Syllabus of M.Sc (Computer Science)-II

Applicable for the Autonomous College affiliated to

Savitribai Phule Pune University

M. Sc(Computer Science)

(Choice Based Credit System)

(NEP 2023 Pattern)

With effect

from June 2024

M.Sc. (Computer Science) –II Program Structure and Syllabus

Sr.No	Program	Sem	Offered as	Course Code	Course title	No.of Credit
1	M.Sc(Computer Science)	III	Major Mandatory	23SMCS31MM	Business Intelligence	4
2	M.Sc(Computer Science)	III	Major Mandatory	23SMCS32MM	DevOps	4
3	M.Sc(Computer Science)	III	Major Mandatory	23SMCS33MM	Practical based on DevOps	4
4	M.Sc(Computer Science)	III	Major Mandatory	23SMCS34MM	Natural Language Processing	2
5	M.Sc(Computer Science)	III	Major Elective	23SMCS31MEA	Digital Image Processing	2
7	M.Sc(Computer Science)	III	Major Elective	23SMCS32MEA	Practical based on Digital Image Processing	2
8	M.Sc(Computer Science)	III	Major Elective	23SMCS31MEB	Full Stack Development	2
9	M.Sc(Computer Science)	III	Major Elective	23SMCS32MEB	Practical based on Full Stack Development	2
10	M.Sc(Computer Science)	III	Research Project	23SMCS3RP	Research Project	4
11	M.Sc(Computer Science)	IV	Major Mandatory	23SMCS4MM	Industrial Training(IT)	18
12	M.Sc(Computer Science)	IV	Major Elective	23SMCS4ME	Online MOOC Course	04

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M.Sc. -II (Computer Science)

Course/ Paper Title	Business Intelligence
Course Code	23SMCS31MM
Semester	III
No. of Credits	4
Course Type	Major (MJ)

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To understand the role of BI in enterprise performance management and decision support.
2.	To understand the applications of data mining and intelligent systems in managerial work.
3.	To understand data warehousing and online analytical processing (OLAP) concepts, including dimensional modeling, star and snowflake schemas, attribute hierarchies, metrics, and cubes.
4.	To learn data analysis and reporting using an available BI software.

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Student will able to identify role of BI and use it for decision making.
2.	Student will able to do analysis of provided data using BI software.

Syllabus

Unit No	Title with Contents	No. of Lectures
Unit I	**Introduction to Business intelligence**	**10**
	1. Definition and History of BI 2. Functions of BI 3. Transaction processing versus analytical processing 4. BI implementation 5. Major tools and techniques of BI	2 2 3 3
Unit II	**Data Warehousing**	**14**
	1. Definition and concepts, 2. Data warehouse architecture, 3. ETL process, data warehouse development, 4. Top down vs. Bottom up, 5. Data Mart vs. EDW, 6. Implementation issues, 7. Real-time data warehousing	1 3 2 2 2 2 2
Unit III	**Business performance management**	**14**
	1. Key performance indicators and operational metrics	3
	2. Balanced scorecard	4
	3. Six Sigma	3
	4. Dashboards and scorecards	4
Unit IV	**Data Mining for Business Intelligence**	**12**
	1. Data mining process	4
	2. Data mining methods	4
	3. ANN for Data Mining	4

Unit V	Text, and Web mining for Business intelligence	10
	1. Text mining Applications	1
	2. Process and Tools	2
	3. Web content	2
	4. Web Structure mining	1
	5. Web usage mining	1
	6. Introduction of Tableau	1
	7. Data Visualization in Tableau	2

References:

1. Business Intelligence: A Managerial Approach, 2nd Edition, PEARSON 2012 Authors: EfraimTurban, Ramesh Sharda, Dursun Delen, and David King ISBN-10: 0-13-610066-X ISBN-13: 978-0-13-610066-9

2. Oracle Business Intelligence Applications, McGraw Hill Education 2013 Authors : Simon Miller, William Hutchinson ISBN-10: 93-5134-153-4 ISBN-13: 978-93-5134-153-6

Web References:

1) https://www.tableau.com/resource/business-intelligence

2) https://www.techtarget.com/searchbusinessanalytics/definition/business-intelligence-BI

3) https://www.javatpoint.com/business-intelligence-bi

M.Sc. -II (Computer Science)

Course/ Paper Title	DevOps
Course Code	**23SMCS32MM**
Semester	III
No. of Credits	4
Course Type	Major (MJ)

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To understand History and Architecture of Devops.
2.	To study Devops different tools which is used in practicals.
3.	To study different tools like Jenkins , Terraform, Ansible etc.
4.	To learn Basic Linux and administration.

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Student will able to create docker container
2.	Students will able to recognize the different tools of devops.
3.	Students will able to do hands on practical on devops.

Syllabus

Unit No	Title with Contents	No. of Lectures
Unit I	**Introduction to Devops**	10
	1. What is DevOps? 2. Why DevOps? 3. DevOps History 4. DevOps Architecture Features 5. DevOps Architecture 6. DevOps Lifecycle 7. DevOps Workflow 8. DevOps Principles 9. Continuous Integration & Deployment 9.1. Jenkins 9.2. Jenkins as a standalone server 9.3. Jenkins running on a k8s cluster 10.Containers and Virtual Development 10.1. Docker 10.2. Vagran	2 2 3 3
Unit II	**LINUX Basic and Admin**	14
	1. Linux OS Introduction 2. Importance of Linux in DevOps 3. Linux Basic Command Utilities 4. Environment Variables **5. Linux User Administration** 5.1. Types of users 5.2. User Creation Process 5.3. Useradd Process 5.4. Usermode Process 5.5. Userdel Commands	1 3 2 2 2 2 2

	6. Linux Software Management 6.1. About Utilies of software Installation 6.2. Install software using RPM 6.3. Install software using YUM **7. Linux Service Management** 7.1. Needs of Service Management 7.2. Service – start, stop, reload, restart, status	
Unit III	**Tools of DevOps**	14
	1. Configuration Management Tools 1.1. Ansible 1.2. Terraform **2. Version Control-GIT** 2.1 Introduction to Git and GitHub 2.2. GIT Features 2.3. 3-Tree Architecture 2.4. GIT – Clone /Commit / Push 2.5. Installing Git 2.6. Configuration Git-4 Creating a Git repository	3 4 3 4
Unit IV	**Docker**	12
	1. How to get Docker Image? 2. What is Docker Image 3. Docker Installation 4. Working with Docker Containers 4.1. What is Container 4.2. Docker Engine 4.3. Crating Containers with an Image 4.5. Working with Images 5. Docker Command Line Interphase 6. Docker Compose 7. Docker Hub 8. Docker Trusted Registry 9. Docker File & Commands	4 4 4
Unit V	**Introduction to Cloud Computing andAWS Services**	10
	1. Basics – Desired features of Cloud Computing 2. Elasticity in Cloud 3. On demand provisioning 4. Applications of cloud 5. Benefits of cloud 6. Cloud Components	1 2 2 1

	6.1.Clients	1
	6.2.Datacenters	1
	7. Applications of Cloud computing	
	8. Amazon Elastic Compute Cloud(EC2)	2
	9. Amazon Simple Storage Service (S3)	
	10. Elastic Block Storage (EBS)	
	11. Elastic Load Balancing (ELB)	
	12. Amazon Relational Database Service (RDS) Amazon	
	12.1 DynamoDB	
	13. Identity and Access Management (IAM)	
	14. Virtual Private Cloud (VPC)	
	15. Simple Email Services (SES)	
	16. Simple Queue Services (SQS)	
	17. Simple Notification Services (SNS)	

References:

1. **By Joseph Joyner:** DevOps for Beginners

2. **By Thomas Uphill John Arundel Hideto Saito Hui-Chuan Chloe Lee Neependra Khare : Devops: Puppet, Docker, and Kubernetes**

3. Effective DevOps: Building a Culture of Collaboration, Affinity, and Tooling at Scale

Web References:

1. **Basics of Devops:** https://about.gitlab.com/topics/devops/

2. **Tools of Devops:** https://github.com/collections/devops-tools

3. **Basics of Cloud computing:** https://www.javatpoint.com/introduction-to-cloud-computing

4. **Dockers:** https://staragile.com/blog/docker-in-devops

M.Sc.II (Computer Science)

Course/ Paper Title	**Practical based on DevOps Practical**
Course Code	23SMCS33MM
Semester	III
No. of Credits	4
Course Type	Major (MJ)

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To learn the systematic way of solving problem.
2.	To lean deep insights and knowledge into various tools such as Ansible, Jenkins and Docker.
3.	To learn installing, configuring, and managing a multi-user Linux computer system.

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will able to create different designs using devops tools
2.	To differentiate the usage of various Tools in problem solution.
3.	Students will able to create docker and basic linux commands

Practical Syllabus

Assignment No.	Assignments	No. of Sessions
1.	Assignment No. 1 based on Devops	02
2.	Assignment No. 2 based on Docker	02
3.	Assignment No. 3 based on Devops Tools of Jenkins	02
4.	Assignment No. 4 based on Devops Tools of Git	02
5.	Assignment No. 5 based on basic Linux and Admin	02

M.Sc.-II (Computer Science)

Course/ Paper Title	Natural Language Processing
Course Code	23SMCS34MM
Semester	III
No. of Credits	2
Course Type	Major (MJ)

Aims & Objectives of the Course

Sr. No.	Objectives
1	The prime objective of this course is to introduce the students to the field of Language Computing and its applications ranging from classical era to modern context.
2	Course also aims to provide understanding of various NLP tasks and NLP abstractions such as Morphological analysis, POS tagging
3	Course provide knowledge of different approaches/algorithms for carrying out NLP tasks

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Extract information from text automatically using concepts and methods from natural language processing (NLP) including stemming, n-grams, POS tagging, and parsing.
2.	Develop speech-based applications that use speech analysis (phonetics, speech recognition, and synthesis).
3	Analyze the syntax, semantics, and pragmatics of a statement written in a natural language.

Syllabus

Unit No	Title with Contents	No. of Lecture
I	**Introduction to NLP**	**4**
	1. History of NLP	**1**
	2. Generic NLP system	
	3. levels of NLP	**1**
	4. Knowledge in language processing	
	5. Ambiguity in Natural language	**1**
	6. stages in NLP,	
	7. challenges of NLP	**1**
	8. Applications of NLP	
2	**Word Level Analysis**	**8**
	1. Morphology analysis –survey of English Morphology,	**2**
	2. Inflectional morphology & Derivational morphology,	
	3. Lemmatization,	**2**
	4. Regular expression,	
	5. finite automata,	**2**
	6. finite state transducers (FST)	
	7. Morphological parsing with FST	**2**
	8. Lexicon free FST Porter stemmer. N –Grams	
3	**Syntax analysis**	**8**

		1. Part-Of-Speech tagging(POS)- Tag set for English (Penn Treebank)	**2**
		2. Rule based POS tagging	
		3. Stochastic POS tagging,	**2**
		4. Issues –Multiple tags&words, Unknown words.	
		5. Introduction to CFG	**2**
		6. Sequence labelling: Hidden Markov Model (HMM),	
		7. Maximum Entropy	**2**
4	**Semantic Analysis**		**10**
		1. Lexical Semantics	**2**
		2. Attachment for fragment of English sentences, noun phrases, Verb phrases, prepositional phrases	**3**
		3. Relations among lexemes & their senses –Homonymy Polysemy, Synonymy, Hyponymy, Robust Word Sense Disambiguation (WSD),Dictionary based approach	**5**
5	**Text Summarization, Text Classification**		**6**
		1. Text summarization- LEXRANK , Optimization based approaches for summarization , Summarization evaluation	**3**
		2. Text classification	**3**

References:

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.

  2. Chris Manning and Hinrich Schütze. Foundations of Statistical Natural Language Processing. MIT Press, Cambridge, MA: May 1999.

Web References:

1) https://www.javatpoint.com/nlp

2) https://www.ibm.com/topics/natural-language-processing

3)https://www.geeksforgeeks.org/natural-language-processing-overview

M. C. E. Society's
Abeda Inamdar Senior College
Of Arts, Science and Commerce, Camp, Pune-1
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NAAC accredited 'A' Grade

M.Sc.-II (Computer Science)

Course/ Paper Title	Digital Image Processing
Course Code	23SMCS31MEA
Semester	III
No. of Credits	2
Course Type Elective	Major Elective(ME)

Aims &Objectives of the Course

Sr. No.	Objectives
1.	To Understand Digital Image Processing Concepts.
2.	To Study Various Methods for Image Enhancement using Spatial and Frequency Domain
3.	To Learn Classification Techniques for Image Segmentation.
4.	To Study Various Image Restoration Techniques

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Fundamental concepts of a digital image processing system and different types of image transformations
2	Evaluate the techniques for image enhancement and image restoration.
3	Interpret image segmentation and representation techniques.

Syllabus

Unit No	Title with Contents	No. of Lectures
I	**Introduction**	3
	1. What is Digital Image Processing? 2. Applications of Digital Image Processing 3. The origins of Digital Image Processing 4. Examples of Fields that use Digital Image Processing 5. Fundamental steps in Digital Image Processing 6. Components of an Image Processing System	1 1 1
II	**Digital Image Processing Fundamentals**	4

	1. Elements of Visual Perception
	2. Light and the Electromagnetic Spectrum
	3. Image sensing and Acquisition
	4. Image Sampling and Quantization
	5. An Introduction to the Mathematical Tools Used in Digital Image Processing
	   5.1 Array versus Matrix Operations
	   5.2 Linear versus Nonlinear Operations
	   5.3 Arithmetic Operations
	   5.4 Set and Logical Operations
		2
		
		1
		
		1

III	**Intensity Transformation and Spatial Filtering**	4

	1. Some Basic Intensity Transformation Functions
	2. Histogram Processing
	   2.1 Histogram Equalization
	   2.2 Histogram Matching (Specification)
	   2.3 Local Histogram Processing
	3. Fundamentals of Spatial Filtering
	4. Smoothing Spatial Filters
	5. Sharpening Spatial Filters
	6. Combining Spatial Enhancement Methods
		1
		
		2
		
		1
		
		1

IV	**Filtering in the Frequency Domain**	5
	1. Sampling and the Fourier Transform of Sampled Functions	1
	2. The Discrete Fourier Transform (DFT) of One variable	1
	3. Properties of the 2-D Discrete Fourier Transform	1
	4. The Basics of Filtering in the Frequency Domain	
	5. Image Smoothing Using Frequency Domain Filters	1
	6. Image Sharpening Using Frequency Domain Filters	1
V	**Image Restoration and Reconstruction**	5
	1. A Model of the Image Degradation / Restoration Process	
	2. Noise Models	1
	3. Restoration in the Presence of Noise Only- Spatial Filtering	1
	4. Periodic Noise Reduction by Frequency Domain Filtering 4.1 Bandreject Filters 4.2 Bandpass Filters 4.3 Notch Filters	2
	5. Estimating the Degradation Function	1
	6. Minimum Mean Square Error(Wiener) Filtering	
VI	**Image Segmentation**	4
	1. Point, Line, and Edge Detection	
	2. Detection of Isolated Points	1
	3. Line Detection	1
	4. Edge Models	1
	5. Thresholding	
	6. Basic Global Thresholding	1
VII	**Representation and Description**	5
	1. Representation and Description	
	2. Representation 8.2 Boundary (Border) Following	1
	3. Chain Codes	
	4. Shape Numbers	1
	5. Polygonal Approximations Using MinimumPerimeter Polygons	2 1
	6. Other Polygonal Approximation Approaches	

References

1. Gonzalez, R. C. and Woods, R. E. [2002/2008], Digital Image Processing, 3rd ed., Prentice Hall Reference Books:

2. Sonka, M., Hlavac, V., Boyle, R. [1999]. Image Processing, Analysis and Machine Vision (2nd edition), PWS Publishing, or (3rd edition) Thompson Engineering, 2007

3. Gonzalez, R. C., Woods, R. E., and Eddins, S. L. [2009]. Digital Image Processing Using MATLAB, 2nd ed., Gatesmark Publishing, Knoxville, TN

4. A.K. Jain, "Fundamentals of digital image processing", PHI, 1995

Web References:
1. https://www.tutorialspoint.com/dip/index.htm 3.
2. https://www.javatpoint.com/applications-of-digital-image-processing
3. https://www.geeksforgeeks.org/image-restoration-using-spatial-filtering/

M.Sc.-II (Computer Science)

Course/ Paper Title	Practical based on Digital Image Processing
Course Code	23SMCS32MEA
Semester	III
No. of Credits	2
Course Type	Major Elective (ME)

Aims & Objectives of the Course

Sr No	Course Objectives
1.	To study of various image formats and their handling in Matlab/ Scilab/ Python.
2.	To study Image Transformation, Image Enhancements and Image restoration

Expected Course Specific Learning Outcome

Sr No	Learning Outcome
1.	Students will learn handling various image formats in Matlab/ Scilab/ Python.
2.	Students will learn to implement Image Enhancement Techniques, Image Transformation ,Filtering Techniques and Image Restoration

Syllabus

Assignment No.	Assignments	No. of Sessions
1	Assignment based on Image formats and their handling	02
2	Assignment based on Image Transformation	02
3	Assignment based on Filtering Techniques	02
4	Assignment based on Image Enhancement	02
5	Assignment based on Image Restoration	02

M.Sc.-II (Computer Science)

Course/Paper Title	Full Stack Development
Course Code	23SMCS31MEB
Semester	III
No. of Credits	2
Course type	Major Elective (ME)

Aims & Objectives of the Course

Sr. No	Course Objectives
1.	To become knowledgeable about the most recent web development technologies.
2.	Idea for creating two tier and three tier architectural web applications.
3.	Design and Analyse real time web applications.
4.	Constructing suitable client and server side applications.
5.	To learn core concept of both front end and back end programming.

Expected Course Specific Learning Outcome

Sr.No	Learning Outcome
1.	Develop a fully functioning website and deploy on a web server.
2.	Gain Knowledge about the front end and back end Tools
3.	Find and use code packages based on their documentation to produce working results ina project.
4.	Create web pages that function using external data.
5.	Implementation of web application employing efficient database access.

Syllabus

Unit No	Title with Contents	No. of Lecture
Unit I	**Web Development Basic**	2
	1. Web servers Shell - UNIX CLI 2. Version control - Git & Github HTML 3. CSS	1 1
Unit II	**JavaScript basics**	4
	1. OOPS Aspects of JavaScript 2. Memory usage and Functions in JS 3. AJAX for data exchange with server 4. jQuery Framework 5. jQuery events 6. JSON data format	2 2
Unit III	**REACT JS: Introduction to React**	8
	1. React Router and Single Page Applications 2. React Forms 3. Introduction to Redux 4. More Redux 5. Client-Server Communication	2 2 2 2
Unit IV	**Java Web Development:**	8
	1. Java Programming Basics 2. Model View Controller (MVC) 3. MVC Architecture using Spring 4. Restful API using Spring Framework **5.** Building an Application using Maven	5 3
Unit V	**Databases & Deployment**	8
	1. Relational Schemas and Normalization 2. Structured Query Language 3. Data Persistence using Spring 4. JDBC Agile Development 5. Principles and Deploying Application in Cloud	3 3 2

References

1) Web Design with HTML, CSS, JavaScript and JQuery Set Book by Jon Duckett ProfessionalJavaScript for Web Developers Book by Nicholas C. Zakas

2) Learning PHP, MySQL, JavaScript, CSS & HTML5: A Step-by- Step Guide to Creating Dynamic Websites by Robin Nixon

3) Full Stack JavaScript: Learn Backbone.js, Node.js and MongoDB.

4) Mastering Full Stack React Web Development Paperback – April 28, 2017 by TomaszDyl , Kamil Przeorski , Maciej Czarnecki

5) Full-Stack JavaScript Development by Eric Bush

Web References:

1) https://www.w3schools.com/js/
2) https://legacy.reactjs.org/tutorial/tutorial.html
3) https://github.com/topics/html-tutorial

M.Sc.-II (Computer Science)

Course/Paper Title	Practical based on Full Stack Development
Course Code	23SMCS32MEB
Semester	III
No. of Credits	2
Course type	Major Elective (ME)

Aims & Objectives of the Course

Sr. No	Course Objectives
1.	To learn web development using CSS technology.
2.	To Learn AJAX to make our application more dynamic.
3.	To learn Reactjs technology to make application more interactive.
4.	To use MVC based framework easy to design and handling the errors in dynamic website.
5.	To learn how to use Database and how deploy the database.

Expected Course Specific Learning Outcome

Sr.No	Learning Outcome
1.	To understand how to develop dynamic and interactive Web Page
2.	To Build dynamic website
3.	To understand how to handle PHP using AJAX.
4.	To understand how to use JQuery libarary.

Syllabus

Assignment No.	Assignments	No. of Sessions
1.	Assignment No. 1 based on Web Development Basic.	01
2.	Assignment No. 2 based on JavaScript Basics	02
3.	Assignment No. 3 based on ReactJS	02
4.	Assignment No. 4 based on Java Web Development	02
5.	Assignment No. 5 based on Database and Deployment	02

SEM-IV

M.Sc.-II (Computer Science)

Course/ Paper Title	Industrial Training
Course Code	23SMCS4MM
Semester	IV
No. of Credits	18
Course type	Major (MJ)

Aims & Objectives of the Course

Sr. No.	Objectives
1.	To provide to students the feel of the actual working environment.
2.	To gain practical knowledge and skills, which in turn will motivate, develop and build their confidence
3.	To provide the students the basis to identify their key operational area of interest.

Expected Course Specific Learning Outcome

Sr. No.	Learning Outcome
1.	Students will able to communicate efficiently.
2.	Student can acquire Industrial experiences and at the same time familiarize themselves with the real working environment at the Industrial training site.
3.	Student will take a hold on profession ethical values as basis to venture into professional career in the future.

Syllabus

Unit No	Title with Contents	No. of Sessions
Unit I	**Guidelines:** • Each student must individually complete full time Industrial training / Institutional project in the 4th semester. • College should assign a student mentor to every student. The mentor will monitor the progress of the student throughout the semester for continuous assessment. • Student should submit a valid offer letter and synopsis within two weeks of starting the internship. • There will be continuous assessment of the work done by the student during the internship period. • Continuous assessment guidelines: 1. Student should submit a weekly report in the college to the mentor. 2. The report should contain the following details: Name of student, project title, company name, company mentor, daily activities and results/output, proposed work for next week. 3. The weekly report should be duly signed by the student and company mentor/ institute guide (CM). 4. Student Mentor should maintain weekly attendance record for every student. 5. Two reports should be conducted for each student (first report after first month and second report after 3rd month) 6. Student Mentor should take feedback from the Company mentor regarding overall performance of the student. • At the end of the internship period, each student should prepare a report which should confirm to international academic standards. • The report should follow the style in academic journals and books, with contents such as: abstract, background, aim, design and implementation, testing, conclusion and full references. Tables and figures should be numbered and referenced to in the report.	45