SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

(NAAC Re-accredited with 'A' Grade)

School of Computational Sciences

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

CURRICULUM FRAMEWORK AND SYLLABUS

FOR OUTCOME BASED EDUCATION IN

Master of Computer Applications (M.C.A) Degree Program

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2019-2020 ONWARDS

www.srtmun.ac.in

BOS meeting approved: __/__/2019

Approved in ____ Academic Council meeting on __/__/2019

Director
School of Computational Sciences
S.R.T.M. University, Nanded (M.S.)

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY

SCHOOL OF COMPUTATIONAL SCIENCES

VISION

"Enlightened Student: A Source of Immense Power"

MISSION

"Swami Ramanand Teerth Marathwada University pledges itself to uphold zealously its mission of promoting acquisition and dissemination of knowledge through fearless and sustained pursuit of excellence aimed at molding personalities of students entering its portals to grow with an upright character filled with enlightenment and to be the value adhering members of a just and humane society".

As a Department, We are committed to

- Achieve academic excellence in Computer Applications through innovative teaching and learning processes.
- To prepare the students to be professionally competent to face the challenges in the industry.
- Promote inter-disciplinary research among the faculty and the students to create state of art research facilities.
- To promote quality and ethics among the students.
- Motivate the students to acquire entrepreneurial skills to become global leaders.

The School of Computational Sciences exists since inception of the University and offers Masters, M.Phil. and Ph.D. programs.

Master Degree Programs, M.Sc.(CS), M.Sc.(CN) and M.Sc.(CA), being officered are two years full time post graduate programs revised with industry expectations. These all programs have four semesters, which are normally completed in two years.

The MCA program is a three-year full time AICTE approved program which is normally completed in six semesters.

Above all programs are offered as per CBCS (Choice Based Credit System) pattern, in which within discipline and cross discipline migration choices of courses are given to the students under open electives and subject electives. The students can choose open electives from the same program or from other programs of the same school or from other programs of other schools. The Evaluation of performance of a student for the course under Choice based Credit System (CBCS) is based on principle of continuous assessment through internal and external evaluation mechanisms. CBCS policy had emphasis given on imparting skills to students.

The eligibility criteria and fees structure shall be same as that of Campus Prospectus.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY

SCHOOL OF COMPUTATIONAL SCIENCES

Draft Report on CBCS enabled syllabi of MCA Program.

In compliance with the Hon‟ble Vice Chancellor‟s directions, resolution passed by the Hon‟ble Management Council and in the light of circular being communicated by the Deputy Registrar, Academics, a committee comprising of the Director of the School, Head Department and three faculties from the school have strived hard for reframing and revision the syllabi of 3 years full time MCA course which exists in the school of Computational Sciences.

The committee members agreed unanimously to adhere the guidelines given by AICTE, New Delhi were observed for MCA program well as SRTMUN policy draft on Choice Based Credit System – CBCS, being circulated to the school MCA program. The model CBCS syllabus framed by UGC, New Delhi was also reviewed. It was decided to have at least one open elective as a compulsory course in the program, in all the semesters. Accordingly, the interdisciplinary applications of Computers, IT, Scientific computing allied courses were found out across the various disciplines and relevant courses have been spread over all semesters of all the streams with two internal credits in each semester. The Communication Skills (given in UGC Scheme as a compulsory Ability Enhancement Course (AECC) to be taught) was also introduced as an Open Elective in early semesters.

While restructuring the courses to fit into the CBCS pattern, care has been taken to consider local needs placed in a national context so as to fulfill global demands. Due care is taken to introduce application oriented interdisciplinary learning. Therefore, students pursuing post-graduation degrees over here, in specific courses are encouraged to imbibe knowledge and skills which enable all round personality development, skill enhancement and in-depth learning of technology platforms. Under the CBCS pattern, students would post graduate MCA program with a total number of 26 credits which includes minimum 05 compulsory credits from theory subjects, 4 credits from practical, and 2 credits from University recognized MOOC/ (NPTEL / SWAYAM / others) OR Intra / Inter Departmental / School Open Electives Wherein the students would be required to choose the courses from the choices available in each semester from each up to 5^{th} semester and at the 6^{th} semester Major Project Development Activity of 25 credits.

The directions given by Hon‟ble Pro Vice Chancellor sir reading intra school and inter school open electives was specifically accepted by the committee and due care is taken to embed them. Accordingly, horizontal and vertical migration among MCA programs with other programs offered by other schools in the campus is allowed.

The discussions with Hon‟ble Pro Vice Chancellor sir lead to following specific agenda of the CBCS syllabi

1. To provide mobility and flexibility for students within and outside the Computational Science School as well as to migrate between institutions

2. To help students to learn at their own pace

3. To have provision for audit and credit courses

4. To impart more job-oriented skills to students

5. To make any course multi-disciplinary in approach

In order to move ahead on the agenda, the committee members continuously sat together on all week days and finalized all semesters one by one. There were discussions on a uniform structure per semester, which is likewise to be extended across all semesters so as to make a MCA program worth of 155 credits, five semesters have 26 credits each and 6^{th} semester of 25 credits.

Accordingly, 05 theory courses of 04 credit each, 02 Lab courses of 02 credits each and 01 open elective course of 02 credits, were drafted for Semester 01 to Semester 03 of MCA program. These courses are marked as compulsory foundation and core courses which at as brush up / revision courses for entry level students. This was intentionally done as the student population coming to school primarily comes from Permanent Non-Grant colleges.

The fourth and fifth semesters have compulsory and departmental elective courses to be completed, with open electives. These are program specific courses which enable in depth learning in the allied courses. The electives are designed as per the relevant demand of a course in IT industry / Research area. In fourth semester, there are 03 theory courses of 04 credits each, 02 specialized electives of 04 credits, 02 Lab courses of 02 credits and 01 open elective of 02 credits. This also sums up to 26 credits.

In the fifth semester there are 03 theory courses of 04 credits each, 02 specialized elective of 04 credits, 02 Lab courses of 02 credits each, 01 mini project activity of 02 credits, This also sums up to 26 credits.

In the Sixth semester, A major project development activity was intentionally introduced for 25 credits so as give a real time feel of industry activities to the students. A unified course numbering system was used for proper numbering of all courses, viz,

Foundation Course

Core Courses

Program Specific Courses

Department Specific Elective Subject for all programs

Mini and Major Project

Open Elective

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

First three semesters have compulsory foundation and core courses along with open electives. The fourth and fifth semesters of the program consists of three major components. They are program specific core courses, elective courses and department specific elective courses. Also, a compulsory component of open elective is mandatory per semester.

A core course is the course offered by the parent program, totally related to the major subject, components. Elective Course is also offered by the parent program whose objective is to provide choice and flexibility within the program. The student can choose his/her elective paper. Elective is related to the major subject. The difference between core course and elective course is that there is choice for the student. The program is at liberty to offer certain number of elective courses any semester.

The Departmental elective course is an inter program course offered by a program for the students belonging to other programs. The objective is to provide mobility and flexibility outside the parent program. This is introduced to make every course multi-disciplinary in nature. It is to be chosen from a list of courses offered by various programs in the school. The list is given in the syllabus copy.

The open electives are of application oriented and inter-disciplinary in nature. These courses can be offered by the concern program or concern school for the students in same program / school or for other schools. These have 02 internal credits.

All faculties were told to outline the specific topics of their interest and elaborate them further with objectives and outcome. The final version of syllabi is outcome oriented which smoothes the understanding of students regarding the skills he/she will be getting after the completion of the course. This has also made faculties to be specialized of the courses being drafted by them.

In order to see the employability of the skills being imparted through the revised syllabi, the syllabi draft was forwarded to Industry experts. Due care is taken to incorporate suggestions and modifications given by these experts. These experts are 1) Dr. Parvin Pawar, Philips Research Lab, Bangalore 2) Mr. Sanjay Kurundkar, Creve Info Tech Ltd, Pune 3) Mr. Ashish Tendulakr, Google Inc, Pune

UGC and AICTE guidelines regarding CBCS syllabi workout were duly considered while framing underlined syllabi. Efforts are made for incorporating skill enhancement components in the underlined syllabi. In order to offer more choices for learning, the certified MOOC courses, Spoken tutorial courses and SWAYAM courses are considered equivalent for open electives. However, in these cases, students must produce certificate towards successful completion of the said courses during the course year in order to claim credits for open electives.

It was decided to pass this draft for final approval from the Administrative Authorities including Dean of the faculty, Hon‟ble Vice Chancellor sir,

Submitted with respects

1. Dr. G.V. Chowdhary, Director
2. Dr. S. D. Khamitkar, HOD
3. Dr. H. S. Fadewar, Assistant Professor
4. Dr. P. U. Bhalcahndra, Assistant Professor
5. Mr. M. R. Mahamune, Assistant Professor

Final draft of syllabi was approved by all the faculties in the school.

1. Dr. N. K. Deshmukh, Assistant Professor
1. Dr.S. N. Lokhande, Assistant Professor
2. Mr. S. R. Mekewad, Assistant Professor
3. Ms. A. H. Sable, Assistant Professor
4. Mr. M. S. Darak. Assistant Professor
5. Mr. M. D. Wangikar, Assistant Professor

Place: Nanded

Date:

Program Educational Objectives (PEO)

Post graduates of MCA program will be

PEO1: Utilizing strong technical aptitude and domain knowledge to develop smart software solutions for the upliftment of society.

PEO2: Applying research and entrepreneurial skills augmented with a rich set of communication, teamwork and leadership skills to excel in their profession.

PEO3: Showing continuous improvement in their professional career through life-long learning, appreciating human values and ethics.

Graduate Attributes for MCA Program (GA)

1. Computational Knowledge:

Apply domain knowledge appropriate for the computing specialization to the abstraction and conceptualization of computing models from defined problems and requirements.

2. Problem Analysis:

Identify, formulate, research literature, and solve *complex* computing problems reaching substantiated conclusions using fundamental principles of computing sciences.

3. Design /Development of Solutions:

Design and evaluate solutions for *complex* computing problems that meet specified needs with appropriate consideration for cultural, societal, and environmental considerations.

4. Conduct Investigations of Complex Computing Problems:

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. Modern Tool Usage:

Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to *complex* computing activities, with an understanding of the limitations.

6. Professional Ethics:

Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional computing practice.

7. Life-long Learning:

Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.

8. Project management and finance:

Demonstrate knowledge and understanding of the computing and management principles and apply these to one's own work, to manage projects and in multidisciplinary environments.

9. Communication Efficacy:

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. Societal and Environmental Concern:

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

11. Individual and Team Work:

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

12. Innovation and Entrepreneurship

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 Outcomes (PO) for Master of Computer Applications (2019-2020)

On completion of MCA program, the students are expected to

PO1: 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.

PO2: Identify, formulate, research literature, and solve complex computing problem searching substantiated conclusions using fundamental principles of mathematics, computing sciences, and relevant domain disciplines.

PO3: 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.

PO4: 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.

PO5: Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.

PO6: Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional computing practice.

PO7: Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.

PO8: 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.

PO9: 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.

PO10: Understand and assess societal, environmental, health, safety, legal, and cultural issues within local and global contexts, and the consequential responsibilities relevant to professional computing practice.

PO11: Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary environments.

PO12: 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.

PEO-PO Mapping:

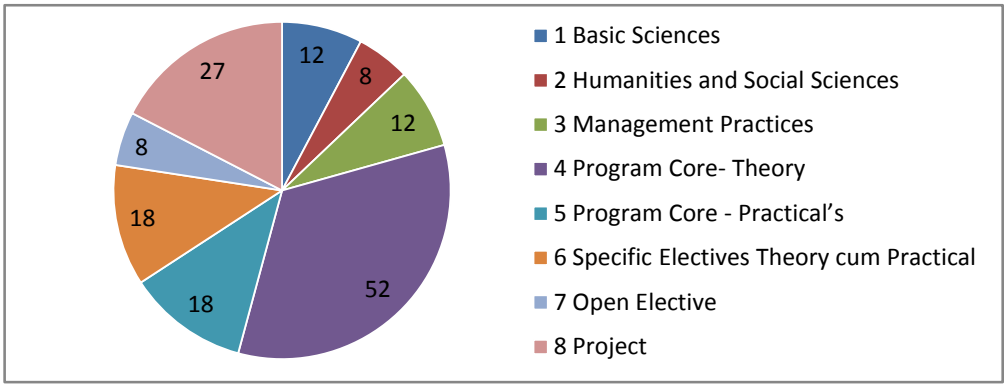
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEO1												
PEO2												
PEO3												

PO-GA MAPPING:

	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11	GA12
PO1												
PO2												
PO3												
PO4												
PO5												
PO6												
PO7												
PO8												
PO9												
PO10												
PO11												
PO12												

Credit Distribution:

Sr. No.	Category of courses	Credits	Percentage of Credits to Total Credits
1	Basic Sciences	12	7.74%
2	Humanities and Social Sciences	08	5.16%
3	Management Practices	12	7.74%
3	Program Core- Theory	52	33.55%
4	Program Core - Practical's	18	11.61%
5	Specific Electives Theory cum Practical	18	11.61%
5	Open Elective	08	5.16%
6	Project	27	17.42%
	Total Credits	155	**100%**



Basic Science (BS) & Humanities & Social Sciences Courses:

Semester	Name of the Course	Category	Credits
1	Mathematical Foundations	BS	4
2	Probability & Statistics	BS	4
3	Graph Theory	BS	4
		BS Total Credits	**12**
1	Programming Logic	HSS	4
2	Oral & Written Communication Skills	HSS	4
		HSS Total Credits	**8**

Program Core, Elective & Practical Courses:

Semester	No. of Core Theory Courses	Credits	No. of Core Practical Courses	Credits	No. of Specific Elective Courses	Credits	No. of Open Elective Courses	Credits	Total Credits
I	05	20	02	04	-	-	01	02	26
II	05	20	02	04	-	-	01	02	26
III	05	20	02	04	-	-	01	02	26
IV	03	12	02	04	02	08	01	02	26
V	03	12	03	06	02	08	-	-	26
VI	Major Project								25
								Total Credits	**155**
I to V	**Total Credits for Core Courses**	84	**Total Credits for Practical Courses**	22	**Total Credits for Specific Elective Courses**	16	**Total Credits for Open Elective Courses**	08	130
VI	**Major Project**								25
								Total Credits	**155**

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SCHOOL OF COMPUTATIONAL SCIENCES

Scheduling of Courses

Semester	Theory					Practical			Credits
I	MCA 101 Programming Logic	MCA 102 Data Structure using C	MCA 103 Computer Organization & Architecture	MCA 104 Introduction to Mgt. Functions	MCA 105 Mathematical Foundation	MCA 106 Lab-1 C Programming.	MCA 107 Lab-2 COA	MCA 108 Open Elective	26
II	MCA 201 SAD	MCA 202 DA A using C++	MCA 203 Management Information System	MCA 204 Prob. & Stat.	MCA 205 Oral & Written Comm. Skills	MCA 206 Lab-3 SAD	MCA 207 Lab-4 C++ Programming.	MCA 208 Open Elective	26
III	MCA 301 Software Engineering	MCA 302 Visual Programming Tools.	MCA 303 Data Communications & Computer Networks	MCA 304 Relational Database Management System	MCA 305 Graph Theory	MCA 306 Lab-5 Visual Programming Tools.	MCA 307 Lab-6 RDBMS	MCA 308 Open Elective	26
IV	MCA 401 Compiler Designing	MCA 402 Java Programming.	MCA 403 Operating Systems	MCA 404 Elective-1	MCA 405 Elective-2	MCA 406 Lab-7 Java Programming.	MCA 407 Lab-8 Lunux OS	MCA 408 Open Elective	26
V	MCA 501 Cryptography & Net. Sec.	MCA 502 Data Mining & DW	MCA 503 Theory of Computation	MCA 504 Elective-3	MCA 505 Elective-4	MCA 506 Lab-9 DM & DW	MCA 507 Lab-10 Elective-4	MCA 508 Mini Project	26
VI	MCA 601: Project Development								25
	Synopsis Submission	Progress Report-1 System Analysis	Progress Report-2 Designing & Scheduling	Progress Report-3 Coding and modeling	Progress Report-4 Testing & Implementation	Project Dissertation Documentation	Via voice Project Presentation		
								Total Credits	155

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED
SCHOOL OF COMPUTATIONAL SCIENCES
Master of Computer Applications (M.C.A) Degree Program

COURSES OF STUDY
(For the candidates admitted from 2019-2020 onwards)

FIRST SEMESTER

Course Code	Name of Course	Category	No. Of Hours/Week			Credits
			L	T	P	
Theory						
MCA 101	Programming Logic	HSS	4	1	-	4
MCA 102	Data Structure using C	PC	4	1	-	4
MCA 103	Computer Organization & Architecture	PC	4	1	-	4
MCA 104	Introduction to Management Function	MP	4	1	-	4
MCA 105	Mathematical Foundation	BS	4	1	-	4
Practical						
MCA 106	Lab-1 C Programming	PCL	-	-	6	2
MCA 107	Lab-2 Computer Organization & Architecture	PCL	-	-	6	2
Open Elective						
MCA 108	Open Elective	OE	2	1	-	2
		Total	22	06	12	26

SECOND SEMESTER

Course Code	Name of Course	Category	No. Of Hours/Week			Credits
			L	T	P	
Theory						
MCA 201	System Analysis and Design	PC	4	1	-	4
MCA 202	Design Analysis & Algorithm using C++	PC	4	1	-	4
MCA 203	Management Information System	MP	4	1	-	4
MCA 204	Probability & Statistics	BS	4	1	-	4
MCA 205	Oral and Written Communication Skills	HSS	4	1	-	4
Practical						
MCA 206	Lab-3 C++ Programming	PCL	-	-	6	2
MCA 207	Lab-4 Data Communication	PCL	-	-	6	2
Open Elective						
MCA 208	Open Elective	OE	2	1	-	2
		Total	22	06	12	26

THIRD SEMESTER

Course Code	Name of Course	Category	No. Of Hours/Week			Credits
			L	T	P	
Theory						
MCA 301	Software Engineering	PC	4	1	-	4
MCA 302	Visual Programming Tools	PC	4	1	-	4
MCA 303	Data Communication and Computer Networks	PC	4	1	-	4
MCA 304	Relational Database Management System	MP	4	1	-	4
MCA 305	Graph Theory	BS	4	1	-	4
Practical						
MCA 306	Lab-5 Visual Programming	PCL	-	-	6	2
MCA 307	Lab-6 RDBMS	PCL	-	-	6	2
Open Elective						
MCA 308	Open Elective	OE	2	1	-	2
		Total	22	06	12	26

FOURTH SEMESTER

Course Code	Name of Course	Category	No. Of Hours/Week			Credits
			L	T	P	
Theory						
MCA 401	Compiler Designing	PC	4	1	-	4
MCA 402	Java Programming	PC	4	1	-	4
MCA 403	Operating System Concepts	PC	4	1	-	4
MCA 404	Elective-1	PE	4	1	-	4
MCA 405	Elective-2	PE	4	1	-	4
Practical						
MCA 406	Lab-7 Java Programming	PCL	-	-	6	2
MCA 407	Lab-8 Advance Data Structure	PCL	-	-	6	2
Open Elective						
MCA 408	Open Elective	OE	2	1	-	2
		Total	22	06	12	26

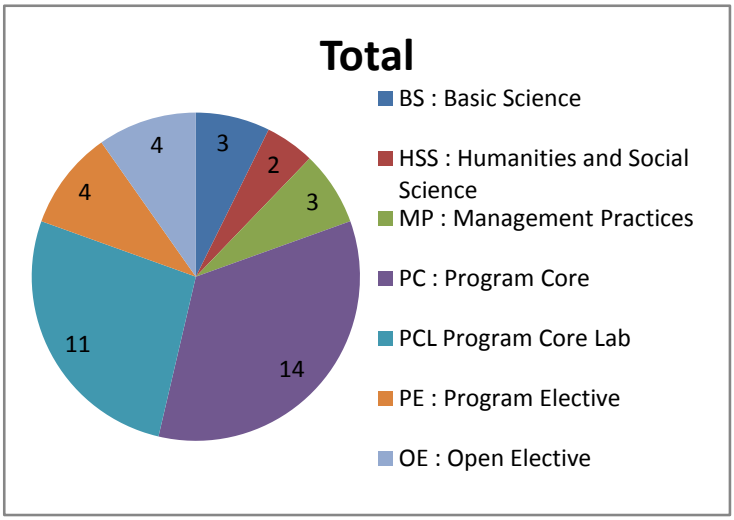
FIFTH SEMESTER

Course Code	Name of Course	Category	No. Of Hours/Week			Credits
			L	T	P	
Theory						
MCA 501	Cryptography & Network Security	PC	4	1	-	4
MCA 502	Data Mining & Data Warehousing	PC	4	1	-	4
MCA 503	Theory of Computation	PC	4	1	-	4
MCA 504	Elective-3	PE	4	1	-	4
MCA 505	Elective-4	PE	4	1	-	4
Practical						
MCA 506	Lab-7 Java Programming	PCL	-	-	6	2
MCA 507	Lab-8 Based on Elective-4	PCL	-	-	6	2
MCA 508	Mini Project	PC	-	-	6	2
		Total	20	05	18	26

SIXTH SEMESTER

Course Code	Name of Course	Category	No. Of Hours/Week			Credits
			L	T	P	
MCA 601	Major Project Activity	PC	-	-	12	25
		Total	-	-	12	25

PC	: Program Core
BS	: Basic Science
HSS	: Humanities & Social Science
MP	: Management Practices
PCL	: Program Core Lab
PE	: Program Elective
OE	: Open Elective
L	: Lecture
T	: Tutorial
P	: Practical



Notes

1. For Theory, 04 credits means 02 internal credits and 02 external credits
2. For Practical, 02 credits means 01 internal and 01 external credits
3. For Mini Project Development Activity, 02 credits are purely internal
4. For Major Project Development Activity, 12 Internal and 13 External Credits
5. For Open electives, 02 credits are purely internal credits
6. Student has to earn at least 02 credits in any semester from the interdisciplinary open elective course offered by other school.
7. * Internal Assessment evaluation pattern will differ from subject to subject and for different tests. This will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follow the declared pattern
8. ** External Assessment Examination will be conducted for maximum marks of 50 marks for the award of end semester examination marks

Code:	MCA101	Programming Logic	Credits: 04
Course Objectives:			
This course provides a complete introduction to programming in C, including both ANSI C and Kernighan & Ritchie C. In addition to covering basic syntax and semantics, the course emphasizes problem solving methodology and modular programming techniques.			
Course Outcome:			
Upon successful completion of this course, students will understand the facility in using common programming constructs, including loops and conditionals; Facility in performing stream input/output; Facility in incorporating auxiliary libraries into a C program.			
CO1: Describe the reason why different constructs are available for iteration, such as "for" loops, "do...while" loops CO2: Demonstrate the difference between iteration and recursion in terms of C programming CO3: Develop C programs for arrays and linked lists CO4: Develop C programs for Data structure concept with functions CO5: Summarize the Hardware interaction using Port I/O CO6: Develop C programs for File Management concept			
Unit-1:	**Introduction**		
What is a Programming Language, What is a Compiler, C Syntax and Constructs Writing C Programs Gearing up with logic and algorithms, flowcharts. Building logic for writing C Programs.			
Unit-2:	**C programming constructs**		
Basic input and Output in C , variables, declarations, operators, functions Steps to Compiling a Program , Compilation Phases, Multi-File Compilation, Header Files The Standard Library			
Unit-3:	**Advanced C programming features**		
Control structures and Loops Pointers, Addresses and Memory			
Unit-4:	**Parameter passing**		
Passing Parameters by Address, Arrays, Address Structures, Pointers and Arrays			
Text Books:			
1.	The C Programming Language (2nd edition), Brian W. Kernighan, Dennis M. Ritchie, Prentice Hall Software Series.		
2.	C : The Complete Reference by Herbert Schildt.		
Reference Books			
1.	Programming in ANSI C by E Balagurusamy		
2.	Let Us C by YashavantKanetkar		

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	-	-	-	-	-	-	-	-	-	-	-
CO2	S	S	S	M	S	-	M	-	-	M	-	-
CO3	S	S	S	M	S	-	-	-	M	-	-	-

CO4	S	S	S	M	S	-	M	-	-	-	-	-
CO5	M	-	-	-	-	-	M	-	-	M	-	-
CO6	S	S	S	M	S	-	-	-	-	-	-	-
S- Strong; M-Medium; L-Low												

Code:	MCA 102	Data Structures using C	Credits: 04

Course Objectives:

1. IT will demonstrate familiarity with major algorithms and data structures.
2. Analyze performance of algorithms.
3. Choose the appropriate data structure and algorithm design method for a specified application.
4. Demonstrate understanding of the abstract properties of various data structures such as stacks, queues, lists, trees and graphs.
5. Use various data structures effectively in application programs.
6. Demonstrate understanding of various sorting algorithms, including bubble sort, insertion sort, selection sort, merge sort, quick sort and heap sort.
7. Understand and apply fundamental algorithmic problems including Tree traversals, Graph traversals, and shortest paths.
8. Demonstrate understanding of various searching algorithms.
9. Compare different implementations of data structures and to recognize the advantages and disadvantages of the different implementations.

Course Outcome:

CO1: Explain the organization and operations of data structures Stack, Queues, Trees, Graphs, Heaps and Hash tables.
CO2: Compare and contrast the functionalities and applications of different data structures
CO3: Demonstrate specific search and sort algorithms using data structures given specific user requirements.
CO4: Apply the operations of data structures in designing software procedures based on specific requirements
CO5: Assess the applicability of given data structures and associated operations to real time computer applications
CO6: Identify suitable algorithms with appropriate data structures for real time software requirements
CO7: Modify the existing operations of data structures for changing needs of the software requirements

Unit-1:	Introduction to Algorithm

Data, Variables (Local and Global), Data types, arrays Introduction to Algorithm, The efficiency of Algorithms, Analysis of Algorithms, overview of Space and Time Complexities, some fundamental algorithms for exchange , counting , summation

Unit-2:	Introduction to data structures

Introduction to data structures, Basic terminology, Primitive data structure operations
Overview of STACKS, QUEUES, LINKED LISTS, BINARY TREES and GRAPHS (Basic Definition , Representations, Characteristics , Types, Applications)

Unit-3:	Tree and Graph

Minimum Spanning Trees, Growing a minimum spanning tree, The algorithms of Kruskal and Prim Graphs : DFS and BFS algorithms associated with Graphs, Single-source shortest Paths, The Bellman-ford algorithm

Unit-4:	Sorting and Searching

Introduction to searching and sorting problems, Linear search , Binary search, Selection sort

, Bubble sort , Insertion sort , Merge sort, Complexities of searching and sorting algorithms		
Unit-5:	**Divide and Conquer Techniques**	
Divide and conquer, General method, Binary search, Merge sort, Strassen‟s matrix multiplication		
Unit-6:	**Advanced Data Structure**	
Introduction to Greedy method, The general method, Container loading knapsack problem, Introduction to Dynamic Programming, General method, Introduction to NP Theory		
Text Books:		
1.	Fundamentals of Computer Algorithms- Ellis Horowitz, Satraj Sahani, University Press	
2.	Data Structures and Algorithms by A.V. Aho, J.E. Hopcroft and T.D. Ullman, Original edition, Addison-Wesley, 1999, Low Priced Edition.	
Reference Books		
1.	How to solve it by Computers- R.G. Dromey , 8th Edition , Pearson Education	
2.	Data Structures, Lipschutz , Tata McGraw Hills	

Mapping with Program Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**P10**	**P11**	**P12**
CO1	M	-	-	-	-	-	-	-	-	--	-	-
CO2	M	L	-	-	-	-	-	-	-	-	-	-
CO3	S	L	-	-	-	-	-	-	-	-	-	-
CO4	S	L	M	L	L	-	M	-	-	-	-	-
CO5	S	L	M	M	L	-	S	-	-	-	-	-
CO6	S	L	M	M	-	-	S	-	-	-	-	-
CO7	S	L	M	M	L	-	S	-	-	-	-	-

Code:	MCA-103	Computer Architecture & Organization	Credits: 04

Course Objectives:

1. To have a thorough understanding of the basic structure and operation of a digital computer.
2. To study the different ways of communicating with I/O devices and standard I/O interfaces.
3. To learn the architecture and assembly language programming of 8085microprocessor.
4. To study peripherals and their interfacing with 8085 microprocessor.

Course Outcome:

CO1: Explain about computer architecture
CO2: Understanding Logic gates, flip flops and counter
CO3: Pipeline processing
CO4: Compute simple arithmetic operations for fixed-point and Apply floating- point addition, subtraction, multiplication & division.
CO5: Develop a base for advance micro-processors
CO6: Learn the concepts of parallel processing, pipelining and inter processor communication.
CO7: Exemplify in a better way the I/O and memory organization.
CO8: Define different number systems, binary addition and subtraction, 2's complement representation and operations with this representation.

Unit-1:

Number system :Introduction to Number system, BCD, ASCII, Conversion of Numbers from one Number system to the other, Binary arithmetic, Signed numbers , 1"s and 2"s complement method.

Unit-2:

Logic Gates: Basic Logic Gates , Basic Theorems and Properties of Boolean Algebra , NAND, NOR implementation, Sum of Products, Product of Sums, Karnaugh map, Don't Care Conditions.

Unit-3:

Processor Organization :General Register Organization, Stack Organization, Addressing modes, Instruction codes, Instruction Formats.

Unit-4:

Control Unit :Register transfer and micro operations, Timing and Control, Control Memory, Micro programming, Hard wired control

Unit-5:

Introduction to Microprocessor : Internal Architecture, Instruction Set

Unit-6:

Input – Output organization :Peripheral Devices, Input /Output interface, Asynchronous Data Transfer (Strobe & Handshaking Method), Modes of Transfer,

Text Books:

1.	Carl Hamacher, Zvonko Vranesic and Safwat Zaky, "Computer Organization", Fifth Edition, Tata McGraw-Hill.

2.	John P. Hayes, "Computer Architecture and Organization", Third Edition.
3.	B. Govindarajulu, "Computer Architecture and Organization: Design Principles and Applications", Second Edition, Tata McGraw-Hill.
Reference Books	
1.	M. Morrris Mano, "Digital Logic and Computer Design", PHI.
2.	M. Morrris Mano, " Computer system architecture " 3rd Edition, PHI/ Pearson Education.
3.	Albert Paul Malvino, Donald P. Leach, " Digital Principles and Applications " , Tata Mc GrawHill Pub. Company Ltd.
4.	J.P.Hayes, " Computer Architecture and Organization" Tata Mc Graw Hill Pub. Company Ltd.

Mapping with Program Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	S	S	S	S	M	L	M	S	S	-		-
CO2	S	S	S	M	M	L	M	M	S	-	-	-
CO3	S	S	S	M	M	L	L	M	S	-	-	-
CO4	S	S	S	M	M	L	L	M	S	-	-	-
CO5	S	S	S	M	M	L	S	M	L	-	-	-
CO6	S	S	S	S	M	L	L	M	S	-	-	-
CO7	S	S	S	S	M	L	L	M	S	-	-	-
CO8	S	S	S	S	M	L	L	M	S	-	-	-

S- Strong; M-Medium; L-Low

Code:	MCA -104	Introduction to Management Functions	Credits: 04
Course Objectives In this paper, the domain specific knowledge from which most of the Computer applications arises will be imparted. Particulars, this paper is an overview of all functional areas of management namely, HRD, Marketing, Finance, Manufacturing, and Strategy. Some of these topics will be taught elaborately in subsequent papers.			
Course Outcomes			
CO1: Understanding of various management concepts and contribution of various management gurus. CO2: understanding the importance of planning and controlling and how to implement it. CO3: Study the motivation theories and use it in real world problems. CO4: understanding the quality concepts and social responsibility of Business.			
Unit-1:	**Introduction to Management**		
Definition, Characteristics of management, Importance of Management, Administration , Management thoughts: Contribution of F.W. Taylor , Henry Fayol , Peter Drucker, etc Management process school, Systems Management School,			
Unit-2:	**Planning and Controlling**		
Planning: Definition, Characteristics, Nature, Importance, Types of Plans:(Standing and Single Use Plans),Planning Process Controlling: Concept, Definition, Principles of Controlling, Objectives of controlling, Importance of Controlling			
Unit-3:	**Organizing**		
Concept, Definition, Process of organization, Principles of organization, Authority, Responsibility and Delegation, Forms of organization. Centralization and Decentralization			
Unit-4:	**Leadership and Motivation**		
Concept of Leadership, Definition, Qualities of Leadership, Leadership Styles Motivation: Meaning and Definition, Theories of Motivation1. Maslow‟s Need Hierarchy McGregor‟s Theory “X‟ and Theory „Y”			
Unit-5:	**Staffing**		
Human Resource Planning, Recruitment, Selection, Training, Training and development, Performance appraisal methods			
Unit-6:	**Quality Concepts and Social responsibility of Business**		
Total Quality Management, ISO, Quality Circle Social Responsibility of Business: Definition, Responsibilities towards owners, workers, consumers, suppliers, state, society etc.			
Text Books:			
1.	Essentials Of Management: Harold Koontz , Heinz Weihrich, Tata Mcgraw Hill.		
2.	Principles And Practice Of Management: Dr. S. C. Saxena, Sahitya Bhavan Publications.		
Reference Books			
1.	Principles Of Management: R. N. Gupta, S. Chand & Company		

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	S	S	M	L	M	S	S	-		-
CO2	S	S	S	M	M	L	M	M	S	-	-	-
CO3	S	S	S	M	M	L	L	M	S	-	-	-
CO4	S	S	S	M	M	L	L	M	S	-	-	-

S- Strong; M-Medium; L-Low

Code:	MCA -105	Mathematical Foundations	Credits: 04
Course Objectives Cultivate clear thinking and creative problem solving. Thoroughly train in the construction and understanding of mathematical proofs. Exercise common mathematical arguments and proof strategies.			
Course Outcomes At the end of the course student will be able to Understand the notion of mathematical thinking, mathematical proofs and to apply them in problem solving. Ability to understand use of functions, graphs and their use in programming applications. Apply discrete structures into computing problems, formal specification, artificial intelligence, cryptography, Data Analysis.			
CO1: Prove implication problems using truth table method, replacement process, Analyze method, truth table, technique, rules of inference method CO2: Obtain PCNF and PDNF of given logical expression CO3: Check the validity of the verbal or symbolic arguments using rules of inference CO4: Construct verbal arguments with predicates in symbolic form and also to validate them CO5: Represent the given relation in matrix, digraph and vice versa CO6: Verify a given function is objective or not, and also to find composition of functions CO7: Design Karnaugh map to get simplified form of a Boolean function CO8: Check whether the given grammar is regular or not using pumping lemma			
Unit-1:	**Set theory**		
Sets, Venn diagrams, Operations on Sets, Laws of set theory, Power set and Products, Partitions of sets, The Principle of Inclusion and Exclusion			
Unit-2:	**Prepositional calculus**		
Propositions and logical operations, Truth tables , Equivalence, Implications ,Laws of logic, Normal Forms, Predicates and Quantifiers, Mathematical Induction			
Unit-3:	**Relations and functions**		
Relations, Paths and Digraphs, Properties and types of binary relations , Operations on relations, Closures, Warshall‟s algorithm, Equivalence and partial ordered relations, Poset, Hasse diagram and Lattice ,Functions: Types of functions - Injective, Surjective and Bijective Composition of functions , Identity and Inverse function, Pigeon-hole principle			
Unit-4:	**Permutations and combinations**		
Permutations, Combinations, Elements of Probability, Discrete Probability and Conditional Probability, Generating Functions and Recurrence Relations, Recursive Functions, Introduction to Functional Programming			
Unit-5:	**Graph Theory**		
Graphs Definitions, Paths and circuits: Eulerian and Hamiltonian, Types of graphs, Sub Graphs Isomorphism of graphs			
Unit-6:	**Algebraic structure**		
Algebraic structures with one binary operation: semigroup, monoid and group, Abelian group Isomorphism, Homomorphism and Automorphism, Cyclic groups, Normal subgroups, Codes and group codes			

Text Books:	
1.	Discrete Mathematics and applications- K. H. Rosen, Tata McGraw Hill publishing Company
2.	Discrete Mathematical Structures- C. L. Liu, Second Edition, McGraw-Hill Book Company.
3.	Discrete Mathematical Structures- BernadKolman, Robert Busby, Pearson Education.
Reference Books	
1.	Discrete Mathematical Structures- Y N Singh, Wiley-India Press.
2.	Discrete Mathematics for Computer Scientists and Mathematicians- J. L. Mott, A.Kandel, Prentice Hall of India.
3.	Discrete Mathematical Structures with Applications to Computer Science- Discrete Mathematics for Computer Scientists and Mathematicians, Tata Mcgraw-Hill.

Mapping with Program Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	S	S	S	S	M	L	M	S	S	-		-
CO2	S	S	S	M	M	L	M	M	S	-	-	-
CO3	S	S	S	M	M	L	L	M	S	-	-	-
CO4	S	S	S	M	M	L	L	M	S	-	-	-
CO5	S	S	S	M	M	L	S	M	L	-	-	-
CO6	S	S	S	S	M	L	L	M	S	-	-	-
CO7	S	S	S	S	M	L	L	M	S	-	-	-
CO8	S	S	S	S	M	L	L	M	S	-	-	-

S- Strong; M-Medium; L-Low

Code:	MCA -106	Lab -1 C Programming	Credits: 02

Course Objectives

This Laboratory course will enable students to identify, formulate and solve real world engineering problems that require usage of algorithms in C. The course serves as a foundation laboratory for improving the problem solving skills of students.

Course Outcomes

At the end of the course student will be able to Understand the notion of mathematical thinking, mathematical proofs and to apply them in problem solving. Ability to understand use of functions, graphs and their use in programming applications. Apply discrete structures into computing problems, formal specification, artificial intelligence, cryptography, Data Analysis.

CO1: Design algorithms for the given problem specifications.
CO2: Write C programs for the designed algorithm specification.
CO3: Write C programs to implement linear data structures : Stack andQueue using arrays and linked list in an application context
CO4: Implement Non linear data structures: Graph, Trees, Hashtable in an application context
CO5: Implement specific sort algorithms in application context.
CO6: Generate different test cases for testing the validity of the developed programs
CO7: Write technical report on the observations from the experiments

Develop C programs for

1. Conditional and Iterative Structures
2. Arrays, Functions and Strings
3. Structures and Unions
4. Pointers
5. File Handling
6. Stack ADT implementation – Array implementation
7. Queue ADT implementation – Linked list implementation
8. Binary Search tree implementation
9. Hash table implementation
10. Graph representation and traversals
11. Sorting Algorithms:
    A) Sorting algorithm of O(n2)
    B) Sorting algorithm of O(n log n)

Note:

The Exercises are collection of program specifications shall be designed by the course instructor and assigned to the students.

Reference Books

1.	Brian W Kernighan & Dennis Ritchie, "The C programming language", 2nd Edition, Prentice Hall ,2015
2.	Yashavant Kanetkar," Let us C", BPB Publications 8th Edition, 2014
3.	Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Printice hall International, 2010.
4.	Mark Allen Weiss,"Data Structures and Algorithm Analysis in C", Pearson Education, 2011.
5.	Robert Kruse & Clovis L. Tondo " Data Structures and Program Design in C",Prentice Hall , 2012.

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	S	L	L	M	M	-	-	-	-	-
CO2	S	S	S	L	M	M	M	-	-	-	-	-
CO3	S	S	S	L	M	M	M	-	-	-	-	-
CO4	S	S	S	L	M	M	M	-	-	-	-	-
CO5	S	S	S	L	M	M	M	-	-	-	-	-
CO6	S	S	S	M	L	M	M	-	-	-	-	-
CO7	S	M	M	L	L	M	L	-	M	-	-	-

S- Strong; M-Medium; L-Low

Code:	MCA -107	Lab -2 Computer Organization & Architecture	Credits: 02

Course Objectives

This Laboratory course will enable students to learn various logic gates and logic circuits and perform the logical operations like flip-flops; Encoder, Decoder, etc. The course serves as a foundation laboratory for improving the logic building and perform electronic operations.

Course Outcomes

At the end of the course student will be able to Understand the notion of mathematical thinking, mathematical proofs and to apply them in problem solving. Ability to understand use of functions, graphs and their use in programming applications. Apply discrete structures into computing problems, formal specification, artificial intelligence, cryptography, Data Analysis.

CO1: Perform various logic circuit operations
CO2: Understanding the familiarity with IC-Chips.
CO3: Design Adder/ Subtracter
CO4: Understand the concepts of Multiplexer/ De-multiplexer

Develop C programs for

1. Review of the different logic design ckts.,
   e.g. a) Flip/Flop(RS, JK, D, T), b)Register,(4/8 bit Synchronized Data Transfer), c)Tri-state logic Gates
2. Familiarity with state of art IC-chips,
   e.g. a)Multiplexer , b) Decoder, c) Encoder, d) Counter, e)Shift-Register, f)adder Truth Table verification and clarification from Data-book.
3. Design a BCD adder.
4. Design an Adder/Subtracter composite unit .
5. Design a carry-look ahead Adder.
6. Design a ripple counter and carry-look ahead counter and assess the complexity of both the ckts.
7. Use a multiplexer unit to design a composite ALU .
8. Design a multiplex display unit using counter, multiplexer, decoder etc.
9. Design a keyboard Encoder unit in 2 Dimension.
10. Test a RAM chip and cascade two chips for vertical and horizontal expansion. Use wired OR tri-state output interconnection.
11. Use ALU chip for multibit arithmetic operation.

Note:

The Exercises are collection of program specifications shall be designed by the course instructor and assigned to the students.

Reference Books

1.	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", MIT Press, Third Edition 2009
2.	Tanaenbaum A.S.,Langram Y. Augestein M.J " Data Structures using C" Pearson Education , 2004
3.	Mark Allen Weiss,"Data Structures and Algorithm Analysis in C", Pearson Education, 2011.
4.	Robert Kruse & Clovis L. Tondo " Data Structures and Program Design in C",Prentice Hall , 2012
5.	Ellis Horrowitz et al.," Fundamentals of Data Structures in C", Silicon press, Second edition, 2007.

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	S	L	L	M	M	-	-	-	-	-
CO2	S	S	S	L	M	M	M	-	-	-	-	-
CO3	S	S	S	L	M	M	M	-	-	-	-	-
CO4	S	S	S	L	M	M	M	-	-	-	-	-

S- Strong; M-Medium; L-Low

Code:	MCA -108	Presentation Skills and Open Elective	Credits: 02

Presentation Skills Course Objectives

This course will enable students to learn various presentation skills and improve their soft skills. This course will also provide a platform to students to presentation. It will motivate them for public speaking.

Course Outcome:

CO1: Students will be able to make presentations and participate in group discussions with high level of self-confidence.
Co2: Students will be able to perform well in the interviews
Co3: They will have adequate reading and writing skills needed for workplace situations

Syllabus	Preparing slides with animation related to the current topic –organizing the material - Introducing oneself to the audience –introducing the topic –answering questions – individual presentation practice—presenting the visuals effectively –10 minute presentation

Guidelines for Seminar

1. Students need to confirm Presentation Topic with consent of guide

2. Student should submit the presentation report in hard copy (spiral binding) and Soft Copy (Report + Presentation) as per the guideline below

- 2.1 Introduction of Seminar Topic
- 2.2 Abstract of study
- 2.3 Survey/Analysis
- 2.4 Detail Study
- 2.5 Results
- 2.6 Conclusion
- 2.7 References

2. Student should Give Presentation (With PPT)

Open Elective Course Objectives

Students can choose one of the open electives offered by various schools of campus or the courses offered on various e-learning platforms like SWAYAM/MOOC/NPTEL, etc. But they need to take prior permission from School Director before joining one of these elective courses. \they must produce successful completion certificate / credits earned to the School after completing the underwent course.

Reference Books

1.	T. Meenakshi Raman and Sangeeta Sharma. Technical Communication: Principles and Practice. New Delhi: Oxford, 2009
2.	P. Bhatnagar. English for Competitive Examinations. 3rdEdition. New Delhi: Macmillan, 2009
3.	Kapoor, A. N. A Guide to Business Correspondence and Communication Skills. NewDelhi: S. Chand, 2004 (Revised & Enlarged Edition)
4.	Sadanand Kamlesh and Susheela Punitha. Spoken English: A Foundation Course.Part 2. Mumbai: Orient BlackSwan, 2009

Code:	MCA-201	System Analysis and Design	Credits: 04
Course Objectives:			
System analysis helps in discovering means to design systems where sub-system may have apparently conflicting objectives. It helps in achieving inter compatibility and unity of purpose of sub-systems. It offers a means to create understanding of the complex structures.			
Course Outcome:			
After successfully completing this course, students will understand concepts of Analysis and Designing Information Systems. Students will understand writing system proposals, system development scheduling, and cost-benefits analysis etc. also dealing with quality assurance.			
CO1: To learn basic things of systems, System development Life cycle, and System Analyst. CO2: To determine specific needs of system. CO3: Discuss approaches and tasks of system. Planning for developing system CO4: Evaluate tools and techniques. CO5: Use appropriate methods and techniques to design software. CO6: Implementation of Developed System, Evaluation and Testing of system.			
Unit-1:	**Introduction to Systems**		
System Definition, Characteristics, Elements and Types of system, Need of System Analysis and design, Role and Qualities of System Analyst, System Development Life Cycle			
Unit-2:	**Unit Name**		
Project Initiation, Feasibility study, Ascertaining HW/SW needs, Criteria for HW/SW selection, Make v/s Buy Decision, Cost Benefit Analysis			
Unit-3:	**Unit Name**		
Structured Analysis tools- DFD, Data Dictionary, Decision Tree, Decision Table, Structured English, Activity planning control, Activity Diagrams, Case modelling, UML, Class Diagram			
Unit-4:	**Unit Name**		
System Proposal, Project Scheduling, Information Gathering Tools- Interviews, Questionnaire, JAD, Prototyping			
Unit-5:	**Unit Name**		
System Design, Input/output Design, From Design, Database Design, File organization			
Unit-6:	**Unit Name**		
System Implementation Plan, Activity Network for Conversion, Combating Resistance to Change, System Testing, Test Plan AND test data, Types of System Test, Quality Assurance, Documentation			
Text Books:			
1.	System Analysis and Design, Kendall & Kendall, Pearson Education, Inc., Prentice Hall.		
Reference Books			
1.	Modern System Analysis and Design, Jeffrey A. Hoffer, Prentice-Hall, Inc.		
2.	System Analysis and Design, Awad E.M., Galgotia Publications Pvt. Ltd		

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	S	S	M	L	M	S	S	-		-
CO2	S	S	S	M	M	L	M	M	S	-	-	-
CO3	S	S	S	M	M	L	L	M	S	-	-	-
CO4	S	S	S	M	M	L	L	M	S	-	-	-
CO5	S	S	S	M	M	L	S	M	L	-	-	-
CO6	S	S	S	S	M	L	L	M	S	-	-	-

S- Strong; M-Medium; L-Low

Code:	MCA-202	Design and Analysis of Algorithms using C++	Credits: 04

Course Objectives:

Reinforce basic design concepts (e.g., pseudo code, specifications, top-down design)
Knowledge of algorithm design strategies
Familiarity with an assortment of important algorithms
Ability to analyze time and space complexity

Course Outcome:

CO1: Describe basic organization of computer and the architecture of 8086 microprocessor.
CO2: Implement assembly language program for given task for 8086 microprocessor.
CO3: Demonstrate control unit operations and conceptualize instruction level parallelism.
CO4: Demonstrate and perform computer arithmetic operations on integer and real numbers.
CO5: Categorize memory organization and explain the function of each element of a memory hierarchy.
CO6: Identify and compare different methods for computer I/O mechanisms

Unit-1:

Review of Algorithms , complexity notations, elementary data structures , Graphs and Trees Algorithms on graphs including searching algorithms like DFS and BFS , Shortest path Algorithms like , the Bellman-ford algorithm, the Dijkstra algorithm ,the Floyd-Warshall algorithm, Johnson‟s algorithm.

Unit-2:

Divide and conquer mechanism ,General method, binary search, merger sort, quick sort, Strassen‟ s matrix multiplication.

Unit-3:

The Greedy method ,The general method, container loading knapsack problem, job sequence with deadlines.

Unit-4:

Introduction to Spanning trees , Minimum Spanning Trees ,Growing a minimum spanning tree, the algorithms of Kruskal and Prim.

Unit-5:

Introduction to String matching: Robin – Karp algorithm, Knuth – Morris Pratt algorithm, Algorithm for parallel computers, parallelism, the PRAM models and simple PRAM algorithms. Amortized Analysis method , Aggregate Analysis, The Accounting Method Dynamic Programming mechanism : General method and one example.

Unit-6:

Introduction to NP completeness , Polynomial Time , Polynomial Time Verification , NP Completeness and reducibility, NP completeness proofs , NP completeness problems

Text Books:

1.	Fundamentals of Computer Algorithms, Ellis Horowitz, Satraj Sahani, Universities Press Inc
2.	Introduction to Algorithms, Corman , Leiserson and others , 2nd edition , PHI
3.	Design and Analysis of Algorithms , Dave and Dave , Pearson Education Inc

Reference Books

1.	Data Structures, Lipschutz , Tata McGraw Hills
2.	Design Methods and Analysis of Algorithms , S.K.Basu , PHI.

3.	The Art of Computer Programming, Vol 1,2,3 , Dr.Kunth , Addison Wesley
4.	The Design and Analysis of Computer Algorithms, Aho , Hopcroft and Ullman, Addison Wesley.

Mapping with Program Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	S	S	S	S	M	L	M	S	S	-		-
CO2	S	S	S	M	M	L	M	M	S	-	-	-
CO3	S	S	S	M	M	L	L	M	S	-	-	-
CO4	S	S	S	M	M	L	L	M	S	-	-	-
CO5	S	S	S	M	M	L	S	M	L	-	-	-
CO6	S	S	S	S	M	L	L	M	S	-	-	-

S- Strong; M-Medium; L-Low

Code:	MCA-203	Management Information System	Credits: 04

Course Objectives:

This is an active learning-oriented course designed to provide a managerial understanding and approach to the technical subject of Information System and Technology Management. The course will illustrate the important role that information systems play in an organization; and provide the student with a background to understand the subject and a foundation upon which to build his or her management decisions. Topics include Managing Information Assets, IT Technology and Strategy and IT Technology and Organization. This course is the capstone course for acquiring knowledge in Management Information System (MIS). It focuses on issues of real world application faced by the IT managerial professional in modern organizations.

Course Outcome:

CO1: Describe the changing organizational environment and the use of information technology to manage contemporary organizations;
CO2: Identify the business impacts of business and social networking, as well as ways the IT Managerial professional can leverage the new reality of human connectivity on the Internet;
CO3: Learn IT Managerial Professional leadership responsibilities and opportunities;
CO4: Apply MIS to current enterprise systems best practices in terms of the relationship between customer preferences and shareholder wealth;
CO5: Apply the technological foundations of information systems, i.e., hardware, software and telecommunications;
CO6: Evaluate the organizational context of information systems, including decision making and information processing concepts;
CO7: Identify best practices for one of the Internet's newest and most revolutionary technologies: cloud computing and ways it is shaping the new economics of business.

Unit-1:	Management Information system

Need, Purpose and objectives-contemporary approaches to MIS–Information as a strategic resources-use of information for competitive advantage-capital MIS as an instrument for the organizational change.

Unit-2:	Information Management and Decision Making

Model of Decision Making – Classical, administrative and Herbert Simon‟s Models, Attributes of Information & its relevant to decision making – Types of Information.

Unit-3:	Information Technology

Definition, IT Capabilities and their organizational impact – Telecommunication and Networks – Types and Topologies of Networks – IT in enabled Services such as call Centers, Geographical Information System etc

Unit-4:	DBMS & Systems Analysis and Design

Data warehousing and Data mining, System Development Life Cycle – Alternative Systems Building Approaches – Proto Typing Development Strategies-Structured Analysis -Prototyping- Rapid Developing Tool s – CASE Tool s –Object oriented systems (only introduction to these tools and techniques).

Unit-5:	Decision Support System

Group Support System – Executive Information Systems - Executive Support Systems –Experts Systems and Knowledge based Experts Systems – Artificial Intelligence.

Unit-6:	Management Issues in MIS
Information Security and controls- Quality assurance – Ethical and Social Dimension – Intellectual Property Rights as related to IT services/ IT products – Managing Global Information Systems.	
Text Books:	
1.	Brown, C.V., DeHayes, D.W., Hoffer, J.A., Martin, E.W., & Perkins, W.C. (2012). Managing Information Technology. (7th Ed). Pearson/Prentice Hall.
2.	Management Informant ion Systems, Jawadekar Tata McGraw Hill.
Reference Books	
1.	Management Information Systems-Landon 7th Edition, Pearson Education, Asia.
2.	Management Information Systems, Davis and Olson, Tata McGraw Hill .
3.	Management Information Systems, Jayant Oke.

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	S	-	L	-	L	-	L	-	-	L	-
CO2	L	M	-	L	-	-	-	M	-	-	L	-
CO3	S	S	S	M	M	-	-	L	-	L	L	-
CO4	S	S	S	M	L	-	-	M	S	L	L	-
CO5	S	S	S	M	M	L	S	M	L	-	-	-

S- Strong; M-Medium; L-Low

Code:	MCA-204	Probability and Statistics	Credits: 04
Course Objectives:			
Distinguish between quantitative and categorical data, Apply different statistical measures on data, Identify, formulate and solve problems, Classify different types of Probability and their fundamental applications			
Course Outcome:			
CO1: Apply probability theory via Bayes‟ Rule CO2: Describe the properties of discrete and continuous distribution functions CO3: Assess the sampling distribution, efficiency and biasedness of estimatorsUse statistical tests in testing hypotheses on data CO4: Analyze goodness of fit, ANOVA for one-way and two-way classification data			
Unit-1:	**Introduction to Probability**		
Random experiment, Sample space, Events, Axiomatic Probability, Algebra of events			
Unit-2:	**Conditional Probability**		
Conditional Probability, Multiplication theorem of Probability, Independent events, Baye's Theorem			
Unit 3:	**Random variables**		
Discrete random variable, Continuous random variable, Two-dimensional random variable, Joint probability distribution, Stochastic independence			
.			
Unit-4:	**Mathematical Expectation**		
Expected value of a random variable, Expected value of a function of a random variable, Properties of Expectation and Variance, Covariance, Binomial distribution –Poison distribution-Uniform distribution -Normal distribution			
Unit-5:	**Measures of Central Tendency &Measures of Dispersion**		
Frequency Distribution, Histogram, Stem and leaf diagram, ogives, Frequency Polygon, Mean, Median, Mode, Range, Quartile Deviation, Mean Deviation, Box whisker plot, Standard Deviation, Coefficient of Variation			
Unit-6:	**Skewness, Correlation & Regression**		
Karl Pearson's coefficient of Skewness, Bowley's coefficient of Skewness, Scatter Diagram, Karl Pearson's coefficient of correlation, Spearman's rank correlation coefficient , Linear Regression and Estimation, Coefficients of regression			
Text Books:			
1.	Fundamentals of Mathematical Statistics – 1st Edition S.C.Gupta, V.K.Kapoor , S Chand		
2.	Introduction to Probability & Statistics – 4th Edition J.Susan Milton, Jesse C. Arnold Tata McGraw Hill		
3.	Probability and Statistics with Reliability, Queuing, And Computer Science Applications (English) 1st Edition:Kishore Trivedi, PHI		
Reference Books			
1.	Fundamentals of Statistics : 7th edition S C Gupta, Himalaya Publishing house		
2.	Schaum's Outlines Probability, Random Variables & Random Process 3rd Edition Tata McGraw Hill		
3.	Probability & Statistics for Engineers: Dr J Ravichandran, Wiley		

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	-	L	L	-	-	L	L	-	L	-
CO2	L	-	M	-	M	-	S	M	-	-	L	-
CO3	S	L	-	-	S	L	-	S	-	S	-	-
CO4	S	M	M	S	-	-	M	S	-	M	-	-

S- Strong; M-Medium; L-Low

Code:	MCA -207	Lab -3 C++ Programming	Credits: 02

Course Objectives

This Laboratory course will enable students to identify, formulate all techniques of software development in the C++ Programming Language and demonstrate these techniques by the solution of a variety of problems spanning the breadth of the language.

Course Outcomes

At the end of the course student will be able to Understand the notion of mathematical thinking, mathematical proofs and to apply them in problem solving. Ability to understand use of functions, graphs and their use in programming applications. Apply discrete structures into computing problems, formal specification, artificial intelligence, cryptography, Data Analysis.

CO1: Explain the concepts of oops for building object based applications.
CO2: Write a program in different logic with suitable validations for a given problem.
CO3: Implement the techniques and features of the Object Oriented Programming constructs to construct an application.
CO4: Implement method overloading and method overriding for different user specifications.
CO5: Write programs implementing inheritance for an application domain.
CO6: Write technical report on the observations from the experiments.

Develop C++ programs for

1. Constructor and copy constructor.
2. Storage classes like auto, extern, register and static.
3. Static member data, static member function and bitwise operators.
4. Overloading and method overriding.
5. Inheritance
6. Pointer Arithmetic.
7. Inline Functions.
8. Functions & Recursion.
    a. Recursion
    b. Function with "this" pointer
9. Friend Function & Friend Class.
10. Exception handling methods.
11. Overload Unary & Binary Operators as Member Function & Non Member Function.
    a. Unary operator as member function
    b. Binary operator as non member function
12. Class Templates

Note:

The Exercises are collection of program specifications shall be designed by the course instructor and assigned to the students.

Reference Books

1.	Bjarne Stroustrup ,"The C++ Programming Language", 4th Edition, Addison-Wesley, 2015
2.	Scott Meyers," Effective C++ 55 Specific Ways to Improve Your Programs and Designs", Third Edition, Addison-Wesley, 2011
3.	Paul Deital & Harvey Deital, "C++ How to Program", 7th Edition, Pearson Education, 2010
4.	Stanley Lippman, "C++ Primer", 4th Edition, Pearson Education, 2007.
5.	Yashavant P. Kanetkar, "Let Us C++", BPB Publications, 2007.

6.	Robert Laffore, "Object Oriented Programming using C++", 4th Edition, Sams Publishing, 2002.

Mapping with Program Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	S	S	M	S	S	S	-	-	-	-	-	-
CO2	S	M	S	S	M	-	-	-	-	-	-	-
CO3	S	M	M	S	S	S	-	-	-	-	-	-
CO4	S	S	M	S	S	M	-	-	-	-	-	-
CO5	S	S	S	S	S	M	-	-	-	-	-	-
CO6	S	S	S	S	S	M	-	-	-	-	-	-

S- Strong; M-Medium; L-Low

Code:	MCA -208	Case Study and Open Elective	Credits: 02

Case Study Course Objectives

This course will enable students to learn how to develop a case study and improve their academic writing skills. This course will also provide a platform to students to improve their thinking process and develop a theoretical module on a real world problem.

Course Outcome:

CO1: Students will be able to write a report in the form of case study and participate in group discussions with high level of self-confidence.
Co2: Students will be able to develop a theoretical module.
Co3: They will have adequate reading and writing skills needed for workplace situations

Syllabus	Preparing a case study report with a PPT presentation on recent topic –organizing the material -Introducing oneself to the audience –introducing the topic –answering questions –individual presentation practice—presenting the visuals effectively –10 minute presentation
	Guidelines for Seminar

1. Students need to confirm case study with consent of guide

2. Student should submit the report in hard copy (spiral binding) and Soft Copy (Report + Presentation) as per the guideline below

- 2.1 Introduction of Topic
- 2.2 Abstract of study
- 2.3 Survey/Analysis
- 2.4 Detail Study
- 2.5 Results
- 2.6 Conclusion
- 2.7 References

2. Student should Give Presentation (With PPT)

Open Elective Course Objectives

Students can choose one of the open electives offered by various schools of campus or the courses offered on various e-learning platforms like SWAYAM/MOOC/NPTEL, etc. But they need to take prior permission from School Director before joining one of these elective courses. \they must produce successful completion certificate / credits earned to the School after completing the underwent course.

Reference Books

1.	Case Study Handbook: How to Read, Discuss and Write Persuasively About Cases by Ellet, Harvard Business Publication.
2.	Case Study Handbook, Revised Edition, William Ellet, Harvard Business Review

Code:	MCA 301	Software Engineering	Credits: 04
Course Objectives:			
To explain the basic terminologies and implement systems effectively using various system models. To comprehend the testing Process and software evolution in order to meet dynamic changing requirements. To develop understanding of advanced concepts and methods required for construction of large software systems. To apply project management strategies for effective software development.			
Course Outcome:			
CO1: Explain a process model for a software project Development. CO2: Prepare the SRS, Design document, Project plan of a given software system CO3: Apply Project Management and Requirement analysis, Principles to S/W project development. CO4: Analyze the cost estimate and problem complexity using various estimation techniques CO5: Generate test cases using the techniques involved in selecting: Analyze(a) White Box testing (b) Block Box testing CO6: Explain the advantages of configuration management and risk management activities.			
Unit-1:	Software, Software Engineering, and Process		
The nature of Software, The unique nature of WebApps, Software engineering-A layered technology, General principles of software engineering practice, Software myths, Agile development: What is an Agile Process?, Capability Maturity Model Integration (CMMI).			
Unit-2:	Process Models, Software Requirements & System Modeling		
A Generic process model (framework), Process assessment and improvement, Prescriptive process models: The waterfall model, Incremental process models, Evolutionary process models, The Unified process, Functional and Non-functional requirements; User requirements; The software requirements document, Requirements Engineering Processes: Requirements elicitation and analysis; Requirements validation; Requirements management, Context models; Behavioral models; Data models; Object models; Structured Methods.			
Unit-3:	Design concepts & Architectural Design		
Design Concepts, Architectural design decisions; System organization; Modular decomposition styles;			
Unit-4:	Object-Oriented design		
Objects and Object Classes; An Object-Oriented design process; Design Evolution			
Unit-5:	Verification and Validation & Software testing		
Planning verification and validation; Software inspections; automated static analysis; Verification and formal methods. System testing; Component testing; Test case design; Test automation, Quality management: Software Quality Assurance.			
Unit-6:	Project Management & Software Cost Estimation		
Management activities; Project planning; Project scheduling; Risk management. Software Productivity; Estimation techniques; The COCOMO II Model, Project duration and staffing.			
Text Books:			
1.	Roger S. Pressman. Software Engineering -A Practitioners approach. McGraw-Hill,		

	2007, 7thEd.
2.	Ian Sommerville. Software Engineering. Pearson Education Publications, 2007,8thEd.
Reference Books	
1.	Shari Lawrence Pfleeger, Joanne M. Atlee. Software Engineering Theory and Practice. Pearson Education, 2006, 3rdEd.
2.	Waman S Jawadekar. Software Engineering Principles and Practice, Tata McGraw Hill, 2004

Mapping with Program Outcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	M	-	M	M	S	L	L	M	S	L	L	-
CO2	L	-	L	M	M	L	L	M	M	-	M	L
CO3	L	L	S	M	M	L	L	L	S	L	L	L
CO4	M	-	M	L	M	M	L	S	L	L	L	M

S-Strong; M-Medium; L-Low

Code:	MCA-302	Visual Programming Tools	Credits: 04

Course Objectives:

Design and Develop professional console and window based .NET application.
Construct classes, methods and assessors and instantiate objects.
Create and manipulate GUI components in VB.
Design and Implement database connectivity using ADO.NET in window based application.
Identify industry defined problem and suggesting solution(s) using .NET applications

Course Outcome:

Upon completion of this course, the student will be able apply technical knowledge and perform specific technical skills, including design web applications using ASP.NET.

CO1: This course will cover the practical aspects of multi-tier application development using the .NET framework.
CO2: This course is to introduce the basics of distributed application development.
CO3: Technologies covered include the Common Language Runtime (CLR), .NET framework classes, VB, ASP.NET, and ADO.NET.
CO4: It cover service oriented architecture, design, performance, security, content managements and deployment issues building multi-tier applications.

Unit-1: Web Components

Introduction to Internet, Web Client/Server Model, Protocols for Web Client/Server Communication, Understanding Web Server IIS.

Unit-2: Introduction to ASP.NET

DOT NET Framework, CLR, Framework Class Library, Garbage Collection, MSIL, Web Services, COM+ Component Services, Intro to ASP.NET, ASP.NET and HTML Controls, ASP.NET Events and Events Handler.

Unit-3: Web Programming with VB.

Data Types, Variables, Expressions, Flow Control, Operators, Conditional Statements, Looping Structures, Arrays, OOP Concepts, Objects, Properties, Methods, Classes, Scope, Events

Unit-4: Essentials ASP.NET

Working with Web forms, Directory Structure in ASP.NET, ASP.NET Compilation Model, Code behind Model, Working with Web form Controls, Navigation Controls, Validation Controls, Validation Groups, Client/Server Side Validation.

Unit-5: ASP.NET Master Page

ASP.NET Master Page Overview, Master Page Layout with CSS, Master Page Directive and Content Place Holder, Creating and Applying Themes, Cookies, ASP.NET Session State, Application State

Unit-6: Data Access with ADO.NET

Working with ADO.NET, Overview of ADO.NET Objects, Working with Connection Object, Command Object, Data Adapter Object, Data Set Object, Data Reader Object, Data Table Object.

Text Books:

1.	ASP.NET3.5 in C# and VB- Bill Evjen, S. Hanselman, Devin Rader, Wrox Publication
2.	Ado.Net: The Complete Reference- Michael Otey, Tata McGraw-Hill Education
3.	ASP.net – The Complete Reference- Matthew MacDonald, Tata McGraw Hill

Reference Books

1.	ASP.NET and VB.NET Web Programming - Coruch Matt J, Addison Wesley.
2.	Beginning ASP.NET - John Wiley and Sons, Wrox Publication.
3.	ASP.NET in C# and VB- Bill Evjen, S. Hanselman, Devin Rader, Wrox Publication

Mapping with Program Outcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	S	S	S	-	M	L	M	S	S	-		-
CO2	S	S	S	M	M	L	M	M	S	-	-	-
CO3	S	S	S	M	M	L	L	M	S	-	-	-
CO4	S	S	S	M	M	L	L	M	S	-	-	-

S- Strong; M-Medium; L-Low

Code:	MCA-303	Data Communications & Computer Networks	Credits: 04

Course Overview

At the end of the course, students will be able to understand basic computer network technology. Understand and explain various components of computer networks. Identify the different types of network topologies and protocols. Enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of each layer. Identify the different types of network devices and their functions within a network. Understand and build the skills of routing mechanisms.

Course Outcome

CO1: Describe the building blocks of Computer Networks
CO2: Explain the functionalities and protocols of various layers in ISO/OSI Network model.
CO3: Implement a suitable routing strategies for a given network
CO4: Use suitable transport/application layer protocol based on application requirements
CO5: Suggest appropriate access control, congestion control and congestion avoidance technique for a given traffic scenario
CO6: Examine performance analysis for a network using tools like NS2, wire shark

Unit-1:	**Fundamentals and Link layer**

Building a network – Requirements – Layering and protocols – Internet Architecture – Network software – Performance ; Link layer Services – Framing – Error Detection – Flow control

Unit-2:	**Medium Access Control**

Media access control – Ethernet (802.3) – Wireless LANs – 802.11 – Bluetooth – Switching and bridging

Unit-3:	**Routing**

Routing (RIP, OSPF, metrics) – Basic Internetworking (IP, CIDR, ARP, DHCP, ICMP)Switch basics – Global Internet (Areas, BGP, IPv6), Multicast – addresses – multicast routing

Unit-4:	**Transport layer**

Overview of Transport layer – UDP – Reliable byte stream (TCP) – Connection management – Flow control – Retransmission – TCP Congestion control – Congestion avoidance (DECbit, RED) – QoS – Application requirements

Unit-5:	**Traditional Applications**

Traditional applications -Electronic Mail (SMTP, POP3, IMAP, MIME) – HTTP – Web Services – DNS – SNMP

Unit-6:	**Socket Programming**

TCP and UDP socket programming , Client server paradigm

Text Books:

1.	Andrew S. Tanenbaum, "Computer Networks", 4th ed., Prentice Hall, 2003.
2.	Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.

Reference Books

1.	William Stallings, Data and Computer Communications, Tenth Edition, Pearson

	Education, 2013.
2.	James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet, Sixth Edition, Pearson Education, 2013.

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	M	L	L	M							
CO2	L	M	L	L	M							
CO3	S	S	S	L	S			L				
CO4	S	S	S	L	S			L				
CO5	S	S	S	S	S			L				
CO6	S	S	S	S	S			L				

S- Strong; M-Medium; L-Low

Code: MCA 304	Relational Data Base Management System	Credits: 04

Course Objectives :

1. To understand the features of Relational database.
2. To describe data models and schemas in DBMS.
3. To use SQL- the standard language of relational databases for database operations.
4. To understand the functional dependencies and design of the databases.

Course Outcome :

CO1: To study the basic concepts of relational databases
CO2: Learn and practice data modeling using the entity-relationship and developing database designs.
CO3: Understand the use of Structured Query Language (SQL) and learn SQL syntax for writing queries.
CO4: Apply normalization techniques to normalize the databases.

Unit-1:	Introduction Database Concepts

Introduction, characteristics of databases, components of databases, users of database system, DBMS system architectures, database administrator.

Unit-2:	Entity–Relationship Data Model

Introduction, benefits of data modeling, types of models, phases of database modeling, the Entity-Relationship (ER) Model, generalization, specialization and aggregation, Extended Entity-Relationship (EER) Model, keys and relationships issues.

Unit-3:	Relational Model and Algebra

Introduction, mapping the ER and EER Model to the Relational Model, data manipulation, advantages of the relational model, relational algebra, relational algebra queries, relational calculus.

Unit-4:	Structured Query Language (SQL)

Overview of SQL, data definition commands, set operations, aggregate function, null values, data manipulation commands, data control commands, views in SQL, nested and complex queries.

Unit-5:	Integrity and Security in Database

Domain constraints, referential integrity, assertions, trigger, security policies and authorization in SQL

Unit-6:	Relational–Database Design

Design guidelines for relational schema, function dependencies, Normal Forms- 1NF, 2 NF, 3NF, BCNF ,4NF, 5NF

Text Books:

1.	An Introduction to Database System, Bipin Desai, Galgotia Publications

Reference Books

1.	Database System Concepts, Korth, Slberchatz,Sudarshan, 6th Edition, McGraw Hill Publications
2.	Fundamentals of Database Systems,Elmasri and Navathe, 5thEdition, PEARSON Education.
3.	Database Management Systems,Raghu Ramkrishnan and Johannes Gehrke,TMH
4.	Ivan Bayross, SQL-PLSQL, BPB Publications

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	-	S	-	-	S	-	L	-	-	S	-
CO2	S	-	M	-	S	-	L	M	-	-	-	-
CO3	L	-	-	-	L	-	-	-	-	-	M	M
CO4	S	-	-	-	-	-	-	-	-	-	L	L
CO5	S	-	-	-	-	-	-	-	-	-	M	M

S- Strong; M-Medium; L-Low

Code:	MCA-305	Graph Theory	Credits: 04
Course Objectives:			
1. To understand and apply the fundamental concepts in graph theory 2. To apply graph theory based tools in solving practical problems 3. To improve the proof writing skills.			
Course Outcome:			
The students will be able to apply principles and concepts of graph theory in practical situations			
CO1: Use the discrete methods in subsequent courses in the design and analysis of algorithms, computability theory, and software engineering and computer systems. CO2: Reason mathematically about basic data types and structures used in computer algorithms and systems; distinguish rigorous definitions and conclusions from merely plausible ones; synthesize elementary proofs, especially proofs by induction. CO3: Demonstrate an appreciation for the power of mathematics, Create mathematical models for variety of problems CO4: Be exposed to concepts and properties of algebraic structures such as semi groups, monoids and groups. CO5: Be aware of a class of functions which transform a finite set in to another finite set which relates to input output functions in computer science. CO6: Demonstrate the capacity to engage in logical thinking and Critically read technical information. Define, evaluate and perform operations on functions.			
Unit-1:	**Unit Name**		
Preliminaries: Graphs, isomorphism, sub-graphs, matrix representations, degree, operations on graphs, degree sequences Connected graphs and shortest paths: Walks, trails, paths, connected graphs, distance, cut-vertices, cut-edges, blocks, connectivity, weighted graphs, shortest path algorithms			
Unit-2:	**Unit Name**		
Trees: Characterizations, number of trees, minimum spanning trees Special classes of graphs: Bipartite graphs, line graphs, chordal graphs			
Unit-3:	**Unit Name**		
Eulerian graphs: Characterization, Fleury's algorithm, chinese-postman-problem Hamilton graphs: Necessary conditions and sufficient conditions			
Unit-4:	**Unit Name**		
Independent sets, coverings, matchings: Basic equations, matchings in bipartite graphs, perfect matchings, greedy and approximation algorithms Vertex colorings: Chromatic number and cliques, greedy coloring algorithm, coloring of chordal graphs, Brook's theorem			
Unit-5:	**Unit Name**		
Edge colorings: Gupta-Vizing theorem, Class-1 graphs and class-2 graphs, equitable edge-coloring			
Unit-6:	**Unit Name**		
Planar graphs: Basic concepts, Eulers formula, polyhedrons and planar graphs, characterizations, planarity testing, 5-color-theorem Directed graphs: Out-degree, in-degree, connectivity, orientation, Eulerian directed graphs, Hamilton directed graphs, tournaments			

Text Books:		
1.	J.A.Bondy and U.S.R.Murty: Graph Theory and Applications (Freely downloadable from Bondy's website; Google-Bondy)	
2.	D.B.West: Introduction to Graph Theory,Prentice-Hall of India/Pearson, 2009 (latest impression)	
Reference Books		
1.	R.Diestel: Graph Theory,Springer(low price edition) 2000.	
2.	Graph Theory with Applications to Engineering and Computer Science,byNarsingDeo,PHI(1979)	

Mapping with Program Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	S	S	-	-	-	M	-	-	-	M	M	S
CO2	S	S	-	-	-	M	-	-	-	M	M	S
CO3	S	S	-	-	-	M	-	-	-	M	M	S
CO4	S	S	-	-	-	M	-	-	-	M	M	S
CO5	S	S	-	-	-	M	-	-	-	M	M	S

S- Strong; M-Medium; L-Low

Code:	MCA 306	Lab-5 Visual Programming Tools	Credits: 02

Course Objectives:

This course will cover the practical aspects of multi-tier application development using the .NET framework. This course is to introduce the basics of distributed application development. Technologies covered include the Common Language Runtime (CLR), .NET framework classes, VB, ASP.NET, and ADO.NET. It also cover service oriented architecture, design, performance, security, content managements and deployment issues building multi-tier applications.

Course Outcome:

Upon completion of this course, the student will be able to develop static and dynamic web pages and perform specific technical skills, including design web applications using ASP.NET.

CO1: Design, document, code and test small VB console and GUI applications.
CO2:Design, document, code and unit test class libraries as part of a larger projects
CO3: Use an object browser and .NET documentation to examine VB and the .NET framework namespace contents.
CO4:Use the Visual Studio IDE to create and debug application and class library solutions and projects

List of Experiments

1. Simple application using web controls a) Finding factorial Value b) Money Conversion c) Quadratic Equation d) Temperature Conversion e) Login control
2. States of ASP.NET Pages
3. Ad-rotator Control
4. Calendar control a) Display messages in a calendar control b) Display vacation in a calendar control c) Selected day in a calendar control using style d) Difference between two calendar dates
5. Tree-view control a) Tree-view control and data-list b) Tree-view operations
6. Validation controls
7. Query textbox and Displaying records
8. Display records by using database
9. Data-list link control
10. Data-binding using drop-down-list control
11. Inserting record into a database
12. Deleting record into a database
13. Data-binding using data-list control
14. Data-list control templates
15. Data-binding using data-grid
16. Data-grid control template
17. Data-grid hyperlink
18. Data-grid button column
19. Data-list event
20. Data-grid paging
21. Creating own table format using data-grid

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	-	-	-	M	-	-	-	M	M	S
CO2	S	S	-	-	-	M	-	-	-	M	M	S
CO3	S	S	-	-	-	M	-	-	-	M	M	S
CO4	S	S	-	-	-	M	-	-	-	M	M	S

S- Strong; M-Medium; L-Low

Code:	MCA 307- Lab-6	RDBMS	Credits: 02

Course Objectives:

This course aims at giving adequate exposure to students on the Database design and E-R modelling. The course also facilitates students with hands on training on SQL and programming language extension to SQL within the RDBMS environment.

Course Outcome:

CO1: Model Entity Relationship with E-R diagrams
CO2: Design database schema considering normalization and relationships within database
CO3: Write SQL queries to user specifications
CO4: Develop triggers, procedures, user defined functions and design accurate and PLSQL programs in Oracle and DB2.
CO5: Use the database from a front end application
CO6: Prepare technical report on the observations of the experiments

List of Experiments

1. Basic SQL – DDL & DML, Views, Group operations, aggregate operations, System operations in Oracle
2. Intermediate SQL –Joins, Subqueries, DCL operations
3. Advanced SQL – Nested tables, V-arrays
4. ER Modeling
5. Database Design and Normalization
6. Stored procedures and using them in a client application
7. Triggers and their front end application
8. DBA mechanisms – Installation, Backup and recovery operations, Batch processing

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	-	-	-	M	-	-	-	M	M	S
CO2	S	S	-	-	-	M	-	-	-	M	M	S
CO3	S	S	-	-	-	M	-	-	-	M	M	S
CO4	S	S	-	-	-	M	-	-	-	M	M	S
CO5	S	M	L	-	-	M	-	-	-	-	-	-
CO6	-	S	L	-	-	M	-	-	-	-	-	-

S- Strong; M-Medium; L-Low

Code:	MCA 308	Professional Practices	Credits: 02

Course Objectives:

The purpose of introducing professional practices is to provide opportunity to students to undergo activities which will enable them to develop confidence. Industrial visits, expert lectures, seminars on technical topics and group discussion are planned in a semester so that there will be increased participation of students in learning process.

Course Outcome:

Student will be able to: Acquire information from different sources, Prepare notes for given topic., Present given topic in a seminar., Interact with peers to share thoughts., Prepare a report on industrial visit, expert lecture.

Unit-1: Guest Lectures: (Any Two)

Guest lectures by industry experts, other professional are to be arranged from the following topics or any other suitable technical area. The brief report is to be submitted by individual student as part of term work.

1. 3-D animation techniques. 2. Stress management. 3. IT Act 2008. 4. Linux installation and administration. 5. Resume writing and preparation of C.V. 6. Introduction of "Python" programming language. 7. Career opportunities in IT industry. 8. Plastic Memory 9. Psychological Personality Development. 10. Managing emotional quotient 11. Internet Marketing. 12. Any Other Relevant Topic.

Unit-2: Information Search: (Any Two)

Form a group of 2 students. Information should be collected from various resources like Internet, books, journals etc. on the following allocated topics or any other suitable topic suggested by guide.

Prepare Individual technical report on selected topics of 8-10 pages and deliver seminar on at least one topic.

1. Android O.S. of mobile systems. 2. Autonomic computing to manage complexity of network components. 3. Cloud computing application (any one). 4. Biometrics – in secure E-transactions. 5. Pervasive Computing 6.E–MINE: A novel web mining approach 7. 5G wireless systems 7.Jini – advanced set of network protocols 8.Parasitic Computing 9.E – wallet 10.Any other relevant topic.

Unit-3: Group Discussion: (Any One)

Form a group of 5 students and write a brief report on selected topic as a part of term work.

Some of the suggested topics: 1.Role of UN in peace keeping 2.Effect of cinema on youth 3.Government contribution to IT 4.Balance between professionalism and family 5.Position of women India compare to other nations. 6. Present state of Indian Cricket Team 7.Is globalization really necessary? 8. Is India growing spiritually? 9. Any other suitable topic.

Unit-4: Mini Projects:

A group of 6to8 students be formed for group discussion; 1. Prepare a report on Computerization of Lab or Office 2. E-learning Open source Application installation and demonstration to educational institution.3. Any other relevant topics.

Unit-5: Prepare Yourself : (Any Two)

Preparation towards Interview. Write a brief report on selected topic as a part of term work.

1. Mock Interview 2.Mock aptitude test and puzzle solving. (Attach answer paper) 3.CV Preparation.(Attach CV). 4. Any other relevant activity.

Unit-6: Social Contribution:

Socially Relevant activities Conduct any one activity through active participation of students and write the report Group of students – maximum 4 Report – not more than 6 pages List of suggested activities – (Activity may be thought in terms of campus improvement) i) Go green movement ii) Literacy camps iii) Building ethical and moral values iv) Conservation of electrical energy v) Water conservation vi) Clean campus / city vii) Awareness to avoid use of plastic carry bags viii) Educating students / people about fire fighting equipment ix) Rain water harvesting x) Traffic management within campus / city.

Reference Books		
1.	Books on personality development and soft skills.	
2.	Engineering Subjects Reference books.	
3.	Journals and Magazines –IEEE journals, IT Technologies, PC Quest, Linux for You, CSI, Computer Today etc.	
4.	Local News Paper. 5.Books on General Knowledge, Aptitude Test, Puzzle Solving by – R .S. Agarwal, Shakuntala Devi	
5.	Websites - www.groupdiscussion.com - www. Seminarprojects.com	

Code:	**MCA 308**	**Open Elective**	**Credits: 02**
Course Objectives:			
University Recognized MOOC (NPTEL/ SWAYAM/ Others) OR Intra/Inter Departmental OR Intra/ Inter School Open Electives			
Course Outcome:			
Students can choose one of these open electives. But they need to take prior permission from School Director before joining one of these elective courses. \they must produce successful completion certificate / credits earned to the School after completing the underwent course.			

Code:	MCA-401	COMPILER DESIGN	Credits: 04

Course Objectives:

To discuss the techniques of scanning, parsing & semantic elaboration well enough to build or modify front end.

To expose the critical issues in modern compilers & provide them with the background to tackle those problems.

Course Outcome:

CO1: Identify all essential steps for automatically converting source code into object code.(Understand)

CO2: Generate the low-level code for calling functions/methods in modern languages. (Apply)

CO3: Discuss opportunities for optimization introduced by naïve translation and approaches for achieving optimization such as instruction selection, instruction scheduling, register allocation, and peephole optimization.(Apply)

CO4: Interpret benefits and limitations of automatic memory management. (Understand)

CO5: Explain advantages, disadvantages and difficulties of just in time and dynamic recompilation. (Understand)

Unit-1: Introduction to Compiling and Lexical Analysis

Definition, analysis of the source program, the phases of a compiler, the grouping of phases, Compiler- Construction tools, The role of the Lexical analyzer, Input buffering, Specification of Tokens, A Language for Specifying Lexical Analyzers, Design of a Lexical Analyzer generator.

Unit-2: Syntax Analysis

The role of the Parser, Context-free grammars, Writing a Grammar, Top-Down Parsing, BottomUp Parsing, Operator-precedence Parsing, LR-Parsers, Using Ambiguous Grammars, Parser Generators.

Unit-3: Syntax-Directed Translation

Definitions, Construction of Syntax Trees, Bottom-Up Evaluation of S-attributed definitions, Top-Down Translation, Bottom-Up Evaluation of Inherited attributes.

Unit-4: Intermediate Code Generation

Intermediate Languages, Declarations, Assignment Statements, Boolean Expressions, Case Statements, Back patching, Procedure Calls.

Unit-5: Code Generation

Issues in the Design of a Code Generator, The target Machine, Run-Time Storage Management, Basic Blocks and Flow Graphs, Next-Use Information, Simple Code Generator, Register allocation and Assignment, The DAG Representation of Basic Blocks, Generating Code from DAGs, Dynamic Programming, Code-Generation Algorithm, Code-Generators.

Unit-6: Code Optimization

Peephole Optimization, Principal sources of optimization, Introduction to Global data flow analysis.

Text Books:

1.	Aho, Sethi, Ullman, Compilers-tools and Techniques, Addison Wesley, 1987
2.	Trembly, Sorenson,Theory and Practice of Compiler Writing, McGraw Hill, 1984.
3.	Hopcroft, Introduction to Automata Theory, Languages and Computation, Pearson Publication
Reference Books	
1.	Paul G. Sorenson, Compiler Writing, Tata McGraw Hill.
2.	Hunter, The Essence of Compilers, Pearson Publication
3.	Lewis, Elements of the Theory of Computation, Pearson Publication

Mapping with Program Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	M	-	M	-	-	S	-	L	-	-	S	-
CO2	S	-	S	-	S	-	L	M	-	-	-	-
CO3	L	-	-	-	L	-	-	-	-	-	S	M
CO4	S	-	-	-	-	-	-	-	-	L	L	L
CO5	S	-	-	-	-	-	-	-	S	-	M	M

S- Strong; M-Medium; L-Low

Code:	MCA 402	Java Programming	Credits: 04
Course Objectives:			
The objective of this course is to create Java programs that leverage the object-oriented features of the Java language, such as encapsulation, inheritance and polymorphism, use data types, arrays and other data collections, implement error-handling techniques using exception handling, create and event-driven GUI using Applet.			
Course Outcome:			
CO1: To design, write, compile, test and execute straightforward programs using a high level language. CO2: To implement, compile, test and run Java programs comprising more than one class, to address a particular software problem CO3: To demonstrate the ability to use simple data structures like arrays in a Java program. CO4: To demonstrate the ability to employ various types of selection constructs in a Java program. CO5: To employ a hierarchy of Java classes to provide a solution to a given set of requirements.			
Unit-1:	**Introduction to java:**		
History, Features, Java program structure, Java tokens, Java Statements, Java virtual machine, Command line arguments, Constants, Variable, Data types, Decision making and branching, looping, Class, Methods, Objects, Method overloading, Nesting of methods			
Unit-2:	**Inheritance and System packages**		
Overriding methods, Final variables, Final methods, Final Classes, Abstract methods, Abstract Classes, Visibility Control, Arrays, Strings, Vectors, Naming conventions, Creating and accessing packages, Introduction to multithreaded programming, Creating and extending threads, Life cycle of thread, Thread exception, Thread priority, Synchronization, Exception handling, Multiple catch statements, finally statement, Throwing our own exceptions, Exception for debugging			
Unit-3:	**Applets and Graphics**		
Applet code, Applet life cycle, creating an executable applet, designing a web page, Applet tag, passing parameter to applet, Lines, Rectangles, Circles, Ellipses, Arcs, Polygons, Line graphs, Bar charts, Control loops in applet			
Unit-4:	**Java Database Connectivity**		
The design of JDBC, JDBC driver types, Basic JDBC programming, concept.			
Unit-5:	Java Beans and Swing:		
Introduction to Java Bean, Advantages of Java beans, Application Builder tools, Using BDK, JAR Files, JApplet, JIconsand Labels, Textfields, Buttons, Combo Boxes, Scroll panes, Trees, Tables, Menu, Bars and Menus, Tool Bars, Dialog Boxes, File dialog, Progress Bar.			
Unit-6:	**Servlets**		
Servlets and Java Server Pages : The life cycle of a servlets, Using Tomcat for server development, A simple servlet, Using cookies, Session Tracking, Introduction to java server pages, A simple JSP, example, Scripting.			

Text Books:	
1.	Programming with Java A Primer – E.Balaguruswamy, McGrawhill
2.	Java 7 Programming Black Book - Kogent Learning Solutions Inc, Dream Tech press
Reference Books	
1.	Java Fundamentals A comprehensive introduction- Herbert Schildt, Dale Skrien, McGraw Hill.
2.	The Complete Reference, Java 2 – Herbert Schild, Fourth Edition, - TMH.
3.	Core Java Volume-I Fundamentals- Horstmann and Cornell, - Pearson Education.

Mapping with Program Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	S	S	S	-	S	S	S	-	S	-	L	-
CO2	S	S	S	-	S	S	S	-	S	-	-	-
CO3	M	S	S	-	M	S	S	-	S	-	L	-
CO4	L	M	S	-	L	M	S	-	L	-	L	-

S- Strong; M-Medium; L-Low

Code:	MCA-403	Operating System Concepts	Credits: 04

Course Objectives:

1. To learn the fundamentals of Operating Systems.
2. To learn the mechanisms of OS to handle processes and threads and their communication
3. To learn the mechanisms involved in memory management in contemporary OS
4. To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols
5. To know the components and management aspects of concurrency management
6. To learn programmatically to implement simple OS mechanisms

Course Outcome:

Students will be able to:

CO1: Analyze the structure of OS and basic architectural components involved in OS design

CO2: Analyze and design the applications to run in parallel either using process or thread models of different OS

CO3: Analyze the various device and resource management techniques for timesharing and distributed systems

CO4: Understand the Mutual exclusion, Deadlock detection and agreement protocols of Distributed operating system

CO5: Interpret the mechanisms adopted for file sharing in distributed Applications

CO6: Conceptualize the components involved in designing a contemporary OS

Unit-1: Introduction

Introduction: System structure, user perspective, operating system services, system commands, assumption about Hardware, Shell Programming: Bourne shell and C shell programming, variables, constants, environments, control structures, shell scripts examples

Unit-2: Introduction to Kernel

Architecture of Unix Operating system, System concepts, kernel data structures, system administration.

Unit-3: Internal Representation of files

Inodes, Structure of a regular file, Directories, super block, Inode assignment to new file, allocation of disk blocks

Unit-4: System Calls for the file System

Open, Read, Write, file and recording locking, close, file creation, creation of special files, change directory and change root.

Unit-5: Structure of process

Process states & Transition, layout of system memory, layout of the kernel, Context of process, saving the context of the process, SLEEP

Unit-6: Process Control

Process creation, signals, process Termination, awaiting process termination, invoking other Programs, UID of a process, changing the size of a process, The shell, system boot and the init process.

Text Books:

1. Andrew Tanenbaum, **"**Modern Operating Systems**"**, Fourth Edition, Pearson Education,Global edition
2. Abraham Silberschatz, Greg Gagne, Peter B. Galvin, **"**Operating System

	Concepts", 9th edition, Wiley,
Reference Books	
1.	The Design of the Unix operating System by Maurice J. Bach
2.	Unix System Administration A Beginner"s Guide by Steve Maxwell publishing by McGraw-Hill/Osborne
3.	Learning the Unix Operating By Jerry Peek, Grace Todino & John Strang; ISBN 1-56592-390-1, 4 thEd. O"REILLY
4.	William Stallings, Operating Systems, Prentice Hall.
5.	Harvey M. Deitel, An introduction to operating systems. Addison-Wesley.

Mapping with Program Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	L	S	L	S	L							
CO2	S	M	M	S	M	S						
CO3.	S	M	M	S	M	S						
CO4.	S	S	S	S	S	L		L				
CO5.	S	S	S	S	S	L		L				
CO6.	L	S	M	L	M	L		L				

S- Strong; M-Medium; L-Low

Code:	MCA-404 (a)	Software Metrics and Project Management	Credits: 04

Course Objectives:

At the end of this course the students will Understand

1. Understand the five process groups and nine knowledge areas of the PMI Book.
2. Understand approaches for managing and optimizing the software development process.
3. Understand efficient techniques for managing each phase of the systems development lifecycle, Use and application of tools to facilitate the software project management process.

Course Outcome:

CO1: Software Project Management covers details about handling the project activities.
CO2: To study about the principals and modern software project management practices.
CO3**:** TO understand the five process groups and nine knowledge areas of the Project Management Institute Body of Knowledge (PMI BOK) are examined in the context of the systems development lifecycle.
CO4: Portfolio management and the use and application of software project management tools are also discussed

Unit-1: Fundamentals of Project Management

Definition, Characteristics of Project, Types of Project, Project Phases, Project management Process, Project life cycle, Project Life Cycle Models

Unit-2: Project formulation

Significance of project formulation, Step-Wise Approach to Project formulation, Feasibility analysis, Cost Benefit Analysis, Cash flow forecasting, Return on Investment.

Unit-3: Software project Approach Selection

Project Vs Activity, Activity Planning, Planning Approaches, Process models, Waterfall model, V Model, Spiral model, Software prototyping, appropriate model selection

Unit-4: Software Effort Estimation

Software estimation techniques, Estimation Approaches, Definition of Project scheduling, Project controls and importance, Network techniques of Project Management: Gantt chart, CPM, PERT, COCOMO

Unit-5: Risk and Uncertainty Decisions

Project Risk, Types of Project Risk, Identification of Risk, Risk Prioritization, Project risk Analysis, Qualitative analysis and Quantitative analysis, Sensitivity Analysis, Break Even analysis, Risk Planning

Unit-6: Resource Allocation

Resources, Barman's Priority list, Cost Schedules, Software quality assurance, relation between software quality and software productivity, Role of project manager in software development

Text Books:

1. Software Project Management, Bob Hughes and Mike Cottrell, Tata McGraw Hill.
2. Project Management, S. Chaudhary, Tata McGraw Hill.

Reference Books

1.	Project-Preparation, Appraisal, Budgeting and Implementation, Prassna Chandra, Tata McGraw Hill.
2.	Software Project Management: A real-world Guide to Success, Joel Henry, Pearson education.

Mapping with Program Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**P10**	**P11**	**P12**
CO1	M	-	-	-	S	-	-	S	-	--	-	-
CO2	M	L	-	L	S	-	-	S	M	-	L	-
CO3	S	L	-	L	M	-	-	S	M	-	-	L
CO4	S	L	M	L	L	-	M	-	M	-	-	-

Code:	MCA-404 (b)	Software Testing Tools	Credits: 04
Course Objectives:			
To understand the testing concepts with software quality measures and quality assurance. To understand the defect management and improve software quality. To understand the testing tools.			
Course Outcome:			
This course will give deep knowledge about software testing concepts with various kinds of software tools and techniques. This course also guides students to learn software quality measures and quality improvement strategies.			
CO1: The students will be able to understand the concepts of software testing and its techniques. CO2: Knowledge of verification and validation activities. CO3: Study of black box and white box testing techniques. CO4: Study the concept of regression testing and its techniques. CO5: Study of object oriented testing techniques. CO6: Study of case studies and various testing automation and debugging tools. CO7: Study of various testing metrics.			
Unit-1:	**Introduction**		
Introduction, Nature of errors, an example for Testing, Definition of Quality, QA, QC, QM and SQA, Software Development Life Cycle , Software Quality Factors Verification and Validation Definition of V andV, Different types of V and V Mechanisms, Concepts of Software Reviews, Inspection and Walkthrough.			
Unit-2:	**Software Testing Methods and strategies**		
Testing Fundamentals, Test Case Design, White Box Testing and its types, Black Box Testing and its types, Strategic Approach to Software Testing, Unit Testing, Integration Testing, Validation Testing, system Testing.			
Unit-3:	**Software Metrics and Defect Management**		
Concept and Developing Metrics, Different types of Metrics, complexity metrics, Definition of Defects, Defect Management Process, Defect Reporting, Metrics Related to Defects, Using Defects for Process Improvement.			
Unit-4:	**Quality Improvement**		
Introduction, Pareto Diagrams, Cause-effect Diagrams, Scatter Diagrams, Run charts.			
Unit-5:	**Software Quality Assurance and Quality Costs**		
Concepts, Quality Movement, Background issues and SQA activities Software Reviews, Formal Technical Reviews, Formal approaches to SQA Statistical Quality Assurance, Software Reliability, SQA Plan, The ISO 9001 Quality Standard, Six sigma, Informal Reviews, Quality Cost Measurement, Utilizing Quality Costs for Decision-Making .			
Unit-6:	**Testing Tools**		
Testing Tools, Introduction to Junit, Apache Jmeter, Winrunner, Loadrunner, Rational Robot			
Text Books:			
1.	Software Engineering A Practitioners Approach-, Roger S. Pressman, Tata McGraw Hill		
2.	Software Engineering for Students- A Programming Approach - Douglas Bell, Pearson		

3.	Software engineering: An Engineering approach- J.F.Peters, W.Pedrycz, Wiley Press
Reference Books	
1.	Quality Management- Donna C. S. Summers, 5th ed., Prentice-Hall.
2.	Total Quality Management- Dale H. Besterfield, Prentice Hall.
3.	Software testing- Yogesh Singh, Cambridge publication

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COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	M	S	-	L	L	-	L	-	L	-	-	L
CO2	-	M	L	M	-	-	L	-	L	-	L	-
CO3	-	M	L	S	-	L	L	-	-	M	-	-
CO4	-	M	-	L	-	M	L	-	L	-	-	M
CO5	L	M	M	M	-	L	L	-	L	-	-	-
CO6	-	-	-	M	-	-	-	-	L	M	-	-
CO7	L	-	L	-	-	-	L	-	L	M	-	-

S- Strong; M-Medium; L-Low

Code:	MCA-404 (c)	Accounting and Management Control	Credits: 04
Course Objectives:			
This course aims the students to have better idea about the accounting principles and concepts as well as their application, basic accounting-related vocabulary and how to work with accounting data. It generally prepares students for related business courses and work as an accounting professional			
Course Outcome:			
CO1: Acquire knowledge about general aspects of business operations. CO2: Describe the role of accounting information system and its limitations. CO3: Analyze and evaluate costing systems, prepare master budgets, evaluate managerial performance provide decision support for cost management and other managerial decisions. CO4: Analyze transaction cycles and accounting processes, evaluate risk, and recommend internal controls for accounting processes. CO5: Use software to improve efficiency and internal control, analyze data and support decision making.			
Unit-1:	**Financial accounting**		
Meaning and scope of accounting –Principles –Concepts –Conventions -Accounting Standards -Final accounts -Trial balance -Trading account -Profit and loss account-Balance sheet -Accounting ratio analysis -Funds flow analysis -Cash flow analysis			
Unit-2:	**Accounting**		
Meaning –Objectives- Elements of cost -Cost sheet -Marginal costing and cost volume Profit analysis -Break even analysis –Applications –Limitations -Standard costing and variance analysis –Material –Labor –Overhead –Sales -Profit Variances.			
Unit-3:	**Budgets and budgeting control**		
Budgets and budgetary control –Meaning –Types -Sales budget -Production budget -Cost of production budget -Flexible budgeting -Cash budget -Master budget -Zero base budgeting -Computerized accounting.			
Unit-4:	**Investment decisions**		
Objectives and functions of financial management –Risk -Return relationship -Time value of money concepts			
Unit-5:	**Cost of capital**		
Capital budgeting -Methods of appraisal -Cost of capital -Factors affecting cost of capital -Computation for each source of finance and weighted average cost of capital.			
Unit-6:	**Financing decision and working capital management**		
Capital structure -Factors affecting capital structure –Dividend policy -Types of dividend Policy -Concepts of working capital -Working capital policies -Factors affecting working capital -Estimation of working capital requirements.			
Text Books:			
1.	Maheswari, S. N., Financial and Management Accounting, Sultan Chand and Sons, 2011		
Reference Books			
1.	Pandey, I. M., Financial Management, 10thEdition, Vikas Publications, 2010		

2.	Iyengar, S.P., Cost and Management Accounting, Sultan Chand and Co.,5thEdition,2010

Mapping with Program Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	M	S	-	L	L	-	L	-	L	-	-	L
CO2	-	M	L	M	-	-	L	-	L	-	L	-
CO3	-	M	L	S	-	L	L	-	-	M	-	-
CO4	-	M	-	L	-	M	L	-	L	-	-	M
CO5	L	M	M	M	-	L	L	-	L	-	-	-

S- Strong; M-Medium; L-Low

Code:	MCA-404 (d)	Enterprise Resource Planning	Credits: 04

Course Objectives:

With the basic concepts of ERP systems for manufacturing or service companies, and the differences among(Material Requirement Planning)MRP, MRP II, and ERP systems; .Apply the principles of ERP systems, their major components, and the relationships among these components; with the knowledge of typical ERP systems, and the advantages and limitations of implementing ERP systems. To comprehend the technical aspects of ERP systems. To be able to map business processes using ERP concepts and technique.

Course Outcome:

CO1: To understand the significance of ERP and their impact on organizational growth.
CO2: To learn ERP and related technology in terms of integrated data modeling.
CO3: To analyze ERP from the manufacturing perspective.
CO4: To understand the different type of ERP modules and their information flow.
CO5: To enable students to understand the ERP implementation lifecycle.
CO6: Highlight the benefits of different ERP modules and Differentiate ERP modules with their information flow

Unit-1: Introduction to ERP:

Introduction, Evolution of ERP, What is ERP? Reasons for the growth of the ERP market, The advantages of ERP, Why do Man ERP Implementations Fail? Why are ERP packages Being used Now? Integrated Management Information, Business modeling, Integrated Data Model.

Unit-2: ERP and Related Technologies:

Introduction, Business Process Reengineering, Management Information System, Decision Support System, Executive Information Systems, Data Ware housing, Data Mining, On-line Analytical Processing, Supply Chain Management.

Unit-3: ERP - Manufacturing Perspective:

Introduction, ERP. CAD/CAM, Materials Requirements Planning, Bill of Material, Closed Loop MRP. Manufacturing Resource Planning, Distribution Requirements Planning, JIT and Kanban, Product Data Management, Benefits of PDM, Make-to-order, and Make-to Stock, Assemble to order, Engineer to order, Configure-to order.

Unit-4: ERP Modules & Benefits:

Introduction, Finance, Plant Maintenance, Quality Management, Materials Management. Introduction, Reduction of Lead time, On-time shipment, Reduction in Cycle Time, Improved Resource Utilization, Better Customer Satisfaction, Improved Suppler Performance, Increased Flexibility, Reduced Quality Costs, Improved Information Accuracy and Decision–making capability.

Unit-5: ERP Implementation Life Cycle:

Pre-evaluations Screening, Package Evaluation, Project Planning Phase, Gap Analysis, Reengineering, Configuration, Implementation of Team Training, Testing, Going Live, End user Training, Post implementation Vendor, Consultants and Users: Introduction, In-house implementation–Pros and Cons, Vendors, Consultants, End-users.

Unit-6: Case Studies:

SAP R/3, People Soft, Oracle Financials, Architecture, data dictionary, development tools, administration tools, reporting and analysis tools, integration tools.

Text Books:		
1.	EnterpriseResourcePlanning,Alexis Leon,TataMc Graw HillPublishingCompany Ltd-2002.	
2.	EnterpriseResourcePlanningConceptandPractice,VinodKumarGargandVenkitakrishnan, PrenticeHall,India-2ndEdition,2004	
3.	J.A.Hernandez, "The SAP R/3 Handbook", 1998.	
Reference Books		
1.	ManufacturingPlanning& Controls,ThomasVolloman,et,al.	
2.	Michael Hsmmer, "Enterprise Resource Planning", 1998.	
3.	K.Nagappan, "Digital Computers and Data Processing ", 1996.	

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COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	S	S	-	-	M	-	L	-	L	M	M	L
CO2	S	S	-	-	M	-	L	-	L	-	L	-
CO3	S	S	-	-	M	-	L	-	-	M	M	-
CO4	S	S	-	-	M	-	L	-	L	-	M	M
CO5	S	S	-	-	M	-	L	-	L	M	M	-
CO6	S	S	-	-	M	-	-	-	-	M	-	-

S- Strong; M-Medium; L-Low

Code:	MCA-405 (a)	Optimization Techniques	Credits: 04

Course Objectives:

The primary emphasis of the course is to introduce the important optimization techniques of Operations Research applied in the Industry, Economy, Business, Resource Allocation, Finance, Marketing, Simulation and Network Analysis. Optimization techniques use mathematical, computational, and scientific methods for making decisions to solve real life optimization problems.

Course Outcome:

CO1: Understand the optimization techniques and Proficiency with tools from optimization, probability, statistics, simulation, and engineering
CO2: Create economic analysis, including fundamental applications of those tools in industry contexts Involving uncertainty and scarce or expensive resources.
CO3: Apply the facility with mathematical and computational modeling of real decision-making problem
CO4: Analyze the modeling tools and computational tools, as well as analytic Skills to evaluate the problems.
CO5: Evaluate the facility with the design, implementation, and analysis of computational experiments.
CO6: Identify problems which can be formulated as a linear programming problem

Unit-1: Basics of Operations Research

Introduction of Operation Research, definitions, features, advantages and applications, Linear Programming Problem (L.P.P.), Mathematical definition of a L.P.P. with its components: objective function and constraints, optimal solution, slack, surplus and artificial variables, Graphical method, Simplex method (Maximization case)

Unit-2: Dynamic Programming:

Transportation problem, Assignment problem. Basic Concepts, Bellman's optimality principles, Dynamics programming approach indecision making problems, optimal subdivision problem.

Unit-3: Linear Programming Problem and Sequencing Problem

Simplex method (Minimization case), Two Phase Method, Big –M method ,Introduction of Job Sequencing, Notation, Terminology and Assumptions, Johnson's algorithm for processing n jobs through 2 machines, Johnson's algorithm for processing n jobs through 3machines, Johnson's algorithm for processing n jobs through m machines, Processing 2jobs through m machines using graphical method. (Exclude: Dual Problem and Revised Simplex Methods)

Unit-4: Transportation Problem

Introduction of Transportation problem (T.P.), Mathematical Models of T.P., Method to find initial basic feasible solution, North-West Corner Method (NWCM), Least Cost Cell Entry Method (LCM), Vogel's Approximation Method (VAM), Test of optimality for finding an optimum solution –MODI method, Variations in Transportation Problem (Unbalanced supply and demand) (Exclude: Degeneracy resolution, Alternative Optimal Solution Prohibited transportation routes)

Unit-5: Assignment Problem (A.P.)

Introduction of Assignment Problem (A.P.), Mathematical Models of an Assignment Problem, Method to find an optimum solution -Hungarian Method, Variations of the Assignment Problem: Multiple optimal solutions, Maximization case, Unbalanced Assignment Problem, Restrictions on Assignments

Unit-6:	**Project Management (PERT and CPM)**	
Introduction of Project Management, basic difference between PERT and CPM, Network Concepts, Components, Rules for Network Construction, Critical Path Analysis (Forward Pass, Backward Pass, Critical Path)		
Text Books:		
1.	Computer based optimization techniques, Shubham Agarwal, Alpha science international limited, 2015.	
2.	J. K. Sharma, "Operations Research–Theory and Application", 4th Edition, Macmillan Publishers India Ltd.	
3.	Introduction to Operation Research, Computer Oriented Algorithmic approach Gillet B.E.Tata McgrawHill publishingLtd,NewDelhi,1982.	
Reference Books		
1.	Operations Research, P.K. Gupta & D.S. Hira, S.Chand &Co.	
2.	Operations Research: Theory and Applications, J.K. Sharma, MacMillan.	
3.	Operations Research, S.D. Sharma, Kedar Nath Ram Nath, Meerut(UP).	

Mapping with Program Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	S	S	-	M	M	-	-	-	-	M	M	L
CO2	S	S	-	M	M	-	-	-	-	-	L	-
CO3	S	S	-	M	M	-	-	-	-	M	M	-
CO4	S	S	-	M	M	-	-	-	-	-	M	M
CO5	S	S	-	M	M	-	-	-	-	M	M	-
CO6	S	S	-	M	M	-	-	-	-	M	-	-

S- Strong; M-Medium; L-Low

Code:	MCA-405 (b)	Statistical Computing	Credits: 04
Course Objectives:			
To provide students with a framework that will help them choose the appropriate descriptive methods in various data analysis situations. And To apply estimation and testing methods to make inference and hypothesis for decision making.			
Course Outcome:			
CO1: How to calculate and apply measures of central tendency and measures of dispersion –in real time data CO2: Compute and interpret the results of Bivariate and Multivariate Regression and Correlation Analysis for comparison and forecasting purpose CO3: Perform Test of Hypothesis as well as calculate confidence interval for a population parameter for single sample and two sample cases. CO4: Understand the concept of p-values. CO5: Learn non-parametric test such as the Chi-Square test for Independence as well as Goodness of Fit also perform ANOVA and F-test			
Unit-1:	**Introduction to Statistics:**		
Introduction to Statistics and data analysis-Measures of central tendency, Measures of dispersion, Skewness and Kurtosis.			
Unit-2:	**Correlation and regression:**		
Correlation and Regression–Rank Correlation-Partial and Multiple Correlation Regression, Multiple Regressions.			
Unit-3:	**Testing of hypothesis I:**		
Introduction-Types of errors, Critical region, procedure of testing hypothesis-Large sample tests Z-test for Single Proportion, Difference of Proportion, Single mean and difference of means.			
Unit-4:	**Testing of hypothesis II:**		
Small Sample Tests -Student t-test, F-test, Chi-Square test for independence of Attributes, Analysis of Variance-One-way, Two-way Classification, Principles of experimental design, Completely randomized design, Randomized block design, Latin Square design-Problems.			
Unit-5:	**Statistics using SPSS**		
Introduction to SPSS, SPSS: general description, functions, menus, commands, SPSS file management, Input and data cleaning, Data manipulation, Descriptive analysis of data, Statistical tests, Correlation and regression, Multivariate analysis.			
Unit-6:	**Industry Expert Lecture**		
Organize Industry Expert Lecture on the recent trends and statistical computing methods used for research.			
Text Books:			
1.	Applied Statistics and Probability for Engineers, 6ed, (2016),Douglas C. Montgomery George C. Runger, John Wiley & Sons		
2.	Introduction to Probability and Statistics: Principles and Applications for Engineering and the Computing Sciences(2017) by J. Susan Milton and Jesse Arnold, Mc.Grawhill education		

Reference Books	
1.	Statistics for Engineers and Scientists (2017) by Navidi ,McGraw-Hill Education –Europe
2.	Fundamentals of Statistics (2016) by S.C. Gupta seventh revised and enlarged edition

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	-	M	M	-	-	-	-	M	M	L
CO2	S	S	-	M	M	-	-	-	-	-	L	-
CO3	S	S	-	M	M	-	-	-	-	M	M	-
CO4	S	S	-	M	M	-	-	-	-	-	M	M
CO5	S	S	-	M	M	-	-	-	-	M	M	-

S- Strong; M-Medium; L-Low

Code:	MCA-405 (c)	Cyber Law and Security	Credits: 04
Course Objectives:			
To understand the basics of cyber law, its related issues and ethical laws of computer for different countries.			
Course Outcome:			
CO1 Understanding about Cybercrime and cyber offenses CO2 Understanding about security challenges of mobile devices CO3 Analyzing on Tools and Methods Used in Cybercrime CO4 Understanding about Cyber Law and Cyber security CO5 Understanding about strengths and weaknesses of Indian ITAct CO6 Understanding about Cyber Forensics			
Unit-1:	**Introduction to Cybercrime:**		
Introduction, Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security Who are Cybercriminals?, Classifications of Cybercrimes,· Cybercrime: The Legal Perspectives, Cybercrimes: An Indian Perspective, · Cybercrime and the Indian ITA 2000,·AGlobalPerspective on Cybercrimes			
Unit-2:	**Cyber Offenses:**		
Introduction, How Criminals Plan the Attacks, Social Engineering Cyber stalking, Cyber café and Cybercrime, Botnets, The Fuel for Cyber crime, Attack Vector, Cloud Computing			
Unit-3:	**Cybercrime: Mobile and Wireless Devices**		
Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Device Registry,SettingsforMobileDevices,AuthenticationServiceSecurity,Attacks on Mobile/ Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops			
Unit-4:	**Tools and Methods Used in Cybercrime:**		
Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks Phishing and Identity Theft Introduction, Phishing, Identity Theft(ID Theft)			
Unit-5:	**Cybercrimes and Cyber security:**		
The Legal Perspectives Introduction, Cybercrime and the Legal Landscape around the World, Why Do We Need Cyber laws: The Indian Context, The Indian IT Act, Challenges to Indian Law and Cybercrime Scenario in India, Consequences of Not Addressing the Weakness in Information Technology Act, Digital Signatures and the Indian IT Act, Amendments to the Indian IT Act, Cybercrime and Punishment, Cyber law, Technology and Students: Indian Scenario			
Unit-6:	**Computer Forensics:**		
Understanding Computer Forensics · Introduction, Historical Background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber forensics and Digital Evidence, Forensics Analysis of E-Mail· Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Setting up a Computer Forensics Laboratory: Understanding the Requirements, Computer			

ForensicsandSteganography,RelevanceoftheOSI7Layer Model to Computer Forensics. Forensics and Social Networking Sites: The Security/ Privacy Threats, Computer Forensics from Compliance Perspective, Challenges in Computer Forensics · Special Tools and Techniques, Forensics Auditing Anti forensics		
Text Books:		
1.	Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives–Nina Godbole, Sunit Belapure, Wiley :April2011IndiaPublications Released	
2.	Windows Forensics: The field guide for conducting corporate computer investigations-Chad Steel, Wiley ,December2006IndiaPublications	
Reference Books		
1.	Internet Forensics:UsingDigitalEvidencetoSolveComputerCrime-RobertJones,O'Reilly Media,Released:October2005	

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	M	M	L	L	S	S	M	M	L	L
CO2	S	S	S	S	M	M	L	L	M	S	S	-
CO3	S	S	S	S	S	S	M	M	L	L	S	-
CO4	S	S	M	M	L	L	S	S	M	L	M	M
CO5	S	S	S	M	M	L	S	L	S	M	M	-
CO6	S	M	M	S	S	L	S	S	M	S	M	-

S- Strong; M-Medium; L-Low

Code:	MCA -405 d)	Information Security	Credits: 04

Course Objectives:

1. To understand the basic categories of threats to computer and network.
2. To understand intrusion and intrusion detection.
3. To defend the need for protection, security, and the role of ethical consideration in computer use.
4. To describe efficient basic number algorithms.
5. To discuss the fundamental ideas and algorithms of secret key, cryptography and public key cryptography.

Course Outcome:

CO1: To explore a comprehensive study of the principles and practices of computer system security
CO2: To continually strengthen and improve the overall capabilities of the information security management system
CO3: To increase professional skills in terms of information security management and technology
CO4: To establish quantified information security goals annually through management and review meetings

Unit-1: Introduction to Cryptography

Active vs. passive attacks, Layers and cryptography, Authorization, Viruses, Worms, Trojan horses, The multi level model of security, Legal issues, What is cryptography? Breaking an encryption scheme, Types of cryptographic functions, Secret key cryptography, Public key cryptography, Hash algorithms.

Unit-2: Secret Key Cryptography

Generic block encryption, Data encryption standards, International data encryption algorithm, Advanced encryption standard.

Unit-3: Modes of Operation, Hashes and Message Digests

Encrypting a large message, Generating MACs, Multiple encryptions DES, MD2, MD4, MD5,
SHA-1, HMAC.

Unit-4: Public Key Algorithms

Modular arithmetic, RSA, Diffie-Hellman, Digital signature standard, Elliptic curve cryptography.

Unit-5: Number Theory and Authentication

Password based and Cryptographic based authentication protocol

Unit-6: Cryptographic Standards

Kerberos, PKI, IPSec.

Text Books:

1.	Kaufman Charlie, Perlman Radia, Speciner Mike, Network Security: Private Communication in public World, PHI publication, 2001.
2.	William Stalling, Network Security Essentials: Applications and Standards, 2nd edition, Prentice Hall publication,2002.

3.	William Stalling, Cryptography and Network Security, Prentice Hall publication, 2003
Reference Books	
1.	Vyless, Internet Security Protocol, Pearson publication.
2.	Comer D.E., Internetworking with TCP/IP, 5th edition, Pearson publication, 2006
3.	Morrison, Information Security-An Overview, PHI publication, 1995

Mapping with Program Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	M	M	-	L	L	-	L	-	L	-	-	L
CO2	-	M	M	M	M	-	L	-	L	-	L	-
CO3	L	M	M	S	-	L	L	-	-	M	-	M
CO4	-	M	-	L	-	L	L	-	L	-	-	L

S- Strong; M-Medium; L-Low

Code:	MCA -406	Lab -7 Java Programming	Credits: 02

Course Objectives

To enable the students practice the concepts of java programming language and develop solutions for real world problems.

Course Outcomes

CO1: Understand the enabling technologies for building internet applications. Understand
CO2: Write Java programs for techniques and features of the networking and remote method development to Construct a internet application. Apply
CO3: Implement packages, access specifiers and interfaces in a program Apply
CO4: Implement Program for Events and interactivity using Layout Manager. Apply
CO5: Generate program for network chatting Analyze
CO6: Write technical report on the observations from the experiments

Develop programs for

1. Use of Objects
2. Using classes and inheritance
3. JNI concepts
4. Multithread applications
5. Exception handling
6. Implementing packages, access specifiers and interfaces
7. Streams
8. JDBC program using different statements
9. Applet program for Animation text, images and sounds
10. Events and interactivity using Layout Manager.
11. Socket program for network chatting
12. Client server application using RMI techniques

Note:

The Exercises are collection of program specifications shall be designed by the course instructor and assigned to the students.

Reference Books

1.	Herbert Schildt, "Java the Complete Reference", 9th Edition, McGraw Hill, 2014
2.	Margaret Levine Young, "The Internet - Complete Reference" , 2nd Edition, Tata McGraw Hill, 2002, (Reprint 2016).
3.	Paul Deitel,Harvey Deitel,Abbey Deitel, “Internet and WWW How to Program”, 5th Edition, Tata McGraw Hill, 2011.

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	M	S	S	S	M	-	-	-	-	-
CO2	S	M	S	S	M	M	M	-	-	-	-	-
CO3	S	S	M	S	S	S	M	-	-	-	-	-
CO4	S	S	M	S	S	M	M	-	-	-	-	-
CO5	S	S	S	S	S	M	M	-	-	-	-	-

CO6	S	S	S	S	S	M	M	-	-	-	-	-

S- Strong; M-Medium; L-Low

Code:	MCA -407	Lab -8 Linux Operating System	Credits: 02

Course Objectives

To enable the students practice the concepts of Operating systems and develop solutions for real world problems.

Course Outcomes

CO1: Have a good orientation towards concept-based approach and practical-based approach
CO2: Students will be able to describe the components of a modern operating system
CO3: Apply operating system concepts practically
CO4: Apply the concepts of operating systems design to practical problems

Develop programs for

1. Configuring Operating System, Basic Linux Commands
2. Header files: Process creation and Process joining
3. Create processes using for k() and check different states i.e. zombie, orphan
5. Sum of numbers from1to10, by dividing the job into two processes (parent and one child)
6. Copy the contents of one array to another.
7. Create two child processes and display the output.
8. Program to add four integer values using 2 process
9. Program to find out the factoids of a number
10.Program to fork a child and print the process id of parent and child process
11. Program to create a thread and join the thread
12. Program to find maximum number from the integer numbers using thread
13. Implement ROUND ROBIN algorithm for CPU scheduling.
14. Implement Shortest Job First algorithm for CPU scheduling
15. Implement IPC using pipe to read and write a string from the user.

Note:

The Exercises are collection of program specifications shall be designed by the course instructor and assigned to the students.

Reference Books

1.	"Modern Operating Systems", by Andrew S. Tannenbaum, PHI, 3rd Edition
2.	"Operating System Concepts",William Stallings, Pearson, 5th Ed
3.	"Operating Systems", Madnick E.,Donovan J., TataMcGrawHill,2001

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	M	S	S	S	M	-	-	-	-	-
CO2	S	M	S	S	M	M	M	-	-	-	-	-
CO3	S	S	M	S	S	S	M	-	-	-	-	-
CO4	S	S	M	S	S	M	M	-	-	-	-	-

S- Strong; M-Medium; L-Low

Code:	MCA 408	Open Elective	Credits: 02
Course Objectives:			
University Recognized MOOC (NPTEL/ SWAYAM/ Others) OR Intra/Inter Departmental OR Intra/ Inter School Open Electives			
Course Outcome:			
Students can choose one of these open electives. But they need to take prior permission from School Director before joining one of these elective courses. \they must produce successful completion certificate / credits earned to the School after completing the underwent course.			

Code:	MCA-501	Cryptography and Network Security	Credits: 04

Course Objectives:

1. To compare various cryptographic techniques.
2. To understand the designs secure applications.
3. To inject secure coding in the developed applications.

Course Outcome:

CO1: Identify common network security vulnerabilities/attacks.
CO2: Understand the foundations of Cryptography and network security.
CO2: Understand encryption and decryption of messages using block ciphers.
CO3: Demonstrate detailed knowledge of the role of encryption to protect data.
CO4: Analyze Network Security Practice And System Security.

Unit-1:

Introduction: Basic objectives of cryptography, secret-key and public-key cryptography, one-way and trapdoor one-way functions, cryptanalysis, attack models, classical cryptography

Unit-2:

Block ciphers: Modes of operation, DES and its variants, RCS, IDEA, SAFER, FEAL, Blow Fish, AES, linear and differential cryptanalysis. Stream ciphers: Stream ciphers based on linear feedback shift registers, SEAL, unconditional security.

Unit-3:

Message digest: Properties of hash functions, MD2, MD5 and SHA-1, keyed hash functions, attacks on hash functions. Public-key parameters: Modular arithmetic, gcd, primality testing.

Unit-4:

Chinese remainder theorem, modular square roots, finite fields. Intractable problems: Integer factorization problem, RSA problem, modular square root problem, discrete logarithm problem, Diffie-Hellman problem, known algorithms for solving the intractable problems.

Unit-5:

Public-key encryption: RSA, Rabin and EIGamal schemes, side channel attacks. Key exchange: Diffie-Hellman and MQV algorithms. Digital signatures: RSA, DAS and NR signature schemes, blind and undeniable signatures.

Unit-6:

Entity authentication: Passwords, challenge-response algorithms, zero-knowledge protocols. Standards: IEEE, RSA and ISO standards. Network issues: Certification, public-key infrastructure (PKI), secured socket layer (SSL), Kerberos.

Text Books:

1.	Cryptography and Network Security- William Stallings, Prentice Hall of India.
2.	Cryptography and Network Security- Forouzan, Tata McGraw-Hill.

Reference Books

1.	Network Security: Private Communication in a Public World- Charlie Kaufman, Prentice Hall Series.

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	-	L	L	-	L	-	L	-	-	L
CO2	-	M	M	M	M	-	L	-	L	-	L	-
CO3	L	M	M	S	-	L	L	-	-	M	-	M
CO4	-	M	-	L	-	L	L	-	L	-	-	L

S- Strong; M-Medium; L-Low

Code:	MCA-502	Data Mining & Data Warehousing	Credits: 04

Course Objectives:

The student should be made to

1. Understand the concept of building a data warehouse and to analyze the mapping concepts.
2. Be familiar with the OLAP tools, application and its categories of application.
3. Understand the concept of data mining techniques, process and about its query languages.
4. Analyze the various mining association rules and understand the concept of classifications.
5. Be familiar with the cluster analysis and categorization of clustering methods.

Course Outcome:

CO1:Student able to design a data mart or data warehouse for any organization
CO2:Student able to asses raw input data and preprocess it to provide suitable input for range of data mining algorithms
CO3:Student able to extract association rules and classification model
CO4:Student able to identify the similar objects using clustering techniques
CO5:Student able to explore recent trends in data mining such as web mining, spatial-temporal mining

Unit-1:	Introduction

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

Unit-2:	Data Mining Techniques

Introduction, Statistical perspective on Data Mining, Decision Tree, Neural networks

Unit-3:	Classification

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

Unit-4:	Clustering

Introduction, Hierarchical algorithms, Partitional algorithms, Clustering large databases

Unit-5:	Association Rules

Introduction, Basic algorithms, Parallel and distributed algorithms

Unit-6:	Web Mining & Introduction to Data Warehousing

Introduction, Web content mining, Web structure mining, Web usage mining

Text Books:

1.	1. Data Mining – Introductory and Advanced Topics by Margaret H. Dunham & S. Shridhar
2.	2. Data Warehousing Fundamentals by Paulraj Ponniah

Reference Books

1.	1. Raph Kimball, "Data Warehouse Toolkit", John Wiley and Sons Publications
2.	2. Michael. J. Berry, Gordon Linoff, "Data Mining Techniques: Marketing, Sales, Customer support", John Wiley and Sons.

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	S	S	-	S	-	L	-	-	S	-
CO2	S	S	M	S	S	-	L	L	-	-	-	-
CO3	S	S	-	S	S	-	-	-	-	-	M	M
CO4	S	S	-	S	-	-	-	-	-	-	M	M
CO5	S	S	-	S	-	-	-	-	-	-	M	M

S- Strong; M-Medium; L-Low

Code:	MCA-503	Theory of Computation	Credits: 04
Course Objectives:			
The learning objectives of this course are to introduce students to the mathematical foundations of computation including automata theory, the theory of formal languages and grammars, the notions of algorithm, decidability, complexity, and computability, enhance/develop students' ability to understand and conduct mathematical proofs for computation and algorithms.			
Course Outcome:			
CO1: Ability to prove results using proof by induction, proof by contradiction, proof by construction, proof by case exhaustion CO2: Understanding of regular and context-free languages. CO3: Ability to describe and transform regular expressions and grammars CO4: Understanding of the key results in algorithmic complexity, computability and solvability of problems. CO5: Using the Prolog language as an experimental tool for testing properties of basic computational structures.			
Unit-1:	**Finite Automata and Regular Expressions:**		
Definition of Deterministic Finite Automata, Non Deterministic Finite Automata, Moore and Mealy Machines and their conversions, Regular Expressions, recursive definition, NFA with e -Moves, Inter conversion between NFA and DFA and DFA regular expression and FA, Pumping lemma.			
Unit-2:	**Context Free Grammars:**		
Definition, production rules, ambiguous grammar, removal of ambiguity, Chomsky hierarchy, Context Free Grammar (CFG) - definition simplification of CFG.			
Unit-3:	**Context Free Languages:**		
Definition of Context free Languages, regular grammar definition, left linear right linear grammar, Inter conversion between left linear and right linear regular grammar, Regular grammar and finite automata, CNF, GNF, derivation graphs type0 and type1 grammars.			
Unit-4:	**Pushdown automata:**		
Formal definition, Pushdown automata (PDA), deterministic pushdown automata (DPDA) – definition, non- deterministic pushdown automata (NPDA)-definition relative powers of DPDA and NPDA.			
Unit-5:	**Turing Machines:**		
The definition of a Turing machine, computing with Turing machine, Extensions of Turing machines, Random access Turing machines, Non-deterministic Turing machines, Grammars. The Church‟s Turing Hypothesis, Universal Turing Machines, the Halting problem, Unsolvable problems about Turing machines.			
Unit-6:	**Applications:**		
Applications of RE and FA - Lexical analyzer, text editor, and searching using RE. Applications of PDA - Expression conversion. Applications of CFG – syntax analysis, Language definition.			
Text Books:			
1.	Hopcroft, Ullman, Introduction to Automata Theory, Languages,and Computation, Addison Wesley Pub.		
2.	Daniel I. A. Cohen, Introduction to computer theory, Willey Pub.		

Reference Books	
1.	John C. Martin, Introduction to Languages and Theory of Computation, McGraw Hill.
2.	Papadimitriou, Elements of the Theory of Computations, PHI.
3.	E. V. Krishnmurthy, Theory of Computer Science, EWP

Mapping with Program Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	S	S	S	S	-	S	-	L	-	-	S	-
CO2	S	S	M	S	S	-	L	L	-	-	-	-
CO3	S	S	-	S	S	-	-	-	-	-	M	M
CO4	S	S	-	S	-	-	-	-	-	-	M	M
CO5	S	S	-	S	-	-	-	-	-	-	M	M

S- Strong; M-Medium; L-Low

Code:	MCA 504 (a)	E-Commerce	Credits: 04
Course Objectives:			
To prepare students competent enough to take up to employment and self employment opportunities in E-Commerce and M-Commerce fields.			
Course Outcome:			
Student will understand and familiar with environment and operations in the field of E-Commerce. Students training and practical approach by exposing them to modern technology.			
CO1: The students are able to understand the concept of E- Commerce and about its functions. CO2: Knowledge about the various functional areas of E-Business Strategies CO3: Study of modern Business management concepts in 21stcentury. CO4: Study of total quality management, electronic data interchange and just in time approach. CO5: Study of various types of management information systems and their applications. CO6: Study about the electronic commerce and electronic transactions and impact of electronic commerce on organizations and society. CO7: Study of various security issues while doing electronic transactions.			
Unit-1:	**Introduction to E-Commerce**		
Electronic Commerce Framework, Electronic Commerce and Media Convergence, Anatomy of E-Commerce, Electronic Commerce Applications. Network Infrastructure for Electronic Commerce: Components of I-way, Network Access Equipment, Global information Distribution Networks.			
Unit-2:	**The Internet as a Network Infrastructure**		
Internet Terminology, NSFNET Architecture, National Research and Education Network, Internet Governance. The Business of Internet Commercialization: Telco/Cable/On-Line Companies, National Independent ISPs, Regional ISPs, Local ISPs, Internet Connectivity options.			
Unit-3:	**Electronic Commerce and the World Wide Web**		
Architectural Framework for Electronic Commerce, Technology behind the Web, Security and the Web, Consumer-Oriented Electronic Commerce: Consumer-Oriented Applications, Mercantile Process Model.			
Unit-4:	**Electronic Payment Systems**		
Types of Electronic Payment Systems, Digital Token based Electronic Payment Systems, Credit Card Based Electronic Payment Systems, Risk and Electronic Payment Systems, Designing Electronic Payment Systems. Inter Organizational Commerce and EDI: Electronic Data Interchange, EDI Applications in Business, EDI: Legal, Security and Privacy issues.			
Unit-5:	**Advertising and the Marketing on the Internet**		
The New Age of Information, Advertising on Internet, Information search and retrieval, Electronic Commerce Catalogs, Information filtering.			
Unit-6:	**On-Demand Education and Digital Copyrights**		
Computer Based Education and Training, Technological Components of Education on demand, Digital Copyrights. Software Agents: Characteristics and Properties of Agents, the Technology behind Software Agents, Browsers and Software Agents.			

Text Books:	
1.	Frontiers of Electronic Commerce, Ravi Kalakota, Pearson Education.
Reference Books	
1.	E-Commerce: Business, Technology, Society, Ken Laudon, Jeffrey Travis, Prentice Hall.

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	S	S	-	S	-	L	-	-	S	-
CO2	S	S	M	S	S	-	L	L	-	-	-	-
CO3	S	S	-	S	S	-	-	-	-	-	M	M
CO4	S	S	-	S	-	-	-	-	-	-	M	M
CO5	S	S	-	S	-	-	-	-	-	-	M	M
CO6	-	M	L	-	L	-	-	-	-	-	L	L
Co7	L	-	L	-	-	-	-	-	-	-	L	L

S- Strong; M-Medium; L-Low

Code:	MCA-504 (b)	Internetworking Protocols	Credits: 04

Course Objectives:

To familiarize the students with various inter-networking protocols and their functionalities. Internetworking technology allows computing devices talk to other internal and external devices, components or systems.

Course Outcome:

Use of these protocols to cater the user needs while using the internet based various applications. Student will Also try to think of modifying existing protocols to improve the performance.

CO1: Describe how networks function, identifying major components, function of network components, and the OSI reference model
CO2: Using the host-to-host packet delivery process, describe issues related to increasing traffic on an Ethernet LAN and identify switched LAN technology solutions to Ethernet networking issues
CO3: Describe the reasons for extending the reach of a LAN and the methods that can be used, with a focus on RF wireless access
CO4: Describe the reasons for connecting networks with routers and how routed networks transmit data through networks using TCP/IP
CO5: Describe the function of WANs, the major devices of WANs, and configure PPP encapsulation, static and dynamic routing, PAT, and RIP routing
CO6: Use the command-line interface to discover neighbours on the network and manage the router start-up and configuration

Unit-1:	Review to foundations of Internetworking

Review of Networking Technologies and Internetworking Concepts and Architectural Model: Application level and network level interconnection, Properties of the internet, Internet architecture, Interconnection through IP routers.

Unit-2:	Internet addressing and resolution

Universal identifiers, Three primary classes of IP addresses, Network and broadcast addresses, Limited broadcast, Dotted decimal notation, Weakness in internet addressing, Loopback addresses, Address resolution problem, Two types of physical addresses, Resolution through direct mapping, Resolution through dynamic binding, Address resolution cache, ARP to other protocols, Reverse address resolution protocol, Timing RARP transaction, Primary and backup RARP serve

Unit-3:	IP routing mechanisms

The concepts of unreliable delivery, Connectionless delivery system, Purpose of the internet protocol, The internet datagram, Routing in an internet, Direct and indirect delivery, Table driven IP routing, Next hop routing, Default routes, Host specific routes, The IP routing algorithm, Handling incoming datagram's , Establishing routing tables

Unit-4:	Error reporting and control

The internet, Control message protocols, Error reporting versus error detection, ICMP message format, Detecting and reporting various network problems through ICMP, Transparent router, Proxy ARP, Subnet addressing, Implementation of subnets with masks representation, Routing in the presence of subnets, A unified algorithm.

Unit-5:	UDP protocol functioning
Format of UDP message, UDP pseudo header, UDP encapsulation and protocols layering and the UDP checksum computation, UDP multiplexing, De-multiplexing and ports.	
Unit-6:	**TCP protocol functioning**
The transmission control protocol, Ports, Connections and endpoint, Passive and active opens, The TCP segment format, TCP implementation issues	
Text Books:	
1.	Douglas E. Comer, Internetworking with TCP/IP: Principles, Protocols and Architecture, Volume 1, 5 th edition, PHI publication, 2006.
2.	Behrouz A. Forouzan, TCP-IP Protocol Suite, 3 rd edition, Mc-Graw Hill publication, 2005.
3.	W. Richard Stevens, Unix Network Programming: Volume 1, 2nd edition, PHI publication, 1999.
Reference Books	
1.	Comer, Internetworking with TCP-IP Vol. 3, 2nd edition, Pearson publication, 2001.
2.	W. Richard Stevens, Unix Network Programming: Inter process Communications, Volume 2, 2nd edition, PHI publication, 1999.
3.	William Stalling, SNMP SNMPv2, SNMPv3, and RMON 1 and 2, 2nd edition, Pearson Education publication, 2001.

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	S	S	-	S	-	L	-	-	S	-
CO2	S	S	M	S	S	-	L	L	-	-	-	-
CO3	S	S	-	S	S	-	-	-	-	-	M	M
CO4	S	S	-	S	-	-	-	-	-	-	M	M
CO5	S	S	-	S	-	-	-	-	-	-	M	M
CO6	-	M	L	-	L	-	-	-	-	-	L	L

S- Strong; M-Medium; L-Low

Code:	MCA-504 (c)	Internet of Things	Credits: 04

Course Objectives:

1. To Understand the Architectural Overview of IoT
2. To Understand the IoT Reference Architecture and Real World Design Constraints
3. To Understand the various IoT Protocols (Datalink, Network, Transport, Session, Service)

Course Outcome:

Applications based on IoT concepts and protocols need to be explored to optimize the resources.

CO1: Explain in a concise manner how the general Internet as well as Internet of Things works.
CO2: Understand constraints and opportunities of wireless and mobile networks for Internet of Things.
Co3: Use basic measurement tools to determine the real-time performance of packet based networks.
CO4: Analyze trade-offs in interconnected wireless embedded sensor networks.

Unit-1:	OVERVIEW

IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics, Knowledge Management

Unit-2:	REFERENCE ARCHITECTURE

IoT Architecture-State of the Art – Introduction, State of the art, Reference Model and architecture, IoT reference Model - IoT Reference Architecture Introduction,

Unit-3:	Different views of IoT

Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints- Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control.

Unit-4:	IOT DATA LINK LAYER & NETWORK LAYER PROTOCOLS

PHY/MAC Layer(3GPP MTC, IEEE 802.11, IEEE 802.15), Wireless HART,Z-Wave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4, IPv6, 6LoWPAN, 6TiSCH,ND, DHCP, ICMP, RPL, CORPL, CARP

Unit-5:	TRANSPORT & SESSION LAYER PROTOCOLS

Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)-(TLS, DTLS) – Session Layer-HTTP, CoAP, XMPP, AMQP, MQTT

Unit-6:	SERVICE LAYER PROTOCOLS & SECURITY

Service Layer -oneM2M, ETSI M2M, OMA, BBF – Security in IoT Protocols – MAC 802.15.4 , 6LoWPAN, RPL, Application Layer

Text Books:

1.	Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1 st Edition, Academic Press, 2014.
2.	Peter Waher, “Learning Internet of Things”, PACKT publishing, BIRMINGHAM – MUMBAI
3.	Bernd Scholz-Reiter, Florian Michahelles, “Architecting the Internet of Things”, ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer

Reference Books

1.	Daniel Minoli, “Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications”, ISBN: 978-1-118- 47347-4, Willy Publications
2.	Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-on Approach)”, 1st Edition,

	VPT, 2014.
3.	https://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html

Mapping with Program Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	M	-	-	-	S	-	-	-	-	-	-	-
CO2	L	-	L	-	-	-	-	-	-	-	M	L
CO3	L	L	-	-	-	-	-	-	-	-	-	L
CO4	M	-	M	L	M	-	-	-	-	-	L	M

S- Strong; M-Medium; L-Low

Code:	MCA-504 (d)	Cloud Computing	Credits: 04

Course Objectives:

1. The objective of this course is establishing the definition of cloud computing,
2. Describing the various service delivery models of a cloud computing architecture
3. Explaining the ways in which clouds can be deployed as public, private, hybrid, and community clouds.

Course Outcome:

CO1: Ability to identify various cloud services.
CO2: Assess cloud characteristics and service attributes, for compliance with enterprise objectives.
CO3: Explain the four primary cloud category "types".
CO4: Evaluate various cloud delivery models.
CO5: Contrast the risks and benefits of implementing cloud computing.

Unit-1: Introduction:

Defining Cloud computing, essential characteristics of Cloud computing, Cloud deployment model, Cloud service models, Multi-tenancy, Cloud cube model, Cloud economics and benefits, Cloud types and service scalability over the cloud, challenges in cloud NIST guidelines.

Unit-2: Virtualization:

Virtualization concepts, types, Server virtualization, Storage virtualization, Storage services, Network virtualization, Service virtualization, Virtualization management, Virtualization technologies and architectures, Internals of virtual machine, Measurement and profiling of virtualized applications. Hypervisors: KVM, Xen, HyperV Different hypervisors and features

Unit-3: Architecture:

Architecture for federated cloud computing, SLA management in cloud computing: Service provider's perspective, performance prediction for HPC on Clouds, Monitoring Tools.

Unit-4: Security:

Cloud Security risks, Security, Privacy, Trust, Operating system security, Security of virtualization, Security risks posed by shared images, Security risk posed by a management OS, Trusted virtual machine monitor

Unit-5: Cloud Platforms:

Cloud Platforms: Amazon EC2 and S3, Cloudstack, Intercloud, Google App Engine, Open Source cloud Eucalyptus, Open stack, Open Nebulla, etc., Applications

Unit-6: Applications:

Basics and Vision, Applications and Requirements, Smart Devices and Services, Human Computer Interaction, Tagging, Sensing and controlling, Context-Aware Systems, Ubiquitous Communication, Management of Smart Devices, Ubiquitous System Challenge and outlook

Text Books:

1.	Cloud Computing Principles and Paradigms- Rajkumar Buyya, J. Broberg, A. Goscinski, Wiley

	Publishing
2.	Cloud Security: Comprehensive guide to Secure Cloud Computing- Ronald Krutz, Wiley Publishing
Reference Books	
1.	Cloud Computing: Practical Approach- Anthony T. Velte, McGraw Hill
2.	Cloud Security and Privacy- Tim Mather, O"REILLY Publication.

Mapping with Program Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	M	S	-	L	L	-	L	-	L	-	-	L
CO2	S	M	L	M	-	-	L	-	L	-	M	-
CO3	S	M	L	S	-	-	L	-	-	M	-	-
CO4	-	M	-	L	-	-	M	-	S	-	-	M
CO5	-	L	L	-	-		-	M	-	L	-	-

S- Strong; M-Medium; L-Low

Code:	MCA-505 (a)	Python Programming	Credits: 04

Course Objectives:

1. Basic concept of python programming language.
2. Handling string manipulations.
3. Developing Basic application using the python.
4. Understand the OOPS concepts in python.

Course Outcome:

CO1: Use and manipulate several core data structures: Lists, Dictionaries, Tuples, and Strings
CO2: Apply object-oriented programming concepts to develop dynamic interactive Python applications.
CO3: Apply python exception handling model to develop robust programs.
CO4: Create and apply regular expression for data verification.
CO5: Construct simple graphical user interfaces using Tkinter.
CO6: Build a web application using Django framework.

Unit-1:	Introduction to Python:

Python Basics: Data Types, Operators, Input/Output Statements, Creating Python Programs. Python Flow Control statements Decision making statements, Indentation, Conditionals, loops, break, continue, pass statements Strings lists, Tuples, dictionaries.

Unit-2:	Python Functions:

Defining functions, DOC strings, Function parameters: default, keyword required and variable length arguments, key-word only parameters, local and global variables, pass by reference versus value, Anonymous functions, Recursion.

Unit-3:	Functional Programming:

Mapping, Filtering and Reduction, Lambda Functions, List Comprehensions.

Unit-4:	Object Oriented Programming:

Definition and defining a class, Constructor, Destructor, self and del keywords, Access to Attributes and Methods, geattr and hasattr attributes, Data, Regular Expressions: Defining Regular Expressions and String Processing

Unit-5:	File I/O and Exceptions Handling:

File object attributes, Read and Write into the file, Rename and Delete a File. Handling Exceptions, Built-in Exceptions and User defined Exceptions. GUI Programming: Introduction to Python GUI Programming, Tkinter Programming, Tkinter widgets, Events and Bindings

Unit-6:	Working with Django PART-I:

Rendering Templates into HTML and Other Formats, Understanding Models, Views, and Templates, Separating the Layers(MVC)-Models, Views, Templates, Overall Django Architecture.

Text Books:

1.	Timothy A. Budd: Exploring Python, Tata McGraw-Hill,2011.
2.	Python Essential Reference, David Beazley, Third Edition

Reference Books	
1.	Ascher, Lutz: Learning Python,4th Edition, O'Reilly, 2009
2.	Wesley J Chun: Core Python Applications Programming, Pearson Education,3rdEdition,2013
3.	Programming with python, A users Book, Michael Dawson, Cengage Learning Python Bible

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	-	M	S	-	-	-	-	M	-	S	L
CO2	-	S	M	S	-	-	-	-	M	-	S	-
CO3	S	S	M	S	-	-	-	-	M	-	S	-
CO4	S	S	M	S	-	-	-	-	M	-	S	M
CO5	-	S	M	S	-	-	-	M	M	-	S	-
Co6	S	-	M	S	-	-			M	-	S	-

S- Strong; M-Medium; L-Low

Code:	MCA-505 (b)	Biometrics Sciences	Credits: 04

Course Objectives:

In this course, students will learn to methods of biometrics, devices of biometrics, use for computer security, design and build a secure system

Course Outcome:

CO1: Use of Input-output channels.
CO2: reasoning and problem solving, Skill acquisition.
CO3: Apply Motivations for Using Biometric Systems.
CO4: Implementation of Biometrics for Dynamic Signature Analysis, Facial Imaging or Recognition, Fingerprint, Hand Geometry, Iris Recognition.

Unit-1: Introduction:

Input-output channels: Vision, Hearing, Touch, Movement, Human memory: Sensory memory, Short-term memory, Long-term memory, thinking: reasoning and problem solving, Skill acquisition, Errors and mental models. Motivations for Using Biometric Systems, Human Identity and Biometrics, Levels of Identification, Biometrics for Identity Management

Unit-2: Fundamentals of Biometrics

Biometric Technologies Work In General, Overview of Applications, Errors and Error Rates, Failure to Acquire, Personal Biometric Criteria, Biometric System-Level Criteria, Key Elements of Biometric Systems, Biometric Performance Metrics, Template Storage Considerations, Terms and Definitions Related to Biometrics

Unit-3: Types of Biometric Technologies

Dynamic Signature Analysis, Facial Imaging or Recognition, Fingerprint, Hand Geometry, Iris Recognition, Keystroke Analysis/Keystroke Dynamics, Palm print, Retinal Scan, Skin Spectroscopy/Skin Texture/Skin Contact, Speaker Verification, Vascular Biometrics, Other Biometric Technologies

Unit-4: The Biometric System Design Process

System Concept Development, Operational Considerations and Constraints, The Requirements Definition, The System Specification, Biometric Access Control, The Architectural Aspects of an Automated Access

Unit-5: Structure of Biometric Standards

Introduction, Current Work in Biometric Standards, Development, International Standards Organizations, Bio API Consortium, Common Biometric Exchange Framework Format (CBEFF), Best Practices in Standards Development

Unit-6: Testing and Evaluation

Introduction, Understanding Biometric System Performance, Comparison of Types of Testing, Technology Testing, Scenario Testing, Operational Testing

Text Books:

1. Biometric Technology Application Manual, Volume One: Biometric Basics Compiled and Published by: National Biometric Security Project Updated Summer 2008

Reference Books

1.	Human Computer Interaction- Alan Dix, Janet Finlay, Gregory D. Abowd, Russell Beale.
2.	Biometric Recognition: Challenges and Opportunities, Joseph N. Pato and Lynette, National Research Council

Mapping with Program Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	S	-	M	S	-	-	-	-	M	-	S	L
CO2	-	S	M	S	-	-	-	-	M	-	S	-
CO3	S	S	M	S	-	-	-	-	M	-	S	-
CO4	S	S	M	S	-	-	-	-	M	-	S	M

S- Strong; M-Medium; L-Low

Code:	MCA-505(c)	Digital Image Processing	Credits: 04

Course Objectives:

1. To understand the recent trends in the field of Digital Image processing and identify its applications.
2. To appreciate the need for Digital Image processing.
3. To expose the students to the problems related to Image processing - To understand the different concepts as Image processing in spatial and frequency domain.
4. To understand the concepts of image segmentation.
5. To understand concepts of morphological image processing.

Course Outcome:

CO1: Understand the basic concepts in digital image processing.
CO2: Analyze the histogram and filtering techniques for image enhancement.
CO3: Analyze the image Degradation/Restoration process.
CO4: Synthesize the various image compression and segmentation methods.
CO5: Apply the knowledge of representation and description of images.
CO6: Analyze and interpret objects through pattern classes.

Unit-1: Digital Image Processing Fundamentals:

Digital Image Processing Systems: Fundamental steps in DIP. Components of an Image Processing System, Elements of Visual Perception, Image sensing and acquisition, Image sampling and quantization Digital Image Representation, Data Classes and Image types and Converting between Data Classes and Image types.

Unit-2: Intensity transformation and spatial filtering:

Background, some basic gray level transformations, Histogram processing, enhancement using arithmetic and logic operations, basic of spatial filtering, smoothing spatial filters, sharpening spatial filters.

Unit-3: Frequency Domain Processing:

Background, Introduction to FT and frequency domain, smoothing frequency domain filters, sharpening frequency domain filters, additional properties of the 2-D FT, convolution.

Unit-4: Image Restoration:

A Model of the Image Degradation /Restoration Process, Noise Models, Restoration in presence of Noise only –spatial filtering, Periodic Noise Reduction by Frequency domain filtering

Unit-5: Image Segmentation:

Line detection, Edge Detection, Edge Linking and boundary detection, Global Thresholding, multiple thresholds, variable threshold, multi variant threshold, Region based Segmentation. Corner Detection.

Unit-6: Color Image Processing:

Color Image Representation, Converting to other Color.

Text Books:

1.	Digital Image Processing- R.C. Gonsales R. E. Woods, Second Edition, Pearson Education.

2.	Fundamentals of Image Processing- Anil K. Jain, PHI Publishing.
Reference Books	
1.	Digital Image Processing using MATLAB- R.C. Gonsales R. E. Woods, Second Edition, Pearson Education.
2.	Digital Image Processing – by William K. Pratt 3rd Edition John Wiley and Sons Inc.
3.	Chanda & Majumdar, Digital image processing and analysis, PHI,

Mapping with Program Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	S	S	S	S	-	S	-	L	-	-	S	-
CO2	S	S	M	S	S	-	L	L	-	-	-	-
CO3	S	S	-	S	S	-	-	-	-	-	M	M
CO4	S	S	-	S	-	-	-	-	-	-	M	M
CO5	S	S	-	S	-	-	-	-	-	-	M	M
CO6	-	M	L	-	L	-	-	-	-	-	L	L

S- Strong; M-Medium; L-Low

Code:	MCA-505(d)	Mobile Application Development	Credits: 04

Course Objectives:

1. To understand the recent trends in the field of Mobile programming and identify its applications.
2. To appreciate the need for Android Programming.
3. To expose the students to the real world problems related to mobile device
4. To understand the various concepts of android programming
5. To develop and implement android development projects.

Course Outcome:

CO1:Learn and understand the terminology related to mobile application development and the need for mobile web presence
CO2: Understand designing of Android user interfaces and types of mobile websites
CO3: Understand the tools needed for android installation and to manage screen orientations
CO4: Learn the various user interface views and to handle user preferences through content Providers
CO5: Learn to use Android's communication APIs for SMS and mail and to learn basics of networking
CO6: Learn to use the Location-based services offered by Android Applications

Unit-1: Introduction

Preliminary Considerations, Cost of Development, Importance of Mobile Strategies in Business World, Mobile Myths, Third-Party Frameworks Mobile Applications: Mobile Web Presence, Marketing, Web Services for Mobile Devices, Web Services Languages

Unit-2: Mobile User Interface Design:

Effective Use of Screen Real Estate, Understanding Mobile Application Users, Understanding Mobile Information Design, Understanding Mobile Platforms

Unit-3: Mobile Websites:

Choosing a Mobile Web Option, Adaptive Mobile Websites, Dedicated Mobile Websites, Mobile Web Applications with HTML5

Unit-4: Getting Started with Android:

Why Target Android? Getting the Tools You Need , Anatomy of an Android Application Android User Interface: Understanding Components of a Screen –Adapting to Display Orientation – Managing Changes to Screen Orientation–Creating User Interface Programmatically–Listening for UI Notifications

Unit-5: Types of Views:

Designing Your User interface using Views –Displaying Pictures and Menus with Views–Analog Clock and Digital Clock Views Data Persistence: Saving and loading user Preferences- Persisting data to files–Creating and using Data bases–Content Providers

Unit-6: Android Messaging and Networking:

SMS Messaging– Sending SMS– Receiving SMS- Sending E-mail Location Based Services: Displaying Maps–Obtaining Map API Key –Displaying the Map–Zoom Control–Changing Views–Navigating –Adding Markers–Getting the Location that was Touched–Geo coding and

Reverse Geo coding.		
Text Books:		
1.	Professional Mobile Application Development, Jeff Mc Wherter and Scott Gowell, 2012,WroxPublishers	
2.	Beginning Android Application Development, Wei –MengLee,Wiley,2011.	
Reference Books		
1.	Professional Android 4 Application Development, Reto Meier, Wrox Publications,2012.	
2.	Beginning iOS 6 Development: Exploring the iOS SDK, David Mark, Jack Nutting, Jeff LaMouche, and Fredric Olsson, Apress,2013.	
3.	Android in Practice, Charlie Collins, Michael Galpin and Matthias Kappler,Dream Tech,2012.	

Mapping with Program Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	S	S	S	S	-	S	-	L	-	-	S	-
CO2	S	S	M	S	S	-	L	L	-	-	-	-
CO3	S	S	-	S	S	-	-	-	-	-	M	M
CO4	S	S	-	S	-	-	-	-	-	-	M	M
CO5	S	S	-	S	-	-	-	-	-	-	M	M
CO6	-	M	L	-	L	-	-	-	-	-	L	L

S- Strong; M-Medium; L-Low

Code:	MCA -506	Lab -9 Data Mining & Data Warehousing	Credits: 02

Course Objectives

In this laboratory, students will implement the various Data Warehousing and Data Mining concepts using Oracle and WEKA / R tool.

Course Outcomes

CO1: Develop various real time applications using data mining techniques
CO2: Test the developed code using VB.net and Weka / R tool
CO3: Apply text mining on the data warehouse
CO4: Perform multi-dimensional data model using Oracle
CO5: Develop a program using a R Tool to solve a association rule
CO6: Develop a program to perform clustering and Classification using various algorithms.

Develop programs for

1. Execute Queries and PL/SQL
2. Multi-dimensional data model using SQL queries. E.g. Star, snowflake and Fact constellation schemas
3. OLAP operations such slice, dice, roll up, drill up, pivot etc.
4. Text mining on the given data warehouse
5. Correlationship analysis between for the given data set
6. Attribute relevance analysis on the given data
7. Information gain for a particular attribute in the given data
8. Data pre-processing for data mining in Weka/R tool
9. Clustering in Weka/R tool. 10. Association rule analysis in Weka / R tool

Note:

The Exercises are collection of program specifications shall be designed by the course instructor and assigned to the students.

Reference Books

1.	Herbert Schildt, "Java the Complete Reference", 9th Edition, McGraw Hill, 2014
2.	Margaret Levine Young, "The Internet - Complete Reference" , 2nd Edition, Tata McGraw Hill, 2002, (Reprint 2016).
3.	Paul Deitel,Harvey Deitel,Abbey Deitel, “Internet and WWW How to Program”, 5th Edition, Tata McGraw Hill, 2011.

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	M	S	-	M	-	-	-	-	-	-
CO2	M	M	M	M	M	-	-	-	-	-	-	-
CO3	M	S	S	M	M	L	-	-	-	-	-	-
CO4	L	S	M	M	S	L	-	-	-	-	-	-
CO5	S	L	S	S	M	L	-	-	-	-	-	-
CO6	M	M	S	M	M	L	-	-	-	-	-	-

S- Strong; M-Medium; L-Low

Code:	MCA -508	Mini Project	Credits: 02

General Instruction Regarding Preparation of Project Report

1] Spiral Binding of Project Report with Following Front page

Mini Project Report

On

[PROJECT TITLE]

Submitted By

[Name of the Student]

MASTER OF COMPUTER APPLICATION

School of Computational Science

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY

NANDED (M. S.) 431606

Year 2019-20

Guidelines for front page

Font : **Times New Roman**

Font Size:**14 Pt.** For- (Project Report On, Submitted By, School of Computational Science, Swami Ramanand Teerth Marathwada University, Nanded (M. S.) 431606, year 2018-19)

14 Pt. For - Name of the Student

16 Pt. For- Project Title and Master Of Computer Application (All Caps)

No Border for the pages, No header and Footer, Line spacing – Multiple at 1.5

3. Blank white thick page

5. Certificate Page

CERTIFICATE

(TNR-18/Caps/Bold/Centre)

(Certificate Text – TNR-12)

This is to certify that, the project "Title of the Project (in Bold)" submitted by

(Name of the student) (TNR-12/Bold)

Is a bonafide work completed under my supervision and guidance in partial fulfillment for award of Master of Computer Application Degree of Swami Ramanand Teerth Marathwada University, Nanded.

Place : Nanded

Date :

(Name of the Guide) (Name of Director)

(Do not prefix any Prof/Lect etc)

Guide Director

CONTENTS

(TNR-16/Bold/Centre)

(All above – if applicable and Give list only) – (TNR-12/Bold)

Chapter Titles in (TNR-14/Caps/Bold) and Subtopics (TNR-12/Bold)

4.7 Coding

4.8 Report Formats

5. PERFORMANCE ANALYSIS

5.1 Testing

5.2 Implementing Testing

6. CONCLUSION

6.1 Conclusion

6.2 Future Scope

6.3 Applications/Utility

6.4 User Manual

6.5 Operations Manual / Menu Explanation

6.6 Forms and Report Specifications

6.7 Drawbacks and Limitations

6.8 Proposed Enhancements

REFERENCES

ANNEXURES

ACKNOWLEDGEMENT

Instructions –

- For subtopics, each first letter of the word should be capital except the words such as and, of, for etc.
- For sub-sub topic only first letter of the title should be capital. for ex.

1. INTRODUCTION

1.1 Introduction of Cryptography

1.1.1 General aspect

- After the last chapter of conclusions in the contents, it may have appendix or data sheets as per the requirement.
- Text for all chapters should be in TNR-12 and topic headings should be in TNR-14/Bold.

7. About References – (This should be towards end of the report)

- References should be placed in Square Bracket [ ] at appropriate places in various chapters
- Reference Page Title should be in TNR-14/Bold

References

- References must be in the standard format such as

[1] A.S. Tanenbaum, "Computer Networks", 2nd Edition, PHI

[2] Web Site – http://www.cnn.com

These reference numbers should appear at appropriate places in the Project report.

9. **Acknowledgement -** (This should be at the end of the report and 1 page only)

Acknowledgement

(TNR-14/Bold/Centre)

(Names of the student with Signature

Roll No.)

(After Acknowledgement there should be 2 Blank pages in the report.)

9. Instructions about paper to be used.

- Page Size – A/4, Executive Bond, Super white, more than 70 GSM.
- Use front face for printing

10. Instructions about Page Numbering/Figure Numbering etc..

1) First page of first chapter should not have a printed page no.

2) From second chapter the page no should be printed at the centre-bottom top-right corner of the page.

3) The title of the **table** should be at the top …

Table 2.1 Timing Analysis

4) The title of **figure/photograph/graph** should be at the bottom.

5) The titles should start at top/bottom with no additional line spacing.

11. About Size of the Report –

Normally the Project Report would be approximately 60 pages. It may be in the range of 60 to 70 pages (including appendix, data sheets etc.). This may change in exceptional cases.

12. No. of Copies to be prepared –

1 Copy for Department

1 Copy for Guide

1 Copy for student

13. General Guidelines

- Paper size A4 , Left margin – 1.5”
- Right Margin -0.5”
- Top Margin – 1”
- Bottom Margin – 1”
- Text should be justified.
- Line Spacing 1.5

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Code:	MCA -601	Major Project Activity	Credits: 25

General Instruction Regarding Preparation of Project Report

1] Hard Binding with Black Color and Gold letters

Project Report

On

PROJECT TITLE

Submitted By

Name of the Student

MASTER OF COMPUTER APPLICATION

School of Computational Science

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY

NANDED (M. S.) 431606

Year 2019-20

Guidelines for front page

Font : **Times New Roman**

Font Size:**14 Pt.** For- (Project Report On, Submitted By, School of Computational Science, Swami Ramanand Teerth Marathwada University, Nanded (M. S.) 431606, year 2018-19)

14 Pt. For - Name of the Student

16 Pt. For- Project Title and Master Of Computer Application (All Caps)

No Border for the pages, No header and Footer, Line spacing – Multiple at 1.5

2] Spine/Side view of the Report –

MCA

Project

TITLE

2019 -

2019

3. Blank white thick page

4. Next Page -

Project Report

On

PROJECT TITLE

Submitted By

Name of the Student

[Seat No.]

Guided By

Name of the Guide

In partial fulfillment for the award of

MASTER OF COMPUTER APPLICATION

School of Computational Science

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY

NANDED (M. S.) 431606

Year 2018-19

5. Certificate Page

CERTIFICATE

(TNR-18/Caps/Bold/Centre)

(Certificate Text – TNR-12)

This is to certify that, the project “Title of the Project (in Bold)” submitted by

(Name of the student) (TNR-12/Bold)

Is a bonafide work completed under my supervision and guidance in partial fulfillment for award of Master of Computer Application Degree of Swami Ramanand Teerth Marathwada University, Nanded.

Place : Nanded

Date :

(Name of the Guide) (Name of Director)

(Do not prefix any Prof/Lect etc)

Guide Director

CONTENTS

(TNR-16/Bold/Centre)

(All above – if applicable and Give list only) – (TNR-12/Bold)

Chapter Titles in (TNR-14/Caps/Bold) and Subtopics (TNR-12/Bold)

4.6 Front End Design, Menu Tree, Menu Screens, Input Screens

4.7 Coding

4.8 Report Formats

5. PERFORMANCE ANALYSIS

5.1 Testing

5.2 Implementing Testing

6. CONCLUSION

6.1 Conclusion

6.2 Future Scope

6.3 Applications/Utility

6.4 User Manual

6.5 Operations Manual / Menu Explanation

6.6 Forms and Report Specifications

6.7 Drawbacks and Limitations

6.8 Proposed Enhancements

REFERENCES

ANNEXURES

ACKNOWLEDGEMENT

Instructions –

- For subtopics, each first letter of the word should be capital except the words such as and, of, for etc.
- For sub-sub topic only first letter of the title should be capital. for ex.

1. INTRODUCTION

1.1 Introduction of Cryptography

1.1.1 General aspect

- After the last chapter of conclusions in the contents, it may have appendix or data sheets as per the requirement.
- Text for all chapters should be in TNR-12 and topic headings should be in TNR-14/Bold.

7. About References – (This should be towards end of the report)

- References should be placed in Square Bracket [ ] at appropriate places in various chapters
- Reference Page Title should be in TNR-14/Bold

References

- References must be in the standard format such as

[1] A.S. Tanenbaum, "Computer Networks", 2nd Edition, PHI

[2] Web Site – http://www.cnn.com

These reference numbers should appear at appropriate places in the Project report.

10. **Acknowledgement -** (This should be at the end of the report and 1 page only)

Acknowledgement

(TNR-14/Bold/Centre)

(Names of the student with Signature

Roll No.)

(After Acknowledgement there should be 2 Blank pages in the report.)

9. Instructions about paper to be used.

- Page Size – A/4, Executive Bond, Super white, more than 70 GSM.
- Use front face for printing

10. Instructions about Page Numbering/Figure Numbering etc..

1) First page of first chapter should not have a printed page no.

2) From second chapter the page no should be printed at the centre-bottom top-right corner of the page.

3) The title of the **table** should be at the top …

Table 2.1 Timing Analysis

4) The title of **figure/photograph/graph** should be at the bottom.

5) The titles should start at top/bottom with no additional line spacing.

11. About Size of the Report –

Normally the Project Report would be approximately 60 pages. It may be in the range of 60 to 70 pages (including appendix, data sheets etc.). This may change in exceptional cases.

12. No. of Copies to be prepared –

1 Copy for Department

1 Copy for Guide

1 Copy for student

13. General Guidelines

- Paper size A4 , Left margin – 1.5"
- Right Margin -0.5"
- Top Margin – 1"
- Bottom Margin – 1"
- Text should be justified.
- Line Spacing 1.5

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Director
School of Computational Sciences
S.R.T.M. University, Nanded (M.S.)

MCA 19-20