ACADEMIC REGULATIONS

COURSE STRUCTURE

AND

DETAILED SYLLABI

FOR

M.C.A TWO YEAR POST GRADUATE PROGRAM

(for the batches admitted from 2020-2021)

CHOICE BASED CREDIT SYSTEM

SREE VIDYANIKETHAN ENGINEERING COLLEGE (AUTONOMOUS)

(Affiliated to JNTUA, Ananthapuramu, Approved by AICTE, Programs Accredited by NBA, Accredited by NAAC with 'A' grade)
SREE SAINATH NAGAR, A. Rangampet -517102:: NEAR TIRUPATI (A.P)

VISION

To be one of the Nation's premier Engineering Colleges by achieving the highest order of excellence in Teaching and Research.

MISSION

- To foster intellectual curiosity, pursuit and dissemination of knowledge.
- To explore students' potential through academic freedom and integrity.
- To promote technical mastery and nurture skilled professionals to face competition in ever increasing complex world.

QUALITY POLICY

Sree Vidyanikethan Engineering College strives to establish a system of Quality Assurance to continuously address, monitor and evaluate the quality of education offered to students, thus promoting effective teaching processes for the benefit of students and making the College a Centre of Excellence for Engineering and Technological studies.

DEPARTMENT OF MASTER OF COMPUTER APPLICATIONS

Vision

To become a Nation's center of excellence in the field of computer science and applications through teaching, training, and research.

Mission

- The department of computer applications is established to provide solutions through computer applications.
- Through contemporary curriculum the knowledge of the diverse group of students in dissemination.
- Creating a talent pool of faculty in diverse domains of computer applications through continuous training.
- Domain and transferable skill development for holistic personality of students and employability.
- Inculcating values and Ethics for effective professional practice.

PROGRAM EDUCATIONAL OBJECTIVES

After few years of completion of the Program, the graduates of MCA would be:

1. Enrolled or completed higher education/research studies in the core and allied areas of computer science.
2. Successful entrepreneurs and professionally excelled in diverse application skills in the core or allied area of computer science of societal importance.
3. Professionals in industry, academia and organizations with ability to adapt to evolving technologies in the core and allied areas of computer science.

PROGRAM OUTCOMES

On successful completion of the Program, the graduates of M.C.A Program will be able to:

1. Apply knowledge of computing fundamentals, computing specialization, mathematics, and domain knowledge appropriate for the computing specialization to the abstraction and conceptualization of computing models from defined problems and requirements.
2. Identify, formulate, research literature, and solve complex computing problems reaching substantiated conclusions using fundamental principles of mathematics, computing sciences, and relevant domain disciplines.
3. Design and evaluate solutions for complex computing problems, and design and evaluate systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.
6. Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional computing practices.
7. Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.
8. Demonstrate knowledge and understanding of the computing and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
9. Communicate effectively with the computing community, and with society at large, about complex computing activities by being able to comprehend and write effective reports, design documentation, make effective presentations, and give and understand clear instructions.

10. Understand and assess societal, environmental, health, safety, legal, and cultural issues within local and global contexts, and the consequential responsibilities relevant to professional computing practices.

11. Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary environments.

12. Identify a timely opportunity and using innovation to pursue that opportunity to create value and wealth for the betterment of the individual and society at large.

PROGRAM SPECIFIC OUTCOMES

On successful completion of the Program, the graduates of M.C.A Program will be able to:

PSO1: Design, implement and test applications for complex computing problems for desired specifications through modern tool usage, appropriate technologies and programming skills.

PSO2: Use managerial and domain Skills of Information Management to model an application's data requirements using domain specific modeling tools, Transaction & Query processing, Indexing & Searching techniques, and extract information for interpreting the datasets for Decision Making.

PSO3: Apply suitable techniques and algorithms to Integrate Operating System, Services, Network devices, Security mechanisms and Infrastructure to meet the requirements for the deployment of an application and to communicate on computer networks.

SREE VIDYANIKETHAN ENGINEERING COLLEGE

(AUTONOMOUS)

(Affiliated to J.N.T. University Anantapur, Ananthapuramu)

ACADEMIC REGULATIONS (SVEC-20)

CHOICE BASED CREDIT SYSTEM

Master of Computer Applications (M.C.A)
Two Year Post Graduate Degree Program
(For the batches admitted from the academic year 2020–2021)

For pursuing two year Post Graduate Degree Program in Master of Computer Applications (M.C.A) offered by Sree Vidyanikethan Engineering College under Autonomous status and hereinafter referred to as SVEC:

1. Applicability: All the rules specified herein, approved by the Academic Council, shall be in force and applicable to the students admitted from the academic year 2020-2021 onwards. Any reference to "College" in these rules and regulations stands for SVEC.

2. Extent: All the rules and regulations, specified hereinafter shall be read as a whole for the purpose of interpretation. As and when a doubt arises, the interpretation of the Chairman, Academic Council shall be final and ratified by the Academic Council in the forthcoming meeting. As per the requirements of statutory bodies, Principal, Sree Vidyanikethan Engineering College shall be the Chairman, Academic Council.

3. Admission:

3.1. Admission into First year of Two Year Post Graduate Degree Program MCA :

3.1.1. Eligibility:

Admission to the two year Post Graduate Degree Program MCA shall be made subject to the eligibility, qualifications prescribed by the competent authority from time to time. Admissions shall be made on the basis of rank obtained by the qualifying candidates at the Andhra Pradesh Integrated Common Entrance Test (APICET), subject to reservations or policies framed by the Government of Andhra Pradesh from time to time.

3.1.2. Admission Procedure:

Admissions are made into the two year Post Graduate Degree Program MCA as per the stipulations of A.P State Council of Higher Education (APSCHE), Government of Andhra Pradesh.

(a) By the Convener, APICET, (for Category-A Seats).

(b) By the Management (for Category-B Seats).

4. Duration of the Program:

4.1. Minimum Duration: The program will extend over a period of two years leading to the Degree of Master of Computer Applications (M.C.A) of the J.N.T. University Anantapur, Ananthapuramu. The two academic years will be divided into FOUR semesters with two semesters per year. Each semester shall normally consists of 21 weeks (minimum of 90 working days) having - Continuous Internal Evaluation (CIE) and Semester End Examination (SEE). Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS) as suggested by UGC and Curriculum as suggested by AICTE are followed.

4.2. Maximum Duration:

The student shall complete all the passing requirements of the M.C.A Program within a maximum duration of **FOUR** years excluding the Gap year. This duration is reckoned from the commencement of the semester to which the student is first admitted to the program.

5. Structure of the Program:

The Post Graduate Degree Program MCA shall consist of:

(i) Humanities, Mathematics and Management Courses

(ii) PC (Professional Core) Courses

(iii) PE (Professional Electives)

(iv) Open Elective Course (MOOC)

(v) Audit Courses (AC)

(vi) Internship

(vii) Project Work (PR) (Internship, Project Work)

Course Category	Course Description	Number of Credits
HS– Humanities and Management	Includes courses related to Humanities and Management.	6.5
BS – Mathematics	Includes courses related to Mathematics Management.	04
PC– Professional Core	Includes core courses related to the program of study.	46.5
PE– Professional Elective	Includes Elective courses related to the program. The electives can be chosen based on the interest of the student to broaden the skills and knowledge.	16
OE-Open Elective(MOOC)	Includes Open Elective courses aimed at unlimited participation and open access Via the web to diversify their spectrum of knowledge. The open elective can be chosen with the recommendations of chairman BOS.	03
AC - Audit Courses	Skill Development / Value Added Courses.	--
Internship	A course of study to undertake Internship in an industry related to the program of study.	02
Project Work	A course of study planned to undertake Application / Research oriented project.	12

Contact Periods:

Depending on the complexity and volume of the course, the numbers of contact periods per week are assigned.

6. Credit Courses: Courses are to be registered by a student in a Semester to earn Credits. Credits shall be assigned to each Course in an L: T: P: C (Lecture Hours: Tutorial Hours: Practical Hours: Credits) structure, based on the following pattern.

6.1. Theory Courses: One hour Lecture (L) per Week in a Semester = 01 Credit.

6.2. Practical Courses: One Practical hour (P) per Week in a Semester = 0.5 Credit.

6.3. Tutorial: One hour Tutorial (T) per Week in a Semester = 01 Credit.

6.4. Open Elective (MOOC): 03 Credits

6.5. Audit Courses (AC): **NO CREDITS** are awarded

6.6. Other student activities like NCC, NSS, Sports, Study Tour, Guest Lecture etc. will carry **'NO'** Credits.

6.7. For courses like Internship/ Project Work, where formal contact periods are not specified, credits are assigned based on the complexity of the work to be carried out.

6.8. The Two year curriculum of Post Graduate Degree Program MCA shall have total of **90** credits.

7. Choice Based Credit System (CBCS):

7.1. Choice Based Credit System (CBCS) is introduced in line with UGC guidelines in order to promote:

- Student cantered learning
- Students to learn courses of their choice
- Interdisciplinary learning

A Student has a choice of registering for courses comprising program core, professional electives, open elective through MOOC course.

8. Course Enrolment and Registration:

8.1. Each student, on admission shall be assigned to a Faculty Advisor (Mentor) who shall advice and counsel the student about the details of the academic Program and the choice of courses considering the student's academic background and career objectives.

8.2. The enrollment of courses in I-Semester will commence on the day of admission of MCA program. The student shall enroll for the courses with the help of the student's Faculty Advisor (Mentor). The enrollment for the courses of the succeeding semester will commence 10 days prior to the last instructional day of the preceding semester and complete the registration process duly authorized by the Chairman, Board of studies of the department.

For the enrollment of courses in succeeding semesters, a student shall follow the course registration process as applicable for the admitted student.

8.3. If any student fails to register the courses in a semester, he shall undergo the courses as per the program structure.

8.4. After registering for a course, a student shall attend the classes, satisfy the attendance requirements, earn Continuous Assessment marks and appear for the Semester-End Examinations.

8.5. Elective courses shall be offered by the department only if a minimum of 20 students register for that course.

9. Open Elective(MOOC):

OPEN ELECTIVE (MOOC) is an online course aimed at unlimited participation and open access via the web.

9.1. A Student is offered an Open Elective (MOOC), in the IV-Semester of MCA, and pursued through Massive Open Online Course (MOOC) platforms. The duration of the MOOC course shall be for a minimum period of 08 weeks.

9.2. The student shall confirm registration by enrolling the course within 10 days prior to the last instructional day of the II-Semester along with other courses.

9.3. The list of courses along with MOOC service providers shall be identified by the Chairman, BOS, and Head of the Department. The identified Open Elective (MOOC) courses are to be approved by the Chairman, Academic Council.

9.4. The HOD shall appoint one faculty member as **mentor** (one mentor for each course with minimum of 20 students and maximum of 60 students) during the II-Semester for each Open Elective Course (MOOC) identified.

9.5. There shall be only semester-end examination for open elective (MOOC) course. It shall be evaluated by the department through ONLINE for **THREE HOURS duration** with 50 multiple choice questions for 100 marks. The department shall prepare the Question Bank for Conducting the ONLINE Open Elective (MOOC) Examination.

10. Break of Study from a Program (Gap Year)

10.1. A student is permitted to go on break of study for a maximum period of one year

10.2. The student shall apply for break of study in advance, in any case, not later than the last date of the first assessment period in a semester. The gap year concept is introduced for start-up (or) incubation of an idea, National/International Internships, and Professional Volunteering. The application downloaded from the website and duly filled in by the student shall be submitted to the Principal through the Head of the department. A Committee shall be appointed by the Principal in this regard. Based on recommendations of the committee, Principal shall decide whether to permit the student to avail Gap Year or not.

10.3. The students permitted to rejoin the program after break of study shall be governed by the Curriculum and Regulations in force at the time of rejoining.

The students rejoining in new regulations shall apply to the Principal in the prescribed format through Head of the Department at the beginning of the re-admitted semester for registering additional/equivalent courses to comply with curriculum in-force.

10.4. The one year period of break of study shall not be counted for the maximum period for the award of the degree (i.e. 05 years shall be the maximum period for the award of degree for the students availing Gap Year).

10.5. If a student has not reported to the college after completion of approved period of break of study, he is deemed to be detained in that semester. Such students are eligible for readmission into the semester when offered next.

11. Examination System: All components in the MCA program shall be evaluated through internal evaluation and/or an external evaluation conducted as semester-end examination.

11.1. Distribution of Marks:

Sl. No.	Course	Marks	Examination and Evaluation		Scheme of examination
1.	Theory	60	Semester-end examination of 3 hours duration (External evaluation)		The examination question paper in theory courses shall be for a maximum of 60 marks. The question paper shall be of descriptive type with 10 questions each of 12 marks, taken two from each unit. Each unit will have internal choice and 5 questions shall be answered, one from each unit.
		40	Mid-term Examination of 2 hours duration (Internal evaluation)		Two mid-term examinations each for 40 marks are to be conducted. For a total of 40 marks, 80% of better one of the two and 20% of the other one are added and finalized. **Mid-I:** After first spell of instruction (I & II Units). **Mid-II:** After second spell of instruction (III, IV & V Units). The question paper shall be of descriptive type with 5 essay type questions each of 10 marks, out of which 3 are to be answered and evaluated for 30 marks. There will also be 5 short answer questions each of 2 marks, all are to be answered and evaluated for 10 marks.
2.	Laboratory	50	Semester-end Lab Examination for 3 hours duration (External evaluation)		The examination shall be conducted by the faculty member handling the laboratory (Examiner-2) and another faculty member (Examiner-1) appointed by the Chief Controller of examinations.
		50	30	Day-to-Day evaluation for Performance in laboratory experiments and Record. (Internal evaluation)	Two laboratory examinations, which include Day-to-Day evaluation and Practical test, each for 50 marks are to be evaluated by the faculty members handling the laboratory. For a total of 50 marks 80% of better one of the two and 20% of the other one are added and finalized. **Laboratory Examination-I:** Shall be conducted just before FIRST mid-term examinations. **Laboratory Examination-II:** Shall be conducted just before SECOND mid-term examinations.
			20	Practical test (Internal evaluation)	
3.	Internship	100	Semester-end Examination		The semester-end evaluation shall be done by the Department Evaluation Committee **(DEC**) as given in 11.2.2.
4.	Open Elective (MOOC)	100	Semester-end Examination for 3 hours duration		The evaluation shall be done by the department through ONLINE with 50 multiple choice questions.
5	Audit Courses	-	-		As detailed in 11.2.3

Sl. No.	Course	Marks	Examination and Evaluation		Scheme of examination
6.	Project Work	200	100	Internal Evaluation	Continuous evaluation shall be done by the Project Evaluation Committee **(PEC)** as given in 11.2.3.
			100	Semester-end Evaluation	**Project Work** Viva-Voce Examination shall be conducted by a Committee at the end of the semester as given in 11.2.3.

11.2. Internship /Project Work/ Audit Course Evaluation:

11.2.1. Internship

A student shall undergo **Internship** in an Industry/ National Laboratories relevant to the program of study. This course is to be registered in the II semester, and taken up during the summer vacation for about FOUR weeks duration. The Internship shall be submitted in a Report form, and a presentation of the same shall be made before a Department Evaluation Committee **(DEC).** The **DEC** shall consist of Head of the Department, the concerned supervisor of Internship, and a Senior Faculty Member of the Department. The DEC is constituted by the Principal on the recommendations of the Head of the Department. There shall be NO internal marks for Internship. The Internship report shall be evaluated at the end of the III Semester.

11.2.2. Project Work

The Project Work Viva-Voce examination shall be conducted by a Committee consisting of External examiner (nominated by the Chief Controller of Examinations), HOD and Concerned Supervisor. The evaluation of project work shall be conducted at the end of the IV Semester. The Internal Evaluation shall be conducted by the Project Evaluation Committee **(PEC),** consisting of concerned supervisor and two senior faculty members on the basis of TWO project reviews conducted on the topic of the Project Work. The **PEC** is constituted by the Principal on the recommendations of the Head of the Department.

11.2.2.1. A student shall be allowed to submit the report on the recommendations of the **PEC** and then attend viva-voce examination of the Project Work. The Project Work Viva-Voce examination may be conducted once in three months for all the eligible candidates.

11.2.2.2. Student can initiate the Project Work only after obtaining the approval of Title of Project Work from **PEC** within TWO weeks from the commencement of IV

Semester. In Project Work Review-I, a student has to present the title, objective, Problem Definition, Scope of Work, Literature Survey, analysis of the problem, implementation tools / methodologies, plan of action (in consultation with his Project Supervisor) and design of the problem to the **PEC** for approval within NINE weeks from the commencement of IV Semester. The Project Work Review-I will be evaluated by **PEC** for 100 Marks.

11.2.2.3. In Project Work Review-II, student has to present the implementation, Verification and Validation of Project Work along with the report to the PEC for approval within NINE Weeks after Project Work Review-I. The Project Work Review-II will be evaluated by **PEC** for 100 Marks.

For a total of 100 marks, 80% of better one of the two and 20% of the other one are added and finalized.

11.2.2.4. If a student wishes to change his supervisor or topic of the project work, he can do so with the approval of the **PEC**. However, the **PEC** shall examine whether or not the change of topic/supervisor leads to a major change of his initial plans of project proposal. If yes, his date of registration for the project work is deemed to be started from the date of change of Supervisor or change of topic as the case may be.

11.2.2.5. Three copies of the dissertation certified in the prescribed form by the concerned supervisor and HOD shall be submitted to the Department. One copy is to be submitted to the Chief Controller of Examinations and one copy to be sent to the examiner. The examiner shall be nominated by the Chief Controller of the Examinations from the panel of three examiners submitted by the department for a maximum of 10 students for adjudication.

11.2.2.6. If the report of the examiner is favourable, Viva-Voce examination shall be conducted by a Committee consisting of the concerned Supervisor, Head of the Department and the examiner who adjudicated the dissertation. The Committee shall jointly evaluate the student's project work. If the report of the examiner is not favourable, the student should revise and resubmit the project report followed by Viva-Voce examination.

11.2.2.7. The student who fails in Viva-Voce examination shall have to re-appear the Viva-Voce examination after three months. Extension of time within the total permissible limit for completing the project is to be obtained from the Chairman, Academic Council, SVEC.

11.2.3. Audit Courses: Audit courses carry "**ZERO"** credits. There shall be **NO Internal** and **Semester-end examination**. However, ATTENDANCE in Audit

courses shall be considered while calculating aggregate attendance in a semester. The student should study all the audit courses, and it shall be indicated in the GRADE Sheet.

11.3. Eligibility to appear for the Semester-End Examination (SEE):

11.3.1. A student shall be eligible to appear for semester-end examinations if he acquires a minimum of 75% of attendance in aggregate of all the courses in a semester.

11.3.2. Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester may be granted by the College Academic Committee.

11.3.3. Shortage of Attendance below 65% in aggregate shall **in no case be condoned**.

11.3.4. Student whose shortage of attendance is not condoned in any semester is not eligible to take their end examination of that class and their registration shall stand cancelled.

11.3.5. A student shall not be promoted to the next semester unless he satisfies the attendance requirements of the current semester, as applicable. The student may seek readmission for the semester when offered next. He will not be allowed to register for the courses of the semester while he is in detention. A student detained due to shortage of attendance, will have to repeat that semester when offered next.

11.3.6. A stipulated fee shall be payable to the College towards condonation of shortage of attendance.

11.3.7. The attendance in Student Development Activities shall be considered for finalization of aggregate attendance.

11.3.8. For the calculation of a student attendance in any semester, the total number of classes conducted shall be counted as scheduled in the class-work time table.

11.4. Evaluation:

Following procedure governs the evaluation:

11.4.1. Marks for components evaluated internally by the faculty shall be submitted to the Controller of Examinations one week before the commencement of the End examinations. The marks for the internal evaluation components shall be added

to the external evaluation marks secured in the Semester-end examinations, to arrive at the total marks for any course in that semester.

11.4.2. Performance in all the courses is tabulated course-wise and shall be scrutinized by the Results Committee and moderation is applied if needed and course-wise marks are finalized. Total marks obtained in each course are converted into letter grades.

11.4.3. Student-wise tabulation shall be done and individual grade sheet shall be generated and issued to the student.

11.5. Recounting/Revaluation/Personal Verification/Challenging Evaluation:
Students shall be permitted to apply for **Recounting /Revaluation/Personal Verification/ Challenging Evaluation** of the Semester-end examination answer scripts within a stipulated period after payment of the prescribed fee. After completion of the process of **Recounting /Revaluation/Personal Verification/ Challenging Evaluation**, the records are updated with changes if any, and the student shall be issued a revised grade sheet. If there are no changes, the student shall be intimated the same through a notice.

11.6. Supplementary Examination: In addition to the regular semester-end examinations conducted, the College may also schedule and conduct supplementary examinations for all the courses of other semesters when feasible for the benefit of students. Such of the candidates writing supplementary examinations may have to write more than one examination per day.

12. Re-Registration for improvement of Internal Marks:

Following are the conditions for Re-Registration of Theory Courses for improvement of Internal Marks:

12.1. The student should have completed all the course work and obtained examinations results from I to III semesters.

12.2. If the student has failed in the examination due to internal evaluation marks secured being less than 50%, he shall be given one chance for a maximum of 3 theory courses for improvement of internal evaluation marks.

12.3 The candidate has to register for the chosen courses and fulfil the academic requirements (i.e. a student has to attend the classes regularly and appear for the mid-examinations and satisfy the attendance requirements to become eligible for appearing at the semester-end examinations).

12.4. For each course, the candidate has to pay a fee equivalent to one third of the semester tuition fee and the amount is to be remitted in the form of D.D./ Challan in favour of the Principal, Sree Vidyanikethan Engineering College payable at Tirupati along with the requisition through the concerned Head of the Department.

12.5. A student availing the benefit for Improvement of Internal evaluation marks, the internal evaluation marks as well as the semester-end examinations marks secured in the previous attempt(s) for the re-registered courses stands cancelled.

13. Academic Requirements for completion of Post Graduate Degree Program MCA:

The following academic requirements have to be satisfied in addition to the attendance requirements for completion of Post Graduate Degree Program MCA.

For students admitted into Post Graduate Degree Program MCA for the academic year 2020-2021:

13.1. A student shall be deemed to have satisfied the minimum academic requirements for each theory, laboratory course, and project work, if he secures not less than 40% of marks in the semester-end examination and a minimum of 50% of marks in the sum total of the internal evaluation and Semester-end examination taken together. **For the Internship, he should secure not less than 50% of marks in the semester-end examination.**

13.2. A student shall register for all the **90** credits and earn all the **90** credits. Marks obtained in all the **90** credits shall be considered for the calculation of the DIVISION based on CGPA.

13.3. A student who fails to earn **90** credits as indicated in the course structure within **four** academic years from the year of their admission shall forfeit his seat in M.C.A Program and his admission stands cancelled.

14. Transitory Regulations:

Students who got detained for want of attendance (**or**) who have not fulfilled academic requirements (**or**) who have failed after having undergone the Program in earlier regulations (**or**) who have discontinued and wish to continue the Program are eligible for admission into the unfinished semester from the date of commencement of class work with the same (**or**) equivalent courses as and when courses are offered and they will be in the academic regulations into which they are presently readmitted. A student has to satisfy all the eligibility requirements within the maximum stipulated period of **four years** for the award of M.C.A Degree.

15. Grades, Semester Grade Point Average and Cumulative Grade Point Average:

15.1. Grade System: After all the components and sub-components of any course (including laboratory courses) are evaluated, the final total marks obtained shall be converted into letter grades on a "10 point scale" as described below.

Grades conversion and Grade points attached

% of Marks obtained	Grade	Description of Grade	Grade Points (GP)
≥ 95	O	Outstanding	10
≥ 85 to < 95	S	Superior	9
≥ 75 to < 85	A	Excellent	8
≥ 65 to < 75	B	Very Good	7
≥ 55 to < 65	C	Good	6
≥ 50 to <55	D	Pass	5
< 50	F	Fail	0
Not Appeared	N	Absent	0

Pass Marks: A student shall be declared to have passed theory course, laboratory course and project work if he secures minimum of 40% marks in external examination, and a minimum of 50% marks in the sum total of internal evaluation and external examination taken together. For the Internship, he shall be declared to have passed if he secures minimum of 50% of marks in the Semester-End Examination. Otherwise, he shall be awarded fail grade – **'F'** in such a course irrespective of internal marks. **'F'** is considered as a fail grade indicating that the student has to pass the semester-end examination in that course in future and obtain a grade other than **'F'** and **'N'** for passing the course.

15.2. Semester Grade Point Average (SGPA):

SGPA shall be calculated as given below on a "10 point scale" as an index of the student's performance at the end of each semester:

$$SGPA = \frac{\sum (C \, x \, GP)}{\sum C}$$

Where ***C*** denotes the "Credits" assigned to the courses undertaken in that semester and ***GP*** denotes the "Grade Points" earned by the student in the respective courses.

Note: SGPA is calculated only for the candidates who passed all the courses in the semester-end regular examinations in a particular Semester.

15.3. Cumulative Grade Point Average (CGPA):

The CGPA shall be calculated for a candidate passed all the courses in the semester-end examinations (including regular and supplementary) till that semester. The CGPA will be displayed in the grade sheet of the regular semester-end examinations and also in the consolidated grade sheet issued at the end of the program. The CGPA is computed on a 10 point scale as given below:

$$CGPA = \frac{\sum (C \; x \; GP)}{\sum C}$$

Where ***C*** denotes the "Credits" assigned to courses undertaken up to the end of the Program and ***GP*** denotes the "Grade Points" earned by the student in the respective courses.

16. Grade Sheet: A grade sheet (Marks Memorandum) shall be issued to each student indicating the SGPA and CGPA, provided if he passed all the courses registered in the regular semester-end examinations.

17. Consolidated Grade Sheet: After successful completion of the entire Program of study, a Consolidated Grade Sheet indicating performance of all academic years shall be issued as a final record. Duplicate Consolidated Grade Sheet will also be issued, if required, after payment of requisite fee.

18. Award of Degree: The Degree shall be conferred and awarded by Jawaharlal Nehru Technological University Anantapur, Ananthapuramu on the recommendations of the Chairman, Academic Council, SVEC (Autonomous)

18.1. Eligibility: A student shall be eligible for the award of M.C.A Degree if he fulfills all the following conditions:

18.1.1. Registered and successfully completed all the components prescribed in the Program of study to which he is admitted.

18.1.2. Successfully acquired all the required credits as specified in the curriculum of post graduate degree program MCA within the stipulated time.

18.1.3. Obtained CGPA greater than or equal to 5.0 (Minimum requirement for declaring as passed).

18.1.4. Has NO DUES to the College, Hostel, and Library etc. and to any other amenities provided by the College.

18.1.5. No disciplinary action is pending against him.

18.2. Award of Division: Declaration of Division is based on CGPA.

Awarding of Division

CGPA	Division
> = 7.0	First Class with Distinction
> = 6.0 and < 7.0	First Class
> = 5.0 and < 6.0	Second Class

19. Additional Academic Regulations:

19.1 A student may appear for any number of supplementary examinations within the stipulated time to fulfil regulatory requirements for award of the degree.

19.2 In case of malpractice/improper conduct during the examinations, guidelines shall be followed as given in the **ANNEXURE-I**.

19.3 When a student is absent for any examination (Mid-term or Semester-end) he shall be awarded **zero** marks in that component (course) and grading will be done accordingly.

19.4 When a component is cancelled as a penalty, he shall be awarded zero marks in that component.

20. Withholding of Results:

If the candidate has not paid dues to the College/University (or) if any case of indiscipline is pending against him, the result of the candidate shall be withheld and he will not be allowed/promoted to the next higher semester.

21. Amendments to Regulations:

The Academic Council of SVEC (Autonomous) reserves the right to revise, amend, or change the Regulations, Scheme of Examinations, and/or Syllabi or any other policy relevant to the needs of the society or industrial requirements etc., with the recommendations of the Board of Studies.

22. Attendance for student development activity periods indicated in the class time tables shall be considered as in the case of a regular course for calculation of overall percentage of attendance in a semester.

23. General: The words such as "he", "him", "his" and "himself" shall be understood to include all students irrespective of gender connotation.

Note: Failure to read and understand the regulations is not an excuse.

ANNEXURE-I

GUIDELINES FOR DISCIPLINARY ACTION FOR MALPRACTICES / IMPROPER CONDUCT IN EXAMINATIONS

Rule No.	Nature of Malpractices/Improper conduct	Punishment
	If the candidate:	
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the course of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the course of the examination)	Expulsion from the examination hall and cancellation of the performance in that course only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that course only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the course of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the courses of that Semester. The Hall Ticket of the candidate is to be cancelled.
3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred for four consecutive semesters from class work and all Semester-end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the courses of the examination (including labs and project work) already appeared and shall not be allowed to appear for examinations of the remaining courses of that semester. The candidate is also debarred for four consecutive semesters from class work and all Semester-end examinations, if his involvement is established. Otherwise, The candidate is debarred for two consecutive semesters from class work and all Semester-end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination	Expulsion from the examination hall and cancellation of performance in that course and all the other courses the candidate has already appeared

	or answer book or additional sheet, during or after the examination.	including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester. The candidate is also debarred for two consecutive semesters from class work and all Semester-end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that course only.
6.	Refuses to obey the orders of the Chief Controller of Examinations/Controller of Examinations/any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the Controller of Examinations or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the Controller of Examinations, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that course and all other courses the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the courses of that semester. If the candidate physically assaults the invigilator/Controller of the Examinations, then the candidate is also debarred and forfeits his/her seat. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester. The candidate is also debarred for two consecutive semesters from class work and all Semester-end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester. The candidate is also debarred and forfeits the seat.

Note: Whenever the performance of a student is cancelled in any course(s) due to Malpractice, he has to register for Semester-end Examinations in that course(s) consequently and has to fulfill all the norms required for the award of Degree.

SREE VIDYANIKETHAN ENGINEERING COLLEGE

(AUTONOMOUS)

(Affiliated to JNTUA, Ananthapuramu; Approved by AICTE)

SREE SAINATH NAGAR, TIRUPATI – 517 102

MASTER OF COMPUTER APPLICATIONS (MCA)

SVEC-20: REGULATIONS

COURSE STRUCTURE

MCA I- Semester

Sl. No	Course Code	Course Title	Contact Periods per Week				C	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
1.	20MC1BS01	Computer Oriented Statistical Techniques	3	1	-	4	4	40	60	100
2.	20MC10101	Computer Networks	4	-	-	4	4	40	60	100
3.	20MC10102	Database Management Systems	4	-	-	4	4	40	60	100
4.	20MC10103	Data Structures and Algorithms	3	1	-	4	4	40	60	100
5.	20MC10104	Python Programming	3	1	-	4	4	40	60	100
6.	20MC1HS31	Communicative English Lab	-	-	3	3	1.5	50	50	100
7.	20MC10131	Database Management Systems Lab	-	-	3	3	1.5	50	50	100
8.	20MC10132	Data Structures and Python Programming Lab	-	-	3	3	1.5	50	50	100
9.	20MC1AC01	Software Engineering	2	-	-	2	-	-	-	-
		TOTAL	**19**	**3**	**9**	**31**	**24.5**	**350**	**450**	**800**

MCA II- Semester

Sl. No	Course Code	Course Title	Contact Periods per Week				C	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
1.	20MC2HS01	Financial and Management Accounting	4	-	-	4	4	40	60	100
2.	20MC20101	Data Warehousing and Data Mining	4	-	-	4	4	40	60	100
3.	20MC20102	Object Oriented Programming through JAVA	4	-	-	4	4	40	60	100
4.	**Professional Elective –I**		4	-	-	4	4	40	60	100
	20MC20103	Cryptography and Network Security								
	20MC20104	M-Commerce								
	20MC20105	Multimedia Application Development								
	20MC20106	R Programming								
	20MC20107	Software Architecture and Design Patterns								
5.	**Professional Elective –II**		4	-	-	4	4	40	60	100
	20MC20108	Cyber Security								
	20MC20109	Machine Learning								
	20MC20110	Mobile Application Development								
	20MC20111	Programming with C#								
	20MC20112	Software Testing and Quality Assurance								
6.	20MC20131	Data Warehousing and Data Mining Lab	-	-	3	3	1.5	50	50	100
7.	20MC20132	LINUX Programming Lab	-	-	3	3	1.5	50	50	100
8.	20MC20133	Object Oriented Programming through JAVA Lab	-	-	3	3	1.5	50	50	100
9.	20MC2AC01	Operating Systems	2	-	-	2	-	-	-	-
		TOTAL	**22**	**-**	**9**	**31**	**24.5**	**350**	**450**	**800**

MCA III- Semester

S. No	Course Code	Course Title	Contact Periods per Week				C	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
1.	20MC30101	Cloud Computing	4	-	-	4	4	40	60	100
2.	20MC30102	Data Analytics	4	-	-	4	4	40	60	100
3.	20MC30103	Web Programming	4	-	-	4	4	40	60	100
4.	**Professional Elective – III**		4	-	-	4	4	40	60	100
	20MC30104	Artificial Intelligence								
	20MC30105	Blockchain Technologies								
	20MC30106	DevOps Application Development								
	20MC30107	Programming with AngularJS								
	20MC30108	Software Project Management								
5.	**Professional Elective – IV**		4	-	-	4	4	40	60	100
	20MC30109	Computer Oriented Optimization Techniques								
	20MC30110	Full Stack Development								
	20MC30111	Internet of Things								
	20MC30112	Programming in Ruby								
	20MC30113	User Interface Design								
6.	20MC3HS31	Soft Skills Lab	-	-	2	2	1	50	50	100
7.	20MC30131	Cloud Computing and Data Analytics Lab	-	-	3	3	1.5	50	50	100
8.	20MC30132	Web Programming Lab	-	-	3	3	1.5	50	50	100
9.	20MC30133	Internship	-	-	-	-	2	-	100	100
10.	20MC3AC01	Server Side Development with NodeJS	-	-	2	2	-	-	-	-
TOTAL			**20**	**-**	**10**	**30**	**26**	**350**	**550**	**900**

MCA IV- Semester

Sl. No	Course Code	Course Title	Contact Periods per Week				C	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
1.	20MC4MOOC	Open Elective (MOOC)	-	-	-	-	3	-	100	100
2.	20MC40131	Project Work	-	-	-	-	12	100	100	200
TOTAL			-	-	-	-	**15**	**100**	**200**	**300**

TOTAL No. OF CREDITS : 90

TOTAL MARKS : 2800

MCA I – SEMESTER
(20MC1BS01) COMPUTER ORIENTED STATISTICAL TECHNIQUES

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	3	1	-	4

PRE-REQUISITES: --

COURSE DESCRIPTION:

Concepts of descriptive statistics; basics in R; Probability distributions; Correlation and Regression analysis; Testing of hypothesis.

COURSE OUTCOMES:

After successful completion of the course students should be able to:

CO1. Understand the concepts of descriptive statistics, basics in R, Probability distributions, Testing of Hypothesis, Correlation and Regression.

CO2. Apply testing of hypothesis on small and large sample tests using Z-test, t-test, F-test and chi-square test to draw the valid inferences and solve the problems on probability distributions.

CO3. Use R programming tools to Simulate Binomial, Poisson and Normal distributions, Calculate Correlation and Regression Coefficients, Fitting lines of Regression.

CO4. Analyze the relationship between variables using Correlation and Regression.

DETAILED SYLLABUS:

UNIT I - INTRODUCTION TO DESCRIPTIVE STATISTICS (9 Periods)

Measures of Central Tendency: Arithmetic Mean, Arithmetic Mean Computed from Grouped data, Median, Mode, Empirical Relation Between the Mean, Median,and Mode, Geometric Mean, Harmonic Mean.

Measures of Dispersion: The Range, The Mean Deviation, The Semi- Interquartile Range, The Standard Deviation, The Variance, coefficient of variation and Moments, measures of Skewness and Kurtosis.

UNIT II - BASICS IN R (10 Periods)

Introduction, R Studio, how to run R, Variables, Data Types, Vectors, Data Frames, Lists, Matrices, Arrays, Classes, Functions, Graphical and diagrammatical presentations in R.

UNIT III - PROBABILITY DISTRIBUTIONS (8 Periods)

Discrete Probability Distributions: Binomial Distribution- Mean and variance and

fitting of Binomial distribution; Poisson distribution -Mean and variance and fitting of Poisson distribution.

Continuous Probability Distributions: Normal Distribution- Mean, variance and area properties of Normal distribution.

Implementing in R: Simulate Binomial, Poisson and Normal distributions

UNIT IV- CORRELATION AND REGRESSION ANALYSIS. (8 Periods)

Correlation Analysis: Linear Correlation, scatter diagram, Karl Pearson's coefficient of Correlation and Spearman's Rank correlation coefficient (with and without tied ranks).

Regression Analysis: Regression Lines, Fitting of two lines of Regression, Regression coefficients and multiple regression

Implementing in R: Calculate Correlation and Regression Coefficients and Fitting lines of Regression

UNIT V - TESTING OF HYPOTHESIS (10 Periods)

Large sample Tests: Null hypothesis and Alternative hypothesis, Type-I and Type-II errors, Level of significance, Critical Region, one tailed and two tailed tests; Test of Significance of single proportion, Difference of two Proportions, Single mean, Difference of two Means.

Small sample tests: t-test: Single mean, Difference of two Means; F-test; chi-square test**:** chi-square test for independence of attributes, chi-square test for goodness of fit.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. T. K. V. Iyengar, B. Krishna Gandhi etal., *"Probability and Statistics,"* S. Chand and Company ltd: New Delhi, 3rd Edition, 2011.

2. Allerhand M. Tiny Handbook of R – Springer Briefs in Statistics, 2011
.

REFERENCE BOOKS:

1. Shanaz Bhatul, *"Probability and Statistics,"* RIDGE Publications, 2nd Edition, 2006.
2. S.C. Gupta and V.K. Kapoor, *"Fundamentals of Applied Statistics,"* S. Chand and Sons, New Delhi, 2010.
3. Baayen R. *"Analyzing Linguistic Data - A Practical Introduction to Statistics using R,"* 2008.

4. Alain F. Zuur, Elena N. Ieno, Erik H.W.G. Meesters *"Beginner's Guide to R,"* Springer,2009.

ADDITIONAL LEARNING RESOURCES:

1. http://www.nptelvideos.in/2012/11/probability-and-statistics.html.
2. https://www.classcentral.com/course/swayam-probability-and-statistics-5228.
3. https://www.coursera.org/browse/data-science/probability-and-statistics.

MCA I - SEMESTER
(20MC10101) **COMPUTER NETWORKS**

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	-	-	4

PRE-REQUISITES:--

COURSE DESCRIPTION:

Concepts of Computer Networks; The Physical Layer; The Data Link Layer; The Medium Access Control Sub layer; The Network Layer; The Transport Layer; The Application Layer.

COURSE OUTCOMES:

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

CO1. Understand the concepts of Networking, reference models, transmission media, framing and routing policy, internetworking in data communication.

CO2. Apply error and flow control techniques and implement congestion control mechanisms and transport protocols for reliable data communication.

CO3. Analyze design issues of layers, medium access control protocols, techniques for quality of service, elements of transport and application Protocols ensuring the communication procedures.

CO4. Examine the layered and e-mail architectures, networking protocols and e-mail message formats in compliance with communication standards.

DETAILED SYLLABUS:

UNIT I- NETWORK CONCEPTS AND PHYSICAL LAYER (11 Periods)

Network Concepts: Uses of Computer Networks, Network Hardware LAN, MAN and WAN, Topologies, Wireless Network-system interconnection, Wireless LAN, Wireless WAN. Internetworks, Network Software-Protocol hierarchies, Design issues for the layers, Connection Oriented and Connection less Service, Service Primitives, The relationship of Services to Protocols, Reference Models-OSI, TCP/IP.

The Physical Layer: Guided Transmission media - Magnetic Media, Twisted Pairs, Coaxial Cable, Fiber Optics. Wireless Transmission - The Electromagnetic Spectrum, Radio Transmission, Microwave Transmission, Infrared Transmission and Light Transmission.

UNIT II- THE DATA LINK LAYER (14 Periods)

The Data Link Layer: Data Link layer design issues, Error Detection and Correction, Elementary Data Link Protocols - Unrestricted simplex protocol, Simplex stop-and-wait protocol, Simplex protocol for a noisy channel. Sliding Window protocols - One-bit sliding window protocol, Protocol using Go back N, Protocol using Selective Repeat.

The Medium Access Control Sub layer - The Channel Allocation problem, Multiple access protocols-ALOHA, Pure ALOHA, Slotted ALOHA. Carrier Sense Multiple Access Protocols-Persistent and Non persistent CSMA - CSMA with collision detection. Collision Free protocols - Bit map protocol, Token Passing, Binary countdown, Limited Contention protocols.

UNIT III- THE NETWORK LAYER (12 Periods)

Network layer design issues, Routing Algorithms-Optimality principle, Shortest Path Routing, Flooding, Distance Vector Routing, Link State Routing, Hierarchical Routing, Broadcast Routing, Multicast Routing, Routing for Mobile Hosts, Routing in Ad Hoc Networks. Congestion Control Algorithms-Congestion Prevention Policies, Jitter Control, Techniques for achieving good quality of service, Congestion control for multicasting, Internetworking, The Network layer in the Internet-The IP Version 4 protocol, IP Addresses, IP version 6 protocol, Internet control protocols-OSPF, BGP.

UNIT IV- THE TRANSPORT LAYER (11 Periods)

The Transport service, Elements of Transport protocols - Addressing, Connection Establishment, Connection Release, Error Control and Flow Control, Multiplexing and Crash recovery; A simple Transport protocol, The Internet Transport protocols - Introduction to UDP, Remote Procedure Call, Real time transport Protocol; Introduction to TCP, The TCP Service Model, TCP protocol and TCP Segment Header, TCP Connection Establishment, TCP Connection Release, Transmission Policy, TCP Sliding Window, TCP Timer Management, TCP Congestion Control.

UNIT V -THE APPLICATION LAYER (7 Periods)

The Application Layer: Introduction to Application Layer, DNS - The Domain name space, Resource records and Name servers; Electronic Mail-Architecture and services, the user agent, message formats, message transfer and Final Delivery.

Total Periods: 55

Topics for self-study are provided in the lesson plan.

TEXT BOOK:

1. Andrew S. Tanenbaum and David J. Wetherall*, "Computer Networks,"* Pearson Education,

5^{th} Edition, 2015.

REFERENCE BOOKS:

1. Behrouz A. Forouzan, *"Data Communications and Networking,"* The McGraw-Hill, 4^{th} Edition, 2011.

2. James F. Kurose and Keith W. Ross, "*Computer Networking: A Top-Down Approach*," Pearson Education, 6^{th} Edition, 2017.

ADDITIONAL LEARNING RESOURCES:

1. https://nptel.ac.in/courses/106/105/106105081/
2. https://www.cisco.com/c/en/us/solutions/small-business/resource-center/networking/networking-basics.html
3. https://memberfiles.freewebs.com/00/88/103568800/documents/Data.And.Computer.Communications.8e.WilliamStallings.pdf
4. https://www01.ibm.com/servers/resourcelink/svc0302a.nsf/pages/zVMV7R1sc246333/$file/kijl0_v7r1.pdf
5. https://www.youtube.com/watch?v=6_PINy02_g0
6. http://ns2simulator.com/ns2-tcp-congestion-control/

MCA I-SEMESTER
(20MC10102) DATABASE MANAGEMENT SYSTEMS

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	-	-	4

PRE-REQUISITES: --.

COURSE DESCRIPTION:

Databases; Database Architecture and Database Design; Concepts of Relational Database and its Design; Representation of ER Diagram to Relational model; SQL queries; Normal forms; Recovery and Concurrency Control mechanism; Storage and Indexing mechanism.

COURSE OUTCOMES:

After successful completion of this course, the student will be able to:

CO1. Understand the concepts of Relational Database Design, Transaction management, Recovery management, Storage and indexing mechanisms.

CO2. Analyze schema refinement, data normalization techniques, Storage and Index data structures for the construction of relational database systems.

CO3. Design Entity Relationship diagrams, Integrity Constraints over Relations, Database design and basics of SQL to find solutions of real time applications.

CO4. Use SQL to create Nested Queries, Joins, Views, Group functions in updating and managing the relational database system.

CO5. Apply Transaction processing approaches, Concurrency control and Recovery mechanisms for an optimal database application system.

DETAILED SYLLABUS:

UNIT I- INTRODUCTION TO DATABASES, DATABASE ARCHITECTURE AND DATABASE DESIGN (11 Periods)

Databases and Database Users: Concepts, Characteristics of the Database approach, Actors on the Scene, Workers behind the scene, Advantages of the using the DBMS Approach.

Database System Concepts and Architecture: Data Models, Schemas and Instances, Three Schema architecture and Data Independence, Database Languages and Interfaces, Database system environment, Centralized and Client/Server Architectures for DBMS, Classification of Database Management Systems.

Database Design: Database design and ER-diagrams, Entities, Attributes and Entity sets, Relationships and Relationship sets, Additional features of ER-model, Conceptual Design with the ER-Model.

UNIT II - RELATIONAL MODEL AND BASIC SQL (10 Periods)

Relational Model: Relational Model, Integrity Constraints over Relations, Enforcing Integrity constraints, Querying relational data, Logical data base Design: ER to Relational.

Case Study: ER-diagram for banking enterprise and university database.

Basic SQL: SQL data definition and data types, CREATE table command in SQL, attribute data types in SQL, specifying constraints in SQL: specifying attribute constraints and attribute defaults, specifying key and Referential integrity constraints, specifying CHECK constraints on tuples.

UNIT III - SQL, SCHEMA REFINEMENT AND NORMAL FORMS (12 Periods)

SQL: Form of Basic SQL Query, Examples of queries in SQL: Insert, Delete and Update statements; Nested Queries, Correlated Nested Queries, Set Comparison Operators, Aggregate Operators, NULL values, Comparison using Null values, Logical connectives: AND, OR , NOT; Impact on SQL Constructs, Outer Joins, Disallowing NULL values, Views, Destroying /altering Tables and Views, Triggers and Active Databases.

Schema Refinement and Normal Forms: Schema Refinement: Problems Caused by redundancy, Decompositions; Problem related to decomposition, Functional dependencies, Normal Forms: FIRST, SECOND, THIRD Normal forms, BCNF; Properties of decompositions: Loss less, join decomposition, Dependency preserving decomposition.

UNIT IV - OVERVIEW OF TRANSACTION MANAGEMENT, CRASH RECOVERY AND CONCURRENCY CONTROL (11 Periods)

Overview of Transaction Management: ACID Properties, Transactions and Schedules, Concurrent Execution of Transactions, Lock Based Concurrency Control, Performance of Locking.

Concurrency Control: 2Phase Locking (2PL), Serializability and Recoverability, Lock Management, Lock Conversions.

Crash recovery: ARIES, the Log, Other Recovery related Structures, Write-Ahead Log Protocol, Check pointing, Recovering from a System Crash.

UNIT V - OVERVIEW OF STORAGE AND INDEXING (11 Periods)

Overview of Storage and Indexing: Data on External Storage, File Organization and Indexing: Clustered Indexes, Primary and Secondary Indexes; Index Data Structures: Hash based Indexing, Tree based Indexing.

Storing Data: Memory Hierarchy: Magnetic disks, Performance implications of disk structure; Redundant Arrays of Independent Disks.

Tree Structured Indexing: Intuitions for tree Indexes, Indexed Sequential Access Methods (ISAM), B+ Trees: A Dynamic Index Structure.

Total Periods: 55

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Raghu Ramakrishnan and Johannes Gehrke, "*Data base Management Systems*," Tata McGraw-Hill, 3rd Edition, 2013.
2. RamezElmasri, ShamkantB.Navathe, *"Database Systems*," Pearson Education, 6th Edition, 2013.

REFERENCE BOOKS:

1. A.Silberschatz, H.F. Korth, S.Sudarshan, "*Data base System Concepts*," McGraw hill, 6th Edition, 2011.

2. C.J.Date, "*Introduction to Database Systems,*" Pearson Education, 8th Edition, 2006.

ADDITIONAL LEARNING RESOURCES:

1. http://www.nptelvideos.in/2012/11/database-management-system.html

2. http://www.oracle.com/technetwork/tutorials/index.html

3. https://www.tutorialcup.com/dbms

4. https://www.javatpoint.com/oracle-tutorial

MCA I-SEMESTER
(20MC10103)DATA STRUCTURES AND ALGORITHMS

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	3	1	-	4

PRE-REQUISITES:--

COURSE DESCRIPTION:

Algorithm Analysis; Linked Lists; Stacks and Queues; Trees; Binary search trees; AVL trees; Heaps; Multiway search trees; Graphs; Sorting and Searching; Hashing

COURSE OUTCOMES:

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

CO1. Understand the fundamental concepts of data structures, asymptotic notations and algorithm analysis techniques to measure the performance of an algorithm.

CO2. Analyze performance of sorting and searching algorithms by making use of time and space complexity.

CO3. Design algorithms to solve societal problems by applying linked lists

CO4. Solve computational problems by using stacks and queues

CO5. Apply suitable data structure to perform operations on trees and graphs

CO6. Construct hash tables by using Hash functions and relevant collision resolution technique.

DETAILED SYLLABUS:

UNIT I– INTRODUCTION, SORTING AND SEARCHING (11 periods)

Introduction: Introduction to data structures, Introduction to Algorithm, Performance Analysis- Space Complexity, Time Complexity, Asymptotic Notation- Big Oh, Omega, Theta notations, Guidelines for Asymptotic Analysis, Algorithms Analysis: Problems and Solutions.

Sorting: Bubble Sort**,** Insertion sort, Selection Sort, Shell Sort, Radix sort and their performance analysis.

Searching: Linear Search, Binary Search and their performance analysis

UNIT II – LINKED LIST (8 periods)

Single Linked List, Circular Linked List, Double Linked List, Circular Double Linked List, Applications of Linked List- Sparse Matrix Representation and its performance analysis, Addition of Polynomials and its performance analysis

UNIT III – STACKS AND QUEUES (8 periods)

Stacks: Introduction, Definition, Implementation of stacks using arrays, Implementation of stacks using linked list, Applications of Stacks

Queues: Introduction, Definition, Implementation of queues using arrays, Implementation of queues using linked list, Circular Queue, Deque, Priority Queue, Applications of Queues

UNIT IV – TREES, SEARCH TREES AND HEAPS (9 periods)

Trees: Basic Terminologies, binary trees, Properties of binary tree, Representation of Binary Tree, Binary tree traversals.

Search Trees: Binary Search Trees, Operations on Binary Search Trees, AVL Trees and Operations on AVL trees

Heap: Heap Trees, Implementation of Heap Trees, Applications of Heap – Heap Sort and Its performance Analysis

UNIT V – MULTI WAY TREES, GRAPHS AND HASHING (9 periods)

Multiway Trees: M-way search trees, B-trees, Operations on B-trees, B+-trees

Graphs: Introduction, Basic Terminologies, Representation of Graphs, Breadth First Search and its Complexity Analysis, Depth First Search and its Complexity Analysis

Hashing: Introduction, Hash Table Structure, Hash Functions, Linear Open Addressing, Chaining and their performance analysis.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Debasis Samanta, *"Classic Data Structures,"* PHI Learning private limited, Second Edition, 2017.
2. Narasimha Karumanchi, *"Data Structures and Algorithms made easy,"* Career Monk, 5th Edition, 2017.

REFERENCE BOOKS:

1. G A V Pai, *"Data Structures and Algorithms: Concepts, Techniques and Applications,"* Mc graw Hill Edition.
2. Satraj Sahani, *"Data Structures, Algorithms and Applications in Java,"* Universities Press, 2nd Edition, 2008.
3. Michael T. Goodrich, Roberto Tamassia, *"Data Structures and Algorithms in java,"* Wiley India, 2nd Edition, 2007.

ADDITIONAL LEARNING RESOURCES:

1. https://www.coursera.org › Browse › Computer Science › Algorithms
2. https://nptel.ac.in/courses/106102064
3. https://nptel.ac.in/courses/106103069
4. https://nptel.ac.in/courses/106102064/24
5. https://swayam.gov.in/course/235-data-structure

MCA I-SEMESTER
(20MC10104) **PYTHON PROGRAMMING**

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	3	1	-	4

PRE-REQUISITES:--

COURSE DESCRIPTION:

Data types and Expressions; Control Statements; Strings; Text Files; Lists; Dictionaries; Functions; Objects and their use; Exception Handling; Design with Classes; Graphical user Interface.

COURSE OUTCOMES:

After successful completion of this course, the student will be able to:

CO1. Understand the concepts of computer algorithms, problem solving, data types, control structures, expressions, lists, dictionaries, and tuples.

CO2. Use functions, modules, algorithms to solve recursive and non-recursive problems.

CO3. Apply python programming constructs, Objects, strings and text files to develop Object Oriented Programming applications using Jupyter Notebook.

CO4. Implement towers of hanoi, Cigarette Use/ Lung cancer Correlation programs using Dictionaries, list, sets, tuples and functions.

CO5. Develop GUI based applications using tkinter, Python programming and object-oriented programming constructs to solve problems.

DETAILED SYLLABUS:

UNIT I- PYTHON PROGRAMMING CONCEPTS (10 Periods)

Computer science and problem solving, Computer and algorithms a perfect match, Computer software - Syntax, semantics and problem translation, the process of computational problem solving, The Python programming language, python development environment, basics of python, first program in Python-calculating the drake equation.

Data Types and Expressions: Literals, Variables and Identifiers, Operators, Expressions and Data types, program to calculate individuals age in seconds.

UNIT II- CONTROL STRUCTURES, LISTS, DICTIONARIES, TUPLES AND SETS (9 Periods)

Control Structures: Control structures, Boolean expressions, Selection control and Iterative control.

Lists: List structures, Lists in Python, Iterations over lists, Assigning and copying lists, List comprehensions.

Dictionaries, Tuples and Sets: Dictionary types, Implementation of Dictionary, Tuples, Sets, program to add and access elements from the dictionary.

UNIT III- DESIGN FUNCTIONS, MODULES, STRINGS AND TEXT FILES (8 Periods)

Functions: Program routines, Functions.

Recursion: Recursion-Recursive functions, Recursive problem solving, comparing Iteration with Recursion.

Case study 1: Towers of Hanoi using recursion (The Towers of Hanoi problem is based on a legend of unknown origin. According to the legend, there is a Vietnamese temple with a large room containing three pegs and 64 golden disks. Each disk has a hole in it so that it can be slipped onto any of the pegs. In addition, each disk is of different size. The 64 disks are moved by priests from one peg to another with the following conditions:

- Only one disk can be moved at a time.
- At no time can a larger disk be placed on top of a smaller one.

Text Files: Using text files, String processing, Exception handling.

Module Design: Modules, Top-down design, Python modules.

Case study 2: Cigarette Use/ Lung cancer Correlation program. (Computing the correlation between Cigarette use/ Lung cancer)

UNIT IV- OBJECTS AND OBJECT ORIENTED PROGRAMMING (9 Periods)

Objects: Software objects, Turtle graphics- Creating a turtle graphics window, default turtle, Fundamental turtle attributes and behaviour, Additional turtle attributes, creating multiple turtles.

Case Study: Horse Race Simulation problem (design, implement and test a program that simulates a horse race)

Object Oriented Programming: concepts of object-oriented programming, Encapsulation, Inheritance and Polymorphism.

UNIT V- GRAPHICAL USER INTERFACE PROGRAMMING (9 Periods)

Tkinter Overview - tkinter pragmatics, Documentation, Extensions, structure; making widgets; tkinter coding alternatives, configuring widgets, adding buttons and callbacks-lambda, bound method, callable class object, Binding events; adding multiple widgets, Reusable GUI Components with classes, Dialogs, Entry, check buttons, Radio buttons, Scales and Menus.

Case Study: Create a Canvas with options, where user presses the button, it should draw a required shape on the canvas.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Charles Dierbach, "*Introduction to Computer Science using Python: A Computational Problem-Solving Focus,"* Wiley India Edition, 2016.
2. Mark Lutz, "*Programming Python*," O'Reilly Publications, 4th Edition, 2011.

REFERENCE BOOK:

1. Kenneth Lambert and B.L. Juneja, "*Fundamentals of Python*," Cengage Learning, 3rd Edition, 2012.

ADDITIONAL LEARNING RESOURCES:

1. https://docs.python.org/3/tutorial/
2. https://pythonprogramming.net/introduction-to-python-programming/

MCA I-SEMESTER
(20MC1HS31) COMMUNICATIVE ENGLISH LAB

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
50	50	100	-	-	3	1.5

PRE REQUISITE: --

COURSE DESCRIPTION:

Just a Minute, Elocution/Impromptu; Phonetics; Vocabulary Building; Grammar; Giving Directions; Role Plays; Public Speaking; Letter Writing; Describing Objects; Reading Comprehension; Information Transfer; Listening Comprehension

COURSE OUTCOMES:

After successful completion of this course, the student will be able to:

CO1. Demonstrate knowledge of Phonetics by examining and applying sounds of English in vocabulary.

CO2. Analyze the situations and apply appropriate listening, speaking, reading, writing skills for effective communication through grammatical structures.

CO3. Function effectively as an individual and as a member in diverse teams examining and applying public speaking skills through just a minute sessions and role play to communicate effectivelywith the engineering community and society.

***First ten exercises are mandatory among the following:**

LIST OF EXERCISES:

1. **Just a Minute, Elocution/Impromptu**
   Steps to be followed, Useful tips, Do's & Don'ts, Preparation, Examples**.**

2. **Phonetics**
   Sounds of English, Consonants, Vowels, Speech Organs, Phonetic Transcription, Word Accent, Basics of Intonation.

3. **Vocabulary Building**
   Prefixes & Suffixes, Synonyms & Antonyms, Phrasal verbs, Idioms, One word substitutes, Words often confused.

4. **Grammar**
   Tenses, Nouns, Word order and error correction.

5. **Giving Directions**
   Useful phrases, Sample conversations, Exercises.

6. **Role Plays**
   Useful tips, Do's and Don'ts, Exercises, Role Plays for practice.

7. Public Speaking
Stage presence, Voice control, Body Language, Rehearsals, Audience, Delivery, Do's and Don'ts, Project Submission.

8. Letter Writing

Introduction, Objective, Formats, Types, Exercises.

9. Describing Objects
Jargon, Useful Phrases,Do's and Don'ts, Exercises.

10. Reading Comprehension
Introduction, Types of listening, Practice, Benefits of listening, Exercises.

11. Information Transfer
Tables, Pie-Charts, Venn Diagrams, Graphs, Flow Charts, Steps to be followed, Exercises.

12. Listening Comprehension
Introduction, Types of reading, Inferring, Critical analysis, Exercises.

TEXT BOOK:

1. Communicative English Lab Manual, SVEC, 2019.

REFERENCE BOOKS:

1. D. Sudha Rani, "*A Manual for English Language Laboratories*," Pearson, Noida, 2010.
2. Nira Kumar, "*English Language Laboratories*," PHI Learning Pvt. Ltd., New Delhi, 2011.

SUGGESTED SOFTWARES:

1. SoftX
2. Speech Solutions
3. English Pronunciation Dictionary by Daniel Jones
4. Learning to Speak English 8.1, The Learning Company – 4 CDs.
5. Mastering English: Grammar, Punctuation and Composition.
6. English in Mind, Herbert Puchta and Jeff Stranks with Meredith Levy, Cambridge.
7. Dorling Kindersley Series of Grammar.
8. Language in Use 1, 2 and 3
9. Cambridge Advanced Learner's Dictionary - 3rd Edition
10. Centronix – Phonetics
11. Let's Talk English, Regional Institute of English South India.

ADDITIONAL LEARNING RESOURCES:

1. https://goo.gl/IjE45p: Amazon India site – with thousands of different product descriptions.
2. https://goo.gl/3ozeO6: 15 ways to calm your nerves before giving a presentation.
3. https://goo.gl/p20ttk: useful site for more language about introducing yourself.
4. https://goo.glsvMHZ1: information and advice about describing line graphs
5. https://goo.gl/NqFJuc: an informative presentation about using line graphs

MCA I-SEMESTER
(20MC10131) DATABASE MANAGEMENT SYSTEMS LAB

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
50	50	100	-	-	3	1.5

PRE-REQUISITES: --

COURSE DESCRIPTION:

Creation of Data Definition commands; Implementation of Data Manipulation Commands; Table level and Column level Constraints; Construction of ER diagrams; Implementation of GROUP BY, HAVING, ORDER By clause; Creation and dropping of Views; Implementation of Nested Queries; Joins; Cursors; Functions; Procedures and Triggers.

COURSE OUTCOMES:

After successful completion of this course, the student will be able to:

CO1. Analyse University, Bank, Library and College database applications to identify the Relations, necessary integrity constraints in creating an optimal relational database system.

CO2. Design and implement Entity Relationship diagrams, Relational schemas, table and column level constraints, simple SQL queries to find solutions of real time database applications.

CO3. Use SQL language to create Nested Queries, Joins, Views, Group functions in updating and managing the relational database system.

CO4. Select and apply Cursors, Triggers, Functions and procedures to develop Relational Database applications using PL/SQL language.

CO5. Work independently and in ~~a~~ teams to solve problems with effective communication.

CO6. Write and present a technical report/ document effectively.

LIST OF EXERCISES:

1. Creation of DDL Commands

Consider the following relation schemas:

a)**Client_master**(Client_no, Name, Address1, Address2, City, State, Pincode, Bal_due)

b)**Product_master**(Product_no, Description, Unit_measure, Qty_on_hand, Record_lvl, Sell_price, Cost_price)

c)**Salesman_master**(Salesman_id, Name, Address1, Address2, City, State, Pincode, Sal_amt, Target_amt, Remarks)

Create the above tables, insert suitable tuples and perform the following DDLoperations (CREATE, ALTER, DROP, RENAME, TRUNCATE) in Oracle SQL.

2. Creation of DML Commands

Using the tables client master and product master implement the following Queries.

i. Change the selling price of '1.44 floppy drive to Rs.1150.00

ii. Delete the record with client 0001 from the client master table.

iii. Change the city of client_no'0005' to Bombay.

iv. Change the bal_due of client_no '0001, to 1000.

v. Find the products whose selling price is more than 1500 and also find the new selling price as original selling price *15.

vi. Find out the clients who stay in a city whose second letter is a.

vii. Find out the name of all clients having 'a' as the second letter in their names.

viii. List the products in sorted order of their description.

ix. Count the total number of orders

x. Calculate the average price of all the products.

xi. Calculate the minimum price of products.

xii. Determine the maximum and minimum prices . Rename the tittle as 'max_price' and min_price respectively.

xiii. Count the number of products having price greater than or equal to 1500.

3. Creation of Table level and Column level Constraints

Implement table level and column level constraints like Domain Integrity constraints (NOT NULL, CHECK), Entity integrity constraints (UNIQUE, PRIMARRY KEY) and Referential integrity constraints (FOREIGN KEY) for the below tables.

a) Create table **Salesman_master** with the following columns and constraints-

Column name	Data type	Size	Attributes
Salesman_no	Varchar2	6	Primary key/first letter must start with 's'
Sal_name	Varchar2	20	Not null
Address	Varchar2	20	Not null
City	Varchar2	20	
State	Varchar2	20	
Pincode	Number	6	
Sal_amt	Number	8,2	Not null, cannot be 0
Tgt_to_get	Number	6,2	Not null, cannot be 0
Ytd_sales	Number	6,2	Not null, cannot be 0
Remarks	Varchar2	30	

b) Create table **sales_order** with following columns and constraints

Column name	Data type	Size	Attributes
S_order_no	Varchar2	6	Primary/first letter must be 0
S_order_date	Date	6	Primary key reference client_no of client_master table
Client_no	Varchar2	25	
Dely_add	Varchar2	6	
Salesman_no	Varchar2	6	Foreign key references salesman_no of salesman_master table
Dely_type	Char	1	Delivery part(P)/full(F),default F
Billed_yn	Char	1	
Dely_date	Date		Can not be lessthans_order_date
Order_status	Varchar2	10	Values ('In Process';'Fulfilled';Back Order';Canceled

c) Create table **sales_order_details** with following columns and constraints

Column name	Data type	Size	Attributes
S_order_no	Varchar2	6	Primary key/foreign key references s_order_no of sales_order
Product_no	Varchar2	6	Primary key/foreign key references product_no of product_master
Qty_order	Number	8	
Qty_disp	Number	8	
Product_rate	Number	10,2	

4. Construction of ER diagram

a) Construct an ER diagram for a **University** database application. Identify the Relations and include necessary integrity constraints.

Problem: An University has many departments, where each department has multiple Instructors. An Instructor belongs to only one department. Each department offers multiple Courses, each of which is taught by a single Instructor. A student may enroll for many courses offered by the department.

For the above problem create the following:

i. Analyze the date required

ii. Normalize the attributes

iii. Create the logical data model (ER diagram)

a) Construct an ER diagram for a **Banking Database** by considering the following set of requirements that is used to keep track of Customer.

Problem:

i. Each bank has a unique name.
ii. Each branch has a number, name, address (number, street, city), and set of phones.
iii. Customer includes their name, set of address (P.O. Box, city, zip code, country), set of phones, and social security number.
iv. Accounts have numbers, types (e.g. saving, checking) and balance. Other branches might use the same designation for accounts. So to name an account uniquely, we need to give both the branch number to which this account belongs to and the account number.
v. Not all bank customers must own accounts and a customer may have at most 5 accounts in the bank.
vi. An account must have only one customer.
vii. A customer may have many accounts in different branches.

5. Group functions: Implement queries using Aggregate functions, GROUP BY, HAVING, ORDER By clause and Creation, dropping of Views for the above tables using SQL.

6. Sub queries: Implement queries using SUBQUERIES for the above tables using SQL.

7. Joins: Implement queries using JOINS and OUTER JOINS for the above tables using SQL.

PL/SQL PROGRAMS:

8. Implement the following PL/SQL programs using control statements

a) Check whether the given input is prime or not.
b) Find the factorial of a given number.
c) Check whether the given input is character or number or symbol.
d) Find the reverse of a given number.

9. Write A PL/SQL Program to display all the details of Employee using %Rowtype.

10. PL/SQL **CURSOR** program: Write a PL/SQL program for generation of Electricity Bill using CURSORS.

Note: *Create a table for Electricity bill consists of Customer_no, Customer_name, Customer_type, Prev_met_read, Curr_met_read, Month_name. Assume there are three Customer types namely Industrial, Agriculture and Domestic. Calculate the total charges based on the type of customer.*

11. Triggers

Generate a database trigger to update the salary of an employee before/after performing any DML operations.

12. Procedures and Functions

a) Write a procedure which takes the department_id as an input parameter and lists the names of all employees belonging to that department.

b) Write a PL/SQL block of code that lists the highest salary drawn by an employee in each of the departments. It should make use of a function dept_highest which return the highest salary drawn by an employee for the given department.

Mini Project 1: Consider the following schema for a **Library Database:**

BOOK(Book_id, Title, Publisher_Name, Pub_Year)

BOOK_AUTHORS(Book_id, Author_Name)

PUBLISHER(Name, Address, Phone)

BOOK_COPIES(Book_id, Branch_id, No-of_Copies)

BOOK_LENDING(Book_id, Branch_id, Card_No, Date_Out, Due_Date)

LIBRARY_BRANCH(Branch_id, Branch_Name, Address)

Implement the following SQL queries to :

1. Retrieve details of all books in the library – id, title, name of publisher, authors, number of copies in each branch, etc.
2. Get the particulars of borrowers who have borrowed more than 3 books, but from Jan 2017 to Jun 2017.
3. Delete a book in BOOK table. Update the contents of other tables to reflect this data manipulation operation.
4. Partition the BOOK table based on year of publication. Demonstrate its working with a simple query.
5. Create a view of all books and its number of copies that are currently available in the Library.

Mini Project 2: Consider the schema for **College Database**:

STUDENT(USN, SName, Address, Phone, Gender)

SEMSEC(SSID, Sem, Sec)

CLASS(USN, SSID)

SUBJECT(Subcode, Title, Sem, Credits)

IAMARKS(USN, Subcode, SSID, Test1, Test2, Test3, FinalIA)]

Implement the following SQL queries to:

1. List all the student details studying in fourth semester 'C' section.
2. Compute the total number of male and female students in each semester and in each section.
3. Create a view of Test1 marks of student USN '1BI15CS101' in all subjects.
4. Calculate the FinalIA (average of best two test marks) and update the corresponding table for all students.
5. Categorize students based on the following criterion: If FinalIA = 17 to 20 then CAT = 'Outstanding' If FinalIA = 12 to 16 then CAT = 'Average' If FinalIA< 12 then CAT = 'Weak' Give these details only for 8th semester A, B, and C section students.

REFERENCE BOOKS:

1. Ivan Bayross, *"SQL, PL/SQL The Programming Language of ORACLE,"* BPB Publications, 2010.
2. Dr. P. S. Deshpande, "*SQL & PL/SQL for Oracle 10g Black Book*," Dreamtech Press, 2011.
3. J. J. Patrick, "*SQL Fundamentals,"* Pearson Education, 3rd Edition, 2008.
4. Rick F. Vander Lans*,"Introduction to SQL,"* Addison-Wesley Professional, 4th Edition, 2006.

ADDITIONAL LEARNING RESOURCES:

1. http://plsql-tutorial.com
2. http://k.web.umkc.edu/kumarv/cs471/oracle-arch.htm
3. http://www.computer.org
4. http://www.dbpd.com
5. http://www.dmreview.com
6. http://www.oracle.com/oramag/

MCA I- SEMESTER
(20MC10132) DATA STRUCTURES AND PYTHON PROGRAMMING LAB

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
50	50	100	-	-	3	1.5

PRE-REQUISITES:

Courses on Data Structures and Algorithms and Python Programming.

COURSE DESCRIPTION:

Implementation of Data Structures; Hands on practice – Scripting using Python Programming constructs; Conditional statements; Loops; Text Files; Lists; Dictionaries; Strings; Functions; GUI.

COURSE OUTCOMES:

After successful completion of the course, students will be able to:

CO1. Demonstrate python programming constructs, data types, control structures, expressions, objects, lists, dictionaries, tuples, strings, event, exception handling and Data Structures to solve computational problems.

CO2. Identify and analyse classes, functions, modules, algorithms to solve searching and sorting problems.

CO3. Design and develop GUI based application using tkinter, Python programming and object oriented programming constructs.

CO4. Select and Apply python 3.7.5,C, C++, Java, Anaconda Navigator, Jupyter notebook, notepad++ to solve problems.

CO5. Work independently or in a team to solve problems with effective Communication.

CO6. Write and present a technical report/ document effectively.

LIST OF EXERCISES:

1. Write a program to implement stack and queue.
2. Write a program to implement Singly linked list.
3. Write a program to perform the following searching operations:
   a) Linear search b) Binary search.
4. Write a program to implement the following sorting algorithms:
   a) Bubble Sort b) Quick Sort c) Merge Sort
5. Write a program to create Binary Search Tree and perform operations on it.
6. Write a program to implement prim's algorithm.
7. a) Write a python script to display Fibonacci sequence of numbers using while loop, for loop and do-while loop constructs.
   b) Write a python script to demonstrate string methods.

8. a) Write a python script to find GCD of two numbers using recursive and non recursive functions.

b) Write a python script to convert the following using functions:

(i) Fahrenheit to Celsius temperature.

(ii) Celsius to Fahrenheit temperature.

9. a) Write a python script to draw a square using set position method in absolute positioning.

b) Write a python script to draw a triangle using left, right and Forward methods in relative positioning.

c) Write a python script using penup and pendown methods to draw "W" character using turtle graphics.

d) Write a python script to create your own polygon shape and create an interesting design with it.

10.a) Write a GUI Script for creating text label in a window.

b) Write a Python Script to create a command button. When the button is clicked the event should be handled and the message on the window should change from "Hello" to "Good Bye".

11.a) Write a python script to demonstrate the Exception Handling.

b) Write a Python script to demonstrate the Mouse and Key Event handling.

12. Write a python script to demonstrate menu driven applications.

Note: Exercises from 1 to 6 can be implemented using C/C++/Java language.

REFERENCE BOOKS:

1. Richard F.Gilberg and Behrouz A. Forouzan, "*Data Structure: A Pseudo code Approach with C,*" Thomson India Edition, 2nd Edition, 2007.
2. Charles Dierbach, "*Introduction to Computer Science using Python: A Computational Problem-Solving Focus,"* Wiley India Edition, 2016.
3. Mark Lutz, "*Programming Python,"* O'Reilly Publications, 4th Edition, 2011.

Software / Tools Used:

C/C++/Java,Notepad++, Jupyter notebook, Tkinter, python 3.7.5, anaconda navigator

ADDITIONAL LEARNING RESOURCES:

1. https://www.coursera.org › Browse › Computer Science › Algorithms
2. https://nptel.ac.in/courses/106102064
3. https://nptel.ac.in/courses/106103069
4. https://nptel.ac.in/courses/106102064/24
5. https://swayam.gov.in/course/235-data-structure
6. https://docs.python.org/3/tutorial/
7. https://pythonprogramming.net/introduction-to-python-programming/

MCA I- SEMESTER
(20MC1AC01) SOFTWARE ENGINEERING

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
-	-	-	2	-	-	-

PRE-REQUISITES: --

COURSE DESCRIPTION:

Software Engineering, Process Models, Agile Development, Requirements Modeling; Design Concepts, Architectural and Component-Level Design; User Interface Design, Metrics for Process and Products, Testing Strategies and Risk Management.

COURSE OUTCOMES:

After successful completion of this course, the student will be able to:

CO1. Understand the concepts of Software engineering, Requirements Engineering, Process models, Data Modeling and Design.

CO2. Analyze requirements modeling strategies, process and design models, risks and testing strategies to develop an application software.

CO3. Use design principles, user interface design rules, Architecture Styles, Architectural Design, component-level design and metrics to design and develop a quality software product.

DETAILED SYLLABUS:

UNIT I - SOFTWARE AND SOFTWARE ENGINEERING, PROCESS MODELS AND AGILE DEVELOPMENT (6 Periods)

Software and Software Engineering: Nature of Software, Unique Nature of WebApps, Software Engineering

Process Models: Generic Process Model, Prescriptive Process Models, Specialized Process Models: Water fall Model, incremental Model, Evolutionary Model; Agile Development process.

UNIT II - REQUIREMENTS MODELING (6 Periods)

Requirements Modeling: Requirements Engineering, Requirements Analysis, Scenario-Based Modeling, Data Modeling Concepts, Class-Based Modeling, Flow-Oriented Modeling, Creating a Behavioral Model.

UNIT III- DESIGN CONCEPTS (6 Periods)

Design Concepts: Design with Context of Software Engineering, Design Process, Design Concepts, Design Model, Software Architecture, Architecture Styles, Architectural Design.

UNIT IV- COMPONENT-LEVEL AND DESIGN USER INTERFACE DESIGN (6 Periods)

Component-Level Design: Component, Designing Class-Based Components, Conducting Component-level Design.

User Interface Design: Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps.

UNIT V - TESTING STRATEGIES AND RISK MANAGEMENT (6 Periods)

Testing Strategies: Strategic approach to software testing, test strategies for conventional software, Validation testing, System testing, Black-box testing and White-box testing.

Metrics for Process and Products: Software measurement and metrics for software quality.

Risk management: software risks, Risk identification, Risk projection, Risk refinement, RMMM, RMMM plan.

Total Periods: 30

TEXT BOOKS:

1. Roger S. Pressman, "*Software engineering A practitioner's Approach*", Tata Mc-Graw Hill International Education, 7th Edition, 2016.
2. Ian Sommerville, "*Software Engineering,*" Pearson, 9th Edition, 2011.

REFERENCE BOOKS:

1. Rajib Mall, "*Fundamentals of Software Engineering*", PHI, 5th Edition, 2018.
2. Hans Van Vliet, "*Software Engineering: Principles and Practices",* Willey Publications, 3rd Edition,2010.

ADDITIONAL LEARNING RESOURCES:

https://nptel.ac.in/courses/106101061

MCA II – SEMESTER
(20MC2HS01)FINANCIAL AND MANAGEMENT ACCOUNTING

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	-	-	4

PRE REQUISITE:-

COURSE DESCRIPTION: Accounting concepts, Principles of accountancy, Types of accounts, Journal, Ledger and Trial Balance; Trading account, Profit and Loss account, Balance sheet, Computerized Accounting; Ratio analysis, Types of ratios, Financial analysis through ratios; Break - Even – Analysis, Decision making by using BEA, Capital budgeting techniques.

COURSE OUTCOMES:

After successful completion of the course, students will be able to:

CO1. Demonstrate the concepts of Financial Accounting in preparation of Financial Statements.

CO2. Analyze and interpret the financial data using Ratio Analysis, Break-Even Analysis and CapitalBudgeting Techniques for the decision-making of an Organization.

DETAILED SYLLABUS:

UNIT I- ACCOUNTING (11 Periods)

Meaning and Definition - Objectives – Functions – **Principles of accountancy:** Concepts and Conventions - Double entry system of accounting - Types of accounts – Journal - Ledger and Trial Balance

UNIT II- PREPARATION OF FINANCIAL STATEMENTS (11 Periods)

Trading account - Profit and Loss Account and Balance Sheet (with simple adjustments) – Computerized Accounting – Computerized accounting *Vs.* Manual Accounting - Advantages and Disadvantages –Tally ERP 9.0.

UNIT III- RATIO ANALYSIS (11 Periods)

Ratio Analysis – Advantages and disadvantages of Ratio Analysis –Types of Ratios – Profitability Ratios, Activity Ratios, Liquidity Ratios, Solvency Ratios (Simple Problems)

UNIT IV- BREAK-EVEN-ANALYSIS (11 Periods)

Break-Even-Analysis – Assumptions, Managerial significance of Break-Even-Analysis – Concept of Break Even Point (BEP) – Break-Even Chart –Determination of BEP – Profit/Volume (P/V) ratio – Margin of safety (Simple Problems).

UNIT V- CAPITAL BUDGETING (11 Periods)

Features, Proposals, **Methods of Capital Budgeting:** Payback Period Method – Accounting Rate of Return (ARR) – Time value of money – Net Present Value Method (NPV) – Profitability Index (PI) – Internal Rate of Return (IRR) (Simple problems)

Total Periods: 55

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Tyagi, C.L. and MadhuTyagi, "*Financial and Management Accounting*," Atlantic Publishers and Distributors, New Delhi, 2016.

2. Madhuvij, "*Financial and Management Accounting*," Anmol Publishers New Delhi, 11th Edition, 2018.

REFERENCE BOOKS:

1. Pauline Weetman, "*Financial and Management Accounting – An Introduction*," Financial Times Prentice Hall, New Delhi, 4th edition, 2014.

2. Jain, S.P. and Narang, K.L., "*Financial Accounting*," Kalyani Publishers, Ludhiana, 2th Edition, 2016.

MCA II – SEMESTER
(20MC20101) DATA WAREHOUSING AND DATA MINING

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	-	-	4

PREREQUISITES:

A Course on Database Management Systems.

COURSE DESCRIPTION:

Data Warehouse Components; Building Data Warehouse; Data mining; Data Preprocessing; Association Rule Mining; Classification and Clustering techniques; Mining different types of data and its Applications.

COURSE OUTCOMES:

After successful completion of this course, the student will be able to:

CO1. Design and develop data warehouse architecture, multidimensional schemas to perform business analysis using OLAP tools.

CO2. Select and apply association rule mining and classification algorithms to identify the frequent patterns and predictions effectively.

CO3. Apply Clustering algorithms on pre-processed datasets to find solutions of real time applications.

CO4. Analyse data pre-processing methods and data mining functionalities to mine text, multimedia, web and spatial data to discover knowledge.

DETAILED SYLLABUS:

UNIT I- DATA WAREHOUSE COMPONENTS (11 periods)

Data Warehouse Components: Data Warehousing, Paradigm Shift, Business Problem Definition, operational and informational Data Stores, Data Warehouse Definition and Characteristics, A Multi-tiered Data Warehouse Architecture. Meta data, data marts, Data Warehouse Administration and Management, Benefits of Data Warehousing, Multidimensional Data Model-From tables and spread sheets to Data Cubes and Star, Snowflake and fact constellation Schemas, Role of Concept hierarchies, Measures, OLAP Operations, From online Analytical processing to Multidimensional Data Mining.

UNIT II- DATA MINING AND DATA PREPROCESSING (11 periods*)*

Data Mining: Motivated Data Mining, Kinds of Data, Data mining Functionalities, classification of Data mining systems, Data mining primitives, Integration of Data mining Systems with a Database or Data Warehouse System, Major issues in Data Mining.

DATA PREPROCESSING: Need for Pre-processing the Data, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation.

UNIT III- ASSOCIATION RULE MINING AND CLASSIFICATION (12 periods)

Association Rule Mining: Basic Concepts, The Apriori algorithm for finding frequent itemsets using candidate generation, generating association rules from frequent itemsets, Mining frequent itemsets without candidate generation.

Classification: Classification, issues in classification and prediction, Classification by Decision Tree Induction, Bayesian Classification, Rule-based classification, Prediction: Linear Regression, Accuracy and Error measures, evaluating the accuracy of a classifier or predictor, bagging and boosting.

UNIT IV- CLUSTER ANALYSIS (11 periods)

Clustering: Cluster Analysis**,** Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Partitioning methods - k-means and k-mediods methods, CLARANS, Hierarchical Methods**-**Agglomerative and divisive hierarchical clustering, Density-Based Method-DBSCAN, Grid-Based Method-STING, Outlier Analysis.

UNIT V- MINING DIFFERENT TYPES OF DATA AND ITS APPLICATIONS

(10 periods)

MINING DIFFERENT TYPES OF DATA: Multimedia Data Mining, Text Mining - Text data analysis and informational retrieval, text mining approaches, Spatial Mining, Mining the World Wide Web- Mining web page layout structure, Mining web's link structures, Web usage mining.

Data Mining Applications: Financial data Analysis, Retail Industry, Telecommunication Industry.

Total Periods: 55

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Jiawei Han, Micheline Kamber and Jian Pei, Data Mining: Concepts and Techniques, Elsevier, 3rd Edition, 2013.
2. Berson Alex and Stephen J Smith, *"Data Warehousing, Data Mining and OLAP,"* Tata McGraw-Hill, 2004.

REFERENCE BOOKS:

1. Ralph Kimball, Margy Ross, Warren Thornthwaite and Joy Mundy, Bob Becker, *"The Data Warehouse Life cycle Tool kit,"* John Wiley and Sons Inc, 2nd Edition, 2007.

2. William H Inmon, *"Building the Data Warehouse,"* John Wiley and Sons Inc, 4th Edition, 2005.

3. Arun K Pujari, *"Data Mining Techniques,"* Universities Press (India) Pvt. Ltd, 2nd Edition, 2001.

4. G. K. Gupta, *"Introduction to Data Mining with Case Studies,"* Easter Economy Edition, Prentice Hall of India, 2006.

ADDITIONAL LEARNING RESOURCES:

1. https://nptel.ac.in/courses/106/105/106105174/
2. https://www.youtube.com/watch?v=vuc93jbO2Dw.
3. Data Mining - Concepts and Techniques (3rd edition) by Jiawei Han, Micheline Kamber and Jian Pei.
4. Tutorial on Data Mining Algorithms by Ian.
5. *Mining of Massive Datasets* by Anand Rajaraman and Jeff Ullman.
6. Open source tools for data mining: http://eprints.fri.uni-lj.si/893/1/2008-OpenSource DataMining.pdf

MCA II-SEMESTER
(20MC20102) OBJECT ORIENTED PROGRAMMING THROUGH JAVA

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	-	-	4

PREREQUISITES:

A course on Data Structures and Alogorithms.

COURSE DESCRIPTION:

Principles of Object Oriented Programming; Representation of Java Classes and methods; Inheritance and Polymorphism using Java, Creation of Packages and Interfaces; Implementation of Utility Classes and Input/output; Exception handling mechanism and multithreading; Event handling techniques; GUI applications by using AWT and Swings.

COURSE OUTCOMES:

After successful completion of this course, the student will be able to:

CO1. Understand the Object Oriented Programming Principles to develop java programs.
CO2. Design and develop user defined classes using packages and interfaces.
CO3. Use advanced java programming concepts AWT, Swings and applets to develop complex user interface applications.
CO4. Analyze Inheritance, Exception Handling mechanisms for implement applications.

DETAILED SYLLABUS:

UNIT I - JAVA PROGRAMMING (10 Periods)

Java Programming: Java Buzzwords, Object-Oriented Programming, Beginner Program, Data Type, Variables, Operators, Control Statements, Arrays; Classes: Class and Objects, Methods, Constructors, this Keyword, Garbage Collection, finalize Method; Overloading Methods, Access Control, static Keyword, final Keyword, Nested and Inner Classes, String Class.

UNIT II - INHERITANCE AND POLYMORPHISM (11 Periods)

Inheritance and Polymorphism: Inheritance, super, Multilevel Hierarchy, Method Overriding, Dynamic Method Dispatch, Abstract Classes, Final with Inheritance, Object Class.

Packages and Interfaces: Packages, Access Protection, Importing Packages; Interfaces: Interface, Implementing Interfaces, Nested Interfaces, Applying Interfaces, Variables in Interfaces.

UNIT III - UTILITY CLASSES AND INPUT/OUTPUT (11 Periods)

Utility Classes: Java Collections, Java Collection Frame Work, Collection Interfaces: Set, List, Queue, Map; Collection Classes: Hash Set, LinkedHashSet, SortedSet, Linked List, Stack, Array List, Vector, Hash table; Iteration over Collections: Iterator Interface, Comparator Interface, ListIterator Interface and Enumeration Interface; StringTokenizer, Date, Calendar, Random, Formatter, Scanner.

Input/output: Stream Classes: Byte Streams, Character Streams, Console Class, Stream I/O, Serialization.

UNIT IV - EXCEPTION HANDLING AND MULTITHREADING (11 Periods)

Exception Handling: Exception Handling, Exception Types, Uncaught Exceptions, try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java's Built-in Exceptions, User defined Exceptions, Exception Subclasses, Chained Exceptions.

Multithreading: Java Thread Model, Thread life Cycle, Main Thread, Threads, Multiple Threads, Thread Priorities, Synchronization, Interthread Communication, Suspending, Resuming and Stopping Threads.

UNIT V - EVENT HANDLING AND GUI PROGRAMMING WITH JAVA (12 Periods)

Event Handling: Delegation Event Model, Event Classes, Sources of Events, Event Listener Interfaces.

JDBC: performing insert, update, and search operations using JDBC,

GUI Programming with Java: Abstract Window Toolkit (AWT): AWT Classes, Windows, Working with Frame Windows, Graphics and Color, AWT Controls: Labels, Buttons, Check Boxes, Lists, Scroll Bars, Text Field, Text Area, Layout Managers; Applets: Applet, Applet Architecture, Applet Skeleton, Applet Display Methods, Passing Parameters to Applets.

Swings: Swings, Hierarchy of Swing Components, JFrame, JWindow, JDialog, JPanel ; Swing Components: JLabel, JTextField, JButton, JToggleButton, Check Boxes, Radio Buttons, JTabbedPane, JScrollPane, JList, JComboBox, Trees, JTable.

Total Periods: 55

Topics for self-study are provided in the lesson plan.

TEXT BOOK:

1. Herbert Schildt, "*The Complete Reference Java*", Tata McGraw-Hill, 10th Edition, 2017.

REFERENCE BOOKS:

1. B. Eswar Reddy, T. V. Suresh Kumar and P. Ragavan, *"Object Oriented Programming with Java,"* Pearson Sanguine Publications, 2nd Edition, 2011.
2. H. M. Dietel and P. J. Dietel, *"Java How to Program,"* Pearson Education India, 10th Edition, 2016.

ADDITIONAL LEARNING RESOURCES:

1. https://nptel.ac.in/courses/106105191
2. https://javabeginnerstutorial.com/core-java-tutorial
3. https://www.javatpoint.com/java-tutorial

MCA II- SEMESTER
(20MC20103) CRYPTOGRAPHY AND NETWORK SECURITY
(Professional Elective – I)

Int.	Ext.	Total	L	T	P	C
40	60	100	4	-	-	4

PRE-REQUISITES:

A course on Computer Networks.

COURSE DESCRIPTION:

Cryptographic algorithms; Classical Encryption Techniques; Public key and Private key encryption; Security models; Hash Algorithms; E-mail, IP and Web Security; ensuring system security and security over the Internet; Intrusion Detection and Trusted systems.

COURSE OUTCOMES:

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

CO1. Understand Network security model and cryptographic techniques for secure communication.

CO2. Apply Cryptographic techniques to provide security for E-Mail and IP based communication.

CO3. Analyze Cryptographic algorithms and provide solutions for secure data transmission.

CO4. Use web and system security techniques to prevent the data from digital attacks.

DETAILED SYLLABUS:

UNIT I- COMPUTER AND NETWORK SECURITY CONCEPTS AND CLASSICAL ENCRYPTION TECHNIQUES (09 Periods)

Computer Security Concepts, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, Fundamental Security Design Principles, Attack Surfaces and Attack Trees, A Model for Network Security, Standards.

Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques – Caesar Cipher, Monoalphabetic Ciphers, Polyalphabetic Ciphers, Playfair Cipher and Transposition Techniques.

UNIT II- CONFIDENTIALITY USING SYMMETRIC AND ASYMMETRIC CIPHERS (13 Periods)

Block Ciphers and the Data Encryption Standard: Traditional Block Cipher Structure, The Data Encryption Standard (DES), The Strength of DES, Block Cipher Design Principles.

Advanced Encryption Standard and Block Cipher Operation: AES Structure, Multiple Encryption and Triple DES, Electronic Codebook, Cipher Block Chaining Mode, Cipher Feedback Mode, Output Feedback Mode and Counter Mode. Stream Ciphers and RC4,

Placement of Encryption Function, Traffic Confidentiality.

Public-Key Cryptography: Principles of Public-Key Cryptosystems, Public-Key Cryptographic algorithms - The RSA Algorithm, Diffie – Hellman Key Exchange.

Case Study: Implement RSA and Diffie – Hellman Key Exchange algorithms.

UNIT III-CRYPTOGRAPHIC DATA INTEGRITY ALGORITHMS AND MUTUAL TRUST

(14 Periods)

Cryptographic Hash Functions: Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Requirements and Security, Hash Functions Based on Cipher Block Chaining and Secure Hash Algorithm (SHA).

Message Authentication Codes: Message Authentication Requirements, Message Authentication Functions, Requirements for Message Authentication Codes, Security of MACs, MACs Based on Hash Functions: HMAC and MACs Based on Block Ciphers: DAA and CMAC.

Digital Signatures: Digital Signatures, NIST Digital Signature Algorithm.

Key Management and Distribution: Symmetric Key Distribution Using Symmetric Encryption, Symmetric Key Distribution Using Asymmetric Encryption, Distribution of Public Keys, X.509 Certificates and Public-Key Infrastructure.

User Authentication: Remote User – Authentication Principles, Kerberos, Federated Identity Management, Personal Identity Verification.

Case Study: To check the integrity of files in a system using any open source security algorithm.

UNIT IV- ELECTRONIC MAIL SECURITY AND IP SECURITY (09 Periods)

Electronic Mail Security: Email Threats and Comprehensive Email Security, S/MIME and Pretty Good Privacy (PGP).

IP Security: IP Security Overview, IP Security Policy, Authentication Header (AH), Encapsulating Security Payload (ESP), Combining Security Associations and Internet Key Exchange.

UNIT V- WEB SECURITY AND SYSTEM SECURITY (10 Periods)

Transport-Level Security: Web Security Considerations, Secure Socket Layer and Transport Layer Security, Secure Electronic Transaction.

System Security: Intruders, Intrusion Detection systems, Viruses and Related Threats, Virus Countermeasures, Firewall Design Principles, Trusted Systems.

Case Study: A study on Challenges to mitigate security risks associated with digital Payments.

Total Periods: 55

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. William Stallings, "*Cryptography and Network Security (Principles and Practice)*", Pearson Education, 7th Edition, 2020.
2. William Stallings, "*Cryptography and Network Security*", Pearson Education, 4th Edition, 2009.

REFERENCE BOOKS:

1. William Stallings, "*Network Security Essentials (Applications and Standards)*", Pearson Education, 3rd Edition, 2009.
2. Bernard L. Menezes, Ravinder Kumar, "*Cryptography, Network Security and Cyber Laws*", Cengage Learning, 2019.
3. Behrouz A. Forouzan, "*Cryptography and Network Security*", Tata McGraw-Hill, 2007.

ADDITIONAL LEARNING RESOURCES:

1. https://nptel.ac.in/courses/106/105/106105031/ lecture by Dr. Debdeep Mukhopadhyay, IIT Kharagpur
2. https://www.udemy.com/introduction-to-cryptography-online-course-rahsoft-crypto-certificate/ by Dr. Sourabh Prakash Head of Rahsoft Cyber Security and Cryprography Department
3. https://www.coursera.org/learn/asymmetric-cryptography offered by university of Colorado
4. https://www.khanacademy.org/computing/computer-science/cryptography- Journey into Cryptography.

MCA II - SEMESTER
(20MC20104) **M-COMMERCE**
(Professional Elective-I)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	-	-	4

PRE-REQUISITES:

Courses on Database Management Systems and Computer Networks.

COURSE DESCRIPTION:

Electronic Commerce; E-Commerce applications and web; Process models; Electronic payment systems; Mobile Commerce; Wireless/wired Commerce; Framework for the study of Mobile Commerce; NTT Docomo's I–Mode; Classification framework for Mobile Location Based Services; Mobile Data Technologies and Small Business Adoption And Diffusion; M–Commerce business models.

COURSE OUTCOMES:

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

CO1. Understand E-Commerce concepts, electronic payment systems, architectures/ Frameworks /Mercantile models used for E-Commerce applications.

CO2. Identify and analyze wireless technologies, mobile data technologies used for developing M-Commerce applications.

CO3. Analyze M-Commerce applications, framework of M-Commerce, technologies of wireless business to design business models.

CO4. Apply marketing business model, advertising business model and MMS, SMS for mobile commerce applications in marketing and advertising to Customers.

CO5. Commit to code of ethics and cyber regulations to design electronic payment systems, mobile business services of E-commerce and M-commerce applications.

DETAILED SYLLABUS:

UNIT I– ELECTRONIC COMMERCE (11 periods)

Electronic Commerce: Electronic Commerce Framework, anatomy of E-Commerce applications, E-Commerce Consumer applications, E-Commerce Organization Applications. **Electronic commerce and World Wide Web:** Architectural Framework for E-Commerce, WWW as the Architecture, Technology behind the Web, Security and the Web.

UNIT II – CONSUMER ORIENTED ELECTRONIC COMMERCE (12 periods)

Consumer Oriented Electronic commerce: Mercantile Process models, Mercantile Models from Consumer's Perspective, Mercantile Models from Merchant's Perceptive.

Electronic payment systems: Types of Electronic Payment Systems: Digital Token-Based, Smart Cards, Credit Cards, Risks and Electronic Payment systems, Designing Electronic payment System.

UNIT III – MOBILE COMMERCE (10 periods)

Mobile Commerce: Infrastructure of M–Commerce, Types of Mobile Commerce Services, Technologies of Wireless Business, Benefits and Limitations, Support, Mobile Marketing and Advertisement, Non– Internet applications in M–Commerce, Wireless/Wired Commerce comparisons.

UNIT IV – MOBILE COMMERCE TECHNOLOGY (10 periods)

A framework for the study of Mobile Commerce, NTT Docomo's I– Mode, Wireless devices for Mobile Commerce, Classification framework for Mobile Location Based Services, Wireless personal and Local Area Networks, the impact of technology advances on strategy formulation in mobile communications networks.

UNIT V – MOBILE COMMERCE THEORY AND APPLICATIONS (12 periods)

The Ecology of Mobile Commerce, the Wireless Application Protocol, Mobile Business Services, Mobile Portal, factors influencing the adoption of Mobile Gaming Services, Mobile Data Technologies and Small Business Adoption and Diffusion, M–Commerce in the automotive industry, Location– Based services, Criteria for adoption and solution deployment, the role of Mobile advertising in building a brand, M–Commerce business models.

Total Periods: 55

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Ravi Kalakota, B. Andrew Whinston, "*Frontiers of Electronic Commerce,*" Pearson Education, 2003.
2. E. Brian Mennecke, J. Troy Strader, "*Mobile Commerce: Technology, Theory and Applications,*" Idea Group Inc., IRM press, 2003.

REFERENCE BOOKS:

1. P. J. Louis, "*M-Commerce Crash Course,*" McGraw- Hill Companies February 2001.

2. Paul May, "*Mobile Commerce: Opportunities, Applications, and Technologies of Wireless Business,*" Cambridge University Press March 2001.

ADDITIONAL LEARNING RESOURCES:

1. https://www.edx.org/learn/ecommerce
2. https://www.coursera.org/learn/digital-business-models
3. https://www.udemy.com/topic/e-commerce/
4. https://www.oxfordhomestudy.com/courses/online-management-courses/e-commerce-online-course

MCA II - SEMESTER
(20MC20105) MULTIMEDIA APPLICATION DEVELOPMENT
(Professional Elective –I)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	-	-	4

PRE-REQUISITES:--

COURSE DESCRIPTION: Multimedia Concepts; Data Representation; Action script Programming Concepts; Dynamic Action Script and Event Handling Mechanism; Video and audio compression Techniques and Multimedia communication and data transmission.

COURSE OUTCOMES:

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

CO1. Understand the concepts of Multimedia, hypermedia, validation of forms and action script programming and Event Handling.

CO2. Design and Develop online media applications using searching of motor vectors and Moving Picture Expert Group (MPEG) techniques for visual design.

CO3. Demonstrate Bitmap Programming, multimedia software tools, graphic software, scanning and digital photography to create original images.

CO4. Analyze image data representation graphics, image data types, file formats, color models in images and color models in videos to design graphics and videos.

CO5. Investigate and solve the compression of audio and video problems using audio and video compression techniques.

CO6. Adapt compression standards, Adaptive Differential Pulse Code Modulations (ADPCM), Vocoders and Linear Predictive Coding (LPC) to develop quality applications.

DETAILED SYLLABUS:

UNIT I- MULTIMEDIA AUTHORING AND DATA REPRESENTATIONS (11 Periods)

Multimedia Authoring and Data Representations: Multimedia and hypermedia, World Wide Web, overview of multimedia software tools. Graphics and image data representation graphics/image data types, file formats, Color in image and video: color science, color models in images, color models in video.

UNIT II- ACTION SCRIPT (11 Periods)

Action Script: Core Concepts, Conditionals and Loops, Instance Methods Revisited, Static Variables and Static Methods, Functions, Inheritance, Compiling and Running a program, Data types and Type Checking, Interfaces.

UNIT III- DISPLAY AND INTERACTIVITY (11 Periods)

Display and Interactivity: Events and Event Handling, Exceptions and Error Handling**,** Dynamic Action Script, Scope**,** Events and Display Hierarchies, Interactivity. Screen Updates, Programmatic Animation, Drawing with Vectors, Bitmap Programming, Text Display and Input.

UNIT IV- BASIC VIDEO COMPRESSION TECHNIQUES (11 Periods)

Basic Video Compression Techniques: Introduction to video compression, video compression based on motion compensation, search for motion vectors, MPEG video coding I- MPEG-1 and 2, Basic Audio Compression Techniques: ADPCM in Speech Coding, G.726 ADPCM, Vocoders, LPC.

UNIT V- MULTIMEDIA COMMUNICATION AND RETRIEVAL (11 Periods)

Multimedia Communication and Retrieval: Computer and Multimedia Networks**:** Basics of Computer and Multimedia Networks, Multiplexing Technologies, LAN and WAN, Access Networks. Multimedia Network Communications and Applications: Quality of Multimedia Data Transmission, Multimedia over IP, Multimedia over ATM Networks, Transport of MPEG-4, Media-On- Demand (MOD).

Total Periods: 55

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Ze-Nian Li, and Mark S. Drew*," Fundamentals of Multimedia"*, Pearson Education,2008.
2. Colin Moock, SPD O, REILLY*, "Essentials ActionScript 3.0"*, 1st Edition, 2007.

REFERENCE BOOKS:

1. Nigel chapman, and jenny chapman, "*Digital Multimedia"*, Wiley-Dreamtech, 2005.
2. Fred Halsall, "*Multimedia Communications: Applications, Networks, Protocols and Standards"*, Pearson Education, 2001.

MCA II - SEMESTER
(20MC20106) **R PROGRAMMING**
(Professional Elective –I)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	-	-	4

PRE-REQUISITES:

Courses on Computer Oriented Statistical Techniques and Object Oriented Programming through JAVA.

COURSE DESCRIPTION: Overview of R; R Data Structures; Vectors; Matrices and Arrays; Lists; Creating Data Frames; Factors and Tables; R Programming Structures; Object-Oriented Programming; Input/output; String Manipulation and Graphics.

COURSE OUTCOMES:

After successful completion of the course students should be able to

- **CO1.** Understand R programming concepts Run R, Interactive Mode, Batch Mode, data structures, R Programming Structures concepts Control Statements, Arithmetic and Boolean Operators and Values.
- **CO2.** Use R tool to perform Vectors, Structures, Data Frames, Factors and Tables for statistical data analysis and modelling.
- **CO3.** Design and develop R programs using Input/output and String Manipulation functions.
- **CO4.** Analyze and apply Graphics functions for visualizing data and model output.
- **CO5.** Select and apply S3 and S4 Classes to develop object oriented programming in R to solve problems.

DETAILED SYLLABUS:

UNIT I- OVERVIEW OF R AND VECTORS (10 Periods)

OVERVIEW OF R: Run R, Interactive Mode, Batch Mode, Basic R Session, Functions, R Data Structures, help() Function, example() Function.

VECTORS: Scalars, Vectors, Arrays, and Matrices, Declarations, Recycling, Common Vector Operations, Vectorized Operations, NA and NULL Values, Filtering.

UNIT II- MATRICES, ARRAYS and LISTS (11 Periods)

MATRICES AND ARRAYS: Creating Matrices, General Matrix Operations, Applying Functions to Matrix Rows and Columns, Adding and Deleting Matrix Rows and Columns.

LISTS: Creating Lists, General List Operations, Accessing List Components and Values, Applying Functions to Lists, Recursive Lists.

UNIT III- DATA FRAMES, FACTORS AND TABLES (11 Periods)

DATA FRAMES: Creating Data Frames, Other Matrix-Like Operations, Merging Data Frames.

FACTORS AND TABLES: Factors and Levels, Common Functions Used with Factors, Working with Tables, Other Factor- and Table-Related Functions.

UNIT IV- R PROGRAMMING STRUCTURES (11 Periods)

R PROGRAMMING STRUCTURES: Control Statements, Arithmetic and Boolean Operators and Values. Default Values for Arguments, Return, Functions Are Objects, No Pointers in R, Recursion, Math Functions, Calculating a Probability, Cumulative Sums and Products, Minima and Maxima, Calculus, Functions for Statistical Distributions, Sorting, Linear Algebra Operations on Vectors and Matrices, Set Operations, Simulation Programming in R.

UNIT V- OBJECT-ORIENTED PROGRAMMING, INPUT/OUTPUT, STRING MANIPULATION AND GRAPHICS (12 Periods)

OBJECT-ORIENTED PROGRAMMING: S3 Classes, S4 Classes, S3 Versus S4, Managing Objects.

INPUT/OUTPUT : Accessing the Keyboard and Monitor, Reading and Writing Files,

STRING MANIPULATION: String-Manipulation Functions- grep(), nchar(), paste(), sprintf(), substr(), strsplit(), regexpr(), gregexpr()

GRAPHICS: Creating Graphs, The plot() Function The abline() Function, The points() Function,The legend() Function, The text() Function, Customizing Graphs, Saving Graphs to Files.

Total Periods: 55

Topics for self-study are provided in the lesson plan.

TEXT BOOK:

1. Norman Matloff, *"The Art of R Programming",* William Pollock, 2011.

REFERENCE BOOKS:

1. Dr. Mark Gardener, "*Beginning R the statistical programming language",* Wiley Publications,2015.
2. Garrett Grolemund *"Hands-On Programming with R"* O'Reilly Media, Inc, 2014.

ADDITIONAL LEARNING RESOURCES:

https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf

MCA II- SEMESTER

(20MC20107) SOFTWARE ARCHITECTURE AND DESIGN PATTERNS

(Professional Elective –I)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	-	-	4

PRE-REQUISITES:
A course on Software Engineering.

COURSE DESCRIPTION:

Design patterns, Catalog of design pattern, object-oriented development, Analysis of System, Creational Patterns, Structural patterns, Interactive systems and MVC Architecture, Designing with Distributed Objects.

COURSE OUTCOMES:

After successful completion of this course, the student will be able to:

- **CO1.** Understand interactive systems, MVC architecture, range of design patterns, code qualities needed to keep code flexible.
- **CO2.** Design system and subsystem with distributed objects and implement codes with higher performance and lower complexity.
- **CO3.** Analyze system design principles and assess the quality of a design with respect to principles.
- **CO4.** Select and apply suitable pattern from design patterns catalog in specific contexts to solve design problems.

DETAILED SYLLABUS:

UNIT-I: DESIGN PATTERNS (11 Periods)

Design patterns: Design Pattern, Catalog of design pattern, organizing the catalog, solve design problems using design patterns, selection of design pattern, use of design pattern; object-oriented development, key concepts of object oriented design, benefits and drawbacks of the paradigm.

UNIT II - ANALYSIS OF SYSTEM (11 Periods)

Analysis of System: Overview of the analysis phase, stage 1: gathering the requirements functional requirements specification, defining conceptual classes and relationships, using the knowledge of the domain; Design and Implementation, discussions and further reading.

UNIT III- DESIGN PATTERN CATALOG (11 Periods)

Design Pattern Catalog: Creational Patterns: Abstract factory, Builder, Factory method, Prototype, Singleton; Structural patterns: Adapter, bridge, composite, decorator, facade, flyweight, proxy.

UNIT IV- INTERACTIVE SYSTEMS AND THE MVC ARCHITECTURE (11 Periods)

Interactive systems and the MVC Architecture: Introduction, The MVC architectural pattern, analyzing a simple drawing program, designing the system, designing of the subsystems, getting into implementation, implementing undo operation, drawing incomplete items, adding a new feature, pattern based solutions.

UNIT V - DESIGNING WITH DISTRIBUTED OBJECTS (11 Periods)

Designing with Distributed Objects: Client server system, java remote method invocation, implementing an object oriented system on the web a note on input and output, selection statements, loops arrays.

Total Periods: 55

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Brahma Dathan, Sarnath Rammath, *"Object-oriented analysis, design and implementation,"* Universities Press (India) Private Ltd, 2nd Edition, 2015.
2. Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, *"Design patterns,"* Pearson Publication, 2013.

REFERENCE BOOKS:

1. Frank Bachmann, Regine Meunier, Hans Rohnert *"Pattern Oriented Software Architecture,"* Volume 1, 1996.
2. William J Brown et al., "*Anti-Patterns: Refactoring Software, Architectures and Projects in Crisis",* John Wiley, 1998.

ADDITIONAL LEARNING RESOURCES:

1. https://nptel.ac.in/content/storage2/courses/106105087/pdf/m08L18.pdf
2. http://nptelvideos.com/video.php?id=916
3. https://freevideolectures.com/course/2318/software-engineering/15
4. https://www.coursera.org/learn/design-patterns

MCA II-SEMESTER

(20MC20108) **CYBER SECURITY**

(Professional Elective-II)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	-	-	4

PRE-REQUISITES:

A Course on Computer Networks

COURSE DESCRIPTION:

Computer Security and threats, Browser Attacks, Privacy Impacts of Emerging Technologies, Managing the incidents, Computer Forensics technologies and Cyber Crimes, Computer Forensic Evidences and Investigations

COURSE OUTCOMES:

After successful completion of this course, the student will be able to:

CO1. Understand the concepts of Threats, Harm, Vulnerabilities, Computer Forensics Fundamentals and Forensics evidences for providing Cyber Security.

CO2. Analyze Internet of Things, Economics, Electronic Voting, Cyber Warfare and privacy impacts of emerging techniques to identify the critical issues.

CO3. Use Forensic SIM, WinHex and forensic techniques to acquire and verify the evidence.

CO4. Commit ethics of cyber regulations, responsibilities, and norms to manage incidents using privacy principles, policies, Cyber Welfare and International Laws to adapt in cyberspace and follow law of enforcement standards for digital Forensics and crime investigations.

DETAILED SYLLABUS:

UNIT I– CYBER SECURITY (10 periods)

Computer Security, Threats, Harm, Vulnerabilities, Controls, Authentication, Access Control and Cryptography, Web User Side, Browser Attacks, Web attacks Targeting Users, Obtaining User or Website Data, Email Attacks.

UNIT II – PRIVACY IN CYBERSPACE (9 periods)

Privacy Concepts ,Privacy Principles and Policies, Authentication and Privacy, Data Mining, Privacy on the Web, Email Security, Privacy Impacts of Emerging Technologies, Where the Field Is Headed.

UNIT III – MANAGEMENT AND INCIDENTS (12 periods)

Security Planning, Business Continuity Planning, Handling Incidents, Risk Analysis, Dealing with Disaster, Emerging Technologies, The Internet of Things, Economics, Electronic Voting, Cyber Warfare, Cyberspace and the Law, International Laws, Cyber Warfare and Home Land Security.

UNIT IV- COMPUTER FORENSICS TECHNOLOGY AND CYBERCRIME (12 periods)

computer Forensics fundamentals , Use of computer Forensics in Law Enforcement, Computer Forensics Assistance to Human Resources/Employment Proceedings, Computer Forensics Services, Benefits of Professional Forensics Methodology, Steps taken by Computer Forensics Specialists, Types of Military Computer Forensic Technology, Types of Law Enforcement - Computer Forensic Technology, Types of Business Computer Forensic Technology, occurrence of Cybercrime, Cyber Detectives, Cyber Crime with risk management techniques.

UNIT V- COMPUTER FORENSICS EVIDENCE AND TOOLS (12 periods)

Importance of Collecting Evidence, Collection Options, Obstacles, Types of Evidence, The Rules of Evidence, Volatile Evidence, General Procedure, Collection and Archiving, Methods of Collection, Artifacts, Collection Steps, Controlling Contamination- The Chain of Custody; Duplication and preservation of digital evidence- Preserving the digital crime scene; Computer evidence processing steps; Forensic Card Reader, Cell Seizure, MOBILedit, Forensic SIM, WinHex.

Total Periods: 55

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Charles P. Pfleeger Shari Lawrence Pfleeger Jonathan Margulies, *"Security in Computing,"* 5th Edition, Pearson Education, 2015.
2. John R.Vacca, *"Computer Forensics, Computer Crime Scene Investigation",* Firewall Media, 2009.

REFERENCE BOOKS:

1. George K.Kostopoulous, *"Cyber Space and Cyber Security,"* CRC Press, 2013.
2. MarttiLehto, PekkaNeittaanmäki, *"Cyber Security: Analytics, Technology and Automation"*, Springer International Publishing Switzerland, 2015.
3. Bill Nelson, Amelia Phillips, Christopher Steuart, *"Guide to Computer Forensics and Investigations"*, Cengage Learning,*4th* Edition, 2009.
4. Chris Prosise, Kevin Mandia, *"Incident Response and Computer Forensics"*, McGraw-Hill Osborne Media, 2nd Edition, July 2003.
5. EoghanCasey*,"Handbook Computer Crime Investigation's Forensic Tools and Technology",* Academic Press, 2001.

ADDITIONAL LEARNING RESOURCES:

1. https://www.edx.org/course/cyber,security,basics,a,hands,on,approach.
2. https://www.cyberaces.org/courses/
3. https://www.futurelearn.com/courses/introduction,to,cyber,security
4. https://swayam.gov.in/nd2_cec20_cs09/preview

MCA II- SEMESTER
(20MC20109) **MACHINE LEARNING**
(Professional Elective-II)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	-	-	4

PRE-REQUISITES: --

COURSE DESCRIPTION:

Learning problems, designing a learning system, Issues in machine learning, decision tree learning, artificial neural networks, evaluation hypotheses, estimation hypothesis accuracy, bayesian learning and computational learning theory, learning sets of rules and analytical learning, combining inductive and analytical learning, reinforcement learning and Dynamic Programming.

COURSE OUTCOMES:

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

CO1. Understand Machine learning concepts, learning problems, decision tree learning, artificial neural networks and Bayesian learning, computational learning theory and probabilities.

CO2. Select and apply decision tree learning, artificial neural networks algorithms and probabilities to evaluate Learning problem hypothesis of an applications.

CO3. Analyze learning sets of rules, analytical learning of domain theories and inductive analytical approaches of combining inductive to infer insights for learning problems.

CO4. Analyze reinforcement learning, Bayesian learning and computational learning theory to classify and assess results of real time applications.

DETAILED SYLLABUS:

UNIT I- INTRODUCTION TO MACHINE LEARNING (10 Periods)

Well-posed learning problems, Designing a learning system, Perspectives and issues in machine learning; Concept learning and the general to specific ordering , concept learning task, concept learning as search, Find-S: finding a maximally specific hypothesis, Version spaces and candidate elimination algorithm, Remarks on version spaces and candidate elimination, inductive bias.

UNIT II - DECISION TREE LEARNING, ARTIFICIAL NEURAL NETWORKS AND EVALUATION HYPOTHESES (12 Periods)

Decision Tree Learning: Decision tree representation, problems for decision tree learning, basic decision tree learning algorithm, hypothesis space search in decision tree learning, inductive bias in decision tree learning, issues in decision tree learning.

Artificial Neural Networks: Neural network representation, problems for neural network learning, perceptions, multilayer networks and the back propagation algorithm, remarks on the back propagation algorithm.

Evaluation Hypotheses: Motivation, estimation hypothesis accuracy, basics of sampling theory, a general approach for deriving confidence intervals, difference in error of two hypotheses, comparing learning algorithms.

UNIT III - BAYESIAN LEARNING AND COMPUTATIONAL LEARNING THEORY

(12 Periods)

Bayesian Learning: Bayes theorem, concept learning, maximum likelihood and least squared error hypotheses, Maximum likelihood hypotheses for predicting probabilities, Minimum description length principle, Bayes optimal classifier, gibs algorithm, Naïve Bayes classifier, example learning to classify text, Bayesian belief networks The EM algorithm.

Computational learning theory: Probability learning, approximately correct hypothesis, sample complexity for Finite Hypothesis Space, Sample Complexity for infinite Hypothesis Spaces, and mistake bound model of learning.

UNIT IV - LEARNING SETS OF RULES AND ANALYTICAL LEARNING (11 Periods)

Learning Sets of Rules: Sequential Covering Algorithms, Learning Rule Sets: Summary, Learning First Order Rules, Learning Sets of First Order Rules: FOIL, Induction as Inverted Deduction, Inverting Resolution.

Analytical Learning: Learning with perfect domain theories: Prolog-EBG Remarks on Explanation-Based Learning, Explanation-Based Learning of Search Control Knowledge.

UNIT V - COMBINING INDUCTIVE AND ANALYTICAL LEARNING, REINFORCEMENT LEARNING (10 Periods)

Combining Inductive and Analytical Learning: Motivation, inductive-analytical approaches to Learning, Prior Knowledge to initialize the Hypothesis, Prior Knowledge to alter the Search Objective, Prior Knowledge to Augment Search Operators.

Reinforcement Learning: Learning Task, Q Learning, Non-Deterministic, rewards and actions, temporal difference learning, generalizing from examples, relationship to Dynamic Programming.

Total Periods: 55

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Tom M. Mitchell, *"Machine Learning,"* Mc Graw Hill, Indian Edition, 2017.
2. Stephen Marsland, *"Machine Learning: An Algorithmic Perspective,"* Taylor and Francis (CRC), 2nd Edition, 2015.

REFERENCE BOOKS:

1. William W Hsieh, *"Machine Learning Methods in the Environmental Sciences, Neural Networks,"* Cambridge University Press, 2009.
2. Richard O. Duda, Peter E. Hart and David G. Stork, "*Pattern classification*," John Wiley and Sons Inc., 2001.
3. Chris Bishop, *"Neural Networks for Pattern Recognition,"* Oxford University Press, 1995.
4. Peter Flach, *"Machine Learning,"* Cambridge University Press, 2012.

ADDITIONAL LEARNING RESOURCES:

http://ww.cs.cmu.edu/~tom/mlbook-chapter-slides.html

MCA II- SEMESTER
(20MC20110) MOBILE APPLICATION DEVELOPMENT
(Professional Elective –II)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	-	-	4

PRE-REQUISITES:

Courses on Object Oriented Programming through Java.

COURSE DESCRIPTION:

Mobile platforms; Mobile User Interface and tools; Introduction to Android; Activities; Views; Menus; Database Storage; SMS; e-mail; Displaying Maps; Building a Location Tracker Web Services Using HTTP; Sockets Programming; Communication between a Service and an Activity; Introduction to iOS.

COURSE OUTCOMES:

After successful completion of the course, students will be able to:

- **CO1.** Demonstrate knowledge on mobile platforms, mobile user interface and user interface design requirements.
- **CO2.** Design user interfaces by analyzing user requirements.
- **CO3.** Develop mobile applications and publish in different mobile platforms.

DETAILED SYLLABUS:

UNIT I- INTRODUCTION AND MOBILE USER INTERFACE DESIGN (10 periods)

Mobile web presence, Mobile applications, Marketing, App as a mobile web app; User interface design - Effective use of screen real estate, Mobile application users, Mobile information design, Mobile platforms, Tools of mobile interface design.

Android versions, Features and architecture, required tools, Android application launching.

UNIT II- ACTIVITIES, INTENTS AND ANDROID USER INTERFACE (11 periods)

Activities, Linking activities using intents, Calling Built – In Applications Using Intents, Displaying notifications, Components of a screen, Adapting to display orientation, Managing changes to screen orientation, Utilizing the action bar, Listening for UI notifications.

UNIT III- ADVANCED USER INTERFACE AND DATA PERSISTENCE (12 periods)

Basic views, Picker views, List view, Image view, Menus with views, Web view, Saving and loading user preferences, Persisting data to files, Creating and using databases.

UNIT IV- MESSAGING, LOCATION-BASED SERVICES, AND NETWORKING

(11 Periods)

SMS messaging, sending e-mail, Displaying maps, Getting location data, Monitoring a location, Consuming web services using HTTP.

UNIT V- ANDROID SERVICES, PUBLISHING ANDROID APPLICATIONS AND IOS

(11 Periods)

Services, Communication between a service and an activity, Binding activities to services, Threading, Preparing for publishing, Deploying APK files.

iOS tools, iOS project, Debugging iOS apps, Objective-C basics, Hello world app, Building the derby app in iOS.

Total Periods: 55

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. J. F. DiMarzio, "*Beginning Android Programming with Android Studio,*" Wiley India, 4th Edition, 2017.
2. Wei – Meng Lee, "*Beginning Android 4 Application Development",* Wrox, 2017.

REFERENCE BOOKS:

1. Jeff McWherter and Scott Gowell, *"Professional Mobile Application Development,"* Wiley India, 1st Edition, 2012.
2. Neils Smyth *"Android Stduio Development Essentials,"* Creative Space Independent publishing platform, 7th Edition 2016.
3. Paul Deital and Harvey Deital, *"Android How to Program,"* Detial associates publishers, 1st Edition, 2013.

ADDITIONAL LEARNING RESOURCES:

1. https://www.youtube.com/playlist?list=PLknSwrodgQ72X4sKpzf5vT8kY80HKcUSe
2. https://developer.android.com/

MCA II-SEMESTER
(20MC20111) **PROGRAMMING WITH C#**
(Professional Elective-II)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	-	-	4

PREREQUISITES:

Course on Object Oriented Programming through Java.

COURSE DESCRIPTION:

Introduction to .NET and Building blocks to the .NET Platform; Concepts of C# Programming; Implementation of interfaces, creating custom delegates and Events; Applications on ADO.NET; Design and development of ASP.NET Web Forms.

COURSE OUTCOMES:

After successful completion of the course, students will be able to:

CO1. Understand .NET Framework, principles of C#, Microsoft Visual C# and Visual Studio.

CO2. Design and develop web applications using ADO.NET and ASP.NET.

CO3. Use Microsoft Visual Studio tool to develop web applications.

CO4. Analyze mechanisms of ASP.NET and web controls, sessions and cookies techniques to design Client/Server applications.

CO5. Investigate object oriented programming principles to solve Exception Handling and Multithreading problems to implement C# Programming.

CO6. Commit to Key security standards of .NET to design secure web applications for an individual and society.

DETAILED SYLLABUS:

UNIT I- INTRODUCING C# AND .NET PLATFORM (11 Periods)

Benefits of the .NET platform, Building blocks of the .NET platform, Overview of .NET assemblies, Common type system, Common language specification, Common language runtime, Platform-independent nature of .NET, Introduction to Visual Studio. The role of the .NET framework, Building .NET application using visual studio, Anatomy of a simple c# program, System. Console class, System data types and corresponding c# keywords. Working with string data, C# iteration constructs Decision constructs and the Relational/equality operators.

UNIT II- CORE C# PROGRAMMING, OOP WITH C# AND EXCEPTION HANDLING (11 Periods)

Understanding C# arrays, C# class type, Constructors, this keyword, static keyword, Pillars of OOP, C# access modifiers, C# encapsulation services, Understanding automatic properties , mechanics of inheritance , C#'s polymorphic support. Role of .NET Exception Handling, example, System-level exceptions, Application level exceptions, processing multiple exceptions.

UNIT III- INTERFACES, GENERICS, DELEGATES AND EVENTS (11 Periods)

Understanding interface types, Defining custom interfaces, Implementing an interface, Implementing an interfaces using visual studio, Role of generic type parameters , Creating custom generic methods, Creating custom generic structures and classes, Understanding the .NET delegate type, Delegate example, Generic delegate, and C #events , Understanding operator overloading.

UNIT IV- ADO.NET (11 Periods)

High level definition of ADO.NET, ADO.NET data provider, ADO.NET namespaces, Connected layer of ADO.NET, Data Readers , Database transactions, Disconnected layer of ADO.NET, Role of the dataset, Working with DataColumns, Data Rows, DataTable , Binding DataTable objects to windows forms GUIs, DataAdapters.

UNIT V -ASP.NET WEB PAGES AND WEB CONTROLS (11 Periods)

ASP.NET, ASP.NET web forms, Role of http, Web applications and web servers, Role of client side scripting, Posting back to the web server. Overview of ASP.NET API, Building a single file ASP.NET web page, building an ASP.NET webpage using Code Files, ASP.NET web sites vs. ASP.NET Web applications, ASP.NET web site directory structure, The life cycle of an ASP.NET web page, Role of the web.config file, Understanding the nature of web controls, Major categories of ASP.NET web control, The Role of validation controls, Maintaining session data and Cookies.

Key Security Concepts in .NET: Type safety and security, Principle, Authentication and Authorization.

Total Periods: 55

Topics for self-study are provided in the lesson plan.

TEXT BOOK:

1. Andrew Troelsen, *"Pro C# 5.0 and the .NET 4.5 Framework,"* 6th Edition, Apress, 2013.

REFERENCE BOOKS:

1. Christian Nagel, Bill Evjen, Jay Glynn, Karli Watson, Morgan Skinner, *"Professional C# 4 and .NET 4,"* Wrox Publications, 2010, ISBN: 978-0-470-50225-9.
2. Mathew Mac Donald "*The Complete Reference ASP.NET,"* TATA McGraw Hill, 2010.

ADDITIONAL REFERENCE

https://docs.microsoft.com/en-us/dotnet/standard/security/key-security-concepts

MCA II-SEMESTER
(20MC20112) SOFTWARE TESTING AND QUALITY ASSURANCE
(Professional Elective-II)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	4	-	-	4

PREREQUISITES: --

COURSE DESCRIPTION:

Software Testing basics: Goals, Defects, Terminology, Methodology, Software Testing Life Cycle (STLC) in Software Development Life Cycle (SDLC), Verification and Validation; Software Testing Techniques: White box testing, Black Box Testing, Regression testing; Test Management: Test Planning, Design and Specifications; Test Automation: Tool selection and Guidelines, Software Quality Assurance.

COURSE OUTCOMES:

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

CO1. Understand concepts of Software Testing, Terminology and Methodology, Test Management and Metrics to analyze Software testing and Software Quality Assurance concepts for maintain the quality of the software.

CO2. Use testing tools such as Unified Functional Testing (UFT)/ Rational Functional Tester (RFT)/Selenium to control and monitor the functional testing for Airline Reservation System.

CO3. Analyze Testing Techniques, Static testing, Efficient Test Suit Management and Regression Testing and Test Automation strategies to Synthesis the quality of software.

CO4. Analyze and apply the Software Quality Factors, Pre-project software quality components, Ishikawa's Seven Basics to maintain the quality of the software.

DETAILED SYLLABUS:

UNIT I- INTRODUCTION TO SOFTWARE TESTING (10 periods)

Evolution of Software Testing, Software Testing: Myths and Facts; Goals of software testing, Psychology for software testing, Software testing definitions, Model for software testing, Effective software testing vs. exhaustive software testing, Effective testing is hard, Software testing as a process.

Terminology and Methodology: Software testing terminology, Software Testing Life Cycle (STLC), Software testing methodology.

UNIT II- TESTING TECHNIQUES (12 periods)

White Box Testing

Need of white-box testing, Logic coverage criteria, basis path testing, Graph matrices, Loop testing, Data flow testing, Mutation testing.

Black Box Testing

Boundary Value Analysis (BVA), Equivalence class testing, State table-based testing, Decision table-based testing, Cause-effect graphing based testing, Error guessing.

UNIT III - SOFTWARE TEST MANAGEMENT AND METRICS (11 periods)

Test Management: Test organization, Structure of testing group, Test planning, detailed test design, Test specifications.

Software Metrics: Definition of software metrics, Classification of software metrics, Size metrics.

Efficient Test Suit Management: Minimizing Test Suite and benefits, Test Suit Minimization problem, Test suite Prioritization, Types of Test case prioritization, Prioritization Techniques.

UNIT IV - REGRESSION AND AUTOMATION (10 periods)

Static Testing: Inspections, Walkthroughs, Technical reviews.

Regression Testing: Progressive vs. regressive testing, Regression testing produces quality software, Regression testability, Objectives of regression testing, Regression testing

types, Define regression test problem, Regression testing techniques.

Automation and Testing Tools: Need for automation, Categorization of testing tools, Selection of testing tools, Costs incurred in testing tools, Guidelines for automated testing,

Overview of commercial testing tools.

UNIT V- SOFTWARE QUALITY ASSURANCE (12 Periods)

Software Quality Assurance: The software quality challenge, Meaning of software quality, Software quality factors , Software Quality Lessons Learned, The components of the software quality assurance system, Pre-project software quality components: Contract Review, Development and quality plans, SQA components in the project life cycle: Integrating quality activities in the project life cycle, Assuring the quality of software maintenance components, Assuring the quality of external participants' contributions,

CASE tools, Software quality infrastructure components, Pareto Principles, Total Quality Management, Ishikawa's Seven Basics.

Total Periods: 55

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Naresh Chauhan, "*Software Testing: Principles and Practices*," Oxford University Press, 2nd Edition, 2016.
2. Daniel Galin, "*Software Quality Assurance: From theory to implementation*," Pearson Education Limited, 2004, ISBN 0201 70945 7.

REFERENCE BOOKS:

1. KshirasagarNaik, Priyadarshi Tripathy, "*Software Testing and Quality Assurance-Theory and Practice,"* John Wiley and Sons, Inc., 2008, ISBN 978-0-471-78911-6 2.
2. Fenton, Pfleeger, "*Software Metrics: A Rigourous and practical Approach*", Thomson Brooks/Cole, ISBN 981-240-385-X.
3. Boris Beizer, "*Software Testing Techniques*," Dream Tech Press, 2nd Edition, 2004.

ADDITIONAL LEARNING RESOURCES:

1. https://nptel.ac.in/courses/106/105/106105150/
2. https://www.toolsqa.com/software-testing-tutorial/
3. https://www.softwaretestinghelp.com/manual-testing-tutorial-1/
4. https://www.softwaretestinghelp.com/selenium-tutorial-1/

MCA II – SEMESTER
(20MC20131) DATA WAREHOUSING AND DATA MINING LAB

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
50	50	100	-	-	3	1.5

PREREQUISITES:

A course on Data Warehousing and Data Mining.

COURSE DESCRIPTION:

Hands-on experience on developing active/passive transformations; Creation of Datasets; Data Pre-processing; Association Rule Mining; Classification and Clustering techniques using Data Warehouse ETL and WEKA tool.

COURSE OUTCOMES:

After successful completion of the course, students will be able to:

CO1. Design and develop solutions for data acquisition process from one data source to other target data source using ETL tool.

CO2. Select and Apply Classification and Clustering algorithms on pre-processed datasets to infer predictions effectively.

CO3. Apply methods of data mining to assess and provide analytical solutions for societal issues.

CO4. Analyse pre-processing techniques, data mining algorithms and identify frequent itemsets using Apriori algorithm to extract interesting patterns from large databases using WEKA components.

CO5. Function effectively as an individual and as a member in a team to manage and implement data mining applications**.**

CO6. Write and present a technical report/ document effectively.

LIST OF EXERCISES

PART –A

Creation of Active/Passive transformations using Data Warehouse (Extract, Transform, Load) ETL Tool

1. Construct data acquisition process to extract, transform and load data from different databases.
2. Design and implement data acquisition process to perform
   a) Expression Transformation
   b) Joiner Transformation

3. Design and implement data acquisition process to perform
   a) Aggregator Transformation
   b) Source Qualifier Transformation
4. Design and implement data acquisition process to perform
   a) Filter Transformation
   b) Router Transformation
5. Design and implement data acquisition process to perform
   a) Ranker Transformation
   b) Sorter Transformation

PART -B

Working with Data Mining - WEKA tool.

6. Create data sets in ARFF and CSV formats and load into the Weka Explorer.
7. Perform data preprocessing steps on weather nominal and student information data sets as follows:
   a) Handle missing values for categorical and nominal values.
   b) Select relevant attributes.
   c) Apply normalization techniques
8. Generate strong Association rules by applying Apriori algorithm on preprocessed dataset with Min_Sup=60% and Min_Conf=80%.
9. i) Implement the Classification using Decision Tree algorithm on 'Weather' dataset. Draw the confusion matrix and report the model with accuracy.
   (ii) Implement Bayesian Classification and analyze the results on 'iris' dataset.
10. Implement simple k-Means clustering algorithm on 'iris' dataset.
11. Use Experimenter WEKA component to rank the performance of j48, oneR, ID3, algorithms on 'weather nominal' dataset.
12. Verify ID3 classifier performance using Gain ration and Ranker method using a Knowledge flow WEKA component.
13. **Minor Project**

    Step 1: Creation of data set.

    Step 2: Apply preprocessing techniques on constructed data sets.

    Step 3: Implement appropriate data mining algorithms such as:
    a. Apriori algorithm – to find frequent itemsets using various support and confidence levels
    b. FP growth association mining
    c. ID3 decision tree classifier

d. Build a confusion matrix to compute sensitivity, specificity, precision, recall, weighted accuracy and correlation between the attributes.

Data sets: Super Market data, Health data, Banking system, Weather forecasting and social media data.

REFERENCE BOOKS:

1. Ian H. Witten, Eibe Frank, and Mark,"*A Data Mining: Practical Machine Learning Tools and Techniques,"* Hall Morgan Kaufmann, 3rd Edition, 2011.
2. Ralph Kimball, *"The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling,"* John Wiley and Sons Inc, 3rd Edition, 2013.
3. G. K. Gupta, *"Introduction to Data Mining with Case Studies,"* PHI, New Delhi, 3rd Edition, 2009.

ADDITIONAL LEARNING RESOURCES:

1. https://www.cs.waikato.ac.nz/ml/weka/book.html
2. http://infolab.stanford.edu/~ullman/mmds/book.pdf
3. Open source tools for data mining: http://eprints.fri.uni-lj.si/893/1/2008-OpenSourceDataMining.pdf
4. https://www.kaggle.com/datasets
5. https://www.edureka.co/blog/informatica-etl/
6. https://www.coursera.org/specializations/data-warehousing

MCA II-SEMESTER
(20MC20132) LINUX PROGRAMMING LAB

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
50	50	100	-	-	3	1.5

PREREQUISITES: --

COURSE DESCRIPTION: LINUX operating system features; LINUX environment; Vi-editor; Types of shell; Shell Script; Scheduling Algorithms; Disk Scheduling Algorithm; Synchronization Problems; Page Replacement Algorithms; Deadlocks ; Memory Management Techniques.

COURSE OUTCOMES:

After successful completion of the course, students will be able to:

CO1. Demonstrate LINUX operating system concepts and File Handling, Disk, Text Processing and Backup, awk and Bourne shell.

CO2. Use the vi editor to execute commands and implement programs in shell script.

CO3. Implement LINUX file API's and process API's in LINUX operating system.

CO4. Investigate and select appropriate technique from semaphores, Messages and Shared Memory to solve the problems in Inter Process Communication.

CO5. Work independently or in teams to solve problems with effective Communication.

LIST OF EXERCISES:

1. Execute the following Linux commands.
   a) File Handling Utilities and Disk utilities
   b) Text Processing Utilities and Backup utilities
2. a) Write a shell script that displays a list of all files in the current directory to which the user has read, write and execute permissions.
   b) Write a shell script that deletes all lines containing the specified word in one or more files supplied as arguments to it.
3. a) Write a shell script that accepts a list of file names as its arguments, counts and reports the occurrence of each word that is present in the first argument file on other argument files.
   b) Write a shell script to find factorial of a given number.
4. Write an awk script to implement below using case control structure.
   a) Splitting a Line Into Fields
   b) Print multiplication table of a given number
5. Write a C Program to implement FIFO scheduling algorithm.

6. Write a C program to implement LOOK disk scheduling algorithm.
7. Write a C program to implement producer and consumer problem using semaphore.
8. Write a C program to which illustrates inter process communication between using parent and child using pipes.
9. Write a C program to implement internal and external fragmentation concepts.
10. Write a C program to implement banker's algorithm.
11. Write a C program to implement first fit, best fit and worst fit dynamic memory allocation strategies.
12. Write a C program to implement FIFO page replacement algorithms.

REFERENCE BOOKS:

1. W.R. Stevens, "*UNIX Network Programming*," Pearson Education, 2008
2. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, *"Operating System Concepts,"* John Wiley and Sons. Inc, 8th Edition, 2009.
3. Graham Glass, King Ables, "*UNIX for programmers and users,*" Pearson Education, 3rd Edition, 2003.
4. Kernighan and Pike, "*UNIX programming environment*," Pearson Education, 2006.

MCA II-SEMESTER
(20MC20133) OBJECT ORIENTED PROGRAMMING THROUGH JAVA LAB

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
50	50	100	-	-	3	1.5

PRE-REQUISITES:

Course on "Object oriented Programming through JAVA".

COURSE DESCRIPTION:

Object oriented concepts, recursive and non-recursive function; String Tokenizer class; Method Overloading; String Operations; Creation of package and Interfaces; Handling predefined and User Defined Exceptions; Creation of Files and its Operations; Implementation of Multithreading; Creating and testing Applets; Event handling techniques**,** GUI applications using AWT and Swings.

COURSE OUTCOMES:

After successful completion of this course, the student will be able to:

CO1. Understand the Object-Oriented Programming Principles to develop java programs.

CO2. Design and develop user defined classes using packages and interfaces.

CO3. Use advanced java programming concepts AWT, Swings and applets to develop complex user interface applications.

CO4. Analyse Inheritance and Exception Handling mechanisms to implement in Object oriented applications.

CO5. Work independently and in team to solve problems with effective communication.

LIST OF EXERCISES:

1. a) Write a Java program that prints all real solutions to the quadratic equation using command line argument.

$ax^2 + bx + c = 0.$

b) Write a Java program to implement Adjacency matrix.

2. a) Write a Java program that prompts the user for an integer and print out all prime numbers up to the given integer.

b) Write a Java Program that reads a line of integers, and then displays each integer, and the sum of all the integers (Use StringTokenizer class of java.util)

3. Write a Java program to illustrate method overloading.

4. Write a Java program to implement the Polynomial ADT using a class:

a) Addition b) Subtraction

5. Write a Java program to implement the following:

a) Create and Access a package b) Interfaces.

6. Write a Java program to implement the following:

a) Predefined exceptions b) User defined exceptions

7. a) Write a Java program that reads a file name from the user, and then displays information about whether the file exists, whether the file is readable, whether the file is writable, the type of file and the length of the file in bytes.

b) Write a Java program to display the number of characters, lines and words in a text file.

8. a) Write a Java program to implement multithreading techniques.

b) Write a Java program to implement producer consumer problem using the concept of inter thread communication.

9. a)Write a java program to develop GUI components in java (AWT) with appropriate Event Handling techniques .

b)Write a Java program to create user interface to perform integer divisions using Swings.

10. a) Develop an applet in Java to display a message.

b) Develop an applet to perform factorial of a given value.

Mini Project

1. Use Eclipse IDE to implement calculator using AWT and SWINGS.

2. Application for Temperature Conversion

a). Write a temperature conversion applet that converts from Fahrenheit to Celsius.

Use the following formula for the conversion:

Celsius = ((5/9)*(Ferenheit-32)).

b). Enhance the temperature conversion applet by adding the Kelvin temperature scale.

Use the following formula for the conversion between Kelvin and Celsius

Kelvin = Celsius + 273.15

REFERENCE BOOKS:

1. B. Eswar Reddy, T. V. Suresh Kumar and P. Ragavan, *"Object Oriented Programming with Java,"* Pearson Sanguine Publications, 2nd Edition, 2011.
2. Harvey Dietel and Paul Dietel, *"Java How to Program,"* Pearson Education, 11th Edition, 2018.

MCA II- SEMESTER
(20MC2AC01) **OPERATING SYSTEMS**

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
-	-	-	2	-	-	-

PRE-REQUISITES:--

COURSE DESCRIPTION:

Operating Systems; CPU Scheduling Algorithms; Synchronization Methods; Memory Management Techniques; Protection.

COURSE OUTCOMES:

After successful completion of this course, the student will be able to:

CO1. Identify and analyze System Structures, Inter Process Communication (IPC), Process Synchronization, Memory Management, Process Scheduling, System protection mechanisms.

CO2. Select and apply Synchronization tools, Process Scheduling and Page Replacement algorithms to interpret and resolve optimal resource allocation problems.

DETAILED SYLLABUS:

UNIT I – SYSTEM STRUCTURES (6 periods)

System Structures: Operating System concepts, Role of Operating System, Operating System services, Operating system structure, System calls, types of system calls, System programs, Virtual machines.

UNIT II- PROCESS AND PROCESS SCHEDULING (6 periods)

Processes: Process concept, Process scheduling, Operations on processes, Inter process communication (IPC), Examples of IPC systems.

Process Scheduling: Basic Concepts, Type of Scheduler, Scheduling Criteria, Scheduling Algorithms.

UNIT III - PROCESS SYNCHRONIZATION (6 periods)

Process Synchronization: Concepts, Critical-Section problem, Peterson's Solution, Synchronization hardware, Semaphores, Classic problems of Synchronization, Critical regions.

UNIT IV - MEMORY MANAGEMENT (6 periods)

Memory Management: Concepts, Swapping, Contiguous memory allocation, Paging, Structure of page table, Segmentation.

UNIT V - VIRTUAL MEMORY MANAGEMENT AND SYSTEM PROTECTION(6 periods)

Virtual Memory Management: Concepts, Demand paging, Copy on write, Page replacement, Allocation of frames, Thrashing.

System Protection: Goals of Protection, Principles of Protection, Domain of Protection, Access Matrix.

Total Periods: 30

TEXT BOOK:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, *"Operating System Concepts,"* John Wiley & Sons. Inc, 8th Edition, 2009.

REFERENCE BOOKS:

1. Achyut S. Godbole, *"Operating Systems,"* Tata McGraw-Hill, 3rd Edition, 2017.
2. William Stallings, *"Operating Systems: Internals and Design Principles,"* Pearson Education, 9th Edition, 2018.

ADDITIONAL LEARNING RESOURCES:

1. https://www.javatpoint.com/os-tutorial
2. https://www.os-book.com/OS10/slide-dir/index.html