMESTER				
Sl. No.	**Course**	**Hours/Week**	**Credits**	**Total Marks**
1	AEC 3 (English)	4	3	75
2	AEC 4 (Additional Langauges)	4	3	75
3	MDC A/B	3/4	3	75
4	DSC A3	5	4	100
5	DSC B2	5	4	100
6	DSC B3	4/5	4	100
	Total	**25/26**	**21**	**525**

III SEMESTER				
Sl. No.	**Course**	**Hours/Week**	**Credits**	**Total Marks**
1	MDC 3 (Kerala Studies)	3/4	3	75
2	VAC A/B	3/4	3	75
3	DSC A4	5	4	100
4	DSC A5	5	4	100
5	DSC B4	4/5	4	100
6	DSC B5	4/5	4	100
	Total	**24/26**	**22**	**550**

IV SEMESTER				
Sl. No.	**Course**	**Hours/Week**	**Credits**	**Total Marks**
1	SEC A/B	4	3	75
2	VAC A/B	3/4	3	75
3	VAC A/B	3/4	3	75
4	DSC A6	5	4	100
5	DSC A7	5	4	100
6	DSC B6	4/5	4	100
	Internship (KU4INTDSL209)		2	50
	Total	**24/25**	**23**	**575**

V SEMESTER				
Sl. No.	**Course**	**Hours/Week**	**Credits**	**Total Marks**
1	SEC A/B	4	3	75
2	DSC A8	5	4	100
3	DSE A9	5	4	100
4	DSC A10	4/5	4	100
5	DSC B7	4/5	4	100
6	DSE B8	4/5	4	100
	Total	**26/29**	**23**	**575**

VI SEMESTER				
Sl. No.	**Course**	**Hours/Week**	**Credits**	**Total Marks**
1	SEC A/B	4	3	75
2	DSC A11	5	4	100
3	DSE A12	5	4	100
4	DSC B9	4/5	4	100
5	DSC B10	4/5	4	100
6	DSE B11	4/5	4	100
	Total	**26/29**	**23**	**575**
On completion of 3-year UG Student will get **68 credits in major A** (48 + 18+2 = 68 (50% of 133)) and **53 credits in Major B** (44 + 9 = 53 (40% of 133))				

STUDENT CAN EXIT WITH UG DEGREE / PROCEED TO FOURTH YEAR WITH MINIMUM 133 CREDITS.

VII SEMESTER				
Sl. No.	**Course**	**Hours/Week**	**Credits**	**Total Marks**
1	DSC A1	4/5	4	100
2	DSC A2	4/5	4	100
3	DSC A3	4/5	4	100
4	DSC A4	4/5	4	100
5	DSC A5	4/5	4	100
	Total	**20/25**	**20**	**500**

VIII SEMESTER (Degree Honours with Research))				
Sl No.	**Course**	**Hours/Week**	**Credits**	**Total Marks**
1	DSC A6	4/5	4	100
2	DSC A7	4/5	4	100
3	DSC A8	4/5	4	100
OR				
4	KU8DSCDSL412 (Project for Honours with Research)		12	300
OR				

5	KU8DSCDSL414 (Project for Honours)		8	200
6	Any one DSC Capstone Course from major discipline	4/5	4	100
	Total		**12**	**300**
ELECTIVES: Three elective courses are compulsory for Honours and Honours with Research Programmes. For Honours with research Programme one must be **KU8DSCDSL406 (Research Fundamentals and Publication Ethics)**.				
7	DSE A1	4/5	4	100
8	DSE A2	4/5	4	100
9	DSE A3	4/5	4	100
OR				
10	DSE B1	From any discipline/ any three disciplines	4	100
11	DSE B2		4	100
12	DSE B3		4	100
Two of these courses can be in the online mode. These online courses can be taken either in semester VII or in semester VIII, but their credits shall be added to the student's account only in semester VIII. For those students who go to another institution for doing the Project, all these three courses can be in the online mode or in the in-person mode from the institution where the Project is being done.				
	Total	**12**	**12**	**300**

SEMESTER WISE COURSE DETAILS

General Foundation Courses

			CREDITS				
Semester	**Course Code**	**Course Name**	**Lecture/ Tutorial**	**Practical**	**Total Credit**	**Hours / Week**	**Total Marks**
Multi-Disciplinary Courses (MDC)							
I	KU1MDCDSL101	Fundamentals of Data Science	3	0	3	3	75
	KU1MDCDSL102	Basic Statistics for Data Science	2	1	3	4	75
	KU1MDCDSL103	Database Concepts and Design	3	0	3	3	75
II	KU2MDCDSL104	Logistics & Supply Chain Management	3	0	3	3	75
	KU2MDCDSL105	Internet and Web Technologies	2	1	3	4	75
	KU2MDCDSL106	Basics of Supply Chain Management	3	0	3	3	75
Value-Added Courses (VAC)							
III	KU3VACDSL101	Ethical AI and Responsible Data Usage	3	0	3	3	75
	KU3VACDSL102	Digital Literacy for Data Science	2	1	3	4	75
IV	KU4VACDSL103	Environmental Sustainability in Logistics	2	1	3	4	75
	KU4VACDSL104	E-Commerce and Digital Logistics	2	1	3	4	75
	KU4VACDSL105	Cyber Laws and Ethics	3	0	3	3	75
	KU4VACDSL106	Ethical and Responsible Data Science	2	1	3	4	75
Skill Enhancement Courses (SEC)							
IV	KU4SECDSL101	Data Visualization using Power BI / Tableau	2	1	3	4	75
V	KU5SECDSL102	Cloud Computing for Data Science	2	1	3	4	75
VI	KU6SECDSL103	GIS for Logistics	2	1	3	4	75
	KU6SECDSL104	Advanced Database Technologies	2	1	3	4	75

Discipline Specific Core (DSC) Courses

			CREDITS				
Semester	**Course Code**	**Course Name**	**Lecture/ Tutorial**	**Practical**	**Total**	**Hours / Week**	**Total Marks**
DSC							
I	KU1DSCDSL101	Fundamentals of Data Science and Programming	3	1	4	5	100
	KU1DSCDSL102	Python Programming for Problem Solving	3	1	4	5	100
	KU1DSCDSL103	Data Analytics	3	1	4	5	100
II	KU2DSCDSL104	Fundamentals of Logistics	3	1	4	5	100
	KU2DSCDSL105	R Programming	3	1	4	5	100
	KU2DSCDSL106	E-Commerce Logistics	3	1	4	5	100
III	KU3DSCDSL201	Numerical Methods and Statistical Analysis (Department of Statistics)	3	1	4	5	100
	KU3DSCDSL202	Object-Oriented Programming using Python	3	1	4	5	100
	KU3DSCDSL203	Logistics Information Systems	3	1	4	5	100
	KU3DSCDSL204	Fundamentals of Production Logistics	3	1	4	5	100
IV	KU4DSCDSL205	DBMS Concepts & SQL Querying	3	1	4	5	100
	KU4DSCDSL206	Data Structures and Algorithms	3	1	4	5	100
	KU4DSCDSL207	Supply Chain Logistic Operations	4	0	4	4	100
	KU4DSCDSL208	Statistical Pattern Recognition (Department of Statistics)	3	1	4	5	100
	KU4INTDSL209	Internship			2		50
V	KU5DSCDSL301	Logistics Information Systems and Analytics	3	1	4	5	100
	KU5DSCDSL302	Artificial Intelligence: A Modern Approach	4	0	4	4	100
	KU5DSCDSL303	Machine Learning for Data Science	3	1	4	5	100
	KU5DSCDSL304	Business Logistics	4	0	4	4	100
VI	KU6DSCDSL305	Advanced Logistics Systems	3	1	4	5	100
	KU6DSCDSL306	Inventory Control Models and Decision Theory (B COM Department)	3	1	4	5	100
	KU6DSCDSL307	Industry Project & Application Development	3	1	4	5	100
	KU6DSCDSL308	Operations Research (Mathematics Department)	3	1	4	5	100
	KU7DSCDSL401	Logistics Network Design	3	1	4	5	100

VII	KU7DSCDSL402	In-plant Logistics	4	0	4	4	100
	KU7DSCDSL403	International Logistics	4	0	4	4	100
	KU7DSCDSL404	Digital Image Processing	3	1	4	5	100
	KU7DSCDSL405	Time Series Data Analysis	3	1	4	5	100
Semester 8 - DSC Courses							
VIII	KU8DSCDSL406	Research Fundamentals & Publication Ethics (Mandatory Course)	4	0	4	4	100
	KU8DSCDSL407	Healthcare Data Analytics	3	1	4	5	100
	KU8DSCDSL408	Air Transport and Logistics	4	0	4	4	100
	KU8DSCDSL409	Social Media Analytics	3	1	4	5	100
	KU8DSCDSL410	Customs Procedure	4	0	4	4	100
	Three capstone level credit 4 courses from any discipline Major/Minor (DSC/DSE) need to be completed.						
Semester 8 - Degree Honours with Research – Compulsory Courses							
KU8DSCDSL411		Paper Presentation in National/International Conferences	4	0	4	4	100
KU8DSCDSL412		Research Project			12	12	
Semester 8 - Degree with Honours							
KU8DSCDSL411		Paper Presentation in National / International Conferences (Optional)	4	0	4	4	100
KU8DSCDSL413		Seminar	4	0	4	4	100
KU8DSCDSL414		Research Project (Optional)			8	8	200

Discipline Specific Elective (DSE) Courses

			CREDITS				
Semester	**Course Code**	**Course Name**	**Lecture/ Tutorial**	**Practical**	**Total**	**Hours / Week**	**Total Marks**
DSE COURSES							
V	KU5DSEDSL301	Data Mining for Data Science & Logistics	4	0	4	4	100
	KU5DSEDSL302	NLP: Basics and Techniques	4	0	4	4	100
	KU5DSCDSL303	Logistics Management and Analysis	3	1	4	5	100
VI	KU6DSEDSL304	Deep Learning Techniques	4	0	4	4	100

	KU6DSEDSL305	Cloud Computing for Data Science & Logistics	4	0	4	4	100
VIII	KU8DSEDSL401	Advanced Predictive Analytics	3	1	4	5	100
	KU8DSEDSL402	Marketing Analytics	4	0	4	4	100
	KU8DSEDSL403	Gen AI & Agentic AI	3	1	4	5	100
	KU8DSEDSL404	MOOC/ Online Course			4		100
	Total Credit for Semester 1 to 6		133				
	Total Credit for Semester 8		24				
	Total Credit for Semester 7 and Semester 8		44				
	Total Credits from Semester 1 to Semester 8		177 (133 +44)				

ASSESSMENT AND EVALUATION

The assessment shall be a combination of Continuous Comprehensive Assessment (CCA) and an End Semester Evaluation (ESE)

- As per the regulation of Kannur University, one credit corresponds to 25 marks. Hence a 3-credit course must be evaluated for 75 marks and 4 credit courses for 100 marks. The ratio of continuous comprehensive assessment (CCA) to End semester examination (ESE) for theory/lecture courses is 30:70 and for the practical courses, it is 40:60.
- The 4-credit courses (Major and Minor courses) and 3 credit (Foundational Courses) are of two types:
    a) Courses with only theory
    b) Courses with 3-credit theory and 1-credit practical.
- In 4-credit courses with only theory component, out of the total 5 modules of the syllabus, one teacher specific module with 20% content is designed by the faculty member teaching that course, and it is internally evaluated.
- In 4-credit courses with 3-credit theory and 1-credit practical components, out of the total 5 modules of the syllabus, 4 modules are for theory and the fifth module is for practical.
- The 3 credit courses (Foundational Courses) are of two types:
    a) Courses with only theory
    b) Courses with 2-credit theory and 1-credit practical.
- In 3-credit courses with only theory component, out of the total 5 modules of the syllabus,

one teacher specific module with 20% content is designed by the faculty member teaching that course, and it is internally evaluated.

- In 3-credit courses with 2-credit theory and 1-credit practical components, out of the total 5 modules of the syllabus, 4 modules are for theory and the fifth module is for practical.

Course Credit	Credit		Mark		L		P		
4	L	P	L	P	CCA (30%)	ESE (70%)	CCA (40%)	ESE (60%)	Total marks
	4	0	100	0	30	70	0	0	100
	3	1	75	25	25	50	10	15	100
3	L	P	L	P	CCA (30%)	ESE (70%)	CCA (60%)	ESE (40%)	Total marks
	3	0	75	0	25	50	0	0	75
	2	1	50	25	15	35	15	10	75

(L – Lecture/Theory, P – Practical/Practicum components, CCA – Continuous Comprehensive Assessment, ESE – End Semester Evaluation)

- Continuous Evaluation includes assignments, seminars, periodic written examinations, or other measures as proposed in the syllabus and approved by the university.

Practical Exams

- The end-semester practical examination and viva-voce, and the evaluation of practical records shall be conducted by the course in-charge and an internal examiner appointed by the Department Council. Duration of ESE may be 2 to 2.5 Hrs.
- There shall be a Continuous Evaluation of practical courses conducted by the Course- In-Charge.
- The process of continuous evaluation of practical courses shall be completed before 10 days from the commencement of the end-semester examination.
- Those who passed in continuous evaluation alone will be permitted to appear for the end semester examination and viva-voce.

Mark Distribution for Discipline Specific Courses and Foundation Courses:

The detailed distribution table with the components

A. 3 Credit Course (Theory only)

Evaluation Type		Marks
	ESE	50
	CCA	25
a)	*Test Paper	10
b)	**Assignment/ Book- Article Review/Activities/ Case Study	5
c)	Seminar/ Viva -Voce	10
Total		**75**

B. 4 Credit Course (3 Credit Theory + 1 Credit Practical):

Evaluation Type			Marks	Evaluation Type			Marks	Total
Lecture			75	Practical			25	100
a)	ESE		50	a)	ESE		15	
b)	CCA		25	b)	CCA		10	
	i	*Test Paper	10		i	Punctuality	3	
	ii	**Assignment/ Book-Article review/Activities/ Case Study	10		ii	Model Exam	4	
	iii	Seminar/ Viva-Voce	5		iii	Record	3	

C. 3 Credit Course (2 credit theory + 1 credit practical)

Evaluation Type			Marks	Evaluation Type			Marks	Total
Lecture			**50**	**Practical**			**25**	75
a)	ESE		**35**	a)	ESE		**15**	
b)	CCA		**15**	b)	CCA		**10**	
	i	*Test Paper	**8**		i	Punctuality	**3**	
	ii	**Book-Article review/ Assignment/Activities/ Case Study	**2**		ii	Model exam	**4**	
	iii	Seminar/ Viva-Voce	**5**		iii	Record	**3**	

* Best out of two test papers. ** Or any other evaluation technique like quiz, open book exam, group activity.

INTERNSHIP

- All students should undergo Internship of 2-credits during the first six semesters in a firm, industry or organization, or training in labs with faculty and researchers of their own institution or other Higher Educational Institutions (HEIs) or research institutions.
- Internship can be for enhancing the employability of the student or for developing the research aptitude.
- Internship can involve hands-on training on a particular skill/ equipment/ software. It can be a short project on a specific problem or area. Attending seminars or workshops related to an area of learning or skill can be a component of Internship.
- A faculty member/ scientist/ instructor of the respective institution, where the student does the Internship, should be the supervisor of the Internship.

Guidelines for Internship

- Internship can be in Data Science, Logistics or allied disciplines.
- There should be minimum 60 hrs. of engagement from the student in the Internship.
- Summer vacations and other holidays can be used for completing the Internship.

In BSc. Data Science and Logistics Honours program, institute/ industry visit or study tour can be part of Internship. Visit to national research institute, research laboratory and place of scientific importance should be part of the study tour. A brief report of the study tour.

- The students should make regular and detailed entries in to a personal log book through the period of Internship. The log book will be a record of the progress of the Internship and the time spent on the work, and it will be useful in writing the final report. It may contain experimental conditions and results, ideas, mathematical expressions, rough work and calculation, computer file names etc. All entries should be dated. The Internship supervisor should periodically examine and countersign the log book.
- The log book and the report must be submitted at the end of the Internship.
- The institution at which the Internship will be carried out should be prior-approved by the Department Council of the College where the student has enrolled for the UG Honours program.

Evaluation of Internship

- The evaluation of Internship shall be done internally through continuous assessment mode

by a committee internally constituted by the Department Council of the college where the student has enrolled for the UG Honours program.

- The credits and marks for the Internship will be awarded only at the end of semester 5.

The scheme of CCA and ESE is given below:

Components of Evaluation of Internship	Weightage	Marks for Internship 2 Credit/50 Marks
Continuous Comprehensive Assessment (CCA)	**30%**	**15**
End Semester Evaluation	**70%**	**35**

The detailed distribution table with the components

Evaluation Type		Marks
ESE		**35**
a)	Acquisition of skill	20
b)	Report	15
CCA		**15**
a)	Punctuality	5
c)	Logbook	10
Total		**75**

PROJECT IN HONOURS PROGRAMME

- In Honours programme, the student has the option to do a Project of 12-credits in Major instead of three major Courses or Project of 8-credits in Major and one major course in semester 8.
- The Project can be done in the same institution/ any other higher educational institution (HEI) / research centre/ training centre.
- The Project in Honours programme can be a short research work or an extended internship or a skill-based training programme.
- A faculty member of the respective institution, where the student does the Project,

should be the supervisor of the Project.

PROJECT IN HONOURS WITH RESEARCH PROGRAMME

- Students who secure 75% marks and above (equivalently, CGPA 7.5 and above) cumulatively in the first six semesters are eligible to get selected to Honours with Research stream in the fourth year.
- In Honours with Research programme, the student has to do a mandatory Research Project of 12-credits instead of three Core Courses in Major in semester 8.
- The number of seats for the Honors with research shall be determined as per the availability of eligible faculty.
- The selection criteria for Honors with research stream shall be in accordance with the guidelines of UGC or as approved by Kannur University.
- Students who have chosen the honours with research stream shall be mentored by a faculty with a PhD.
- The mentor shall prescribe suitable advanced-level courses for a minimum of 20 credits to be taken within the institutions along with the papers on research methodology, research ethics, and research topic-specific courses for a minimum of 12 credits which may be obtained either within the institution or from other recognized institutions, including online and blended modes.
- These students who have opted for the honours with research should complete a research project under the guidance of the mentor and should submit a research report for evaluation. They need to successfully defend the research project to obtain 12 credits under a faculty member of the University/College within the University.
- The research outcomes of their project work may be published in peer-reviewed journals or presented at conferences or seminars or patented.

Guidelines for the Project in Honours Programme and Honours with Research Programme

- Project can be in Data Science, Logistics or allied disciplines.
- Project should be done individually.
- Project work can be of experimental/ theoretical/ computational in nature.
- There should be minimum 360 hrs. of engagement from the student in the Project work in Honours programme as well as in Honours with Research programme.

- There should be minimum 13 hrs./week of engagement (*the hours corresponding to the three core courses in Major in semester 8*) from the teacher in the guidance of the Poject(s) in Honours programme and Honours with Research programme.
- The various steps in project works are the following:
  - ✓ Investigation on a problem in systematic way.
  - ✓ Systematic recording.
  - ✓ Reporting the results with interpretation in a standard documented form.
  - ✓ Presentation of the results before the examiners.
- The report must be submitted at the end of the Project. A copy of the report should be kept for reference at the department. A soft copy of the report too should be submitted, to be sent to the external examiner in advance.
- The project report shall have an undertaking from the student and a certificate from the research supervisor for originality of the work, stating that there is no plagiarism, and that the work has not been submitted for the award of any other degree/ diploma in the same institution or any other institution.

Evaluation of Project

- The evaluation of Project will be conducted at the end of the eighth semester by both internal and external modes.
- The internal evaluation of the Project work shall be done through continuous assessment mode by a committee internally constituted by the Department Council of the college where the student has enrolled for the UG Honours programme. 30% of the weightage shall be given through this mode.
- The remaining 70% shall be awarded by the external examiner appointed by the University.

Project type	**Max. Marks**	**CCA (30%)**	**ESE (70%)**
Research Project of 12 Credits (UG Honours with research, mandatory)	300	90	210
Research Project of 12 Credits (UG Honours, optional)	300	90	210
Research Project of 8 Credits (UG Honours, optional)	200	60	140

The scheme of evaluation of the Project is given below:

The detailed distribution table with the components:

CCA			
Sl.No	Components of Evaluation of Project	Marks for the Project (Honours/ Honours with Research) 12 credits	Marks for the Project (Honours/ Honours with Research) 8 credits
1	Skill in doing project work	30	20
2	Internal Presentation and Viva-Voce	20	15
3	Punctuality and attendance*	20	15
4	Organization of Project Report	20	10
	Total Marks	**90**	**60**

*Attendance certificate should be produced by the students who have done their projects in any higher educational institution (HEI)/ research centre/ training centre.

ESE - (Honours / Honours with Research)			
Sl. No	Components of Evaluation of Project	Marks for the Project (12 credits)	Marks for the Project (8 Credits)
1	Content & relevance of the Project, Methodology, Quality of analysis, & Innovations of Research	50	40
2	Presentation of the Project	50	30
3	Project Report	40	20
4	Viva-Voce	70	50
	Total Marks	**210**	**140**

EXTERNAL EVALUATION

- Examinations will be conducted at the end of each semester. The students can write the external examinations in Data Science and Logistics in both English and Malayalam languages.
- Individual questions are evaluated in marks and the total marks are converted into grades by the University based on 10-point grading system.

Letter Grade	Grade Point (P)

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

- A minimum of grade point 4 (Grade P) is needed for the successful completion of a Course.
- A student who has failed in a Course can reappear for the End Semester Examination of the same Course along with the next batch without taking re-admission or choose another Course in the subsequent Semesters of the same programme to acquire the minimum credits needed for the completion of the Programme.
- There shall not be provision for improvement of CE and ESE.
- A student who has successfully completed the CE requirements in a subsequent semester can also appear for the ESE subject to the maximum duration permitted.

Computation of SGPA and CGPA

The following method is recommended to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

- The SGPA is the ratio of the sum of the product of the number of credits with the grade points 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.

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

Where Ci is the number of credits of the course and Gi is the grade point scored by the student in the course.

Example:

Semester	Course	Credit	Letter Grade	Grade point	Credit Point (Credit x Grade)
I	Course 1	3	A	8	3 X 8 = 24
I	Course 2	4	B+	7	4 X 7 = 28
I	Course 3	3	B	6	3 X 6 = 18
I	Course 4	3	O	10	3 X 10 = 30
I	Course 5	3	C	5	3 X 5 = 15
I	Course 6	4	B	6	4 X 6 = 24
		20			139
SGPA					139/20=**6.95**

- 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 = Σ(Ci x Si) / Σ Ci

  Where Si is the SGPA of the semester and Ci is the total number of credits in that semester.
- The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts. Transcript (Format): Based on the above recommendations on Letter grades, grade points and SGPA and CCPA, the HEIs may issue the transcript for each semester and a consolidated transcript indicating the performance in all semesters.

Example:

Semester I	Semester II	Semester III	Semester IV	Semester V	Semester VI
Credit: 21 SGPA: 6.9	Credit: 21 SGPA: 7.8	Credit: 22 SGPA: 5.6	Credit: 24 SGPA: 6.0	Credit: 23 SGPA: 6.3	Credit: 22 SGPA: 8.0
CGPA = (21 x 6.9 + 21 x 7.8 + 22 x 5.6 + 24 x 6.0 + 23 x 6.3 + 22 x 8.0) / 133 = 6.74					

- The SGPA is the ratio of the sum of the product of the number of credits with the grade points 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) = Σ(Ci x Gi) / ΣCi

Where Ci is the number of credits of the course and Gi is the grade point scored by the student in the course.

CGPA	Overall letter Grade
9.5 and above	O
8.5 and above but less than 9.5	A+
7.5 and above but less than 8.5	A
6.5 and above but less than 7.5	B+
5.5 and above but less than 6.5	B
4.5 and above but less than 5.5	C
4.0 and above but less than 4.5	D
Less than 4.0	F

Appearance for Continuous Evaluation (CE) and End Semester Examination (ESE) are compulsory, and no Grade shall be awarded to a candidate if the candidate is absent for CE or ESE or both.

SYLLABUS: GENERAL FOUNDATION COURSES

MULTIDISCIPLINARY COURSES

KU1MDCDSL101: Fundamentals of Data Science

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
1	MDC	100-199	KU1MDCDSL101	3	45

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	0	1	25	50	75	1.5 hrs

Course Description:

This course introduces the fundamental concepts and techniques of Data Science. It covers the complete data science lifecycle, including data collection, preprocessing, analysis, and visualization. Students will learn how to handle different types of data and apply basic statistical methods to extract meaningful insights.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand the concepts of Data Science, data types, data formats, and roles in data science.	U
2	Collect, clean, preprocess, and normalize data using appropriate techniques.	A
3	Perform exploratory data analysis and interpret data using statistical measures.	A/An
4	Visualize data using appropriate charts and tools to communicate insights.	An
5	Understand basic concepts of Machine Learning and Data Mining with real-life applications.	U
6	Apply basic machine learning and data mining techniques for simple problem-solving tasks.	A

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	1			1		
CO2	3	2		1	2		1
CO3	3	3	1	2	2		
CO4	2	2	2	3	2		
CO5	1	2			1	1	2
CO6	2	3	3	2	2	2	1

Mapping of Course Outcomes to POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	1			
CO2	2	3	2	2		1
CO3	3	2	3	3		
CO4	2	2	3	2	3	
CO5	1	2	1	1		2
CO6	2	3	3	3	2	1

COURSE CONTENTS

	QB No.		DESCRIPTION	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Importance of Data Science (DS)**	9
	1	1.1	Need for DS – DS Process – Business Intelligence and DS – Prerequisites for a Data Scientist - Components of DS	
		1.2	Types of Data (Structured, Semi-structured, Unstructured)	
	2	1.3	Introduction to Data Formats (CSV, Excel, JSON)	
		1.4	Tools and Skills Needed, Roles in Data Science, Data Security Issues	
MODULE 2				
	UNIT 2		**MODULE 2: Data Collection and Preprocessing**	9
	3	2.1	Primary and Secondary Data Collection Methods	
		2.2	Data Preprocessing Steps: Cleaning, Integration, Transformation, Reduction, Benefits of Data Preprocessing, Handling Missing Data	
	4	2.3	Data normalization: Need of Normalization**,** Decimal Scaling Method, Min-Max Scaling, Z-Score Normalization, Robust Scaling	
		2.4	L2 Normalization, Advantages & Disadvantages of Data Normalization	
MODULE 3				
	UNIT 3		**MODULE 3: Data Analysis and Visualization**	9
	5	3.1	Exploratory Data Analysis – Data Format, Types of EDA – Graphical EDA	
		3.2	Univariate and Multivariate Non-graphical EDA	
	6	3.3	Descriptive Statistics: Mean, Median, Mode, Variance, Basic Data	

			Interpretation	
		3.4	Data Visualization Techniques: Bar Chart, Histogram, Pie-chart, Scatter Plot, Quantile Plot, Tools for Visualization	
MODULE 4				
	UNIT 4		**MODULE 4: Machine Learning & Data Mining**	9
	7	4.1	What is Machine Learning, Real-Life Applications (introduction only): Demand forecasting, Inventory management, Customer behavior analysis, Route optimization	
		4.2	Types of Machine Learning: Supervised, Unsuprevised, Semi-supervised, Reinforcement Learning	
	8	4.3	Machine Learning Process, Basic Algorithms: Linear Regression, Classification, Clustering	
		4.4	Data Mining: Definition, Importance, Data Mining Process, Real-Life Examples, Common Data Mining Techniques, Difference between Data Mining & Machine Learning	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	9
		Lab exercises:		
		1	Creating Simple Visual Reports, Creating Charts and Graphs	
		2	Basic Statistical Analysis, Data Cleaning using Excel / Python	
		3	Case Study: Analyze a Dataset and Present Results	

Essential Readings:

1. Sanjeev Wagh, Manisha Bhende, Anuradha Thakare, Fundamentals of Data Science, CRC Press, 1st Edition, 2022.
2. Howard J. Seltman, Experimental Design and Analysis, CMU, 2018.
3. https://nrcmec.org/pdf/Course-Content/CSE-DS/III_ISem/IDS/IDS%20COURSE%20CONTENT.pdf
4. Thomas Nield, Essential Math for Data Science, O'Reilly Media Inc., 2022.
5. Data Mining. Concepts and Techniques, 3rd Edition by Jiawei Han, Micheline Kamber, Jian Pei

Assessment Rubrics:

Evaluation Type		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	5
b)	Model exam	10
c)	Assignment	5
d)	Lab Exercises	5
e)	Book/ Article Review	
f)	Viva-Voce	

g)	Field Report	
Total		**75**

Model Question Paper (Credit 3)

Time: 90 Minutes **Max. Marks: 50**

Type A (Answer any six questions – 2 marks each) (6 × 2 = 12 marks)

1. Define Data Science.
2. What are structured and unstructured data?
3. What is the role of a Data Scientist?
4. Define data preprocessing.
5. What is normalization?
6. Define Exploratory Data Analysis (EDA).
7. What is supervised learning?
8. What is data mining?

Type B (Answer any four questions – 6 marks each) ***(4 × 6 = 24 marks)***

9. Explain the Data Science lifecycle with a diagram.
10. Describe different types of data and their formats (CSV, Excel, JSON).
11. Explain data preprocessing steps and handling missing data.
12. Discuss normalization techniques: Min-Max and Z-score normalization.
13. Explain types of EDA: graphical and non-graphical methods.
14. Describe types of Machine Learning with examples.

Type C (Answer any one question – 14 marks each) *(1 × 14 = 14 marks)*

15. Explain the Machine Learning process and discuss basic algorithms such as Linear Regression, Classification, and Clustering with examples.

OR

16. Discuss data visualization techniques (Bar chart, Histogram, Pie chart, Scatter plot) and explain their importance in data analysis.

KU1MDCDSL102: Basic Statistics for Data Science

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
1	MDC	100-199	KU1MDCDSL102	3	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
2	2	0	25	50	75	1.5 hrs

Course Description:

This course introduces fundamental statistical concepts required in the field of Data Science. It covers data collection, visualization, descriptive statistics, probability, distributions, correlation, regression, and hypothesis testing. The course also provides practical exposure to statistical analysis using modern data science tools. Students will develop analytical and interpretation skills essential for data-driven decision-making.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand the fundamental concepts of statistics, types of data, and methods of data presentation.	U
2	Apply descriptive statistical techniques to summarize and analyze datasets.	A
3	Use probability concepts and probability distributions for solving basic statistical problems.	E
4	Analyze relationships between variables using correlation, regression, and basic statistical inference techniques.	An
5	Perform statistical analysis and data visualization using spreadsheet tools and basic Python libraries for data science applications.	C

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	1	2	1	1	1
CO2	3	3	1	2	1	2	1
CO3	2	3	2	1	1	2	1
CO4	2	3	2	2	1	3	1

CO5	3	2	2	3	2	2	1

Mapping of Course Outcomes to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	1	2	1	1	1
CO2	3	2	3	2	1	1
CO3	3	2	2	2	1	1
CO4	3	2	3	3	1	1
CO5	3	3	3	2	2	1

COURSE CONTENTS

	QB No.		**DESCRIPTION**	**HOURS**
MODULE 1	**UNIT 1**		**MODULE 1: Introduction to Statistics & Data Visualization**	12
	1	1.1	Introduction to statistics in data science, Types of data and data sources, Scales of measurement	
		1.2	Data collection methods and Data preprocessing basics	
	2	1.3	Classification and tabulation of data	
		1.4	Data visualization techniques: Bar chart, Pie chart, Histogram, Box plot. Frequency polygon and Scatter plot	
MODULE 2				
	UNIT 2		**MODULE 2: Descriptive Statistics**	12
	3	2.1	Measures of central tendency: Mean, Median, Mode and Weighted mean	
		2.2	Measures of dispersion: Range, Variance, Standard deviation, Coefficient of variation	
	4	2.3	Skewness and kurtosis	
		2.4	Data normalization and standardization	
MODULE 3				
	UNIT 3		**MODULE 3: Probability Distributions**	12
	5	3.1	Basics of probability, Conditional probability, and Bayes' theorem	
		3.2	Random variables, Probability distributions: Binomial distribution	
	6	3.3	Poisson distribution and Normal distribution	
		3.4	Central Limit Theorem (introduction only) and Applications in predictive analytics	
MODUL				
	UNIT 4		**MODULE 4: Correlation, Regression, & Statistical Inference**	12
	7	4.1	Correlation analysis, Pearson and Spearman correlation,	

			Simple linear regression	
		4.2	Sampling techniques, Hypothesis testing	
	8	4.3	t-test and chi-square test, Confidence intervals	
		4.4	Introduction to statistical inference in data science	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	12
		Activities / Practicals:		
		1	Create a frequency distribution table for a given dataset using MS Excel	
		2	Represent a dataset using: Bar chart, Pie chart, and Histogram	
		3	Calculate the following for a given dataset: Mean, Median and Mode	
		4	Find the following measures of dispersion: Range, Variance and Standard deviation	
		5	Perform data normalization using z-score normalization $z=(x-\mu)/\sigma$	
		6	Create a box plot and identify outliers in a dataset.	
		7	Compute probabilities for simple events using probability formulas.	
		8	Generate random samples and study their statistical properties.	
		9	Compare two datasets using descriptive statistical measures.	
		10	Calculate Pearson correlation coefficient for two variables and interpret the relationship.	

Essential Readings:

1. Gareth James et al. – An Introduction to Statistical Learning
2. Sheldon Ross – Introduction to Probability and Statistics
3. Trevor Hastie et al. – The Elements of Statistical Learning
4. Andy Field – Discovering Statistics Using SPSS
5. Joel Grus – Data Science from Scratch

Web Resources

- Khan Academy Statistics and Probability
- NPTEL Data Science Courses
- Python Documentation
- Pandas Documentation

Assessment Rubrics:

Evaluation Type		**Marks**
End Semester Evaluation		**35**
Practical ESE: 2 hrs.		**15**
Content Writing	5	
Presentation	5	

Viva	3	
Record	2	
Continuous Evaluation - Theory		**15**
Test Paper- 1	5	
Model exam	5	
Assignment/Activities	5	
Continuous Evaluation - Practical		**10**
Punctuality – weekly exercises	3	
Model Examination	4	
Viva	3	
Total		**75**

MODEL QUESTION PAPER (Credit 3)

Time: 90 Minutes **Max Marks:** 35

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

1. What is primary data collection?
2. Define frequency distribution.
3. Define mean and median.
4. What is coefficient of variation?
5. What is conditional probability?
6. Define binomial distribution.
7. What is regression analysis?
8. Define null hypothesis.

Type B (Answer any FOUR questions) *(4 × 4 = 16 marks)*

9. Discuss different types of data with examples.
10. Explain data normalization techniques.
11. Explain measures of central tendency.
12. Explain addition and multiplication theorems of probability.
13. Explain Poisson distribution with an example.
14. Explain types of sampling techniques.

Type C (Answer any ONE question) *(1 × 7 = 7 marks)*

15. Explain various graphical methods used for data visualization with examples.
16. Explain Bayes' theorem with suitable examples.

KU1MDCDSL103: Database Concepts and Design

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
1	MDC	100-199	KU1MDCDSL103	3	45

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	0	1	25	50	75	1.5 hrs

Course Description:

This course introduces the fundamental concepts of database systems and their applications in real-world scenarios. It covers database models, relational database concepts, SQL queries, database design, normalization, and database administration techniques. Students will learn how to design and manage databases using ER modelling and relational schemas. The course also provides an overview of database security, backup and recovery, data warehousing, and recent trends in database technologies.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand fundamental concepts of databases, DBMS, & different data models.	U
2	Apply relational database concepts & construct basic SQL queries using DDL, DML, DCL, and TCL commands.	A
3	Design databases using ER modelling & convert them into relational schemas.	A/An
4	Analyze database requirements & implement normalization techniques to reduce redundancy and improve data integrity.	An
5	Describe database administration concepts including security, backup, recovery, and emerging trends in databases.	U
6	Develop simple database applications and perform practical SQL operations for real-world scenarios.	C

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7

CO1	2	1	-	-	2	-	-
CO2	2	2	-	-	3	-	-
CO3	2	-	1	3	3	-	-
CO4	3	2	-	-	3	-	-
CO5	1	-	-	-	3	1	2
CO6	2	2	1	2	3	1	-

Mapping of Course Outcomes to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	1	-	-	-
CO2	2	3	2	1	-	-
CO3	2	2	2	2	-	-
CO4	3	2	3	3	-	-
CO5	1	1	-	1	-	3
CO6	2	3	3	2	2	1

COURSE CONTENTS

	QB No.		**DESCRIPTION**	**HOURS**
MODULE 1	**UNIT 1**		**MODULE 1: Introduction to Databases**	9
	1	1.1	Overview of databases and their importance	
		1.2	Basic concepts: data, information, database management system (DBMS), data abstraction	
	2	1.3	Data Models: Introduction to hierarchical, network, E-R and relational data models.	
		1.4	Examples of database applications in real life	
MODULE 2				
	UNIT 2		**MODULE 2: Relational Database concepts**	9
	3	2.1	Understanding tables, rows, columns, and keys	
		2.2	Introduction to SQL components of SQL.	
	4	2.3	Basic SQL queries: DML (select, insert, update, delete), DDL (create, alter, drop)	
		2.4	DCL (grant, revoke) and TCL (commit and rollback)	
MODULE 3				
	UNIT 3		**MODULE 3: Database Design**	9
	5	3.1	Entity-Relationship (ER) modelling	
		3.2	Creating ER diagrams to represent relationships between entities	

	6	3.3	Converting ER diagrams to relational schemas	
		3.4	Introduction to normalization (1NF, 2NF, 3NF)	
MODULE 4				
	UNIT 4		**MODULE 4: Database Management and Application**	9
	7	4.1	Database administration and security	
		4.2	Backup and recovery strategies	
	8	4.3	Introduction to data warehousing and data mining	
		4.4	Recent trends in databases	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	9
		Lab exercise: Practice 5 SQL queries by implementing:		
		1	DML commands	
		2	DDL Commands	
		3	Simple database creation and query execution	

Essential Readings:

1. Database System Concepts by Abraham Silberschatz, Henry F. Korth, and S. Sudarshan, McGraw-Hill
2. DBMS by Raghu Ramakrishnan and Johannes Gehrke 3. A Guide to the SQL Standard, C. J. Date and Hugh Darwen, 1997, Addison- Wesley
3. An Introduction to Database Systems, C. J. Date, 8th edition.
4. Understanding the New SQL, Jim Melton and Alan R. Simon, Morgan Kaufmann

Assessment Rubrics:

Evaluation Type		Marks
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	5
b)	Model exam	10
c)	Assignment	5
d)	Database Querying using SQL	5
e)	Book/ Article Review	
f)	Viva-Voce	
g)	Field Report	
Total		**75**

MODEL QUESTION PAPER

Time: 90 Minutes **Max Marks:** 50

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

1. Define a database.
2. What is DBMS?
3. What is data abstraction?
4. List any two types of data models.
5. What is a primary key?
6. What is SQL?
7. Define normalization.
8. What is data warehousing?

Type B (Answer any FOUR questions – 6 marks each) *(4 × 6 = 24 marks)*

9. Explain the importance of databases in real life with examples.
10. Describe hierarchical, network, and relational data models.
11. Explain the structure of a table with rows and columns.
12. Write and explain basic SQL queries
13. Explain ER model with an example.
14. Describe normalization (1NF, 2NF, 3NF) with examples.

Type C (Answer any ONE question – 14 marks each) *(1 × 14 = 14 marks)*

15. a) Explain ER diagram with symbols.
    b) Convert an ER diagram into a relational schema.

OR

16. a) Explain database administration and security.
    b) Discuss backup and recovery strategies in databases.

KU2MDCDSL104: Logistics & Supply Chain Management

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
2	MDC	100-199	KU2MDCDSL104	3	45

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	0	1	25	50	75	1.5 hrs

Course Description:

This course introduces the fundamental concepts, functions, and importance of logistics and supply chain management. It covers key areas such as transportation, warehousing, inventory management, and logistics strategy. Students will learn how logistics systems support business operations and improve efficiency and customer service.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand the concepts, scope, functions, and importance of logistics and supply chain systems.	U
2	Analyze logistics strategies, service quality, and inventory planning techniques.	An
3	Describe warehousing, transportation systems, and logistics network design.	A/U
4	Evaluate material handling systems and packaging methods for efficient logistics operations.	An
5	Apply logistics concepts to solve real-world supply chain problems and support decision-making.	A

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	1	1	-	-	1	-	1
CO2	2	3	1	-	2	2	-
CO3	2	1	1	1	2	2	-
CO4	2	1	-	1	2	2	1

CO5	3	3	2	2	3	3	2

Mapping of Course Outcomes to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	1	-	-	-
CO2	3	1	2	3	-	-
CO3	2	1	2	2	-	-
CO4	2	1	2	2	-	1
CO5	3	2	3	3	2	1

COURSE CONTENTS

	QB No.		**DESCRIPTION**	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Introduction to Logistics**	9
	1	1.1	Definition, objectives, scope, & functions of logistics, Definitions & concepts of supply chain, Integrated logistics: inventory flow, information flow.	
		1.2	Role of logistics in competitive strategy, Logistics performance metrics	
	2	1.3	Concepts, objectives and importance of the supply chain, Role of logistics in supply chain, Customer service in logistics and supply chain, Difference between Logistics and Supply Chain Management.	
		1.4	Supply network, Example of a confectionery network map, Material flow, Information flow	
MODULE 2				
	UNIT 2		**MODULE 2: Logistics Strategy & Inventory Planning**	9
	3	2.1	Logistics strategy: Definition, Differentiating strategies, Alignment in relation to supply chain processes	
		2.2	Marketing perspective of Logistics Strategy, Segmentation and its implications	
	4	2.3	Quality of Service, Setting priorities for logistics strategy	
		2.4	Concept, types, and functions of inventory, Inventory Costs, Concepts, objectives & importance of inventory planning.	
MODULE 3				
	UNIT 3		**MODULE 3: Warehousing & Transportation**	9
	5	3.1	Concept, importance, and types of warehousing,	
		3.2	Design principles & layout of warehousing, Different warehouse strategies.	
	6	3.3	Concept & objectives of transportation, Role of transportation in logistics, Transportation selection decision.	
		3.4	Transport Economics, Transportation industry in India,	

			Challenges and future of transportation industry, Transportation models	
MODULE 4				
	UNIT 4		**MODULE 4: Material Handling & Packaging**	9
	7	4.1	Concepts, objectives, importance & principles of material handling	
		4.2	Material handling equipment types, Selection of equipment	
	8	4.3	Concept, objectives & role of packaging, Packaging materials, Consumer and industrial packaging	
		4.4	Logistics future challenges and opportunities: Internal alignment, Selecting collaborative opportunities upstream and downstream, Managing with cost-to-serve to support growth and profitability, The supply chain manager of the future.	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	9
		Activities:		
		1	Suppose you are a newly appointed Logistics manager in a manufacturing company. You have to present a report detailing the role of logistics in the company's supply chain. Compile a report for the same. You can take the help of the Internet for any related searches.	
		2	Using the Internet, compare the transportation infrastructure of India with that of the U.S.A. Present your comparison in a short note.	
		3	Determine warehousing needs of a supermarket. Present your findings in a short note. You can take the help of the Internet for any related searches.	
		4	XYZ always faces a problem of increased transportation cost and spoilage of products during their handling, storage and transportation. This problem just grew with time. To overcome it, the owner of XYZ hired a research agency and asked them to identify the root cause of the problem and provide a solution for it.	
		5	Suppose you are a newly-appointed manager of a manufacturing company. You have to ensure the correct material handling equipment is used to transport your company's essential products. What equipment will you recommend for use and why? Discuss.	

Essential Readings:

1. https://dde.pondiuni.edu.in/files/StudyMaterials/MBA/MBA3Semester/OSCM/2LogisticsManagement.pdf
2. Logistics Management and Strategy by Alen Horrison & Remko van Hoek, 3rd Edition.
3. G. Raghuram (IIMA), Logics and supply chain management, Macmillan, 2000

4. Emiko Bonafield, Harnessing value in supply chain, Johnwiley - Singapore, 1999.
5. B.S. Sahay, Macmillan – Supply Chain Management, 2000, (Pearson Education, 2004)

Assessment Rubrics:

Evaluation Type		Marks
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	5
b)	Model exam	10
c)	Assignment	5
d)	Activities	5
e)	Book/ Article Review	
f)	Viva-Voce	
g)	Field Report	
Total		**75**

MODEL QUESTION PAPER (Credit 3)

Time: 90 Minutes **Max Marks:** 50

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

1. Define logistics and explain its key objectives.
2. What are logistics performance metrics? Give examples
3. Differentiate between various logistics strategies.
4. Define inventory and explain its functions.
5. Define warehousing and explain its importance.
6. What is transportation economics?
7. Define packaging and explain its objectives.
8. What are different types of material handling equipment?

Type B (Answer any FOUR questions – 6 marks each) *(4 × 6 = 24 marks)*

9. Explain the importance of supply chain management.
10. Explain material flow and information flow in logistics.
11. Explain the role of transportation in logistics.
12. What are different warehouse strategies?
13. Differentiate between consumer and industrial packaging.
14. What are the key functions of a warehouse?

Type C (Answer any ONE question – 14 marks each) *(1 × 14 = 14 marks)*

15. a) Explain the role of logistics in competitive strategy.
    b) What are inventory costs? Explain briefly.

OR

16. a) Explain the role of a supply chain manager in modern logistics.
    b) Explain challenges in the Indian transportation industry.

KU2MDCDSL105: Internet and Web Technologies

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
2	MDC	100-199	KU2MDCDSL105	3	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
2	2	0	25	50	75	1.5 hrs

Course Description:

This course introduces the fundamental concepts of internet technologies, web connectivity, online communication, and cybersecurity. It covers internet architecture, domain names, DNS, web pages, browsers, communication tools, cloud-based services, and safe internet practices. The course also provides practical exposure to web technologies, email management, online collaboration, and secure internet usage. It enables students to effectively use internet resources for academic, professional, and digital communication purposes.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand the fundamentals of internet technologies, networking concepts, domain names, and DNS.	U
2	Explain web connectivity, web architecture, browsers, search engines, and webpage access mechanisms.	A
3	Use web pages, online communication tools, email services, and cloud-based collaboration platforms effectively.	E
4	Apply concepts of web technologies, internet communication, and digital interaction in real-world applications.	An
5	Identify cyber threats and practice safe internet usage, cybersecurity awareness, and ethical online behavior.	C

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	1	1	1	2	1	1
CO2	2	2	1	2	2	1	1

CO3	2	1	1	3	2	1	2
CO4	3	2	2	3	2	2	2
CO5	1	1	1	1	2	1	3

Mapping of Course Outcomes to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	2	1	1	1	1
CO2	2	3	2	2	1	1
CO3	1	3	2	2	3	1
CO4	2	3	3	3	2	1
CO5	1	2	2	2	1	3

COURSE CONTENTS

	QB No.		**DESCRIPTION**	**HOURS**
MODULE 1	**UNIT 1**		**MODULE 1: Introduction to Internet**	12
	1	1.1	Introduction to the internet, History and evolution of the internet, Functions of Internet	
		1.2	Principal actors, Infrastructure providers, Intermediaries: Transmission hosts, Resource hosts, Communication services, and Transaction facilitation services	
	2	1.3	Domain Names: Definition, Syntax, Types, Initial Allocation, Resolution of domain name disputes	
		1.4	DNS Basics	
MODULE 2				
	UNIT 2		**MODULE 2: Web Connectivity**	12
	3	2.1	Types of networks: LAN, MAN and WAN	
		2.2	Internet architecture and working: World Wide Web (WWW), Websites and web pages, Web browsers: Internal structure	
	4	2.3	Search engines, URLs meaning and domain names	
		2.4	Fetching a page that contains multiple items	
MODULE 3				
	UNIT 3		**MODULE 3: Web Pages and Communication**	12
	5	3.1	Static and dynamic pages, Steps to access static and dynamic web page, Personalized web pages and dynamic content	
		3.2	Pop-ups and pop-up blockers, User Interaction With Forms, Cookies, Animation with a browser script, Technologies used: Java, JavaScript, And HTML5	
	6	3.3	Email and its features, Creating and managing email accounts, Internet communication tools, Video conferencing and collaboration tools	
		3.4	Social networking concepts, Online messaging platforms, Cloud-	

			based communication services, Digital etiquette and online communication ethics	
MODULE 4				
	UNIT 4		**MODULE 4: Internet Security and Cyber Safety**	12
	7	4.1	Introduction to cybersecurity, Safe internet practices, Password management techniques, Two-factor authentication basics	
		4.2	Malware, viruses and spyware, Phishing and online frauds, Spam emails and scam detection, Data privacy and protection	
	8	4.3	Cyber ethics and cyber laws, Digital identity and online reputation, Responsible use of social media, Copyright and intellectual property basics	
		4.4	Secure online transactions, Internet banking safety, Security settings in browsers, Emerging trends in internet technologies	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	12
		Activities / Practical:		
		1	Compose and send emails with attachments and Email signatures. Use CC and BCC options accordingly	
		2	Web browsing practice: Effective web searching techniques, Bookmarking and browser settings	
		3	Enable and disable pop-up blockers in a web browser and record the observations.	
		4	Enable, disable, and clear cookies in a web browser.	
		5	Demonstrate password management techniques and two-factor authentication setup.	
		6	Compare different web browsers based on: • Speed • Security • Extensions • User interface	

		7	Simulate Payment: Do NOT make a real payment. Instead:
			• Observe payment methods:
			  ○ UPI
			  ○ Debit/Credit card
			  ○ Net banking
			  ○ Wallets
			• Identify secure payment gateway features	

Essential Readings:

1. Douglas E. Comer, *The Internet Book: Everything You Need to Know About Computer Networking and How the Internet Works,* 5th Edition.
2. Chris Reed, *Internet Law-Text and Materials*, Universal Law Publishing Co., New Delhi, 2nd Edition, 2005
3. Andrew S. Tanenbaum – *Computer Networks*

4. Alexis Leon & Mathews Leon – *Internet for Everyone*

Web Resources

- Mozilla Developer Network (MDN)
- W3Schools Web Technologies Tutorials
- Cisco Networking Academy
- Google Safety Center
- NPTEL Computer Networks Courses

Assessment Rubrics:

Evaluation Type		Marks
End Semester Evaluation		**35**
Practical ESE: 2 hrs.		**15**
Content Writing	5	
Presentation	5	
Viva	3	
Record	2	
Continuous Evaluation - Theory		**15**
Test Paper- 1	5	
Model exam	5	
Assignment/Activities	5	
Continuous Evaluation - Practical		**10**
Punctuality – weekly exercises	3	
Model Examination	4	
Viva	3	
Total		**75**

MODEL QUESTION PAPER (Credit 3)

Time: 90 Minutes **Max Marks:** 35

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

1. Define DNS and domain name?
2. Differentiate between LAN and WAN.
3. What is URL?
4. What is a static and dynamic web page?
5. What is a web browser? Define search engine.
6. What is two-factor authentication?
7. What is digital etiquette?
8. Define pop-up blockers.

Type B (Answer any FOUR questions) *(4 × 4 = 16 marks)*

9. Describe the role of DNS in Internet communication.
10. Discuss the features of email services.
11. Explain cloud-based communication services.
12. Discuss cyber laws and digital identity.
13. Discuss password management techniques.
14. Explain the internal structure of a web browser.

Type C (Answer any ONE question) *(1 × 7 = 7 marks)*

1. Explain Internet architecture and the working of the World Wide Web.
2. Explain technologies used in web communication such as Java, JavaScript, and HTML5.
3. Discuss cybersecurity practices and data privacy protection techniques.

KU2MDCDSL106: Basics of Supply Chain Management

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
2	MDC	100-199	KU2MDCDSL106	3	45

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	0	1	25	50	75	1.5 hrs

Course Description:

This course provides a comprehensive introduction to the concepts, principles, and practices of Supply Chain Management (SCM) and Logistics. It covers the design, planning, and management of supply chain processes, including procurement, transportation, distribution networks, and coordination among various stakeholders.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand SCM concepts and activities in business operations.	U
2	Explain supply chain strategies and drivers influencing supply chain performance.	An
3	Analyze transportation and sourcing decisions in supply chains.	An
4	Evaluate IT applications in supply chain	A/E
5	Assess coordination and collaboration techniques	A/E
6	Apply logistics and forecasting methods to solve real-world supply chain problems.	A

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	1	1	1	1	1	1
CO2	2	2	1	1	1	2	1
CO3	3	2	2	1	1	3	1
CO4	2	2	2	3	2	2	2
CO5	2	2	2	2	1	3	2

CO6	3	3	3	3	2	3	2

Mapping of Course Outcomes to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	1	1	1	1
CO2	2	2	2	2	1	1
CO3	3	2	2	3	1	1
CO4	2	3	2	2	2	1
CO5	2	2	2	3	2	2
CO6	3	3	3	3	2	2

COURSE CONTENTS

	QB No.		**DESCRIPTION**	**HOURS**
MODULE 1	**UNIT 1**		**MODULE 1: Introduction to SCM & Distribution Network (DN)**	9
	1	1.1	Introduction to Supply Chain, Supply Chain Management (SCM), Objectives, Importance and Activities of SCM	
		1.2	Decision Phases and Process View of Supply Chain, Business & SCM strategies, Supply Chain Drivers	
	2	1.3	Barriers in SCM, Scope of Supply Chain Activities, Marketing Mix Model, Role of DN, Factors Influencing DN Design	
		1.4	Design Options for a DN, E-business and its Impact, DN Design in the Supply Chain, Factors Influencing DN Design.	
MODULE 2				
	UNIT 2		**MODULE 2: Transportation Networks, Sourcing and Pricing**	9
	3	2.1	Transportation in Supply Chain, Importance of Transportation, Transportation Infrastructure and Policies	
		2.2	Design Options for Transportation Network, Tailored Transportation, Trade-off in Transportation Design, Routing & Scheduling in Transportation	
	4	2.3	Sourcing, In-house and Outsource, 3PL and 4PL, Benefits of Effective Sourcing Decisions, Supplier Scoring and Assessment	
		2.4	Supplier Selection, Procurement Process, Pricing & Revenue Management for Multiple Customers, Perishable Products & Seasonal Demand.	
MO DU				
	UNIT 3		**MODULE 3: IT and Coordination in Supply Chain**	9

	5	3.1	Supply Chain IT Framework, Role of Information in Supply Chain, CRM - Customer Relationship Management	
		3.2	Internal Supply Chain and Transaction Management, Enterprise Resource Planning (ERP), E-commerce, Supply Chain IT in Practice.	
	6	3.3	Lack of Supply Chain Coordination, Bullwhip Effect, Managerial Levers, Building Strategic Partnerships and Trust	
		3.4	Continuous Replenishment Program (CRP) and Vendor Managed Inventory (VMI), Collaborative Planning, Forecasting and Replenishment (CPFR)	
MODULE 4				
	UNIT 4		**MODULE 4: Dimensions of Logistics**	9
	7	4.1	Macro and Micro Dimension, Logistics Activities, Approach to Analyzing Logistics Systems, Logistics and Systems Analysis	
		4.2	Techniques of Logistics System Analysis, Supply and Demand Relationship & its Graphical Representation,	
	8	4.3	Demand Management & Forecasting, Demand Planning	
		4.4	Demand Forecasting Error, CPFR, Channels of Distribution	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	9
		Activities:		
		1	**Supply Chain Mapping Activity** • Students draw the supply chain of a product (e.g., milk, mobile phone) • Identify: supplier → manufacturer → distributor → retailer → customer	
		2	**Case Study Discussion** • Example: Amazon delivery system • Identify: Planning, Sourcing, Making, Delivering	
		3	**Strategy Comparison Chart** • Compare two companies (e.g., Reliance vs Amazon) • Students identify different SCM strategies	

Essential Readings:

1. jnu-Supply-Chain-Management.pdf, JNU, Jaipur.
2. Supply chain management - For global competitiveness – B.S. Sahay – Mac Millan India Ltd., 1999.

Assessment Rubrics:

Evaluation Type	Marks

End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	5
b)	Model exam	10
c)	Assignment	5
d)	Case Study	5
e)	Book/ Article Review	
f)	Viva-Voce	
g)	Field Report	
Total		**75**

MODEL QUESTION PAPER (Credit 3)

Time: 90 Minutes **Max Marks:** 50

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

1. Define SCM and explain its objectives.
2. Differentiate between Supply Chain and Supply Chain Management.
3. What are transportation policies?
4. What is routing and scheduling in transportation.
5. What is ERP? Explain its role in supply chain.
6. What is the bullwhip effect? Explain with example.
7. What is Continuous Replenishment Program (CRP)?
8. What is logistics system analysis?

Type B (Answer any FOUR questions – 6 marks each) *(4 × 6 = 24 marks)*

9. What are supply chain strategies? Explain briefly.
10. Differentiate between push and pull strategies in SCM.
11. Discuss different modes of transportation in supply chains.
12. What is CRM? Explain its importance in supply chain.
13. Describe managerial levers to improve coordination.
14. Explain factors affecting demand forecasting.

Type C (Answer any ONE question – 14 marks each) *(1 × 14 = 14 marks)*

15. a) Describe the Marketing Mix (4Ps) in relation to SCM
    b). Describe supply and demand relationship in logistics.

OR

16. a) Compare CRP, VMI, and CPFR.
    b) Discuss challenges in managing perishable and seasonal products.

VALUE ADDED COURSES (VACs)

KU3VACDSL101: Ethical AI and Responsible Data Usage

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
3	VAC	100-199	KU3VACDSL101	3	45

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	0	1	25	50	75	1.5 hrs

Course Description:

This course provides a comprehensive understanding of ethical issues in Artificial Intelligence and data usage. It introduces students to principles such as fairness, accountability, transparency, and privacy while addressing challenges like bias, discrimination, and misuse of data. The course also explores governance frameworks, sustainable AI practices, and real-world case studies.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand the fundamentals of AI ethics, ethical principles, and societal impact of AI systems	U
2	Explain data ethics, privacy concepts, and relevant legal frameworks	An
3	Identify bias, fairness issues, and ethical challenges in AI systems	An
4	Apply techniques to ensure responsible AI design and ethical data handling	A/E
5	Evaluate real-world AI systems and propose ethical, sustainable solutions	A/E

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	1	1	1	-	-	3
CO2	3	1	1	1	1	-	3

CO3	2	2	2	1	1	1	3
CO4	2	2	3	2	2	2	3
CO5	2	3	3	2	2	2	3

Mapping of Course Outcomes to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	2	2	1	3
CO2	2	1	2	2	1	3
CO3	2	2	3	3	1	3
CO4	2	3	3	3	2	3
CO5	2	2	3	3	3	3

COURSE CONTENTS

	QB No.		**DESCRIPTION**	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Introduction to AI Ethics**	9
	1	1.1	What is AI? Basics of AI systems, Need for ethics in AI, Historical cases of unethical technology	
		1.2	Ethical principles: fairness, accountability, transparency, Trustworthy AI concepts, Human-centered AI	
	2	1.3	Types of AI risks (social, economic, cultural), Impact of AI on society	
		1.4	Case studies (facial recognition, hiring systems, social media algorithms)	
MODULE 2				
	UNIT 2		**MODULE 2: Data Ethics & Privacy**	9
	3	2.1	What is data? Types of data, Data lifecycle (collection → processing → storage → usage),	
		2.2	Data privacy concepts, Personal vs sensitive data	
	4	2.3	Data protection laws (GDPR basics, Indian IT Act overview), Consent and user rights	
		2.4	Data misuse cases (Cambridge Analytica, data leaks)	
MODULE 3				
	UNIT 3		**MODULE 3: Bias, Fairness & Responsible AI**	9
	5	3.1	What is bias in AI? Types of bias, Sources of bias in datasets	
		3.2	Fairness in AI systems, Discrimination & algorithmic injustice	
	6	3.3	Techniques to reduce bias, Ethical dataset creation	

		3.4	Case studies on biased AI systems	
MODULE 4				
	UNIT 4		**MODULE 4: Governance, Accountability & Sustainable AI**	9
	7	4.1	AI governance frameworks, Role of governments and organizations	
		4.2	Accountability in AI systems, Explainable AI (XAI) basics	
	8	4.3	Ethical AI design principles, AI for social good	
		4.4	Sustainable AI and SDGs, Future of ethical AI	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	9
		Activities:		
		1	• Case study analysis on AI ethics issues	
		2	• Group discussions on real-world AI problems	
		3	• Identify bias in sample datasets (simple exercises)	
		4	• Privacy policy analysis of apps/websites	
		5	• Write an ethical impact assessment report	

Essential Readings:

1. Virginia Dignum – *Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way*, Springer, 2019, https://content.e-bookshelf.de/media/reading/L-12946936-8bd16d7dc1.pdf
2. Melanie Mitchell – *Artificial Intelligence: A Guide for Thinking Humans*, Penguin, 2019, https://cdn.bookey.app/files/pdf/book/en/artificial-intelligence-by-melanie-mitchell.pdf
3. Luciano Floridi – *Ethics, Governance, and Policies in Artificial Intelligence,* Oxford University Press, https://content.e-bookshelf.de/media/reading/L-16871700-5ce6df8467.pdf
4. *The Cambridge Handbook of Responsible Artificial Intelligence*, Cambridge University Press, 2022.

Additional Reading (For Students):

1. Max Tegmark – *Life 3.0: Being Human in the Age of Artificial Intelligence*, 2017, https://www.cag.edu.tr/uploads/site/lecturer-files/max-tegmark-life-30-being-human-in-the-age-of-artificial-intelligence-alfred-a-knopf-2017-aTvn.pdf

Assessment Rubrics:

Evaluation Type		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	5

b)	Model exam	10
c)	Assignment	5
d)	Activities	5
e)	Book/ Article Review	
f)	Viva-Voce	
Total		**75**

MODEL QUESTION PAPER (Credit 3)

Time: 90 Minutes **Max Marks:** 50

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

1. Define Artificial Intelligence and explain the need for ethics in AI.
2. What are user rights in data protection?
3. What is human-centered AI? Why is it important?
4. What is algorithmic discrimination?
5. What is data lifecycle?
6. Why is privacy important in data usage?
7. What is sustainable AI?
8. What is AI governance? Explain its importance.

Type B (Answer any FOUR questions – 6 marks each) *(4 × 6 = 24 marks)*

9. Explain the principles of fairness and accountability in AI.
10. Explain the concept of Explainable AI (XAI).
11. Explain ethical dataset creation.
12. Explain the Cambridge Analytica case and its ethical issues.
13. Explain GDPR basics and its importance.
14. Discuss ethical concerns in social media algorithms.

Type C (Answer any ONE question – 14 marks each) *(1 × 14 = 14 marks)*

15. a) Explain ethical issues in facial recognition systems.
    b) Explain any two historical cases of unethical technology.

OR

16. a) Discuss a real-world example of biased AI.
    b) Explain AI for social good with examples.

KU3VACDSL102: Digital Literacy for Data Science

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
3	VAC	100-199	KU3VACDSL102	3	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
2	2	0	25	50	75	1.5 hrs

Course Description:

This course introduces students to digital literacy in the context of the information society. It focuses on digital tools, data handling, online communication, and ethical use of digital technologies. Students will develop skills to access, evaluate, and use digital information effectively for data science applications.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand digital literacy concepts and information society	U
2	Use digital tools for communication and data handling	U
3	Analyze digital information and data sources	An
4	Evaluate ethical and security aspects of digital technologies	E
5	Apply digital skills in real-world data science contexts	A

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	1	1	2	1	1	1
CO2	3	2	2	3	2	2	1
CO3	3	3	2	3	2	2	2
CO4	2	2	1	2	2	1	3
CO5	3	3	3	3	3	3	2

Mapping of Course Outcomes to POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2	1	1	1
CO2	2	3	2	2	2	1
CO3	3	2	3	3	1	2
CO4	2	1	2	2	2	3
CO5	3	3	3	3	2	2

COURSE CONTENTS

	QB No.		DESCRIPTION	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Introduction to Digital Literacy**	12
	1	1.1	Concept of information society, Role of digital technologies, Evolution from traditional to digital systems, Impact of ICT on society	
		1.2	Definition and components of digital literacy, Digital vs information literacy, Technology literacy and media literacy, Importance in data science	
	2	1.3	Types of digital devices, Software and applications, Internet and web technologies, Cloud computing basics	
		1.4	Online communication tools, Email, social media, collaboration tools, Digital communication practices, Professional communication skills	
MODULE 2				
	UNIT 2		**MODULE 2: Information and Data Literacy**	12
	3	2.1	Structured vs unstructured data, Digital information sources, Databases and web sources, Open data platforms	
		2.2	Information Retrieval and Evaluation: Search techniques, Evaluating credibility of sources, Identifying misinformation, Data quality assessment	
	4	2.3	Data Handling Basics: Data collection methods, Data cleaning and preprocessing, Data storage and organization, Introduction to datasets	
		2.4	Data Interpretation and Usage: Basic data analysis concepts, Data visualization basics, Charts and graphs interpretation, Data-driven decision making	
MODULE 3				
	UNIT 3		**MODULE 3: Digital Skills for Data Science**	12
	5	3.1	Productivity Tools: MS Office / Google Workspace, Excel basics for data handling, Document and presentation tools	

		3.2	Data Tools: Introduction to Python/Excel tools, Data handling using spreadsheets, Basic coding concepts	
	6	3.3	Online Collaboration Tools: Google Drive, GitHub basics, Sharing and collaboration, Version control basics	
		3.4	Digital Content Creation: Creating digital reports, Presentation design, Data storytelling basics	
MODULE 4				
	UNIT 4		**MODULE 4: Ethics, Security and Digital Citizenship**	12
	7	4.1	Digital Ethics: Ethical use of data, Data privacy principles, Responsible AI concepts, Digital rights	
		4.2	Cyber Security Basics: Types of cyber threats, Safe internet practices, Password and data protection, Security tools	
	8	4.3	Digital Citizenship: Responsible online behaviour, Social media ethics, Digital identity management, Online collaboration ethics	
		4.4	Legal and Social Issues: Copyright and plagiarism, Data protection laws, Digital divide, Social impact of technology.	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	12
		Exercises:		
		1	Prepare a digital report using Google Docs on any one of the following topics: Environmental Impact of Logistics or Usage of Digital Tools. The report must include the following sections: Introduction, Data (tables/charts), Analysis, and Conclusion.	
		2	Create a PowerPoint presentation consisting of 5–8 slides on any one of the following topics: Carbon Footprint, Green Logistics, or Data Science Tools. The presentation should include appropriate visuals, graphs, and simple explanations.	
		3	Create a basic dashboard in Excel using either delivery data or sales data. The dashboard should include appropriate charts, filters, and a summary table to present insights clearly.	
		4	Write a 300–500 words blog on either "The Role of Data Science in Logistics" or "The Importance of Digital Literacy." You may optionally publish your blog on Blogger or Medium.	
		5	Create an infographic on either Digital Literacy Skills or the Data Science Workflow. The infographic should use icons, visuals, and minimal text to effectively communicate the concept.	
		6	Draft formal emails for report submission and data requests, emphasizing clarity, professionalism, and effective digital communication skills.	
		7	Create a 1 – 2-minute video on either Sustainable Logistics or	

			Digital Tools using tools such as a mobile device, Canva, or CapCut. The video must include a clear voice explanation.	

Essential Readings:

5. Pier Cesare Rivoltella – Digital Literacy: Tools and Methodologies for Information Society – 1st Edition
6. Introduction to Digital Literacy (2nd Edition) – Mark Bowles
7. Digital Literacy: Different Cultures, Different Understandings – E. Helsper

Assessment Rubrics:

Evaluation Type		Marks
End Semester Evaluation		**35**
Practical ESE: 2 hrs.		**15**
Content Writing	5	
Presentation	5	
Viva	3	
Record	2	
Continuous Evaluation - Theory		**15**
Test Paper- 1	5	
Model exam	5	
Assignment/Activities	5	
Continuous Evaluation - Practical		**10**
Punctuality – weekly exercises	3	
Model Examination	4	
Viva	3	
Total		**75**

MODEL QUESTION PAPER (Credit 3)

Time: 90 Minutes **Max Marks:** 35

Type A (Answer any SIX questions) *(6 × 2 = 12 marks)*

- Explain the concept of digital literacy.
- Define information society.
- What is structured data?
- What is data visualization?
- Define cyber security.
- What is digital citizenship?
- Discuss digital communication tools and their applications.
- Explain data collection and preprocessing.

Type B (Answer any FOUR questions) *(4 × 4 = 16 marks)*

- Discuss the role of ICT in modern society.
- Explain methods to evaluate information sources.
- Describe types of data with examples.
- Explain the use of productivity tools in data science.
- Describe basic data handling using spreadsheets.
- Discuss cyber security practices for safe data usage.

Type C (Answer any ONE question) *(1 × 7 = 7 marks)*

- Explain digital transformation and its impact on society.
- Discuss digital citizenship and legal issues in digital systems.

KU4VACDSL103: Environmental Sustainability in Logistics

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
4	VAC	100-199	KU4VACDSL103	3	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
2	2	0	25	50	75	1.5 hrs

Course Description:

This course introduces the principles of environmental sustainability in logistics and supply chain management. It focuses on the environmental impacts of logistics activities, including carbon footprint, energy use, and resource management. The course covers green logistics practices, sustainable transportation, warehousing, and packaging strategies. It also emphasizes regulatory frameworks and equips students to apply sustainable solutions in real-world logistics systems.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand the impacts of logistics on environment, economy, and society	U
2	Explain carbon footprint concepts and methods for emission measurement	U
3	Analyze sustainability principles and green logistics practices	An
4	Evaluate strategies for reducing environmental impact in logistics operations	E
5	Apply sustainable and eco-friendly solutions to real-world logistics problems	A

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	1	-	-	-	-	-

CO2	2	2	-	-	-	-	1
CO3	-	2	2	1	-	1	-
CO4	-	-	2	2	2	2	2
CO5	3	3	3	2	2	3	3

Mapping of Course Outcomes to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	1	-	-	-
CO2	2	2	2	-	-	-
CO3	3	-	3	2	-	-
CO4	2	-	2	3	2	-
CO5	3	3	3	3	2	2

COURSE CONTENTS

	QB No.		**DESCRIPTION**	**HOURS**
MODULE 1	**UNIT 1**		**MODULE 1: Introduction to Logistics Impacts**	12
	1	1.1	Overview of logistics activities, Economic impacts (growth, cost, employment), Social impacts (labour, safety, community), Operational impacts (efficiency, service levels), Technological impacts (automation, digitalization).	
		1.2	Environmental Impacts of Logistics: Energy consumption in logistics, Sources of carbon emissions, Resource depletion, Overview of environmental footprint	
	2	1.3	Impacts of Transportation: Climate change and global warming, Air pollution and emissions, Noise pollution, Biodiversity loss and ecosystem impact, Waste and water pollution, Biosecurity risks	
		1.4	Impacts of Warehousing and Packaging: Warehouse impacts: energy use, emissions, land use, Air pollution and climate effects, Packaging impacts: resource consumption, Soil and water pollution, Waste generation, Biodiversity and land occupation.	
MODULE 2				
	UNIT 2		**MODULE 2: Carbon Footprint and Sustainability**	12
	3	2.1	Carbon Footprint Concepts and Measurement: Definition and types of carbon footprint, Carbon footprint in logistics, Process of carbon footprinting, Calculation methods: fuel-based and activity-based, Emission factors and data collection, Guidelines for carbon footprint measurement.	
		2.2	Emission Sources and Reduction Strategies: GHG emissions in road freight transport, Factors affecting emissions (distance,	

			fuel, load), Carbon reduction strategies in logistics, Emission reduction techniques, Sustainable fuel alternatives.	
	4	2.3	Sustainability Concepts in Logistics: Concept of sustainability, Triple Bottom Line (People, Planet, Profit), Key principles and dimensions, Importance of sustainability in logistics, Role in supply chain management.	
		2.4	Sustainable Logistics Practices: Green transportation (EVs, modal shift), Eco-friendly warehousing, Sustainable packaging practices, Role of technology (IoT, AI, route optimization), Carbon reduction initiatives, Case examples of sustainable logistics.	
MODULE 3				
	UNIT 3		**MODULE 3: Sustainable Green Logistics**	12
	5	3.1	Green Logistics Concepts and its Importance, Objectives of Green Logistics and Principles, Evolution of sustainable logistics.	
		3.2	Techniques for implementing green logistics, Green Logistic Management and Practices, Advantages of Green Logistics, Challenges and barriers.	
	6	3.3	Environmental logistics vs traditional logistics, Green logistics strategies, Sustainable supply chain practices, Protocols and frameworks.	
		3.4	Pillars of green logistics: Energy efficiency, Route and process optimization, Emissions reduction, Recycling and use of sustainable materials, Corporate Social Responsibility (CSR).	
MODULE 4				
	UNIT 4		**MODULE 4: Regulations and Green Practices**	12
	7	4.1	Environmental regulations in logistics, Government policies and initiatives, International standards (ISO, etc.), Compliance requirements	
		4.2	Sustainable business models, Ethical logistics practices, Green supply chain integration.	
	8	4.3	Performance measurement and reporting, Green KPIs, Sustainability metrics, Carbon accounting, Sustainability reporting, Benchmarking practices.	
		4.4	Green Warehouse Design Principles, Eco-friendly warehouse layout, Smart logistics infrastructure, Sustainable facility planning, Case-based design approaches.	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	12
		Activities:		
		1	Carbon footprint calculation exercises	
		2	Case study 1: Carbon auditing of road freight transport	

			operations in the UK	
		3	Case study 2: Calculation of external costs of freight transport and development of a total cost tool for internalizing logistics and environmental externalities in Sweden	
		4	Case study 3: Effects of lorry charging in Germany, Austria and the Czech Republic	
		5	Case study 4: Study companies using green logistics (Amazon, DHL)	

Essential Readings:

1. Alan McKinnon, *Green Logistics: Improving the Environmental Sustainability of Logistics*, 3rd Edition
2. John Manners-Bell, *Supply Chain Risk Management: Understanding Emerging Threats to Global Supply Chains*, 2nd Edition
3. David Banister, *Transport Planning*, 2nd Edition
4. Martin Christopher, *Logistics and Supply Chain Management*, 5th Edition
5. Donald Waters, *Logistics: An Introduction to Supply Chain Management*, 2nd Edition
6. https://logingreen.usal.es/wp-content/uploads/LOG-IN-GREEN_Green-Logistics-Book_EN.pdf
7. https://www.joneselitelogistics.com/blog/effective-and-sustainable-green-logistics/#elementor-toc__heading-anchor-23
8. https://egyankosh.ac.in/bitstream/123456789/72294/1/Unit-11.pdf
9. https://acrosslogistics.com/blog/en/green-logistic

Assessment Rubrics:

Evaluation Type		Marks
End Semester Evaluation		**35**
Practical ESE: 2 hrs.		**15**
Content Writing	5	
Presentation	5	
Viva	3	
Record	2	
Continuous Evaluation - Theory		**15**
Test Paper- 1	5	
Model exam	5	
Assignment/Activities	5	
Continuous Evaluation - Practical		**10**
Punctuality – weekly exercises	3	
Model Examination	4	
Viva	3	

Total		**75**

MODEL QUESTION PAPER (Credit 3)

Time: 90 Minutes **Max Marks:** 35

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

1. What is green logistics? Explain its objectives.
4. Discuss the advantages and challenges of green logistics.
5. Discuss pillars of green logistics with examples.
6. What is Corporate Social Responsibility (CSR) in logistics?
7. Explain the Triple Bottom Line with suitable examples.
8. Define carbon footprint.
9. What are the factors affecting GHG emissions in logistics?
10. What are green KPIs?

Type B (Answer any FOUR questions) *(4 × 4 = 16 marks)*

11. Describe green KPIs used in logistics performance measurement.
12. Explain the environmental impacts of warehouses and packaging.
13. Analyze factors affecting GHG emissions in road transport.
14. Explain green logistics strategies and frameworks.
15. Analyze government policies and international standards in logistics.
16. Discuss sustainability reporting and performance measurement.

Type C (Answer any ONE question) *(1 × 7 = 7 marks)*

17. Explain carbon footprint and methods to reduce it in logistics.
18. Explain green logistics and its importance.

KU4VACDSL104: E-Commerce and Digital Logistics

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
4	VAC	100-199	KU4VACDSL104	3	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
2	2	0	25	50	75	1.5 hrs

Course Description:

This course provides an understanding of e-commerce systems and their integration with digital logistics. It focuses on online business models, digital platforms, supply chain technologies, and data-driven logistics operations.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand e-commerce concepts and business models	U
2	Apply digital tools for online business and marketing	A
3	Analyze logistics operations in e-commerce	An
4	Evaluate digital technologies in logistics systems	E
5	Develop basic e-commerce/logistics solutions	C

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	1	1	2	1	1	1
CO2	3	2	2	3	2	2	1
CO3	3	3	2	3	2	3	2
CO4	2	2	2	2	2	2	3
CO5	3	3	3	3	3	3	2

Mapping of Course Outcomes to POs

	PO1	PO2	PO3	PO4	PO5	PO6

CO1	3	1	2	1	1	1
CO2	2	3	2	2	2	1
CO3	3	2	3	3	1	2
CO4	2	2	2	2	1	3
CO5	3	3	3	3	2	2

COURSE CONTENTS

	QB No.		DESCRIPTION	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Introduction to E-Commerce**	9
	1	1.1	Basics of E-Commerce: Definition, scope, evolution of e-commerce, Types: B2B, B2C, C2C, C2B, Advantages & challenges	
		1.2	E-Commerce Business Models: Marketplace model, inventory model, Revenue models (subscription, commission, advertising), Case studies (Amazon, Flipkart)	
	2	1.3	E-Commerce Infrastructure: Internet, web technologies, Payment systems (UPI, cards, wallets), Security issues (SSL, encryption)	
		1.4	Legal and Ethical Issues: Cyber laws, IT Act (India), Data privacy and consumer protection, Ethical issues in e-commerce	
MODULE 2				
	UNIT 2		**MODULE 2: Digital Platforms and Marketing**	9
	3	2.1	E-Commerce Platforms: Shopify, WooCommerce, Magento, Mobile commerce (M-commerce)	
		2.2	Digital Marketing Basics: SEO, SEM, social media marketing, Email marketing, content marketing	
	4	2.3	Customer Relationship Management (CRM): Customer data management, Personalization and recommendation systems	
		2.4	Analytics in E-Commerce: Web analytics tools (Google Analytics), Key metrics: conversion rate, bounce rate	
MODULE 3				
	UNIT 3		**MODULE 3: Logistics and Supply Chain in E-Commerce**	9
	5	3.1	Basics of Logistics: Logistics vs supply chain, Role in e-commerce	
		3.2	Inventory and Warehouse Management: Inventory models (EOQ basics), Smart warehouses, automation	
	6	3.3	Transportation and Delivery: Last-mile delivery, Reverse logistics	
		3.4	Third-Party Logistics (3PL): Role of logistics service providers, Case studies	
M				

	UNIT 4		**MODULE 4: Digital Logistics Technologies**	9
	7	4.1	Emerging Technologies: IoT in logistics, RFID, GPS tracking	
		4.2	Data Science in Logistics: Demand forecasting, Route optimization	
	8	4.3	Blockchain in Supply Chain: Transparency and traceability, Smart contracts	
		4.4	Cloud and ERP Systems: Cloud logistics platforms, ERP (SAP basics)	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	9
		Activities:		
		1	**E-Commerce Website Demo:** Creating a basic online store	
		2	**Dashboard Creation:** Sales/logistics dashboard using Excel	
		3	**Case Study Analysis: Amazon logistics** (Fulfilment centres, technology used, last-mile delivery, prime model, strengths and challenges) or **Flipkart supply chain** (Ekart Logistics, Ware housing, technology used, last-mile delivery, prime model, strengths and challenges)	
		4	**Mini Project:** Design a digital logistics solution **Examples:** • Delivery tracking system using GPS • Inventory management system using Excel • Digital Inventory System for Small Shops • E-commerce Order Management System • Route Optimization for Delivery Vehicles • Sustainable Logistics (reduce fuel usage) **Report should include:** 1. Introduction 2. Problem statement 3. Proposed solution 4. System design 5. Sample data & analysis 6. Conclusion (No coding required (basic level))	

Essential Readings:

1. Kenneth C. Laudon & Carol Guercio Traver, *E-Commerce: Business, Technology, Society*, 16th Edition, 2021, Pearson
2. Dave Chaffey, *Digital Business and E-Commerce Management*, 7th Edition, 2019, Pearson
3. Sunil Chopra & Peter Meindl, *Supply Chain Management: Strategy, Planning, and Operation*, 7th Edition, 2019, Pearson

4. Martin Christopher, *Logistics and Supply Chain Management*, 5th Edition, 2016, Pearson
5. Efraim Turban, David King, Jae Lee, Ting-Peng Liang, *Electronic Commerce: A Managerial Perspective*, 8th Edition, 2015, Springer
6. Rajkumar Buyya, James Broberg, Andrzej Goscinski, *Cloud Computing: Principles and Paradigms*, 1st Edition, 2011, Wiley
7. Paulraj Ponniah, *Data Warehousing Fundamentals*, 2nd Edition, 2010, Wiley

Assessment Rubrics:

Evaluation Type		Marks
End Semester Evaluation		**35**
Practical ESE: 2 hrs.		**15**
Mini Project Implementation	5	
Analysis & explanation	3	
Use of examples	3	
Presentation	2	
Record	2	
Continuous Evaluation - Theory		**15**
Test Paper- 1	5	
Model exam	5	
Assignment/Activities	5	
Continuous Evaluation - Practical		**10**
Punctuality – weekly exercises	3	
Case Study Analysis	4	
Viva	3	
Total		**75**

MODEL QUESTION PAPER (Credit 3)

Time: 90 Minutes **Max Marks:** 35

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

1. Define e-commerce.
2. What is digital logistics?
3. List any two types of e-commerce models.
4. What is last-mile delivery?
5. Define inventory management.
6. What is CRM in e-commerce?
7. What is IoT in logistics?
8. Define reverse logistics.

Type B (Answer any FOUR questions) *(4 × 4 = 16 marks)*

9. Explain different types of e-commerce models.
10. Describe the role of digital marketing in e-commerce.
11. Explain warehouse management in digital logistics.
12. Discuss payment systems used in e-commerce.
13. Explain the concept of demand forecasting.
14. Describe the role of IoT in logistics.

Type C (Answer any ONE question) *(1 × 7 = 7 marks)*

15. Explain the logistics and supply chain process in e-commerce with a diagram.
16. Discuss emerging technologies in digital logistics such as IoT, Blockchain, and Cloud computing.

KU4VACDSL105: Cyber Laws and Ethics

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
4	VAC	100-199	KU4VACDSL105	3	45

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	0	1	25	50	75	1.5 hrs

Course Description: This course introduces students to legal and ethical issues in cyberspace. It covers cyber laws, data protection, privacy, intellectual property rights, and ethical practices in digital environments.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand cyber laws, legal frameworks, and types of cyber crimes.	U
2	Analyze data protection, privacy issues, and security measures in cyberspace.	An
3	Apply knowledge of intellectual property rights (IPR) in digital environments.	A
4	Evaluate ethical issues and professional responsibilities in digital technologies.	E
5	Analyze social and legal impacts of cyber activities and propose responsible solutions.	An

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	1	1	1	1	1	2
CO2	3	2	1	2	2	1	3
CO3	2	2	2	1	2	1	2
CO4	2	1	1	2	1	1	3
CO5	3	2	2	2	2	2	3

Mapping of Course Outcomes to POs

	PO1	PO2	PO3	PO4	PO5	PO6

CO1	3	1	2	1	1	2
CO2	3	1	3	2	1	3
CO3	2	2	2	1	1	2
CO4	2	1	2	2	2	3
CO5	3	1	3	3	2	3

COURSE CONTENTS

	QB No.		DESCRIPTION	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Introduction to Cyber Law**	9
	1	1.1	Basics of Cyber Law: Definition and need for cyber laws, Cyberspace and legal challenges, Evolution of cyber laws	
		1.2	Legal Framework: Indian IT Act 2000, Amendments and key provisions, Role of CERT-In, Digital Signature under the IT Act 2000, Cyber Regulation Appellate Tribunal.	
	2	1.3	Types of Cyber Crimes: Hacking, phishing, identity theft, Cyberstalking, cyberbullying, Online fraud and financial crimes, Actus Reus and Mens Rea, Against Person, Against Property, Against Government.	
		1.4	Characteristics of Cyber Crime, Case Studies: Famous cybercrime cases, Analysis of real-world incidents - Criminal IP's and Netcraft, National Reporting Portals	
MODULE 2				
	UNIT 2		**MODULE 2: Data Protection and Privacy**	9
	3	2.1	Data and Privacy Concepts: Personal vs sensitive data, Data lifecycle, Data Protection Laws: GDPR (overview), Indian data protection laws (DPDP Act basics),	
		2.2	Privacy Issues: Surveillance and tracking, Social media privacy, Data breaches and their implications, Voyeurism, Invasion of Privacy, Law of Privacy: An Indian Perspective	
	4	2.3	Security Measures: Encryption basics, Authentication & access control	
		2.4	Cyberspace: Web space, Web hosting and web Development agreement, Legal and Technological Significance of domain Names, Internet as a tool for global access.	
MODULE 3				
	UNIT 3		**MODULE 3: Intellectual Property Rights (IPR)**	9
	5	3.1	Basics of IPR: Copyright, patents, trademarks	
		3.2	Digital Content Protection: Software piracy, Licensing and open-source	
	6	3.3	Cyber Law & IPR Issues: Copyright infringement online, Digital rights management	

		3.4	Case Studies: Real-world IPR violation cases	
MODULE 4				
	UNIT 4		**MODULE 4: Cyber Ethics**	9
	7	4.1	Ethics in Technology: Definition and importance, Ethical frameworks, Key Ethical Principles in IT	
		4.2	Professional Ethics: Responsibilities of IT professionals, Code of conduct, Digital citizenship & responsible online behaviour.	
	8	4.3	Ethical Issues: Data misuse, AI ethics and bias, Introduction to Block chain Ethics, Online identity and anonymity	
		4.4	Social Impact: Digital divide, Misinformation and fake news, Impact of excessive internet use on mental health, Internet Marketing Fraud, Tax Evasion and Money Laundering.	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	9
		Activities:		
		1	Case Study Analysis: Cybercrime incidents	
		2	Legal Documentation: Writing cyber law reports	
		3	Digital Safety Practices: Password management & Safe browsing	
		4	Ethical analysis of a digital platform: Social media (Instagram, Facebook), E-commerce (Amazon, Flipkart) or Apps (YouTube, WhatsApp, Uber) Privacy Analysis • Does it collect personal data? • Is user data protected? Analyze Data Security, Transparency, Fairness, Social Impact and User Manipulation.	

Essential Readings:

1. Tavani, H. T. (2018). Ethics and Technology: Controversies, Questions, and Strategies for Ethical Computing. John Wiley & Sons.
2. Quinn, M. J. (2014). *Ethics for the Information Age* (7th ed.). Pearson.
3. Himma, K. E., & Tavani, H. T. (2019). The Handbook of Information and Computer Ethics. John Wiley & Sons.
4. Johnson, D. G, Computer Ethics (4th ed.). Prentice Hall.
5. Paul Bocij. (2004). Cyber Stalking: Harassment in the Internet Age and How to protect your family
6. John Q. Newman. (1999) Identity Theft: The Cybercrime of the Millennium
7. Nina Godbole & Sunit Belapure, *Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives*, 1st Edition, 2011, Wiley
8. Pavan Duggal, *Cyber Law in India*, Latest Edition, LexisNexis
9. Charles P. Pfleeger & Shari Lawrence Pfleeger, *Security in Computing* (5th ed.), 2015,

Pearson

Assessment Rubrics:

Evaluation Type		Marks
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	5
b)	Model exam	10
c)	Assignment	5
d)	Ethical Analysis	5
e)	Book/ Article Review	
g)	Field Report	
Total		**75**

MODEL QUESTION PAPER (Credit 3)

Time: 90 Minutes **Max Marks:** 50

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

1. What is the meaning of Identity Theft?
2. Which provision of IT Act protects voyeurism?
3. What is Cyber Stalking?
4. Define cyber law.
5. What is cybercrime?
6. What is phishing?
7. What is GDPR?
8. What is copyright?

Type B (Answer any FOUR questions – 6 marks each) *(4 × 6 = 24 marks)*

9. Explain the need for cyber laws.
10. Discuss the key provisions of the IT Act, 2000.
11. Explain different types of cyber crimes with examples.
12. Describe data privacy issues in social media.
13. Explain intellectual property rights in digital environments.
14. Discuss ethical issues in artificial intelligence.

Type C (Answer any ONE question – 14 marks each) *(1 × 14 = 14 marks)*

15. a). Analyze the impact of cyber crimes on individuals and organizations.
    b). Discuss data protection laws such as GDPR and Indian DPDP Act.

OR

16. a).Explain digital rights management and its importance.
    b). Discuss the social impact of cyberspace, including misinformation and digital divide.

KU4VACDSL106: Ethical and Responsible Data Science

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
4	VAC	100-199	KU4VACDSL106	3	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
2	2	1	25	50	75	1.5 hrs

Course Description:

This course introduces the ethical principles of data science, focusing on data privacy, bias and fairness, transparency, and social impact. It helps students understand how to handle data responsibly, identify ethical issues in algorithms, and design fair, accountable, and human-centered data-driven solutions.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand fundamental concepts of data ethics, ethical principles, and responsible data practices in the data science lifecycle.	U
2	Explain and apply data privacy principles, including data protection, consent, and legal frameworks for secure data handling.	A
3	Identify and analyze different types of bias in data and algorithms, and evaluate fairness issues in machine learning systems.	An
4	Evaluate the importance of transparency, explainability, and accountability in AI and data-driven decision-making systems.	E
5	Design and recommend ethical, fair, and socially responsible data science solutions considering real-world societal impacts.	C

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	1	-	-	-	-	3
CO2	2	2	-	-	1	-	3
CO3	2	2	2	1	-	-	3
CO4	1	2	2	2	1	1	3
CO5	2	3	2	2	1	2	3

Mapping of Course Outcomes to POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	1	-	-	3
CO2	2	1	1	-	-	3
CO3	3	2	2	1	-	3
CO4	2	2	2	2	1	3
CO5	2	2	3	3	2	3

COURSE CONTENTS

	QB No.		DESCRIPTION	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Introduction to Data Ethics**	12
	1	1.1	What are Ethics? Why Data Ethics? Data Ethics Definition, History, Importance of Ethics in Data-driven Systems. Data Science Ethics Equilibrium	
		1.2	What is Data & Meta data? Data Ownership, Main Sources of information, Data Ownership Finale, Data Brokers.	
	2	1.3	Concept of Informed Consent & its limitations, Human Subjects Research & Informed Consent, Copyright, Limits on Recording & Use.	
		1.4	Data Lifecycle, Application of Data Ethics, Data Ethics Tenets, Use Cases: Artificial Intelligence & Bias, Dissemination & Impacts	
MODULE 2				
	UNIT 2		**MODULE 2: Data Privacy and Security**	12
	3	2.1	Privacy as a Human Right, Personally Identifiable Information (PII), Data Protection Laws (GDPR, IT Act India),	
		2.2	Main Drivers of Privacy Violation, Open Government and Privacy	
	4	2.3	Anonymity, De-identification: How de-identification works, Four types of leakage, Massachusetts Re-identification	
		2.4	Encryption Techniques: Symmetric & Asymmetric Key Encryption - Definition, Examples, Advantages and disadvantages	
MODULE 3				
	UNIT 3		**MODULE 3: Bias, Fairness and Accountability**	12
	5	3.1	Data Validity, Choice of Attributes and Measures, Errors in Data Processing, Errors in Model Design, Campbell's Law	
		3.2	Types of Bias in Data (Sampling, Algorithmic Bias), Algorithmic Fairness, Correct but Misleading Results**,** P Hacking,	

	6	3.3	Fairness in Machine Learning, Discrimination in AI Systems, Accountability and Responsibility in AI	
		3.4	Ethical Auditing of Algorithms, Importance of Continuous Ethical Audits, Ethical FAT Framework	
MODULE 4				
	UNIT 4		**MODULE 4: Transparency, Governance and Social Impact**	12
	7	4.1	Explainable AI (XAI), Transparency vs Black-box Models	
		4.2	Data Governance and Ethical Policies, Professional Codes of Ethics (ACM, IEEE), Wrap Up	
	8	4.3	Societal Consequences of Data Science – Social Impact, Echo Chambers, Ossification, Surveillance	
		4.4	Ethical Issues in Healthcare, Finance, Governance, Designing Ethical Data Science Projects, Ethical Considerations When Choosing a Dataset.	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	12
		Activities:		
		1	Case Studies 1: Data Ownership - Rate My Professor and Privacy After Bankruptcy	
		2	Case Studies 2: Data Privacy - The Naked Mile, Sneaky Mobile Apps	
		3	Case Studies 3: Data Validity - Algorithms and Race, Google Flu and Germanwings Crash	
		4	Case Studies 4: Algorithmic Fairness – Geopricing and Your Safety Is My Lost Income	
		5	**Mini Project:** Bias Detection in a Simple Dataset - Identify and analyze bias in a dataset and suggest improvements for fairness. Select any one of the following or any datasets: • Student marks dataset • Hiring dataset (gender-based) • Loan approval dataset **Steps:** Identify Attributes • Example: Gender, Marks, Income, Category Bias Analysis • Check: o Is one group favored? o Are features influencing unfair decisions? Visualization • Use charts (bar graph, pie chart) Step 5: Findings	

			• Write: o Type of bias found o Reason for bias Step 6: Ethical Solution • Suggest improvements: o Remove biased features o Balance dataset o Use fair algorithms Expected Output: • Short report (5–8 pages) • Graphs + observations • Ethical recommendations	

Essential Readings:

1. https://resources.data.gov/assets/documents/fds-data-ethics-framework.pdf
2. https://www.coursera.org/learn/data-science-ethics/supplement/fnK43/what-are-ethics-introduction
3. https://www.futurebeeai.com/knowledge-hub/auditing-dataset-ethics-research
4. Mike Loukides, Hilary Mason, DJ Patil, *Ethics and Data Science*, 2018.
5. David Martens, *Data Science Ethics: Concepts, Techniques and Cautionary Tales,* 2022.
6. Gry Hasselbalch, Pernille Tranberg, *Data Ethics: Practical Strategies for Implementing Ethical Principles,* 2016.

Recommended Readings:

1. Loukides et al., *Ethics and Data Science*, 2018
2. Martens, *Data Science Ethics*, 2022
3. O'Neil, *Weapons of Math Destruction*, 2016
4. Kearns & Roth, *The Ethical Algorithm*, 2019
5. Crawford, *Atlas of AI*, 2021

Assessment Rubrics:

Evaluation Type		Marks
End Semester Evaluation		**35**
Practical ESE: 2 hrs.		**15**
Mini Project Implementation	5	
Analysis & explanation	3	
Use of examples	3	
Presentation	2	
Record	2	
Continuous Evaluation - Theory		**15**
Test Paper- 1	5	

Model exam	5	
Assignment/Activities	5	
Continuous Evaluation - Practical		
Punctuality – weekly exercises	3	**10**
Case Study Analysis	4	
Viva	3	
Total		**75**

MODEL QUESTION PAPER (Credit 3)

Time: 90 Minutes **Max Marks:** 35

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

1. What is informed consent?
2. What is personally identifiable information (PII)?
3. Define algorithmic bias.
4. What is sampling bias?
5. What is fairness in machine learning?
6. Define transparency in AI systems.
7. What is explainable AI (XAI)?
8. What is data anonymization?

Type B (Answer any FOUR questions) *(4 × 4 = 16 marks)*

9. Describe the data science lifecycle and ethical issues involved.
10. Explain data privacy principles and their significance.
11. Discuss different types of bias in data with examples.
12. Explain fairness issues in machine learning models.
13. Describe the concept of accountability in AI systems.
14. Explain data protection laws (GDPR / Indian IT Act) briefly.

Type C (Answer any ONE question) *(1 × 7 = 7 marks)*

15. Explain ethical challenges in data privacy and how to overcome them.
16. Evaluate the importance of fairness, accountability, and transparency (FAT) in AI.

Skill Enhancement Courses (SEC)

KU4SECDSL101: Data Visualization using Power BI / Tableau

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
4	SEC	100-199	KU4SECDSL101	3	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
2	2	1	25	50	75	1.5 hrs

Course Description:

This course introduces the concepts and techniques of data visualization using Power BI and Tableau. It focuses on transforming raw data into meaningful insights through interactive dashboards, charts, and reports, enabling effective decision-making in business and data science applications.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand the fundamentals of data visualization principles and tools.	U
2	Prepare and clean datasets for visualization using Power BI/Tableau.	A
3	Create various charts, graphs, and visual dashboards.	An
4	Analyze data and derive insights using interactive visualizations.	An
5	Design and present professional dashboards for decision-making.	C

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	1	-	1	-	-	1
CO2	3	2	1	1	2	-	1
CO3	3	3	2	3	2	1	1
CO4	3	3	3	3	2	2	1
CO5	3	3	3	3	2	3	1

Mapping of Course Outcomes to POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	1	-	-	1
CO2	3	3	2	1	-	1
CO3	3	3	3	2	1	1
CO4	3	2	3	3	2	1
CO5	2	3	3	3	3	1

COURSE CONTENTS

	QB No.		DESCRIPTION	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Introduction to Data Visualization**	12
	1	1.1	Importance and applications of Data Visualization, Types of Data, Principles of effective visualization.	
		1.2	Data storytelling concepts, Visual perception basics, Overview of Power BI and Tableau, Installation & interface	
	2	1.3	Key Components of Power BI: workspace, dashboard, report, Steps to create insightful reports & dashboards, Applications of Power BI	
		1.4	Data sources and formats (Excel, CSV, Database), Connecting to data in Power BI/Tableau, Types of Data Sources in Power BI Desktop	
MODULE 2				
	UNIT 2		**MODULE 2: Data Preparation and Transformation**	12
	3	2.1	Data loading and data import, Data types and structure	
		2.2	Data cleaning techniques, Handling missing & duplicate values	
	4	2.3	Data transformation (sorting, filtering, grouping), Power Query (Power BI) / Data pane (Tableau)	
		2.4	Data modelling basics, Relationships between tables	
MODULE 3				
	UNIT 3		**MODULE 3: Creating Visualizations**	12
	5	3.1	Basic charts: Bar, Line, Pie, Column, Formatting visuals	
		3.2	Advanced charts: Scatter, Map, Tree map, Tables & Matrices	
	6	3.3	Filters, slicers, and parameters, Conditional formatting	
		3.4	Best practices in visualization, Avoiding misleading graphs	
MODULE 4				
	UNIT 4		**MODULE 4: Dashboard Design and Reporting**	12
	7	4.1	Creating dashboards and reports, Layout design and themes, How to add Reports to Dashboards	
		4.2	Interactivity: Drill-down, Drill-through, Tooltips & Navigation	
	8	4.3	KPI indicators & performance metrics, Storytelling with	

			dashboards	
		4.4	Publishing & sharing reports, Real-world business applications	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	12
		Activities:		
		1	Create a basic dashboard using a small dataset (students/sales)	
		2	Perform data cleaning and transformation task	
		3	Design interactive visualizations with filters/slicers	
		4	Case Study: Analyze a business dataset (sales/logistics)	
		5	Develop a complete dashboard with insights and presentation	

Essential Readings:

1. Data Visualization: A Practical Introduction – Kieran Healy, 2018
2. The Big Book of Dashboards – Steve Wexler, 2017
3. Microsoft Power BI Cookbook – Brett Powell, 2017
4. Learning Tableau – Joshua N. Milligan, 2018
5. Storytelling with Data – Cole Nussbaumer Knaflic, 2015

Web Links:

6. https://www.geeksforgeeks.org/blogs/power-bi-vs-tableau/#what-is-power-bi
7. https://www.datacamp.com/tutorial/data-visualisation-powerbi
8. https://app.powerbi.com/
9. https://www.youtube.com/watch?v=ZjIPbV1_jLg

Assessment Rubrics:

Evaluation Type		**Marks**
End Semester Evaluation		**35**
Practical ESE: 2 hrs.		**15**
Mini Project Implementation	5	
Analysis & explanation	3	
Use of examples	3	
Presentation	2	
Record	2	
Continuous Evaluation - Theory		**15**
Test Paper- 1	5	
Model exam	5	
Assignment/Activities	5	
Continuous Evaluation - Practical		**10**
Punctuality – weekly exercises	3	
Case Study Analysis	4	
Viva	3	
Total		**75**

MODEL QUESTION PAPER (Credit 3)

Time: 90 Minutes **Max Marks:** 35

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

1. What is Power BI?
2. What is Tableau?
3. What is a dashboard?
4. Define data cleaning
5. What is a slicer?
6. What is a KPI?
7. What is drill-down?
8. Define data transformation

Type B (Answer any FOUR questions) *(4 × 4 = 16 marks)*

9. Describe data preparation steps
10. Explain different types of charts
11. Discuss dashboard design principles
12. Explain filters and slicers
13. Compare Power BI and Tableau
14. Explain data modelling basics

Type C (Answer any ONE question) *(1 × 7 = 7 marks)*

15. Explain steps to create interactive dashboards
16. Discuss real-world applications of visualization

KU5SECDSL102: Cloud Computing for Data Science

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
5	SEC	100-199	KU5SECDSL102	3	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
2	2	1	25	50	75	1.5 hrs

Course Description:

This course introduces the fundamental concepts of cloud computing and its applications in data science. It enables students to work with cloud platforms for data storage, processing, and analytics. The course also covers cloud-based tools for deploying data science solutions. Emphasis is given to hands-on learning using real-world datasets and cloud environments to build scalable and efficient applications.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand the fundamental concepts, service models, and deployment models of cloud computing.	U
2	Demonstrate the use of cloud platforms for data storage, management, and security.	A
3	Apply cloud-based tools and environments for data processing and analysis.	A
4	Develop and deploy basic data science applications using cloud services.	C
5	Analyze real-world problems and design cloud-based solutions for data-driven decision making.	An/C

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	1	1	1	1	2
CO2	3	2	1	2	3	1	2
CO3	3	3	2	3	2	2	2
CO4	2	3	3	2	2	3	2
CO5	3	3	2	3	2	3	2

Mapping of Course Outcomes to POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1	1	2
CO2	2	3	2	2	1	2
CO3	3	3	3	2	1	2
CO4	2	3	2	3	2	2
CO5	3	2	3	3	2	2

COURSE CONTENTS

	QB No.		DESCRIPTION	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Introduction to Cloud Computing**	12
	1	1.1	Basics of Cloud Computing, Evolution of Cloud Computing, Characteristics of Cloud (On-demand, Scalability, Elasticity)	
		1.2	Cloud Service Models: IaaS, PaaS, SaaS	
	2	1.3	Cloud Deployment Models: Public, Private, Hybrid	
		1.4	Virtualization Concepts, Advantages and Challenges of Cloud Computing, Applications of Cloud in Data Science	
MODULE 2				
	UNIT 2		**MODULE 2: Cloud Platforms Overview**	12
	3	2.1	Introduction to AWS, AWS Core Services (EC2, S3 Overview),	
		2.2	Introduction to Microsoft Azure, Azure Services Overview	
	4	2.3	Introduction to Google Cloud Platform (GCP), GCP Services Overview	
		2.4	Comparison of AWS, Azure, GCP, Pricing Models and Free Tier, Account Setup and Basic Navigation	
MODULE 3				
	UNIT 3		**MODULE 3: Data Storage & Processing in Cloud**	12
	5	3.1	Cloud Storage Types: Object, Block, File, AWS S3 / Azure Blob Storage, Data Uploading and Retrieval	
		3.2	Cloud Databases: RDS, BigQuery Basics, NoSQL Databases in Cloud, Data Lifecycle Management	
	6	3.3	Data Security Concepts (IAM Basics), Access Control and Authentication, Backup and Recovery in Cloud	
		3.4	Google Colab for Data Science, Running Python Notebooks in Cloud, Data Analysis using Cloud Tools, Visualization in Cloud Environment	
MODULE 4				
	UNIT 4		**MODULE 4: Deploying Data Science Applications**	12
	7	4.1	Big Data Concepts, Hadoop Ecosystem Overview, Apache Spark Basics	
		4.2	Introduction to Model Deployment, APIs and Web Services Basics,	
	8	4.3	Deployment using Cloud Platforms, Introduction to AWS	

			SageMaker/ Azure ML	
		4.4	Automation and Scaling in Cloud, Monitoring Cloud Applications	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	12
		Activities: Perform any two of the following activities		
		1	End-to-End Cloud Application: E-Commerce Sales Analytics System: Workflow: • Upload sales data to cloud (AWS S3 / Azure Blob) • Process data using Python (Google Colab) • Store results in cloud database • Create dashboard (Power BI / Tableau) Outcome: • Identify top-selling products • Monthly revenue trends	
		2	End-to-End Cloud Application: Logistics Delivery Performance System Workflow: • Upload delivery dataset (CSV) to cloud • Analyze delivery time, delays • Predict delays using simple ML model • Visualize KPIs (delivery time, cost, efficiency) Outcome: • Improve delivery efficiency • Identify bottlenecks	
		3	Cloud-Based Demand Forecasting System (Useful for logistics & retail) • Upload product sales data • Use Python to forecast demand • Store results in cloud • Display output dashboard	
		4	Route Optimization System (Basic) (*Highly relevant for logistics)* • Input delivery locations • Use shortest path algorithm • Run model in cloud environment • Display optimal route	
		5	Delivery Delay Prediction Model (*Real-world logistics use case)* • Use logistics dataset • Train simple ML model • Deploy model in cloud • Predict delays	

Essential Readings:

1. Rajkumar Buyya, James Broberg, Andrzej Goscinski, *Mastering Cloud Computing*, McGraw Hill, 2013.

2. Thomas Erl, Ricardo Puttini, Zaigham Mahmood, *Cloud Computing: Concepts, Technology & Architecture*, Pearson, 2014.
3. Michael J. Kavis, *Architecting the Cloud: Design Decisions for Cloud Computing Service Models*, Wiley, 2014.
4. Anand Rajaraman, Jeffrey Ullman, *Mining of Massive Datasets*, Cambridge University Press, 2016.
5. Ben Piper, David Clinton, *AWS Certified Cloud Practitioner Study Guide*, Wiley, 2019

Web Links:

1. Amazon Web Services Training: https://aws.amazon.com/training
2. Microsoft Azure Learn: https://learn.microsoft.com/azure
3. Google Cloud Platform Training: https://cloud.google.com/training
4. Google Colab: https://colab.research.google.com
5. Kaggle (Datasets & Notebooks): https://www.kaggle.com

Assessment Rubrics:

Evaluation Type		Marks
End Semester Evaluation		**35**
Practical ESE: 2 hrs.		**15**
Mini Project Implementation	5	
Analysis & explanation	3	
Use of examples	3	
Presentation	2	
Record	2	
Continuous Evaluation - Theory		**15**
Test Paper- 1	5	
Model exam	5	
Assignment/Activities	5	
Continuous Evaluation - Practical		**10**
Punctuality – weekly exercises	3	
Case Study Analysis	4	
Viva	3	
Total		**75**

MODEL QUESTION PAPER (Credit 3)

Time: 90 Minutes **Max Marks:** 35

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

1. Define cloud computing.
2. What is IaaS? Give one example of a public cloud.

3. What is virtualization?
4. What is AWS S3 used for?
5. Define Big Data.
6. What is Google Colab?
7. What is a cloud database?
8. Mention four advantages of cloud computing

Type B (Answer any FOUR questions) *(4 × 4 = 16 marks)*

9. Explain the characteristics of cloud computing.
10. Differentiate between IaaS, PaaS, and SaaS.
11. Describe AWS EC2 and S3 services.
12. Explain types of cloud storage.
13. Discuss the role of Google Colab in data science.
14. Explain basic steps in deploying a model in cloud.

Type C (Answer any ONE question) *(1 × 7 = 7 marks)*

15. Describe the architecture of cloud computing and its components.
16. Explain the process of developing & deploying a data science application in cloud.

KU6SECDSL103: GIS for Logistics

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
6	SEC	100-199	KU6SECDSL103	3	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
2	2	1	25	50	75	1.5 hrs

Course Description:

This course introduces Geographic Information Systems (GIS) and their applications in logistics and supply chain management. Students will learn spatial data handling, mapping, route optimization, and real-world logistics applications using GIS tools. The course emphasizes hands-on learning and industry-oriented projects.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand GIS concepts and spatial data structures	U
2	Apply GIS tools for mapping and data visualization	A
3	Analyze spatial data for logistics decision-making	An
4	Develop route optimization and location-based solutions	C
5	Design GIS-based solutions for real-world logistics problems	An/C

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	1	1	1	1	2
CO2	3	2	1	3	2	2	1
CO3	3	3	2	3	2	3	2
CO4	2	3	3	2	2	3	1
CO5	3	3	2	3	2	3	2

Mapping of Course Outcomes to POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	1	1	1	2
CO2	2	3	3	2	2	1
CO3	3	2	3	3	1	2
CO4	3	3	2	3	2	1
CO5	3	2	3	3	3	2

COURSE CONTENTS

	QB No.		DESCRIPTION	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Fundamentals of GIS**	12
	1	1.1	Introduction to GIS and its components, Elements of GIS, Applications of GIS in Logistics and Supply Chain, Types of Spatial Data (Raster & Vector),	
		1.2	Coordinate Systems and Map Projections, Projected Coordinate Systems, GPS and Remote Sensing Basics	
	2	1.3	GIS Data Sources (Satellite, Survey, GPS, Open Data), GIS Softwires (QGIS/ArcGIS), Basic Map Creation, Representation of Spatial and Composite Features	
		1.4	Topology & its Importance, Geo-relational and Object-Based Data Models, Case Study: GIS in Transportation Planning	
MODULE 2				
	UNIT 2		**MODULE 2: Spatial Data Handling & Mapping**	12
	3	2.1	Data Collection Methods in GIS, Importing & Managing Spatial Data, Attribute Data & Tables, Geometric transformation & Applications	
		2.2	Data Exploration, Map Layering and Visualization, Thematic Mapping (Choropleth, Heat Maps)	
	4	2.3	Geocoding and Reverse Geocoding, Editing Spatial Data	
		2.4	Data Cleaning and Preprocessing, Case Study: Delivery Location Mapping	
MODULE 3				
	UNIT 3		**MODULE 3: GIS Analysis for Logistics**	12
	5	3.1	Spatial Analysis Concepts, Vector Data Analysis: Buffer, Overlay and Pattern Analysis	
		3.2	Least-cost Path Analysis, Network Analysis - Shortest Path Analysis, TSP and Vehicle Routing Problem	
	6	3.3	Route Optimization Techniques, Location Allocation Analysis,	
		3.4	Demand-Supply Mapping, Geocoding	
MODULE 4				
	UNIT 4		**MODULE 4: GIS Tools & Applications in Logistics**	12
	7	4.1	Introduction to QGIS / ArcGIS / OpenStreetMap Tools, Working with Plugins (OpenRouteService, etc.), GIS for Transportation Management	

		4.2	Fleet Tracking and Monitoring, Integration with GPS and IoT	
	8	4.3	Real-time Data in GIS, GIS in E-commerce Logistics, Urban Logistics and Smart Cities	
		4.4	Basic Elements of GIS Modeling – Binary, Index and regression, Real-time maps & routing using Google Maps Platform (API-based), Case Study: Amazon / Flipkart Logistics Network	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	12
		Activities:		
		1	Install QGIS, explore its interface (Layers Panel, Browser Panel, and Map Canvas), create a new project, and load an OpenStreetMap base map.	
		2	Import shapefile/CSV data into QGIS, view and edit the attribute table, manage layers effectively, and save the project.	
		3	Create a thematic (color-based) map in QGIS, add labels for cities or delivery points, design a map layout (title, legend, scale), and export the map as a PDF.	
		4	Convert addresses into geographic coordinates using Geocoding in QGIS, plot delivery locations on the map, and visualize multiple delivery points effectively.	
		5	Create a buffer (e.g., 5 km) around a warehouse using QGIS, identify the service coverage area, and analyze nearby delivery points within the buffer.	
		6	Install the OpenRouteService plugin in QGIS, select multiple delivery points, compute the shortest route, and compare alternative routes for optimization.	
		7	Create a heat map using delivery data in QGIS, identify high-demand areas, and interpret the spatial distribution of demand.	

Essential Readings:

1. Kang-tsung Chang – *Introduction to Geographic Information Systems*, McGraw Hill
2. Paul A. Longley – *Geographic Information Systems and Science*, Wiley
3. Heywood, Cornelius – *An Introduction to GIS*, Pearson

Web Links:

1. GIS for Transport and and Logistics: https://www.youtube.com/watch?v=Tuhv3n0zsOQ
2. QGIS Official: https://qgis.org
3. OpenStreetMap: https://www.openstreetmap.org
4. Google Maps Platform: https://developers.google.com/maps

Assessment Rubrics:

Evaluation Type		**Marks**
End Semester Evaluation		**35**
Practical ESE: 2 hrs.		**15**
Mini Project Implementation	5	

Analysis & explanation	3	
Use of examples	3	
Presentation	2	
Record	2	
Continuous Evaluation - Theory		**15**
Test Paper- 1	5	
Model exam	5	
Assignment/Activities	5	
Continuous Evaluation - Practical		**10**
Punctuality – weekly exercises	3	
Case Study Analysis	4	
Viva	3	
Total		**75**

MODEL QUESTION PAPER (Credit 3)

Time: 90 Minutes **Max Marks:** 35

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

1 Define GIS. What are the components of GIS?
2 What is raster and vector data?
3 What is GPS? Define map projection.
4 Mention any four GIS data sources.
5 Define geocoding. What is a heat map?
6 What is buffer and network analysis?
7 What is route optimization and fleet tracking?
8 What is OpenStreetMap?

Type B (Answer any FOUR questions) *(4 × 4 = 16 marks)*

9. Explain applications of GIS in logistics and supply chain.
10. Explain coordinate systems and projections.
11. What is geocoding and reverse geocoding?
12. Explain demand-supply mapping.
13. Discuss GIS tools used in logistics.
14. Explain map layering and visualization techniques.

Type C (Answer any ONE question) *(1 × 7 = 7 marks)*

15. Discuss GIS applications in e-commerce logistics with examples.
16. Describe spatial data handling and preprocessing in GIS.

KU6SECDSL104: Advanced Database Technologies

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
6	SEC	100-199	KU6SECDSL104	3	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
2	2	1	25	50	75	1.5 hrs

Course Description:

This course provides comprehensive knowledge of advanced database technologies and modern data management systems used in large-scale applications. It covers NoSQL databases, distributed databases, big data technologies, cloud databases, and graph database systems. The course also focuses on scalability, data security, real-time processing, and advanced database applications in AI and analytics. Students will gain practical skills in designing, managing, and analyzing modern database systems for data-intensive applications.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand the concepts, architecture, and characteristics of advanced database technologies and NoSQL systems.	U
2	Apply CRUD operations, querying, indexing, and data modeling techniques using modern NoSQL databases.	A
3	Analyze distributed database concepts, big data technologies, scalability, replication, and cloud database systems.	An
4	Develop database applications using document, graph, and distributed database technologies for real-world applications.	C
5	Evaluate database security, real-time data processing, and advanced database applications in AI, IoT, and analytics systems.	An/C

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	1	2	1	-	2	1	1
CO2	2	3	1	2	3	1	1
CO3	2	3	2	1	3	2	1
CO4	2	3	2	2	3	2	1

CO5	2	3	2	2	3	2	2

Mapping of Course Outcomes to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	2	2	2	1	1
CO2	3	3	3	3	1	1
CO3	3	3	3	3	2	1
CO4	3	3	3	3	2	2
CO5	2	3	3	3	3	2

COURSE CONTENTS

	QB No.		**DESCRIPTION**	**HOURS**
MODULE 1	**UNIT 1**		**MODULE 1: Fundamentals of Advanced Databases**	12
	1	1.1	Introduction to Advanced Database Systems, Limitations of Relational Databases, Evolution of Database Technologies	
		1.2	Overview of NoSQL Databases, Characteristics and Types of NoSQL Databases	
	2	1.3	CAP Theorem, ACID vs BASE Properties, Distributed Database Concepts	
		1.4	Data Models in NoSQL: Key-Value, Document, Column-Family and Graph Databases	
MODULE 2				
	UNIT 2		**MODULE 2: NoSQL Database Systems**	12
	3	2.1	Document-Oriented Databases: MongoDB Architecture, Collections and Documents	
		2.2	CRUD Operations in MongoDB, Querying and Indexing Techniques	
	4	2.3	Column-Family Databases and Key-Value Stores: Cassandra and Redis Basics	
		2.4	Graph Databases: Neo4j Concepts, Nodes, Relationships and Graph Queries	
MODULE 3				
	UNIT 3		**MODULE 3: Big Data and Distributed Data Management**	12
	5	3.1	Introduction to Big Data Technologies and Hadoop Ecosystem	
		3.2	Distributed File Systems and Data Storage Concepts	
	6	3.3	Data Replication, Sharding and Scalability in Distributed Databases	
		3.4	Cloud Databases and Database-as-a-Service (DBaaS)	
MODULE 4				
	UNIT 4		**MODULE 4: Advanced Database Applications and Security**	12
	7	4.1	Data Warehousing and Data Lakes	
		4.2	Real-Time Data Processing and Streaming Databases	
	8	4.3	Database Security, Backup, Recovery and Access Control	
		4.4	Applications of Advanced Databases in AI, IoT, E-Commerce and Social Media Analytics	

MODULE 5				
	UNIT 5	**MODULE 5: Teacher Specific Module**		12
		Activities:		
		1	Install and perform CRUD operations using MongoDB.	
		2	Design a document database for an e-commerce application.	
		3	Compare SQL and NoSQL databases using sample datasets.	
		4	Develop a simple graph database application using Neo4j.	
		5	Analyze scalability and replication features in distributed databases.	

Reference Books:

1. M. Tamer Özsu and Patrick Valduriez, Principles of Distributed Database Systems, 4th ed., Springer, 2020.
2. Pramod J. Sadalage and Martin Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Addison-Wesley, 2012.
3. Kristina Chodorow, MongoDB: The Definitive Guide, 3rd ed., O'Reilly Media, 2019.
4. Eric Redmond and Jim R. Wilson,
5. Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement, Pragmatic Bookshelf, 2018.
6. Tom White, Hadoop: The Definitive Guide, 4th ed., O'Reilly Media, 2015.
7. Carlos Coronel and Steven Morris, Database Systems: Design, Implementation, and Management, Cengage Learning, 2019.
8. Abraham Silberschatz, Henry F. Korth, and S. Sudarshan, Database System Concepts, 7th ed., McGraw-Hill Education, 2019.
9. Ian Robinson, Jim Webber, and Emil Eifrem, Graph Databases, 2nd ed., O'Reilly Media, 2015.
10. Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, 3rd ed., McGraw-Hill Education, 2003.
11. Dan Sullivan, NoSQL for Mere Mortals, Addison-Wesley Professional, 2015.

Assessment Rubrics:

Evaluation Type		**Marks**
End Semester Evaluation		**35**
Practical ESE: 2 hrs.		**15**
Mini Project Implementation	5	
Analysis & explanation	3	
Use of examples	3	
Presentation	2	
Record	2	
Continuous Evaluation - Theory		**15**
Test Paper- 1	5	
Model exam	5	

Assignment/Activities	5	
Continuous Evaluation - Practical		**10**
Punctuality – weekly exercises	3	
Case Study Analysis	4	
Viva	3	
Total		**75**

DISCIPLINE SPECIFIC CORE COURSES

KU1DSCDSL101: Fundamentals of Data Science and Programming

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
1	DSC	100-199	KU1DSCDSL101	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	35	65	100	1.5 hrs

Course Description:

This course provides a foundational understanding of Data Science and programming using Python. It covers data collection, preprocessing, basic statistics, data visualization, and problem-solving techniques. The course enables students to analyze real-world data, especially in logistics and business contexts, and develop essential computational and analytical skills.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand the fundamentals of Data Science, its lifecycle, and applications in real-world domains such as logistics and business.	U
2	Apply data collection and preprocessing techniques such as cleaning, integration, transformation, reduction, and handling missing data.	A
3	Analyze data using basic statistical measures (mean, median, mode, variance, standard deviation) and data normalization techniques.	An
4	Develop programs using Python concepts including variables, control structures, functions, and data structures.	C
5	Implement problem-solving techniques such as searching, sorting, and data handling using lists, dictionaries, and other Python structures.	C
6	Utilize basic data visualization tools and programming practices to interpret and present data effectively.	C

**Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)*

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	1	1	1	1	1
CO2	3	3	1	2	2	2	2
CO3	3	3	1	3	1	2	1
CO4	2	2	2	2	2	2	1
CO5	3	3	2	2	2	3	2
CO6	2	2	1	3	1	2	1

Mapping of Course Outcomes to POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	2	1	1
CO2	3	3	2	3	1	2
CO3	3	2	3	2	2	1
CO4	2	3	2	3	2	1
CO5	3	3	2	3	2	1
CO6	2	2	3	2	3	1

COURSE CONTENTS

	QB No.		DESCRIPTION	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Data Science (DS) & Data Preprocessing**	15
	1	1.1	Definition and importance/need of DS, DS Process, Business Intelligence & DS, Prerequisites for a Data Scientist, Components of DS	
		1.2	Types of Data (Structured, Semi-structured, Unstructured), Introduction to Data Formats (CSV, Excel, JSON), Data Sources (Databases, APIs, Sensors, Web), Data storage basics, DS lifecycle.	
	2	1.3	Roles in Data Science (Data Analyst, Data Scientist, Engineer), Data Security Issues, Applications in logistics, healthcare, business, Tools for DS (Python, R, Excel) and Skills Needed.	
		1.4	Data Visualization Concepts, Visualization Tools, Charts: Bar, Line, Pie, Histogram using Excel	
MODULE 2	**UNIT 2**		**MODULE 2: Data Handling and Preprocessing**	15

	3	2.1	Introduction to datasets, Data collection methods, Data Preprocessing: Cleaning, Integration, Transformation, Reduction, Benefits of Data Preprocessing, Handling Missing Data	
		2.2	Basic Statistics: Measures of central tendency (mean, median, mode), Measures of dispersion (range, variance, standard deviation), Introduction to Data Interpretation.	
	4	2.3	Data normalization - Decimal Scaling, Min-Max Scaling, Robust Scaling, Z-Score & L2 Normalization, Advantages & Disadvantages of Data Normalization.	
		2.4	Introduction to Jupyter Notebook / Google Colab	
MODULE 3				
	UNIT 3		**MODULE 3: Introduction to Programming & Data Structures in Python**	15
	5	3.1	Overview of Programming Languages, Basics of Python Programming, Variables & Data Types, Input & Output Operations	
		3.2	Whitespace Formatting, Modules, Conditional Statements (if, else, elif), Looping Statements (for, while), Nested Structures	
	6	3.3	Counter, Lists, Tuples, Sets, Dictionaries & Basic Operations on Data Structures, Strings and Booleans in Python	
		3.4	Function definition & usage, Parameters and return values, Basic problem-solving exercises, Bulit-in Modules & Libraries	
MODULE 4				
	UNIT 4		**MODULE 4: Functions and Modules**	15
	7	4.1	Searching, Sorting and List Comprehensions	
		4.2	Generators and Iterators	
	8	4.3	Randomness, Regular Expressions	
		4.4	zip and Argument Unpacking	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	15
		Activities/ Practical Work:		
		1	Writing simple Python programs: 1. Write a Python program to print numbers from 1 to 50. 2. Write a program to find the sum of all elements in a list. 3. Write a program to check whether a number is even or odd. 4. Write a program to find the largest number in a list. 5. Write a program to count the number of vowels in a string.	
		2	Data handling using lists and dictionaries: i) Create a list of 10 numbers and print only even numbers. ii) Write a program to remove duplicate elements from a list. iii) Create a dictionary with student names and marks. Print all students scoring above 75. iv) Write a program to sort a list in ascending and descending order. v) Create a dictionary of products and prices. Find the most expensive product.	
		3	Basic problem-solving (sorting, searching): 1. Implement linear search to find an element in a list. 2. Implement binary search for a sorted list.	

			3. Write a program to sort a list using bubble sort. 4. Write a program to sort a list using built-in functions. 5. Find the second largest number in a list.	
		4	Visualize data using matplotlib and seaborn: 1. Create a bar chart for student marks. 2. Plot a line graph showing monthly sales data. 3. Create a pie chart showing product distribution. 4. Generate a histogram for a dataset. 5. Create a scatter plot to show relationship between two variables.	
		5	Create a simple dataset and visualize using Seaborn (heatmap or countplot).	
		6	Given a list of delivery times, calculate average delivery time.	
		7	Create a dictionary of delivery locations and number of orders. Plot a bar chart.	
		8	Given a dataset of product sales, visualize top 5 products.	
		9	Analyze a list of delivery delays and find how many deliveries are delayed (>30 mins).	
		10	Create a small dataset (students / sales / logistics) • Store data in list/dictionary • Perform sorting/searching • Visualize results using matplotlib	

Essential Readings:

a. Joel Grus – *Data Science from Scratch* (2019)
b. Sanjeev Wagh, Manisha Bhende, Anuradha Thakare, Fundamentals of Data Science, CRC Press, 1st Edition, 2022.
c. Wes McKinney – *Python for Data Analysis* (2018)
d. E. Balagurusamy – *Programming in Python* (Latest Edition)

Recommended Readings:

1. Thomas Nield, Essential Math for Data Science, O'Reilly Media Inc., 2022.
2. Howard J. Seltman, Experimental Design and Analysis, CMU, 2018.
3. Jake VanderPlas – *Python Data Science Handbook* (2016)
4. Han, Kamber & Pei – *Data Mining Concepts and Techniques* (2011)
5. https://nrcmec.org/pdf/Course-Content/CSE-DS/III_ISem/IDS/IDS%20COURSE%20CONTENT.pdf

Web Links for Reference:

1. https://www.python.org/about/gettingstarted/
2. https://www.w3schools.com/python/
3. https://pandas.pydata.org
4. https://numpy.org

Assessment Rubrics:

Evaluation Type	Marks	Evaluation Type	Marks	Total

Theory Marks			75	Practical Marks			25	**100**
a)	**End Semester Evaluation (Theory ESE)**		**50**	a)	**Practical ESE (2.5 hrs.)**		**15**	
					Program code		**6**	
					Output		**4**	
					Viva		**3**	
					Modification		**2**	
b)	**CCA**		**25**	b)	**CCA (2 hrs.)**		**10**	
	i.	Test Paper	5		i.	Punctuality	3	
	ii.	Model exam	10		ii.	Model exam	4	
	iii.	Assignment/ Book-article review / field report	5		iii.	Record	3	
	iv.	Seminar/ Viva-Voce	5					

MODEL QUESTION PAPER (Credit 4)

Time: 90 Minutes **Max Marks:** 50

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

5. Define Data Science and roles of data scientists.
6. What is the Data Science lifecycle?
7. What is structured and unstructured data?
8. What is data preprocessing?
9. Define mean and median with example
10. What is data normalization?
11. What is a variable in Python? Give examples
12. What is a list in Python? Give examples

Type B (Answer any FOUR questions – 6 marks each) *(4 × 6 = 24 marks)*

13. Describe different types of data with examples.
14. Explain data cleaning and its importance.
15. Describe measures of central tendency.
16. Explain data normalization techniques.
17. Describe conditional statements in Python.
18. Explain lists and tuples with examples.

Type C (Answer any ONE question – 14 marks each) *(1 × 14 = 14 marks)*

19. a) Explain the Data Science process with a diagram. (8 Marks)
    b) Describe measures of dispersion with examples. (6 marks)

    OR

20. a) Describe different data structures in Python and their applications (6 marks).
    b) Explain looping and nested structures in Python with examples (8 Marks).

KU1DSCDSL102: Python Programming for Problem Solving

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
1	DSC	100-199	KU1DSCDSL102	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	35	65	100	1.5 hrs

Course Description:

This course introduces the fundamentals of Python programming and problem-solving techniques for developing computational thinking skills. It covers core programming concepts, control structures, functions, object-oriented programming, file handling, and exception management along with data analysis and visualization using Python libraries. The course also provides practical exposure to NumPy, Pandas, Matplotlib, and introductory machine learning techniques for real-world data science applications.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand the fundamentals of Python programming including data types, control structures, lists, tuples, dictionaries, and basic problem-solving techniques.	U
2	Apply functions, recursion, object-oriented programming concepts, modules, and packages	A
3	Analyze and implement file handling, exception handling, and command-line operations	An
4	Apply NumPy, Pandas, Matplotlib, and introductory machine learning techniques	A
5	Develop practical Python-based solutions for real-world computational and data science problems.	C

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	1	1	1	-	1	1
CO2	2	2	2	1	1	1	1
CO3	3	2	1	2	2	1	2
CO4	3	3	3	3	2	2	1

CO5	3	3	3	3	2	3	2

Mapping of Course Outcomes to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	2	2	-	1
CO2	2	3	2	2	1	1
CO3	2	3	2	2	1	2
CO4	3	3	3	3	1	1
CO5	2	3	3	3	2	2

COURSE CONTENTS

	QB No.		**DESCRIPTION**	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Basics of Python Programming**	15
	1	1.1	Introduction to Python – Advantages – Executing Python Programs – Core Data Types – Numeric Types – Strings	
		1.2	Lists: Operations, Slicing, Methods, Looping, Mutability, Aliasing, Cloning	
	2	1.3	Tuples and Dictionaries: Tuple Assignment, Return Values, Dictionary Operations and Methods	
		1.4	List Comprehension and Advanced List Processing	
MODULE 2				
	UNIT 2		**MODULE 2: Control Flow, Functions & Modules**	15
	3	2.1	Assignments – Expressions – Conditional Statements – While and For Loops	
		2.2	Functions: Definition, Calls, Scope, Arguments	
	4	2.3	Recursive Functions – Functional Programming Tools	
		2.4	Classes and Object-Oriented Programming Concepts	
MODULE 3				
	UNIT 3		**MODULE 3: Modules, File Handling & Exception Handling**	15
	5	3.1	Python Modules and Packages – Using Packages	
		3.2	File Handling: Reading and Writing Text Files	
	6	3.3	Command Line Arguments – Format Operator	
		3.4	Errors and Exceptions – Exception Handling	
MODULE 4				
	UNIT 4		**MODULE 4: Data Analysis and Visualization using Python**	15
	7	4.1	NumPy Fundamentals and Matrix Operations	
		4.2	Pandas for Data Cleaning, Wrangling and Data Analysis	
	8	4.3	Data Visualization using Matplotlib	
		4.4	Introduction to Scikit-learn and Machine Learning with Python	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	15
		Activities/ Practical Work:		

		1	Mathematical operations using Python	
		2	Basic Problem Solving a. Prime number checking b. Fibonacci series c. Palindrome checking d. Armstrong number	
		3	Functions & OOP e. Function for calculator operations f. Class creation for student management	
		4	File Handling g. CSV file reading and writing	
		5	Data Science Basics h. Data cleaning using Pandas i. Simple dataset visualization j. Linear regression using Scikit-learn	

Essential Readings:

1. Eric Matthes, *Python Crash Course: A Hands-On, Project-Based Introduction to Programming*, No Starch Press.
2. Mark Lutz, *Learning Python*, O'Reilly, 5th Edition, 2013.
3. Daniel Liang, *Introduction to Programming using Python*, Pearson, 1st Edition, 2021.
4. Wes Mc Kinney, *Python for Data Analysis*, O'Reilly Media, 2012.
5. Tim Hall and J-P Stacey, *Python 3 for Absolute Beginners*, Apress, 1st Edition, 2009.
6. Magnus Lie Hetland, *Beginning Python: From Novice to Professional*, Apress, 2nd
7. Edition, 2005.

Assessment Rubrics:

Evaluation Type			**Marks**	**Evaluation Type**			**Marks**	**Total**
Theory Marks			**75**	**Practical Marks**			**25**	**100**
a)	**End Semester Evaluation (Theory ESE)**		**50**	a)	**Practical ESE (2.5 hrs.)**		**15**	
					Program code		**6**	
					Output		**4**	
					Viva		**3**	
					Modification		**2**	
b)	**CCA**		**25**	b)	**CCA (2 hrs.)**		**10**	
	i.	Test Paper	5		i.	Punctuality	3	
	ii.	Model exam	10		ii.	Model exam	4	
	iii.	Assignment/ Book-article review / field report	5		iii	Record	3	
	iv.	Seminar/ Viva-Voce	5					

MODEL QUESTION PAPER (Credit 4)

Time: 90 Minutes **Max Marks:** 50

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

1. Define tuple assignment.
2. What is a dictionary in Python?
3. What is recursion?
4. Define scope of a variable.
5. Define exception handling.
6. What is data wrangling?
7. Define command line argument.
8. What is an exception?

Type B (Answer any FOUR questions – 6 marks each) *(4 × 6 = 24 marks)*

9. Explain the features and advantages of Python programming.
10. Discuss mutability, aliasing, and cloning of lists.
11. Discuss functions, scopes, and arguments in Python.
12. Discuss NumPy and its applications in matrix operations.
13. Discuss different types of errors and exceptions in Python.
14. Explain file handling operations in Python.

Type C (Answer any ONE question – 14 marks each) *(1 × 14 = 14 marks)*

15. Explain the fundamentals of Python programming, core data types, string handling, and list operations with suitable examples.
16. Discuss object-oriented programming concepts, classes, and modules in Python with examples.

KU1DSCDSL103: Data Analytics

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
1	DSC	100-199	KU1DSCDSL103	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	35	65	100	1.5 hrs

Course Description:

This course introduces the fundamental concepts of Data Analytics, focusing on data collection, preprocessing, and analysis techniques. It covers the Data Science lifecycle, data quality measures, and correlation methods for understanding relationships in data. The course also explores Big Data concepts, data visualization, dashboards, and descriptive statistical measures including probability and sampling. Students will develop the ability to analyze, interpret, and present data effectively for real-world decision-making in business and logistics contexts.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand the concepts of Data Analytics, its lifecycle, types of digital data, and roles of data professionals.	U
2	Apply data preprocessing techniques including data cleaning, integration, transformation, reduction, and discretization to prepare quality datasets.	A
3	Analyze data using statistical measures and correlation techniques.	An
4	Demonstrate understanding of Data Science project lifecycle including problem definition, modelling, evaluation, and deployment.	C
5	Apply concepts of Big Data, data visualization, data queries, and dashboards for effective data interpretation.	A
6	Apply probability distributions, sampling, and data modelling techniques for data-driven decision making.	A

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7

CO1	2	2	1	1	1	1	1
CO2	3	3	1	2	2	2	2
CO3	3	3	1	3	1	2	1
CO4	2	3	2	2	2	2	2
CO5	2	2	2	3	2	3	1
CO6	3	3	2	2	2	3	2

Mapping of Course Outcomes to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	2	2	2	1	1
CO2	3	2	2	3	1	2
CO3	3	2	3	2	2	1
CO4	2	3	2	3	2	2
CO5	2	3	3	2	3	1
CO6	3	2	3	3	1	1

COURSE CONTENTS

	QB No.		**DESCRIPTION**	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Introduction to Data Analytics**	15
	1	1.1	Introduction: Meaning of Data Analytics- Need of Data Analytics	
		1.2	Business Analytics vs. Data Analytics, Importance of Data Analytics life Cycle, Categorization of Data Analytical Models.	
	2	1.3	Data Scientist vs. Data Engineer vs. Data Analyst, Role of Data Analyst, Data Analytics in Practice.	
		1.4	Introduction to Digital Data, Types of Digital Data, Data Collection	
MODULE 2				
	UNIT 2		**MODULE 2: Dealing with Digital Data & Data Science**	15
	3	2.1	Data Quality Measures, Data Cleaning, Data Integration, Data Reduction, Data Transformation, Data Discretization.	
		2.2	Data Science Project Life Cycle, Business Requirement, Data Acquisition, Data Preparation, Hypothesis and Modeling	
	4	2.3	Evaluation and Interpretation, Deployment, Operations, Optimization, Applications for Data Science	
		2.4	Introduction to predictive Analytics: Karl Pearson Correlation Technique, Multiple Correlation, Spearman's Rank Correlation	
MODULE 3				
	UNIT 3		**MODULE 3: Big Data Management and Data Visualization**	15
	5	3.1	Evolution of Big Data concept, Features of Big Data, Big Data Challenges, Big Data Analytics.	
		3.2	Data Visualization concept, Importance of data visualization,	

			Structure of Visualization, Types of data visualization, Tools for Data visualization, Applications of data visualization	
	6	3.3	Data Queries, Types of Data Queries, Data Dashboards,	
		3.4	Principles of effective Data Dashboards, Applications of Data Dashboards.	
MODULE 4				
	UNIT 4		**MODULE 4: Descriptive Statistical Measures (Theory Only)**	15
	7	4.1	Overview of using Data: Population and Samples, Measures of location, Measures of Dispersion	
		4.2	Measures of Variability, Measures of Association	
	8	4.3	Probability Distribution and Data Modeling, Discrete Probability Distribution, Continuous Probability Distribution,	
		4.4	Data Modeling and Distribution fitting, Random Sampling from Probability Distribution	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	15
		Activities/ Practical Work:		
		1	Practical 1: Understanding Data Types • Identify structured and unstructured data from real-world datasets • Classify data (numerical, categorical, time-series) • Tools: Excel / Google Colab *Outcome:* Understand types of digital data and their applications	
		2	Practical 2: Data Collection & Case Study • Collect dataset (logistics / e-commerce / sales) • Identify business problem (e.g., delivery delay analysis) • Document lifecycle of Data Analytics *Outcome:* Understand real-world analytics workflow	
		3	Practical 3: Data Cleaning - Handle missing values, Remove duplicates and correct inconsistent data *Tool:* Python (Pandas)	
		4	Practical 4: Data Transformation • Normalize data (Min-Max, Z-score) • Convert categorical to numerical • Data discretization *Outcome:* Prepare data for analysis	
		5	Practical 5: Dashboard Creation • Create dashboard using Excel / Power BI • Include: KPIs (sales, delivery time, demand), Charts and filters	
		6	Practical 6: Logistics Data Analytics Project • Dataset: Delivery / E-commerce data • Tasks: Data cleaning, Visualization, Correlation analysis, Dashboard creation • Output: o Report + Presentation	

Essential Readings:

1. https://mrcet.com/downloads/MBA/digitalnotes/III/Digital%20Notes_DA.pdf
2. Introduction to Data Analytics: https://www.hubspot.com/hubfs/HubSpots%20Guide%20to%20Data%20Analytics.pdf
3. Intelligent Data Analysis - An Introduction, Michael Berthold & David J. Hand, Springer, https://d-nb.info/956306144/04.

Recommended Readings:

1. Data Analytics Basics A Beginner's Guide, https://cdn.chools.in/DIG_LIB/E-Book/eBook_Data_Analytics.pdf
2. Data Analytics, Anil Maheshwari, 2017
3. Data Science & Big Data Analytics**,** David Dietrich, 2015

Assessment Rubrics:

<table>
<tr><th colspan="3">Evaluation Type</th><th>Marks</th><th colspan="3">Evaluation Type</th><th>Marks</th><th>Total</th></tr>
<tr><td colspan="3">Theory Marks</td><td>75</td><td colspan="3">Practical Marks</td><td>25</td><td rowspan="10">100</td></tr>
<tr><td>a)</td><td colspan="2">End Semester Evaluation (Theory ESE)</td><td>50</td><td>a)</td><td colspan="2">Practical ESE (2.5 hrs.)</td><td>15</td></tr>
<tr><td colspan="4" rowspan="4"></td><td></td><td colspan="2">Program code</td><td>6</td></tr>
<tr><td></td><td colspan="2">Output</td><td>4</td></tr>
<tr><td></td><td colspan="2">Viva</td><td>3</td></tr>
<tr><td></td><td colspan="2">Modification</td><td>2</td></tr>
<tr><td>b)</td><td colspan="2">CCA</td><td>25</td><td>b)</td><td colspan="2">CCA (2 hrs.)</td><td>10</td></tr>
<tr><td></td><td>i.</td><td>Test Paper</td><td>5</td><td></td><td>i.</td><td>Punctuality</td><td>3</td></tr>
<tr><td></td><td>ii.</td><td>Model exam</td><td>10</td><td></td><td>ii.</td><td>Model exam</td><td>4</td></tr>
<tr><td></td><td>iii.</td><td>Assignment/ Book-article review / field report</td><td>5</td><td></td><td>iii</td><td>Record</td><td>3</td></tr>
<tr><td></td><td>iv.</td><td>Seminar/ Viva-Voce</td><td>5</td><td></td><td></td><td></td><td></td></tr>
</table>

MODEL QUESTION PAPER (Credit 4)

Time: 90 Minutes **Max Marks:** 50

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

1. Explain the need for Data Analytics.
2. Differentiate Business Analytics and Data Analytics.
3. Define the Data Analytics lifecycle.

4. What is Karl Pearson correlation?
5. Compare Data Scientist, Data Engineer, and Data Analyst.
6. Explain features of Big Data.
7. Explain measures of central tendency.
8. What is probability distribution?

Type B (Answer any FOUR questions – 6 marks each) *(4 × 6 = 24 marks)*

9. Explain data cleaning and integration.
10. Describe data reduction and transformation techniques.
11. Explain Data Science project lifecycle.
12. Write a short note on predictive analytics
13. Describe types of data visualization.
14. Explain data queries and their types.

Type C (Answer any ONE question – 14 marks each) *(1 × 14 = 14 marks)*

15. a). Discuss data preprocessing methods including cleaning, integration, transformation and reduction in detail (10 Marks)
    b) Explain sampling techniques with examples (4 marks)

OR

16. a). Explain descriptive statistical measures including central tendency, dispersion, and association (7 marks).
    b). Describe correlation techniques (Karl Pearson, Multiple, Spearman) and their applications (7 Marks).

KU2DSCDSL104: Fundamentals of Logistics

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
2	DSC	100-199	KU2DSCDSL104	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	35	65	100	1.5 hrs

Course Description:

This course introduces the fundamental concepts of logistics and supply chain management, including transportation, warehousing, inventory management, and logistics outsourcing. It emphasizes logistics operations, routing, and decision-making along with logistics data and KPIs. The course also covers modern systems such as Transportation Management Systems (TMS) and Warehouse Management Systems (WMS), enabling students to analyze and improve logistics performance in real-world business environments.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand the concepts, components, types, and importance of logistics in business and economy.	U
2	Analyze transportation systems, routing, and decision-making processes in logistics operations.	An
3	Evaluate warehousing operations, design, and warehouse management systems (WMS).	E
4	Apply inventory management techniques and technologies in logistics operations	A
5	Analyze logistics outsourcing strategies (1PL–5PL) and decision-making in outsourcing logistics.	An

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	1	1	1	1	1
CO2	2	3	1	2	1	3	1
CO3	2	2	1	2	2	3	1

CO4	3	3	1	2	2	3	2
CO5	2	2	1	1	2	3	2

Mapping of Course Outcomes to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	2	2	1	1
CO2	3	2	3	3	1	1
CO3	2	2	2	3	2	1
CO4	3	2	2	3	1	2
CO5	2	2	2	3	2	2

COURSE CONTENTS

	QB No.		**DESCRIPTION**	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Fundamentals of Logistics**	15
	1	1.1	Logistics: Concept, Definition, Origin and Evolution, Meaning, Importance & Objectives of Logistics, Role in Business and Economy, Components: Procurement, Warehousing, Transportation, Distribution, Logistics Data & KPIs	
		1.2	Types of Logistics: Inbound, Outbound, 3PL, Reverse Logistics: Objectives, Causes, Types & Challenges, Difference Between Forward Logistics and Reverse Logistics,	
	2	1.3	Seven Pillars of Logistics, Functions of Logistics, Logistics Activities in a Company, Main challenges for a logistics company	
		1.4	Logistics networks and operations, Carrier Opportunities in the Logistics Industry, Integrated Logistics: Definition, Variables affecting the Evaluation and Growth of Integrated Logistic, Activities related to integrated logistics	
MODULE 2				
	UNIT 2		**MODULE 2: Transportation in Logistics**	15
	3	2.1	Role of Transportation in Logistics, Transportation Management, Types of Data Required, Transportation Management Systems (TMS), Transport Infrastructure.	
		2.2	Modes of Transport & their Characteristics: Rail, Road, Water, Air, Pipeline, Intermodal and Multimodal, Last-Mile Delivery, Transport Economics, Transport network	
	4	2.3	Transportation Selection Decision, Documents in Transport Decision Making, Participants in the Transportation Decisions, Factors affecting carrier decisions	
		2.4	Transportation Routing - Choosing a Route Planning System, Vehicle Routing and Scheduling, Freight & fleet Management in Logistics.	
M O				

	UNIT 3		**MODULE 3: Warehousing Management**	15
	5	3.1	Concept & Nature of a Warehouse, Meaning of Warehousing, Importance of a Warehouse, Different Types of Warehouses	
		3.2	Different Types of Warehouse Operations, Warehouse Location, Growth of e-fulfilment & its effect on Warehousing, Warehouse Management Systems (WMS).	
	6	3.3	Functions of Warehouse, Roles & Responsibility of Warehouse Manager, Economic & Operational Benefits of Warehousing, Challenges of Warehousing.	
		3.4	Warehouse Design Criteria, Storage Plan, Warehouse Control Systems, Warehousing Activities: Product Movement & Storage, Information Transfer.	
MODULE 4				
	UNIT 4		**MODULE 4: Inventory Management & Logistics Outsourcing**	15
	7	4.1	Concept, Importance and Functions of Inventory Management in Logistics, Key Strategies for Effective Inventory Management	
		4.2	Technologies Driving Inventory Management in Logistics, Challenges in Inventory Management, Types of inventory management in logistics	
	8	4.3	Logistics Outsourcing: 1PL to 5PL, Advantages and Drawbacks of Logistics Outsourcing, Challenges of Outsourcing Logistics	
		4.4	When & How much should you outsource logistics? How to Outsource Successfully?	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	15
		Activities/ Practical Work:		
		1	**Practical 1:** Create a dataset of deliveries (date, distance, cost, delivery time) using Microsoft Excel. • Calculate KPIs: Delivery time, Cost per delivery, On-time delivery rate *Outcome:* Understand logistics data & performance measurement.	
		2	**Practical 2:** Transportation Mode Analysis • Compare transport modes (road, rail, air, water) • Prepare a table with cost, speed, capacity • Analyze best mode for given scenario *Outcome:* Transportation decision-making skills	
		3	**Practical 3:** Route Planning Exercise • Given multiple delivery locations, design optimal routes • Identify shortest path manually or using Google maps Outcome: Basic routing and scheduling understanding how to find optimal routes (Optimal Route = Minimum Time or Distance)	
		4	**Practical 4:** Warehouse Layout Design using Excel/ AutoCAD/ SketchUp/ AnyLogic/ FlexSim • Draw a simple warehouse layout: [Receiving] → [Storage] → [Picking] → [Packing] → [Shipping]	

			• Mark storage areas, loading/unloading zones *Outcome:* Warehouse planning skills	
		5	**Practical 7: Transportation Cost Analysis** • Analyze cost vs distance • Prepare charts (bar/line graph) *Outcome:* Data interpretation using Excel	

Essential Readings:

1. Logistics Transportation Systems, MD Sarder, Bowling Green State University, USA
2. https://ennilogistics.com/logistics/
3. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBAA7025.pdf
4. Logistics and Warehousing Management, IIMM, 2020
5. https://veritech.in/blog/what-is-inventory-management-in-logistics/

Recommended Readings:

1. Transport Logistics (Shared Solutions to Common Challenges)
2. Warehouse Management, Richards G., 2017
3. Michael Chirchir et al, Fundamentals of Inventory Management, LAP Lambert Academic

Web Links for Reference:

1 C Programming Tutorial: https://www.learn-c.org
2 GeeksforGeeks C Programming: https://www.geeksforgeeks.org/c-programming-language/
3 TutorialsPoint C: https://www.tutorialspoint.com/cprogramming

Assessment Rubrics:

Evaluation Type			**Marks**	**Evaluation Type**			**Marks**	**Total**
Theory Marks			**75**	**Practical Marks**			**25**	**100**
a)	**End Semester Evaluation (Theory ESE)**		**50**	a)	**Practical ESE (2.5 hrs.)**		**15**	
					Program code		**6**	
					Output		**4**	
					Viva		**3**	
					Modification		**2**	
b)	**CCA**		**25**	b)	**CCA (2 hrs.)**		**10**	
	i.	Test Paper	5		i.	Punctuality	3	
	ii.	Model exam	10		ii.	Model exam	4	
	iii.	Assignment/ Book-article review / field report	5		iii	Record	3	
	iv.	Seminar/ Viva-Voce	5					

MODEL QUESTION PAPER (Credit 4)

Time: 90 Minutes **Max Marks:** 50

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

1. Define logistics.
2. What is inbound and reverse logistics?
3. Define Transportation Management System (TMS).
4. What is warehouse & inventory management?
5. What is last-mile delivery?
6. Define logistics outsourcing.
7. What is KPI in logistics?
8. What is intermodal transport?

Type B (Answer any FOUR questions – 6 marks each) *(4 × 6 = 24 marks)*

9. Differentiate inbound and outbound logistics.
10. Describe modes of transportation.
11. Explain logistics network and operations.
12. Explain transportation routing and scheduling.
13. Describe challenges in warehousing.
14. Explain logistics outsourcing (1PL–3PL).

Type C (Answer any ONE question – 14 marks each) *(1 × 14 = 14 marks)*

15. a). Discuss transportation management, routing, and decision-making in logistics (8 Marks)
    b). Discuss transportation management, routing, and decision-making in logistics (6 marks)

OR

16. a). Describe different data structures in Python and their applications (6 marks).
    b). Explain logistics outsourcing in detail with advantages, challenges, and decision-making process (8 Marks).

KU2DSCDSL105: R Programming

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
2	DSC	100-199	KU2DSCDSL105	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	35	65	100	1.5 hrs

Course Description:

This course introduces the fundamentals of programming using R with a focus on statistical computing and data analysis. It covers basic programming concepts, functions, control structures, data structures, and data manipulation. The course also emphasizes graphical visualization and statistical techniques such as correlation, variance, and probability distributions, enabling students to analyze and interpret real-world data effectively.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand the fundamentals of R programming, its environment, features, and applications in data analysis.	U
2	Apply functions, control structures, and operators in R to solve computational problems	A
3	Use R data structures (vectors, lists, matrices, data frames) for data handling and manipulation.	A
4	Develop R programs for data processing, including data import, export, and transformation.	C
5	Create graphical visualizations and apply statistical techniques using R.	C

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	1	1	1	1	1
CO2	3	3	1	1	1	2	1
CO3	3	3	1	2	2	2	1
CO4	3	3	2	2	2	2	1
CO5	2	3	1	3	1	2	1

Mapping of Course Outcomes to POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	2	2	1	1
CO2	3	3	2	3	1	1
CO3	3	3	3	2	2	1
CO4	2	3	3	3	2	1
CO5	3	2	3	2	3	1

COURSE CONTENTS

	QB No.		DESCRIPTION	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Basics of R Programming**	15
	1	1.1	Introduction to R, Features of R, Why use R for statistical computing and graphics? Applications of R Programming in Real World, Local Environment Setup – R Studio.	
		1.2	Character sets, Identifiers: Variables, Constants, Symbolic Constant, Key Words, Data Types, Character Vectors, R Numbers	
	2	1.3	Operators: Arithmetic, Relational, Logical, Assignment, Increasing, Decreasing, Special Operators	
		1.4	Precedence and Associativity of different operators in R	
MODULE 2				
	UNIT 2		**MODULE 2: Functions & Control Statements**	15
	3	2.1	Functions in R: Single Input Single Output, Multiple Input Multiple Output, Input and output functions, Data Import and Export functions	
		2.2	Basic built-in functions: Math, String & Statistical Functions, R Booleans, Function Creation in R, Nested Functions, Recursion	
	4	2.3	Conditional Statements (if and if-else), Loops (for, while & repeat), Nested Loops	
		2.4	Unconditional Statements (Break, Next & goto), Pattern Programs	
MODULE 3				
	UNIT 3		**MODULE 3: Data Structures**	15
	5	3.1	Data Structure: Vectors, Lists, Data frames, Matrices, Arrays, Factors	
		3.2	Creating objects; c(), matrix(), data.frame(), seq(), rep()	
	6	3.3	Accessing elements in a vector(), matrix(), data.frame(), list() by element name or index.	
		3.4	Basic operations on data structures, Adding rows/columns to a matrix using rbind() or cbind()	
MODULE 4				
	UNIT 4		**MODULE 4: R Graphics & R Statistics**	15
	7	4.1	R plot, R Line, R Scatter Plot, R Pie Charts and R Bar Charts	
		4.2	Histogram, Frequency polygon, Ogive curve	
	8	4.3	R Statistics: Mean, median and mode, Minimum and maximum	

			value, Percentiles	
		4.4	Variance and Standard Deviation, Covariance and Correlation, Probability distributions.	
MODULE 5				
	UNIT 5	**MODULE 5: Teacher Specific Module**		15
		Activities/ Practical Work:		
		1	Program to display numbers from 1 to 5 using while loop in R	
		2	Write a program to find Prime numbers in a given range	
		3	Write a program to check if number is odd or even	
		4	Write a program to find sum of first n natural numbers:	
		5	Monthly sales of 10 small shops are given below 100,190, 210, 160, 150, 160, 190, 200, 170, 152 Calculate A.M., G.M., H.M. of the above data and also calculate median, mode and quartiles using R programming	
		6	For the following frequency distribution x: 1 2 3 4 5 f: 7 11 9 8 3 Calculate A.M., G.M. and H.M using R programming	
		7	The number of mistakes in a page recorded for 20 pages are as follows. 2, 5, 9, 7, 11, 6, 5, 2, 7, 9, 3, 2, 8, 12, 14, 6, 3, 9, 8, 7 Calculate mean, deviation about mean, variance and standard deviation using R programming	

Essential Readings:

1. https://kvmwai.edu.in/upload/StudyMaterial/r_programme_(TY)_(6).pdf
2. https://www.w3schools.com/r/default.asp
3. Hadley Wickham – *R for Data Science* (2017)
4. Robert Kabacoff – *R in Action* (2015)
5. Tilman Davies – *The Book of R* (2016)

Recommended Readings:

6. Thomas Nield, Essential Math for Data Science, O'Reilly Media Inc., 2022.
7. Gareth James – *An Introduction to Statistical Learning* (2013)

Web Links for Reference:

1. https://ds.dfci.harvard.edu/~aedin/courses/R/CDC/Intro2R.pdf
2. https://www.stats.ox.ac.uk/~evans/Rprog/LectureNotes.pdf

Assessment Rubrics:

Evaluation Type		**Marks**	**Evaluation Type**		**Marks**	**Total**
Theory Marks		**75**	**Practical Marks**		**25**	
a)	**End Semester Evaluation (Theory ESE)**	**50**	a)	**Practical ESE (2.5 hrs.)**	**15**	
				Program code	**6**	
				Output	**4**	
				Viva	**3**	

					Modification		2	100
b)	**CCA Theory**		**25**	b)	**CCA (2 hrs.)**		**10**	
	i.	Test Paper	5		i.	Punctuality	3	
	ii.	Model exam	10		ii.	Model exam	4	
	iii.	Assignment/ Book-article review / field report	5		iii	Record	3	
	iv.	Seminar/ Viva-Voce	5					

MODEL QUESTION PAPER (Credit 4)

Time: 90 Minutes **Max Marks:** 50

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

1. What is R and RStudio?
2. Define vector and lists in R.
3. What is a loop and factor?
4. Define function in R.
5. What is a histogram?
6. Define mean and mean deviation.
7. Describe data types in R.
8. What is data frame in R?

Type B (Answer any FOUR questions – 6 marks each) *(4 × 6 = 24 marks)*

9. Explain functions and recursion in R.
10. Discuss loops and conditional statements with examples.
11. Explain data structures in R with operations.
12. Describe data import and export in R.
13. Explain different types of plots in R.
14. Discuss statistical measures using R.

Type C (Answer any ONE question – 14 marks each) *(1 × 14 = 14 marks)*

15. A). Discuss functions, control structures, and recursion in R with examples (8 marks).
    B). Explain data structures in R and their applications in data analysis (6 Marks)

    OR

16. A). Describe graphical visualization techniques in R with examples (8 Marks).
    B). Explain statistical analysis using R including mean, variance, correlation, and probability distributions (6 marks).

KU2DSCDSL106: E-Commerce Logistics

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
2	DSC	100-199	KU2DSCDSL106	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	35	65	100	1.5 hrs

Course Description:

This course provides a comprehensive understanding of e-commerce logistics, covering order fulfillment, warehousing, transportation, last-mile delivery, reverse logistics, and logistics analytics. It emphasizes the integration of logistics operations with digital platforms, performance measurement using KPIs, and data-driven decision-making to improve efficiency and customer satisfaction in online retail systems.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand the fundamentals of e-commerce logistics, business models, and order lifecycle processes.	U
2	Analyze order fulfillment systems, warehousing operations, and warehouse technologies such as WMS.	An
3	Evaluate transportation networks, routing, scheduling, and last-mile delivery challenges.	E
4	Apply reverse logistics and returns management strategies in e-commerce systems.	A
5	Analyze logistics data, KPIs, and customer experience to improve operational performance.	An

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	1	1	1	1	1
CO2	3	2	1	2	2	2	1
CO3	2	3	1	2	1	3	1
CO4	2	2	1	1	2	3	2

CO5	3	3	1	3	2	3	2

Mapping of Course Outcomes to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	2	2	1	1
CO2	3	2	2	3	2	1
CO3	3	2	3	3	1	1
CO4	2	2	2	3	2	2
CO5	3	2	3	3	2	2

COURSE CONTENTS

	QB No.		**DESCRIPTION**	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Introduction to E-Commerce Logistics**	15
	1	1.1	Meaning and scope of e-commerce logistics, Role of logistics in online retail, Importance of logistics in supply chain, Key components of e-commerce logistics	
		1.2	Business Models and Logistics: B2C, B2B, C2C, Comparison of traditional vs e-commerce logistics, Logistics challenges in online business, Role of digital platforms	
	2	1.3	Order lifecycle: Order placement and confirmation, Order processing and inventory check, Order tracking systems, Delivery and customer notification	
		1.4	Customer Satisfaction: Customer expectations in delivery, Delivery speed and reliability, Impact of logistics on customer experience, Role of feedback and service quality	
MODULE 2				
	UNIT 2		**MODULE 2: Order Fulfillment & Warehousing**	15
	3	2.1	Fulfillment Models: In-house fulfilment, Third-party logistics (3PL), Dropshipping model, Advantages, and limitations.	
		2.2	Warehouse Operations: Structure of e-fulfillment centers, Warehouse layout and design, Storage systems and racks, Space utilization techniques	
	4	2.3	Picking, Packing, Sorting: Picking methods (manual/automated), Packing techniques, Sorting processes, Dispatch operations	
		2.4	Warehouse Technology: Warehouse Management Systems (WMS), Automation and robotics, Barcode and RFID systems, Inventory tracking systems	
MODULE 3				
	UNIT 3		**MODULE 3: Transportation & Last-Mile Delivery**	15
	5	3.1	Transportation Network: Logistics network design, Distribution centers and hubs, Flow of goods in e-commerce, Role of	

			transportation	
		3.2	Last-Mile Delivery: Concept of last-mile delivery, Challenges in last-mile logistics, Delivery time optimization, Customer delivery preferences	
	6	3.3	Routing and Scheduling: Route planning techniques, Vehicle routing methods, Delivery scheduling, Optimization of routes.	
		3.4	Performance Metrics: Key Performance Indicators (KPIs), Delivery time and cost analysis, Efficiency measurement, Performance improvement strategies	
MODULE 4				
	UNIT 4		**MODULE 4: Reverse Logistics & Analytics**	15
	7	4.1	Reverse Logistics: Concept and importance, Types of returns, Reverse supply chain flow, Role in sustainability	
		4.2	Returns Management: Reasons for product returns, Return handling process, Refund and replacement systems, Challenges in return logistics.	
	8	4.3	Logistics Data & Analytics: Data collection in logistics, Performance metrics analysis, Data-driven decision making, Use of analytics tools.	
		4.4	Customer Experience: Service quality in logistics, Customer feedback systems, Improving delivery experience, Customer retention strategies	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	15
		Activities/ Practical Work:		
		1	**Practical 1: Order Lifecycle Analysis** • Create a sample order dataset (order ID, product, date, status) • Map stages: order placed → processed → shipped → delivered • Identify delays in each stage • Suggest improvements *Outcome:* Understanding order fulfillment workflow	
		2	**Practical 2: Delivery Dataset & KPI Calculation** • Create dataset (distance, delivery time, cost, status) • Calculate KPIs: Delivery time, Cost per delivery, On-time delivery rate, Delivery efficiency *Outcome:* Logistics performance analysis	
		3	**Practical 3: Route Planning for Delivery** • Select 4–6 delivery locations • Use Google Maps • Identify shortest/fastest route • Compare alternative routes *Outcome:* Route optimization skills	
		4	**Practical 4: Warehouse Layout Design** • Draw warehouse layout (Excel / paper) • Mark: Storage area, Packing zone, Shipping/receiving area, Show flow of goods	

			Outcome: Warehouse planning	
		5	**Practical 5: E-Commerce Logistics Performance Analysis** • Dataset: Delivery + inventory data • Tasks: Data cleaning, KPI calculation, Visualization, Suggest improvements **Output:** Report + charts + presentation	

Essential Readings:

1. Deborah L. Bayles, "*E-Commerce Logistics & Fulfillment: Delivering the Goods",* 1st edition, 2020.
2. Yingli Wang & Stephen Pettit, "*E-Logistics: Managing Digital Supply Chains for Competitive Advantage",* 1st edition, 2016.
3. Ramón Abalo Costa, "*eLogistics: Logistics for Ecommerce",*1st edition, 2021.

Recommended Readings:

1. M. Christopher, *Logistics & Supply Chain Management*, 5th ed., 2016.
2. S. Chopra and P. Meindl, *Supply Chain Management: Strategy, Planning, and Operation*, 7th ed., 2019.
3. D. J. Bowersox, D. J. Closs, and M. B. Cooper, *Supply Chain Logistics Management*, 5th ed., 2019

Web Links for Reference:

1. https://assets.kpmg.com/content/dam/kpmg/in/pdf/2018/05/e-commerce-retail-logistics.pdf
2. https://pdfs.semanticscholar.org/1ddb/17f04e758c324a17faf782c2da1adc70ebe1.pdf

Assessment Rubrics:

Evaluation Type			**Marks**	**Evaluation Type**			**Marks**	**Total**
Theory Marks			**75**	**Practical Marks**			**25**	**100**
a)	**End Semester Evaluation (Theory ESE)**		**50**	a)	**Practical ESE (2.5 hrs.)**		**15**	
					Program code		**6**	
					Output		**4**	
					Viva		**3**	
					Modification		**2**	
b)	**CCA Theory**		**25**	b)	**CCA (2 hrs.)**		**10**	
	i.	Test Paper	5		i.	Punctuality	3	
	ii.	Model exam	10		ii.	Model exam	4	
	iii.	Assignment/ Book-article review / field report	5		iii	Record	3	
	iv.	Seminar/ Viva-Voce	5					

MODEL QUESTION PAPER (Credit 4)

Time: 90 Minutes **Max Marks:** 50

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

1. Define e-commerce logistics.
2. What is B2C model?
3. What is order lifecycle?
4. Define last-mile delivery.
5. What is reverse logistics?
6. What is 3PL?
7. Define KPI in logistics.
8. What is customer retention?

Type B (Answer any FOUR questions – 6 marks each) *(4 × 6 = 24 marks)*

9. Explain e-commerce business models and logistics challenges.
10. Discuss fulfillment models (in-house, 3PL, dropshipping).
11. Explain warehouse design and storage systems.
12. Discuss transportation network and delivery optimization.
13. Explain reverse logistics and returns management.
14. Discuss logistics analytics and performance improvement.

Type C (Answer any ONE question – 14 marks each) *(1 × 14 = 14 marks)*

15. A). Explain the complete e-commerce logistics system including order lifecycle, fulfillment, and delivery (8 marks).
    B). Discuss warehouse operations, WMS, and e-fulfillment centers in detail (6 marks).

OR

16. A). Explain transportation systems, routing, and last-mile delivery challenges (6 marks).
    B). Analyze reverse logistics and returns management with real-world examples (8 Marks).

KU3DSCDSL201: Numerical Methods and Statistical Analysis

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
3	DSC	200-299	KU3DSCDSL201	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	35	65	100	1.5 hrs

Course Description:

This course covers numerical and statistical techniques for solving real-world problems, including interpolation, probability, and data analysis. It equips students with analytical skills required for data-driven decision-making.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand numerical methods and their applications in problem-solving.	U
2	Apply numerical techniques to solve equations and interpolation problems.	A
3	Analyze probability distributions and random variables.	An
4	Apply statistical methods for data analysis and interpretation.	A
5	Solve real-world problems using numerical and statistical techniques.	E

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	1	1	1	1	1
CO2	3	2	1	1	1	2	1
CO3	3	3	1	2	1	2	1
CO4	3	3	2	2	2	2	1
CO5	3	3	2	2	2	3	2

Mapping of Course Outcomes to POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2	2	1	1

CO2	3	2	2	3	1	1
CO3	3	1	3	2	1	1
CO4	3	2	3	3	2	1
CO5	3	2	3	3	2	1

COURSE CONTENTS

	QB No.		DESCRIPTION	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Fundamentals of Numerical Methods**	15
	1	1.1	Basics of Numerical Computation: Importance of numerical methods, Errors (round-off, truncation), Accuracy and precision, Applications in real-world problems	
		1.2	Solution of Algebraic Equations: Bisection method, Regula-Falsi method, Newton-Raphson method, Fixed-point iteration	
	2	1.3	Matrix Methods: Systems of linear equations, Gauss elimination method, Gauss-Seidel method, LU decomposition	
		1.4	Interpolation Methods: Newton's forward interpolation, Newton's backward interpolation, Lagrange interpolation, Applications of interpolation	
MODULE 2				
	UNIT 2		**MODULE 2: Numerical Differentiation & Integration**	15
	3	2.1	Numerical Differentiation: Forward difference, Backward difference, Central difference, Applications	
		2.2	Numerical Integration: Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule, Applications	
	4	2.3	Curve Fitting: Method of least squares, Linear regression, Polynomial fitting, Applications	
		2.4	Introduction to Optimization: Basic optimization concepts, Maxima and minima, Applications in logistics, Simple problems	
MODULE 3				
	UNIT 3		**MODULE 3: Probability and Random Variables**	15
	5	3.1	Basics of Probability: Sample space and events, Conditional probability, Bayes' theorem, Applications	
		3.2	Random Variables: Discrete and continuous variables, Probability mass function (PMF), Probability density function (PDF), Expectation	
	6	3.3	Probability Distributions: Binomial, Poisson, and Normal distribution, Applications	
		3.4	Sampling Techniques: Types of sampling, Random sampling, Sampling distribution, Applications	
MODULE 4				
	UNIT 4		**MODULE 4: Reverse Logistics & Analytics**	15
	7	4.1	Descriptive Statistics: Mean, Median, Mode, Variance and Standard Deviation, Skewness and kurtosis, Data representation	
		4.2	Correlation and Regression: Karl Pearson & Spearman rank	

			correlations, Linear regression, Interpretation	
	8	4.3	Hypothesis Testing: Null and alternative hypothesis, t-test, chi-square test, Applications	
		4.4	Time Series Analysis: Components of time series, Trend analysis, Moving averages, Applications in forecasting	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	15
		Practical Work: Perform the following tasks using Microsoft Excel / Python / R		
		1	Solve equations using numerical methods	
		2	Perform interpolation and integration	
		3	Compute probability and distributions	
		4	Analyze datasets using statistical tools	
		5	Perform regression and correlation analysis	
		6	Mini Task: Analyze real dataset (logistics / business) and apply statistical techniques. Interpret results and present findings	

Essential Readings:

1. S. S. Sastry, *Introductory Methods of Numerical Analysis*, 5th ed., 2012.
2. B. S. Grewal, *Higher Engineering Mathematics*, 44th ed., 2017.
3. S. C. Gupta & V. K. Kapoor, *Fundamentals of Mathematical Statistics*, 12th ed., 2020.
4. R. K. Jain and S. R. K. Iyengar, *Advanced Engineering Mathematics*, 3rd ed., 2009.

Recommended Readings:

1. M. K. Jain, S. R. K. Iyengar, and R. K. Jain, *Numerical Methods for Scientific and Engineering Computation*, 6th ed., New Delhi, India: New Age International, 2012.

Web Links for Reference:

1. Khan Academy, https://www.khanacademy.org, Basics of probability, statistics, and algebra.
2. MIT OpenCourseWare, https://ocw.mit.edu, Advanced numerical methods and statistics courses
3. NPTEL, https://nptel.ac.in, Engineering mathematics and statistics lectures
4. Coursera, https://www.coursera.org, Data science, probability, and statistical methods
5. Stat Trek, https://stattrek.com, Easy explanations of statistics and probability
6. Wolfram MathWorld, https://mathworld.wolfram.com, Advanced mathematical and numerical concepts

Assessment Rubrics:

Evaluation Type		**Marks**	**Evaluation Type**		**Marks**	**Total**
Theory Marks		**75**	**Practical Marks**		**25**	
a)	**End Semester Evaluation (Theory ESE)**	**50**	a)	**Practical ESE (2.5 hrs.)**	**15**	
				Program code	**6**	

					Output		**4**	**100**
					Viva		**3**	
					Modification		**2**	
b)	**CCA Theory**		**25**	b)	**CCA (2 hrs.)**		**10**	
	i.	Test Paper	5		i.	Punctuality	3	
	ii.	Model exam	10		ii.	Model exam	4	
	iii.	Assignment/ Book-article review / field report	5		iii	Record	3	
	iv.	Seminar/ Viva-Voce	5					

MODEL QUESTION PAPER (Credit 4)

Time: 90 Minutes **Max Marks:** 50

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

1. Define Newton's forward and backward interpolation
2. Define PMF and PDF.
3. Define numerical methods.
4. What is truncation error?
5. What is the bisection method?
6. What is Newton-Raphson method?
7. Define probability. What is a random variable?
8. Define mean, median and variance?

Type B (Answer any FOUR questions – 6 marks each) *(4 × 6 = 24 marks)*

9. Discuss interpolation techniques with applications.
10. Explain numerical integration methods with examples.
11. Describe binomial and normal distributions.
12. Explain correlation and regression analysis.
13. Discuss hypothesis testing with suitable example.
14. Explain sampling and its importance in statistics.

Type C (Answer any ONE question – 14 marks each) *(1 × 14 = 14 marks)*

15. A). Explain numerical methods for solving equations (6 marks).

    B). Discuss statistical methods with applications (8 marks).

OR

16. A). Explain probability distributions (binomial, Poisson, normal) with applications (6 marks).

    B). Explain statistical measures including central tendency, dispersion, and correlation (8 Marks).

KU3DSCDSL202: Object-Oriented Programming using Python

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
3	DSC	200-299	KU3DSCDSL202	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	35	65	100	1.5 hrs

Course Description:

This course focuses on object-oriented programming (OOP) concepts using Python. It introduces classes, objects, inheritance, polymorphism, abstraction, and real-world application design. The course enables students to build modular, reusable, and scalable software systems using Python.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand core principles of object-oriented programming	U
2	Design programs using classes and objects	A
3	Apply inheritance, polymorphism, and encapsulation	A
4	Develop modular and reusable programs using OOP principles	C
5	Build real-world applications using OOP	C

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	1	1	1	1	1
CO2	3	3	1	2	1	2	1
CO3	3	3	1	2	2	2	1
CO4	3	3	2	2	2	2	1
CO5	3	3	2	3	2	3	2

Mapping of Course Outcomes to POs

	PO1	PO2	PO3	PO4	PO5	PO6

CO1	2	2	2	2	1	1
CO2	3	3	2	3	1	1
CO3	3	3	3	3	2	1
CO4	2	3	2	3	2	1
CO5	3	3	3	3	2	1

COURSE CONTENTS

	QB No.		DESCRIPTION	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Introduction to OOP Concepts**	15
	1	1.1	Introduction to OOP: Procedural vs object-oriented programming, Features of OOP, Benefits of OOP, Applications of OOP	
		1.2	Classes and Objects: Class definition, Object creation, Attributes and methods, Instance vs class variables	
	2	1.3	Constructors and Methods: __init__() constructor, Instance methods, Class methods, Static methods	
		1.4	Basic Programs: Simple class-based programs, Object interaction, Real-world examples (student system), Code organization	
MODULE 2				
	UNIT 2		**MODULE 2: OOP Principles**	15
	3	2.1	Encapsulation: Data hiding, Access specifiers, Getter and setter methods, Practical examples	
		2.2	Inheritance: Types of inheritance, Single and multiple inheritance, Multilevel & Hierarchical inheritance	
	4	2.3	Polymorphism: Method overloading, Method overriding, Operator overloading, Dynamic typing	
		2.4	Abstraction: Abstract classes, Interfaces (concept), Use of modules, Applications	
MODULE 3				
	UNIT 3		**MODULE 3: Advanced OOP Concepts**	15
	5	3.1	Special Methods: Magic methods (__str__, __len__), Operator overloading, Object representation, Practical examples	
		3.2	Exception Handling in OOP: try-except in classes, Custom exceptions, Error handling strategies, Debugging	
	6	3.3	File Handling with OOP: File operations using classes, Data storage using objects, Reading/writing files, Applications	
		3.4	Modular Programming: Modules and packages, Importing modules, Code reusability, Project structuring	
MODULE 4				
	UNIT 4		**MODULE 4: Application Development using OOP**	15
	7	4.1	GUI Basics / Application Concepts: Introduction to GUI (optional), Event-driven programming, Application design basics, Use cases	
		4.2	Database Connectivity (Intro): Connecting Python with database , CRUD operations, Data storage concepts, Applications	
	8	4.3	Real-world Case Studies, Inventory management system, Library	

			management system, Logistics tracking system, Banking system	
		4.4	Best Practices: Code optimization, Documentation, Testing basics, Debugging techniques	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	15
		Activities/ Practical Work:		
		1	Create a class Student with attributes (name, roll number, marks) and display student details.	
		2	Write a program to create a class Rectangle and calculate area and perimeter.	
		3	Write a program to demonstrate **single inheritance** using class *Person* and *Student*.	
		4	Implement **multilevel inheritance** using classes *Vehicle* → *Car* → *ElectricCar*.	
		5	Write a Python program to demonstrate method **overriding** using base and derived classes. Create a base class Shape with a method area() and derive a class Rectangle that overrides the area() method to calculate the area of a rectangle. Display the result.	
		6	Write a program to show **operator overloading** (e.g., adding two objects).	
		7	Create a class hierarchy for Bank Account and implement **polymorphism** for interest calculation.	
		8	Implement **try-except-else-finally** block with an example.	
		9	Write a program to store student details in a **file** using a class.	
		10	Develop a class **Product** with encapsulated attributes and display product details.	
		11	Mini Task: Build a **Library Management System** demonstrating all OOP concepts.	

Essential Readings:

1. Mark Lutz – *Learning Python* (5th ed., 2013)
2. Allen B. Downey – *Think Python* (2nd ed., 2015)
3. Robert C. Martin – *Clean Code* (2008)
4. Kenneth A. Lambert – *Fundamentals of Python* (Latest Edition)

Recommended Readings:

1. M. Lutz, *Learning Python*, 5th ed., Sebastopol, CA, USA: O'Reilly Media, 2013.
2. A. B. Downey, *Think Python: How to Think Like a Computer Scientist*, 2nd ed., Boston, MA, USA: O'Reilly Media, 2015.
3. K. A. Lambert, *Fundamentals of Python: First Programs*, 2nd ed., Boston, MA, USA: Cengage Learning, 2018.
4. E. Matthes, *Python Crash Course*, 2nd ed., San Francisco, CA, USA: No Starch Press, 2019.
5. R. C. Martin, *Clean Code: A Handbook of Agile Software Craftsmanship*, Upper Saddle River, NJ, USA: Prentice Hall, 2008.

Web Resources / Online Learning

1. Python Software Foundatio, https://www.python.org, Official documentation and tutorials
2. W3Schools, https://www.w3schools.com/python, Beginner-friendly Python and OOP tutorials
3. GeeksforGeeks, https://www.geeksforgeeks.org, OOP concepts with examples and code
4. Real Python, https://realpython.com, Advanced Python and OOP tutorials
5. Programiz, https://www.programiz.com/python-programming, Simple explanations with examples
6. Kaggle, https://www.kaggle.com, Practice Python with datasets
7. Coursera, https://www.coursera.org, Python and OOP certification courses

Assessment Rubrics:

Evaluation Type			**Marks**	**Evaluation Type**			**Marks**	**Total**
Theory Marks			**75**	**Practical Marks**			**25**	**100**
a)	**End Semester Evaluation (Theory ESE)**		**50**	a)	**Practical ESE (2.5 hrs.)**		**15**	
					Program code		**6**	
					Output		**4**	
					Viva		**3**	
					Modification		**2**	
b)	**CCA Theory**		**25**	b)	**CCA (2 hrs.)**		**10**	
	i.	Test Paper	5		i.	Punctuality	3	
	ii.	Model exam	10		ii.	Model exam	4	
	iii.	Assignment/ Book-article review / field report	5		iii	Record	3	
	iv.	Seminar/ Viva-Voce	5					

MODEL QUESTION PAPER (Credit 4)

Time: 90 Minutes **Max Marks:** 50

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

1. Define method overriding in Python.
2. What is the purpose of method overriding?
3. Which OOP concept is related to method overriding?
4. What happens if a derived class does not override a base class method?
5. Can method overriding be applied without inheritance? Justify.
6. What is super() in method overriding?
7. What are the rules for method overriding in Python?
8. Explain the difference between overriding and overloading.

Type B (Answer any FOUR questions – 6 marks each) *(4 × 6 = 24 marks)*

9. Explain method overriding with a simple example.
10. Differentiate method overloading and method overriding.
11. Write a short note on runtime polymorphism with reference to method overriding.
12. Write a Python program to demonstrate method overriding using a base class Shape and derived class Circle.
13. Develop a program to show method overriding using Person and Student classes.
14. Explain method overriding with program and output.

Type C (Answer any ONE question – 14 marks each) *(1 × 14 = 14 marks)*

15. Explain the concept of **method overriding** in detail. Write a Python program demonstrating method overriding using base and derived classes, and explain the output.
16. Design a Python program to demonstrate **runtime polymorphism** using method overriding in a real-world example (e.g., Employee salary calculation or Vehicle type).

KU3DSCDSL203: Logistics Information Systems

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
3	DSC	200-299	KU3DSCDSL203	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	35	65	100	1.5 hrs

Course Description:

This course introduces information systems used in logistics and supply chain operations. It covers digital tools, databases, enterprise systems, and technologies such as WMS, TMS, and ERP. The course emphasizes data-driven logistics, system integration, and real-time tracking for efficient decision-making in modern logistics environments.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand logistics information systems and their components.	U
2	Analyze WMS, TMS, and ERP systems in logistics operations.	A
3	Apply database and data handling techniques in logistics.	A
4	Use analytics tools for logistics performance evaluation.	C
5	Understand emerging technologies and their role in logistics systems.	

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	1	1	2	1	1
CO2	2	3	1	2	3	3	1
CO3	3	3	2	2	3	3	1
CO4	3	3	2	3	3	3	1
CO5	2	2	2	2	2	3	2

Mapping of Course Outcomes to POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	2	1	1	1
CO2	3	2	2	3	2	1
CO3	3	3	2	3	3	1
CO4	3	3	3	3	3	1
CO5	2	2	2	2	3	2

COURSE CONTENTS

	QB No.		DESCRIPTION	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Introduction to Logistics Information Systems**	15
	1	1.1	Basics of Logistics Information Systems: Definition and importance, Role in supply chain management, Types of information systems, Benefits in logistics operations	
		1.2	Components of LIS: Hardware and software components, Data and database systems, Communication networks, Users and processes	
	2	1.3	Information Flow in Logistics: Data flow in supply chain, Order processing systems, Inventory information flow, Real-time data usage	
		1.4	Digital Transformation in Logistics: Role of IT in logistics, Automation in logistics, Cloud-based logistics systems, Industry 4.0 concepts	
MODULE 2				
	UNIT 2		**MODULE 2: Logistics Software Systems**	15
	3	2.1	Warehouse Management Systems (WMS): Functions of WMS, Inventory tracking, Order picking systems, Benefits of WMS	
		2.2	Transportation Management Systems (TMS): Routing and scheduling, Fleet management, Cost optimization, Performance monitoring	
	4	2.3	Enterprise Resource Planning (ERP): ERP basics, Modules related to logistics, Integration of functions, Advantages of ERP	
		2.4	Other Logistics Tools: CRM in logistics, Barcode and RFID systems, GPS tracking systems, Automation tools	
MODULE 3				
	UNIT 3		**MODULE 3: Database and Data Management**	15
	5	3.1	Database Concepts: Database basics, DBMS concepts, Types of databases, Data storage	
		3.2	Data Handling in Logistics: Data collection methods, Data entry and validation, Data cleaning and Data security	
	6	3.3	Data Integration: Data sharing across systems, Integration of WMS, TMS, ERP, Cloud databases, Data synchronization	
		3.4	SQL Basics: Introduction to SQL, Basic queries (SELECT, INSERT), Data retrieval, Applications in logistics	
M				

	UNIT 4		**MODULE 4: Analytics and Emerging Technologies**	15
	7	4.1	Logistics Analytics: KPI analysis, Performance measurement, Data-driven decision-making, Visualization tools	
		4.2	E-Logistics Systems: Digital logistics platforms, E-commerce logistics integration, Online tracking systems, Customer interfaces	
	8	4.3	Emerging Technologies: IoT in logistics, Artificial Intelligence, Blockchain in supply chain, Automation and robotics	
		4.4	Security and Challenges: Data security issues, Cybersecurity in logistics, System failures, Challenges in implementation	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	15
		Activities/ Practical Work:		
		1	Create logistics database and perform basic SQL queries	
		2	Analyze logistics data and KPIs	
		3	Design simple WMS/TMS workflow	
		4	Create dashboard for logistics performance	
		5	Design a Logistics Information System: Data collection, System workflow, KPI analysis, Dashboard/report	

Essential Readings:

[1] J. A. Tompkins et al., *Facilities Planning*, 4th ed., 2010.

[2] M. Christopher, *Logistics & Supply Chain Management*, 5th ed., 2016.

[3] S. Chopra and P. Meindl, *Supply Chain Management*, 7th ed., 2019.

[4] K. Laudon and J. Laudon, *Management Information Systems*, 15th ed., 2018.

Assessment Rubrics:

Evaluation Type			**Marks**	**Evaluation Type**			**Marks**	**Total**
Theory Marks			**75**	**Practical Marks**			**25**	**100**
a)	**End Semester Evaluation (Theory ESE)**		**50**	a)	**Practical ESE (2.5 hrs.)**		**15**	
					Program code		**6**	
					Output		**4**	
					Viva		**3**	
					Modification		**2**	
b)	**CCA**		**25**	b)	**CCA (2 hrs.)**		**10**	
	i.	Test Paper	5		i.	Punctuality	3	
	ii.	Model exam	10		ii.	Model exam	4	
	iii.	Assignment/ Book-article review / field report	5		iii	Record	3	
	iv.	Seminar/ Viva-Voce	5					

MODEL QUESTION PAPER (Credit 4)

Time: 90 Minutes **Max Marks:** 50

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

1. Define Logistics Information System (LIS).
2. What is Warehouse Management System (WMS)?
3. What is Transportation Management System (TMS)?
4. Expand ERP and state its purpose.
5. Define KPI in logistics.
6. What is RFID?
7. What is GPS tracking?
8. What is cloud computing in logistics?

Type B (Answer any FOUR questions – 6 marks each) *(4 × 6 = 24 marks)*

9. Explain the components of a Logistics Information System.
10. Discuss the functions of Warehouse Management System (WMS).
11. Explain Transportation Management System (TMS) with applications.
12. Describe database concepts and data handling in logistics.
13. Explain logistics analytics and KPI-based performance evaluation.
14. Discuss emerging technologies (IoT, AI) in logistics systems.

Type C (Answer any ONE question – 14 marks each) *(1 × 14 = 14 marks)*

15. a) Analyze logistics analytics, KPIs, and dashboards used for performance evaluation
    b) Explain database management and data integration in logistics systems with suitable examples

OR

16. a) Discuss emerging technologies such as IoT, AI, and Blockchain in logistics and their impact on modern supply chains.

    b). Explain Logistics Information Systems in detail, including components, information flow, and role in supply chain management.

KU3DSCDSL204: Fundamentals of Production Logistics

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
3	DSC	200-299	KU3DSCDSL204	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	35	65	100	1.5 hrs

Course Description:

This course introduces the principles of production logistics, focusing on the planning, control, and optimization of material flow in manufacturing systems. It covers inventory management, production planning, scheduling, and integration with supply chain operations.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand the concepts and importance of production logistics	U
2	Apply inventory management techniques for efficient operations	A
3	Analyze production planning and scheduling systems	A
4	Evaluate logistics operations within production environments	C
5	Apply optimization and modern technologies in production logistics	C

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	1	1	1	2	2
CO2	3	3	2	1	1	3	1
CO3	3	3	2	2	2	3	1
CO4	2	2	2	3	2	3	2
CO5	2	3	3	3	2	3	2

Mapping of Course Outcomes to POs

	PO1	PO2	PO3	PO4	PO5	PO6

CO1	2	1	1	1	1	2
CO2	3	2	2	3	1	1
CO3	3	2	3	3	1	1
CO4	2	2	3	3	2	1
CO5	3	3	2	3	2	2

COURSE CONTENTS

	QB No.		DESCRIPTION	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Introduction to Production Logistics**	15
	1	1.1	Introduction to Production Logistics, Role of Logistics in Manufacturing, Production Systems (Job, Batch, Mass Production)	
		1.2	Material Flow in Production Systems, Types of Manufacturing Layouts (Process, Product, Fixed)	
	2	1.3	Production vs Service Logistics, Integration of Production and Supply Chain	
		1.4	Key Performance Indicators (KPI) in Production, Case Study: Production Logistics in Manufacturing Industry	
MODULE 2				
	UNIT 2		**MODULE 2: Inventory Management & Production Control**	15
	3	2.1	Introduction to Inventory, Types of Inventory (Raw, WIP, Finished Goods), Inventory Costs	
		2.2	Inventory Control Techniques (EOQ, ABC Analysis), Reorder Level and Safety Stock, Just-In-Time (JIT)	
	4	2.3	Inventory Tracking Systems, Warehouse Integration, Case Study: Inventory Optimization	
		2.4	Production Control Systems, Shop Floor Control	
MODULE 3				
	UNIT 3		**MODULE 3: Production Planning and Optimization**	15
	5	3.1	Production Planning Concepts, Demand Forecasting Basics, Aggregate Planning	
		3.2	Scheduling Techniques, Capacity Planning	
	6	3.3	Material Requirement Planning (MRP), Case Study: Production Scheduling System	
		3.4	Optimization Techniques in Production, Basics of Linear Programming, Simulation in Production Systems	
MODULE 4				
	UNIT 4		**MODULE 4: Logistics Operations in Production**	15
	7	4.1	Material Handling Systems, Packaging and Storage, Transportation within Production	
		4.2	Lean Manufacturing, Waste Reduction Techniques, Quality Control Basic	
	8	4.3	Automation in Production Logistics, Industry 4.0 Concepts, Case Study: Smart Manufacturing System	
		4.4	Digital Logistics and ERP Systems, Risk Management in	

			Production, Role of Data Science in Production Logistics	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	15
		Activities/ Practical Work:		
		1	EOQ Calculator in Excel for calculating Economic Order Quantity automatically (input columns: Annual Demand (D), Ordering Cost (S), Holding Cost (H)). Excel Formula: =SQRT((2*D*S)/H) Tasks: a) Create a table for 5 products b) Calculate EOQ for each c) Identify optimal order size	
		2	Inventory Control Sheet to track stock levels and reorder alerts (columns are Product Name, Current Stock, Reorder Level, Safety Stock, Status). Formula: =IF(Current Stock<=Reorder Level, "Order Now", "OK") Tasks: a) Create inventory sheet for 10 items b) Highlight low stock using Conditional Formatting	
		3	Visualize production schedule using Stacked Bar Chart (Columns are Task, Start Date and Duration). Steps: • Hide first series (start date) • Show timeline	
		4	Reorder Level & Safety Stock to automate reorder calculations (Inputs are Daily Demand, Lead Time and Max Usage) Formulas: ✓ Reorder Level = Daily Demand * Lead Time ✓ Safety Stock = (Max Usage - Avg Usage) * Lead Time Tasks: • Create sheet for 5 products • Compare reorder points	
		5	Analyze logistics expenses using Transport cost, Storage cost and Labor cost. Tasks: • Create Pie Chart • Create Bar Chart • Identify highest cost	
		6	Find break-even point using Fixed Cost, Variable Cost and Selling Price and create graph showing cost vs revenue Formula: Break-even = Fixed Cost / (Selling Price - Variable Cost)	
		7	**Mini Project:** A small manufacturing company wants to manage its production and inventory efficiently using Microsoft Excel. You are required to design a simple system to support decision-making. Create a dataset for at least 5 products with the following fields: a) Product Name	

			b) Annual Demand c) Ordering Cost d) Holding Cost e) Current Stock f) Daily Demand g) Lead Time 1. Calculate Economic Order Quantity (EOQ) for each product using Excel formula and identify the optimal order quantity. 2. Calculate Reorder Level and Safety Stock ✓ Create a status column (e.g., "Order Now" / "Sufficient Stock") ✓ Apply conditional formatting for low stock 3. Create the following charts: ✓ Bar chart → Product vs Demand ✓ Line chart → Demand trend ✓ Pie chart → Inventory distribution 4. Analysis (Very Important) ✓ Identify product with highest demand & product needing immediate reorder ✓ Suggest 2 improvements for better inventory management	

Essential Readings:

1. Martin Christopher – *Logistics & Supply Chain Management*, Pearson
2. Sunil Chopra – *Supply Chain Management*, Pearson
3. Bowersox, Closs – *Logistical Management*, McGraw Hill
4. Ronald H. Ballou – *Business Logistics Management*, Pearson

Web Resources / Online Learning

1. https://www.apics.org
2. https://www.supplychainbrain.com
3. https://www.investopedia.com/logistics

Assessment Rubrics:

Evaluation Type			**Marks**	**Evaluation Type**			**Marks**	**Total**
Theory Marks			**75**	**Practical Marks**			**25**	**100**
a)	**End Semester Evaluation (Theory ESE)**		**50**	a)	**Practical ESE (2.5 hrs.)**		**15**	
					Practical Exercises		**8**	
					Viva		**3**	
					Modification		**4**	
b)	**CCA Theory**		**25**	b)	**CCA (2 hrs.)**		**10**	
	i.	Test Paper	5		i.	Punctuality	3	
	ii.	Model exam	10		ii.	Model exam	4	

	iii.	Assignment/ Book-article review / field report	5		iii.	Record	3	
	iv.	Seminar/ Viva-Voce	5					

MODEL QUESTION PAPER (Credit 4)

Time: 90 Minutes **Max Marks:** 50

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

1. Define production logistics. What is job production?
2. What is material flow? Define process layout.
3. What is warehouse integration?
4. Define production planning.
5. What is MRP and ERP?
6. Define capacity planning.
7. What is material handling?
8. What is lean manufacturing?

Type B (Answer any FOUR questions – 6 marks each) *(4 × 6 = 24 marks)*

9. Explain material flow in production systems.
10. Explain inventory costs and describe EOQ with formula.
11. Describe scheduling techniques.
12. Explain quality control basics.
13. Explain MRP system.
14. Explain types of production systems.

Type C (Answer any ONE question – 14 marks each) *(1 × 14 = 14 marks)*

15. A). Discuss the role of logistics in manufacturing systems (7 marks)
    B). Compare production and service logistics (7 marks)

    OR

16. C). A company has high inventory cost. Analyze the problem and suggest solutions using EOQ and ABC analysis (8 marks)
    D). Discuss Industry 4.0 and its impact on production logistics (6 marks)

KU4DSCDSL205: DBMS Concepts & SQL Querying

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
4	DSC	200-299	KU4DSCDSL205	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	35	65	100	1.5 hrs

Course Description:

This course introduces the fundamentals of database systems, including data modeling, relational design, and SQL querying. It equips students with the skills to design databases, manage data efficiently, and apply SQL for real-world applications.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand database concepts, DBMS architecture, and data models	U
2	Design relational databases using keys, constraints, and normalization	A
3	Apply SQL commands for data definition and manipulation	A
4	Analyze and implement advanced SQL queries and database concepts	C
5	Develop practical SQL-based solutions for real-world problems	C

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	1	1	1	2	1	2
CO2	3	2	1	1	3	1	1
CO3	3	3	2	2	3	2	1
CO4	3	3	2	3	3	2	1
CO5	3	3	3	3	3	2	2

Mapping of Course Outcomes to POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	1	1	1	2

CO2	3	2	2	2	1	1
CO3	2	3	2	3	2	1
CO4	3	3	3	3	2	1
CO5	3	3	2	3	2	2

COURSE CONTENTS

	QB No.		DESCRIPTION	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Introduction to DBMS**	15
	1	1.1	Introduction to DBMS and its advantages, Data vs Information, Database Users & Roles	
		1.2	DBMS Architecture (1-tier, 2-tier, 3-tier)	
	2	1.3	Types of Databases (Relational, NoSQL basics), Data Models (Hierarchical, Network, Relational)	
		1.4	Entity-Relationship (ER) Model, ER Diagrams (Entities, Attributes, Relationships)	
MODULE 2				
	UNIT 2		**MODULE 2: Relational Model & Database Design**	15
	3	2.1	Relational Model Concepts, Keys (Primary, Foreign, Candidate, Super Key)	
		2.2	Constraints (Domain, Entity Integrity, Referential Integrity)	
	4	2.3	Relational Algebra (Basic operations)	
		2.4	Functional Dependencies, Normalization (1NF, 2NF, 3NF, BCNF), Schema Design and Anomalies	
MODULE 3				
	UNIT 3		**MODULE 3: SQL – Data Definition & Manipulation**	15
	5	3.1	Introduction to SQL, Data Types in SQL, DDL Commands: • CREATE, ALTER, DROP	
		3.2	DML Commands: • INSERT, UPDATE, DELETE	
	6	3.3	SELECT statement WHERE, ORDER BY, GROUP BY	
		3.4	Aggregate Functions (SUM, AVG, COUNT, MAX, MIN)	
MODULE 4				
	UNIT 4		**MODULE 4: Advanced SQL & Database Concepts**	15
	7	4.1	Joins (Inner, Outer, Self Join)	
		4.2	Subqueries, Views, Indexing basics	
	8	4.3	Transactions (ACID properties)	
		4.4	Concurrency Control basics, Security and Authorization	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	15
		Activities/ Practical Work:		
		1	WorkOn Databases: ✓ emp (eno, ename, bdate, title, salary, dno) ✓ proj (pno, pname, budget, dno)	

			✓ dept (dno, dname, mgreno) ✓ workson (eno, pno, resp, hours)	
		2	Insert 5-10 records into the databases.	
		3	Write an SQL query that returns the project number and name for projects with a budget greater than $100,000.	
		4	Write an SQL query that returns all works on records where hours worked is less than 10 and the responsibility is 'Manager'.	
		5	Write an SQL query that returns the employees (number and name only) who have a title of 'EE' or 'SA' and make more than $35,000.	
		6	Write an SQL query that returns the employees (name only) in department 'D1' ordered by decreasing salary.	
		7	Write an SQL query that returns the project name, hours worked, and project number for all works on records where hours > 10.	
		8	Write an SQL query that returns the project name, department name, and budget for all projects with a budget < $50,000.	
		9	Write an SQL query that returns the employee name, project name, employee title, and hours for all works on records.	
		10	Write an SQL query that returns the employee numbers and salaries of all employees in the 'Consulting' department ordered by descending salary.	
		11	Perform Join Operations	
		12	Create a VIEW for high-salaried three employees	

Essential Readings:

- Korth, Silberschatz & Sudarshan – *Database System Concepts*
- Elmasri & Navathe – *Fundamentals of Database Systems*
- Raghu Ramakrishnan – *Database Management Systems*
- C.J. Date – *An Introduction to Database Systems*

REFERENCE BOOKS:

- Peter Rob, Carlos Coronel (2009), Database Systems Design, Implementation and Management, 7thedition

Web Resources / Online Learning

- ✓ Learn SQL (W3Schools): https://www.w3schools.com/sql/?utm_source=chatgpt.com
- ✓ SQL Tutorial (GeeksforGeeks): https://www.geeksforgeeks.org/sql/sql-tutorial/
- ✓ MySQL Official Documentation: https://dev.mysql.com/doc/
- ✓ PostgreSQL Tutorials: https://www.postgresql.org/docs/

Assessment Rubrics:

Evaluation Type		**Marks**	**Evaluation Type**		**Marks**	**Total**
Theory Marks		**75**	**Practical Marks**		**25**	
a)	**End Semester Evaluation (Theory ESE)**	**50**	a)	**Practical ESE (2.5 hrs.)**	**15**	

					Program code		6	100
					Output		4	
					Viva		3	
					Modification		2	
b)	**CCA Theory**		**25**	b)	**CCA (2 hrs.)**		**10**	
	i.	Test Paper	5		i.	Punctuality	3	
	ii.	Model exam	10		ii.	Model exam	4	
	iii.	Assignment/ Book-article review / field report	5		iii	Record	3	
	iv.	Seminar/ Viva-Voce	5					

MODEL QUESTION PAPER (Credit 4)

Time: 90 Minutes **Max Marks:** 50

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

1. Define DBMS. What is a data model?
2. Define primary key and foreign key.
3. What is normalization? Explain Types
4. What is a table and view?
5. Explain ACID properties
6. Define DDL and DML Commands
7. What are different join operations? Explain
8. Define transaction.

Type B (Answer any FOUR questions – 6 marks each) *(4 × 6 = 24 marks)*

9. Explain DBMS architecture.
10. Describe types of keys.
11. Explain normalization with examples.
12. Write SQL commands for CREATE and INSERT.
13. Explain GROUP BY and ORDER BY.
14. Describe different types of joins.

Type C (Answer any ONE question – 14 marks each) *(1 × 14 = 14 marks)*

15. A). Design a database for a student management system and write SQL queries (10 Marks).
    B). Explain SQL aggregate functions with examples (4 Marks).

    OR

16. A). Explain normalization up to BCNF with examples (10 Marks).
    B). Explain ER model with diagram (4 Marks).

KU4DSCDSL206: Data Structures and Algorithms

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
4	DSC	200-299	KU4DSCDSL206	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	35	65	100	1.5 hrs

Course Description:

This course introduces the fundamental concepts of data structures and algorithm analysis, including time and space complexity and searching techniques. It covers essential data structures such as arrays, stacks, queues, linked lists, and trees along with their operations and applications. The course also focuses on sorting techniques, graph representations and traversals, and shortest path algorithms. Additionally, it explores hashing methods and collision resolution techniques for efficient data storage and retrieval.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand and analyze fundamental concepts of data structures and algorithms and apply searching techniques like linear and binary search	U
2	Apply and implement various sorting algorithms and perform operations on stacks, queues.	A
3	Design and implement linked lists and perform operations.	A
4	Understand and demonstrate concepts of advanced tree structures.	U/An
5	Perform graph traversals (BFS, DFS), and apply shortest path algorithms like Dijkstra's algorithm	C
6	Apply hashing techniques, design hash tables, and resolve collisions	A

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	1	-	-	1	-	-
CO2	2	2	-	-	1	-	-
CO3	2	1	-	-	2	-	-
CO4	1	1	-	-	2	-	1
CO5	2	3	1	-	1	2	-

CO6	2	2	-	-	3	2	1

Mapping of Course Outcomes to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	1	2	1	-
CO2	3	3	1	3	1	-
CO3	2	3	1	3	1	-
CO4	2	2	-	2	-	1
CO5	3	3	2	3	1	-
CO6	3	3	1	3	-	1

COURSE CONTENTS

	QB No.		**DESCRIPTION**	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Data Structures & Array Searching**	15
	1	1.1	Introduction to Data Structures and its types, Basics Analysis on Algorithm, Time and space complexity, worst-case and average-case analyses, Use of order notations.	
		1.2	Algorithm Design Techniques: Brute Force, Divide and Conquer, Dynamic Programming, Greedy Method, Backtracking, Branch and Bound (Definitions and examples only).	
	2	1.3	Master's theorem and its applications	
		1.4	Arrays: Definition, 1D & Multidimensional Arrays, Linear & Binary Search	
MODULE 2				
	UNIT 2		**MODULE 2: Sorting, Stacks and Queue**	15
	3	2.1	Sorting: Bubble Sort & Selection Sort, Quick Sort and Merge Sort	
		2.2	Stack and Queue operations & applications	
	4	2.3	Circular Queue and Priority Queue	
		2.4	Heaps: Max Heap and Min Heap, Applications	
MODULE 3				
	UNIT 3		**MODULE 3: Linked Lists and Trees**	15
	5	3.1	Representation and Operations of Linked Lists, Singly Linked List, Doubly Linked List	
		3.2	Circular Linked List and Circular Doubly Linked List	
	6	3.3	Trees: Binary Tree, Binary Search Tree, Strictly Binary Tree, Complete Binary Tree, Tree Traversal, Operations: Searching, Insertion and Deletion	
		3.4	Threaded Binary Tree, AVL Tree, B Tree, B+ Tree – Definitions only	
MODULE 4				
	UNIT 4		**MODULE 4: Graphs, Searching, Sorting and Hashing**	15
	7	4.1	Representation to Graphs, Graph Traversals	

		4.2	Shortest Path Algorithms: Dijkstra's Algorithm	
	8	4.3	Hash Table, Hashing, Types of Hash Functions	
		4.4	Collision and Collision Resolution Techniques	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	15
		Activities/ Practical Work:		
		1	Implement Linear Search and Binary Search	
		2	Create and perform operations on 1D Arrays: Insert, Delete and Traverse	
		3	Implement 2D Array (Matrix) operations: Addition & Multiplication	
		4	Implement Stack using Array and linked list	
		5	Implement Queue using Array	
		6	Implement Bubble Sort	
		7	Implement Quick Sort	
		8	Implement Singly and Doubly Linked Lists: • Insert (beginning, end, position) • Delete • Traverse	

Recommended Readings:

1. T.Cormen, C.Lieserson, R.Rivest, and C.Stein, "Introductions to Algorithms", Prentice-Hall/India, 3rd edition, 2009
2. Data structures, Algorithms and Applications in C++, S.Sahni, University Press (India) Pvt.Ltd, 2nd edition, Universities Press Orient Longman Pvt. Ltd. Education.
3. Gilberg & Forouzan, Data Structures: A Pseudo-code approach with C, 2nd Ed, Cengage Learning,2014.
4. Reema Thareja, Data Structures using C, 3rd Ed, Oxford press, 2012.
5. Jean-Paul Tremblay & Paul G. Sorenson, An Introduction to Data Structures with Applications, 2 nd Ed, McGraw Hill, 2013
6. A M Tenenbaum, Data Structures using C, PHI, 1989 5. Robert Kruse, Data Structures and Program Design in C, 2nd Ed, PHI, 1996.

Web Resources / Online Learning

- https://sbs.ac.in/wp-content/uploads/2021/02/BCA-3rd-Data-Structure.pdf
- https://mrcet.com/downloads/digital_notes/CSE/II%20Year/DATA%20STRUCTURES%20DIGITAL%20NOTES.pdf

Assessment Rubrics:

Evaluation Type		**Marks**	**Evaluation Type**		**Marks**	**Total**
Theory Marks		**75**	**Practical Marks**		**25**	
a)	**End Semester Evaluation (Theory ESE)**	**50**	a)	**Practical ESE (2.5 hrs.)**	**15**	
				Program code	**6**	
				Output	**4**	

					Viva		**3**	**100**
					Modification		**2**	
b)	**CCA Theory**		**25**	b)	**CCA (2 hrs.)**		**10**	
	i.	Test Paper	5		i.	Punctuality	3	
	ii.	Model exam	10		ii.	Model exam	4	
	iii.	Assignment/ Book-article review / field report	5		iii	Record	3	
	iv.	Seminar/ Viva-Voce	5					

MODEL QUESTION PAPER (Credit 4)

Time: 90 Minutes **Max Marks:** 50

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

1. What is time complexity? Define Big-O notation.
2. What is linear search and binary search?
3. Define stack and queue?
4. Define linked list. What is a doubly linked list?
5. What is a binary tree and binary search tree?
6. What is BFS and DFS?
7. Define collision in hashing.
8. What is a heap? Define Min Heap.

Type B (Answer any FOUR questions – 6 marks each) *(4 × 6 = 24 marks)*

9. Explain Bubble Sort with example.
10. Describe algorithm design techniques with example.
11. What is circular queue? Explain with diagram.
12. Explain singly linked list operations.
13. Write short notes on Binary Search Tree.
14. Explain collision resolution techniques.

Type C (Answer any ONE question – 14 marks each) *(1 × 14 = 14 marks)*

15. A). Write algorithm for Merge Sort and explain step-by-step (8 Marks).
    B). Implement stack using linked list with algorithm (6 Marks).

    OR

16. A). Explain Dijkstras algorithm step-by-step (8 Marks).
    B). Explain hashing techniques and all collision resolution methods (6 Marks).

KU4DSCDSL207: Supply Chain Logistic Operations

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
4	DSC	200-299	KU4DSCDSL207	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2 hrs

Course Description:

This course provides a comprehensive understanding of supply chain logistics operations including inventory management, transportation, procurement, warehousing, and logistics network design. It focuses on planning, coordination, and optimization of logistics activities for efficient supply chain performance. The course also introduces transportation economics, procurement strategies, packaging, and warehouse operations. Students will gain practical knowledge of modern logistics systems and strategic decision-making in global supply chains.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand inventory functionality, inventory carrying costs, safety stock concepts, and inventory management policies used in supply chain logistics operations.	U
2	Analyze transportation functionalities, transportation modal structures, transportation economics, pricing, and transportation management practices.	An
3	Explain procurement objectives, supplier selection methods, procurement interfaces, and supply chain planning applications with forecasting techniques.	U
4	Evaluate warehousing operations, packaging perspectives, handling efficiency, warehouse decisions, and enterprise facility network concepts.	E
5	Apply concepts of total cost integration, logistics network design, and logistical strategy formulation for effective supply chain management in a global economy.	A

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	1	1	1	3	1

CO2	2	3	1	1	1	3	2
CO3	2	3	2	1	1	2	1
CO4	2	2	1	2	1	3	2
CO5	2	3	2	2	2	3	2

Mapping of Course Outcomes to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	1	2	2	1	1
CO2	3	2	3	3	1	1
CO3	2	2	3	3	2	1
CO4	2	2	2	3	2	1
CO5	3	2	3	3	2	2

COURSE CONTENTS

	QB No.		**DESCRIPTION**	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Inventory**	12
	1	1.1	Inventory Functionality and Definitions, Inventory Carrying Cost: Capital, Taxes, Insurance Obsolescence and Storage, Planning Inventory	
		1.2	Managing Uncertainty: Demand Uncertainty, Performance Cycle Safety Stock with Combined Uncertainty, Estimating Full Rate, Dependent Demand Replenishment	
	2	1.3	Inventory Management Policies: Inventory Control, Reactive Methods, Planning Methods, Collaborative inventory Replenishment	
		1.4	Inventory Management Practices: Product/Market Classification, Segment Strategy Definition, Policies and Parameters	
MODULE 2				
	UNIT 2		**MODULE 2: Transportation**	13
	3	2.1	Transport Functionalities and Participants, From Regulation to a Free Market System, Transportation Modal Structure (Rail, Truck, Water, Pipeline, Air)	
		2.2	Modal Comparative Characteristics and Capabilities, Infrastructure in Crisis, Specialized Transportation Services (Package Services, Intermodal, Nonoperating Intermediaries)	
	4	2.3	Transportation Economics and Pricing (Economy of Distance, Weight and Density, Other Pricing Factors, Costing and Pricing Freight)	
		2.4	Transportation Management, Documentation, Product Pricing &Transportation	
M QB				
	UNIT 3		**MODULE 3: Procurement**	12

	5	3.1	Procurement Objectives and Strategy	
		3.2	Supplier Selection and Assessment	
	6	3.3	Logistical Interfaces with Procurement	
		3.4	Supply Chain Planning Applications and Forecasting	
MODULE 4				
	UNIT 4		**MODULE 4: Warehousing, Packaging, Handling & Network Design**	10
	7	4.1	Strategic Warehousing, Warehouse Operations, Warehouse Ownership Arrangements, Warehouse Decisions	
		4.2	Packaging Perspectives, Packaging for Handling Efficiency, Handling	
	8	4.3	Enterprise Facility Network, Warehouse Requirements, Systems Concept and Analysis, Total Cost Integration	
		4.4	Formulating Logistical Strategy, Other Considerations in Logistics Network Design, Logistics in Global Economy	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	10
		Activities:		
		1	https://nptel.ac.in/courses/110106045, Submit Operations and Supply Chain Management Course Completion Certificate offered by IIT Madras (NPTEL).	
		2	Apply concepts of total cost integration, logistics network design, and logistical strategy formulation for effective supply chain management in a global economy.	

Text Books:

1. Donald J. Bowersox, David J Closs, Bixby Cooper M. (2014). Supply Chain Logistics Management. McGraw Hill Education.

References:

1. Sunil Chopra, Peter Meindl, Kalra D.V. (2018). Supply Chain Management: Strategy, Planning and Operation (7th edition). Pearson Education Ltd.
2. Nada R. Sanders (2013). Supply Chain Management: A Global Perspective. John Wiley & Sons.
3. Sahay B.S. (2012). Supply Chain Management for Global Competitiveness. MacMillan India Ltd.
4. David N Burt, Donald W. Dobler, Stephen L Starling (2012). World Class Supply Chain Management: The Key to Supply Chain Management. McGraw Hill Education.
5. Sople V.V. (2013). Logistics Management: Supply Chain Imperative. Pearson Education.
6. Alan. E. Branch (2008). Global Supply Chain Management and International Logistics. Routledge.

Assessment Rubrics:

Evaluation Type		**Marks**
a)	**End Semester Evaluation (Theory ESE)**	**70**

b)	**CCA**		**30**
	i.	Test Paper	5
	ii.	Model exam	10
	iii.	Assignment/ Book-article review / field report	5
	iv.	Seminar/ Viva-Voce	5
	V	Certificate	5
Total			**100**

MODEL QUESTION PAPER (Credit 4)

Time: 2 hrs. **Max Marks:** 70

Type A (Answer any SIX questions – 3 marks each) *(6 × 3 = 18 marks)*

1. List the components of inventory cost.
2. Differentiate dependent and independent demand.
3. What is collaborative inventory replenishment?
4. Define economy of distance.
5. What is freight pricing?
6. What is procurement objective?
7. Explain logistics strategy formulation.
8. List the objectives of warehousing.

Type B (Answer any FOUR questions – 6 marks each) *(4× 6 = 24 marks)*

9. Explain reactive and planning methods in inventory management.
10. Discuss product/market classification in inventory management.
11. Explain transportation documentation.
12. Discuss transportation economics and pricing factors.
13. Discuss supplier selection and assessment methods.
14. Explain enterprise facility networks and warehouse requirements.

Type C (Answer any TWO questions – 14 marks each) *(2 × 14 =28 marks)*

15. A). Explain inventory management policies and practices in detail.
    B). Discuss the integration of procurement with logistics operations.
16. A). Discuss formulation of logistical strategies and global logistics challenges.
    B). Evaluate the role of packaging and handling systems in logistics efficiency.
17. A). Discuss transportation costing and freight pricing methods in detail.
    B). Explain the role of inventory planning in supply chain logistics operations.

KU4DSCDSL208: Statistical Pattern Recognition

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
4	DSC	200-299	KU4DSCDSL208	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	35	65	100	1.5 hrs

Course Description:

This course introduces the principles and techniques of statistical pattern recognition for analyzing and classifying data. It covers decision theory, distance-based classification, Bayesian methods, clustering algorithms, and feature selection techniques. Students will learn supervised and unsupervised pattern recognition approaches and their practical applications. The course also explores dimensionality reduction methods for developing efficient and accurate pattern recognition systems.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Explain the fundamental concepts, applications, and classification approaches used in pattern recognition systems.	U
2	Analyze and formulate decision functions, discriminant functions, and distance-based classifiers for pattern classification.	A
3	Apply statistical pattern recognition techniques, including Bayesian classification, probability distributions, and distance measures, to solve classification problems.	A
4	Implement clustering algorithms and evaluate their effectiveness in discovering patterns and structures in data.	C
5	Utilize feature selection, feature extraction, and dimensionality reduction techniques to improve the performance of pattern recognition systems.	

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	1	-	-	-	-
CO2	3	3	2	-	-	1	-
CO3	3	3	3	-	-	1	1
CO4	2	2	3	1	-	2	-

CO5	3	3	2	1	1	1	1

Mapping of Course Outcomes to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	1	2	-	-	-
CO2	3	2	3	2	-	-
CO3	3	3	3	3	-	1
CO4	2	3	3	3	1	-
CO5	3	3	2	2	-	1

COURSE CONTENTS

	QB No.		**DESCRIPTION**	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Pattern Recognition & Decision functions**	15
	1	1.1	Basic Concepts in Pattern Recognition, Pattern Recognition Applications, Knowledge discovery (KD) and data mining (DM).	
		1.2	Pattern Representation and Feature Vectors, Training, Validation & Testing Data Sets, Curse of Dimensionality, Classifiers: Bayes Classifiers, Fuzzy Classifiers, & Neural Nets	
	2	1.3	Decision Functions: Basic Concepts, Linear Decision Functions, Absolute Separation and Pairwise Separation	
		1.4	Hyperplanes and Basic Properties, Dichotomies	
MODULE 2				
	UNIT 2		**MODULE 2: Decision Functions and Classifications**	15
	3	2.1	Orthogonal Functions: Univariate and Multivariate Functions	
		2.2	Orthogonal Polynomial Functions: Legendre, Laguerre and Hermite Polynomials.	
	4	2.3	Minimum-Distance Classifiers, Single Prototype and Multi-prototype Classification, Nearest Neighbour Classification	
		2.4	k-Nearest Neighbour (k-NN) Classification, Fisher Linear Discriminant, Classes with Non-similar Patterns	
MODULE 3				
	UNIT 3		**MODULE 4: Clusters and Clustering**	15
	5	3.1	Introduction, Similarity and Distance Measures, Threshold Order-Dependent Clustering Algorithm	
		3.2	Max-Min Distance Method, c-Means Iterative Algorithm	
	6	3.3	ISODATA Algorithm	
		3.4	Hierarchical Clustering: Agglomerative and Divisive Clustering	
MODULE 4				
	UNIT 4		**MODULE 4: Statistical Pattern Recognition**	15
	7	4.1	Introduction, A Priori and a Posteriori Probabilities, Conditional Probabilities, Bayes Decision Theory, Bayesian Classification	

		4.2	Univariate and Multivariate Normal Distributions, Euclidean and Mahalanobis distance	
	8	4.3	Mean Vector and Covariance Matrix, Probability Density Functions, Maximum Likelihood Estimation (MLE), Maximum Entropy	
		4.4	Feature Selection: Types, Distance Measures, Feature Selection by Entropy Minimization and Functional Approximation, Feature Extraction vs Feature Selection.	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	15
		Activities/ Practical Work:		
		1	**Data Preprocessing:** Load datasets, Handle missing values, Data normalization and standardization, Visualization of features.	
		2	**Distance Measures:** Compute Euclidean Distance, Manhattan Distance & Mahalanobis Distance, Compare results for sample datasets.	
		3	**Minimum Distance Classifier:** Implement Minimum Distance Classification and Classify patterns using single prototypes.	
		4	**Nearest Neighbour Classification:** Implement KNN classifier and calculate classification accuracy.	
		5	**Bayesian Classification:** Implement Bayes Classifier and compute prior and posterior probabilities, Classify sample datasets.	
		6	**Fisher Linear Discriminant:** Implement Fisher's Linear Discriminant and visualize class separation.	
		7	**Feature Selection:** Correlation-based and Entropy-based feature selection. Compare classification performance before and after feature selection.	
		8	**Principal Component Analysis (PCA):** Reduce dimensionality using PCA and visualize transformed data, then analyze explained variance.	

Essential Readings:

1. Pattern Classification – Richard O. Duda, Peter E. Hart and David G. Stork.
2. Introduction to Pattern Recognition.
3. Pattern Recognition and Machine Learning.

Assessment Rubrics:

Evaluation Type			**Marks**	**Evaluation Type**			**Marks**	**Total**
Theory Marks			**75**	**Practical Marks**			**25**	**100**
a)	**End Semester Evaluation (Theory ESE)**		**50**	a)	**Practical ESE (2.5 hrs.)**		**15**	
					Program code		**6**	
					Output		**4**	
					Viva		**3**	
					Modification		**2**	
b)	**CCA**		**25**	b)	**CCA (2 hrs.)**		**10**	
	i.	Test Paper	5		i.	Punctuality	3	

	ii.	Model exam	10		ii.	Model exam	4	
	iii.	Assignment/ Book-article review / field report	5		iii	Record	3	
	iv.	Seminar/ Viva-Voce	5					

KU5DSCDSL301: Logistics Information Systems & Analytics

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
5	DSC	300-399	KU5DSCDSL301	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	35	65	100	1.5 hrs

Course Description:

This course introduces information systems used in logistics and supply chain operations. It covers digital tools, databases, enterprise systems, and technologies such as WMS, TMS, and ERP. The course emphasizes data-driven logistics, system integration, and real-time tracking for efficient decision-making in modern logistics environments.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand logistics information systems and their components.	U
2	Analyze WMS, TMS, and ERP systems in logistics operations.	A
3	Apply database and data handling techniques in logistics.	A
4	Use analytics tools for logistics performance evaluation.	C
5	Understand emerging technologies and their role in logistics systems.	

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	1	1	2	1	1
CO2	2	3	1	2	3	3	1
CO3	3	3	2	2	3	3	1
CO4	3	3	2	3	3	3	1
CO5	2	2	2	2	2	3	2

Mapping of Course Outcomes to POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	2	1	1	1
CO2	3	2	2	3	2	1
CO3	3	3	2	3	3	1
CO4	3	3	3	3	3	1
CO5	2	2	2	2	3	2

COURSE CONTENTS

	QB No.		DESCRIPTION	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Introduction to Logistics Information Systems**	15
	1	1.1	Basics of Logistics Information Systems: Definition and importance, Role in supply chain management, Types of information systems, Benefits in logistics operations	
		1.2	Components of LIS: Hardware and software components, Data and database systems, Communication networks, Users and processes	
	2	1.3	Information Flow in Logistics: Data flow in supply chain, Order processing systems, Inventory information flow, Real-time data usage	
		1.4	Digital Transformation in Logistics: Role of IT in logistics, Automation in logistics, Cloud-based logistics systems, Industry 4.0 concepts	
MODULE 2				
	UNIT 2		**MODULE 2: Logistics Software Systems**	15
	3	2.1	Warehouse Management Systems (WMS): Functions of WMS, Inventory tracking, Order picking systems, Benefits of WMS	
		2.2	Transportation Management Systems (TMS): Routing and scheduling, Fleet management, Cost optimization, Performance monitoring	
	4	2.3	Enterprise Resource Planning (ERP): ERP basics, Modules related to logistics, Integration of functions, Advantages of ERP	
		2.4	Other Logistics Tools: CRM in logistics, Barcode and RFID systems, GPS tracking systems, Automation tools	
MODULE 3				
	UNIT 3		**MODULE 3: Database and Data Management**	15
	5	3.1	Database Concepts: Database basics, DBMS concepts, Types of databases, Data storage	
		3.2	Data Handling in Logistics: Data collection methods, Data entry and validation, Data cleaning and Data security	
	6	3.3	Data Integration: Data sharing across systems, Integration of WMS, TMS, ERP, Cloud databases, Data synchronization	
		3.4	SQL Basics: Introduction to SQL, Basic queries (SELECT, INSERT), Data retrieval, Applications in logistics	
MODULE 4				
	UNIT 4		**MODULE 4: Analytics and Emerging Technologies**	15

	7	4.1	Logistics Analytics: KPI analysis, Performance measurement, Data-driven decision-making, Visualization tools	
		4.2	E-Logistics Systems: Digital logistics platforms, E-commerce logistics integration, Online tracking systems, Customer interfaces	
	8	4.3	Emerging Technologies: IoT in logistics, Artificial Intelligence, Blockchain in supply chain, Automation and robotics	
		4.4	Security and Challenges: Data security issues, Cybersecurity in logistics, System failures, Challenges in implementation	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	15
		Activities/ Practical Work:		
		1	Logistics Information Flow Mapping Tool: Draw.io / Lucidchart • Create a data flow diagram (DFD) for order processing • Show flow between supplier → warehouse → customer *Skill:* Process visualization (used in analyst roles) Data: Order_ID,Customer_ID,Order_Date,Warehouse_ID,Dispatch_Date,Delivery_Date,Status 101,C1,01-01-2024,W1,02-01-2024,04-01-2024,Delivered 102,C2,02-01-2024,W2,03-01-2024,06-01-2024,Delivered 103,C3,03-01-2024,W1,05-01-2024,08-01-2024,Delayed 104,C4,04-01-2024,W3,05-01-2024,07-01-2024,Delivered The dataset shows how an order moves through the system: • Order placed → Warehouse assigned → Dispatch → Delivery Students learn how data moves across systems (WMS, TMS, ERP)	
		2	LIS Components Identification Tool: Excel / Case Study • Identify hardware, software, users in a logistics company • Map system architecture *Skill:* System understanding (useful for ERP roles) Data: Component_ID,Type,Description,Department 1,Hardware,Barcode Scanner,Warehouse 2,Software,WMS System,Inventory 3,Network,Cloud Server,IT 4,User,Manager,Operations	
		3	Warehouse Management System (WMS) Simulation Tool: Odoo / Zoho Inventory • Create warehouse • Track inventory • Perform order picking *Skill:* Warehouse operations (high demand job skill) WMS Dataset: Item_ID,Item_Name,Warehouse_ID,Stock_Level,Reorder_Level,Location 1,ItemA,W1,100,50,A1 2,ItemB,W1,80,40,A2 3,ItemC,W2,60,30,B1 4,ItemD,W3,120,60,C1	
			Transportation Management System (TMS) Tool: Excel / Python • Plan delivery routes	

		4	• Optimize cost & time *Skill:* Transport planning TMS Dataset: Vehicle_ID,Route,Distance_km,Fuel_Cost,Delivery_Time_hr V1,A-B,100,500,3 V2,B-C,150,700,5 V3,A-C,200,900,6 V4,C-D,120,600,4	
		5	ERP Hands-on Practice Tool: Odoo / SAP (Demo) • Create purchase order • Process sales order • Generate reports *Skill:* ERP executive roles ERP Dataset: Order_ID,Product,Quantity,Supplier,Order_Status,Payment_Status 201,P1,100,S1,Processed,Paid 202,P2,150,S2,Pending,Unpaid 203,P3,200,S3,Shipped,Paid 204,P4,120,S1,Delivered,Paid	
		6	Barcode & RFID Simulation Tool: Online barcode generator / Excel • Generate barcodes • Simulate scanning & tracking *Skill:* Inventory automation Barcode/RFID Tracking Data: Item_ID,Barcode,Scan_Time,Location,Status 1,123456,10:00,W1,Received 2,234567,11:00,W1,Stored 3,345678,12:00,W2,Dispatched 4,456789,13:00,W3,Delivered	
		7	Data Cleaning & Validation Tool: Excel / Python (Pandas) • Handle missing values • Remove duplicates *Skill:* Data preprocessing Data Cleaning Dataset: Order_ID,Customer,Amount 101,Alice,5000 102,Bob, 103,Charlie,6000 103,Charlie,6000 104,,7000	
		8	Data Integration Task Tool: Excel / Power BI • Combine data from WMS + TMS • Create unified dataset *Skill:* Data integration Database (Orders + Customers): Customer_ID,Name,City C1,Alice,Delhi C2,Bob,Mumbai	

			C3,Charlie,Chennai C4,David,Kochi Order_ID,Customer_ID,Amount,Date 101,C1,5000,01-01-2024 102,C2,7000,02-01-2024 103,C3,6000,03-01-2024 104,C4,8000,04-01-2024	
		9	Design a Logistics Information System: ✓ Data collection ✓ System workflow ✓ KPI analysis ✓ Dashboard/report	

Essential Readings:

[1] J. A. Tompkins et al., *Facilities Planning*, 4th ed., 2010.

[2] M. Christopher, *Logistics & Supply Chain Management*, 5th ed., 2016.

[3] S. Chopra and P. Meindl, *Supply Chain Management*, 7th ed., 2019.

[4] K. Laudon and J. Laudon, *Management Information Systems*, 15th ed., 2018.

Assessment Rubrics:

Evaluation Type			**Marks**	**Evaluation Type**			**Marks**	**Total**
Theory Marks			**75**	**Practical Marks**			**25**	**100**
a)	**End Semester Evaluation (Theory ESE)**		**50**	a)	**Practical ESE (2.5 hrs.)**		**15**	
					Program code		**6**	
					Output		**4**	
					Viva		**3**	
					Modification		**2**	
b)	**CCA**		**25**	b)	**CCA (2 hrs.)**		**10**	
	i.	Test Paper	5		i.	Punctuality	3	
	ii.	Model exam	10		ii.	Model exam	4	
	iii.	Assignment/ Book-article review / field report	5		iii	Record	3	
	iv.	Seminar/ Viva-Voce	5					

MODEL QUESTION PAPER (Credit 4)

Time: 90 Minutes **Max Marks:** 50

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

1. Define Logistics Information System (LIS).
2. What is Warehouse Management System (WMS)?
3. What is Transportation Management System (TMS)?
4. Expand ERP and state its purpose.
5. Define KPI in logistics.
6. What is RFID?
7. What is GPS tracking?
8. What is cloud computing in logistics?

Type B (Answer any FOUR questions – 6 marks each) *(4 × 6 = 24 marks)*

9. Explain the components of a Logistics Information System.
10. Discuss the functions of Warehouse Management System (WMS).
11. Explain Transportation Management System (TMS) with applications.
12. Describe database concepts and data handling in logistics.
13. Explain logistics analytics and KPI-based performance evaluation.
14. Discuss emerging technologies (IoT, AI) in logistics systems.

Type C (Answer any ONE question – 14 marks each) *(1 × 14 = 14 marks)*

15. a) Analyze logistics analytics, KPIs, and dashboards used for performance evaluation
    c) Explain database management and data integration in logistics systems with suitable examples

OR

16. a) Discuss emerging technologies such as IoT, AI, and Blockchain in logistics and their impact on modern supply chains.
    b). Explain Logistics Information Systems in detail, including components, information flow, and role in supply chain management.

KU5DSCDSL302: Artificial Intelligence: A Modern Approach

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
5	DSC	300-399	KU5DSCDSL302	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2 hrs

Course Description:

This course provides a comprehensive introduction to Artificial Intelligence (AI) concepts, intelligent agents, and problem-solving techniques. It covers search strategies, adversarial search, constraint satisfaction problems, logical reasoning, and knowledge representation methods used in AI systems. The course also focuses on first-order logic, probabilistic reasoning, Bayesian networks, and decision-making under uncertainty. Students will gain foundational knowledge of AI techniques and their applications in intelligent decision support systems.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand the fundamental concepts of Artificial Intelligence, intelligent agents, problem-solving approaches, and search strategies used in AI systems.	U
2	Analyze uninformed and informed search techniques, heuristic functions, adversarial search methods, and constraint satisfaction problems in AI.	An
3	Apply logical reasoning, propositional logic, first-order logic, and knowledge representation techniques for intelligent problem solving.	A
4	Evaluate inference mechanisms including unification, forward chaining, backward chaining, and resolution methods in knowledge-based systems.	E
5	Analyze uncertainty handling, probabilistic reasoning, Bayesian networks, utility theory, and decision-making techniques in intelligent systems.	An

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	1	2	2	-	-	1	1
CO2	1	3	3	-	-	2	1

CO3	1	3	2	1	-	2	1
CO4	1	3	2	1	-	2	1
CO5	2	3	2	1	-	3	2

Mapping of Course Outcomes to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	2	2	1	1
CO2	3	2	3	3	1	1
CO3	3	2	3	3	1	1
CO4	3	2	3	3	1	1
CO5	3	2	3	3	2	2

COURSE CONTENTS

	QB No.		**DESCRIPTION**	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Introduction & Problem Solving**	15
	1	1.1	Definitions of AI – Intelligent Agents	
		1.2	Problem solving by searching: Problem-solving agents – Example problems – Search for solutions	
	2	1.3	Uninformed search strategies – Informed search strategies	
		1.4	Heuristic Functions	
MODULE 2				
	UNIT 2		**MODULE 2: Adversarial search & CSPs**	13
	3	2.1	Adversarial search: Games – Optimal decisions in games	
		2.2	Alpha-beta pruning – Imperfect real time decisions	
	4	2.3	Constraint Satisfaction Problems (CSP): Defining CSPs	
		2.4	Constraint Propagation: Inference in CSPs – Backtracking search for CSPs.	
MODULE 3				
	UNIT 3		**MODULE 3: Logics and Knowledge Representation**	12
	5	3.1	Logical agents: Knowledge-based agents – The Wumpus world – Logic	
		3.2	Propositional logic: A very simple logic – Propositional theorem proving.	
	6	3.3	First order logic: Representation – Syntax and semantics of first order logic – Using first order logic – PROLOG basics.	
		3.4	Inference in first order logic: Propositional versus first order inference– Unification and lifting –Forward chaining – Backward chaining – Resolution	
MODULE 4				
	UNIT 4		**MODULE 4: Uncertainty and Decision Making**	10
	7	4.1	Making Simple Decisions: Combining beliefs and desires under Uncertainty - Utility Theory - Utility Functions - Multi-attribute	

			utility functions.	
		4.2	Quantifying uncertainty: Acting under uncertainty - Probability basics – Bayes' Rule and its use.	
	8	4.3	Probabilistic reasoning: Representing knowledge in uncertain domain- The semantics of Bayesian networks	
		4.4	Decision networks - The value of information - Decision theoretic expert systems.	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	10
		Activities:		
		1	Python AI search implementation.	

Text Books:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence – A Modern Approach", 3rd Edition, Pearson Education / Prentice Hall of India, 2015.
2. Elaine Rich, Kevin Knight, Shivashankar.B. Nair, "Artificial Intelligence", Tata Mc Graw Hill, Third Edition, 2009

References:

1. Nils J. Nilsson, "Artificial Intelligence: A new Synthesis", Harcourt Asia Pvt. Ltd., 2000.
2. George F. Luger, "Artificial Intelligence-Structures and Strategies for Complex Problem Solving", Pearson Education / PHI, 2002
3. David L. Poole, Alan K. Mackworth, "Artificial Intelligence: Foundations of Computational Agents", Cambridge University Press, 2010

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. http://aima.cs.berkeley.edu
2. http://nptel.ac.in/courses/106106126/4
3. https://medium.freecodecamp.org/an-introduction-to-q-learningreinforcement-learning-14ac0b4493cc

Assessment Rubrics:

Evaluation Type			**Marks**
a)	**End Semester Evaluation (Theory ESE)**		**70**
b)	**CCA**		**30**
	i.	Test Paper	5
	ii.	Model exam	10
	iii.	Assignment/ Book-article review / field report	5
	iv.	Seminar/ Viva-Voce / Activities	10
Total			**100**

MODEL QUESTION PAPER (Credit 4)

Time: 2 hrs. **Max Marks:** 70

Type A (Answer any SIX questions – 3 marks each) *(6 × 3 = 18 marks)*

1. What is an intelligent agent?
2. Define informed search strategy.
3. Define adversarial search. What is alpha-beta pruning?
4. What are imperfect real-time decisions?
5. Define propositional logic and first-order logic.
6. What is forward chaining and backward chaining?
7. Define knowledge-based agent.
8. What is a decision-theoretic expert system?

Type B (Answer any FOUR questions – 6 marks each) *(4× 6 = 24 marks)*

9. Explain heuristic functions and heuristic search techniques.
10. Explain constraint propagation techniques in CSPs.
11. Discuss optimal decision-making in games.
12. Describe knowledge representation using first-order logic.
13. Explain logical agents and knowledge-based systems.
14. Explain Bayesian networks and their semantics.

Type C (Answer any TWO questions – 14 marks each) *(2 × 14 =28 marks)*

15. Analyze uninformed and informed search techniques used for problem solving.
16. Explain alpha-beta pruning and its role in improving search efficiency.
17. Explain decision networks, value of information, and decision-theoretic expert systems in detail.

KU5DSCDSL303: Machine Learning for Data Science

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
5	DSC	300-399	KU5DSCDSL303	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	35	65	100	1.5 hrs

Course Description:

This course introduces machine learning techniques for analyzing and predicting data patterns. It covers supervised and unsupervised learning methods, model evaluation, and real-world applications. Students will learn to build predictive models using Python. The course emphasizes practical implementation in data science and business problems.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand fundamental concepts of machine learning, data types, and preprocessing techniques.	U
2	Apply regression models for prediction and analyze model performance using evaluation metrics.	A
3	Implement classification algorithms such as Logistic Regression, KNN, Decision Trees, and Naïve Bayes.	C
4	Apply unsupervised learning techniques like clustering, PCA, and association rule mining for data analysis.	A
5	Develop machine learning models and evaluate them for real-world applications in data science and logistics.	C

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	-	1	1	1	-
CO2	2	3	1	2	2	2	-
CO3	2	3	3	2	2	3	-
CO4	2	3	2	3	2	3	-
CO5	3	3	3	3	3	3	1

Mapping of Course Outcomes to POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	2	1	1	-
CO2	3	2	3	3	1	-
CO3	2	3	3	3	2	-
CO4	2	2	3	3	2	-
CO5	3	3	3	3	2	1

COURSE CONTENTS

	QB No.		DESCRIPTION	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Introduction to Machine Learning and Data Preprocessing**	15
	1	1.1	Basics and importance of Machine Learning, Types: Supervised, Unsupervised, Reinforcement Learning	
		1.2	Applications in Data Science and Logistics, Machine Learning workflow	
	2	1.3	Data collection and dataset types, Data cleaning (missing values, outliers), Data transformation, and normalization	
		1.4	Feature selection and feature engineering, Exploratory Data Analysis (EDA)	
MODULE 2				
	UNIT 2		**MODULE 2: Supervised Learning – Regression**	15
	3	2.1	Introduction to regression, Simple Linear Regression and Multiple Linear Regression	
		2.2	Polynomial Regression	
	4	2.3	Model evaluation (MSE, RMSE, R^2)	
		2.4	Applications in demand prediction	
MODULE 3				
	UNIT 3		**MODULE 3: Supervised Learning – Classification**	15
	5	3.1	Introduction to classification, Logistic Regression, k-Nearest Neighbours (KNN)	
		3.2	Decision Trees, Naïve Bayes	
	6	3.3	Evaluation metrics (Accuracy, Precision, Recall, F1-score), Confusion matrix, AUC-ROC , Logarithmic Loss	
		3.4	Regression Metrics: MAE, MSE and RMSE	
MODULE 4				
	UNIT 4		**MODULE 4: Unsupervised Learning and Neural Networks**	15
	7	4.1	Introduction to clustering, K-Means Clustering, Hierarchical Clustering	
		4.2	Dimensionality Reduction (PCA), Association Rule Mining (Apriori), Applications in customer segmentation and logistics	

	8	4.3	Introduction to Neural Networks, Overfitting & Regularization	
		4.4	Cross-validation, Real-world applications (healthcare, logistics, finance), Clustering Metrics: Silhouette Score & Davies-Bouldin Index	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	15
		Activities/ Practical Work:		
		1	Simple Linear Regression Dataset: Salary Dataset 🔗 https://www.kaggle.com/datasets/karthickveerakumar/salary-data-simple-linear-regression Tasks: • Load dataset (YearsExperience vs Salary) • Fit linear regression model • Plot regression line • Predict salary for new input *Skill:* Basic prediction modeling	
		2	Multiple Linear Regression Dataset: House Price Dataset 🔗 https://www.kaggle.com/datasets/harishkumardatalab/housing-price-prediction Tasks: • Select multiple features (area, bedrooms, etc.) • Train regression model • Evaluate using R^2, RMSE *Skill:* Multi-variable prediction	
		3	Logistic Regression (Classification) Dataset: Social Network Ads 🔗 https://www.kaggle.com/datasets/rakeshrau/social-network-ads Tasks: • Train logistic regression model • Predict customer purchase (Yes/No) • Plot decision boundary *Skill:* Binary classification	
		4	K-Nearest Neighbors (KNN) Dataset: Iris Dataset 🔗 https://www.kaggle.com/datasets/uciml/iris Tasks: • Train KNN model • Test different K values • Evaluate accuracy *Skill:* Instance-based learning	
		5	Decision Tree Classifier Dataset: Titanic Dataset 🔗 https://www.kaggle.com/datasets/yasserh/titanic-dataset Tasks: • Build decision tree model • Visualize tree	

			• Predict survival *Skill:* Rule-based classification	
		6	PCA (Dimensionality Reduction) Dataset: Iris Dataset 🔗 https://www.kaggle.com/datasets/uciml/iris Tasks: • Apply PCA • Reduce dataset to 2 components • Visualize results *Output:* Reduced feature dataset	
			Association Rule Mining (Apriori) Dataset: Market Basket Dataset 🔗 **https://www.kaggle.com/datasets/heeraldedhia/groceries-dataset** Tasks: • Convert transactions into matrix format • Apply Apriori algorithm • Generate association rules *Output:* Frequent itemsets & rules	
		7	K-Means Clustering (Customer Segmentation) Dataset: Mall Customers Dataset 🔗 https://www.kaggle.com/datasets/vjchoudhary7/customer-segmentation-tutorial Tasks: • Load dataset using Pandas • Select features (Age, Income, Spending Score) • Apply K-Means clustering • Visualize clusters *Output:* Customer groups based on behaviour	
		8	Hierarchical Clustering Dataset: Wholesale Customers Dataset 🔗 https://www.kaggle.com/datasets/binovi/wholesale-customers-data-set Tasks: • Normalize data • Apply hierarchical clustering • Plot dendrogram • Identify clusters *Output:* Group similar customers	
		9	Model Evaluation Metrics and Cross Validation Dataset: Any classification dataset (Iris / Titanic) Tasks: • Calculate confusion matrix • Compute precision, recall, F1-score • Compare models • Apply k-fold cross validation and Compare Models *Skill:* Model evaluation	
		10	**Mini Project:** Loan Prediction Dataset (or Any)	

			https://www.kaggle.com/datasets/altruistdelhite04/loan-prediction-problem-dataset **Tasks:** • Build classification/regression model • Evaluate performance • Present results *Skill:* Real-world ML application	

Essential Readings:

- Tom M. Mitchell, *Machine Learning*, McGraw-Hill, 1997.
- Aurelien Geron, *Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow*, 3rd Edition, O'Reilly, 2022.
- Ethem Alpaydin, *Introduction to Machine Learning*, 4th Edition, MIT Press, 2020

Web Resources

- NPTEL – Machine Learning Course: https://nptel.ac.in/courses/106105152
- Coursera – Machine Learning Courses: https://www.coursera.org/browse/data-science/machine-learning
- Kaggle – Learn Machine Learning: https://www.kaggle.com/learn
- MIT OpenCourseWare – Machine Learning: https://ocw.mit.edu
- Fast.ai Practical Deep Learning: https://course.fast.ai
- Scikit-learn Documentation – https://scikit-learn.org

Assessment Rubrics:

Evaluation Type			**Marks**	**Evaluation Type**			**Marks**	**Total**
Theory Marks			**75**	Practical Marks			**25**	**100**
a)	End Semester Evaluation (Theory ESE)		**50**	a)	Practical ESE (2.5 hrs.)		**15**	
					Program code		**6**	
					Output		**4**	
					Viva		**3**	
					Modification		**2**	
b)	**CCA**		**25**	b)	**CCA (2 hrs.)**		**10**	
	i.	Test Paper	5		i.	Punctuality	3	
	ii.	Model exam	10		ii.	Model exam	4	
	iii.	Assignment/ Book-article review / field report	5		iii	Record	3	
	iv.	Seminar/ Viva-Voce	5					

MODEL QUESTION PAPER (Credit 4)

Time: 90 Minutes **Max Marks:** 50

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

1. What are supervised and unsupervised learning?
2. What is a dataset? Define data normalization?
3. Define feature selection.
4. What is overfitting?
5. What is KNN algorithm?
6. Define precision and recall.
7. What is PCA?
8. What is Apriori algorithm?

Type B (Answer any FOUR questions – 6 marks each) *(4 × 6 = 24 marks)*

9. Explain multiple linear regression and its applications.
10. Describe Decision Tree and Naive Bayes algorithms.
11. Explain confusion matrix and performance evaluation metrics.
12. Describe PCA and its importance in dimensionality reduction.
13. Explain association rule mining using Apriori algorithm.
14. Discuss overfitting and regularization techniques.

Type C (Answer any ONE question – 14 marks each) *(1 × 14 = 14 marks)*

15. A). Explain the process of building a machine learning model from data collection to evaluation (7 Marks).
    B). Compare supervised and unsupervised learning with suitable examples (7 Marks).

OR

16. A). Explain KNN algorithm with a suitable example and discuss its advantages and limitations (8 Marks).
    B). Discuss neural networks and their applications in real-world problems (6 Marks).

KU5DSCDSL304: Business Logistics

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
5	DSC	300-399	KU5DSCDSL304	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2 hrs

Course Description:

This course provides comprehensive knowledge of business logistics, transportation, procurement, inventory management, warehousing, and customer service in supply chain operations. It covers logistics strategies, order processing, information systems, and modern logistics practices including E-logistics and reverse logistics. The course also focuses on supply chain risk management, resilience strategies, and logistics coordination in global business environments. Students will gain practical understanding of logistics decision-making, operational efficiency, and technology-enabled supply chain management.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Explain the concepts, functions, strategies, and performance measures of business logistics and transportation systems.	U
2	Analyze procurement processes, inventory control methods, warehouse operations, and supply coordination techniques in supply chain management.	An
3	Evaluate logistics customer service, order processing systems, and factors affecting logistics service performance.	E
4	Apply logistics information systems, ERP/SCM systems, and technology-enabled logistics integration practices in business operations.	A
5	Analyze current logistics issues, supply chain risks, resilience strategies, outsourcing practices, and reverse logistics in modern supply chains.	An

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	1	1	-	-	-	2	1
CO2	2	2	1	1	1	3	1
CO3	1	2	-	1	-	2	1

CO4	2	2	1	3	2	2	1
CO5	2	2	1	2	1	3	3

Mapping of Course Outcomes to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1	1	2	2	1	1
CO2	2	1	3	3	2	1
CO3	1	1	3	3	2	1
CO4	2	3	2	3	2	2
CO5	2	2	3	3	3	2

COURSE CONTENTS

	QB No.		**DESCRIPTION**	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Introduction to Business Logistics & Transportation**	15
	1	1.1	Introduction to Business Logistics, Logistic Strategies, Demand Planning in Logistics	
		1.2	Customer Service in Logistics, Logistics Performance Measurement	
	2	1.3	Role of Logistics in Business Organizations and Global Economy	
		1.4	Transport Fundamentals and Transport Decision	
MODULE 2				
	UNIT 2		**MODULE 2: Procurement, Inventory & Warehouse Management**	13
	3	2.1	Introduction to Supply Chain, Types of Purchases, Suppliers, E-Procurement	
		2.2	Inventory management in the supply chain, Periodic review inventory control methods, DRP system, Multilevel control, Beer Distribution Game.	
	4	2.3	Warehouse management and coordination of supply, Stock, Warehouse operations, Storage & handling systems, Just in time (JIT)	
		2.4	Quick response and ECR, Cross-Docking	
MODULE 3				
	UNIT 3		**MODULE 3:** Customer Service, Order Processing, and Information systems	12
	5	3.1	Logistics Customer Service: Customer Service Defined, Order Cycle Time, Importance of Logistics Customer Service, Defining a Sales-Service Relationship, Modeling the Sales-Service Relationship	
		3.2	Cost versus Service, Determining Optimum Service Levels, Service as a Loss Function, Service as a Constraint, Service Contingencies	
	6	3.3	Defining Order Processing, Order Processing Examples, Factors Affecting Order Processing Time, Handling	
		3.4	Introduction to information systems for logistics management, Computer systems for logistics, ERP / SCM systems, Logistics integration using information systems	

MODULE 4				
	UNIT 4		MODULE 4: Issues and Risk Management	10
	7	4.1	Current issues in logistics: E-logistics, Management of Global Supply Chains, Outsourcing of Logistics Services, Integration and Collaboration, Reverse Logistics	
		4.2	Supply Chain Risk Sources, Supply Chain Risks and Challenges, Importance of Supply Chain Risk Management (SCRM), SCRM Process.	
	8	4.3	Supply Chain Resilience: Definition, Key Pillars, Strategies for Building Resilience, Benefits	
		4.4	Best Practices for Managing Supply Chain Risk, Best Risk Management Software, 5 Key Features to Prioritize in Risk Management Software, How to Choose Risk Management Software	
MODULE 5				
	UNIT 5		MODULE 5: Teacher Specific Module	10
		Activities:		
		1	Find out list of 10 of the leading supply chain risks and and ways to mitigate them.	
		2	Bill Gates of Microsoft describes the 2000s as 'business @ the speed of thought'. Discuss the importance of speed in the supply chain. How can speed be increased within the supply chain?	
		3	Analyze a real-world supply chain disruption case (COVID-19, Suez Canal blockage, semiconductor shortage, etc.) and explain resilience strategies adopted by organizations.	
		4	Visit a warehouse or logistics center and prepare a report on warehouse operations, storage systems, and inventory management practices.	
		5	Conduct a case study analysis on Amazon, Flipkart, or DHL supply chain operations and identify the logistics strategies used for customer satisfaction.	
		6	Study the implementation of Just in Time (JIT) and Cross-Docking practices in logistics companies and present the operational benefits.	
		7	Identify major causes of delays in order processing and suggest methods to improve order cycle time and customer service efficiency.	

Text Books:

1. Ronald H. Ballou, *Business Logistics Management: Planning Organizing and Controlling the Supply Chain*, 4th Edition., Prentice -Hall International, Inc.
2. Ballou R.H., *Business Logistics/ Supply Chain Management*, Prentice Hall.
3. Bowersox D.J., D.J. Closs, M. B. Cooper, *Supply Chain Logistics Management*, McGraw-Hill, 2013.
4. Chopra S. & Meindl P., *Supply Chain Management: Strategy, Planning, and Operation*, Pearson Education, 2004.
5. Martin Christopher, *Logistics and Supply Chain Management*, 5th Edition., Pearson.
6. https://optro.ai/blog/supply-chain-risk-management-best-practices
7. https://optro.ai/blog/best-risk-management-software

References:

a. John J. Coyle, Edward J. Bardi, and C. John Langley Jr., *The Management of Business Logistics*, Cengage Learning.
b. Sunil Chopra and Peter Meindl, *Supply Chain Management: Strategy, Planning and Operation*, Pearson.
c. Jeremy F. Shapiro, *Modeling the Supply Chain*, Cengage Learning.
d. Janat Shah, *Supply Chain Management: Text and Cases*, Pearson Education.
e. CSCMP (Council of Supply Chain Management Professionals), *Supply Chain Management Definitions and Practices*.

Assessment Rubrics:

Evaluation Type			**Marks**
a)	**End Semester Evaluation (Theory ESE)**		**70**
b)	**CCA**		**30**
	i.	Test Paper	5
	ii.	Model exam	10
	iii.	Assignment/ Book-article review / field report	5
	iv.	Seminar/ Viva-Voce	5
	V	Case Study	5
Total			**100**

MODEL QUESTION PAPER (Credit 4)

Time: 2 hrs. **Max Marks:** 70

Type A (Answer any SIX questions – 3 marks each) *(6 × 3 = 18 marks)*

1. Explain the objectives and scope of business logistics.
2. What is logistics strategy?
3. What is multilevel inventory control?
4. Define Beer Distribution Game.
5. What is SCM software?
6. Define logistics information system.
7. Define supply chain risk management (SCRM).
8. What is integration and collaboration in logistics?

Type B (Answer any FOUR questions – 6 marks each) *(4× 6 = 24 marks)*

1. Discuss demand planning methods in logistics operations.
2. Explain warehouse operations and storage systems.
3. Discuss cost versus service relationship in logistics.
4. Explain order processing and factors affecting order processing time.

5. Explain supply chain resilience and its key pillars.
6. Discuss best practices in managing supply chain risks.

Type C (Answer any TWO questions – 14 marks each) *(2 × 14 =28 marks)*

1. Explain the concepts, functions, and strategic importance of business logistics in modern organizations.
2. Evaluate JIT, Quick Response, ECR, and Cross-Docking systems in logistics management.
3. Analyze current issues in logistics including E-logistics, outsourcing, and reverse logistics.

KU6DSCDSL305: Advanced Logistics Systems

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
6	DSC	300-399	KU6DSCDSL305	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	35	65	100	1.5 hrs

Course Description:

This course introduces the fundamentals and strategic importance of logistics and supply chain management. It covers advanced transportation systems, optimization techniques, and the role of AI and analytics in logistics decision-making. Students will learn about warehouse automation, inventory control, and modern logistics technologies. The course also explores international logistics, sustainability, and global supply chain operations.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Explain the fundamental concepts of logistics and supply chain management, including strategic frameworks, competitive advantage, and performance metrics.	U
2	Analyze supply chain design and transportation networks using advanced models, routing algorithms, and optimization techniques.	A
3	Apply analytical and AI-based tools for logistics decision-making, including demand forecasting, real-time routing, and control tower systems.	C
4	Evaluate warehouse operations, material handling systems, and inventory management techniques using modern automation and digital tools.	A
5	Assess international logistics operations, including global transportation, Incoterms, customs procedures, and logistics service providers.	C
6	Examine sustainability, risk, and resilience strategies in logistics, including green logistics practices and disruption management.	

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	1	1	1	2	1
CO2	2	3	2	1	2	3	1

CO3	3	3	3	2	2	3	1
CO4	3	2	2	2	2	3	1
CO5	2	2	1	2	1	2	2
CO6	1	2	1	1	1	2	3

Mapping of Course Outcomes to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	1	2	2	1	1
CO2	3	2	3	3	1	1
CO3	3	3	3	3	2	1
CO4	2	2	3	3	2	1
CO5	2	1	2	2	2	2
CO6	2	1	2	3	1	3

COURSE CONTENTS

	QB No.		**DESCRIPTION**	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Strategic Logistics & Supply Chain Foundations**	15
	1	1.1	Logistics Strategy & Competitive Advantage: Role of logistics in supply chain competitiveness, Logistics as a value driver (cost, service, agility), Customer-centric logistics strategy, Market-driven vs resource-driven logistics	
		1.2	Strategic Frameworks for Logistics Analysis: IRIC Framework (Integration, Responsiveness, Innovation, Cost), PESTLE Analysis for logistics environment scanning, SWOT & TOWS in logistics decision-making, Triad Analysis (Shipper–Carrier–Customer relationships), Porter's Value Chain in logistics	
	2	1.3	Supply Chain Design & Network Strategy: Push vs Pull supply chain strategies, Lean, Agile, and Hybrid (Leagile) logistics models, Decoupling point concept, Global vs Local supply chain design, Risk pooling and postponement strategies. Logistics Performance & Strategic Metrics: KPIs - Service level, lead time, cost-to-serve, Balanced Scorecard in logistics, Total Cost Analysis (TCA), Customer profitability analysis.	
		1.4	Digital Transformation in Logistics Strategy: Role of AI, IoT, and Big Data in logistics planning, Control towers and visibility platforms, Blockchain in logistics transparency. Risk, Resilience & Sustainability in Logistics: Supply chain risk management (disruptions, uncertainties), Resilient and adaptive logistics networks, Green logistics and circular supply chains, ESG (Environmental, Social, Governance) in logistics.	
M				

	UNIT 2		**MODULE 2: Advanced Transportation Management Operational Networks**	15
	3	2.1	Advanced Network Modeling & Design: Stochastic transportation network design (uncertain demand & supply), Robust and resilient network optimization, Multi-echelon and multi-modal network integration, Dynamic network reconfiguration (real-time adaptation), Trade-offs: cost vs service level vs carbon emissions	
		2.2	Advanced Routing & Optimization Algorithms: Advanced VRP variants: VRP with Time Windows (VRPTW), Pickup and Delivery Problem (PDP), Capacitated VRP (CVRP), Metaheuristic algorithms: Genetic Algorithms, Ant Colony Optimization, Tabu Search, Reinforcement learning for dynamic routing, Real-time adaptive routing under uncertainty	
	4	2.3	Transportation Analytics & AI Systems: Predictive analytics for demand and traffic forecasting, Prescriptive analytics for routing decisions, Control tower systems (end-to-end visibility), Anomaly detection in logistics networks, Graph analytics for transportation networks	
		2.4	Digital & Autonomous Transportation Systems: Digital twins of transportation networks, Autonomous trucks and platooning systems, Drone-based logistics networks, Intelligent Transport Systems (ITS), Edge AI for real-time decision-making. Platform logistics (Uber Freight, digital freight matching), Crowdshipping and gig logistics models.	
MODULE 3				
	UNIT 3		**MODULE 3: Material Handling and Storage Systems Automation**	15
	5	3.1	Air Cargo Systems: Introduction, Where and when to implement, Key benefits, Automated Warehouse Solutions: Definition, Types of Automated Storage & Retrieval Systems (ASRS), Advanced technologies used, Key Benefits of Automated Warehousing, Solving Modern Logistics Challenges with Automation. Sorting Systems, Baggage Handling Systems and Smart Solutions, Benefits of automated baggage handling systems.	
		3.2	Inbound and Outbound Logistics: Definition, difference, challenges, and activities, When goods move backwards (Reverse Logistics), How to optimize inbound and outbound logistics, Damage Liability in Logistics, Step-by-Step Inbound and Outbound Logistics Processes, Examples, importance and benefits. Inbound and outbound logistics services and management software.	
	6	3.3	Advanced Inventory Management: Automated Replenishment, Demand Forecasting, Real-Time Tracking, Inventory Optimization, Key Metrics: Inventory Turnover Ratio, Days Sales of Inventory (DSI), Fill Rate / Service Level, Stockout Rate and Carrying Cost, ERP-Based Inventory Systems & features, Cloud Inventory Software, AI & Advanced Analytics Tools.	
		3.4	Advanced Warehouse Management Systems (WMS) Functions: Receiving & Putaway, Storage Optimization, Order Picking &	

			Packing, Inventory Control, Automation & Robotics, Advanced Techniques: Warehouse Slotting Optimization, Cross-Docking, Multi-Warehouse Coordination, Real-Time Data & IoT, Popular Tools: SAP Extended Warehouse Management, Oracle Warehouse Management Cloud, Manhattan WMS and Blue Yonder WMS.	
MODULE 4				
	UNIT 4		**MODULE 4: International logistics**	15
	7	4.1	Evolution of international logistics, Cultural differences and foreign labour laws, Logistics security, Green logistics.	
		4.2	Global Transportation: Choosing transportation modes, Shipping conferences and alliances, Containerization, Inbound logistics, International documentation, Incoterms: Definition and functions, Classification, Incoterms 2020: EXW and FCA, CPT and CIP, DAP, DPU and DDP, Maritime terms.	
	8	4.3	Types of international logistics service providers, International freight forwarders and consolidators, Non-vessel operating common carriers, Export management companies and export packers, Customs clearance specialists, Outsourcing global logistics.	
		4.4	Global logistics: Inventory control, Warehouse and distribution center locations, Shipping and receiving, Packaging, Global reverse logistics, risk management.	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	15
		Activities/ Practical Work:		
		1	Case Study 1: Blockchain in Supply Chain Transparency Scenario: A food company wants to track product origin and prevent fraud. Tasks: • Explain blockchain workflow • Identify stakeholders (supplier, distributor, retailer) • Compare traditional vs blockchain systems • Evaluate cost vs benefit Outcome: Knowledge of secure and transparent logistics	
		2	Case Study 2: Digital Twin in Logistics Scenario: A logistics company wants to simulate operations before implementation. Tasks: • Define digital twin concept • Identify required data inputs • Suggest use cases (routing, warehouse design) • Analyze benefits in decision-making Outcome: Understanding simulation & optimization	
		3	Case Study 3: AI-Based Demand Forecasting Scenario: A retail company faces frequent stockouts and overstock issues. Tasks: • Identify demand patterns (seasonality, trends)	

			• Suggest ML models (ARIMA, LSTM, Regression) • Compare traditional vs AI forecasting • Recommend improvement strategy Outcome: Students understand predictive analytics in logistics	
		4	Case Study 4: Smart Warehouse using IoT Scenario: A warehouse wants real-time inventory visibility. Tasks: • Design IoT architecture (RFID, sensors) • Explain data flow from sensors → dashboard • Identify benefits (accuracy, speed) • Analyze implementation challenges Outcome: Understanding IoT-enabled logistics systems	
		5	Logistics Dashboard Creation Tool: Excel / Power BI / Tableau Tasks: • Create KPIs: lead time, fill rate, inventory turnover • Build interactive dashboard • Analyze logistics performance Output: Visual dashboard	
		6	IoT Simulation (Conceptual) Tool: Diagram tools / simple simulation Tasks: • Design smart warehouse architecture • Show sensor → cloud → dashboard flow • Present system diagram Output: System design diagram	

Essential Readings:

- Dmitry Ivanov et al., *Digital Supply Chain and Industry 4.0*
- M. Christopher, *Logistics and Supply Chain Management*, 5th ed. Harlow, UK: Pearson, 2016.
- S. Chopra and P. Meindl, *Supply Chain Management: Strategy, Planning, and Operation*, 7th ed. Boston, MA, USA: Pearson, 2019.
- D. Simchi-Levi, X. Chen, and J. Bramel, *Designing and Managing the Supply Chain*, 4th ed. New York, NY, USA: McGraw-Hill, 2021.
- P. Toth and D. Vigo, *Vehicle Routing: Problems, Methods, and Applications*, 2nd ed. Philadelphia, PA, USA: SIAM, 2014.
- M. G. H. Bell and Y. Iida, *Transportation Network Analysis*. Chichester, UK: Wiley, 1997.
- E. Cascetta, *Transportation Systems Analysis: Models and Applications*, 2nd ed. New York, NY, USA: Springer, 2009.
- G. Richards, *Warehouse Management: A Complete Guide to Improving Efficiency and Minimizing Costs in the Modern Warehouse*, 3rd ed. London, UK: Kogan Page, 2018.
- P. A. David, *International Logistics: The Management of International Trade Operations*, 4th ed. Cincinnati, OH, USA: Atomic Dog Publishing, 2017.

Learning Platforms & Tools

- https://als.systems/services/
- https://www.netsuite.com/portal/resource/articles/inventory-management/inbound-outbound-logistics.shtml
- https://www.linkedin.com/learning/international-logistics/introduction-to-international-logistics
- MIT Center for Transportation and Logistics: https://ctl.mit.edu
- Coursera: Supply Chain Analytics courses
- edX: Logistics & AI programs
- McKinsey & Company (Supply Chain insights)
- Deloitte (Logistics 4.0 reports)
- World Bank, "Logistics Performance Index (LPI)," [Online]. Available: https://lpi.worldbank.org

Assessment Rubrics:

Evaluation Type			**Marks**	**Evaluation Type**			**Marks**	**Total**
Theory Marks			**75**	Practical Marks			**25**	**100**
a)	End Semester Evaluation (Theory ESE)		**50**	a)	Practical ESE (2.5 hrs.)		**15**	
					Program code		**6**	
					Output		**4**	
					Viva		**3**	
					Modification		**2**	
b)	**CCA**		**25**	b)	**CCA (2 hrs.)**		**10**	
	i.	Test Paper	5		i.	Punctuality	3	
	ii.	Model exam	10		ii.	Model exam	4	
	iii.	Assignment/ Book-article review / field report	5		iii	Record	3	
	iv.	Seminar/ Viva-Voce	5					

MODEL QUESTION PAPER (Credit 4)

Time: 90 Minutes **Max Marks:** 50

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

1. Define logistics strategy.
2. What is IRIC framework?
3. What is PESTLE analysis?
4. What is VRP and CVRP?

5. What is bill of lading?
6. Define inbound and outbound logistics.
7. What is decoupling point? Define total cost analysis.
8. Define freight forwarding.

Type B (Answer any FOUR questions – 6 marks each) *(4 × 6 = 24 marks)*

1. Explain IRIC framework in logistics.
2. Describe PESTLE analysis with examples.
3. Discuss global transportation modes.
4. Analyze role of automation in warehouses.
5. Evaluate stochastic vs deterministic models.
6. Evaluate lean vs agile supply chain with case example.

Type C (Answer any ONE question – 14 marks each) *(1 × 14 = 14 marks)*

1. A). Compare different routing algorithms (7 Marks).
   B). Evaluate global logistics strategies (7 Marks).

   OR

2. A). Describe transportation network modeling (6 Marks).
   B). Discuss inventory control techniques (4 Marks).
   C). Discuss challenges in warehouse management (4 Marks).

KU6DSCDSL306: Inventory Control Models and Decision Theory

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
6	DSC	300-399	KU6DSCDSL306	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2 hrs

Course Description:

This course introduces the fundamental concepts and techniques of inventory management and decision theory used in business and supply chain systems. It covers inventory control models, EOQ techniques, probabilistic inventory systems, and decision-making under certainty, risk, and uncertainty. The course also emphasizes practical applications of inventory optimization and forecasting in logistics and operations management. Students will develop analytical and problem-solving skills for effective inventory planning and managerial decision-making.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand the basic concepts of inventory, inventory costs, and inventory control systems used in business and logistics management.	U
2	Apply EOQ and deterministic inventory models to solve inventory planning and replenishment problems.	A
3	Analyze probabilistic inventory models and inventory problems under uncertain demand conditions.	An
4	Apply decision theory techniques for decision-making under certainty, risk, and uncertainty in supply chain and logistics environments.	A
5	Develop analytical and problem-solving skills for optimizing inventory and improving operational efficiency using quantitative techniques.	C

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	1	1	1	2	1
CO2	2	3	2	1	1	3	1

CO3	2	3	2	1	1	3	1
CO4	1	3	1	2	1	3	2
CO5	2	3	2	2	1	3	2

Mapping of Course Outcomes to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	1	2	1	1	1
CO2	3	2	2	3	1	1
CO3	3	2	3	3	1	1
CO4	2	1	2	3	2	1
CO5	3	2	3	3	2	2

COURSE CONTENTS

	QB No.		**DESCRIPTION**	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Inventory Control Models**	15
	1	1.1	Definitions of inventory and inventory control, Classifications of inventories, Costs Associated with Inventory, Functional Role of Inventory, Reasons for Carrying Inventory, Factors Involved in Inventory Problem Analysis	
		1.2	Inventory Control Systems (P-System, Q-System, P-Q System, ABC, VED, XYZ, FSN/FNSD, EOQ), Types of Inventory Models	
	2	1.3	Deterministic Models (Definitions and problems only): EOQ with Constant Rate of Demand, EOQ by Trial and Error Method, Harris lot size formula, EOQ for purchase model problems.	
		1.4	EOQ with Different Rates of Demand, Quantity Discount Model	
MODULE 2				
	UNIT 2		**MODULE 2: EOQ Models**	15
	3	2.1	Economic Lot Size with finite rate of replenishment	
		2.2	EOQ for Integrality of Items	
	4	2.3	Deterministic Models with Shortages	
		2.4	Models with Restrictions	
MODULE 3				
	UNIT 3		**MODULE 3: Probabilistic Inventory Control Models** (Derivations not required)	10
	5	3.1	Classification of Probabilistic Inventory Control Models, Single period model with uniform demand	
		3.2	Basic Newsvendor model	
	6	3.3	Inventory Problems with Uncertain Demand and Variable Purchase Price	
		3.4	Forecasting methods: Moving average and Simple exponential smoothing	
M				

	UNIT 4		**MODULE 4: Decision Theory**	10
	7	4.1	Decision: Definition, Two Phases, Classifications of Decisions, Steps in Decision Theory Approach,	
		4.2	Decision Making Under Certainty, Risk and Uncertainty	
	8	4.3	Criterion of Optimism, Pessimism and Regret, Decision Making Under Conflict and Competition, Criterion of Realism	
		4.4	Decision Trees - Stochastic Decision Trees	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	10
		Activities:		
		1	EOQ calculation in Excel	
		2	ABC analysis using spreadsheets	
		3	Demand forecasting exercises	
		4	E-commerce inventory management	
		5	Inventory decision scenarios	
		6	Warehouse inventory examples and Retail inventory cases	

Essential Readings:

1. https://www.bbau.ac.in/dept/UIET/EME-601%20Operation%20Research.pdf
2. https://ycmou.ac.in/media/post_image/Operations_Research.pdf
3. Sharma J.K. – *Operations Research: Theory and Applications*, 6th Edition, Trinity Press
4. Kanti Swarup, Gupta & Man Mohan – *Operations Research* (Sultan Chand & Sons)
5. Hamdy A. Taha – *Operations Research: An Introduction* (Pearson)
6. Panneerselvam R. – *Operations Research* (PHI Learning)
7. Hiller & Lieberman – *Introduction to Operations Research* (McGraw Hill)

Web Resources

- NPTEL – Operations Research: https://nptel.ac.in
- MIT Open Courseware – Operations Research: https://ocw.mit.edu

Assessment Rubrics:

Evaluation Type			**Marks**
a)	**End Semester Evaluation (Theory ESE)**		**70**
b)	**CCA**		**30**
	i.	Test Paper	5
	ii.	Model exam	10
	iii.	Assignment/ Book-article review / Field report (any two)	5
	iv.	Seminar/ Viva-Voce	5
	v	Case Study	5
Total			**100**

MODEL QUESTION PAPER (Credit 4)

Time: 90 Minutes **Max Marks:** 70

Type A (Answer any SIX questions – 3 marks each) *(6 × 3 = 18 marks)*

1. Differentiate between ordering cost and carrying cost.
2. What are the reasons for carrying inventory?
3. Explain ABC analysis.
4. What are deterministic models with shortages?
5. What is Economic Production Quantity (EPQ)?
6. Define setup cost and holding cost.
7. Differentiate deterministic and probabilistic inventory models.
8. What is decision making under uncertainty?

Type B (Answer any FOUR questions – 6 marks each) *(4 × 6 = 24 marks)*

9. Explain the advantages and limitations of EOQ models.
10. Discuss the costs associated with inventory.
11. Explain deterministic inventory models with shortages and restrictions in detail.
12. Explain inventory problems under uncertain demand.
13. Explain the steps in decision theory approach.
14. Explain optimism and pessimism criteria.

Type C (Answer any TWO question – 14 marks each) *(2 × 14 = 28 marks)*

1. Explain decision making under certainty, risk, and uncertainty with suitable examples.
2. Discuss various decision-making criteria such as optimism, pessimism, regret, and realism in detail.
3. Construct and explain decision trees used in inventory and logistics decision-making.

KU6DSCCSC307: Industry Project & Application Development

Students of the B.Sc. Data Science and Logistics Programme are required to undertake a project work carrying FOUR credits under the guidance of a faculty member, as prescribed in the curriculum. The project duration shall be six months, and the dissertation must be submitted at the end of the sixth semester. Individual projects are encouraged; however, in cases where the number of supervising faculty members is limited, students may undertake the project in groups. The maximum number of students permitted in a group shall not exceed THREE.

PROJECT EVALUATION

Evaluation of the Project Work shall be done under Mark System at two stages:

1. Internal Assessment (supervising teachers will assess the project and award internal Marks)
2. External evaluation (external examiner appointed by the University) Marks secured for the project will be awarded to candidates, combining the internal and external Marks.

Assessment of different components may be taken as below.

CONTINUOUS EVALUATION FOR PROJECT:

COMPONENT	WEIGHTAGE
Relevance of Topic and Problem Identification	10%
System Study / Design / Methodology	15%
Mid-term Presentation and Progress Evaluation	10%
Regularity, Performance and Internal Assessment	15%
Presentation & Viva-voce	30%
Project Report	20%
Total	**100**

END SEMESTER EVALUATION FOR PROJECT:

COMPONENT	WEIGHTAGE
Written Synopsis/Abstract	12.5%
Content of the Project	12.5%
Quality of project work/Use of software/ tools	12.5%
Perfection of the work (Designs of tables/ Input & Output forms)	20%
Live demo	12.5%
Viva-voce	20%
Industry Experience Certificate	10%
Total	**100**

KU6DSCDSL308: Operations Research

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
6	DSC	300-399	KU6DSCDSL308	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	35	65	100	1.5 hrs

Course Description:

This course introduces operations research techniques for solving logistics and data-driven decision problems. It covers transportation, assignment, sequencing, game theory, and queuing models. Students will learn mathematical modeling and optimization methods. The course emphasizes real-world applications in supply chain and service systems.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand fundamental concepts of operations research and formulate mathematical models for logistics problems.	U
2	Apply transportation and assignment models to optimize resource allocation and logistics operations.	A
3	Analyze sequencing and scheduling problems to improve operational efficiency.	An
4	Evaluate decision-making situations using decision theory and game theory techniques.	E
5	Apply queuing models and optimization techniques to solve real-world logistics and service system problems.	A

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	1	-	-	1	2	-
CO2	2	3	1	1	2	3	-
CO3	2	2	1	-	1	3	-
CO4	1	3	-	1	-	2	1
CO5	3	3	2	2	2	3	1

Mapping of Course Outcomes to POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	1	2	-	-
CO2	3	2	2	3	1	-
CO3	2	1	2	3	1	-
CO4	2	1	2	3	1	1
CO5	3	2	3	3	2	1

COURSE CONTENTS

	QB No.		DESCRIPTION	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Introduction to Operations Research & Transportation Problems**	15
	1	1.1	Definition, scope, and applications in logistics & data science, Phases in OR study, Characteristics and limitations of OR, Models used in OR, Methods for Solving Operations Research Models.	
		1.2	OR Models in Practice, Computer Software Packages for OR, Case Study: Daily News Paper and Supply Chain Management.	
	2	1.3	Mathematical Formulation of Transportation Problem (TP), Solution of a Transportation Problem, Finding an Initial Basic Feasible Solution (NWCM – LCM – VAM)	
		1.4	Test for Optimality: Dual of Transportation Model and MODI Method	
MODULE 2				
	UNIT 2		**MODULE 2: Assignment Problems and Decision Theory**	15
	3	2.1	Mathematical Formulation of Assignment Problem (AP), Solution Methods of AP: Hungarian Method	
		2.2	Variations in AP, Travelling Salesman Problem using AP	
	4	2.3	Steps Of Decision-Making Process, Types of Decision-Making Environments, Criteria of decision-making under uncertainty	
		2.4	Expected Monetary Value (EMV), Baye's decision rule, Decision Tree, Utility Curve	
MODULE 3				
	UNIT 3		**MODULE 3: Sequencing Problem and Game Theory**	15
	5	3.1	Sequencing Models: Basic Concepts, Priority Rules, Johnson's Rule, Processing of n Jobs through Two, Three and m Machines	
		3.2	Processing of Two Jobs through m Machines (Graphical method)	
	6	3.3	Introduction to Game Theory, Two Person Zero-Sum Games, Maximin and Minimax Principle	
		3.4	Mixed Strategies: Games without Saddle Point, Principles of Dominance, Solution Methods Games without Saddle Point	
MODULE 4				
	UNIT 4		**MODULE 4: Queuing Theory**	15
	7	4.1	Introduction, Structure and Performance Measures of Quing System	

		4.2	Probability Distributions in Queuing Systems	
	8	4.3	Classification of Queuing Models	
		4.4	Single-Server and Multi Server Queuing Models	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	15
		Activities/ Practical Work:		
		1	Transportation Problem (TP) Tool: Python (PuLP) • Solve TP using NWCM, LCM, VAM • Find optimal solution using MODI *Skill:* Logistics cost optimization	
		2	Assignment Problem Tool: Python • Solve using Hungarian Method • Resource allocation case *Skill:* Task scheduling	
		3	Travelling Salesman Problem (TSP) Tool: Python (OR-Tools) • Find shortest route for delivery *Skill:* Route optimization	
		4	Decision Tree Analysis Tool: Excel / Draw.io • Construct decision tree • Calculate EMV *Skill:* Decision-making under uncertainty	
		5	Sequencing Problem Tool: Excel • Apply Johnson's Rule • Minimize processing time *Skill:* Production/logistics scheduling	
		6	Game Theory Analysis Tool: Excel • Solve 2-person zero-sum games • Maximin & Minimax *Skill:* Strategic decision-making	
		7	Queuing Model Analysis Tool: Python • Calculate waiting time, queue length • Analyze M/M/1 model *Skill:* Service system optimization	
		8	Simulation of Queue System Tool: Python • Simulate arrival & service process *Skill:* System modeling	
		9	Mini Project Tool: Python • Solve real logistics problem (inventory, routing, scheduling)	

			Skill: Industry readiness	

Essential Readings:

1. Sharma J.K. – *Operations Research: Theory and Applications*, 6th Edition, Trinity Press
2. Kanti Swarup, Gupta & Man Mohan – *Operations Research* (Sultan Chand & Sons)
3. Hamdy A. Taha – *Operations Research: An Introduction* (Pearson)
4. Panneerselvam R. – *Operations Research* (PHI Learning)
5. Hiller & Lieberman – *Introduction to Operations Research* (McGraw Hill)

Web Resources

- NPTEL – Operations Research: https://nptel.ac.in
- MIT OpenCourseWare – Operations Research: https://ocw.mit.edu
- Coursera – Operations Research Courses: https://www.coursera.org
- Python Optimization (PuLP Documentation):https://coin-or.github.io/pulp/
- Solver Tutorials (Excel Solver):https://support.microsoft.com

Assessment Rubrics:

Evaluation Type			**Marks**	**Evaluation Type**			**Marks**	**Total**
Theory Marks			**75**	Practical Marks			**25**	**100**
a)	End Semester Evaluation (Theory ESE)		**50**	a)	Practical ESE (2.5 hrs.)		**15**	
					Program code		**6**	
					Output		**4**	
					Viva		**3**	
					Modification		**2**	
b)	**CCA**		**25**	b)	**CCA (2 hrs.)**		**10**	
	i.	Test Paper	5		i.	Punctuality	3	
	ii.	Model exam	10		ii.	Model exam	4	
	iii.	Assignment/ Book-article review / field report	5		iii	Record	3	
	iv.	Seminar/ Viva-Voce	5					

MODEL QUESTION PAPER (Credit 4)

Time: 90 Minutes **Max Marks:** 50

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

2. Define Operations Research.
3. What is a transportation problem?

4. Define assignment problem.
5. What is EMV (Expected Monetary Value)?
6. Define game theory. What is a saddle point?
7. What is sequencing problem?
8. Define queuing system.
9. What is Johnson's rule?

Type B (Answer any FOUR questions – 6 marks each) *(4 × 6 = 24 marks)*

10. Explain the phases of Operations Research study.
11. Explain NWCM with the following example.

	C1	**C2**	**C3**	**Supply**
W1	2	3	1	20
W2	5	4	8	30
W3	5	6	8	25
Demand	10	25	40	

12. Describe the Hungarian method for assignment problem.
13. Write short notes on decision-making under uncertainty.
14. Explain maximin and minimax principle in game theory.
15. A company has 5 jobs (J1–J5) that must be processed on two machines (M1 and M2) in the same order (first on M1, then on M2). The processing times (in hours) are given below:

Job	**M1**	**M2**
J1	4	7
J2	8	3
J3	6	5
J4	2	6
J5	5	4

    a. Determine the optimal job sequence using Johnson's Rule.
    b. Calculate the total elapsed time.
    c. Find the idle time of each machine.

Type C (Answer any ONE question – 14 marks each) *(1 × 14 = 14 marks)*

16. A company has 3 warehouses (W1, W2, W3) and 4 customers (C1, C2, C3, C4). The transportation cost per unit (₹), supply, and demand are given below:

	C1	**C2**	**C3**	**C4**	**Supply**
W1	19	30	50	10	7
W2	70	30	40	60	9
W3	40	8	70	20	18

Demand	5	8	7	14	

a. Find an Initial Basic Feasible Solution (IBFS) using Vogel's Approximation Method (VAM) (6 Marks).
b. Test the solution for optimality using MODI method (6 Marks).
c. If the solution is not optimal, improve it and find the optimal transportation cost (2 Marks).

OR

17. A service center receives customers at an average rate of 10 customers per hour ($\lambda = 10$). The service facility can serve customers at an average rate of 15 customers per hour ($\mu = 15$) (M/M/1 Model)
    a. Find the average number of customers in the system (L)
    b. Find the average waiting time in the system (W)
    c. Find the average number of customers in the queue (Lq)
    d. Find the average waiting time in the queue (Wq)

Discipline Specific Elective Courses (DSE)

KU5DSEDSL301: Data Mining for Data Science & Logistics

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
5	DSE	300-399	KU5DSEDSL301	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	35	65	100	1.5 hrs

Course Description:

This course provides a comprehensive understanding of data mining techniques and their applications in data science and logistics. It covers data warehousing, classification, clustering, and advanced mining techniques such as web and text mining. Students will learn to extract meaningful patterns from large datasets and apply analytical methods for decision-making. The course emphasizes real-world applications in Logistics 4.0 and data-driven supply chain optimization.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand data warehousing concepts, OLAP operations, and data preprocessing techniques.	U
2	Apply classification and clustering algorithms to analyze structured and unstructured data.	A
3	Implement advanced data mining techniques such as web mining, text mining, and association rule mining.	C
4	Analyze and apply data mining methods for predictive analytics and decision-making in logistics systems.	An
5	Develop data-driven solutions using data mining tools for real-world applications in data science and logistics.	C

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	-	1	1	1	-

CO2	2	3	2	2	2	3	-
CO3	2	3	2	3	2	3	-
CO4	2	3	3	2	2	3	1
CO5	3	3	3	3	3	3	1

Mapping of Course Outcomes to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	2	1	1	-
CO2	3	2	3	3	1	-
CO3	2	2	3	3	2	-
CO4	3	2	3	3	2	1
CO5	3	3	3	3	3	1

COURSE CONTENTS

	QB No.		**DESCRIPTION**	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Introduction to Data Mining and Data Warehousing**	15
	1	1.1	Data warehouse: Concepts and architecture, Difference between operational databases and data warehouses, Multidimensional data model, schemas (star, snowflake)	
		1.2	OLAP operations, Data warehousing to data mining, Knowledge Discovery in Databases (KDD process)	
	2	1.3	Architecture of data mining systems, Data mining functionalities and issues, Data preprocessing: data cleaning, integration, transformation	
		1.4	Data Reduction: Data cube aggregation, Attribute subset selection, Dimensionality reduction, Numerosity reduction, Discretization, and concept hierarchy generation.	
MODULE 2				
	UNIT 2		**MODULE 2: Advanced classification and Cluster analysis**	15
	3	2.1	Classification: Introduction, Decision tree construction principle, Splitting indices, Information Gain, Gini index	
		2.2	Decision tree construction algorithms: ID3, Decision Tree Construction with Pre-sorting and SLIQ (Overview)	
	4	2.3	Evaluation metrics: Accuracy, Precision, Recall, F1-score, Confusion Matrix	
		2.4	Clustering: Introduction, Clustering Paradigms, Partitioning Algorithm: PAM, Hierarchical Clustering, DBSCAN, Categorical Clustering (ROCK)	
M				

	UNIT 3		**MODULE 3: Advanced Data Mining Techniques**	15
	5	3.1	Web mining: Web content mining, structure mining (PageRank, HITS), Clever	
		3.2	Web usage mining: Preprocessing, Data structures, Pattern discovery and analysis.	
	6	3.3	Text Mining: Text preprocessing and representation, Information retrieval and extraction, Text mining process, Text mining vs. Text analytics.	
		3.4	Text indexing techniques and query processing, Association rule mining: Apriori algorithm, Support, Confidence, Lift, Introduction to NLP basics (tokenization, stop words).	
MODULE 4				
	UNIT 4		**MODULE 4: Data mining in Logistics 4.0**	15
	7	4.1	Introduction to Logistics 4.0 and Industry 4.0, Evolution from traditional logistics to smart logistics, Role of data in Logistics 4.0, Applications of data mining in logistics (forecasting, routing, inventory), Predictive analytics in Logistics.	
		4.2	Challenges and solutions in data mining for logistics companies, Tools and techniques (Python, Power BI, basic Hadoop/Spark concepts), Best Practices in Data Mining Implementation, Future trends in data mining for logistics companies, Step-by-step guide to implementing data mining in logistics, Data privacy in logistics.	
	8	4.3	How Data Science is Revolutionizing Logistics: Self Driving Trucks, Smart Warehouses and Market Forecasting, How to Become a Data Scientist in Logistics, Skills and Tools of a Logistics Data Scientist, Importance of Data Science in Logistics	
		4.4	Data Mining Techniques for Logistics Professionals: Classification, Clustering, Regression, Outlier detection, Predictive analytics, Association rule mining & Neural networks, Difference between data mining, data analytics, & data warehousing, AI tools for mining and logistics, Data mining and logistics service providers in India.	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	15
		Activities/ Practical Work:		
		1	Case studies: smart warehouses, demand forecasting	
		2	Future trends in logistics analytics	
		3	Case study: logistics dataset analysis	
		4	Classification using Decision Trees / Naïve Bayes	
		5	Clustering using K-Means / DBSCAN	
		6	Association rule mining using Apriori	
		7	Mini Project (end-to-end data mining solution)	

Essential Readings:

1. Pang-Ning Tan and Michael Steinbach, "Introduction to Data Mining", Addison Wesley, 2006.
2. Jaiwei Han and Micheline Kamber, "Data Mining Concepts and Techniques", Elsevier, 2006
3. Ian H. Witten – *Data Mining: Practical Machine Learning Tools and Techniques*, 4th Edition, 2016

4. https://www.meegle.com/en_us/topics/data-mining/data-mining-for-logistics-companies
5. https://www.discoverdatascience.org/industries/logistics/
6. https://www.supplychainonline.co.uk/article/5-essential-data-mining-techniques-for-logistics-professionals

Reference Books

1. M Sudeep Elayidom, "Data Mining and Warehousing", 1st Edition, 2015, Cengage Learning India Pvt. Ltd.
2. MehmedKantardzic, "Data Mining Concepts, Methods and Algorithms", John Wiley and Sons, USA, 2003.
3. Arun K Pujari, "Data Mining Techniques", Universities Press Private Limited,2008.
4. Dunham M H, "Data Mining: Introductory and Advanced Topics", Pearson Education, New Delhi, 2003

Web Resources

- NPTEL – https://nptel.ac.in
- Kaggle – https://www.kaggle.com
- UCI Repository – https://archive.ics.uci.edu
- Scikit-learn – https://scikit-learn.org

Assessment Rubrics:

<table>
<tr><th colspan="3">Evaluation Type</th><th>Marks</th><th colspan="3">Evaluation Type</th><th>Marks</th><th>Total</th></tr>
<tr><td colspan="3">Theory Marks</td><td>75</td><td colspan="3">Practical Marks</td><td>25</td><td rowspan="11">100</td></tr>
<tr><td>a)</td><td colspan="2">End Semester Evaluation (Theory ESE)</td><td>50</td><td>a)</td><td colspan="2">Practical ESE (2.5 hrs.)</td><td>15</td></tr>
<tr><td colspan="4" rowspan="4"></td><td></td><td colspan="2">Program code</td><td>6</td></tr>
<tr><td></td><td colspan="2">Output</td><td>4</td></tr>
<tr><td></td><td colspan="2">Viva</td><td>3</td></tr>
<tr><td></td><td colspan="2">Modification</td><td>2</td></tr>
<tr><td>b)</td><td colspan="2">CCA</td><td>25</td><td>b)</td><td colspan="2">CCA (2 hrs.)</td><td>10</td></tr>
<tr><td></td><td>i.</td><td>Test Paper</td><td>5</td><td></td><td>i.</td><td>Punctuality</td><td>3</td></tr>
<tr><td></td><td>ii.</td><td>Model exam</td><td>10</td><td></td><td>ii.</td><td>Model exam</td><td>4</td></tr>
<tr><td></td><td>iii.</td><td>Assignment/ Book-article review / field report</td><td>5</td><td></td><td>iii</td><td>Record</td><td>3</td></tr>
<tr><td></td><td>iv.</td><td>Seminar/ Viva-Voce</td><td>5</td><td></td><td></td><td></td><td></td></tr>
</table>

MODEL QUESTION PAPER (Credit 4)

Time: 90 Minutes **Max Marks:** 50

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

1. Define data mining. What is a data warehouse?
2. What is OLAP? Define KDD process.
3. Define classification. What is decision tree?
4. What is clustering? Define DBSCAN.
5. What is association rule mining?
6. Define support and confidence.
7. What is web mining and text mining?
8. What is Logistics 4.0 and Industry 4.0?

Type B (Answer any FOUR questions – 6 marks each) *(4 × 6 = 24 marks)*

9. Explain predictive analytics in logistics.
10. Write short notes on OLAP operations.
11. Explain Information Gain and Gini Index.
12. Explain DBSCAN algorithm.
13. Explain web content and web structure mining.
14. Describe the role of data mining in logistics.

Type C (Answer any ONE question – 14 marks each) *(1 × 14 = 14 marks)*

15. A). Explain data warehouse architecture and OLAP operations with suitable examples (8 Marks).
    B). Compare classification and clustering with real-world examples (6 Marks).

OR

16. A). Explain how data mining techniques improve supply chain efficiency in Logistics 4.0 (7 Marks).
    B). Discuss web mining and its applications in business and logistics (7 Marks).

KU5DSEDSL302: NLP: Basics and Techniques

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
5	DSE	300-399	KU5DSEDSL302	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2 hrs

Course Description:

Natural Language Processing (NLP) focuses on enabling machines to understand, process, and generate human language. This course covers linguistic foundations, text preprocessing, and representation techniques. It introduces machine learning approaches for solving NLP tasks such as classification and semantic analysis. Students will gain practical knowledge to build real-world NLP applications using modern tools and techniques.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand the fundamentals of NLP, its evolution, and real-world applications.	U
2	Apply text preprocessing and feature extraction techniques such as tokenization, stemming, TF-IDF, and N-grams.	A
3	Analyze linguistic structures using probabilistic models, POS tagging, parsing, and semantic relationships.	An
4	Implement machine learning techniques for NLP tasks such as classification, NER, and word sense disambiguation.	C
5	Evaluate NLP models using appropriate feature selection and performance techniques.	E

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	1	-	-	-	-	-
CO2	3	2	1	-	-	-	-
CO3	2	3	2	-	-	-	-

CO4	2	3	3	1	-	1	-
CO5	3	3	3	2	2	2	1

Mapping of Course Outcomes to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	1	2	1	-	-
CO2	3	3	2	2	-	-
CO3	3	2	3	2	-	-
CO4	3	3	3	3	1	-
CO5	3	2	3	3	2	2

COURSE CONTENTS

	QB No.		**DESCRIPTION**	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Introduction to Natural Language Processing (NLP)**	12
	1	1.1	What is NLP, history and challenges, Corpus, NLP Libraries	
		1.2	NLP pipeline and applications	
	2	1.3	Levels of language analysis (morphology, syntax, semantics)	
		1.4	NLP tasks (classification, translation, and summarization) and real-world use cases.	
MODULE 2				
	UNIT 2		**MODULE 2: Text Preprocessing & Representation**	12
	3	2.1	Tokenization, stop-word removal, Stemming and lemmatization	
		2.2	Regular expressions, Finite State Automata	
	4	2.3	Text normalization techniques	
		2.4	Feature extraction: Bag of Words (BoW), TF-IDF, N-grams	
MODULE 3				
	UNIT 3		**MODULE 3: Linguistic Processing**	15
	5	3.1	Probabilistic Language Models, Markov Assumption	
		3.2	Morphological Parsing- Finite state transducer, POS Tagging	
	6	3.3	Syntax Analysis: CFG, Parsing: Constituency and dependency parsing, CKY Parsing	
		3.4	Hyponymy, Homonymy, Synonymy, Antonymy, Polysemy, Meronomy, Knowledge Representations: Case Grammar, Knowledge graph, Ontology.	
MODULE 4				
	UNIT 4		**MODULE 4: Machine Learning (ML) for NLP**	15
	7	4.1	Named Entity Recognition (NER), Natural Language Understanding, and Natural Language Generation	
		4.2	Semantic analysis and word sense disambiguation	
	8	4.3	Text classification techniques: Rule-based, ML & Deep Learning Techniques., ML Algorithms: Naïve Bayes, SVM, Logistic	

			Regression	
		4.4	Feature selection methods: Filter, Wrapper and Embedded methods	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	6
		Activities:		
			Case study: Computational skills to create NLP processing pipelines using existing NLP libraries. Take an application of NLP and understand NLP pipeline	

Essential Readings:

1. Dan Jurafsky and James Martin. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition. Prentice Hall, Second Edition, 2009. Some draft chapters of the third edition are available online: https://web.stanford.edu/~jurafsky/slp3/
2. James Allen, "Natural Language Processing with Python", First Edition, O'Reilly Media, 2009.
3. Chris Manning and Hinrich Schütze. Foundations of Statistical Natural Language Processing. MIT Press, Cambridge, MA: May 1999.
4. Daniel and James H. Martin "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Second Edition, Prentice Hall of India, 2008.
5. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.
6. Steven Bird, Ewan Klein, Edward Loper, Natural Language Processing with Python – Analyzing Text with the Natural Language Toolkit (O'Reilly 2009, website 2018) http://www.nltk.org/book/

Assessment Rubrics:

Evaluation Type			**Marks**
a)	**End Semester Evaluation (Theory ESE)**		**70**
b)	**CCA**		**30**
	i.	Test Paper	5
	ii.	Model exam	10
	iii.	Assignment/ Book-article review / field report	5
	iv.	Seminar/ Viva-Voce	5
	V	Case Study	5
Total			**100**

MODEL QUESTION PAPER (Credit 4)

Time: 2 hrs. **Max Marks:** 70

Type A (Answer any SIX questions – 3 marks each) *(6 × 3 = 18 marks)*

1. What is tokenization? Define stemming and lemmatization.
2. What is TF-IDF? Define stop-word removal.
3. List the levels of language analysis. What are the major challenges in NLP?
4. What is Named Entity Recognition (NER)?
5. Define word sense disambiguation.
6. What is feature selection? List out different methods used for feature selection.
7. Define Markov assumption.
8. What is CFG?

Type B (Answer any FOUR questions – 6 marks each) *(4× 6 = 24 marks)*

9. Describe the levels of language analysis with examples.
10. Explain text normalization techniques.
11. Explain text classification techniques.
12. Describe Naïve Bayes and SVM for NLP.
13. Explain probabilistic language models.
14. Explain dependency and constituency parsing.

Type C (Answer any TWO questions – 14 marks each) *(2 × 14 =28 marks)*

15. Explain NLP tasks such as classification, translation, and summarization with examples.
16. A). Discuss Finite State Automata and its application in NLP (6 marks)
    B). Explain feature extraction techniques: BoW, TF-IDF, and N-grams in detail (8 marks)
17. Explain syntax analysis using CFG and CYK parsing algorithm.

KU5DSEDSL303: Logistics Management and Analysis

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
5	DSE	200-299	KU4DSEDSL303	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	35	65	100	1.5 hrs

Course Description:

This course introduces the fundamentals of logistics and supply chain management with a focus on customer value and cost efficiency. It covers transportation, sourcing, and pricing strategies in supply chains. The course also explores the role of IT systems like ERP and CRM in coordination. Students will learn demand forecasting and logistics system analysis for effective decision-making.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand logistics concepts, customer service, and performance measurement.	U
2	Analyze logistics costs and profitability using appropriate costing techniques.	An
3	Evaluate transportation networks, routing, and sourcing decisions in supply chains.	E
4	Examine the role of IT systems and coordination strategies in supply chain management.	E
5	Apply demand forecasting and logistics system analysis for decision-making.	A

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	1	-	1	-	1	-
CO2	2	3	-	1	1	2	-
CO3	2	2	1	1	1	3	-

CO4	3	2	1	3	2	2	1
CO5	3	3	2	2	2	3	1

Mapping of Course Outcomes to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	1	1	1	-
CO2	3	1	2	2	-	-
CO3	2	2	2	3	1	-
CO4	1	3	2	2	2	1
CO5	3	2	3	3	1	-

COURSE CONTENTS

	QB No.		**DESCRIPTION**	**HOURS**
MODULE 1	**UNIT 1**		**MODULE 1: Logistics, Customer Value, & Measuring Costs and performance in Logistics**	15
	1	1.1	Marketing and logistics interface, Delivering customer value, Customer service, Impact of out-of-stock, Customer retention, Market-driven supply chains	
		1.2	Customer service objectives and priorities, Setting service standards	
	2	1.3	Logistics and the bottom line, Logistics and shareholder value, Logistics cost analysis, Total cost analysis,	
		1.4	Principles of logistics costing, Customer profitability analysis, Direct product profitability, Cost drivers and activity-based costing.	
MODULE 2				
	UNIT 2		**MODULE 2: Transportation Networks, Sourcing and Pricing**	15
	3	2.1	Transportation in Supply Chain, Importance of Transportation, Transportation Infrastructure and Policies	
		2.2	Design Options for Transportation Network, Tailored Transportation, Trade-off in Transportation Design, Routing & Scheduling in Transportation	
	4	2.3	Sourcing, In-house and Outsource, 3PL and 4PL, Benefits of Effective Sourcing Decisions, Supplier Scoring and Assessment	
		2.4	Supplier Selection, Procurement Process, Pricing & Revenue Management for Multiple Customers, Perishable Products & Seasonal Demand.	
MODULE 3				
	UNIT 3		**MODULE 3: IT and Coordination in Supply Chain**	15
	5	3.1	Supply Chain IT Framework, Role of Information in Supply Chain, CRM - Customer Relationship Management	
		3.2	Internal Supply Chain & Transaction Management, Enterprise Resource Planning (ERP), E-commerce, Supply Chain IT in	

			Practice.	
	6	3.3	Lack of Supply Chain Coordination, Bullwhip Effect, Managerial Levers, Building Strategic Partnerships and Trust	
		3.4	Continuous Replenishment Program (CRP) and Vendor Managed Inventory (VMI), Collaborative Planning, Forecasting and Replenishment (CPFR)	
MODULE 4				
	UNIT 4		**MODULE 4: Dimensions of Logistics**	15
	7	4.1	Macro and Micro Dimensions, Logistics Activities, Approach to Analyzing Logistics Systems, Logistics and Systems Analysis	
		4.2	Techniques of Logistics System Analysis, Supply and Demand Relationship & its Graphical Representation,	
	8	4.3	Demand Management & Forecasting, Demand Planning	
		4.4	Demand Forecasting Error, CPFR, Channels of Distribution	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	15
		Activities:		
		1	Customer Service & KPI Analysis Tool**:** Excel / Power BI • Analyze order fulfillment data • Calculate service level, fill rate, stock-out rate • Create KPI dashboard *Industry Skill:* Logistics performance tracking Data: Order_ID,Customer,Order_Date,Delivery_Date,Quantity_Ordered,Quantity_Delivered,Status 101,Anush,01-01-2024,03-01-2024,100,95,Delivered 102,Binu,02-01-2024,06-01-2024,200,200,Delivered 103,Cinuk,03-01-2024,08-01-2024,150,120,Delayed 104,Deenu,04-01-2024,05-01-2024,180,180,Delivered 105,Empton,05-01-2024,10-01-2024,130,100,Delayed	
		2	Logistics Cost Analysis: Tool: Excel • Compute total logistics cost (transport, storage, inventory) • Perform activity-based costing (ABC) • Compare cost scenarios *Industry Skill:* Cost optimization Data: Month,Transport_Cost,Warehouse_Cost,Inventory_Cost Jan,50000,30000,20000 Feb,60000,32000,21000 Mar,55000,31000,22000 Apr,65000,33000,25000	

		3	Transportation Route Optimization (Distance Matrix): **Tool:** Python (Google OR-Tools / NetworkX) • Solve shortest path / vehicle routing problem • Optimize delivery routes *Industry Skill:* Route planning & fuel cost reduction Data: City,A,B,C,D A,0,10,15,20 B,10,0,35,25 C,15,35,0,30 D,20,25,30,0	
		4	Transportation Network Design: Tool: Excel Solver / Python • Design distribution network • Analyze trade-offs (cost vs time) *Industry Skill:* Supply chain design Data: Warehouse,Customer,Transport_Cost,Capacity W1,C1,10,100 W1,C2,15,120 W2,C1,20,150 W2,C2,25,130	
		5	Supplier Selection & Evaluation Tool: Excel • Use weighted scoring model • Rank suppliers based on cost, quality, delivery *Industry Skill:* Procurement decision-making Data: Supplier,Cost,Quality,Delivery_Time S1,8,9,7 S2,7,8,8 S3,9,7,9 S4,6,8,6	
		6	Procurement & Pricing Analysis Tool: Excel • Analyze pricing strategies • Revenue management for multiple customers *Industry Skill:* Pricing & sourcing Data: Product,Cost_Price,Selling_Price,Demand P1,50,70,200 P2,40,65,250 P3,60,90,180	

			P4,55,80,220	
		7	ERP / Supply Chain Software Exposure Tool: Odoo / SAP (demo) • Create purchase orders • Track inventory & orders *Industry Skill:* ERP operations Data: Item_ID,Item_Name,Stock_Level,Reorder_Level,Supplier 1,ItemA,100,50,S1 2,ItemB,80,40,S2 3,ItemC,60,30,S3 4,ItemD,120,60,S1	
		8	CRM Analysis: Tool: Salesforce (demo) / Zoho CRM • Analyze customer interactions • Measure customer retention *Industry Skill:* Customer relationship management Data: Customer_ID,Name,Purchase_Amount,Last_Purchase_Days,Retention_Status C1,Alice,5000,10,Active C2,Bob,3000,45,Inactive C3,Charlie,7000,5,Active C4,David,2000,60,Inactive	
		9	**Bullwhip Effect Simulation** Tool: Excel / Python • Simulate demand variability across supply chain • Analyze amplification effect *Industry Skill:* Supply chain coordination Data: Week,Retailer_Demand,Distributor_Order,Manufacturer_Order 1,100,120,150 2,110,140,180 3,105,130,170 4,120,160,200	
		10	Inventory Management (EOQ) Tool: Excel / Python • Implement EOQ, safety stock • Reorder point calculation *Industry Skill:* Inventory control Data: Item,Annual_Demand,Ordering_Cost,Holding_Cost A,1000,50,2	

			B,1500,60,3 C,1200,55,2.5	
		11	Demand Forecasting (Time Series) Tool: Python (Pandas, ARIMA) / Excel • Forecast demand using time series • Evaluate forecast accuracy *Industry Skill:* Predictive analytics Data: Month,Sales Jan,200 Feb,220 Mar,250 Apr,270 May,300 Jun,320	
		12	Data Visualization Dashboard (Combined Logistics KPIs) Tool: Power BI / Tableau • Create logistics dashboard • Visualize KPIs (delivery time, cost, demand) *Industry Skill:* Business intelligence Data: Date,Orders,Delivery_Time,Cost,Region 01-01-2024,50,2,10000,North 02-01-2024,60,3,12000,South 03-01-2024,55,2,11000,East 04-01-2024,70,4,14000,West	
		13	Warehouse Layout Optimization Tool: Excel / Simulation tools • Design warehouse layout • Improve storage efficiency *Industry Skill:* Warehouse planning Data: Item,Zone,Frequency,Storage_Cost A,Z1,100,10 B,Z2,80,8 C,Z1,120,12 D,Z3,60,6	
		14	Supply Chain Coordination Models Tool: Excel • Implement VMI / CPFR scenarios • Analyze collaboration benefits *Industry Skill:* Collaborative planning VMI / CPFR Data:	

			Week,Customer_Demand,Supplier_Replenishment,Inventory_Level 1,100,120,200 2,110,130,220 3,120,140,240 4,130,150,260	
		15	Logistics System Analysis Project Tool: Python / Power BI • End-to-end analysis of logistics dataset • Identify inefficiencies and suggest improvements *Industry Skill:* Real-world problem solving Dataset (Integrated): Order_ID,Product,Region,Demand,Inventory,Delivery_Time,Cost 1,P1,North,200,150,3,5000 2,P2,South,250,200,4,6000 3,P3,East,180,160,2,4500 4,P4,West,220,180,5,7000	

Essential Readings:

1. Martin Christopher, *Logistics & Supply Chain Management*, 4th edition, Prentice Hall.
2. jnu-Supply-Chain-Management.pdf, JNU, Jaipur.
3. B.S. Sahay, *Supply chain management - For global competitiveness*, Mac Millan India Ltd., 1999.

Recommended Readings:

1. Chopra, S. & Meindl, P. (2007), *Supply Chain Management: Strategy, Planning and Operation*, Pearson Education.
2. Hult, M. G., Closs, D., Frayer, D, Global (2014), *Supply Chain Management: Leveraging Processes, Measurements, and Tools for Strategic Corporate Advantage*, Mc Graw Hill Ltd.

Assessment Rubrics:

Evaluation Type			**Marks**	**Evaluation Type**			**Marks**	**Total**
Theory Marks			**75**	**Practical Marks**			**25**	**100**
a)	**End Semester Evaluation (Theory ESE)**		**50**	a)	**Practical ESE (2.5 hrs.)**		**15**	
					Practical Exercises		**6**	
					Output		**4**	
					Viva		**3**	
					Modification		**2**	
b)	**CCA Theory**		**25**	b)	**CCA (2 hrs.)**		**10**	
	i.	Test Paper	5		i.	Punctuality	3	

	ii.	Model exam	10		ii.	Model exam	4	
	iii.	Assignment/ Book-article review / field report	5		iii.	Record	3	
	iv.	Seminar/ Viva-Voce	5					

MODEL QUESTION PAPER (Credit 4)

Time: 90 Minutes **Max Marks:** 50

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

1. Define marketing–logistics interface.
2. What is customer value? Define customer service in logistics.
3. What are transportation policies?
4. What is routing and scheduling in transportation.
5. What is ERP? Explain its role in supply chain.
6. What is the bullwhip effect? Explain with example.
7. What is Continuous Replenishment Program (CRP)?
8. What is logistics system analysis?

Type B (Answer any FOUR questions – 6 marks each) *(4 × 6 = 24 marks)*

9. Explain the impact of out-of-stock situations.
10. Describe customer retention strategies.
11. Discuss different modes of transportation in supply chains.
12. What is CRM? Explain its importance in supply chain.
13. Describe managerial levers to improve coordination.
14. Explain factors affecting demand forecasting.

Type C (Answer any ONE question – 14 marks each) *(1 × 14 = 14 marks)*

15. a) Describe the Marketing Mix (4Ps) in relation to SCM

    b). Discuss principles of logistics costing and total cost analysis with an example.

OR

16. a) Compare CRP, VMI, and CPFR.

    b) Discuss challenges in managing perishable and seasonal products.

KU6DSEDSL304: Deep Learning Techniques

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
6	DSE	300-399	KU6DSEDSL304	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	35	65	100	1.5 hrs

Course Description:
This course introduces deep learning techniques for modeling complex data patterns using neural networks. It covers fundamental concepts such as perceptrons, backpropagation, CNNs, RNNs, and advanced topics like transfer learning and transformers. Students will learn model training, optimization, and deployment using modern frameworks.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand fundamental concepts of deep learning, neural networks, activation functions, and optimization techniques.	U
2	Apply training methods such as backpropagation, regularization, and batch normalization to improve model performance.	A
3	Implement convolutional and recurrent neural networks for image and sequential data analysis.	C
4	Apply advanced deep learning techniques including transfer learning and transformers for real-world applications.	A
5	Develop and deploy deep learning models using frameworks like TensorFlow, PyTorch, and Hugging Face.	C

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	-	1	1	1	-
CO2	2	3	2	2	2	2	-
CO3	2	3	3	2	2	3	-
CO4	2	3	2	3	2	3	1
CO5	3	3	3	3	3	3	1

Mapping of Course Outcomes to POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	2	1	1	-
CO2	3	2	3	3	1	-
CO3	2	3	3	3	2	-
CO4	2	2	3	3	2	1
CO5	3	3	3	3	2	1

COURSE CONTENTS

	QB No.		DESCRIPTION	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Introduction to Deep Learning**	15
	1	1.1	Introduction to AI, Machine Learning, Deep Learning, Basics of Neural Networks	
		1.2	Perceptron and Multi-Layer Perceptron (MLP)	
	2	1.3	Activation functions (ReLU, Sigmoid, Tanh), Softmax Output Layers	
		1.4	Loss functions and gradient descent	
MODULE 2				
	UNIT 2		**MODULE 2: Training Deep Neural Networks**	15
	3	2.1	Backpropagation algorithm, Optimization techniques (SGD, Adam)	
		2.2	Weight initialization	
	4	2.3	Overfitting and regularization (Dropout, L2)	
		2.4	Batch normalization	
MODULE 3				
	UNIT 3		**MODULE 3: Convolutional Neural Networks (CNN) & RNN**	15
	5	3.1	Image processing basics, Convolution, pooling, padding	
		3.2	CNN architecture (LeNet, AlexNet basics), Image classification applications	
	6	3.3	RNN: Sequential data and time series, RNN basics	
		3.4	LSTM and GRU, Optimization Challenges in Deep Learning	
MODULE 4				
	UNIT 4		**MODULE 4: Advanced Topics & Applications**	15
	7	4.1	Transfer learning: Introduction, Types, Pre-trained Models, Feature Extraction, Fine-Tuning, Workflow & Applications	
		4.2	Transformers: Introduction, Attention Mechanism, Transformer Architecture, Applications advantages and limitations	
	8	4.3	Hugging Face, Deep learning in logistics, healthcare, finance	
		4.4	Model deployment basics, Introduction to Pytorch and TensorFlow	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	15
		Activities/ Practical Work:		

		1	Build simple ANN for classification using PyTorch	
		2	Optimization & Regularization • Apply dropout and compare performance	
		3	Image classification using CNN	
		4	Build MNIST Classifier in PyTorch	
		5	Time series prediction using RNN/LSTM	
		6	Use pre-trained model (ResNet/VGG)	
		7	Implement real-world deep learning application	

Essential Readings:

1. Ian Goodfellow – *Deep Learning* (MIT Press)
2. François Chollet – *Deep Learning with Python*
3. Aurélien Géron – *Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow*
4. Aggarwal, Charu C - *Neural Networks and Deep Learning*
5. Nikhil Buduma and Nicholas Locascio - *Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms* (1st. ed.,), 2017, O'Reilly Media, Inc.

Reference Books

1. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.
2. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
3. Michael Nielsen, Neural Networks and Deep Learning, 2018

Web Resources

- TensorFlow – https://www.tensorflow.org
- PyTorch – https://pytorch.org
- Kaggle – https://www.kaggle.com
- Fast.ai – https://course.fast.ai

Assessment Rubrics:

Evaluation Type			**Marks**	**Evaluation Type**			**Marks**	**Total**
Theory Marks			**75**	Practical Marks			**25**	**100**
a)	End Semester Evaluation (Theory ESE)		**50**	a)	Practical ESE (2.5 hrs.)		**15**	
					Program code		6	
					Output		4	
					Viva		3	
					Modification		2	
b)	**CCA**		**25**	b)	**CCA (2 hrs.)**		**10**	
	i.	Test Paper	5		i.	Punctuality	3	
	ii.	Model exam	10		ii.	Model exam	4	

	iii.	Assignment/ Book-article review / field report	5		iii	Record	3	
	iv.	Seminar/ Viva-Voce	5					

MODEL QUESTION PAPER (Credit 4)

Time: 90 Minutes **Max Marks:** 50

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

1. Define Artificial Intelligence and Deep Learning?
2. What is a perceptron? Name any two activation functions.
3. What is RNN? What is the purpose of Softmax in RNN?
4. Define loss function and gradient descent?
5. What is backpropagation?
6. What is overfitting and dropout?
7. What is convolution? Define pooling.
8. What is transfer learning?

Type B (Answer any FOUR questions – 6 marks each) *(4 × 6 = 24 marks)*

9. Explain Multi-Layer Perceptron (MLP) with diagram.
10. Describe backpropagation algorithm in detail.
11. Explain CNN architecture with working.
12. Explain optimization techniques (SGD, Adam).
13. Describe feature extraction and fine-tuning in transfer learning.
14. Explain attention mechanism in transformers.

Type C (Answer any ONE question – 14 marks each) *(1 × 14 = 14 marks)*

15. A). Explain the process of training deep neural networks and methods to avoid overfitting (7 Marks).
    B). Discuss CNN and its applications in image processing (7 Marks).

OR

16. A). Explain overfitting and regularization techniques.(6 Marks).
    B). Discuss transfer learning and its applications with examples. (4 Marks).
    C). Describe batch normalization (4 Marks).

KU6DSEDSL305: Cloud Computing for Data Science & Logistics

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
6	DSE	300-399	KU6DSEDSL305	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2 hrs

Course Description:

This course introduces the fundamentals of cloud computing and its applications in logistics and supply chain management. It covers cloud service models, deployment strategies, and leading platforms including SAP HANA Cloud for real-time logistics analytics. The course explores cloud-enabled transportation, warehousing, inventory systems, and secure data management. It also focuses on virtualization, big data technologies, and predictive analytics for intelligent decision-making in modern logistics systems.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand the fundamentals of cloud computing, including service and deployment models.	U
2	Analyze cloud platforms and technologies such as SAP HANA Cloud for logistics applications.	An
3	Apply cloud-based solutions for transportation, warehouse, and inventory management systems.	A
4	Evaluate cloud security mechanisms, identity management, and data privacy issues in logistics environments.	E
5	Demonstrate knowledge of virtualization and cloud infrastructure for efficient resource management.	C
6	Analyze big data technologies and predictive analytics for supply chain optimization and decision-making	An

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	1	-	-	1	-	-

CO2	2	3	1	1	2	1	-
CO3	3	3	2	2	2	2	-
CO4	2	2	-	1	2	1	3
CO5	2	2	2	1	3	2	-
CO6	3	3	3	2	3	3	1

Mapping of Course Outcomes to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	1	1	-	-
CO2	2	3	2	2	-	-
CO3	2	3	3	2	1	-
CO4	2	2	2	3	1	3
CO5	3	3	2	2	-	-
CO6	3	2	3	3	1	1

COURSE CONTENTS

	QB No.		**DESCRIPTION**	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Cloud Computing**	15
	1	1.1	Basics of cloud computing: Definition, Characteristics, Evolution, Advantages, Disadvantages, Applications, Challenges, and Issues of Cloud computing	
		1.2	Components of Cloud Computing, Actors in Cloud Computing Reference Model, Service Models: IaaS, PaaS, SaaS, Cloud Service Providers.	
	2	1.3	Deployment Models: Public, Private, Hybrid, Multi-cloud, Cloud providers overview (AWS, Azure, Google Cloud), Overview of SAP HANA Cloud.	
		1.4	Cloud adoption in logistics industry, Cloud pricing and service-level agreements (SLAs).	
MODULE 2				
	UNIT 2		**MODULE 2: Cloud Applications in Logistics**	13
	3	2.1	Cloud-based Transportation Management Systems (TMS), Warehouse Management Systems (WMS/ EWM) on cloud, Inventory management using cloud platforms.	
		2.2	Use of SAP HANA Cloud in logistics analytics, Real-time inventory and demand forecasting using SAP HANA, Integration of SAP cloud solutions with logistics operations.	
	4	2.3	Cloud security fundamentals, Identity & Access Management (IAM), Data encryption in cloud, Logistics data privacy issues	
		2.4	Real-time shipment tracking and IoT integration, Cloud-enabled demand forecasting and analytics, Digital Supply Chain	

			Transformation using Cloud.	
MODULE 3				
	UNIT 3		**MODULE 3: Cloud Infrastructure and Virtualization**	12
	5	3.1	Implementation Levels of Virtualization, Virtualization Structure/Tools and Mechanisms	
		3.2	Virtualization of CPU/Memory and I/O devices	
	6	3.3	Virtual Clusters and Resource Management	
		3.4	Virtualization for Data Center Automation	
MODULE 4				
	UNIT 4		**MODULE 4: Introduction to Big Data**	10
	7	4.1	Big data: Definition, Sources, Key Characteristics (5Vs), Applications, Benefits and Challenges of big data, Big data processing tools, Types of Big Data	
		4.2	Difference between traditional data and big data, Big data in supply chain analytics, Cycle, How Big Data Works.	
	8	4.3	Big data storage: data lakes, data warehouses and data lakehouses, In-memory databases, Predictive logistics using big data.	
		4.4	Hadoop, HDFS and MapReduce, How MapReduce in Hadoop Works? Parallel and Distributed Data Processing	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	10
		Activities:		
		1	Cloud SQL for MySQL: Discover how Google Cloud SQL for MySQL provide automated management and high availability for MySQL databases?	
		2	Cloud Storage: Qwikstart: Google Cloud Storage provides scalable and secure object storage for managing data, accessible via the Cloud Console or gsutil CLI.	
		3	Creating a Virtual Machine: Configure and deploy a virtual machine with specific CPU and memory requirements in Google Cloud/ Amazon AWS	

Text Books:

1. https://www.lpude.in/SLMs/Master%20of%20Computer%20Applications/Sem_2/DECAP470_CLOUD_COMPUTING.pdf
2. https://mrcet.com/downloads/digital_notes/IT/CLOUD%20COMPUTING%20DIGITAL%20NOTES%20(R18A0523).pdf
3. Kai Hwang, Geoffrey C Fox, and Jack J Dongarra, Distributed and Cloud Computing, Morgan Kaufmann, Elsevier 2012
4. Dan C. Marinescu, Cloud Computing Theory and Practice, Morgan Kaufmann, 2nd Edition, Elsevier 2018
5. Google Cloud Teaching Resources – LMS [for practical component]
6. AWS Cloud Developing – AWS Academy Courses [for practical component]

Reference Books:

1. Rajkumar Buyya, Christian Vecchiola, and Thamrai Selvi, Mastering Cloud Computing McGrawHill Education, 1st Edition, 2017

2. Toby Velte, Anthony Velte, Cloud Computing: A Practical Approach, McGraw-Hill Education, 2017.
3. George Reese, Cloud Application Architectures: Building Applications and Infrastructure in the Cloud, O'Reilly Publication, 1st Edition, 2009
4. John Rhoton, Cloud Computing Explained: Implementation Handbook for Enterprises, Recursive Press, 2nd Edition, 2009

Web links and Video Lectures (e-Resources):

1. https://www.ibm.com/think/topics/big-data#1580786329
2. https://www.oracle.com/in/big-data/what-is-big-data/
3. https://freevideolectures.com/course/4639/nptel-cloud-computing/1
4. https://www.youtube.com/playlist?list=PLShJJCRzJWxhz7SfG4hpaBD5bKOloWx9J
5. https://www.youtube.com/watch?v=EN4fEbcFZ_E
6. https://www.youtube.com/watch?v=RWgW-CgdIk0
7. https://www.geeksforgeeks.org/virtualization-cloud-computing-types/
8. https://www.javatpoint.com/cloud-service-provider-compa

Assessment Rubrics:

Evaluation Type			**Marks**
a)	**End Semester Evaluation (Theory ESE)**		**70**
b)	**CCA**		**30**
	i.	Test Paper	5
	ii.	Model exam	10
	iii.	Assignment/ Book-article review / field report	5
	iv.	Seminar/ Viva-Voce	5
	V	Case Study	5
Total			**100**

MODEL QUESTION PAPER (Credit 4)

Time: 2 hrs. **Max Marks:** 70

Type A (Answer any SIX questions – 3 marks each) *(6 × 3 = 18 marks)*

1. What are IaaS, PaaS, and SaaS?
2. List different cloud deployment models.
3. What are cloud service providers? Give examples.
4. What is Identity and Access Management (IAM)?
5. Define virtualization. What are virtual machines?
6. What is virtual clusters and resource allocation.

7. Define big data and list its 5Vs.
8. Explain types of big data with examples.

Type B (Answer any FOUR questions – 6 marks each) *(4× 6 = 24 marks)*

9. Explain cloud pricing models and cost strategies.
10. Discuss cloud adoption in the logistics industry.
11. Explain cloud-based inventory management systems.
12. Discuss the role of SAP HANA Cloud in logistics analytics.
13. Discuss big data storage systems (data lakes, warehouses, lakehouses).
14. Explain the working of Hadoop and HDFS.

Type C (Answer any TWO questions – 14 marks each) *(2 × 14 =28 marks)*

15. Analyze how cloud computing supports logistics operations like TMS, WMS, and inventory management.
16. A). Explain MapReduce and its role in distributed data processing (6 marks).
    B). Discuss resource management techniques in cloud environments (8 marks).
17. Discuss the architecture of cloud computing with reference to logistics applications.

SEMESTER 7

KU7DSCDSL401: Logistics Network Design

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
7	DSC	400-499	KU7DSCDSL401	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	35	65	100	2 hrs

Course Description:

This course introduces the concepts, models, and analytical techniques used in logistics network design and optimization. It covers warehouse location planning, sourcing strategies, transportation and warehousing costs, distribution network configuration, and service level optimization using data-driven approaches. The course also focuses on logistics data collection, aggregation, validation, and model optimization for efficient supply chain and distribution management.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand the fundamentals, components, models, and structure of logistics network design and distribution systems.	U
2	Apply analytical techniques for warehouse location planning, sourcing strategy, distribution channel selection, and transportation planning.	A
3	Analyze logistics costs including transportation, warehousing, inventory, and facility costs for efficient network optimization.	An
4	Evaluate logistics data, demand forecasting methods, aggregation techniques, and optimization models for supply chain decision-making.	E
5	Develop data-driven logistics network solutions to improve operational efficiency, customer service levels, and cost optimization in supply chain systems.	C

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	1	1	1	2	1

CO2	3	3	2	2	1	3	1
CO3	3	3	2	2	1	3	1
CO4	3	3	2	3	2	3	2
CO5	3	3	3	3	2	3	2

Mapping of Course Outcomes to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	1	2	2	1	1
CO2	3	2	3	3	1	1
CO3	3	2	3	3	1	1
CO4	3	3	3	3	1	2
CO5	2	3	3	3	2	2

COURSE CONTENTS

	QB No.		**DESCRIPTION**	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Introduction**	15
	1	1.1	Components of Logistics network: Facilities - Plants/Vendors - Ports	
		1.2	Warehouse Retailers/Distribution Centers - Customers - Raw materials and finished products that flow between the facilities.	
	2	1.3	Three models of Network Design: Logistics network design with differentiated delivery lead time, Logistics network design with price discount	
		1.4	Consolidated logistics network design using consolidation hubs	
MODULE 2				
	UNIT 2		**MODULE 2: Key issues of Network design & Data Required**	13
	3	2.1	Key issues of Network design: Pick the optimal number, location, and size of warehouses and/or plants, Determining optimal sourcing strategy	
		2.2	Which plant/vendor should produce which product? Determining best distribution channels -Which warehouses should service which customers?	
	4	2.3	A listing of all products - Location of customers, stocking points and sources - Demand for each product by customer location, Transportation rates - Warehousing costs	
		2.4	Shipment sizes by product - Order patterns by frequency, size, and season, content -Order processing costs -Customer service goals	
MODULE 3				
	UNIT 3		**MODULE 3: Strategic Decisions**	12
	5	3.1	The strategic decisions in terms of warehouses when plants and retailer locations are fixed; Pick the optimal number- location - size of warehouses	

		3.2	Determining optimal sourcing strategy - Which plant/vendor should produce which product - Determining best distribution channels - Which warehouses should service which retailers	
	6	3.3	The objective is to design or reconfigure the logistics network so as to minimize annual system-wide costs, including Production/ purchasing costs Inventory carrying costs, and facility costs (handling and fixed costs) Transportation costs.	
		3.4	Find a minimal-annual-cost configuration of the distribution network that satisfies product demands at specified customer service levels	
MODULE 4				
	UNIT 4		**MODULE 4: Network Modeling and Optimization**	10
	7	4.1	Data Collection - information on: a) Location of customers, stocking points and sources - location theory b) A listing of all products c) Demand for each product by customer location forecast technique d) Transportation Cost -Transportation rates by mode—information system, like rating engine.	
		4.2	e) Mileage estimation f) Warehousing costs (handling and fixed) inventory management g) Service level requirement - probabilistic technique h) Shipment sizes by product	
	8	4.3	Data Aggregation -The impact of aggregate demand -a heuristic to aggregate data.	
		4.4	Data Validation and Model Optimization	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	10
		Suggested Practical Activities:		
		1	Logistics Network Mapping • Identify the components of a logistics network for a selected company. • Draw the flow of raw materials and finished products between plants, warehouses, retailers, and customers. • Analyze the role of distribution centers and ports in the network.	
		2	Warehouse Location Analysis • Study factors affecting warehouse location selection. • Compare two or more possible warehouse locations based on transportation cost, accessibility, and customer reach. • Prepare a simple warehouse location optimization report.	
		3	Transportation Cost Analysis • Collect transportation cost data for different transport modes. • Calculate and compare transportation costs for multiple routes. • Analyze the effect of transportation rates on logistics network design.	
		4	Demand Forecasting for Logistics • Collect product demand data from different customer locations. • Apply simple forecasting techniques for demand prediction. • Interpret forecasting results for logistics planning.	
		5	Distribution Channel Evaluation • Identify different distribution channels used by a company. • Analyze channel efficiency, delivery lead time, and service quality.	

			• Suggest improvements for distribution optimization.	
		6	Data Aggregation and Validation • Aggregate logistics data from multiple sources. • Perform data cleaning and validation. • Analyze the impact of aggregated demand on logistics planning.	
		7	Service Level Analysis • Study customer service level requirements in logistics systems. • Compare service levels across different distribution strategies. • Evaluate the relationship between service level and logistics cost.	
		8	Mini Project • Design a basic logistics network for a retail or manufacturing company. • Determine warehouse locations, sourcing strategy, transportation mode, and customer allocation. • Present the optimized logistics network with cost and service analysis.	

Text Books:

1. Course Material Prepared by LSC
2. Supply Chain Management: Logistics Network Design by Donglei Du, Faculty of Business Administration, University of New Brunswick, NB Canada Fredericton.
3. Joseph D. Patton, Logistics Technology and Management, Soloman, 1986.
4. Philip T. Frohne, Quantitative Measurements for Logistics, McGraw Hill, 2007

Assessment Rubrics:

Evaluation Type			**Marks**
a)	**End Semester Evaluation (Theory ESE)**		**70**
b)	**CCA**		**30**
	i.	Test Paper	5
	ii.	Model exam	10
	iii.	Assignment/ Book-article review / field report	5
	iv.	Seminar/ Viva-Voce	5
	V	Activities	5
Total			**100**

MODEL QUESTION PAPER (Credit 4)

Time: 2 hrs. **Max Marks:** 50

Type A (Answer any SIX questions – 3 marks each) *(6 × 2 = 12 marks)*

1. List the components of a logistics network.
2. What is a distribution center?

3. What is warehouse location analysis?
4. Define distribution channel.
5. What is facility cost?
6. Define transportation optimization.
7. Define data validation.
8. What is model optimization?

Type B (Answer any FOUR questions – 6 marks each) *(4× 6 = 24 marks)*

9. Discuss logistics network design using price discount strategy.
10. Explain the role of consolidation hubs in logistics networks.
11. Explain transportation rates and warehousing costs in logistics planning.
12. Explain strategies for determining optimal sourcing and distribution channels.
13. Discuss data validation and model optimization techniques in logistics networks.
14. Explain logistics data collection techniques.

Type C (Answer any ONE questions – 14 marks each) *(1 × 14 =14 marks)*

15. Explain transportation rates, warehousing costs, shipment sizes, order processing costs, and customer service goals in logistics planning.
16. Discuss logistics data collection methods and explain the role of location theory, demand forecasting, and transportation cost estimation in network design.

KU7DSCDSL402: In-plant Logistics

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
7	DSC	400-499	KU7DSCDSL402	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2 hrs

Course Description:

This course provides comprehensive knowledge of in-plant logistics operations and material flow management in manufacturing environments. It covers inbound and outbound logistics, job shop operations, inventory management, warehouse coordination, production scheduling, and assembly line support systems. The course also focuses on lean manufacturing practices, OTIF, vendor coordination, cargo handling, transportation scheduling, and logistics documentation. Students will gain practical understanding of efficient plant logistics coordination and modern manufacturing support operations.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand the concepts, process flow, and operational activities involved in inbound and in-plant logistics within manufacturing systems.	U
2	Analyze material flow, production planning, job shop operations, lean manufacturing practices, JIT systems, and assembly line coordination processes.	An
3	Evaluate inventory management, inbound and outbound logistics operations, packaging, kitting, transportation scheduling, and vendor coordination techniques.	E
4	Apply logistics documentation procedures, KPI measurement methods, cargo handling practices, and transportation management techniques in in-plant logistics operations.	A
5	Analyze quality control, safety practices, OTIF performance, hazardous material handling, and modern methodologies used in efficient in-plant logistics systems.	An

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	1	1	-	-	-	2	1
CO2	2	2	1	1	-	3	1
CO3	2	2	1	1	1	3	1
CO4	2	3	1	2	1	3	2
CO5	1	2	-	1	-	3	3

Mapping of Course Outcomes to POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	2	2	1	1
CO2	2	1	3	3	2	1
CO3	2	2	3	3	2	1
CO4	3	2	3	3	2	2
CO5	2	1	3	3	3	2

COURSE CONTENTS

	QB No.		DESCRIPTION	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Fundamentals of In-Plant Logistics**	15
	1	1.1	Role of In-bound and In-plant logistics in supply chain, ASN, GVN and GRN Number, Key Components and Process flow of In-plant logistics	
		1.2	Material Flow in Manufacturing Systems, Plant Layout and Facility Planning, Production Planning and Control, Work-in-Progress (WIP) Management	
	2	1.3	Manufacturing process, physical flow, Assembly line, OTIF (on time in full), Lean Manufacturing Concepts, Just in Time (JIT), Kaizen and 5S, Seven wastes (Muda), Line balancing, Continuous improvement practices.	
		1.4	Core Activities of in-plant logistics: Loading, Unloading, Receiving, sorting, Storing, Picking and dispatch activities, Assembly Line Coordination Process.	
MODULE 2				
	UNIT 2		**MODULE 2: Job Shop**	13
	3	2.1	Job shop: Characteristics, Examples of Job Shop Industries, Work allocation	
		2.2	Job Shop in In-Plant Logistics, Difference Between Job Shop and Flow Shop	
	4	2.3	Production scheduling, selection of products/ models/parts/Team table/ Time table	
		2.4	Material flow, production line, feeding just in time inventory, Vendor management	

MODULE 3				
	UNIT 3		**MODULE 3: Inbound and Out bound Logistics**	13
	5	3.1	Inbound Logistics, Inventory Management, Importance, Value Addition, Stock Counts, Audits	
		3.2	Out Bound Logistics – Finished Goods (FG)- Tooling, Binding, Creating, Input Process, Output.	
	6	3.3	Packaging, Kitting, Far Goods (FH), Spare Parts, After Markets Process, Schedule of Transport, Vendor Coordination	
		3.4	Transport Vehicles in In-plant Logistics and Cargo Handling, Dispatchers, Bill of Lading, Freight Bill, Freight Claims, Manifest	
MODULE 4				
	UNIT 4		**MODULE 4: Timely supply and Documentation**	13
	7	4.1	Timely supply – scheduling, vendor coordination quality control, pre delivery Inspection, Quality assurance, on time in full (OTIF)	
		4.2	KPIs: Inventory turnover, Dock-to-stock time, Pick accuracy, Throughput, Logistics cost metrics	
	8	4.3	Material handling safety, PPE and warehouse safety, Hazardous material handling, Safety standards in cargo movement	
		4.4	Full Truckload (FTL) and Less than truckload shipping (LTL), Parcel Carriers, Carrier Rating, Bulk Cargo, Break Bulk Cargo, In-plant Logistics Issues and Methodologies	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	6
		Activities:		
		1	How to use IoT in in-plant logistics?	
		2	Study the material flow process in a manufacturing unit and prepare a flowchart showing inbound, in-process, and outbound logistics activities.	
		3	Prepare a report on the implementation of Lean Manufacturing, 5S, and Kaizen practices in an industrial environment.	
		4	Conduct a case study on Just in Time (JIT) inventory systems and vendor coordination practices.	
		5	Conduct an inventory audit and stock count exercise using sample warehouse data.	

Text Books:

1. Nicholas T. Thomopoulos, *Elements of Manufacturing, Distribution and Logistics: Quantitative Methods for Planning and Control*
2. M. P. Groover, *Automation, Production Systems, and Computer-Integrated Manufacturing*, 4th ed. Noida, India: Pearson Education, 2015.
3. J. A. Tompkins, J. A. White, Y. A. Bozer, and J. M. A. Tanchoco, *Facilities Planning*, 4th ed. Hoboken, NJ, USA: Wiley, 2010.
4. T. Ohno, *Toyota Production System: Beyond Large-Scale Production*. Boca Raton, FL, USA: CRC Press, 1988.
5. Ozan ATEŞ, *In-plant Logistics Issues and Methodologies Analysis: Case Study*

References:

1. J. Bowersox, D. J. Closs, and M. B. Cooper, *Supply Chain Logistics Management*, 4th ed. New York, NY, USA: McGraw-Hill Education, 2013.
2. R. Panneerselvam, *Production and Operations Management*, 3rd ed. New Delhi, India: PHI Learning, 2012.
3. S. N. Chary, *Production and Operations Management*, 6th ed. New Delhi, India: McGraw-Hill Education, 2019.
4. A. Rushton, P. Croucher, and P. Baker, *The Handbook of Logistics and Distribution Management*, 6th ed. London, U.K.: Kogan Page, 2017.

Assessment Rubrics:

Evaluation Type			**Marks**
a)	**End Semester Evaluation (Theory ESE)**		**70**
b)	**CCA**		**30**
	i.	Test Paper	5
	ii.	Model exam	10
	iii.	Assignment/ Book-article review / field report	5
	iv.	Seminar/ Viva-Voce	5
	V	Case Study and Activities	5
Total			**100**

MODEL QUESTION PAPER (Credit 4)

Time: 2 hrs. **Max Marks:** 70

Type A (Answer any SIX questions – 3 marks each) *(6 × 3 = 18 marks)*

1. Explain OTIF in logistics operations.
2. What are the core activities of in-plant logistics?
3. Explain material flow in production lines.
4. What is feeding Just in Time inventory?
5. Explain vendor coordination.
6. What is value addition in logistics?
7. Explain hazardous material handling.
8. Differentiate FTL and LTL shipping.

Type B (Answer any FOUR questions – 6 marks each) *(4× 6 = 24 marks)*

9. Discuss production planning and control in manufacturing logistics.
10. Explain Lean Manufacturing concepts and Just in Time (JIT) systems.
11. Explain the importance of vendor management in manufacturing logistics.

12. Describe packaging and kitting processes in logistics operations.
13. Explain the importance of inbound logistics in manufacturing systems.
14. Discuss bulk cargo and break bulk cargo handling procedures.

Type C (Answer any TWO questions – 14 marks each) *(2 × 14 =28 marks)*

15. Discuss Lean Manufacturing, JIT, Kaizen, 5S, and Seven Wastes (Muda) in industrial logistics operations.
16. Evaluate transportation systems, carrier selection, and cargo methodologies used in in-plant logistics operations.
17. Explain inventory management, value addition, stock counts, and audit procedures in logistics operations.

KU7DSCDSL403: International Logistics

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
7	DSC	400-499	KU7DSCDSL403	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2 hrs

Course Description: This course provides a comprehensive understanding of international logistics, global trade operations, and supply chain management practices. It covers international trade laws, export sales contracts, purchasing systems, multimodal transportation, and global logistics service providers. The course also focuses on Incoterms, trade finance, shipment organization, insurance, and crisis management in international logistics. Students will gain practical knowledge of global transportation systems and strategic decision-making in export and import logistics operations.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand the concepts, trade environment, and supply chain functions involved in international logistics operations.	U
2	Analyze export sales contracts, international purchasing systems, trade finance, and logistics service providers in global trade.	An
3	Evaluate international transportation systems, multimodal logistics, shipment organization, and transportation trade-offs in global supply chains.	E
4	Apply Incoterms, insurance policies, and trade documentation procedures in export and import operations.	A
5	Analyze real-world global supply chain coordination challenges, supplier collaboration practices, and strategic logistics issues through case studies and teacher-specific activities.	An

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	1	1	-	-	-	2	1
CO2	1	2	-	1	-	3	1
CO3	1	2	1	1	-	3	2

CO4	1	2	-	1	1	2	2
CO5	2	2	1	2	1	3	2

Mapping of Course Outcomes to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1	1	2	2	1	1
CO2	1	2	3	3	2	1
CO3	2	2	3	3	2	1
CO4	1	2	2	3	2	2
CO5	2	2	3	3	3	2

COURSE CONTENTS

	QB No.		**DESCRIPTION**	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Introduction to International Logistics**	15
	1	1.1	Managing the Supply Pipeline for Global Trade Flows, The Global Logistics Operator, Comparison between National (Domestic) and International Logistics.	
		1.2	International Trade Law, Employment Law, Globalization and International Trade Environment, Commodities in International Trade, Barter Trade, Balance of Trade, Balance of Payment, Importer on Record, Trade Agreements.	
	2	1.3	Factors Driving Global Supply Chain Management, Customs and Global Supply Chain Management, Management of the Inventory in the Supply Chain Analysis Including Vendor Management.	
		1.4	Factors Contributing to the Development of Logistics, Asset Management in the Supply Chain, Lean Supply Chain Management, Lean Supply Workforce.	
MODULE 2				
	UNIT 2		**MODULE 2: Export Sales Contract & International Purchasing**	13
	3	2.1	Market Environment, Market Entry Strategy, Constituents of the Export Sales Contract, Evolution and Revolution of Logistics and Supply Chain Management, Modern Logistics Concepts, Logistics Department, Logistics Providers	
		2.2	Contract of Affreightment: Terms of Delivery – Incoterms, Factors Determining Choice of Incoterms, Trade Finance, Currency, Credit Terms, UCP 600 – Documentary Credits and Allied Documents, Market Development Strategy with Global Logistics Focus, B2B, B2C.	
	4	2.3	International Purchasing Systems Constituents, Negotiating the Contract, Financing Global Supply Chains.	
		2.4	Criteria of Selecting the 3PL Operator, Factors in the Development of a Successful 3PL, Contract Logistics, ISO Supply Chain, Six Core	

			Products.	
MODULE 3				
	UNIT 3		**MODULE 3: International Transport**	12
	5	3.1	Trade-Offs Inherent in International Logistics – Multi-Modalism, Key Factors in a Transport Mode(s) Trade-Off, IT and E-Commerce	
		3.2	Project Installation Management	
	6	3.3	GSC Overland Transport, GSC Maritime Transport, GSC Air Transport, GSC Intermodal Systems, GSC Transport Comparisons	
		3.4	Key players in International Logistics, How to Organize a Shipment, Strait of Hormuz Case Study and Crisis Management	
MODULE 4				
	UNIT 4		**MODULE 4: INCOTERM in Export and Import**	10
	7	4.1	Multimodal Transport and Incoterms Selection, Role of Incoterms in Trade Contract,	
		4.2	Risk and Cost, Ex Works (EXW), Free Carrier (FCA), Free Alongside Ship (FAS)	
	8	4.3	Free On Board (FOB), Cost and Freight (CFR), CIF CIP CPT	
		4.4	Types of Insurance, DAP and DPU, Delivered Duty Paid (DDP)	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	10
		Activities:		
		1	Walmart–Supplier Collaboration in India	
		2	Barriers to Supply Chain Coordination in Fragmented Indian Markets	
		3	Coordination Challenges in Global Supply Chains	
		4	Case Study: Coordinating a Global Supply Chain at Toyota	

Text Books:

6. Alan E. Branch, *Global Supply Chain Management and International Logistics,* Routledge.
7. https://www.coursera.org/learn/spjimr-supply-chain-management#modules
8. International Logistics & Transportation in Supply Chain, Available online: https://www.udemy.com/course/shipping-logistics-business-in-supply-chain-export-import/?couponCode=PMNVD2025
9. Udemy Course: Global Logistics: Shipping, Freight, & Supply Chain

References:

a. Donald J. Bowersox, David J. Closs, and M. Bixby Cooper, *Supply Chain Logistics Management*, McGraw-Hill Education.
b. Pierre A. David and Richard Stewart, *International Logistics: The Management of International Trade Operations*, Cengage Learning.
c. Douglas Long, *International Logistics: Global Supply Chain Management*, Springer.
d. John J. Coyle, C. John Langley Jr., Robert A. Novack, and Brian Gibson, *Supply Chain Management: A Logistics Perspective*, Cengage Learning.
e. Sunil Chopra and Peter Meindl, *Supply Chain Management: Strategy, Planning, and Operation*, Pearson.
f. Ballou R. H., *Business Logistics and Supply Chain Management*, Pearson.

g. World Trade Organization (WTO), *International Trade Reports and Guidelines*.
h. Government of India – Directorate General of Foreign Trade (DGFT), *Export–Import Policy and Procedures Handbook*.
i. UNCTAD, *Review of Maritime Transport Reports*.
j. International Chamber of Commerce (ICC), *Incoterms® Rules*.

Assessment Rubrics:

Evaluation Type			**Marks**
a)	**End Semester Evaluation (Theory ESE)**		**70**
b)	**CCA**		**30**
	i.	Test Paper	5
	ii.	Model exam	10
	iii.	Assignment/ Book-article review / field report	5
	iv.	Seminar/ Viva-Voce	5
	V	Case Study	5
Total			**100**

MODEL QUESTION PAPER (Credit 4)

Time: 2 hrs. **Max Marks:** 70

Type A (Answer any SIX questions – 3 marks each) *(6 × 3 = 18 marks)*

1. Differentiate domestic logistics and international logistics.
2. Define balance of trade.
3. Define 3PL operator.
4. What is contract logistics?
5. What is shipment organization?
6. Define crisis management in logistics.
7. Define multimodal transport.
8. What is cargo insurance?

Type B (Answer any FOUR questions – 6 marks each) *(4× 6 = 24 marks)*

9. Discuss factors driving global supply chain management.
10. Explain inventory management in global supply chains.
11. Explain international purchasing systems and contract negotiation.
12. Discuss the factors for successful 3PL operations.
13. Explain intermodal transportation systems and their advantages.
14. Describe EXW, FCA, and FAS terms.

Type C (Answer any TWO questions – 14 marks each) *(2 × 14 =28 marks)*

15. Analyze the importance of Incoterms in international trade operations.
16. Describe project installation management in logistics operations.
17. Describe documentary credits and allied documents.

KU7DSCDSL404: Digital Image Processing

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
7	DSC	400-499	KU7DSCDSL404	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	35	65	100	1.5 hrs

Course Description:

This course introduces the fundamentals of digital image processing, including image representation, enhancement, restoration, segmentation, and compression techniques. It provides knowledge of image analysis methods, morphological operations, and classification approaches used in modern imaging applications. The course also offers practical exposure to image processing tools and techniques using MATLAB for real-world problem solving.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand the fundamentals of digital image processing, image representation, image formation, colour spaces, and image transformations.	U
2	Apply image enhancement and restoration techniques using spatial filtering, edge detection, and noise removal methods.	A
3	Analyze and implement image segmentation, morphological processing, and image compression techniques for digital image analysis.	C
4	Evaluate different classification approaches including supervised, unsupervised, Bayesian, binary, and ensemble classifiers for image-based applications.	A
5	Develop practical skills in image processing using MATLAB functions and tools for real-world image analysis tasks.	C

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	1	1	1	-	-
CO2	2	3	2	1	1	1	-
CO3	2	3	3	2	2	2	-
CO4	2	3	3	2	2	3	1

CO5	3	2	2	3	2	1	1

Mapping of Course Outcomes to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	2	1	-	-
CO2	3	3	2	2	-	-
CO3	3	3	3	2	-	-
CO4	3	3	3	3	1	-
CO5	3	3	2	2	2	1

COURSE CONTENTS

	QB No.		**DESCRIPTION**	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Digital image fundamentals**	15
	1	1.1	Image Representation: Image Layout and Colour, Bit-Plane Splicing, Image Formats, Colour Spaces	
		1.2	Image Formation: How Is an Image Formed? Linear Imaging Systems, Linear Superposition Integral, Linear Shift-Invariant Systems and the Convolution Integral, Convolution, Multiple & Digital Convolution, Fourier Transforms & Its Properties	
	2	1.3	Camera, Digitization Process, Operations Upon Pixels, Point-Based Operations on Images,	
		1.4	Pixel Distributions: Histograms	
MODULE 2				
	UNIT 2		**MODULE 2: Image Enhancement and Restoration**	15
	3	2.1	Enhancement via Image Filtering, Pixel Neighbourhoods, Filter Kernels and the Mechanics of Linear Filtering, Nonlinear Spatial Filtering, Filtering for Noise Removal,	
		2.2	Filtering For Edge Detection, Edge Enhancement	
	4	2.3	Image Restoration: Degradation Model, Noise Models	
		2.4	Inverse Filtering	
MODULE 3				
	UNIT 3		**MODULE 3: Image Segmentation, Compression & Morphological Processing**	15
	5	3.1	Use of Image Properties and Features in Segmentation, Thresholding, Region-Based Segmentation	
		3.2	Canny Edge Detector, Watershed Segmentation, Segmentation Functions	
	6	3.3	Morphological Processing: Dilation, Erosion, Boundary Extraction	
		3.4	Image Compression: Fundamentals, Image Compression Models, Huffman coding, Arithmetic Coding, LZW Coding	
MODULE 4				
	UNIT 4		**MODULE 4: Classification Tasks**	15
	7	4.1	Supervised and unsupervised classification, Classifier design steps	

	8	4.2	Linear discriminant functions, Bayesian classification & decision rule	
		4.3	Introduction to Machine Learning in Image Processing, Feature extraction techniques, Binary and ensemble classifiers	
		4.4	Unsupervised learning: k-means clustering	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	15
		Activities/ Practical Work:		
		1	**Matlab functions:** imread(), imview(), imshow(), subplot(), rand(), fspecial(), filter2(), imresize(), tic(), toc(), imapprox(), rgb2ind(), gray2ind(), imnoise(), imtool(), hdrread(), tonemap(), getrangefromclass()	
		2	**Matlab functions:** imresize, size, whos, imadd, imsubtract, immultiply, imagesc, imcomplement, imabsdiff, implay, uint8, horzcat, tic, toc, rgb2ycbcr	
		3	**Matlab functions:** imnoise, plot, tic, toc, min, max, mean, function, imresize, for,colfilt, roipoly, roifilt, imfilter, fspecial.	
		4	**Matlab functions:** imnoise, mat2gray, fftn, ifftn	

Essential Readings:

- Fundamentals of Digital Image Processing – A practical approach with examples in MATLAB
- Ian T. Young, *Fundamentals of Image Processing,* Delft University of Technology
- Digital Image Processing- Rafeal C. Gonzalez, Richard E. Woods, 3 rd Edition, Pearson, 2008.
- Digital Image Processing- S Jayaraman, S. Essakkirajan, T. Veerakumar-TMH,2010

References:

1. Digital Image Processing and analysis - human and computer vision application with using CVIP Tools – Scotte Umbaugh, 2ndEd, CRC Press, 2011
2. Introduction to Digital Image Processing with MATLAB, Alasdair McAndrew, Thomson Course Technology
3. Fundamentals of Digital Image Processing-A.K. Jain, PHI,1989
4. Digital Image Processing and computer Vision - Somka, Halavac, Boyle - Cengage learning (Indian edition) 2008
5. Digital Image Processing using MATLAB, Rafeal C. Gonzalez, Richard E. Woods, Steven L. Eddins, Pearson Education.
6. Introduction to Image Processing & Analysis-John C. Russ, J. Christian Russ, CRC Press, 2010
7. Digital Image Processing with MATLAB & Lab view - Vipula Singh Elsevier

Web Resources

1. https://www.mathworks.com/videos/getting-started-with-image-processing-1617599799993.html
2. http://www.digimat.in/nptel/courses/video/117105135/L02.html
3. Digital Image Processing Gonzalez video lectures.

Assessment Rubrics:

Evaluation Type			Marks	Evaluation Type			Marks	Total
Theory Marks			**75**	Practical Marks			**25**	**100**
a)	End Semester Evaluation (Theory ESE)		**50**	a)	Practical ESE (2.5hrs.)		**15**	
					Program code		**6**	
					Output		**4**	
					Viva		**3**	
					Modification		**2**	
b)	**CCA**		**25**	b)	**CCA (2 hrs.)**		**10**	
	i.	Test Paper	5		i.	Punctuality	3	
	ii.	Model exam	10		ii.	Model exam	4	
	iii.	Assignment/ Book-article review / field report	5		iii	Record	3	
	iv.	Seminar/ Viva-Voce	5					

MODEL QUESTION PAPER (Credit 4)

Time: 90 Minutes **Max Marks:** 50

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

1. Define convolution in image processing.
2. What is a Fourier Transform?
3. What is nonlinear filtering?
4. Define edge detection.
5. Define thresholding.
6. What is Canny edge detection?
7. What is unsupervised learning?
8. Define ensemble classifiers.

Type B (Answer any FOUR questions – 6 marks each) *(4 × 6 = 24 marks)*

9. Explain the properties of Fourier Transform.
10. Describe histogram representation and its applications.
11. Explain degradation and restoration models.
12. Discuss Canny edge detector and watershed segmentation.
13. Explain Bayesian classification and decision rules.

Type C (Answer any ONE question – 14 marks each) *(1 × 14 = 14 marks)*

14. Discuss image enhancement techniques using linear and nonlinear filtering methods with suitable examples
15. Explain segmentation techniques including thresholding, Canny edge detection, and watershed segmentation.

KU7DSCDSL405: Time Series Data Analysis

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
7	DSC	400-499	KU7DSCDSL405	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	35	65	100	1.5 hrs

Course Description:

This course introduces the fundamental concepts, techniques, and applications of time series analysis and forecasting using statistical, machine learning, and deep learning approaches. It covers time series preprocessing, visualization, autoregressive models, ARIMA, forecasting evaluation metrics, and advanced neural network models such as RNN, GRU, and LSTM for predictive analytics. The course also provides practical exposure to demand forecasting, multivariate forecasting, model deployment, and real-world forecasting applications using Python and PyTorch.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand the fundamental concepts of time series analysis, forecasting techniques, machine learning methods, and deep learning approaches for time-dependent data.	U
2	Apply preprocessing, visualization, feature engineering, and evaluation techniques for analyzing and preparing time series datasets.	A
3	Analyze autoregressive models, ARMA, ARIMA, stationarity measures, and forecasting techniques for predictive modeling applications.	C
4	Evaluate advanced deep learning models such as RNN, GRU, and LSTM for univariate and multivariate time series forecasting tasks.	A
5	Develop practical forecasting solutions using Python, PyTorch, and deployment techniques for real-world business, logistics, and demand forecasting applications.	C

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	3	2	1	-	2	1
CO2	3	3	2	3	1	2	1

CO3	2	3	2	2	1	3	-
CO4	2	3	3	2	2	3	1
CO5	3	3	3	3	2	3	2

Mapping of Course Outcomes to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	2	2	-	1
CO2	3	3	3	2	1	1
CO3	3	3	3	3	1	1
CO4	3	3	3	3	1	1
CO5	2	3	3	3	2	2

COURSE CONTENTS

	QB No.		**DESCRIPTION**	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Introduction & Forecasting Fundamentals**	15
	1	1.1	Introduction to Time series analysis: Long-term and short-term movements, Forecasting aspects	
		1.2	Python for time series forecasting, Machine learning for time series data	
	2	1.3	Deep learning with PyTorch, Time Series as Deep Learning Problem	
		1.4	Univariate, Multivariate, Single Step vs Multistep forecasting	
MODULE 2				
	UNIT 2		**MODULE 2: Time Series Data Preprocessing & Visualization**	15
	3	2.1	Handling Missing Data, Normalization, Trend Removal, Differencing, Sliding Window, Data Ingestion & Exploration	
		2.2	Data Visualization, Stationarity, Correlation, Histograms, Scatterplots, 1D/2D/3D Visualization	
	4	2.3	Feature Engineering Modeling Building and Selection, Training, Validating, Testing, Model optimization	
		2.4	Evaluation metrics (MAE, RMSE, MAPE), Demand forecasting modeling techniques	
MODULE 3				
	UNIT 3		**MODULE 3: Classical Statistical Forecasting Methods**	15
	5	3.1	Autoregression, Moving Average, Autoregressive Moving Average (ARMA)	
		3.2	Stationarity, Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) & ADF test	
	6	3.3	Autoregressive Integrated Moving Average (ARIMA)	
		3.4	Automated Machine Learning, Introduction to Neural Networks for Time Series Forecasting	
MODULE 4				
	UNIT 4		**MODULE 4: Deep Learning Forecasting Methods**	15

	7	4.1	Sequence-to-sequence forecasting basics, Recurrent Neural Networks Architecture - Importing Dataset - Perform Training and Evaluation of RNN Model	
		4.2	Develop GRUs and LSTMs for Time Series Forecasting, Attention mechanism (intro only)	
	8	4.3	Model Deployment for Time Series Forecasting	
		4.4	Introduction to Azure Machine Learning SDK for Python	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	15
		Activities/ Practical Work:		
		1	• Time series visualization using Python • Forecasting using ARIMA • Demand forecasting mini project • RNN/LSTM implementation using PyTorch • Multivariate forecasting • Time series preprocessing tasks • Forecast evaluation using MAE/RMSE • Deployment of forecasting model	

Essential Readings:

1. Francesca Lazzeri, Machine Learning for Time Series Forecasting with Python, Wiley,
2. 2020
3. Ivan Gridin, Time Series Forecasting Using Deep Learning, BPB publications, 2021
4. Aileen Nielsen, Practical Time Series Analysis, O'Reilly, 2019
5. Charu C. Aggarwal, Neural Networks and Deep Learning, Springer International Publishing AG, 2018

Assessment Rubrics:

Evaluation Type			**Marks**	**Evaluation Type**			**Marks**	**Total**
Theory Marks			**75**	Practical Marks			**25**	**100**
a)	End Semester Evaluation (Theory ESE)		**50**	a)	Practical ESE (2.5 hrs.)		**15**	
					Program code		**6**	
					Output		**4**	
					Viva		**3**	
					Modification		**2**	
b)	**CCA**		**25**	b)	**CCA (2 hrs.)**		**10**	
	i.	Test Paper	5		i.	Punctuality	3	
	ii.	Model exam	10		ii.	Model exam	4	
	iii.	Assignment/ Book-article review / field report	5		iii	Record	3	

	iv.	Seminar/ Viva-Voce	5					

MODEL QUESTION PAPER (Credit 4)

Time: 90 Minutes **Max Marks:** 50

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

1. Define forecasting.
2. Define univariate and multivariate forecasting.
3. Define stationarity.
4. What is correlation in time series?
5. Define partial autocorrelation function (PACF).
6. What is moving average model?
7. What is model deployment?
8. Define attention mechanism.

Type B (Answer any FOUR questions – 6 marks each) *(4 × 6 = 24 marks)*

9. Discuss forecasting evaluation metrics such as MAE, RMSE, and MAPE.
10. Discuss demand forecasting modeling techniques.
11. Explain autoregression and moving average models.
12. Discuss ACF and PACF plots in forecasting.
13. Explain the architecture of Recurrent Neural Networks (RNN).
14. Discuss GRU and LSTM models for time series forecasting.

Type C (Answer any ONE question – 14 marks each) *(1 × 14 = 14 marks)*

15. Explain feature engineering, model building, validation, testing, and optimization techniques for time series forecasting.
16. Explain autoregressive, moving average, ARMA, and ARIMA models with suitable examples.

SEMESTER 8: CAPSTONE LEVEL COURSES

KU8DSCDSL406: Research Fundamentals and Publication Ethics

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
8	DSC	400-499	KU8DSCDSL406	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2 hrs

Course Description:

This course provides comprehensive knowledge of research methodology, research design, sampling techniques, and data analysis methods used in scientific research. It covers intellectual property rights, patents, copyrights, plagiarism, publication ethics, and ethical practices in research and scholarly publishing. The course also focuses on research report writing, paper preparation, citation methods, and author-level metrics. Students will gain practical skills in technical writing using LaTeX for preparing professional research articles, reports, and academic documents.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand the concepts, types, significance, and processes involved in scientific research and research problem formulation.	U
2	Apply research design methods, sampling techniques, data collection procedures, and data analysis methods in research studies.	A
3	Analyze intellectual property rights, patents, trademarks, copyrights, and ethical issues related to research and publication practices.	An
4	Evaluate publication ethics, plagiarism issues, citation practices, research misconduct, and author-level research metrics.	E
5	Develop technical and research writing skills for preparing research papers, reports, and academic documents using LaTeX tools and formatting techniques.	C

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	1	1	-	-	-	1	1
CO2	3	3	1	1	1	2	1
CO3	1	1	-	-	-	1	3
CO4	2	2	-	2	1	1	3
CO5	1	1	-	3	2	1	1

Mapping of Course Outcomes to POs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	2	2	1	1
CO2	3	2	3	3	1	1
CO3	1	1	2	2	1	3
CO4	2	1	3	3	2	3
CO5	1	3	2	2	3	2

COURSE CONTENTS

	QB No.		DESCRIPTION	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Introduction to Research Methodology**	15
	1	1.1	Meaning and importance of research, Types of research: Descriptive Vs. Analytical, Applied Vs. Fundamental, Quantitative Vs. Qualitative, Conceptual Vs. Empirical	
		1.2	Significance of research, Research Methods versus Methodology	
	2	1.3	Research process and research problems: Steps, Criteria of good research	
		1.4	Defining and selecting a research problem, Technique involved in defining a problem.	
MODULE 2				
	UNIT 2		**MODULE 2: Research Design and Sampling**	13
	3	2.1	Research Design: Meaning, need for research design, features, Important concepts, Different research designs, and Developing a Research Plan, Primary and secondary data collection, Selection of appropriate method, Case study method	
		2.2	Processing and Analysis of Data: Processing operations, Problems in processing, Types of analysis.	
	4	2.3	Sampling: - Steps in sampling design - Characteristics of a good sample design - Types of sample designs.	
		2.4	Measurement scales, Tests of sound measurement, Sources of error in measurement.	
M O				

	UNIT 3		**MODULE 3: IPR and Publication Ethics**	13
	5	3.1	Intellectual Property Rights: Definition and meaning, Relevance, Business impact, Protection of intellectual property, Copyrights - ownership and classes of copyrights - Copyrights of the author	
		3.2	Patents – steps to file a patent, Trademarks - eligibility criteria and who can apply for a trademark,	
	6	3.3	Research and Publication Ethics: Ethical judgements in research, Managing scientific conduct: Types and integrity concepts, Research fraud: FFP, Ethics of publications: Individual and publisher level, Redundant publication, Selective reporting and misrepresentation of data, Concept of publication and research ethics, Types of research misconduct	
		3.4	Plagiarism: nature, levels, and penalties, Authorship and contributorship, Conflicts of interest, Concept of publication misconduct. Concept of citation, Citation databases, Author level, and article-level metrics.	
MODULE 4				
	UNIT 4		**MODULE 4: Interpretation and Report Writing**	13
	7	4.1	Techniques of interpretation - Different steps in the writing research - Layout of the report - Types of the report - precautions for writing research reports.	
		4.2	Paper title and keywords – Writing an abstract – Writing the different sections of a paper - Revising a paper - Responding to peer reviews - Reviewing research papers	
	8	4.3	Technical writing in Latex: Latex compilation, formatting, writing books as chapters, designing header and footer, designing chapters and sections, creating lists, tables, inserting images, setting labels and reference, index,	
		4.4	Technical writing in Latex: List of figures and tables, math formulae, hyperlinks, bookmarks, bibliography.	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	6
		Activities:		
		1	Case study: Examples of violations of intellectual property.	
		2	Problems encountered by researchers in India	
		3	Write a Literature Review Report using Latex	
		4	Awareness of Software tools and journals: Turnitin, Urkund, Shodhganga, Overleaf, and other open-source software tools, Scimago, Springer, Elsevier, Jane, Wiley, Taylor & Francis, etc.	

Text Books:

1. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age
2. International. 418p.
3. Bhardwaj, M. (n.d.). Intellectual Property A Primer for Academia
4. (https://www.icsi.edu/media/website/IntellectualPropertyRightLaws&Practice.pdf)
5. Dr. Summanta Dutta, Research and Publication Ethics in Social Science

6. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to
7. Research Methodology, RBSA Publishers.
8. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Publications. 2
9. volumes.
10. Helmut Kopka and Patrick W.Daly, Guide to LATEX, fourth edition

References:

1. Cooper, D. R. and Schindler, P. S., (2009), "Business Research Methods", Tata McGraw Hill, 9th Edition.
2. Jackson, S.L., Research Methods and Statistics, Cengage Learning India Private Limited, New Delhi, 2009.
3. Krishnaswamy, K.N., Sivakumar, A.I., and Mathirajan, M., Management Research Methodology, Pearson Education , 2006.
4. Lebrun, J-L., Scientific Writing: A Reader and Writer's Guide, World Scientific Publishing Co. Pte. Ltd., Singapore, 2007.
5. MLA, MLA Handbook for Writers of Research papers, Seventh Edition, Affiliated East West Press Pvt Ltd, New Delhi, 2009.
6. Thiel, D. V., Research Methods for Engineers, Cambridge University Press, 2014.

Assessment Rubrics:

Evaluation Type			**Marks**
a)	**End Semester Evaluation (Theory ESE)**		**70**
b)	**CCA**		**30**
	i.	Test Paper	5
	ii.	Model exam	10
	iii.	Assignment/ Book-article review / field report	5
	iv.	Seminar/ Viva-Voce	5
	V	Case Study and Activities	5
Total			**100**

MODEL QUESTION PAPER (Credit 4)

Time: 2 hrs. **Max Marks:** 70

Type A (Answer any SIX questions – 3 marks each) *(6 × 3 = 18 marks)*

1. What are the characteristics of good research?
2. Differentiate research methods and methodology.
3. Define measurement scale.

4. What is case study method?
5. Define plagiarism. What is research misconduct?
6. Define Intellectual Property Rights (IPR).
7. Define technical writing.
8. Define interpretation in research.

Type B (Answer any FOUR questions – 6 marks each) *(4× 6 = 24 marks)*

9. Explain techniques involved in defining a research problem.
10. Discuss the differences between conceptual and empirical research.
11. Describe steps involved in sampling design.
12. Explain the need and features of research design.
13. Discuss citation databases and author-level metrics.
14. Describe the process of writing and revising a research paper.

Type C (Answer any TWO questions – 14 marks each) *(2 × 14 =28 marks)*

15. Discuss data processing operations and different types of data analysis methods.
16. Explain citation practices, citation databases, author metrics, and article-level metrics.
17. Explain the structure, layout, and precautions involved in research report writing.

KU8DSCDSL407: Healthcare Data Analytics

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
8	DSC	400-499	KU8DSCDSL407	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	35	65	100	2 hrs

Course Description:

This course introduces the concepts, techniques, and applications of healthcare data analytics for extracting meaningful insights from healthcare data sources and biomedical systems. It covers electronic health records, biomedical image and signal analysis, clinical prediction models, healthcare information retrieval, and medical image analytics using data-driven and machine learning approaches. The course also provides practical exposure to healthcare data preprocessing, visualization, disease prediction, biomedical signal analysis, and healthcare image classification techniques.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand healthcare data sources, electronic health records (EHR), biomedical imaging modalities, and the fundamentals of healthcare data analytics.	U
2	Apply biomedical image and signal analysis techniques including segmentation, feature extraction, ECG signal analysis, and signal denoising methods.	An
3	Analyze clinical data mining techniques, prediction models, artificial neural networks, and validation methods for healthcare applications.	E
4	Evaluate healthcare information retrieval systems, medical image analysis methods, and classification techniques for biomedical data processing.	A
5	Develop practical healthcare analytics solutions using healthcare datasets, biomedical images, and machine learning techniques for clinical and healthcare decision-making applications.	An

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	1	1	1	1	2

CO2	3	3	2	2	1	2	1
CO3	3	3	3	2	1	2	2
CO4	2	3	2	2	1	2	2
CO5	3	2	3	3	2	3	2

Mapping of Course Outcomes to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	1	2	2	1	2
CO2	3	3	3	3	1	1
CO3	3	3	3	3	1	2
CO4	3	2	3	3	1	2
CO5	2	3	3	3	2	2

COURSE CONTENTS

	QB No.		**DESCRIPTION**	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Introduction to Healthcare Data**	12
	1	1.1	Healthcare Data Sources and Basic Analytics - Advanced Data Analytics for Healthcare - Applications and Practical Systems for Healthcare - Resources for Healthcare Data Analytics.	
		1.2	Electronic Health Records Survey - Components of EHR - Coding Systems	
	2	1.3	Benefits of EHR - Barriers to Adopting EHR - Challenges of Using EHR Data - Phenotyping Algorithms	
		1.4	Biomedical Imaging Modalities	
MODULE 2				
	UNIT 2		**MODULE 2: Biomedical Image and Signal Analysis**	13
	3	2.1	Object Detection - Image Segmentation	
		2.2	Image Registration - Feature Extraction	
	4	2.3	Types of Biomedical Signals - ECG Signal Analysis	
		2.4	Denoising of Signals – Recent Trends in Biomedical Signal Analysis	
MODULE 3				
	UNIT 3		**MODULE 3: Data Mining and Clinical Prediction Models**	12
	5	3.1	Mining Information from Clinical Text - Challenges for Processing Clinical Reports - Clinical Applications	
		3.2	Decision Tree, Cost-Sensitive Learning, , ANN	
	6	3.3	Advanced Prediction Models	
		3.4	Evaluation Metrics - Internal & External Validation Methods	
MODULE 4				
	UNIT 4		**MODULE 4: Information Retrieval & Healthcare Image Analytics**	10
	7	4.1	Knowledge-Based Information in Healthcare and Biomedicine,	

			Content of Knowledge-Based Information Resources, Indexing	
		4.2	Exact-Match and Partial-Match Retrieval, Retrieval Systems, System-Oriented and User-Oriented Evaluation, Research Directions	
	8	4.3	Image Analysis: Preprocessing and Filtering, Feature Extraction, Registration, Segmentation, Classification	
		4.4	Evaluation of Image Analysis, Mobile Image Analysis	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	10
		Activities:		
		1	Obtain a sample EHR dataset and explore its structure and contents including patient demographics, diagnoses, medications, and procedures.	
		2	Create visualizations such as histograms and bar charts to analyze the distribution of healthcare variables in the EHR dataset.	
		3	Clean and preprocess healthcare datasets by handling missing values, outliers, and inconsistent formatting.	
		4	Implement a simple phenotyping or prediction algorithm using EHR dataset and evaluate its performance using accuracy, sensitivity, and specificity metrics.	
		5	Implement an image segmentation algorithm (e.g., U-Net, Mask R-CNN) to segment specific structures or lesions in biomedical images. Train the model using annotated training data and evaluate its performance on a separate validation set.	
		6	Acquire a biomedical image dataset (e.g., MRI brain scans, X ray images) and explore its characteristics, including image dimensions, pixel values, and annotation labels. Provide a summary of the dataset properties and visualize sample images along with their corresponding annotations.	
		7	Apply denoising techniques such as median filtering, wavelet denoising, adaptive filtering on a noisy biomedical signal (e.g., ECG or EEG). Evaluate the effectiveness of each method in improving signal quality.	
		8	Perform image classification using CNN models for healthcare image datasets.	

Essential Reading:

1. Chandan K. Reddy, Healthcare Data Analytics, CRC Press, Taylor and Francis Group, 1st Edition, 2015.
2. Philippe J. Giabbanelli, Vijay K. Mago, Advanced Data Analytics in Health: 93 (Smart Innovation, Systems and Technologies), Springer, 1st Edition, 2018.

Assessment Rubrics:

Evaluation Type		**Marks**	**Evaluation Type**		**Marks**	**Total**
Theory Marks		**75**	Practical Marks		**25**	
a)	End Semester Evaluation (Theory ESE)	**50**	a)	Practical ESE (2.5 hrs.)	**15**	
				Program code	**6**	

						Output	**4**	**100**
						Viva	**3**	
						Modification	**2**	
b)	**CCA**		**25**	b)	**CCA (2 hrs.)**		**10**	
	i.	Test Paper	5		i.	Punctuality	3	
	ii.	Model exam	10		ii.	Model exam	4	
	iii.	Assignment/ Book-article review / field report	5		iii	Record	3	
	iv.	Seminar/ Viva-Voce	5					

MODEL QUESTION PAPER (Credit 4)

Time: 2 hrs. **Max Marks:** 50

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

1. Define phenotyping algorithms.
2. What are biomedical imaging modalities?
3. What is feature extraction?
4. Define biomedical signals.
5. Define clinical prediction model.
6. What is cost-sensitive learning?
7. What is indexing in information retrieval?
8. Define exact-match retrieval.

Type B (Answer any FOUR questions – 6 marks each) *(4× 6 = 24 marks)*

9. Discuss Electronic Health Records and their components.
10. Discuss image registration and feature extraction methods.
11. Explain decision tree and ANN models for healthcare prediction.
12. Explain preprocessing and filtering techniques in medical image analysis.
13. Discuss internal and external validation methods in prediction systems.
14. Explain object detection and image segmentation techniques in biomedical imaging.

Type C (Answer any ONE question – 14 mark) *(1 × 14 =14 marks)*

15. Explain biomedical signal analysis techniques including ECG signal analysis and signal denoising methods.
16. Discuss indexing, exact-match retrieval, partial-match retrieval, and evaluation methods used in healthcare information retrieval systems.

KU8DSCDSL408: Air Cargo and Logistics

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
8	DSC	400-499	KU8DSCDSL408	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2 hrs

Course Description:

This course introduces students to the fundamentals of the airline and air cargo industry, including airport operations, aviation safety, and cargo handling procedures. It covers airline marketing, customer service, shipment planning, and logistics management practices. Students learn air freight documentation, customs procedures, cargo booking, and dangerous goods handling. The course develops practical and professional skills required in airline, cargo, and logistics sectors.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand the structure, functions, regulations, safety measures, and operational areas of the airline industry.	U
2	Explain air cargo operations, aviation terminology, aircraft types, cargo handling systems, and international air transport procedures.	E
3	Analyze airline marketing strategies, customer service practices, shipment planning, and logistics standardization techniques.	A
4	Apply procedures related to air freight forwarding, cargo booking, documentation, customs clearance, and dangerous goods handling.	A
5	Develop practical skills in cargo operations, communication, freight documentation, and problem-solving in airline and logistics environments.	C

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	1	1	1	1	2	2
CO2	3	2	1	1	1	2	2

CO3	2	2	1	2	1	3	2
CO4	2	2	1	1	2	3	2
CO5	2	2	1	2	2	3	2

Mapping of Course Outcomes to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	2	2	1	1
CO2	2	3	3	3	1	1
CO3	2	2	3	3	2	1
CO4	1	2	3	3	3	2
CO5	1	3	2	3	2	2

COURSE CONTENTS

	QB No.		**DESCRIPTION**	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Introduction to Airline Industry**	12
	1	1.1	History - Regulatory Bodies - Navigation Systems - Air Transport System – Functions – Customers – Standardization	
		1.2	Management – Airside - Terminal Area - Landside Operations – Civil Aviation - Safety and Security	
	2	1.3	Aircraft Operator's Security Program - Security V/S Facilitation - ICAO Security Manual	
		1.4	Training And Awareness – Rescue and Firefighting - Issues and Challenges - Industry Regulations - Future of the Industry	
MODULE 2				
	UNIT 2		**MODULE 2: Introduction to Air Cargo**	13
	3	2.1	Aviation And Airline Terminology - IATA Areas - Country – Currency – Airlines	
		2.2	Aircraft Lay Out - Different Types of Aircraft - Aircraft Manufacturers – ULD - International Air Routes - Airports	
	4	2.3	Codes – Consortium - Hub & Spoke – Process Flow	
		2.4	Air Freight Exports and Imports - Sales & Marketing – Understanding Marketing	
MODULE 3				
	UNIT 3		**MODULE 3: Airline Marketing and Customer Service Standardization in Logistics**	12
	5	3.1	Environment, Marketing Research, Strategies and Planning, Audits, Segmentation	
		3.2	SWOT, Marketing Management Control, Consignee Controlled Cargo – Sales Leads	
	6	3.3	Routing Instructions - Customer Service, Future Trends.	
		3.4	Advices And Bookings SLI – Labeling – Volume/ Weight Ratio –	

			Shipment Planning	
MODULE 4				
	UNIT 4		**MODULE 4: Advices, Bookings & Air Freight Forwarding**	10
	7	4.1	TACT – Air Cargo Rates and Charges - Cargo Operations - Customs Clearance	
		4.2	Air Freight Exports and Imports - Special Cargoes - Consolidation - Documentation - Air Way Bill (AWB)	
	8	4.3	Communication – Handling COD Shipments	
		4.4	Communication – Handling COD Shipments – POD – Conditions of Contract - Dangerous (DGR) or Hazardous Goods	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	10
		Activities:		
		1	Demonstrate airport passenger flow management using diagrams.	
		2	Identify and explain different airport zones: Airside, Landside, and Terminal Area.	
		3	Prepare sample documentation for air freight shipment.	
		4	Practice routing instruction preparation for cargo movement.	
		5	Conduct role-play activities between shipper, freight forwarder, and airline staff.	
		6	Create communication templates for freight forwarding operations.	

Essential Reading:

1. Taylor, S., & Key Note (Firm. (2003). Air transport logistics. Key Note.
2. Smith, P. S. (1974). Air freight: operations, marketing and economics. Faber And Faber.
3. John Walter Wood. (1940). Airports, some elements of design and future development. New York, Coward Mccann Inc.

Assessment Rubrics:

Evaluation Type			**Marks**
a)	**End Semester Evaluation (Theory ESE)**		**70**
b)	**CCA**		**30**
	i.	Test Paper	5
	ii.	Model exam	10
	iii.	Assignment/ Book-article review / field report	5
	iv.	Seminar/ Viva-Voce	5
	V	Case Study	5
Total			**100**

MODEL QUESTION PAPER (Credit 4)

Time: 2 hrs. **Max Marks:** 70

Type A (Answer any SIX questions – 3 marks each) *(6 × 3 = 18 marks)*

1. What are the functions of ICAO?
2. Differentiate between Airside and Landside operations.
3. What are international air routes?
4. What is meant by cargo process flow?
5. Define customer service in logistics.
6. What is shipment planning?
7. Define Air Way Bill (AWB).
8. What is cargo consolidation

Type B (Answer any FOUR questions – 6 marks each) *(4× 6 = 24 marks)*

9. Explain aviation safety and security programs.
10. Explain documentation procedures in air freight exports and imports.
11. Discuss customer service practices in logistics.
12. Explain SWOT analysis in airline marketing.
13. Explain aircraft layout and cargo handling systems.
14. Discuss air freight export and import procedures.

Type C (Answer any TWO questions – 14 marks each) *(2 × 14 =28 marks)*

15. Explain aviation security systems, ICAO security manuals, and future challenges in the airline industry.
16. Discuss customs clearance, cargo consolidation, and AWB documentation procedures in detail.

KU8DSCDSL409: Social Media Analytics

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
8	DSC	400-499	KU8DSCDSL409	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	35	65	100	2 hrs

Course Description:

This course introduces the concepts, techniques, and applications of Social Media Analytics for extracting meaningful insights from social media and web data. It covers text preprocessing, information retrieval, social network analysis, web crawling, opinion mining, sentiment analysis, and recommendation systems using analytical and data-driven approaches.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand the fundamental concepts, characteristics, metrics, tools, challenges, ethical issues, and applications of Social Media Analytics (SMA) and information retrieval systems.	U
2	Apply text and web page preprocessing techniques, duplicate detection methods, and social network analysis algorithms such as PageRank and HITS for analyzing social media and web data.	An
3	Analyze web crawling techniques including crawler architectures, focused and topical crawlers, real-time social media data collection methods, and ethical web scraping practices.	E
4	Evaluate opinion mining, sentiment classification, opinion spam detection, web usage mining, and recommendation system techniques for extracting meaningful insights from social media data.	A
5	Develop analytical and data-driven solutions using social media analytics techniques for business, marketing, customer behavior analysis, and logistics-related decision-making applications.	An

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7

CO1	2	2	1	1	-	1	3
CO2	3	3	2	2	1	1	2
CO3	3	2	2	2	2	2	3
CO4	3	3	3	2	1	2	2
CO5	3	3	2	3	2	3	2

Mapping of Course Outcomes to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	2	1	1	3
CO2	3	3	3	2	1	1
CO3	2	3	3	3	1	3
CO4	3	3	3	3	2	2
CO5	2	3	3	3	3	2

COURSE CONTENTS

	QB No.		**DESCRIPTION**	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Introduction to Social Media Analytics (SMA)**	15
	1	1.1	Core Characteristics of Social Media, Types of Social Media, Social Media Landscape, Need For SMA, SMA in Small & Large Organizations, Social Media Metrics (Engagement, Reach, Impressions).	
		1.2	Purpose of SMA, Social Media vs. Traditional Business Analytics, Seven Layers of SMA, Types of SMA, SMA Cycle.	
	2	1.3	Challenges and Ethical Issues in SMA, SMA Tools, Analytics Process	
		1.4	Information Retrieval and Web Search: Basic Concepts of Information Retrieval, Information Retrieval Models	
MODULE 2				
	UNIT 2		**MODULE 2: Text Pre-Processing and Social Network Analysis**	15
	3	2.1	Text and Web Page Pre-Processing: Stop word Removal, Stemming, Other Pre-Processing Tasks for Text	
		2.2	Web Page Pre-Processing, Duplicate Detection.	
	4	2.3	Social Network Analysis: Network centrality measures, Page Rank Algorithm, HITS Algorithm, Finding Other Eigen vectors,	
		2.4	Relationships with Co-Citation and Bibliographic Coupling, Strengths and Weaknesses of HITS	
MODULE 3				
	UNIT 3		**MODULE 3: Web Crawling**	15
	5	3.1	Web Crawling: A Basic Crawler Algorithm, Implementation Issues, Real-time social media data collection, Scrapy Framework Basics,	
		3.2	Universal Crawlers, Focused Crawlers	

	6	3.3	Topical Crawlers, Evaluation	
		3.4	Crawler Ethics and Conflicts, Some New Developments, Twitter/X API Basics, Ethical Web Scraping	
MODULE 4				
	UNIT 4		**MODULE 4: Opinion Mining and Sentiment Analysis**	15
	7	4.1	Opinion Mining and Sentiment Analysis: The Problem of Opinion Mining, Document Sentiment Classification	
		4.2	Sentence Subjectivity and Sentiment Classification, Mining Comparative Opinions, Opinion Lexicon Expansion, Opinion Search and Retrieval, Opinion Spam Detection	
	8	4.3	Data Modeling for Web Usage Mining, Discovery and Analysis of Web Usage Patterns	
		4.4	Recommendation Problem, Content-Based Recommendation, Collaborative Filtering: using K-Nearest Neighbor, Association Rules & Matrix Factorization	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	15
		Suggested Practical Activities:		
		1	• Collect social media data using APIs • Perform text preprocessing using Python • Conduct sentiment analysis on product reviews • Build a small recommendation system • Analyze hashtag trends • Create social network graphs • Detect spam/fake reviews • Mini project using social media datasets	

Text Books:

1. Social Media Analytics Strategy: Using Data to Optimize Business Performance Alex Gonçalves Las Vegas, Nevada, USA
2. Web Data Mining Exploring Hyperlinks, Contents, and Usage Data Bing Liu Second Edition Springer-Verlag Berlin Heidelberg

References:

1. Gautam Shroff, "Enterprise Cloud Computing", Cambridge, 2010
2. Scott Granneman, "Google Apps Deciphered: Compute in the Cloud to Streamline Your Desktop", Pearson Education, 2008.
3. Social Media Analytics Techniques and Insights from Extracting Business Value Out of Social media Matthew Gains, Avinash Kohirkar IBM press

e-Resources and other Digital Material

- https://nptel.ac.in/courses/110107129
- https://emplifi.io/resources/blog/social-media-analytics-the-complete-guide

Assessment Rubrics:

Evaluation Type	Marks	Evaluation Type	Marks	Total

Theory Marks			**75**	Practical Marks			**25**	
a)	End Semester Evaluation (Theory ESE)		**50**	a)	Practical ESE (2.5 hrs.)		**15**	
					Program code		**6**	
					Output		**4**	
					Viva		**3**	**100**
					Modification		**2**	
b)	**CCA**		**25**	b)	**CCA (2 hrs.)**		**10**	
	i.	Test Paper	5		i.	Punctuality	3	
	ii.	Model exam	10		ii.	Model exam	4	
	iii.	Assignment/ Book-article review / field report	5		iii	Record	3	
	iv.	Seminar/ Viva-Voce	5					

MODEL QUESTION PAPER (Credit 4)

Time: 2 hrs. **Max Marks:** 50

Type A (Answer any SIX questions – 3 marks each) *(6 × 2 = 12 marks)*

1. What are social media metrics?
2. Differentiate social media analytics and traditional business analytics.
3. Define stemming.
4. What is duplicate detection?
5. What are implementation issues in web crawling?
6. What is ethical web scraping?
7. Define opinion spam detection.
8. What is sentence subjectivity?

Type B (Answer any FOUR questions – 6 marks each) *(4× 6 = 24 marks)*

9. Explain the SMA cycle and analytics process.
10. Discuss information retrieval models used in web search.
11. Discuss network centrality measures in social network analysis.
12. Explain focused crawlers and universal crawlers.
13. Discuss real-time social media data collection methods.
14. Discuss document sentiment classification techniques.

Type C (Answer any ONE question – 14 marks each) *(1 × 14 =14 marks)*

15. Explain real-time social media data collection, crawler ethics, Twitter/X API basics, and ethical web scraping practices.
16. Discuss web usage mining, recommendation systems, collaborative filtering, association rules, and matrix factorization techniques.

KU8DSCDSL410: Customs Procedure

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
8	DSC	400-499	KU8DSCDSL410	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2 hrs

Course Description:

This course introduces students to the principles and procedures involved in customs administration, international trade regulations, cargo clearance, and customs duty management. The course provides practical knowledge of import-export procedures, digital customs systems, cargo handling, and global trade compliance. It also explores modern customs technologies and risk management practices used in logistics and supply chain operations.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand the fundamentals of customs administration, functions of customs authorities, and international trade regulations.	U
2	Explain customs operational procedures related to import, export, prohibited goods, and anti-smuggling measures.	E
3	Apply knowledge of customs duty assessment, exemptions, refunds, and import-export documentation procedures.	A
4	Analyze cargo clearance procedures and the role of digital customs systems such as EDI and ICEGATE.	An
5	Evaluate the applications of modern technologies such as AI, blockchain, RFID, and smart port systems in customs and logistics operations.	E
6	Develop practical knowledge and professional skills related to customs compliance, global trade procedures, and logistics management.	C

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	1	1	1	1	2	2
CO2	2	2	1	1	1	3	3
CO3	2	3	1	1	2	3	2

CO4	2	2	1	3	2	3	2
CO5	3	2	2	3	2	3	2
CO6	2	2	1	2	2	3	3

Mapping of Course Outcomes to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	2	1	1	2
CO2	2	1	2	2	1	3
CO3	3	2	3	2	1	2
CO4	2	3	3	2	2	2
CO5	3	3	2	3	1	2
CO6	2	2	2	3	3	3

COURSE CONTENTS

	QB No.		**DESCRIPTION**	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Fundamentals of Customs Administration**	12
	1	1.1	Introduction to Customs – Definitions – Objectives and Functions of Customs – Structure of Customs Department – Officers of Customs – Duties and Responsibilities – Appointments	
		1.2	Powers of Customs Officers – Appointment of Customs Ports, Airports, Inland Container Depots (ICD), and Container Freight Stations (CFS)	
	2	1.3	Prohibition and Restriction on Import and Export of Goods – Power to Prohibit Goods	
		1.4	Powers of Central Government to Notify Goods – Precautions for Persons Acquiring Notified Goods – Role of DGFT and International Trade Regulations	
MODULE 2				
	UNIT 2		**MODULE 2: Customs Operations and Compliance**	13
	3	2.1	Detection of Illegally Imported Goods – Prevention of Illegal Disposal of Goods	
		2.2	Storage and Handling of Notified Goods – Intimation Procedures and Compliance Requirements	
	4	2.3	Prevention and Detection of Illegal Import and Export Activities – Anti-Smuggling Measures – Risk Management in Customs	
		2.4	Power to Exempt Goods – Customs Compliance Procedures – Customs Bonded Warehouses and FTWZ	
MODULE 3				
	UNIT 3		**MODULE 3: Customs Duty and Trade Documentation**	12
	5	3.1	Assessment and Levy of Customs Duty – Dutiable Goods – Types of Customs Duties and Exemptions	

		3.2	Duty on Pilfered Goods – Assessment Procedures – Interest on Delayed Duty Payment	
	6	3.3	Refund of Customs Duty – Claim Procedures – Duty Drawback and Refund Mechanism	
		3.4	Import-Export Documentation: Bill of Entry, Shipping Bill, Invoice, Packing List, Bill of Lading, Airway Bill, Certificate of Origin	
MODULE 4				
	UNIT 4		**MODULE 4: Cargo Clearance & Modern Customs Technologies**	10
	7	4.1	Arrival and Clearance of Vessels and Aircraft – Customs Procedures at Sea and Air Ports - Boarding of Conveyances – Examination and Inspection Procedures	
		4.2	Export Manifest and Export Report – Clearance of Imported and Exported Goods -Clearance for Home Consumption – Electronic Data Interchange (EDI) – ICEGATE – RFID and Digital Customs Systems.	
	8	4.3	AI, Blockchain, and Data Analytics in Customs and Logistics	
		4.4	Smart Ports, Automated Cargo Handling, and Future Trends in Customs Operations	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	10
		Activities:		
		1	Conduct a mock customs documentation process for import/export goods.	
		2	Presentation on smart ports & automated cargo handling systems.	
		3	Study report on bonded warehouses and Free Trade Warehousing Zones (FTWZ).	
		4	Seminar presentation on WTO regulations and international trade agreements or on prevention of smuggling and illegal trade activities.	
		5	Visit to a nearby port, airport cargo terminal, ICD, or logistics company and submission of visit report.	

Essential Reading:

1. Kapoor, N. D. (2002). Elements of Mercantile Law.
2. Bourdet, Y., &Persson, M. (2010). Completing the EU customs union: The effects of trade procedure harmonization. Journal of Common Market Studies, Forthcoming, IFN Working Paper, (848).
3. Heng, D. (2008). Shipping, customs procedures, and the foreign community: the'Pingzhouketan'on aspects of Guangzhou's maritime economy in the late eleventh century, Journal of Song-Yuan Studies, (38), 1-38.
4. Jamieson, A., & Stopford, M. (2020). Shipbrokers and the Law. Informa Law from Routledge.
5. Alderton, P., &Saieva, G. (2013). Port management and operations. Taylo

Reference Books

1. Customs Law Manual — R.K. Jain Publications
2. Indirect Taxes Law and Practice — Taxmann Publications
3. Export Import Procedures and Documentation — Excel Books
4. International Logistics — Biztantra Publications
5. Supply Chain Management and Logistics — McGraw Hill
6. Logistics and Supply Chain Management — Pearson Education
7. Customs Tariff of India
8. International Trade and Export Management — Himalaya Publishing House
9. Maritime Logistics — Emerald Publications
10. Central Board of Indirect Taxes and Customs (CBIC) Official Website
11. ICEGATE Portal
12. Directorate General of Foreign Trade (DGFT)

Assessment Rubrics:

Evaluation Type			**Marks**
a)	**End Semester Evaluation (Theory ESE)**		**70**
b)	**CCA**		**30**
	i.	Test Paper	5
	ii.	Model exam	10
	iii.	Assignment/ Book-article review / field report	5
	iv.	Seminar/ Viva-Voce	5
	V	Case Study	5
Total			**100**

MODEL QUESTION PAPER (Credit 4)

Time: 2 hrs. **Max Marks:** 70

Type A (Answer any SIX questions – 3 marks each) *(6 × 3 = 18 marks)*

1. Define ICD and CFS.
2. State any four functions of Customs Department.
3. State the importance of risk management in customs.
4. What is FTWZ?
5. What is meant by pilfered goods?
6. Mention any two import-export documents.
7. What is home consumption clearance?
8. Mention any two modern customs technologies.

Type B (Answer any FOUR questions – 6 marks each) *(4× 6 = 24 marks)*

9. Explain the role of Customs Ports, Airports, ICD and CFS.

10. Discuss the role of customs in preventing smuggling activities.
11. Explain customs bonded warehouses and their importance.
12. Explain the assessment and levy of customs duty.
13. Discuss the procedures for refund of customs duty.
14. Discuss the role of EDI and ICEGATE in customs operations.

Type C (Answer any TWO questions – 14 marks each) *(2 × 14 =28 marks)*

15. Discuss the procedures and legal provisions related to prohibited and notified goods.
16. Explain the various import-export documents and their role in international trade procedures.

KU8DSCDSL411

Paper Presentation in National or International Conference

Present two papers with the format as specified in the conference procedure and submit the records and result of participation to the concerned tutor.

KU8DSCCSC412

Research Project

(12 credit-13hr./week. Details are specified in the evaluation criteria)

Semester 8 (Degree with Honours)

KU8DSCCSC413

Seminar

(Direction to select topics of seminar and presentation can be decided by the department)

KU8DSCCSC414

Research Project (8 Credit)

(8 credits - 9 hr./week. Details are specified in the evaluation criteria)

SEMESTER 8 – DISCIPLINE SPECIFIC ELECTIVE COURSES

KU8DSEDSL401: Advanced Predictive Analytics

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
8	DSE	400-499	KU8DSEDSL401	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	2	0	35	65	100	2 hrs

Course Description:

This course provides an introduction to Predictive Analytics and Predictive Modeling techniques used for data-driven decision making. It covers data understanding, visualization, statistical analysis, and machine learning models such as Decision Trees, Regression, Naïve Bayes, KNN, and Neural Networks. The course also focuses on model assessment, ensemble methods, and deployment strategies for real-world applications. Students will gain practical knowledge in analyzing data, building predictive models, and evaluating their performance effectively.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand the concepts of predictive analytics, business intelligence, data types, and data-driven decision making.	U
2	Analyze and visualize data using statistical and exploratory data analysis techniques.	An
3	Apply predictive modeling techniques such as Decision Trees, Regression, KNN, Naïve Bayes, and Neural Networks to solve real-world problems.	E
4	Evaluate predictive models using assessment methods, ensemble techniques, and model performance measures.	A
5	Develop the ability to deploy and interpret predictive analytics models for practical applications.	An

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	3	1	1	1	1	1

CO2	3	3	2	3	1	1	1
CO3	2	3	3	2	1	2	1
CO4	1	3	3	2	2	2	2
CO5	1	2	2	3	1	3	2

Mapping of Course Outcomes to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	2	2	1	1
CO2	3	2	3	3	1	1
CO3	3	3	3	3	2	1
CO4	3	2	3	3	1	2
CO5	2	3	3	3	2	2

COURSE CONTENTS

	QB No.		**DESCRIPTION**	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Introduction and Complexities of Data**	12
	1	1.1	Analytics - Predictive Analytics - Business Intelligence - Predictive Analytics vs. Business Intelligence and Similarities.	
		1.2	Recognizing Data Types, Identifying Data Categories, Generating Data-driven and User-driven Predictive Analytics	
	2	1.3	Keyword-based search, Semantic-based search, Contextual search	
		1.4	Exploration of Raw Data, Predictive Analytics vs. Statistics - Statistics and Analytics - Predictive Analytics vs. Data Mining – Uses - Challenges	
MODULE 2				
	UNIT 2		**MODULE 2: Setting up the Problem & Data Understanding**	13
	3	2.1	Defining Data for Predictive Modeling - Defining the Target Variable - Defining Measures of Success for Predictive Models	
		2.2	Building Models First - Early Model Deployment - Case Study: Fraud Detection	
	4	2.3	Data Understanding: Single Variable Summaries - Data Visualization in One Dimension – Histograms - Multiple Variable Summaries.	
		2.4	Hidden Value in Variable Interactions: Simpson's Paradox - The Combinatorial Explosion of Interactions - Correlations - Data Visualization, Two or Higher Dimensions.	
MODULE 3				
	UNIT 3		**MODULE 3: Predictive Modeling**	12
	5	3.1	Decision Trees - The Decision Tree Landscape - Building Decision Trees - Decision Tree Splitting Metrics	
		3.2	Logistic Regression - Neural Networks	

	6	3.3	K-Nearest Neighbor - Naïve Bayes	
		3.4	Regression Models - Linear Regression	
MODULE 4				
	UNIT 4		**MODULE 4: Assessing Predictive Models & Ensemble Models**	10
	7	4.1	Batch Approach to Model Assessment - Percent Correct Classification	
		4.2	Rank-Ordered Approach to Model Assessment - Assessing Regression Models	
	8	4.3	Bias Variance Tradeoff, Bagging, Boosting	
		4.4	Improvements to Bagging and Boosting, Interpreting Model Ensembles, Model Deployment Steps.	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	10
		Activities:		
		1	Explore the distribution of target variables and features using histograms, box plots and scatter plots	
		2	Analyze correlations between features using correlation matrices	
		3	Split the data into training and testing sets using techniques like cross-validation.	
		4	Train various machine learning models such as linear regression, logistic regression, decision trees, support vector machines (SVM), k-nearest neighbours (KNN), etc.	
		5	Evaluate models using appropriate metrics such as accuracy, precision, recall, F1-score, ROC-AUC, etc.	
		6	Compare the performance of different models using cross validation or holdout validation.	

Essential Reading:

1. Dean Abbott, Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst, Wiley, 1st Edition, 2014
2. Anasse Bari, Mohamed Chaouchi, Tommy Jung, Predictive Analytics for Dummies, Wiley, 2nd Edition, 2016
3. Anasse Bari et al., Predictive Analytics for Dümmies, A Wiley Brand, 2nd Edition.

Assessment Rubrics:

Evaluation Type		**Marks**	**Evaluation Type**		**Marks**	**Total**
Theory Marks		**75**	Practical Marks		**25**	
a)	End Semester Evaluation (Theory ESE)	**50**	a)	Practical ESE (2.5 hrs.)	**15**	
				Program code	**6**	
				Output	**4**	
				Viva	**3**	**100**
				Modification	**2**	

b)	**CCA**		**25**	b)	**CCA (2 hrs.)**		**10**
	i.	Test Paper	5		i.	Punctuality	3
	ii.	Model exam	10		ii.	Model exam	4
	iii.	Assignment/ Book-article review / field report	5		iii	Record	3
	iv.	Seminar/ Viva-Voce	5				

MODEL QUESTION PAPER (Credit 4)

Time: 2 hrs. **Max Marks:** 70

Type A (Answer any SIX questions – 2 marks each) *(6 × 2 = 12 marks)*

1. Differentiate between Predictive Analytics and Data Mining.
2. What are the different types of data used in predictive analytics?
3. Define Logistic Regression.
4. What is the importance of data visualization in analytics?
5. Define target variable in predictive modeling.
6. What is K-Nearest Neighbor (KNN)?
7. Differentiate between bagging and boosting.
8. What is model deployment?

Type B (Answer any FOUR questions – 6 marks each) *(4× 6 = 24 marks)*

9. Explain the similarities and differences between Predictive Analytics and Business Intelligence.
10. Discuss the importance of data understanding and single variable summaries.
11. Describe the concept of correlations and variable interactions.
12. Explain the construction and working of Decision Trees.
13. Describe bagging and boosting techniques in ensemble models.
14. Explain the steps involved in predictive model deployment.

Type C (Answer any ONE question – 14 marks) *(1 × 14 =14 marks)*

15. Compare and contrast KNN, Naïve Bayes, and Linear Regression techniques.
16. Explain various model assessment techniques used for classification and regression models.

KU8DSEDSL402: Marketing Analytics

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
8	DSE	400-499	KU8DSEDSL402	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2 hrs

Course Description:

This course introduces the concepts, tools, and techniques used in marketing analytics for data-driven business decision making. It covers market analysis, business strategy, product and pricing analytics, distribution systems, and promotion analytics using statistical and analytical models. The course also provides practical exposure to marketing data analysis, forecasting, customer segmentation, and performance evaluation techniques.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Understand the fundamentals of marketing analytics, market research methods, market segmentation, and strategic analytical frameworks.	U
2	Apply analytical techniques such as regression, clustering, forecasting, and decision models for business and marketing analysis.	An
3	Analyze product, pricing, and distribution strategies using data-driven approaches and marketing performance metrics.	E
4	Evaluate promotion and sales analytics techniques including advertising metrics, e-commerce analytics, and profitability analysis for business decision making.	A
5	Develop practical skills in marketing analytics tools and techniques for solving real-world business and marketing problems.	An

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	2	2	1	1	-	1	1
CO2	3	3	2	2	1	2	1
CO3	2	3	2	2	1	3	1
CO4	2	3	2	3	1	2	1

CO5	3	2	2	3	2	1	2

Mapping of Course Outcomes to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	1	2	2	1	1
CO2	3	3	3	3	1	1
CO3	3	2	3	3	2	1
CO4	2	2	3	3	3	2
CO5	2	3	2	3	2	2

COURSE CONTENTS

	QB No.		**DESCRIPTION**	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Marketing Analytics Framework**	12
	1	1.1	Introduction to Marketing Analytics and Models. Market Insight - Market Data Source – treatment of outliers, Market sizing.	
		1.2	PESTLE Market analysis, Porter Five Force Analysis, Market segment identification, targeting and positioning	
	2	1.3	Tools and Techniques: Regression, Cluster Analysis, and Perceptual Mapping Techniques.	
		1.4	Collect market data from online sources or surveys and identify outliers and perform basic data preprocessing. Then conduct PESTLE and Porter Five Force analysis for a selected company and perform customer segmentation and positioning analysis (Suggested Tools: Excel / Google Sheets / Python / Tableau).	
MODULE 2				
	UNIT 2		**MODULE 2: Business Strategy, Operations & Product Analytics**	13
	3	2.1	Analytics based strategy selection with strategic models - Strategic Scenarios, Strategic Decision Models, and Strategic Metrics.	
		2.2	Business Operations: Forecasting - Predictive Analytics - Data Mining - Balanced Scorecard - Critical Success Factors.	
	4	2.3	Product and Price Analytics: Product analytics: Conjoint Analysis model - Decision Tree Model.	
		2.4	Portfolio Resource Allocation - Product/ service Metrics, Attribute Preference testing.	
MODULE 3				
	UNIT 3		**MODULE 3: Price and Distribution Analytics**	12
	5	3.1	Pricing Techniques - Pricing Assessment - Profitable pricing	
		3.2	Pricing for Business Markets - Price Discrimination	
	6	3.3	Distribution Analytics: Distribution Channel Characteristics - Retail Location selection	
		3.4	Channel Evaluation and Selection, Multi-channel Distribution.	
M QB				
	UNIT 4		**MODULE 4: Promotion and Sales Analytics**	10

	7	4.1	Promotion budget estimation and allocation, Ad value equivalence model	
		4.2	Promotion metrics for traditional media and social media.	
	8	4.3	E Commerce sales model, sales metrics, profitability metrics and support metrics.	
		4.4	Rapid decision models - Data driven presentations - contemporary issues, Opportunities in application of marketing analytics in different sectors.	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	10
		Activities:		
		1	Regression and Cluster Analysis • Apply regression analysis for sales prediction. • Perform cluster analysis for customer grouping. • Create perceptual maps for brand positioning. • Interpret market insights from analytical outputs. Suggested Tools Excel, SPSS, Python (Scikit-learn)	
		2	Business Strategy and Product Analytics • Develop forecasting models using historical business data. • Prepare a balanced scorecard for a business organization. • Conduct conjoint analysis for product preference identification. • Build a simple decision tree model for product selection. Suggested Tools Power BI / Python / RapidMiner	
		3	Pricing and Distribution Analytics • Analyze pricing strategies of competing products. • Study price discrimination methods in different markets. • Evaluate retail location suitability using market indicators. • Compare multi-channel distribution strategies of businesses. Suggested Tools Excel, GIS Tools, Tableau	
		4	Promotion and Sales Analytics • Estimate promotional budget allocation for a product campaign. • Analyze social media promotion metrics and engagement. • Study e-commerce sales metrics and profitability indicators. • Prepare a data-driven presentation using marketing analytics findings. Suggested Tools Google Analytics, Meta Business Suite, Power BI	

Essential Reading:

1. https://measiim.edu.in/wp-content/uploads/2025/12/534ECO-Marketing-Analytics-notes.pdf
2. Stephen Sorger, (2013), MARKETING ANALYTICS, Strategic Models and Metrics,

First Edition, Admiral Press.
3. Mark Jeffery, ―Data Driven Marketing: The 15 Metrics Everyone in Marketing should know‖, Wiley, 2013.
4. Gary L. Lilien and Arvind Rangaswamy (2014), Marketing Engineering: Computer Assisted Marketing Analysis and Planning, 2nd edition, Trafford Publishing UK.
5. Wayne L. Winston (2014), Marketing Analytics: Data-Driven Techniques with Microsoft Excel, First Edition, Wiley, Indianapolis.
6. Paul W. Farris, Neil T. Bendle, Phillip E. Pfeifer, David J. Reibstein (2010), Marketing Metrics, 2nd Edition, Pearson USA.
7. Mike Grigsby (2018), Marketing Analytics: A Practical Guide to Improving Consumer Insights Using Data Techniques, 2nd Edition, NY: Kogan Page Limited, New York.
8. Rajkumar Venkatesan, Paul W. Farris, Ronald T. Wilcox, Marketing Analytics Essential Tools for Data-Driven Decisions, University of Virginia Press, 1st Edition, 2021.

References:

1. Marketing analytics: Methods, practice, implementation, and links to other fields SL France, S Ghose - Expert Systems with Applications, 2019 - Elsevier
2. Marketing analytics for customer engagement: a viewpoint S Nagaraj - International Journal of Information Systems and Social …, 2020 -igi-global.com
3. Journal of Marketing Analytics - Palgrave Macmillan
4. Applied Marketing Analytics | Henry Stewart Publications

Assessment Rubrics:

Evaluation Type			**Marks**
a)	**End Semester Evaluation (Theory ESE)**		**70**
b)	**CCA**		**30**
	i.	Test Paper	5
	ii.	Model exam	10
	iii.	Assignment/ Book-article review / field report	5
	iv.	Seminar/ Viva-Voce	5
	V	Case Study	5
Total			**100**

MODEL QUESTION PAPER (Credit 4)

Time: 2 hrs. **Max Marks:** 70

Type A (Answer any SIX questions – 3 marks each) *(6 × 3 = 18 marks)*

1. Define PESTLE analysis
2. What is Porter's Five Force Analysis?
3. What is forecasting?
4. What is a balanced scorecard?
5. Define distribution analytics.
6. What is retail location selection?
7. What is e-commerce sales analytics?
8. Define profitability metrics.

Type B (Answer any FOUR questions – 6 marks each) *(4× 6 = 24 marks)*

9. Explain market segmentation, targeting, and positioning.
10. Discuss forecasting techniques in business operations.
11. Discuss decision tree models for business decision-making.
12. Explain price discrimination with suitable examples.
13. Explain promotion budget estimation and allocation methods.
14. Discuss opportunities and challenges in marketing analytics applications.

Type C (Answer any TWO questions – 14 marks each) *(2 × 14 =28 marks)*

15. Discuss the marketing analytics framework and explain market insight techniques, market sizing, and treatment of outliers in detail.
16. Discuss forecasting, predictive analytics, data mining, balanced scorecard, and critical success factors in business operations.
17. Discuss various pricing techniques and pricing assessment methods used for profitable pricing decisions.

KU8DSEDSL403: Gen AI and Agentic AI

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
8	DSE	400-499	KU8DSEDSL403	4	60

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	1	0	35	65	100	1.5 hrs

Course Description:

This course provides an introduction to Generative AI and Agentic AI, covering the principles, architectures, and applications of modern AI systems. Students will explore Large Language Models (LLMs), prompt engineering techniques, AI content generation tools, and intelligent agent frameworks. The course also examines multi-agent systems, autonomous decision-making, ethical considerations, and real-world applications of AI across various domains. Through theoretical concepts and hands-on activities, students will develop the skills required to effectively utilize and evaluate modern AI technologies.

Course Prerequisite: NIL

Course Outcomes (COs):

CO No.	Expected Outcome	Learning Domains
1	Explain the fundamental concepts, architectures, applications, and limitations of Generative AI and Large Language Models.	U
2	Apply prompt engineering techniques and Generative AI tools to create text, images, audio, and other digital content.	A
3	Analyze the architecture, components, and workflows of Agentic AI systems and multi-agent frameworks.	An
4	Develop simple AI agents using contemporary frameworks and evaluate their performance in real-world applications.	C
5	Assess ethical, security, privacy, and governance issues associated with Generative AI and Agentic AI technologies.	E

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

Mapping of Course Outcomes to PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	1	2	2	-	-	-	1
CO2	2	2	3	2	-	-	1
CO3	1	2	3	1	-	1	-

CO4	2	2	3	2	1	1	1
CO5	-	1	1	-	-	-	3

Mapping of Course Outcomes to POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	1	2	1	-	1
CO2	2	3	2	3	1	-
CO3	3	2	3	3	1	-
CO4	2	3	3	3	2	1
CO5	1	1	2	2	2	3

COURSE CONTENTS

	QB No.		**DESCRIPTION**	HOURS
MODULE 1	**UNIT 1**		**MODULE 1: Introduction to Generative AI**	12
	1	1.1	Introduction to AI, Machine Learning, Deep Learning, & Generative AI, Generative AI Ecosystem and Workflow, Limitations and challenges of Generative AI	
		1.2	Evolution and applications of Generative AI, Overview of Large Language Models (LLMs)	
	2	1.3	Fundamentals of neural networks and transformer architecture	
		1.4	Foundation Models and Multimodal AI, Popular Generative AI models: GPT, Gemini, DALL·E, Claude, Llama	
MODULE 2				
	UNIT 2		**MODULE 2: Prompt Engineering and AI Tools**	13
	3	2.1	Introduction to prompts and prompt engineering techniques	
		2.2	Zero-shot, one-shot, and few-shot prompting, Chain-of-Thought Prompting and Role-based Prompting	
	4	2.3	Retrieval-Augmented Generation (RAG), AI tools for text, image, audio, and video generation	
		2.4	Evaluation of Prompt Quality, Hands-on use of Generative AI tools for content creation & productivity	
MODULE 3				
	UNIT 3		**MODULE 3: Agentic AI Systems**	12
	5	3.1	Introduction to Agentic AI - intelligent agents & autonomous agents	
		3.2	Components of AI agents: Perception, Reasoning, Memory & Action	
	6	3.3	Multi-agent systems: Architecture, Types (reactive, deliberative, learning, and collaborative agents), Communication and coordination among AI agents, Advantages and Challenges,	
		3.4	AI agent frameworks (LangChain, CrewAI, AutoGen, & AutoGPT) & applications in business, healthcare, logistics, & education, ReAct Framework (Reason + Act), Agent Evaluation Metrics	
M				

	UNIT 4		**MODULE 4: Ethics, Applications, and Future Trends**	10
	7	4.1	Ethical issues in Generative and Agentic AI, Hallucinations and Reliability Issues	
		4.2	AI bias, privacy, security, and responsible AI practices, AI Governance and Regulatory Frameworks	
	8	4.3	Real-world applications of Generative and Agentic AI, Explainable AI (XAI), Responsible Deployment of AI Systems	
		4.4	Future trends in autonomous AI systems and human-AI collaboration	
MODULE 5				
	UNIT 5		**MODULE 5: Teacher Specific Module**	10
		Activities:		
		1	Audio and video content generation using AI applications	
		2	AI chatbot creation	
		3	Exploring AI agent frameworks and simple autonomous agents	
		4	Developing a basic AI assistant/chatbot using no-code or low-code tools	
		5	AI agent workflow demonstration	

Reference Books

1. Artificial Intelligence: A Modern Approach – Stuart Russell and Peter Norvig
2. Deep Learning – Ian Goodfellow, Yoshua Bengio, Aaron Courville
3. Generative Deep Learning – David Foster
4. Hands-On Large Language Models – Jay Alammar and Maarten Grootendorst
5. Building LLM Powered Applications – Valentino Zocca et al.
6. Machine Learning with Python – Andreas C. Müller and Sarah Guido
7. Human Compatible – Stuart Russell
8. Artificial Intelligence for Business – Doug Rose
9. Practical Natural Language Processing – Sowmya Vajjala et al.
10. Architects of Intelligence – Martin Ford

Web Resources

- OpenAI Learning Resources
- Google AI Resources
- DeepLearning.AI Courses
- IBM AI Education
- OpenAI Prompt Engineering Guide
- Learn Prompting
- Google Gemini Documentation
- Canva AI Tools
- LangChain Documentation
- CrewAI Documentation
- Microsoft AutoGen
- Hugging Face AI Models
- UNESCO AI Ethics Guidelines
- OECD AI Principles
- Microsoft Responsible AI
- Google Responsible AI Practices

Assessment Rubrics:

Evaluation Type			Marks
a)	**End Semester Evaluation (Theory ESE)**		**70**
b)	**CCA**		**30**
	i.	Test Paper	5
	ii.	Model exam	10
	iii.	Assignment/ Book-article review / field report	5
	iv.	Seminar/ Viva-Voce	5
	V	Case Study	5
Total			**100**

MODEL QUESTION PAPER (Credit 4)

Time: 2 hrs. **Max Marks:** 70

Type A (Answer any SIX questions – 3 marks each) *(6 × 3 = 18 marks)*

1. What are transformer models?
2. Define Generative AI.
3. Name any three AI content generation tools.
4. What is AI-assisted content creation?
5. Define multi-agent systems.
6. Name any three AI agent frameworks.
7. List the ethical challenges in AI.
8. What is human-AI collaboration?

Type B (Answer any FOUR questions – 6 marks each) *(4× 6 = 24 marks)*

9. Compare AI, Machine Learning, and Deep Learning.
10. Describe the role of AI tools in productivity enhancement.
11. Explain text generation using AI models.
12. Explain communication among collaborative AI agents.
13. Describe the applications of Agentic AI in logistics and healthcare.
14. Explain ethical issues in Generative and Agentic AI.

Type C (Answer any TWO questions – 14 marks each) *(2 × 14 =28 marks)*

15. Explain AI agent frameworks and their applications in business, healthcare, logistics, and education.
16. Discuss prompt engineering techniques and their applications in Generative AI systems.

KU8DSECSC404

MOOC COURSES FROM SWAYAM/NPTEL/COURSEERA
