K. C. E. Society's
Moolji Jaitha College
An 'Autonomous College' Affiliated to
K.B.C. North Maharashtra University, Jalgaon.
NAAC Reaccredited Grade - A (CGPA : 3.15 - 3rd Cycle)
UGC honoured "College of Excellence" (2014-2019)
DST(FIST) Assisted College

KNOWLEDGE IS POWER
ESTD. 1945

के. सी. ई. सोसायटीचे
मूळजी जेठा महाविद्यालय
क.ब.चौ. उत्तर महाराष्ट्र विद्यापीठ, जळगाव संलग्नित
'स्वायत्त महाविद्यालय'
नॅकद्वारा पुनर्मानांकित श्रेणी – 'ए' (सी.जी.पी.ए. : ३.१५ – तिसरी फेरी)
विद्यापीठ अनुदान आयोगाद्वारा घोषित 'कॉलेज ऑफ एक्सलन्स' (२०१४-२०१९)
डी.एस.टी. (फीस्ट) अंतर्गत अर्थसहाय्य प्राप्त

Date :- 01/08/2024

NOTIFICATION

Sub :- CBCS Syllabi of M. Sc. in Comp. Scie (Sem. III & IV)

Ref. :- Decision of the Academic Council at its meeting held on 27/07/2024.

The Syllabi of M. Sc. in Comp. Scie (Third and Fourth Semesters) as per **NATIONAL EDUCATION POLICY – 2020 (2023 Pattern)** and approved by the Academic Council as referred above are hereby notified for implementation with effect from the academic year 2024-25.

Copy of the Syllabi Shall be downloaded from the College Website (www.kcesmjcollege.in)

Sd/-
Chairman,
Board of Studies

To :

1) The Head of the Dept., M. J. College, Jalgaon.
2) The office of the COE, M. J. College, Jalgaon.
3) The office of the Registrar, M. J. College, Jalgaon.

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समर्थ कॉलनी जवळ, जळगांव – ४२५ ००२. (महाराष्ट्र, भारत) । दूरध्वनी क्र. : +९१ २५७–२२३७३६३, २२३४२८१ । ई–मेलः mjcollege@kces.in । वेबसाईटः mjcollege.kces.in

Khandesh College Education Society's

Moolji Jaitha College, Jalgaon

An "Autonomous College"

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SYLLABUS

M.Sc. II Computer Science

Under Choice Based Credit System (CBCS)

and

as per NEP-2020 Guidelines

[w.e.f. AcademicYear:2024-25]

Preface

Skilled human resources is a prerequisite in higher education, and it is to be acquired through in-depth knowledge of theoretical concepts and hands-on laboratory methods of the subject. The present syllabus of M.Sc. part II in Computer Science has been prepared per the guidelines of UGC, NEP-2020 and the Government of Maharashtra. This course is designed to provide one with a comprehensive understanding of the principles, theories, and practices that form the foundation of modern computer science. In today's fast-paced and technology-driven world, computer science plays a crucial role in almost every aspect of our lives. From advanced algorithms and artificial intelligence to data management and current computing trends, the field of computer science offers endless possibilities and opportunities for innovation.This program is tailored to equip students with the knowledge and skills needed to excel in the dynamic and ever-evolving field of computer science. Whether you are a recent graduate or a seasoned professional seeking to enhance student's expertise, this course will challenge and inspire a student to push the boundaries of what is possible.

Throughout this program, students will delve into a wide range of topics, including software development, computer architecture, database systems, machine learning, IoT, and much more. Students will have the opportunity to engage in hands-on projects, collaborate with peers, and learn from experienced faculty members who are leaders in their respective fields.Beyond the technical aspects, this program also emphasizes critical thinking, problem-solving, and effective communication skills. These are essential qualities that will enable students to navigate complex challenges and make meaningful contributions to the field of computer science. Master of Computer Science program will provide students with the necessary foundation and opportunities to excel in their chosen career path. Furthermore, the syllabus is structured to cater to Computer Science’s present and future needs in the research field, industrial and environmental sectors, Entrepreneurship, etc., emphasizing imparting hands-on skills. Hence, the curriculum has more experiments that shall run hand-in-hand with theory. The detailed syllabus of each paper is appended with a list of suggested readings.

Program Outcomes (PO) for M.Sc. Program:

Program outcomes associated with an MSc degree are as follows:

1. Student has an in-depth understanding of advanced theories, concepts, and methodologies in their field of study.
2. Student should demonstrate advanced technical skills and proficiency in utilizing specialized equipment, software, and methodologies relevant to their field of study.
3. Students should be capable of critically analyzing complex problems and synthesizing information from various sources.
4. Students should be proficient in effectively communicating scientific information to both technical and non-technical audiences. They should be able to present their experimental findings through oral presentations, scientific writing, and appropriate visual aids.
5. Students should demonstrate leadership qualities and the ability to work effectively as a team.
6. Students should have developed advanced research skills and the ability to independently design and conduct rigorous scientific investigations. They should be able to analyze scientific literature, formulate research questions, develop research plans, collect and analyze data, draw valid conclusions, and learn about IPR.
7. Students should understand and adhere to their field's ethical principles and professional standards.
8. Students should recognize the importance of continuous learning and professional development. They should have the skills and motivation to stay updated with advancements in their field, engage in lifelong learning, and pursue further academic or professional opportunities.

Program Specific Outcome PSO (M.Sc. Computer Science):

After completion of this course, students are expected to learn/understand the:

No.	PSO
1	Acqire a deep understanding of advanced concepts, theories and principles in various areas of computer science.
2	Attain specialized knowledge and skills in a specific area of computer science.
3	Develop advanced problem-solving skills by applying theoretical knowledge and practical techniques to address complex challenges.
4	Acquire advanced programming and software development skills, including proficiency in multiple programming languages.
5	Foster critical thinking abilities to analyze, evaluate anf assess computer science problems, theories and methodologies.
6	Foster a commitment to lifelong learning and professional development by staying updated with emerging techniques and industry practices.

Credit distribution structure for two years/one-year PG MSc programme

Level	Sem	Major (Core) Subjects		Minor Subjects	OJT/Int, RP	Cumulative Credits/Sem	Degree/ Cumulative Cr.
		Mandatory (DSC)	Elective (DSE)				
6.0	I	DSC-1 (4T) DSC-2 (4T) DSC-3 (4T) DSC-4 (2P)	DSE-1(2T) A/B DSE-2(2P) A/B	RM (4T)		22	First-year PG OR One year PG diploma after 3 years UG
	II	DSC-5 (4T) DSC-6 (4T) DSC-7 (4T) DSC-8 (2P)	DSE-3(2T) A/B DSE-4(2P) A/B		OJT/Int (4)	22	
	Cum. Cr.	28	8	4	4	44	
	Exit option: PG diploma (44 Credits) after three-year UG degree						
6.5	III	DSC-9 (4T) DSC-10 (4T) DSC-11 (4T) DSC-12 (2P)	DSE-5(2T) A/B DSE-6(2P) A/B	--	RP (4)	22	Second-year PG after 3 years UG OR PG degree after 4 years UG
	IV	DSC-13 (4T) DSC-14 (4T) DSC-15 (2P) DSC-16 (2P)	DSE-7(2T) A/B DSE-8 (2P) A/B	...	RP (6)	22	
	Cum. Cr.	54	16		4+10	88	
2 Years-4 Sem. PG Degree (80-88 credits) after Three Year UG Degree or 1 Year-2 Sem PG Degree (40-44 credits) after Four Year UG Degree							

Sem- Semester, **DSC**- Department Specific Course, **DSE**- Department Specific Elective, **T**- Theory, **P**- Practical,
RM- Research Methodology, **OJT**- On Job Training, **Int**- Internship, **RP**- Research Project,
Cum. Cr. : Cumulative Credits

Multiple Entry and Multiple Exit options:

The multiple entry and exit options with the award of UG certificate/ UG diploma/ or three-year degree depending upon the number of credits secured;

Levels	Qualification Title	Credit Requirements		Semester	Year
		Minimum	Maximum		
6.0	One-year PG Diploma program after 3 Yr Degree	40	44	2	1
6.5	Two-year master's Degree program After 3-Yr UG Or PG Degree after 4- Yr UG	80	88	4	2

Examination Pattern for MSc

Theory Question Paper Pattern:

- 60 (External) +40 (Internal) for 4 credits
    - External examination will be of three hours duration
    - There shall be 5 questions, each carrying equal marks (12 marks each), while the tentative pattern of question papers shall be as follows;
    - Q1 Attempt any 3 out of 4 sub-questions; each 4 marks
    - Q 2, Q3, Q4 and Q5 Attempt any 2 out of 3 sub-question; each 6 marks.
- 30 (External) +20 (Internal) for 2 credits
    - External examination will be of 1½ hours duration
    - There shall be 3 questions Q1 carrying 6 marks and Q2, Q3 carrying 12 marks each. while the tentative pattern of question papers shall be as follows;
    - Q1 Attempt any 2 out of 3 sub-questions; each 3 marks
    - Q 2 and Q3 Attempt any 2 out of 3 sub-question; each 6 marks.

Rules of Continuous Internal Evaluation:

The Continuous Internal Evaluation for theory papers shall consist of two methods:

1. Continuous & Comprehensive Evaluation (CCE): CCE will carry a maximum of 30% weightage (30/15 marks) of the total marks for a course. Before the start of the academic session in each semester, the subject teacher should choose any three assessment methods from the following list, with each method carrying 10/5 marks:

i. Individual Assignments
ii. Seminars/Classroom Presentations/Quizzes
iii. Group Discussions/Class Discussion/Group Assignments
iv. Case studies/Case lets
v. Participatory & Industry-Integrated Learning/Field visits
vi. Practical activities/Problem Solving Exercises
vii. Participation in Seminars/Academic Events/Symposia, etc.
viii. Mini Projects/Capstone Projects
ix. Book review/Article review/Article preparation
x. Any other academic activity
xi. Each chosen CCE method shall be based on a particular unit of the syllabus, ensuring that three units of the syllabus are mapped to the CCEs.

2. Internal Assessment Tests (IAT): IAT will carry a maximum of 10% weightage (10/5 marks) of the total marks for a course. IAT shall be conducted at the end of the semester and will assess the remaining unit of the syllabus that was not covered by the CCEs. The subject teacher can decide which units will be assessed using CCEs and which unit will be assessed based on IAT.

The overall weightage of Continuous Internal Evaluation (CCE + IAT) shall be 40% of the total marks for the course. The remaining 60% of the marks shall be allocated to the semester-end examinations.

The subject teachers must communicate the chosen CCE methods and the corresponding syllabus units to the students at the beginning of the semester to ensure clarity and proper preparation.

Practical Examination Credit 2: Pattern (30+20)

External Practical Examination (30 marks):

- Practical examination shall be conducted by the respective department at the end of the semester.
- Practical examination will be of 3 hours and shall be conducted as scheduled.
- There shall be 05 marks for journal and viva voce. A certified journal is compulsory to appear for practical examination.
- The practical examination will be of a minimum of 3 hours duration and shall be conducted as per schedule for 2 consecutive days in case of practical where incubation conditions and allied aspects are essential.

Internal Practical Examination (20 marks):

- Internal practical examination of 10 marks will be conducted by the department as per the schedule given.
- For internal practical examination, students must produce the laboratory journal of practical completed along with the completion certificate signed by the concerned teacher and department head.
- There shall be continuous assessment of 30 marks based on student performance throughout the semester. This assessment can include quizzes, group discussions, presentations and other activities the faculty assigns during regular practical. For details, refer to internal theory examination guidelines.
- Finally, 40 (10+30) students' performance will be converted into 20 marks.

M.Sc. Computer Science Course Structure

Semester	Course Module	Credit	Hours/ week	TH/ PR	Code	TITLE
I	DSC	4	4	TH	CS-DSC-511	Artificial Intelligence
	DSC	4	4	TH	CS-DSC-512	Automata Theory and Computability
	DSC	4	4	TH	CS-DSC-513	Software Engineering
	DSE	2	2	TH	CS-DSE-514A	Advanced C++ Programming
	DSE	2	2	TH	CS-DSE-514B	Digital Image Processing
	DSC	2	4	PR	CS-DSC-515	Practical course based on Artificial Intelligence
	DSE	2	4	PR	CS-DSE-516A	Practical course based on Advanced C++ Programming
	DSE	2	4	PR	CS-DSE-516B	Practical course based on Digital Image Processing
	RM	4	4	TH	CS-RM -517	Research Methodology for Computer Science
II	DSC	4	4	TH	CS-DSC-521	Design and Analysis of Algorithms
	DSC	4	4	TH	CS-DSC-522	Advanced Network Programming
	DSC	4	4	TH	CS-DSC-523	Information Security
	DSE	2	2	TH	CS-DSE-524A	Advanced Java Programming
	DSE	2	2	TH	CS-DSE-524B	PowerBi
	DSC	2	4	PR	CS-DSC-525	Practical course based on Design and Analysis of Algorithms
	DSE	2	4	PR	CS-DSE-526A	Practical course based on Advanced Java Programming
	DSE	2	4	PR	CS-DSE-526B	Practical course based on PowerBi
	OJT	4	8	PR/OJT	CS-OJT-527	On Job Training/Internship
III	DSC	4	4	TH	CS-DSC-611	Current Computing Trends (ASP.NET)
	DSC	4	4	TH	CS-DSC-612	Internet of Things
	DSC	4	4	TH	CS-DSC-613	Compiler Construction
	DSE	2	2	TH	CS-DSE-614 A	Data Mining-I
	DSE	2	2	TH	CS-DSE-614 B	NoSQL-I
	DSC	2	4	PR	CS-DSC-615	Practical on Current Computing Trends (ASP.NET)
	DSE	2	4	PR	CS-DSE-616 A	Practical on Data Mining-I
	DSE	2	4	PR	CS-DSE-616 B	Practical on NoSQL-I
	DSC	4	8	PR/RP	CS-RP-617	Research Project - I
IV	DSC	4	4	TH	CS-DSC-621	Machine Learning
	DSC	4	4	TH	CS-DSC-622	Data Science
	DSE	2	2	TH	CS-DSE-623 A	Data Mining - II
	DSE	2	2	TH	CS-DSE-623 B	NoSQL-II
	DSC	2	4	PR	CS-DSC-624	Practical on Machine Learning
	DSC	2	4	PR	CS-DSC-625	Practical on Data Science
	DSE	2	4	PR	CS-DSE-626 A	Practical on Data Mining-II
	DSE	2	4	PR	CS-DSE-626 B	Practical on NoSQL-II
	OJT	6	12	PR/RP	CS-RP-627	Research Project - II

DSC : Department-Specific Core course
DSE : Department-Specific elective
TH : Theory
PR : Practical
RP : Research project

M.Sc. II (Computer Science)

Semester III

M.Sc. II (Computer Science)
Semester-III
CS-DSC-611: Current Computing Trends (ASP.NET)

Total Hours: 60 **Credits: 4**

Course objectives	• To provide insight into .NET technologies for web programming and enable them design and develop interactive and responsive web applications. • To explain learners the insights into the efficient usage of .NET technologies their facilities • To acquire knowledge of web development	
Course outcomes	Students will be able to • Acquire knowledge of .NET technologies framework • Implement various controls for creating a web Application • Understand the security aspects of web Application.	
Unit	**Content**	**Hours**
Unit I	**Basics of ASP.Net** • **Understanding the .Net Framework** o What is .NET?-The Pieces of .NET, Why we need .NET? o The Common Language Runtime(CLR)- Common Functionality, Namespaces, Assemblies-Versioning and Securing Code. o **Web Applications in ASP.NET** o ASP.NET Coding Models- Inline Code Model, The Code-Behind Model. o ASP.NET Page Directives, Page Events and Page Life Cycle,ASP.NET Application Directory Structure,ASP.NET Application Compilation Models- Normal Compilation Model, Deployment Pre-Compilation, Full Runtime Compilation.	**20**
Unit II	**Server Controls, Validation and State Management** • **ASP.NET Server Controls** o WebControl Class o Label Control o TextBox Control o Button Control o Hyper Link Control o LinkButton Control o DropDownList Control o ListBox Control o Check Button List Control o Radio ButtonList Control o Check Box Control o Radio Button Control o Image Control.	**20**

	• **HTML Controls** o Html Control Class o Html Input Control Class o Html InputText Control o Html Text Area Contro o Html Input Button Control o Html Select Control o Html Input Check Box Control o Html Input Radio Button Control o Html Image Control o Html Input File Control. • **Validation Controls, Rich Controls** o Calendar Control o Ad Rotator Control • **State Management** o Understanding the Problem of State o Using View State o Transferring Information Between Pages o Using Cookies o Managing Session State o Configuring Session State o Using Application State o Comparing State Management Options o .ASP.NET Security: Login Controls.	
Unit III	**Master Pages and Navigation** • **Master Pages** o Creating Simple and Nested Master Pages o Creating Content Pages o Themes. • **Wed Site Navigation and Properties** o Site Map Path Control o TreeView Control o Menu Control o Other navigation methods (Response. Redirect(), Server. Transfer())	**10**
Unit IV	**Building Database – Driven Web Sites with Database Controls** • **ADO.NET Fundamentals** o ADO.NET architecture and Objects (Data Reader, Data Set, Data Adaptor, Command) o Editing data in Data Tables • **Understanding SQL Basics** o SELECT Statement, WHERE Clause, LIKE clause, DISTINCT Clause, ORDER BY Clause, GROUP BY Clause, HAVING Clause, DELETE Statement, UPDATE Statement, Joining Tables	**10**

	• **Data Bound Controls** ○ Grid View Control, FormView Control, Details View Control, Repeater Control, DataList Control, Using Bound list Controls.	
Study Resources	• NET Programming Covering C# 2005,Visual Basic 2005,ASP.NET and .NET Framework-Black Book • Richard Anderson, Brian Francis, Alex Homer, Rob Howard, David Sussman, Karli Watson(2002), Professional ASP.NET 1.0, Special Edition, Wrox Press Ltd., 2002, ISBN 1-861007-0-3-5. • Bill Evjen, Scott Hanselman, Devin Rader (2008), Professional ASP .NET 3.5 in C# and VB, Wiley Publishing Inc.,2008 ISBN:978-0-470-18757-9.	

M.Sc. II (Computer Science)
Semester-III
CS-DSC-612: Internet of Things

Total Hours: 60 **Credits: 4**

Course objectives	• To understand Internet of Things. • To get basic knowledge of RFID Technology, Sensor Technology and Satellite Technology. • To make students aware of resource management and security issues in Internet of Things.	
Course outcomes	Students will be able to • describe key technologies in Internet of Things. • understand wireless sensor network architecture and its framework. • explore resource management in the Internet of Things.	
Unit	**Content**	**Hours**
Unit I	**INTRODUCTION** o What is the Internet of Things? : History of IoT, About IoT, Overview and Motivations o Definition, Characteristics of IoT, IoT Conceptual framework o IoT Architectural view, Physical design of IoT, Logical design of IoT o IoT Network Architecture and Design, Application of IoT, IoT Protocols o IoT communication models, IoT Communication APIs o IoT enabled Technologies – Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems o IoT Levels and Templates, Domain Specific IoTs – Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle, ITU-T Views	**20**
Unit II	**Services of IoT** o Machine-to-machine (M2M), SDN (software defined networking) and NFV(network function virtualization) for IoT, data storage in IoT o IoT Cloud Based Services. Design Principles for Web Connectivity: Web Communication Protocols for connected devices o Message Communication Protocols for connected devices, SOAP, REST, HTTP Restful and Web Sockets. o Internet Connectivity Principles: Internet Connectivity, Internet based communication, IP addressing in IoT, Media Access control.	**20**
Unit III	**Fundamental Iot Mechanisms And Key Technologies and Radio Frequency Identification Technology** o Identification of IoT Objects and Services, Structural Aspects of the IoT o Environment Characteristics, Traffic Characteristics, Scalability, Interoperability, Security and Privacy, Open Architecture, Key IoT Technologies	**10**

	○ Device Intelligence, Communication Capabilities, Mobility Support, Device Power, Sensor Technology, RFID Technology, Satellite Technology ○ RFID: Introduction, Principle of RFID, Components of an RFID system, Issues EPCGlobal Architecture Framework: EPCIS & ONS, Design issues, Technological challenges, Security challenges, IP for IoT, Web of Things. ○ Wireless Sensor Networks: History and context, WSN Architecture, the node, Connecting nodes, Networking Nodes, Securing Communication, WSN specific IoT applications, challenges: Security, QoS, Configuration, Various integration approaches, Data link layer protocols, routing protocols and infrastructure establishment	
Unit IV	**IoT IMPLEMENTATION** ○ IoT Physical Devices and Endpoints – Arduino UNO: Introduction to Arduino Arduino UNO, Installing the software ○ Funtamentals of Arduino Programming .IoT Physical Devices and Endpoints – RaspberryPi: Introduction to RaspberryPi ○ About the RaspberryPi Board: Hardware Layout ,Operating systems on RaspberryPi , Configuring RaspberryPi , Programming RaspberryPi with Python, Wireless Temperature Monitoring System Using Pi , DS18B20 Temperature Sensor , Connecting Raspberry Pi via SSH , ○ Accessing Temperature from DS18B20 sensors , Remote access to RaspberryPi , Smart and Connected Cities , ○ An IoT Strategy for Smarter Cities, Smart City IoT Architecture , Smart City security Architecture , Smart City Use-Case Examples.	**10**
Study Resources	• Raj Kamal, "Internet of Things",Tata McGraw Hill Publication. • Donald Norris "The Internet of Things: Do-It-Yourself at Home Projects for Arduino,Raspberry Pi and BeagleBone Black", McGraw Hill Publication • Vijay Madisetti and ArshdeepBagha , "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT,2014.(978-9352605224) • HakimaChaouchi, "The Internet of Things Connecting objects to the Web" ISBN:978-1-84821-140-7,Willy Publication. • Olivier Hersent, David Boswarthick,OmarElloumi,The Internet Of Things:Key Applications and Protocols, ISBN:978-1-119-99435-0, 2nd Edition, Willy Publication. • Raj Kamal, "Internet of Things : Architecture and Design principles ", 1st Edition, McGraw Hill Education,2017.(ISBN:978-8173719547)	

M.Sc. II (Computer Science)
Semester-III
CS-DSC-613: Compiler Construction

Total Hours: 60 **Credits: 4**

Course objectives	• To apply the theory of language translation introduced in prerequisite courses to build compilers and interpreters. • To build translators from scratch and using compiler generators. • To identify and explore main issues of design of translators. • To construct compiler/interpreter for a small language	
Course outcomes	Students will be able to • Understand the structure of compilers • Design compiler for small application • Learn compiler construction theory	
Unit	**Content**	**Hours**
Unit I	**Compiler structure** o Analysis-synthesis model of compilation o various phases of a compiler o tool-based approach to compiler construction	**10**
Unit II	**Lexical and Syntax Analysis** o **Lexical Analysis** o Interface with input, parser and symbol table, token, lexeme and patterns, o Difficulties in lexical analysis, Error reporting, Implementation, Regular definition, Transition diagrams, LEX. o **Syntax Analysis** o CFGs, ambiguity, associativity, precedence, top down parsing, recursive descent parsing, transformation on the grammars, predictive parsing, bottom up parsing, operator precedence grammars o LR parsers (SLR, LALR, LR) o YACC. o Syntax directed definitions: inherited and synthesized attributes, dependency graph, evaluation order, bottom up and top down evaluation of attributes, L- and S-attributed definitions. o Type checking: type system, type expressions, structural and name 8 equivalence of types, type conversion, overloaded functions and operators, polymorphic functions.	**20**
Unit III	**Run time system** o Storage organization o activation tree o Activation record	**10**

	○ Parameter passing, symbol table ○ Dynamic storage allocation.	
Unit IV	**Code Generation and Instruction Selection** ○ Intermediate representations, translation of declarations, assignments, control flow, Boolean expressions and procedure calls. Implementation issues ○ Issues in code generation and instruction selection, basic blocks and flow graphs, register allocation, code generation, dag representation of programs, code generation from dags, peep hole optimization, code generator generators, specifications of machine.	**20**
Study Resources	• Aho A.V., R. Sethi and J.D. Ullman. Compiler Principle, Techniques and Tools: Addison, Wesley, ISBN 0-321-48681-1. • Barret, Couch. Compiler Construction Theory and Practice: Computer Science series, Asian Student Ed, ISBN 978-0574213358 • Dhamdhere D.M. Compiler Construction Principle and Practice: McMillan India, ISBN 9780333904060 • Gres D. Compiler Construction for Digital Computer: Wiley, ISBN 047132776X. • David Galles (2009). Modern Compiler Design: Pearson Education, ISBN 9788131709412	

M.Sc. II (Computer Science)
Semester-III
CS-DSE-614 A: Data Mining-I

Total Hours: 30 **Credits: 2**

Course objectives	• To understand the concepts of Data Mining • To understand and learn importance of data pre-processing. • To learn association mining	
Course outcomes	Student who learns this course will be able to • Know data mining functionalities and applications • preprocess data • Extract interesting patterns from large amounts of data	
Unit	**Content**	**Hours**
Unit I	**Introduction to Data Mining** o Definition of Data mining o Importance of Data Mining o Knowledge Discovery using Data Mining o Kinds of Data Repositories o Data Mining functionalities o Classification of Data Mining Systems o Basic Data Mining task o Data Mining Issues o Data Mining Applications	**10**
Unit II	**UNIT - II Data Warehousing:** o What is Data Warehouse? o Characteristics of Datawarehouse, o Applications of Datawarehouse, o Difference between OLTP and OLAP, o Multidimensional Data Model, o Data Warehouse Architecture, o Integration of a Data Mining System witha Database or DatawarehouseSystem	**10**
Unit III	**Data Pre-processing** o What is Data Preprocessing o Need for pre-processing of the data o Descriptive Data Summarization o Data Cleaning o Data Integration and transformation o Data Reduction o Data discretization and concept hierarchy generation	**05**
Unit IV	**Association Rule Mining** o Frequent Patterns- Frequent itemset, Sequential Pattern, Structured Pattern	**05**

	○ Efficient and Scalable Frequent Item set Mining Methods ○ Mining Various Kinds of Association Rules ○ Association Mining to Correlation Analysis ○ Constraint-Based Association Mining.	
Study Resources	• Data Mining – Concepts and Techniques – Jiawei Han & Micheline Kamber, 3rd Edition Elsevier • Data Mining T- Charu C. Aggarwal The Textbook, Springer • Data Mining Practical Machine Learning Tools and Techniques- Ian H. Witten &Eibe Frank, Elsevier	

M.Sc. II (Computer Science)
Semester-III
CS-DSE-614 B: NoSQL-I

Total Hours: 30 **Credits: 2**

Course objectives	• Explore the origins of NoSQL databases and the characteristics that distinguish them from traditional relational database management systems. • Understand the architectures and common features of the main types of NoSQL databases (key-value stores, document databases, column-family stores, graph databases) • Discuss the criteria that decision makers should consider when choosing between relational and non-relational databases and techniques for selecting the NoSQL database that best addresses specific use cases	
Course outcomes	After successful completion of this course, students are expected to: • Explain the detailed architecture, Database properties and storage requirements • Differentiate and identify right database models for real time applications • Outline Key value architecture and characteristics • Design Schema and implement CRUD operations, distributed data operations • Compare data ware housing schemas and implement various column store internals • Choose and implement Advanced columnar data model functions for the real time applications	
Unit	**Content**	**Hours**
Unit I	**INTRODUCTION TO NOSQL CONCEPTS** o Data base revolutions: First generation, second generation, third generation, o Managing Transactions and Data Integrity, ACID and BASE for reliable database transactions o Speeding performance by strategic use of RAM, SSD, and disk o Achieving horizontal scalability with Data base sharding, Brewers CAP theorem	**10**
Unit II	**NOSQL DATA ARCHITECTURE PATTERNS** o NoSQL Data model: Aggregate Models • Document Data Model- • Key-Value Data Model • Columnar Data Model, • Graph Based Data Model • Graph Data Model, o NoSQL system ways to handle big data problems, o Moving Queries to data, not data to the query, hash rings to distribute the data on clusters, replication to scale reads, o Database distributed queries to Data nodes.	**10**
Unit III	**KEY VALUE DATA STORES**	**05**

	○ From array to key value databases, Essential features of key value Databases, Properties of keys, ○ Characteristics of Values, Key-Value Database ○ Data Modeling Terms, ○ Key-Value Architecture and implementation Terms, ○ Designing Structured Values, ○ Limitations of KeyValue Databases, ○ Design Patterns for Key-Value Databases, ○ Case Study: Key-Value Databases for Mobile Application Configuration	
Unit IV	**MongoDB** ○ The Document Data Model ○ Documents and Collections ○ MongoDB Use Cases ○ Embedded Data Models ○ Normalized Data ○ Replication via Replica Sets ○ MongoDB Design ○ MongoDB and the CAP Theorem ○ The MongoDB Data Manipulation Language ○ Transactions, Atomicity, and Documents ○ Durability and Journaling ○ Batch Processing and Aggregation ○ Indexing ○ Auto-Sharding, Shard Keys, and Horizontal Scalability ○ Writing to Shards	**05**
Study Resources	• NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence: Pramod J. Sadalage, Martin Fowler • NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence (Paperback) by Pramod J. Sadalage MongoDB: The Definitive Guide (Paperback) by Kristina Chodorow • Making Sense of NoSQL: A guide for managers and the rest of us (Paperback) by Dan McCreary, Ann Kelly	

M.Sc. II (Computer Science)
Semester-III
CS-DSC-615: Practical on Current Computing Trends (ASP.NET)

Total Hours: 60 **Credits: 2**

Course objectives	To understand and learn: • To provide insight into .NET technologies for web programming and enable them design and develop interactive and responsive web applications. • To explain learners the insights into the efficient usage of .NET technologies their facilities • To acquire knowledge of web development	
Course Outcomes	After successful completion of this course, students are expected to: • Acquire practical knowledge of .NET technologies framework • Implement various controls for creating a web Application • Understand the security aspects of web Application.	
Sr. No.	**Content**	**Hours**
1	Demonstrate Page Life Cycle of ASP.NET.	**4**
2	Demonstrate the use of HTML and Web Server Controls for Job Portal	**4**
3	Create a Registration Form to demonstrate the use of various validation controls.	**4**
4	Demonstrate DropDown List box, CheckButtonList, RadioButtonList controls.	**4**
5	Demontrate the use of Calender and Adrotator Control	**4**
6	Demonstrate State Management features of ASP.NET using sample shopping cart application.	**4**
7	Demonstrate Authorization/Authentication using Login controls	**4**
8	Demonstrate the use of Master Pages with applying Themes.	**4**
9	Demonstrate the use of Nested Master Pages.	**4**
10	Demonstrate Properties of website navigation controls.	**4**
11	Demonstrate editing process in DataList controls. Make use of necessary templates for proper visual appearance.	**4**
12	Create a web application to display Data binding using dropdownlist control.	**4**

13	Create a web application for inserting and deleting record from a database. (Using Execute-Non Query).	**4**
14	Create a web application to demonstrate data binding using DetailsView and FormView Control	**4**
15	Create a web application to display Using Disconnected Data Access and Data binding using GridView.	**4**
Study Resources	• .NET Programming Covering C# 2005,Visual Basic 2005,ASP.NET and .NET Framework-Black Book • Richard Anderson, Brian Francis, Alex Homer, Rob Howard, David Sussman, Karli Watson(2002), Professional ASP.NET 1.0, Special Edition, Wrox Press Ltd., 2002, ISBN 1-861007-0-3-5. • Bill Evjen, Scott Hanselman, Devin Rader (2008), Professional ASP .NET 3.5 in C# and VB, Wiley Publishing Inc.,2008 ISBN:978-0-470-18757-9.	

M.Sc. II (Computer Science)
Semester-III
CS-DSE-616 A: Practical on Data Mining-I

Total Hours: 60 **Credits: 2**

Course objectives	• To understand the concepts of Data Mining software • To understand practical concepts of data pre-processing. • To learn association mining	
Course Outcomes	Student who learns this course will be able to • perform data analysis using WEKA software • preprocess data using different algorithms • Extract interesting patterns from large amounts of data	
Sr. No.	**Content**	**Hours**
1	Installation of Weka open-source software for data mining	**4**
2	Introduction to the Weka software interface	**4**
3	Create a new ARFF and csv data file	**4**
4	Opening file from Local machine and Web site	**4**
5	Apply filters for Removing selected attributes from data	**4**
6	Apply filters for Removing Duplicates Records from data	**4**
7	Apply filters for handling missing values from data	**4**
8	Apply filters for Data Discretization	**4**
9	Applying filters for Attribute transformation	**4**
10	Applying filters for normalization	**4**
11	Applying filters for Attribute selection	**4**
12	Generate Association Rules using the Apriori Algorithm	**4**
13	Generating association rules using FP-growth algorithm	**4**
14	Case study on Association rule generation for Market basket analysis	**4**
15	Case study on Association rule generation for Medical Diagnosis dataset (e.g. breast cancer)	**4**
Study Resources	• Data Mining – Concepts and Techniques – Jiawei Han & Micheline Kamber, 3rd Edition Elsevier • Data Mining T- Charu C. Aggarwal The Textbook, Springer • Data Mining Practical Machine Learning Tools and Techniques- Ian H. Witten &Eibe Frank, Elsevier	

M.Sc. II (Computer Science)
Semester-III
CS-DSE-616 B: Practical on NoSQL-I

Total Hours: 60 **Credits: 2**

Course objectives	• Explore the origins of NoSQL databases and the characteristics that distinguish them from traditional relational database management systems. • Understand the architectures and common features of the main types of NoSQL databases (key-value stores, document databases, column-family stores, graph databases) • Discuss the criteria that decision makers should consider when choosing between relational and non-relational databases and techniques for selecting the NoSQL database that best addresses specific use cases	
CourseOutcomes	After successful completion of this course, students are expected to: • Design Schema and implement CRUD operations, distributed data operations • Compare data ware housing schemas and implement various column store internals • Choose and implement Advanced columnar data model functions for the real time applications	
Sr. No.	**Content**	**Hours**
1	Create, alter and delete database using SQL.	**4**
2	Create table and apply appropriate constraints.	**4**
3	Insert, update, delete records in the table.	**4**
4	MongoDB installation and Configuration in windows.	**4**
5	Demonstrate how to create and drop database in MongoDB.	**4**
6	Insert document into mongoDB databases. insertone()	**4**
7	Insert document into mongoDB databases insermany())	**4**
8	Find and select data from mongoDB collection. find()	**4**
9	Find and select data from mongoDB collection. findone()	**4**
10	Update and delete MongoDB documents.	**4**
11	Demonstrate comparison query operators.	**4**
12	Demonstrate logical query operators.	**4**
13	Demonstrate evaluation query operators.	**4**

14	Demonstrate field and array update operators.	**4**
15	Demonstrate MongoDB aggregation pipelines.	**4**
Study Resources	• NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence: Pramod J. Sadalage, Martin Fowler • NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence (Paperback) by Pramod J. Sadalage MongoDB: The Definitive Guide (Paperback) by Kristina Chodorow • Making Sense of NoSQL: A guide for managers and the rest of us (Paperback) by Dan McCreary, Ann Kelly	

M.Sc. II (Computer Science)
Semester-III
CS-RP-617: Research Project - I

Total Hours: 120 **Credits: 4**

Course Objectives

1. To give exposure to the students to research culture and technology
2. To introduce students to how to select a research topic, plan, perform experiments, collect and analyze the data
3. To foster self-confidence and self-reliance in the students as they learn to work and think independently

Course outcomes

After successful completion of this course, students are expected to:

- Conceive a problem based on published research and conduct a comprehensive literature survey.
- Plan and carry out the tasks in the given framework of the dissertation and present the work in writing and viva.
- Learn handling of instruments, use of chemicals and how to conduct the experiments
- Learn how to present the project in PowerPoint and answer the queries to examiners and the science of writing.

Credit distribution (1 credit for each unit)

- Identification of a research topic, formulation of research problem, objectives, sample size and hypothesis, etc
- Preparation of Outline
- Review of literature
- Bibliography

The systematic approach towards the execution of the project should be as follows:

(Wherever applicable)

1. The complete tenure of the research project should be one year. It should be allotted during the third semester and completed in the fourth semester.
2. Weekly 8 hours should be allotted to the research project in a regular timetable.
3. In the third semester, students will be evaluated based on a credit distribution mentioned above. In the fourth semester, students should perform further research work, collect and analyze the data, compile the results and prepare and submit the final dissertation.
4. Students may be given an opportunity to participate in ongoing research activities in the respective Departments/Schools/Supervisors' laboratories. This will familiarize them with the literature survey and give them a fundamental understanding of designing and executing a research project.
5. Students may work individually or in groups (not more than 3 students) to be decided by the concerned department/supervisor.

6. Each research group should have a different research topic with some possible level of novelty.
7. The student should select the topic relevant to priority areas of concern or allied subjects with the guidance of supervisor/ head of the department.
8. Students are encouraged to work on multidisciplinary and applied projects, but it is not mandatory criteria.
9. At the beginning, students should submit the outline of the research work to be carried out in the project. (Writing in order: Title, Aim and objectives, Literature to be collected, Experimental plan or method design, expected outcome etc.)
10. Write and submit a Literature Review Report and Research outline
    Tentative order for review: Title of the Project, Certificates, Acknowledgment, Abstract and Keywords, Contents, Introduction, Literature Review, Aim of the Project, Methodology, Bibliography/reference etc.
    Tentative order for research outline: Title page, introduction, background and significance of study, problems to be investigated, objective, hypothesis, chapter scheme, bibliography.
11. At the end of the third semester, each student should submit a detailed Literature Review Report and research outline.
12. An appropriate and essential conclusive statement must be drawn at the end of the study.
13. Students should maintain lab notebooks, and the Supervisor may ask them to submit the mid-semester progress report.
14. For documents related to project submission: Font- Times New Roman, Heading Font Size-14, Normal Text Size-12, spacing-1.5, both sides justified and 1 inch margin on all side, both side printing on A-4 size.
15. Three copies of the Literature Review Report, research outline should be prepared (one copy for each department, guide, and student).
16. At the end of the semester, the candidate should prepare and present research work using a PowerPoint presentation with modern ICT tools and present the same in front of his/ her respective department during the Internal Examination.
17. For external examination the candidate will have to present the research work and face viva voce.
18. Students may present their research work in Avishkar/Webinars/Conferences.
19. Students should note that plagiarism is strictly prohibited.

Internal examination (40 marks): Components of continuous internal assessment:

- Draft Research Outline (10 marks)
- Draft Review of literature (10 marks)
- Working Bibliography (10 marks)
- PowerPoint presentation, and oral examination (10 marks)

External examination (60 marks) and Components of external assessment:

- Final submitted review report, research outline in bound form at the time of examination **(40 marks)**
- Overall presentation reflecting the contribution of work, response to questions **(20 marks)**

M.Sc. II (Computer Science)

Semester IV

M.Sc. II (Computer Science)
Semester-IV
CS-DSC-621: Machine Learning

Total Hours: 60 **Credits: 4**

Course Objectives	• To understand the basic theory underlying machine learning. • To be able to formulate machine learning problems corresponding to different applications. • To understand a range of machine learning algorithms along with their strengths and weaknesses. • To be able to apply machine learning algorithms to solve problems of moderate complexity. • To apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.	
Course Outcomes	**After successful completion of this course, students** will be able to **:** • Apply an appropriate supervised/ unsupervised learning algorithm for classification / Regression problems (e.g., naive Bayes, support vector machine, logistic regression, neural networks). • Understand probabilities (Bayes rule, conditioning, expectations, independence), linear algebra (vector and matrix operations, eigenvectors, SVD), and calculus (gradients, Jacobians) to derive machine learning methods such as linear regression, naive Bayes, and principal components analysis. • Understand machine learning principles such as model selection, overfitting, and underfitting, and techniques such as cross-validation and regularization. • Implement machine learning algorithms such as logistic regression via stochastic gradient descent, linear regression, or k-means clustering.	
Unit	**Content**	**Hours**
Unit I	**Supervised Learning** • Machine learning o Definition and applications o Basic steps involved in ML o Types of Machine learning • Supervised learning o Working of supervised machine learning o Steps involved in supervised machine learning o Types of supervised machine learning • Linear & Logistic Regression o Linear Regression o Non-linear Regression o Regression tree o Logistic Regression • Classification o Binary & multiclass classifier	**15**

	○ Naïve bayes classifier ○ KNN	
Unit II	**Unsupervised Learning** • Working of unsupervised learning • Types of unsupervised learning • Applications of unsupervised learning • Challenges of unsupervised learning • Supervised Vs unsupervised learning • Advantages and disadvantages of unsupervised learning • Clustering ○ K-Means ○ Hierarchical ○ Probabilistic • Association Rules ○ Apriori algorithm	**15**
Unit III	**More Machine learning algorithms** • Support Vector Machine ○ Support Vectors ○ Hyperplanes ○ 2-D Case ○ Linear Hyperplane ○ SVM Kernal – Linear, Radial, Polynomial ○ SVM algorithm • Decision Tree algorithm • Random forest algorithm	**15**
Unit IV	**Evaluation measures in Machine Learning** • Evaluation metric for classification ○ Cross-validation ○ Confusion Matrix ○ Accuracy ○ Precision ○ Recall ○ F1-score ○ AUC-ROC Curve • Evaluation metric for regression ○ Mean Absolute Error(MAE) ○ Mean Squared Error(MSE) ○ Root Mean Squared Error(RMSE) ○ Mean Absolute Percentage Error (MAPE)	**15**
Study Resources	• Pattern Recognition and Machine Learning, Christopher Bishop. • Machine Learning: A probabilistic perspective, Kevin Murphy. • Machine Learning, Tom Mitchell. • The Elements of Statistical Learning: Data Mining, Inference and Prediction, Trevor Hastie, Robert Tibshirani, Jerome Friedman	

M.Sc. II (Computer Science)
Semester-IV
CS-DSC-622: Data Science

Total Hours: 60 **Credits: 4**

Course objective	• To provide strong foundation for data science and application area related to it • To understand the underlying core concepts and emerging technologies in data science. • To explore raw data in needed form.	
Course outcome	After successful completion of this course, students are expected to: • Explore the fundamental concepts of data science • Understand data analysis techniques for applications handling large data • Understand various machine learning algorithms used in data science process • Visualize and present the inference using various tools. • Learn to think through the ethics surrounding privacy, data sharing and algorithmic decision-making	
Unit	**Contents**	**Hours**
Unit I	**Introduction to core concepts and technologies** o Introduction, Terminology, data science process, data science toolkit o Types of data, Example applications o Mathematical Foundations for Data Science: linear algebra; Analytical and numerical solutions of linear equations, Mathematical structures, concepts and notations used in discrete mathematics. o Introduction to Statistical Methods: basic and some advanced concepts of probability and statistics o Concepts of statistics in solving problems arising in data science	**15**
Unit 2	**Data collection and management** o Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, using multiple data sources o Data analysis: Introduction, Terminology and concepts o Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT o Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.	**15**
Unit 3	**Data visualization**	**15**

	○ Introduction, Types of data visualization, ○ Data for visualization: Data types, Data encodings, Retinal variables, mapping variables to encodings, Visual encodings.	
Unit 4	**Computer science and engineering applications** ○ Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning ○ Applications of Data Science, Technologies for visualization, Bokeh (Python), recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science.	**15**
Study Resources	• Cathy O'Neil, Rachel Schutt, Doing Data Science, Straight Talk from The Frontline. O'Reilly, 2013. • Introducing Data Science, Davy Cielen, Arno D. B. Meysman, Mohamed Ali, Manning Publications Co., 1st edition, 2016 • An Introduction to Statistical Learning: with Applications in R, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer, 1st edition, 2013 • Jure Leskovek, AnandRajaraman, Jeffrey Ullman, Mining of Massive Datasets. v2.1, Cambridge University Press, 2014. • Data Science from Scratch: First Principles with Python, Joel Grus, O'Reilly, 1st edition, 2015. • Doing Data Science, Straight Talk from the Frontline, Cathy O'Neil, Rachel Schutt, O' Reilly, 1st edition, 2013. • Mining of Massive Datasets, Jure Leskovec, AnandRajaraman, Jeffrey David Ullman, Cambridge University Press, 2nd edition, 2014.	

M.Sc. II (Computer Science)
Semester-IV
CS-DSE-623 A: Data Mining - II

Total Hours: 30 **Credits: 2**

Course objective	• To learn various classification and prediction techniques/algorithms • To learn cluster analysis techniques • To know advanced data mining techniques	
Course outcome	• Explore the fundamental concepts of data science • Understand data analysis techniques for applications handling large data • Understand various machine learning algorithms used in data science process • Visualize and present the inference using various tools. • Learn to think through the ethics surrounding privacy, data sharing and algorithmic decision-making	
Unit	**Contents**	**Hours**
Unit I	**Classification and Prediction** o Concept of Classification and Prediction o Issues Regarding Classification and Prediction o Classification o Decision Tree Introduction o Bayesian Classification o Rule Based Classification o Classification by Back propagation o Support Vector Machines o Associative Classification o Lazy Learners o Other Classification Methods o Prediction o Linear Regression o Nonlinear Regression o Other Regression-Based Methods	**08**
Unit 2	**Accuracy and Error Measures** o Classifier Accuracy Measures o Predictor Error Measures o Evaluating the Accuracy of a Classifier or Predictor o Holdout Method o Random Subsampling o Bootstrap o Increasing accuracy with Ensemble Methods o Bagging o Boosting o Model Selection o Estimating Confidence Intervals o ROC Curves	**07**

Unit 3	**Cluster Analysis** o Concept of Cluster analysis o Types of Data in Cluster Analysis o A Categorization of Major Clustering Methods o Partitioning Methods o Hierarchical methods o Density-Based Methods o Grid Based Methods o Model-Based Clustering Methods o Clustering High-Dimensional Data o Constraint-Based Cluster Analysis o Outlier Analysis	**08**
Unit 4	**Introduction to Advanced Concepts** o Web Mining o Web Content Mining, o Web Structure Mining, o Web Usage Mining o Spatial Mining o Spatial Data Overview o Spatial Data Mining Primitive o Spatial Rule o Spatial Classification Algorithm o Temporal Mining o Time Series o Pattern Detection o Sequences o Temporal Association Rules	**07**
Study Resources	• Data Mining – Concepts and Techniques – Jiawei Han & Micheline Kamber, 3rd Edition Elsevier • Data Mining T- Charu C. Aggarwal The Textbook, Springer • Data Mining Practical Machine Learning Tools and Techniques- Ian H. Witten &Eibe Frank, Elsevier • Mining of Massive Datasets, Jure Leskovec, AnandRajaraman, Jeffrey David Ullman, Cambridge University Press, 2nd edition, 2014.	

M.Sc. II (Computer Science)
Semester-IV
CS-DSE-623 B: NoSQL-II

Total Hours: 30 **Credits: 2**

Course objectives	• Explore the origins of NoSQL databases and the characteristics that distinguish them from traditional relational database management systems. • Understand the architectures and common features of the main types of NoSQL databases (key-value stores, document databases, column-family stores, graph databases) • Discuss the criteria that decision makers should consider when choosing between relational and non-relational databases and techniques for selecting the NoSQL database that best addresses specific use cases.	
Course outcomes	After successfully completing this course, students will be able to: • Design Schema and implement CRUD operations, distributed data operations • Compare data ware housing schemas and implement various column store internals • Choose and implement Advanced columnar data model functions for the real time applications • Develop Application with Graph Data model	
Unit	**Content**	**Hours**
Unit I	**DOCUMENT ORIENTED DATABASE** o Document, Collection, o Naming, CRUD operation, o querying, indexing, o Replication, Sharding, o Consistency Implementation: Distributed consistency, Eventual Consistency, o Capped Collection, o Case studies: document oriented database: Mongo DB and/or Cassandra	**10**
Unit II	**COLUMNAR DATA MODEL - I** o Data warehousing schemas: Comparison of columnar and row-oriented storage, o Column-store Architectures: C-Store and Vector-Wise, o Column-store internals and, Inserts/updates/deletes, o Indexing, Adaptive Indexing and Database Cracking.	**10**
Unit III	**COLUMNAR DATA MODEL – II** o Advanced techniques: Vectorized Processing, Compression, o Write penalty, o Operating Directly on Compressed Data o Late Materialization Joins, o Group-by, Aggregation and Arithmetic Operations,	**05**

	○ Case Studies	
Unit IV	**DATA MODELING WITH GRAPH** ○ Comparison of Relational and Graph Modeling, ○ Property Graph Model ○ Graph Analytics: Link analysis algorithm- Web as a graph ○ Page Rank- Markov chain ○ Page rank computation ○ Topic specific page rank (Page Ranking Computation techniques: iterative processing ○ Random walk distribution Querying Graphs ○ Introduction to Cypher, case study: Building a Graph Database ○ Application- community detection	**05**
Study Resources	• NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence: Pramod J. Sadalage, Martin Fowler • NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence (Paperback) by Pramod J. Sadalage MongoDB: The Definitive Guide (Paperback) by Kristina Chodorow • Making Sense of NoSQL: A guide for managers and the rest of us (Paperback) by Dan McCreary, Ann Kelly	

M.Sc. II (Computer Science)
Semester-IV
CS-DSC-624: Practical on Machine Learning

Total Hours: 60 **Credits: 2**

Course objectives	• To learn various machine learning algorithms. • To write the code for implementing Machine Learning models. • To analyze data using machine learning concepts in PYTHON	
Course Outcomes	After successful completion of this course, students are expected to: • identify appropriate ML algorithm to solve a given problem. • apply the suitable algorithms to solve ML problems. • focus on exploring supervised, unsupervised and reinforcement learning and apply them to a range of ML problems.	
Sr. No.	**Content**	**Hours**
1	Study of machine learning frameworks Scikit-learn	4
2	Study of other machine learning frameworks like : TensorFlow&*Keras*	4
3	Study of numpy, pandas, matplotlib,Scikit-Learn, etc.	4
4	Implement Linear Regression using Python.	4
5	Implement Logistic Regression using Python.	4
6	Implement naïve bays classifier using Python.	4
7	Implement KNN classifier Python.	4
8	Implement k-means clustering using Python.	4
9	Implement apriori algorithm using Python.	4
10	Implement hierarchical clustering using Python.	4
11	Implement SVM using Python.	4
12	Implement decision tress using Python.	4
13	Implement random forest using Python.	4
14	Generate confusion matrix for multiclass classification problem using Python.	4
15	Generate precision, recall, f-measure for any classification problem using Python.	4
Study Resources	• An Introduction to Statistical Learning: with Applications in R, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer, 1st edition, 2013 • Elaine Rich, Kevin Knight, "Artificial Intelligence", 2nd Edition, 1991, ISBN:9780071008945, Tata McGrawHill. • Stuart Jonathan Russell, Peter Norvig, "Artificial Intelligence – A modern approach",illustrated, 2010, ISBN:9780136042594, Prentice Hall. • Pattern Recognition and Machine Learning, Christopher Bishop. • Machine Learning: A probabilistic perspective, Kevin Murphy • The Elements of Statistical Learning: Data Mining, Inference and Prediction, Trevor Hastie, Robert Tibshirani, Jerome Friedman	

M.Sc. II (Computer Science)
Semester-IV
CS-DSC-625: Practical on Data Science

Total Hours: 60 **Credits: 2**

Course objectives	• To provide strong foundation for data science and application area related to it • To understand the underlying core concepts and emerging technologies in data science. • To explore raw data in needed form.	
Course Outcomes	After successful completion of this course, students are expected to: • understand practical data analysis techniques for handling large data • understand various machine learning algorithms used in data science process • visualize and present the inference using various tools using PYTHON libraries. • learn to think through the ethics surrounding privacy, data sharing and algorithmic decision-making	
Sr. No.	**Content**	**Hours**
1	Study various platforms used for data science.	4
2	Download, Install and explore the features of Numpy	4
3	Download, Install and explore the features of Pandas	4
4	Download, Install and explore the features of Scikit-learn.	4
5	Demonstrate the working of array with the help of Numpy Package.	4
6	Demonstrates working with Pandas dataframe	4
7	Demonstrates reading data from text, excel file and the web and explore various commands for descript analysis of the Iris dataset.	4
8	Write a program to compute summary statistics such as mean, median, mode, standard deviation and variance of the given different types of data using Python.	4
9	Write a python program to calculate the variance.	4
10	Develop python program for Basic plots using Matplotlib	4
11	Write a python program for correlation with scatter plot	4
12	Implement Linear Regression using Python.	4
13	Implement naïve bays classifier using Python.	4
14	Implement SVM using Python.	4
15	Study of Bokeh library	4
Study Resources	• Data Science from Scratch: First Principles with Python, Joel Grus, O'Reilly, 1st edition, 2015. • Doing Data Science, Straight Talk from the Frontline, Cathy O'Neil, Rachel Schutt, O' Reilly, 1st edition, 2013. • Mining of Massive Datasets, Jure Leskovec, AnandRajaraman, Jeffrey David Ullman, Cambridge University Press, 2nd edition, 2014.	

M.Sc. II (Computer Science)
Semester-IV
CS-DSE-626 A: Practical on Data Mining-II

Total Hours: 60 **Credits: 2**

Course objectives	• Learn to apply classification techniques • Learn to apply clustering techniques • Learn advanced data mining	
Course Outcomes	After successful completion of this course, students are expected to: • Apply classification techniques on the given datasets • Use accuracy measures • Apply Clustering techniques on the given datasets	
Sr. No.	**Content**	**Hours**
1	Build a Decision Tree by using J48 algorithm	4
2	Apply Naïve bayes classification on data set	4
3	Apply Rule Based Classification on data set	4
4	Apply SVM on dataset	4
5	Apply kNN classifier on dataset	4
6	Apply multiclass classifier on dataset	4
7	Apply SVM and kNN on Breast-Cancer dataset and compare the results using accuracy and error measures	4
8	Apply Rule Based Classification and Decision Tree and Compare the results	4
9	Apply Decision Tree, SVM and kNN on dataset and Compare the results	4
10	Apply linear regression on dataset	4
11	Apply non-linear regression on dataset	4
12	Apply k-means clustering on a given data set	4
13	Apply Hierarchical Clustering techniques on dataset	4
14	Apply Density based clustering method on dataset	4
15	Apply Expectation maximisation clustering method on dataset	4
Study Resources	• Jure Leskovek, AnandRajaraman, Jeffrey Ullman, Mining of Massive Datasets. v2.1, Cambridge University Press, 2014. • Data Mining – Concepts and Techniques – Jiawei Han & Micheline Kamber, 3rd Edition Elsevier • Data Mining T- Charu C. Aggarwal The Textbook, Springer • Data Mining Practical Machine Learning Tools and Techniques- Ian H. Witten &Eibe Frank, Elsevier	

M.Sc. II (Computer Science)
Semester-IV
CS-DSE-626 B: Practical on NoSQL-II

Total Hours: 60 **Credits: 2**

Course objectives	• To learn the document database such as MongoDB • To analyze different kind of data using MonogoDB • To write the quires for data extraction.	
CourseOutcomes	After successful completion of this course, students are expected to: • Describe the NoSQL data architecture patterns using MongoDB • Use NoSQL to manage Big Data. • Develop NoSQL desktop and cloud database solutions	
Sr. No.	**Content**	**Hours**
1	Download sample restaurant dataset from MongoDB and solve the assignment 1-5…. Write a MongoDB query to display all the documents, fileds in th collection restaurants.	**4**
2	Write a MongoDB query to display i) all the restaurant, ii) first 5 and next 5 after skipping first 5 which are in the borough Bronx	**4**
3	Write a MongoDB query to find the restaurants who achieved a score: i) More than 90 ii) More than 80 but less than 100 iii) Grade with score of 2 and grade with score of 6 iv) Grade with score of 2 and grade with score of 6 and located in borough of Manhattan	**4**
4	Write a MongoDB query to find i) the average score for each restaurant. ii) Lowest score for each restaurant iii) Highest score for each restaurant	**4**
5	Write a MongoDB query to find i) count of restaurants in each borough. ii) count of restaurants that received a grade of 'A' for each cuisine. iii) find the number of restaurants that have been graded in each month of the year.	**4**
6	DownloadSample listingsAndReviews Dataset from	**4**

	MongoDand and solve the assignment 6-10…. Find the thefollowing of the first record in the listingsAndReviews collection. i) price per night ii) Retrieve the cleaning fee iii) host_name, host_location, host_about	
7	Find the the following of the first record in the listings And Reviews collection i) No. of bedroom ii) No. of guest iii) to check whether the host have a profile picture	**4**
8	Find the top 10 most reviewed listings with listing_url, name, country, review_scoresin the listingsAndReviews collection.	**4**
9	Retrieve all documents with name, address, reviewer_name, review_scores_ratingin the listingsAndReviewscollection i) that have a number_of_reviews field is equal to 0 ii) where the host_is_superhost field is equal to true iii) where the coordinates field is not null	**4**
10	Find all listings with listing_url, name, property_type, bed, price, security_deposit in the listingsAndReviews collection that have a price greater than $500 and a security deposit of $1000 or more.	**4**
11	DownloadSample movie Dataset from MongoD and and solve the assignment 11-15…. Find all movies with full information from the 'movies' collection that i) released in the year 1893. ii) have a runtime greater than 120 minutes. iii) were directed by "William K.L. Dickson" and include complete information for each movie.	**4**
12	Write a query in MongoDB to find the movie with the highest IMDb rating and viewer rating on Tomatoes from the 'movies' collection.	**4**
13	Find the movies released in the year with the highest average IMDb rating from the 'movies' collection in MongoDB.	**4**
14	Find from the 'movies' collection in MongoDB with the most common genre among the movies.	**4**
15	Find all movies with title, languages, released, directors, writers,	**4**

	awards, year, genres, runtime, cast, countries from the 'movies' collection in MongoDB that have at least one nomination.	
Study Resources	• https://www.w3resource.com/mongodb-exercises/#MongoDB_restaurants	

M.Sc. II (Computer Science)
Semester-IV
CS-RP-627: Research Project - II

Hours: 180 **Credits: 6**

Course Objectives

1. To give exposure to the students to research culture and technology
2. To introduce students to how to select a research topic, plan, perform experiments, collect data and analyze the data
3. To foster self-confidence and self-reliance in the students as they learn to work and think independently

Course outcomes

After successful completion of this course, students are expected to:

1. Conceive a problem based on published research and conduct a comprehensive literature survey.
2. Plan and carry out the tasks in the given framework of the dissertation and present the work in writing and viva.
3. Learn handling of instruments, use of chemicals and how to conduct the experiments
4. Learn how to present the project in PowerPoint and answer the queries to examiners and the science of writing.

The systematic approach towards the execution of the project should be as follows:

(Wherever applicable)

1. The complete tenure of the research project should be one academic year. It should be allotted during the third semester and completed in the fourth semester.
2. Weekly 12 hours should be allotted to the research project in a regular timetable.
3. In the fourth semester, students should perform further experimental work, analyze the data and compile the results.
4. Students may be given an opportunity to participate in ongoing research activities in the respective Departments/Schools/Supervisors' laboratories. This will familiarize them with the literature survey and give them a fundamental understanding of designing and executing a research project.
5. The student should clearly mention the need of project, database(s), files required for the project, software used for the project, reasons for selection of that software, inputs required, outputs produced etc.
6. Students may work individually or in groups (not more than 3 students) to be decided by the concerned department/supervisor.
7. Each research group should have a different research topic with some possible level of novelty.
8. The student should select the topic relevant to priority areas of concern or allied subjects.
9. Students are encouraged to work on multidisciplinary and applied projects, but it is not mandatory criteria.

10. Students are expected to work in line with the research outline and literature review, which was submitted in the third semester.
11. Students are expected to learn how to execute the research work systematically and overcome the hurdles. Students will get the opportunity to learn about practical aspects of many characterization techniques or models and further how to effectively employ them in the research work. Students should be able to critically evaluate the literature on the topic, identify the research gaps, plan and perform the experiments, interpret the results, understand the limitations of the work and draw conclusions.
12. At the end of the semester, each student should submit a detailed Research Report.
13. The format of the final research report shall be as per the guidelines of respective department. (**Example**: Title of the Project, Certificates, Acknowledgment, Abstract and Keywords, Contents, Introduction, Literature Review, Aim and objective, Methodology, Results and Discussions, conclusion, limitations, suggestion, future scope, Bibliography, Appendix etc.)
14. An appropriate and essential conclusive statement must be drawn at the end of the study.
15. Students should maintain lab notebooks, and the supervisor may ask them to submit the mid-semester progress report.
16. For documents related to project submission: Font- Times New Roman, Heading Font Size-14, Normal Text Size-12, spacing-1.5, both sides justified and 1 inch margin on all side, both side printing on A-4 size.
17. Three copies of the dissertation should be prepared (one copy for each department, guide, and student).
18. At the end of the semester, the candidate should prepare and present research using a PowerPoint presentation using modern ICT tools during the Internal and External Examination.
19. Besides writing a dissertation, students are encouraged to write a manuscript/patent if the results obtained are worthy of publication.
20. Students may present their research work in Avishkar/Webinars/Conferences.
21. Students should note that plagiarism is strictly prohibited.

Internal examination (60 marks): Components of continuous internal assessment:

- Literature collected, methodological planning, analysis of data, design and work, progress reports etc (30 marks)
- Presentation in Webinars/Conferences/publication and departmental presentation etc (20 marks)
- Oral examination (10 marks)

External examination (90 marks) and Components of external assessment:

- Evaluation of dissertation submitted in bound form at the time of examination **(60 marks)**
- Presentation (PPT format) **(15 marks)**
- Overall presentation reflecting the contribution of work, Response to questions **(15 marks)**