



# स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

'ज्ञानतीर्थ', विष्णुपुरी, नांदेड - ४३१ ६०६ (महाराष्ट्र राज्य) भारत

## SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

'Dnyanteerth', Vishnupuri, Nanded - 431 606 (Maharashtra State) INDIA

स्वामी रामानंद तीर्थ  
मराठवाडा विद्यापीठ, नांदेड

Established on 17th September, 1994. Recognized By the UGC U/s 2(f) and 12(B), NAAC Re-accredited with 'B++' grade

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विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत राष्ट्रीय  
शैक्षणिक धोरण २०२० नुसार पदव्यूत्तर  
द्वितीय वर्षाचे अभ्यासक्रम (Syllabus)  
शैक्षणिक वर्ष २०२४-२५ पासून लागू  
करण्याबाबत.

### प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, या विद्यापीठा अंतर्गत येणा-या सर्व संलग्नित महाविद्यालयामध्ये शैक्षणिक वर्ष २०२४-२५ पासून राष्ट्रीय शैक्षणिक धोरणानुसार पदव्यूत्तर द्वितीय वर्षाचे अभ्यासक्रम लागू करण्याच्या दृष्टीकोनातून विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत येणा-या अभ्यासमंडळांनी तयार केलेल्या पदव्यूत्तर द्वितीय वर्षाच्या अभ्यासक्रमांना मा. विद्यापरिषदेने दिनांक १५ मे २०२४ रोजी संपन्न झालेल्या बैठकीतील विषय क्रमांक १५/५९-२०२४ च्या ठरावाअन्वये मान्यता प्रदान केली आहे. त्यानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील खालील एम. एस्सी द्वितीय वर्षाचे अभ्यासक्रम (Syllabus) लागू करण्यात येत आहेत.

- 1) M. Sc. II year - Analytical Chemistry (Affiliated College)
- 2) M. Sc. II year - Biochemistry (Affiliated College)
- 3) M. Sc. II year - Organic Chemistry (Affiliated College)
- 4) M. Sc. II year - Physical Chemistry (Affiliated College)
- 5) M. Sc. II year - Inorganic Chemistry (Affiliated College)
- 6) M. Sc. II year - Analytical Chemistry (Campus)
- 7) M. Sc. II year - Industrial Chemistry (Campus)
- 8) M. Sc. II year - Medicinal Chemistry (Campus)
- 9) M. Sc. II year - Organic Chemistry (Campus)
- 10) M. Sc. II year - Physical Chemistry (Campus)
- 11) M. Sc. II year - Polymer Chemistry (Campus)
- 12) M. Sc. II year - Computer Management (Affiliated College)
- 13) M. Sc. II year - Computer Science (Affiliated College)
- 14) M. Sc. II year - Software Engineering (Affiliated College)
- 15) M. Sc. II year - System Administration & Networking (Affiliated College)
- 16) M. Sc. II year - Computer Application (Campus)
- 17) M. Sc. II year - Computer Network (Campus)
- 18) M. Sc. II year - Computer Science (Campus)
- 19) M. Sc. II year - Zoology (Campus)
- 20) M. Sc. II year - Zoology (Affiliated College)
- 21) M. Sc. II year - Physics (Campus)
- 22) M. Sc. II year - Physics (Affiliated College)

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या [www.srtmun.ac.in](http://www.srtmun.ac.in) या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी, ही विनंती.

'ज्ञानतीर्थ' परिसर,

विष्णुपुरी, नांदेड - ४३१ ६०६.

जा.क्र.:शै-१/एनइपी/विवत्रविपदवी/२०२४-२५/११३

दिनांक १३.०६.२०२४

प्रत : १) मा. आधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा, प्रस्तुत विद्यापीठ.

२) मा. संचालक, परीक्षा व मुल्यमापन मंडळ, प्रस्तुत विद्यापीठ.

३) मा. प्राचार्य, सर्व संबंधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.

४) मा. संचालक, सर्व संकुले परिसर व उपपरिसर, प्रस्तुत विद्यापीठ

५) सिस्टीम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ. याना देवून कळविण्यात येते की, सदर परिपत्रक संकेतस्थळावर

प्रसिध्द करण्यात यावे.

डॉ. सरिता लोसरवार

सहा.कुलसचिव

शैक्षणिक (१-अभ्यासमंडळ) विभाग

**SWAMI RAMANAND TEERTH**

**MARATHWADA UNIVERSITY, NANDED - 431 606**



**(Structure and Syllabus of Two Years PG Degree Program with  
Multiple Entry and Exit Option)**

**TWO YEAR MASTERS PROGRAMME IN**  
**SCIENCE**

**Subject Software Engineering**

**Under the Faculty of**

**Science and Technology**

Effective from Academic year 2023 – 2024

(As per NEP-2020)

**Swami RamanandTeerthMarathwada University**

**Nanded**

**(Affiliated Colleges)**



**Faculty of Science and Technology**

**NEP-2020 Oriented Structure of Post Graduate Programs**

(as per Govt of Maharashtra GR dated 16-05-2023)

**M.Sc. Software Engineering**

**(Affiliated Colleges)**

**(Second Year)**

***Introduced from Academic Year 2024-2025***

## ***From Desk of Chairman, Board of Studies of the Subject Computer Science and Application***

The School of Computational Sciences, SRTMUN exists since inception of the University and offers Masters, M.Phil. and Ph.D. programs. The Master's Degree Programs, M.Sc.(CS), M.Sc.(CN) and M.Sc.(CA), being officered are two years full time post graduate programs revised with industry expectations. These all programs have four semesters, which are normally completed in two years. These programs as per NEP-2020 guidelines are flexible enough so that within discipline and cross discipline migration choices of relevant courses are given to the students under electives courses. There are program specific core subjects. The students can choose relevant electives from the same program or from other programs of the same school. The Evaluation of performance of a student for the course is based on principle of continuous assessment through internal and external evaluation mechanisms. NEP-2020 policy had emphasis given on imparting skills to students. The eligibility criteria and fees structure shall be same as that of Campus Prospectus.

In compliance with the NEP -2020 guidelines, various resolutions passed by the UGC, Government of Maharashtra, directions of the *SUKANU SAMITEE*, Hon'ble Vice Chancellor's directions, Pro Vice Chancellor's timely guidance, rigorous exercise taken by the Dean and Associate Dean, (Science and Technology), resolution passed by the apex bodies, all faculties in the school have assisted BoS for preparing 2 years full time M.Sc. Computer Application, M.Sc. Computer Network and M.Sc. Computer Science programs being taught by the school in the light of NEP-2020. In Doing so, all members agreed unanimously to adhere the UGC guidelines, guidelines of the Government of Maharashtra, guidelines of the "Sukanusamitee" as well as SRTMUN policy draft on NEP-2020 being circulated to the school for all M.Sc. programs. The model NEP-2020 syllabus framed by Prof R.D. Kulkarni committee was also reviewed. It was decided to have first year common for all M.Sc. programs under school which will help students to have minimum common skills leading to PG Diploma in Computer Science and Application, under first year exist option. While framing program specific core and electives courses, the interdisciplinary applications of Computers, IT, Scientific computing allied courses were found out across the various disciplines and relevant courses have been put.

While framing syllabus as per NEP-2020 pattern, care has been taken to consider local needs placed in a national context so as to fulfill global demands. Due care is taken to introduce application oriented interdisciplinary learning. Therefore, students pursuing post graduation degrees over here, in specific courses are encouraged to imbibe knowledge and skills which enable all round personality development, skill enhancement and in-depth learning of technology platforms. Under the NEP-2020 pattern, students would post graduate M.Sc. programs with a total number of 88 credits which includes compulsory, program specific core, program specific elective and relevant electives across from the choices available in the each semester. The directions given by Hon'ble Vice Chancellor sir reading *intra school* and *inter school* electives was specifically accepted by the committee and due care is taken to embed subject relevant courses. Accordingly, horizontal and vertical migration among all M.Sc. and MCA programs with other programs offered by other schools in the campus is allowed. However, Model MCA syllabus as per NEP-2020 has to come yet. The discussions with Hon'ble Pro Vice Chancellor sir lead to following specific agenda of the syllabi

1. To provide mobility and flexibility for students within and outside the Computational Science School as well as to migrate between institutions
2. To help students to learn at their own pace



3. To have provision for relevant elective courses
4. To impart more job oriented skills to students
5. To make any course multi-disciplinary in approach

In order to move ahead on the agenda, the BoS committee members continuously sat together 04 times in last two months. This activity started in April 2023 and finally ended on 25<sup>th</sup> May 2023. There were discussions on a uniform structure per semester, as per the Govt. of Maharashtra GR dated 16-05-2023, which is likewise to be extended across all semesters so as to make a M.Sc. program worth of 88 credits. All the semesters have 22 credits each. Accordingly, first two semesters are common. The third and fourth semesters have major and elective courses to be completed, as per the rationale of the program. The major courses have been designed as per the perspective of CA/CN and CS programs. These are program specific courses which enable in depth learning in the allied programs. The electives are designed as per the relevant demand of a course in IT industry / Research area.

The project development activity was intentionally introduced in third and fourth semesters of every program so as to give a real time feel of industry activities to the students.

An unified course numbering system was used for proper numbering of all courses was adopted as suggested in common template/ draft guidelines of the university.

The definition of credit in is finally taken as per the NEP-2020, SRTMUN policy, as a weightage to a course, to be given in relation to the hours assigned for the course. Generally one hour per week has one credit. For viability and conformity to the guidelines credits are awarded irrespective of the teaching hours.

A core course is the course offered by the parent program, totally related to the major subject, components.

An Elective Course is also offered by the parent program whose objective is to provide choice and flexibility within the program.

The student can choose his/her elective paper. Elective is related to the major subject. The difference between core course and elective course is that there is choice for the student. The program is at liberty to offer certain number of elective courses any semester. The objective of elective is to provide mobility and flexibility outside the parent program. This is introduced to make every course multi-disciplinary in nature. It is to be chosen from a list of courses offered by various programs in the school. The list is given in the syllabus copy. All faculties were told to outline the specific courses of their interest and elaborate them further with objectives and outcome. The final version of syllabi is outcome oriented which smoothes the understanding of students regarding the skills he/she will be getting after the completion of the program. This has also made faculties to be specialized of the courses being drafted by them.

In order to see the employability of the skills being imparted through these syllabi, the syllabi gist was telephonically consulted with Industry experts. Due care is taken to incorporate suggestions and modifications given by these experts. These experts are 1) Dr.ParvinPawar, Philips Research Lab, Bangalore, 2) Mr. Sanjay Kurundkar, Creve Info Tech Ltd, Pune, 3) Mr.AshishTendulakr, Google Inc, Pune

The structure of the programs is as below

## Swami RamanandTeerthMarathwada University, Nanded

Faculty of Science and Technology

NEP-2020 oriented Structure of Two years Post Graduate Program

**Subject:Software Engineering (Affiliated Colleges)**

Introduced from Academic Year 2024-2025(as per Govt of Maha GR dated 16-05-2023)

Program Year and Sem	Level	Semester	Faculty				Other courses				
Second Year is program for PG programs in the affiliated colleges			<b>Major / Mandatory / SDSC</b>		<b>Electives / SDSC</b>		<b>RM /others</b>	<b>OJT/FP/</b>	<b>RP</b>	<b>Total Sem. credits</b>	<b>Cumu. Credits</b>
			<b>Theory (04 credits)</b>	<b>Practical (01credits)</b>	<b>Theory (04 credits) (03+01)</b>	<b>Practical</b>	<b>(02 credits)</b>	<b>(04 credits)</b>	<b>(04 credits)</b>		
			M.Sc. SE	6.5	Third Semester	SSEC-501 SSEC-502 SSEC-503	SSECP-501 SSECP-502	SSEE-501 (FROM SAME SCHOOL/DEPT)	-----	-----	-----
M.Sc. SE	6.5	Fourth Semester	SSEC-551 SSEC-552	SSECP-551 SSECP-552	SSEE-551 (FROM SAME SCHOOL/DEPT)	-----	SVECP -551 Publication ethics	-----	SSER-552 (06 credits)	22	88
<p><b>Exit Option: After completion of Second year as above with cumulative 88 credits, student will be awarded M.Sc. in Software Engineering Degree depending upon enrollment and completion of program specific core and electives courses **</b></p> <p><b>** ( for students who have done 03 years UG program)</b></p>											

**Program Specific Syllabus: Third Semester  
Software Engineering**

<b>Core Courses Code</b>	<b>Title</b>	<b>Remarks Credits</b>
SSEC-501	Image Processing using Python	04
SSEC-502	Hibernate and Spring Framework	04
SSEC-503	Compiler Designing	04
SSECP-501	Lab 7:IP Using Python Lab	01
SSECP-502	Lab 8: Hibernate and Spring Lab	01
SSEE-501	<b>Chose any one</b> A. Network and Linux Administration B. Advanced Computer Networks C. Internet of Things D. Subject relevant MOOC (NPTEL / SWAYAM / RUSA sponsored Future Oriented Courses / Other recognized \$\$	03 Theory and 01 Lab
SSER-501	Research Project	04

**Program Specific Syllabus: Fourth Semester  
Software Engineering**

<b>Core Courses Code</b>	<b>Title</b>	<b>Remarks Credits</b>
SSEC-551	Web Application with MVC Core	04
SSEC-552	Introduction to AI & Machine Learning	04
SSECP-551	Lab 9: MVC Lab	01
SSECP-552	Lab 10: AI &ML Lab	01
SSEE-551	<b>Chose any one</b> A. Database Administration B. Data Mining and Data Warehousing C. DevOps Fundamental	03 Theory and 01 Lab
SVECP-551	Publication Ethics	02
SSER-551	Research Project	06

**M. Sc. Second Year, Semester III (Level 6.5):Teaching Scheme**

	Course Code	CourseName	CreditsAssigned per course			TeachingScheme (Hrs./ week) per course	
			Theory	Practical	Total	Theory	Practical
Major	SSEC-501 to SSEC-503	All Core Course	12	--	12	12	--
Elective	SSEE-501 and SSEE-551	All Elective Courses	03	--	03	03	--
Special Courses	SSE-501	Research Project	--	04	04	--	02
Major Practical	SSECP-501 to SSECP-502	All Core labs	--	02	02	--	02
Elective Practical	SSEE-501	Elective lab	--	01	01	--	01
<b>Total Credits per semester</b>			<b>15</b>	<b>07</b>	<b>22</b>	<b>15</b>	<b>05</b>

**M. Sc. Second Year, Semester IV (Level 6.5):Teaching Scheme**

	Course Code	CourseName	CreditsAssigned per course			TeachingScheme (Hrs./ week) per course	
			Theory	Practical	Total	Theory	Practical
Major	SSEC-551 to SSEC-552	All Core Course	08	--	08	08	--
Elective	SSEE-551	All Elective Courses	03	--	03	03	--
Special Courses	SSE-551	Research Project	--	06	06	--	04
Special Courses	SVECP -C551	Publication ethics	--	02	02		01
Major Practical	SSECP -551 and SSECP -552	All Core labs	--	02	02	--	02
Elective Practical	SSEE-551	Elective lab	--	01	01	--	01
<b>Total Credits per semester</b>			<b>11</b>	<b>11</b>	<b>22</b>	<b>11</b>	<b>08</b>



**M. Sc. SecondYear, Semester III and IV (Level 6.5 ) :Examination Scheme**

Course Code (2)	CourseName (3)	Theory				Practical		Total Col (6+7) / Col (8+9) (10)
		Continuous Assessment (CA)			ESA	CA (8)	ESA (9)	
		Test I (4)	Test II (5)	Avg of (T1+T2)/2 (6)	Total (7)			
SSEC-501 to SSEC-503 and SSEC-551 to SSEC-552	All core courses	20	20	20	80	--	--	100
SSEE-501 and SSEE-551	All elective courses	15	15	15	60	--	--	75
Special Courses	SSER-501	--	--	--	--	25	75	100
Special Courses	SSER-A551					50	100	150
SSECP-501 to SSECP-502 and SSECP -551 to SSECP -552	All Core Labs	--	--	--	--	05	20	25
SSEE-501and SSEE-551	All Elective labs	--	--	--	--	05	20	25

## Guidelines for Course Assessment:

**A. Continuous Assessment (CA) (20% of the Maximum Marks):** This will form 20% of the Maximum Marks and will be carried out throughout the semester. It may be done by conducting **Two Tests** (Test I on 40% curriculum) and **Test II** (remaining 40% syllabus). Average of the marks scored by a student in these two tests of the theory paper will make his CA score (col. 6).

**B. End Semester Assessment (80% of the Maximum Marks):** *(For illustration we have considered a paper of 04 credits, 100 marks and need to be modified depending upon credits of an individual paper)*

1. **ESA Question paper will consist of 6 questions, each of 20 marks.**
2. **Students are required to solve a total of 4 Questions.**
3. **Question No.1 will be compulsory and shall be based on entire syllabus.**
4. **Students need to solve ANY THREE of the remaining Five Questions (Q.2 to Q.6) and shall be based on entire syllabus.**

**C. Question paper of campus and affiliated colleges shall be different**

**Note:** Number of lectures required to cover syllabus of a course depends on the number of credits assigned to a particular course. One credit of theory corresponds to 15 Hours lecturing and for practical course one credit corresponds to 30 Hours. For example, for a course of two credits 30 lectures of one hour duration are assigned, while that for a three credit course 45lectures.

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**M.Sc. Software Engineering**  
**M.Sc.(SE) S. Y. (Semester III)**  
**SSEC-501 Image Processing Using Python**

**Learning Objectives:**

- i. To understand digital image processing principles.
- ii. To apply image processing techniques and to implement image enhancement and restoration.
- iii. Perform image segmentation and object detection.
- iv. To extract features for analysis and classification.
- v. To develop Python applications for image processing tasks

**Course Outcomes:**

Upon successful completion of this course, students will be able to:

- i. Acquire proficiency in digital image processing fundamentals.
- ii. Demonstrate competence in utilizing Python for image processing.
- iii. Execute techniques for image enhancement and restoration effectively.
- iv. Successfully perform image segmentation and object detection.
- v. Employ feature extraction methods for analysis and classification tasks.
- vi. Create functional Python applications tailored for image processing purposes.

**UNIT: I Introduction to Digital Image Processing**

**9 Hrs.**

Basics of digital images, Image representation (grayscale, RGB, etc.), Image acquisition and sampling, Histogram equalization, Spatial domain methods (e.g., filtering), Frequency domain methods (e.g., Fourier transform)

**UNIT: II Image Restoration**

**9 Hrs.**

Image degradation models, Noise reduction techniques, Image Blurring and sharpening, Thresholding techniques, Edge detection of Image, Region-based segmentation, Texture analysis, Shape descriptors, Corner detection

**UNIT: III Introduction to Python Libraries for Image Processing**

**8 Hrs..**

Overview of OpenCV, scikit-image, NumPy, Matplotlib and seaborn.  
Installation and setup configuration of OpenCV, scikit-image, NumPy, Matplotlib and seaborn.

**UNIT: IV Image Processing with OpenCV and scikit-image**

**8 Hrs.**

Loading and displaying images, Basic image operations, Filtering and convolution, Image manipulation and transformation, Segmentation algorithms, Feature extraction

**UNIT: V Feature Extraction**

**8 Hrs.**

Introduction to feature extraction, Texture analysis using gray-level co-occurrence matrix (GLCM), Shape descriptors: Hu moments, Fourier descriptors

**UNIT: VI Applications of Image Processing**

**8 Hrs.**

Medical image processing: MRI and CT image analysis, Remote sensing applications: satellite image processing, Computer vision applications: object detection and recognition

**References:**

1. Gonzalez, R.C., Woods, R.E., & Eddins, S.L. (2018). Digital Image Processing Using MATLAB.
2. Szeliski, R. (2010). Computer Vision: Algorithms and Applications.
3. Burger, W., & Burge, M.J. (2016). Digital Image Processing: An Algorithmic Approach with MATLAB.
4. Sonka, M., Hlavac, V., & Boyle, R. (2014). Image Processing, Analysis, and Machine Vision.

**M.Sc. Software Engineering**  
**M.Sc.(SE) S. Y. (Semester III)**  
**SSECP-501 Lab 7: IP Using Python Lab**

**Note :-** Conduct at least 15 practical based on given syllabus.

**M.Sc. Software Engineering**  
**M.Sc.(SE) S. Y. (Semester III)**  
**SSEC-502 Hibernate and Spring Framework**

**Learning Objectives:**

- i. To Access databases with JDBC and Hibernate.
- ii. To Acquire knowledge on creation of software components using Spring Framework.
- iii. To Understand REST, and use Spring MVC to build RESTful services.
- iv. To learn the creation of pure Dynamic Web Application using Spring MVC.
- v. To be familiar with using Spring Boot starters.

**Course Outcomes:**

After successful completion of this course, students should be able to:

- i. Implement the web based applications using JDBC and Hibernate.
- ii. Implement web based applications using features of Spring Framework.
- iii. Apply the concepts of server side web applications using Spring MVC.
- iv. Use the core principles of Spring, and of Dependency Injection (DI) / Inversion of Control.

**Unit I: ORM and Hibernate**

**10Hrs.**

Introduction to ORM Framework, ORM advantages, Hibernate Introduction, Hibernate Architecture, Hibernate Session, Hibernate SessionFactory, Hibernate Configuration, Mapping, Mapping with Annotations, Hibernate Aggregation, Hibernate Named Queries, Hibernate Native SQL, HQL- Hibernate Query Language

**Unit II: Working with Hibernate Objects**

**10 Hrs.**

Hibernate Object States, Insert Object, Retrive Object, CRUD Operations, Hibernate with annotations, Hibernate Query Language, Criteria Query, Native SQL, Hibernate Mapping

**Unit III Introduction to Spring**

**8 Hrs.**

Spring Features, Spring Architecture, Spring Core, Bean Configuration file, Inversion of Control, Dependency Injection, Auto Wiring

**Unit IV: Spring MVC**

**8Hrs.**

MVC Overview, Introduction to Spring MVC, Work flow in Spring MVC, Components of Spring MVC, Spring Annotations, First Spring MVC Application

**Unit V: Spring MVC and Hibernate**

**8Hrs.**

Spring MVC Form Handling, Spring MVC Application with Form Handling, Spring-Hibernate Application

**Unit VI: Introduction to Spring Boot**

**10Hrs.**

Overview of Spring Boot, Spring Boot Layers, Spring Boot Flow Architecture, Hello World example, Spring Boot Dependency Injection, Singleton Scope, Prototype Scope, Autowiring, Spring Boot Web App, Spring Boot MVC and JPA H2



**References:**

1. Beginning Hibernate: For Hibernate 5, Fourth Edition, Joseph B. Ottinger Jeff Linwood Dave Minter, APress Publication
2. Spring Framework Cookbook, Java Code Geeks.
3. Introducing Spring Framework, Felipe Gutierrez, APress Publication
4. Spring MVC: A Tutorial, Second Edition, Paul Deck, Brainy Software.
5. Spring MVC Beginner's Guide, Second Edition, AmuthanGaneshan, Packt Publishing Ltd

**M.Sc. Software Engineering****M.Sc.(SE) S. Y. (Semester III)****SSECP-502 Lab8: Hibernate and Spring Framework**

**Note :-** Conduct at least 15 practical based on given syllabus.

**M.Sc. Software Engineering**  
**M.Sc.(SE) S. Y. (Semester III)**  
**SSEC-502 Compiler Designing**

**Course Objectives:**

- i. Describe the design of a compiler including its phases and components.
- ii. To explore the students step by step conversion of Source program into Object code

**Course Outcome:**

- i. To realize the students basics of compiler design and apply for real time applications.
- ii. Students will get knowledge about compiler generation tools and techniques

**Unit-I: Introduction to Compilers and Programming Languages** **10Hrs.**

Compilers and translators, The structure of compiler, Compiler writing tools, High level programming languages, Definitions of programming languages, A lexical and syntactic structure of a language, Data structures, Operators, Statements

**Unit-II: Lexical Analysis & Syntax Analysis** **10Hrs.**

Lexical analysis, Role of a Lexical analyzer, A simple approach to the design of lexical analyzer, regular expressions, Syntax analysis, Finite automata, Minimizing number of states of a DFA, Implementation of a lexical analyzer, Context free grammars

**Unit-III: Basic parsing techniques** **8Hrs.**

Introduction to parsers, Shift reduce parsing, Top-down parsing, Operator Precedence parsing, Predictive parsers, LR, SLR and LALR parsers.

**Unit-IV: Syntax Directed Translation** **8Hrs.**

Introduction, Syntax directed Schemes, Implementation of Syntax directed translators, Intermediate code, Postfix notation and evaluation of postfix expressions

**Unit-V: Symbol tables, Error detection and recovery** **8Hrs.**

Parse trees and syntax trees Symbol Tables -The contents of a symbol table, Data structures for a symbol table, Errors, Lexical-phase errors, Syntactic phase errors, Semantic errors.

**Unit-VI: Code Optimization** **8Hrs.**

Introduction to Code Optimization, Sources of optimization, Loop optimization, Application of Compiler Technology.

**References:**

1. Principals of Compiler Design By Alfred V. Aho, Jeffrey D. Ullman
1. Compilers - Principles, Techniques and Tools - A.V. Aho, R. Shethi and J.D.
2. Introduction to System Software By D. M. Dhamdhere



**M.Sc. Software Engineering**  
**M.Sc.(SE) S. Y. (Semester III)**  
**SSEE-501 A. Network and Linux Administration**

**Note :-** Conduct at least 15 practical based on given syllabus.

**M.Sc. Software Engineering**  
**M.Sc.(SE) S. Y. (Semester III)**  
**SSEE-501 B. Advanced Computer Networks**

**Course Objectives:**

- i. Describe the role of dynamic routing protocols and place these protocols in the context of modern network design
- ii. Understand N/W protocols like RIP, OSPF & EIGRP according to industry requirement
- iii. Study of reference models.

**Course Outcome:**

- i. Practical hands-on will help to interconnect the N/W components & design industrial N/w
- ii. Best Practices for configuring dynamic routing protocols
- iii. Best Practices for network troubleshooting.

**Unit-I: Network Fundamentals**

**10Hrs.**

Compare network topologies, Networking cables, LAN vs VPN, OSI Model, TCP/IP Model, Compare OSI and TCP/IP models, Configure IP, verify and troubleshoot IPv4, addressing, Need for private IPv4 addressing, IPv4 vs IPv6

**Unit-II: Routing Protocol Concepts**

**10Hrs.**

Interior and Exterior Routing Protocols, Connected Routes, Static Routes, Extended ping Command, Default Routes, RIP Protocol, RIP-2 Basic Concepts, Comparing and Contrasting IP Routing Protocols.

**Unit-III: OSPF**

**8Hrs.**

Compare and contrast distance vector and link state routing protocols, OSPF Protocols and Operation, OSPF Neighbors, OSPF Topology Database Exchange, OSPF Configuration

**Unit-IV: EIGRP**

**8Hrs.**

EIGRP Concepts and Operation, Exchanging EIGRP Topology Information, EIGRP Configuring and Verification.

**Unit-V: WAN Technologies**

**8Hrs.**

Satellite communication, VSAT, PPP Concepts, PPP Protocol Field, PPP Link Control Protocol, PPP Configuration

**Unit-VI: Troubleshooting IP Routing**

**8Hrs.**

The Ping and trace route Commands, Internet Control Message Protocol, Troubleshooting the Packet Forwarding Process, Host Troubleshooting Tips Interface Status, Extended Ping.

**Reference Books**

1. CCENT/CCNA ICND1 (Second Edition) - Wendell Odom



**M.Sc. Software Engineering**  
**M.Sc.(SE) S. Y. (Semester III)**  
**SSEE-501 B. Advanced Computer Networks**

**Note :-** Conduct at least 15 practical based on given syllabus.

**M.Sc. Software Engineering**  
**M.Sc.(SE) S. Y. (Semester III)**  
**SSEE-501 C. Internet of Things (IoT)**

**Learning Objectives:**

- i. To study the fundamentals about IoT
- ii. To study about IoT Access technologies
- iii. To study the design methodology and different IoT hardware platforms.
- iv. To study the basics of IoT supporting services.
- v. To study about various IoT case studies and industrial applications.

**Course Outcomes:**

After successful completion of this course, students should be able to:

- i. Understand the basics of IoT.
- ii. Implement the state of the Architecture of an IoT.
- iii. Understand design methodology and hardware platforms involved in IoT.

**Unit I: Basics of IoT Networking**

**10 Hrs.**

Overview of Internet of Things, Wireless Sensor Networks, Machine-to-Machine Communications Cyber Physical Systems

**Unit II: Introduction to Internet of Things**

**10Hrs.**

Evolution of IoT, Enabling IoT and the Complex Interdependence of Technologies, IoT Networking Components, Addressing Strategies in IoT

**Unit III: IoT Sensors, Actuators and Microcontroller devices**

**8Hrs.**

Sensors, Sensor Characteristics, Sensing Types, Actuators, Actuator Characteristics, Actuator Types, Arduino, Raspberry Pi

**Unit IV: Processing in IoT**

**8Hrs.**

Data Format, Importance of Processing in IoT, Processing Topologies, IoT Device Design and Selection Considerations

**Unit V: IoT Connectivity Technologies**

**8Hrs.**

IEEE 802.15.4, Zigbee, RFID, DASH7, NFC, Z-Wave, Cloud Computing, Virtualization, Cloud Models, Sensor-Cloud: Sensors-as-a-Service, Fog Computing and Its Applications

**Unit VI: Application Areas and Futures of IoT**

**10Hrs.**

Agricultural IoT, Components of an agricultural IoT, Advantages of IoT in agriculture, Smart irrigation management system, Vehicular IoT, Components of vehicular IoT, Advantages of vehicular IoT, Healthcare IoT, Components of healthcare IoT, Advantages and risk of healthcare IoT, Evolution of New IoT Paradigms, Challenges Associated with IoT, Emerging Pillars of IoT

**References:**

1. Introduction to IoT by SudipMisra, Anandarup Mukherjee, Arijit Roy | Publication Cambridge University Press | ISBN 9781108842952, ISBN 9781108959742.
2. The Internet of things\_ do-it-yourself projects with Arduino, Raspberry Pi, and BeagleBone Black | ISBN: 978-0-07-183521-3
3. The Internet of Things – Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2012.| ISBN 978-1-11999435-0

**M.Sc. Software Engineering**  
**M.Sc.(SE) S. Y. (Semester III)**  
**SSEE-501 C. Internet of Things (IoT)**

**Note :-** Conduct at least 15 practical based on given syllabus.

**M.Sc. Software Engineering**  
**M.Sc.(SE) S. Y. (Semester IV)**  
**SSEC-551 Web Application with MVC Core**

**Learning Objectives:**

- i. Microsoft .NET Core and ASP.NET MVC 6 course would enable the students in understanding Basics of .NET Core and Designing Web Application with ASP.NET MVC 6
- i. Learn how to design Dynamic Web Application
- ii. Learn fundamental concepts of Model View and Controller, Creating Controller, Creating and generating Different Views.
- iii. Creating and Using Razor View and Partial View.
- iv. Learn how Create database Application with Entity Framework
- v. Learn the use of Scaffolding.
- vi. Learn HTML Helper and Validations

**Course Outcomes:**

After successful completion of this course, students should be able to:

- i. Learn how to build a simple MVC application using .NET 6
- ii. Learn to build Database web applications using Entity Framework.
- iii. Configure database connectivity for Entity Framework
- iv. Understand and use Validations
- v. Learn how to Design the Single Page Web Application

**Unit I: Introduction to .NET Core and MVC 6**

**9Hrs.**

Introduction to .NET Core 6.0, Introduction to MVC 6, NET Web Forms (vs) ASP.NET MVC, Advantages and disadvantages of each, List of Versions of ASP.NET MVC, Differences between versions of ASP.NET MVC, MVC Architecture, Controller and action method, View, and Model, Request Flow in ASP.NET MVC, Overview of Folders and files of MVC project

**Unit II: Controllers**

**9Hrs.**

Introduction to Controllers, Creating Controllers and Actions, Calling action methods thru the browser, Returning from action methods, Parameters in Action methods, ActionLink, URL Routing, The need of URL Routing, Parameters in URL, Default Parameter Values, Parameters with Constraints, Literals in URL

**Unit III: Views, and Model**

**8Hrs.**

Introduction to Views (Razor), ActionResult and ViewResult, Returning a view, Creating a Simple Razor View, Intermingling Code and Markup in Razor Views, View Bag / View Data / Temp Data, Shared Views, ASPX View Engine (vs) Razor, Introduction to LayoutViews, The need of layout views, cshtml, Creating custom layout views, Layout Views with Sections, Partial Views, RenderPartial(), Introduction to Models, Need of models, Creating models using 'CodeFirst approach'

**Unit IV: Entity Framework in MVC and Scaffold Templates in MVC****8Hrs.**

Introduction to Entity Framework, Need of Entity Framework, Creating DbContext and DbSet, Configuring connection string, Introduction to scaffold Templates in MVC, Need of Scaffolding, Creating controllers and views using scaffold, Strongly typed views, Understanding Index, Details, Create, Edit, Delete action methods and views

**Unit V: HTML Helpers, Action Filters, and Validations****8Hrs.**

Introduction to HTML helpers, DisplayNameFor( ), DisplayFor( ), BeginForm( ), LabelFor(), EditorFor( ), ValidationMessageFor( ), RadioButtonFor( ), DropDownListFor( ), ListBoxFor( ), CheckBoxFor( ), AntiForgeryToken(), Introduction to action filters, Introduction to Validations, Model level validations (vs) View level validations, Importing jQuery Validation Plug in, [Required], [RegularExpression]. [Range], [StringLength], [Compare], [Remote], IsValid

**Unit VI: Advanced Programming, Security and Deployment****8Hrs.**

ASP.NET Core Pipeline, ASP.NET Core Filters, Creating Custom Filters, Dependency Injection (DI), Implementing DI in ASP.NET Core, Built-In Container Service, ASP.NET Core Environments, Exceptions Handling and Logging, Authentication and Authorization, Deploying Web Application, Deployment (docker, azure, aws), Running in Production Build Web Application

**References:**

1. Pro ASP.NET Core 6: Develop Cloud-Ready Web Applications Using MVC, Blazor, and Razor Pages 9th ed. Edition -Adam Freeman
2. High Performance Enterprise Apps using C# 10 and .NET 6 Ockert J. du Preez
3. Programming ASP.NET Core Paperback – 1 January 2019 by Dino Esposito (Author)

**M.Sc. Software Engineering**

**M.Sc.(SE) S. Y. (Semester IV)**

**SSEC-551 Lab 9: Web Application with MVC Core**

**Note :-** Conduct at least 15 practical based on given syllabus.



## **M.Sc. Software Engineering**

### **M.Sc.(SE) S. Y. (Semester IV)**

#### **SSEC-552 Introduction to AI & Machine Learning**

##### **Learning Objectives:**

- i. To understand the basic concept of AI & ML.
- ii. To understand strength and weakness of problem solving and search algorithms.
- iii. To know about basic concepts of knowledge, and reasoning, Machine Learning.
- iv. To optimize the different linear methods of regression and classification.
- v. To interpret the different supervised classification methods of support vector machine and tree based models

##### **Course Outcomes:**

After successful completion of this course, students should be able to:

- i. Evaluate Artificial Intelligence (AI) methods and describe their foundations.
- ii. Analyse and illustrate how search algorithms play vital role in problem solving, inference, perception, knowledge representation and learning.
- iii. Demonstrate knowledge of reasoning and knowledge representation for solving real world problems
- iv. Recognize the characteristics of machine learning that makes it useful to real-world problems
- v. Apply the different supervised learning methods of support vector machine and tree based models.
- vi. Use different linear methods for regression and classification with their optimization through different regularization techniques.

##### **Unit I: Introduction to AI**

**10Hrs.**

Basic Definitions and terminology, Foundation and History of AI, Overview of AI problems, Evolution of AI, Applications of AI, Classification/Types of AI. Artificial Intelligence vs Machine learning. Intelligent Agent: Types of AI Agent, Concept of Rationality, nature of environment, structure of agents. Turing Test in AI.

##### **Unit II: Problem Solving**

**10Hrs.**

Search Algorithms in Artificial Intelligence: Terminologies, Properties of search Algorithms, Types of search algorithms: uninformed search and informed search, State Space search Heuristic Search Techniques: Generate-and-Test; Hill Climbing; Properties of A\* algorithm, Best-first Search; Beyond Classical Search: Local search algorithms and optimization problem, local search in continuous spaces, online search agent

##### **Unit III: Knowledge and Reasoning**

**8 Hrs.**

Knowledge-Based Agent in Artificial intelligence: Architecture, Approaches to designing a knowledge-based agent, knowledge representation: Techniques of knowledge representation, Propositional logic, Rules of Inference, First-Order Logic, Forward Chaining and backward chaining in AI, Reasoning in Artificial intelligence: Types of Reasoning and Probabilistic reasoning, Uncertainty.

#### **UNIT IV: Introduction to ML**

**8Hrs.**

Introduction to Machine Learning: History of ML Examples of Machine Learning Applications, Learning Types, ML Life cycle, AI & ML, dataset for ML, Data Pre-processing, Training versus Testing, Positive and Negative Class, Cross-validation.

#### **Unit V: Learning**

**8Hrs.**

Types of Learning: Supervised, Unsupervised and Semi-Supervised Learning. Supervised: Learning a Class from Examples, Types of supervised Machine learning Algorithms, Unsupervised: Types of Unsupervised Learning Algorithm, Dimensionality Reduction: Introduction to Dimensionality Reduction, Subset Selection, and Introduction to Principal Component Analysis.

#### **Unit VI: Classification & Regression**

**8Hrs.**

Classification: Binary and Multiclass Classification: Assessing Classification Performance, Handling more than two classes, Multiclass Classification-One vs One, One vs Rest. Regression: Assessing performance of Regression – Error measures, Overfitting and Underfitting

#### **References:**

1. Russell, S. and Norvig, P. 2015. Artificial Intelligence - A Modern Approach, 3rd edition, Prentice Hall
2. J. Gabriel, Artificial Intelligence: Artificial Intelligence for Humans (Artificial Intelligence, Machine Learning), Create Space Independent Publishing Platform, First edition , 2016
3. Peter Flach: Machine Learning: The Art and Science of Algorithms that Make Sense of Data, Cambridge University Press, Edition 2012.
4. Introduction to Artificial Intelligence & Expert Systems, Dan W Patterson, PHI., 2010 S Kaushik, Artificial Intelligence, Cengage Learning, 1st ed.2011.
5. Ric, E., Knight, K and Shankar, B. 2009. Artificial Intelligence, 3rd edition, Tata McGraw Hill.
6. Luger, G.F. 2008. Artificial Intelligence -Structures and Strategies for Complex Problem Solving, 6th edition, Pearson.
7. Alpaydin, E. 2010. Introduction to Machine Learning. 2nd edition, MIT.
8. EthemAlpaydin: Introduction to Machine Learning, PHI 2nd Edition-2013.
9. Nilsson Nils J, "Artificial Intelligence: A new Synthesis, Morgan Kaufmann Publishers Inc. San Francisco, CA, ISBN: 978-1-55-860467-4

**M.Sc. Software Engineering**

**M.Sc.(SE) S. Y. (Semester IV)**

**SSEC-552 Lab 10: Introduction to AI & Machine Learning**

**Note :-** Conduct at least 15 practical based on given syllabus.

**M.Sc. Software Engineering**  
**M.Sc.(SE) S. Y. (Semester IV)**  
**SSEE-551 A. Database Administration**

**Course Objectives:**

- i. Introduce the students physical and Logical Structure of database
- ii. To aware the students the role of the database administrator

**Course Outcomes:**

- i. Students will be able to explain and evaluate the fundamental theories and requirements that influence the design of modern database systems.
- ii. Students can analyze the background processes involved in queries and transactions, and can explain how these impact on database operation and design

**Unit I: Database Architecture**

**10Hrs.**

Overview of database, pfile, spfile, Instance, Tablespaces, Datafiles, Other files, Oracle managed Files, Users, Schemas, Indexes, View, Sequences, Synonyms, Privileges, Roles, Clusters, Hash Clusters, Internal memory structure, SGA, PGA ,Background processes, External structure, Redo logs, Control files, Trace files, Alert logs, Creating database manually.

**Unit II: Hardware configuration and consideration**

**10Hrs.**

Architectural overview, Standalone hosts, Standalone hosts with disk array, Standalone, Hosts with disk shadowing, Multiple databases, Networked hosts, Networks of databases, Remote updates, Remote application options, Real application, Clusters, Multiple processors, The parallel query and parallel load options, Client/server databases application, Standby databases

**Unit-III: Physical databases layouts**

**8Hrs.**

Database file layouts, I/O connections among data files, I/O bottlenecks among all data files, Defining the system hardware and mirroring architecture, Database space using overview, Implementation of the storage clause, Locally managed Tablespaces, Dictionary managed Tablespaces, Table segments, Index segments, Rollback segments, Temporary, Free space, Resizing Datafiles, Control files, Online redo log Files Deallocate space from segments,

**Unit-IV: Logical Database Layouts**

**8Hrs.**

Describe logical structure of a database, Different types of Tablespaces, Changing the Tablespaces size, allocating segments for temporary segments, Temporary segments in permanents Tablespaces, changing tablespace status, changing tablespace storage settings, Oracle Managed Files (OMFs), Oracle Flexible Architecture (OFA).

**Unit-V: Backup and Recovery**

**8Hrs.**

Types of Logical and Physical backups, Implementations, Integrations of backup procedures, NOARCHIVELOG Mode, ARCHIVELOG Mode, Backup Methods –Closed Database Backup, Open Database Backup, Recovery in NOARCHIVELOG Mode, Recovery in

ARCHIVELOG Mode, Recovery manager architecture, Recovery Manager Features, Using Recovery manager & RMAN, Using OEM backup manager, Generating lists and reports.

**Unit-VI: Networked ORACLE**

**8Hrs.**

Networked Oracle - Overview of SQL \*Net and Net8, Connect descriptors, Service names and Listeners, Net8 assistants, The multi-protocol interchange, Dedicated Server Processes, Oracle Shared Server, Benefits of Oracle Shared Server, Client Server application, Database links.

**References:**

1. Oracle 9i DBA Handbook, Eighth Reprint - Kevin Lonely, Marlene Theriault Oracle Press, Tata McGraw Hill Publication ISBN-0- 07-048674-3.
2. OCA Oracle 9i Associate DBA Certification Exam Guide, Sixth Reprint, Jason Couchman, Sudheer N. Marish Oracle Press, Tata McGraw Hill Publication, 2005, ISBN-0-07-049893-8

**M.Sc. Software Engineering**  
**M.Sc.(SE) S. Y. (Semester III)**  
**SSEE-551 A. Database Administration**

**Note :-** Conduct at least 15 practical based on given syllabus.

**M.Sc. Software Engineering**  
**M.Sc.(SE) S. Y. (Semester IV)**  
**SSEE-551 B. Data Mining & Data Warehousing**

**Course Objectives:**

- i. To identify the scope and essentiality of Data Warehousing and Mining.
- ii. To analyze data, choose relevant models and algorithms for respective applications.

**Course Outcome:**

- i. Students Will be Understand Data Warehouse fundamentals, Data Mining Principles.
- ii. identify appropriate data mining algorithms to solve real world problems

**Unit-I: Introduction**

**10 Hrs.**

Basic Data Mining task, Data Mining Vs Knowledge discovery in databases, Data mining metrics, Social Implication of Data Mining.

**Unit-II: Related Concepts and Data Mining Techniques**

**8 Hrs.**

Database/OLTP systems, Information Retrieval, Decision Support Systems, Dimensional Modeling, OLAP, Web Search Engines, Statistical perspective on Data Mining, Decision Tree, Neural networks

**Unit-III: Classification**

**8 Hrs.**

Introduction, Statistical based algorithms, Distance based algorithms, Decision tree-based algorithms, Neural network-based algorithm.

**Unit-IV: Clustering and Association Rules**

**8 Hrs.**

Introduction, Hierarchical algorithms, Partitioned algorithms, Clustering large databases, Basic algorithms, Parallel and distributed algorithms

**Unit-V: Web Mining**

**8 Hrs.**

Introduction, Web content mining, Web structure mining, Web usage mining, scope of data mining.

**Unit-VI: Data Warehousing**

**8 Hrs.**

Application area of Data Warehousing, challenges of Data Warehousing, Data Warehousing – the only viable solution, Data Warehouse defined.

**References:**

1. Data Mining Introductory and Advanced Topics, 2008, Margaret H. Dunham and S. Sridhar, Pearson Education, ISBN 81-7758-785-4
2. Data Warehousing Fundamentals, 2009, Paulraj Ponniah, Wiley India Publication, ISBN 978-81-



**M.Sc. Software Engineering**  
**M.Sc.(SE) S. Y. (Semester IV)**  
**SSEE-551 B. Data Mining & Data Warehousing**

**Note :-** Conduct at least 15 practical based on given syllabus.

**M.Sc. Software Engineering**  
**M.Sc.(SE) S. Y. (Semester IV)**  
**SSEE-551 C. DevOps Fundamental**

**Learning Objectives:**

- i. DevOps Fundamental course would enable the students in understanding Basics of DevOps, Its Life Cycle, Integration and Deployments.
- ii. To Introduces Cloud Infrastructure with Terraform and Deployment with Packer
- iii. Understanding DevOps CI/CD Pipeline Version Control with Git, Git, Jenkins & Maven Integration
- iv. To Introduce the process of Continuous Integration and Continuous Delivery
- v. To Introduces the tools Docker and Kubernetes
- vi. Understands the tools for testing applications

**Course Outcomes:**

After successful completion of this course, students should be able to:

- i. Understands the basics of DevOps and its Operations
- ii. Learns Terraform and Deployment with Packer
- iii. Understands the different Tools: Git, Jenkins & Maven
- iv. Learns NuGet, Docker and Kubernetes
- v. Understands the use of Postmans

**Unit I: Introduction to Devops**

**10 Hrs.**

What Is Devops, Benefits of working in a DevOps environment, History of Devops, DevOps Main, Objectives, DevOps and Software Development Life Cycle: Waterfall Model, Agile Model, DevOps Stages, Continuous Integration & Deployment: Jenkins Containers and Virtual Development: Docker, Vagrant, Configuration Management Tools: Ansible, Puppet, Chef, DevOps Delivery Pipeline, Understanding IAC Practices

**Unit II: Provisioning Cloud Infrastructure with Terraform and Deployment with Packer** **10 Hrs.**

Technical Requirements, Installing Terraform, Configuring Terraform for Azure, Writing a Terraform scripts to deploy Azure Infrastructure, Deploying the Infrastructure with Terraform, Terraform Command Line and Life Cycle, Overview of Packer Creating packer Template for Azure VMs with Scripts, Executing Packer

**Unit III: DevOps CI/CD Pipeline Version Control with Git, Jenkins & Maven Integration** **8 Hrs.**

Version Control Preview, Git Introduction Preview, Git Installation, Commonly used commands in Git, Working with Remote repository, Branching and merging in Git Preview, Merge Conflicts, Stashing, Rebasing, Reverting and Resetting, Git Workflows

**UNIT IV: Continuous Integration and Continuous Delivery**

**8 Hrs.**

CI/CD Principles, Using Package Manager- NuGet and npm, Introduction to Maven, Maven Architecture, Introduction to Continuous Integration, Introduction to Jenkins, Jenkins Architecture, Plugin



Management in Jenkins Preview, Jenkins Security Management, Notification in Jenkins, Jenkins Master-slave architecture, Jenkins Delivery Pipeline, Jenkins Declarative pipeline, Using Azure Pipelines

**Unit V: Containerized Application With Docker and Kubernetes**

**8 Hrs.**

Installing Docker, Creating Dockerfile, Building and Running Container on a Local Machine, Pushing an Image to Docker Hub, Deploying a Container to ACI with a CI/CD Pipeline, Managing Containers Effectively with Kubernetes- Installing Kubernetes, Kubernetes Architecture Overview, Installing Kubernetes Dashboard, First Example of Kubernetes Application Deployments

**Unit VI: Testing Your Applications**

**8 Hrs.**

Creating Postman Collection with Requests, Installing Postman, Creating Collections, Creating Our First Request, Using Environments and Variables to Dynamizerequests, Writing postman tests, Executing's Postman request tests locally, Understanding the Newman Concepts, Preparing Postman Collection for Newman, Running the Newman Command LineIntegration of Newman in the CI/CD pipeline process.

**References:**

1. Learning DevOps: The complete guide to accelerate collaboration with Jenkins By Mikael Krief
2. The DevOps Handbook: How to Create World-Class Agility, Reliability, & Security in Technology Organizations Kindle Edition
3. DevOps: A Complete Beginner's Guide to DevOps Best Practices Volume 1 of 1 Series, Jim Lewis, Publisher: Independently Published, 2019, ISBN 1673259146, 9781673259148
4. Effective DevOps: Building a Culture of Collaboration, Affinity, and Tooling at Scale 1st Edition, Kindle Edition

**M.Sc. Software Engineering**  
**M.Sc.(SE) S. Y. (Semester IV)**  
**SSEE-551 C. DevOps Fundamental**

**Note :-** Conduct at least 15 practical based on given syllabus.