Curriculum and Syllabus

of

2 Yrs Master in Computer Application (MCA)

(Effective from Admission Batch : 2023-24)

SRUSTI ACADEMY of MANAGEMENT (Autonomous)

Approved by AICTE, Govt. of India | Affiliated to BPUT, Odisha, Rourkela
1st B-School in Odisha with 'A' Grade Accreditation by NAAC

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Master of Computer Application (MCA)

1.1 Introduction

Master of Computer Applications (MCA) is a 2-year degree programme that aims to equip graduates with the advanced tools, technologies and applications in the IT industry to meet the constantly growing requirement of IT professionals. The industry-oriented programme helps learners to develop a thorough understanding of various tools and programming languages in the development of better and faster applications. Increasing applications of computers in almost all areas of human endeavour has led to a vibrant industry with concurrent rapid change in technology. Thus the challenge in designing a curriculum is to identify the areas of core competence which is reasonably stable and provide sufficient number of electives and laboratories to accommodate changes. Thus the suggested curriculum has a strong laboratory and project orientation in which the use of new tools will be emphasized. Most courses will have an associated laboratory and it is expected that they will be equipped with the latest software tools.

2.1 During two years (four semesters) MCA programme students are required to undergo the following:

2.1.1 Foundation course during Deeksharambh (Student Induction Program)

Courses: Core, elective, training and skill development, practical and internship etc.

2.1.2 13 Core Courses

2.1.3 12 Practical papers

2.1.4 04 Elective papers

2.1.5 02 Project (Minor projects and Major projects)

2.1.6 Minimum 2 Value Added Courses

2.1.7 Add-on, non-credit courses

2.1.8 Experiential Learning through Summer Internship, Industry visits, Activity based self Learning, and Live projects.

2.2 Programme Duration

The two year programme is divided into four semesters. During the first semester, the students are provided extensive teaching in a number of core courses. From the second semester onwards till the fourth semester, the students are required to complete core as well as elective courses. Students pursue their special interests in-depth through the electives

offered by the programme. During the month of June and July, students are required to undertake a Summer Internship Project (SIP). Apart from core and elective courses, a student has to undergo practical/lab sessions spread over different semesters. Many co-curricular activities are included for enriching the teaching learning process and extra-curricular activities are also conducted for holistic development of the student

3.1 PEO and PO Statements

3.1.1 PEO Statements

Program Educational Objectives (PEOs) are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve. Three PEOs have been defined for the program:

PEO 1	**To excel as a techno-leader,** keeping pace with the evolving technological advances to contribute in forward looking organization.
PEO 2	To develop and nurture an ecosystem of **innovation, creative spirit and entrepreneurship** in technology driven society.
PEO 3	**To practice ethical behaviour** and **lifelong learning** with concern for **societal wellbeing** while being engaged in professional activities.

3.1.2 PO and PSO Statements

Program Outcomes (POs) describe what students are expected to know and would be able to do by the time of graduation. These relate to the skills, knowledge, and behaviors that students acquire as they progress through the program. There are twelve POs which have been defined by National Board of Accreditation (NBA) for students. Program Specific Outcomes (PSOs) are statements that describe what the graduates of a specific computer application program should be able to do. The institute has defined one Program specific outcome which adds on to the Program outcomes.

PO1:	Apply knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements.
PO2:	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains.
PO3:	Design applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects
PO4:	Ability to invoke the research skills by conducting experiments, interpreting data

	and providing well informed 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 practices.
PO7:	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.
PO8:	Function effectively in the workplace both as a team leader and team member on multi-disciplinary projects demonstrating computing and management skills.
PO9:	Communicate effectively with the computing community as well as society by being able to comprehend effective documentations and presentations.
PO10:	Ability to understand and assess the impact of system solutions in a contemporary, global, economic, environmental, and societal context for sustainable development.
PO11:	Ability to work as a member or leader in diverse teams in multidisciplinary environment.
PO12:	Identifying and pursuing opportunities by using innovative ideas, to create value and wealth for the betterment of the individual and society.
PSO1	Inculcate employability and entrepreneur skills among students who can develop customized solutions for small to large Enterprises.

Scheme of Credit Distribution

Semester	Specifications	Credits	Total Credits
1st	05 Theory papers 03Practical paper 01Practical paper	05X @ 3 credits per paper=15 03X @ 1 credits per paper=03 01X @ 2 credits per paper=02	20
2nd	05 Theory papers 04Practical paper 01Practical paper	05X @ 3 credits per paper=15 04X @ 1 credits per paper=04 01X @ 2 credits per paper=02	21
	03 Theory Paper	03X @ 3 credits per paper=09	
	01 Theory paper of Elective-I	01 X @ 3 credits per paper=03	
	01 Theory paper of Elective-II	01 X @ 3 credits per paper=03	

3rd	03Practical/Lab paper	03 X @ 1 credits per paper =03	24
	01 Minor Project	01 X @ 4 credits per paper =04	
	Training on Advanced JAVA	01 X @ 2 credits per paper =02	
4th	01 Theory papers of Elective– III	01 X @ 3 credits per paper =03	15
	01 Theory papers of Elective-IV	01 X @ 3 credits per paper =03	
	01 Major project	01 X @9 credits per paper =09	
Grand Total			**80**

Programme Structure Analysis

Semester	Core papers	Electives	Practical		Project	Total
			IT Lab	Communication Lab		
1st	05	-	03	01		09
2nd	05	-	05	-		10
3rd	03	02	03	01	01	10
4th		02			01	03
	13	**04**	**10**	**02**	**02**	**32**

Sl. No.	Category of Papers	Number of papers	Credits
i.	Core papers	13	39
ii.	Electives	04	12
iii.	Practical	13	16
iv.	Project	02	13
		Total Papers 32	**Total Credits 80**

Add-on course (by the institute) / Value Added Courses (MOOCs/Swayam /NPTEL/other credible courses) shall be provided as additional non-credit courses of 30 hours.

4.1 Program Highlights

4.1.1 Core courses

The core courses of MCA programs provide a holistic approach to IT education, giving students both an overview of the field, and a basis to build, and specialize upon. These core courses are strong foundation to establish IT knowledge and provide broad multi-disciplined knowledge that can be further studied in depth during the elective phase. A wide range of

core courses provide groundwork in the basic IT disciplines like Artificial Intelligence, Machine Learning, Data Visualization, Data Warehousing and Business Intelligence etc. The integrated foundation is important for students because it not only allows them to build upon existing skills, but also explore career options in a range of industries, and expand their understanding of various IT fields.

4.1.2 Elective courses

The elective courses provides in depth insight towards strengthening knowledge in areas critical to personal and professional growth. Electives are focused on the knowledge and skills critical for those working in innovation-driven environments.

Elective courses are concentrations for further study in functional areas like Artificial Intelligence, Machine Learning, Data Visualization, Data Warehousing and Business Intelligence etc. This makes it stand out from other traditional MCA degree programs as candidates can choose from future-ready domains and play a crucial part in building the future.

4.1.3 Industry Endorsed Curriculum

Since the very purpose of imparting MCA course is to prepare students with requisite knowledge and IT skills to serve Industry, the Institute has a good representation of Industry representatives in its Board of Studies (BOS) which is mandated to first examine the existing curriculum, suggest for addition and deletion of subjects and moderation of modules in those. New areas of elective in emerging areas like Artificial Intelligence, Machine Learning, Data Visualization, Data Warehousing and Business Intelligence etc. has been incorporated.

4.1.4 Value Added Courses (Sector specific)

To bridge the gap between corporate need and syllabus, sector specific Value Added Course (VAC) is offered to students for enhancing employability. Value-Added courses shall be over and above curriculum selected from course offered by SWAYAM / NPTEL / Mooc's / other reputed institutions / Universities etc. to develop skills to increase the employability quotient and equipping the students with practical insights of few sun-rise sectors, which most often offer number of job opportunities.

4.1.5 Emphasis on Practical Learning

In order to emphasize on practical learning, the curriculum has a strong laboratory and project orientation in which the use of new tools will be emphasized evenly distributed in all semesters. Most courses will have an associated laboratory and it is expected that they will be equipped with the latest software tools.

5.1 Pedagogy

Employing effective pedagogical approaches help students achieve learning out comes and realizes their full educational potential. Quality pedagogy provides strong foundations for learning. It aids students in developing advanced concepts and critical thinking abilities

The pedagogy followed shall help the students:

i. To impart knowledge, skills, attitudes and competence among the prospective IT experts;
ii. To offer Multi, Inter and Cross Disciplinary modular programmes in IT enabled teaching learning process to produce market driven IT experts;
iii. To develop a strong intellectual and ethical human capital base with a focus on industry and services sector; and
iv. To infuse entrepreneurial approach within the student with an objective to improve the teaching quality and to enforce improvement in the learning outcome of the students the following pedagogy is adopted.

5.1.1 Blended learning

Online-learning brings many opportunities for students to learn simultaneously from number of institutes across the world. Along with physical class room teaching, online-learning though various platforms, including SWAYAM / MOOC's / NPTEL encourages students in archiving the learning outcomes. For effective blended learning, there is an increased use of various Learning Management solutions (LMS) during the programme.

5.1.2 Case Based Teaching/ Project Based Teaching

Experiment-based teaching/ Project based Teaching is a pedagogical approach that engages students in the process of making real-world decisions, critical thinking and explore innovative solutions through the technology and management skills. The faculty members create problems with experiments that represent authentic workplace situations to encourage students to apply knowledge gained from the classroom or through additional research in order to solve the case. This validates the application of knowledge of IT theories and practices to solve business problems in the industry as provided in programme objectives.

5.1.3 Flipped Class Room

A flipped class room is an instructional strategy and a type of blended learning which aims to increase student engagement and learning by having students completing reading at their home and work on live problem-solving/assignments during class time. This is the reverse of more common practice of introducing new content at Institute/College, then assigning

homework and projects to be completed by the student independently at home. In a common Flipped Class Room scenario, students might watch pre-recorded videos at home then come to Classroom to do the assignment armed with questions and at least some background knowledge

5.1.4 Experiential learning

Experiential learning is an engaged learning process whereby students learn by doing and by reflecting on the experience. Experiential learning activities can include, but are not limited to, hands on field exercises, internships, laboratory experiments, study abroad, and postgraduate research. Experiential learning enhances reflection, critical analysis and synthesis. Experiential learning includes a designed learning experience with the possibilities to learn from natural consequences, mistakes and successes.

5.1.5 Industry Immersion Programme

The Industry Immersion Programme is also an effective experiential leaning methodology and path to bridge the gap between the expectations of the industry and the students. The programme is designed to have continuous evaluation and development of the students. Immersion programs relocate group of students into an unfamiliar environment for a period of time for the purpose of providing meaningful learning opportunities. For maximum effect, the individual/group must be receptive to the social, cultural and/or political circumstances into which they have been placed.

5.1.6 Other Pedagogical Approaches

Learning is dependent on the pedagogical approaches teachers use in the classroom. The institute focuses continuously on how teachers and students relate together as well as the improving instructional approaches implemented in the classroom. *Learner-Centric Pedagogy are implemented like:*

i. **Outbound Training**: Outbound training is included in the curriculum in order to enhance overall Personality Development of students in building life skills. Out bound program helps students undertake field activity and build those skills which are very essential to match with the corporate rigor by involving in activities like managing events, sales, public relations and managing changes and stress. Opportunities are provided for practical training in leadership, self-development, confidence building and develop stamina and manage stress to cope up when students join companies after completion of the program.

ii. **Presentation**: Knowledge assimilated is best assessed when students are able to express and exhibit the talent when presented in the right form and as required by companies/corporate. Hence presentation skills give student to rehearse the knowledge, lessons learnt in the classroom. Students are assessed by individual and group presentations and give feedback and trained on the gaps.

iii. **Quiz**: Quiz one teaching method that helps test students ability to grasp subject.

iv. **Simulation:** Simulations are usually computer-based, using a software-generated model to provide support for the decisions of managers and engineers as well as for training purposes. Simulation techniques aid understanding and experimentation, as the models are both visual and interactive.

Course Types & Definitions

L	Lecture
T	Tutorial
P	Practical

Course Structure for 1st Year MCA

Foundation Course (to be conducted during "Deeksharambh" (Student Induction Programme)

The foundation course shall be for two weeks. The following aspects shall be included in the foundation programme:

- Basic terminologies and FAQs generally used in Computer Applications.
- Career scope in various areas of electives
- Basics of fundamental subjects as a pre-requisite before learning the core subjects of computer applications
- Physical and mental well-being
- Alumni talk
- Management games etc.

Sl. No.	Name of the Subject	L-T-P	Credit	Hours
1.	Data Analytics (Mathematics/Statistics)	10-0-0	0	10
2.	Emerging Technologies (Highlights of Electives)	10-0-0	0	10
3.	Logical Reasoning	5-0-0	0	05
4.	Design Thinking	5-0-0	0	05
5.	Entrepreneurship Development	5-0-0	0	05
6.	Universal Human Values-Introduction	5-0-0	0	05

Semester-1: Autumn Semester (August to December)

Sl. No.	Course Code	Course Title	L-T-P	Total credit
1.	22MCA101	Discrete Mathematics	3-0-0	3
2.	22MCA102	Problem Solving and Programming Language	3-0-0	3
3.	22MCA103	Business Communication	3-0-0	3
4.	22MCA104	Computer System Architecture	3-0-0	3
5.	22MCA105	Database Management Systems	3-0-0	3
PRACTICAL				
1.	22MCA106(P)	Programming Using C Lab	0-0-1	1
2.	22MCA107(P)	Language and communication skills Lab	0-0-1	1
3.	22MCA108(P)	DMS using Oracle Lab	0-0-1	1
4.	22MCA109(P)	Emerging Technology Lab-I (Python Programming)	0-0-2	2
			TOTAL	**20**

Semester-2: Spring Semester (January to May)

Sl. No.	Course Code	Course Title	L-T-P	Total credit
1.	22MCA201	Probability and Statistics	3-0-0	3
2.	22MCA202	Data Structure	3-0-0	3
3.	22MCA203	Object Oriented Programming Systems	3-0-0	3
4.	22MCA204	Operating System	3-0-0	3
5.	22MCA205	Universal Human Values	3-0-0	3
PRACTICAL				
1.	22MCA206(P)	Data Structure Using C Lab	0-0-1	1
2.	22MCA207(P)	Object Oriented Programming using JAVA Lab	0-0-1	1
3.	22MCA208(P)	Operating System Lab	0-0-1	1
4.	22MCA209(P)	Advance Python Programming	0-0-1	1
5.	22MCA210(P)	Emerging Technology Lab-II (Internet & Web Technology Lab)	0-0-2	2
			Total	**21**

Course Structure for 2nd Year MCA

Semester-3: Autumn Semester (August to December)

Sl. No.	Course Code	Course Title	L-T-P	Total credit
1.	22MCA301	Design and Analysis of Algorithms	3-0-0	3
2.	22MCA302	Computer Network	3-0-0	3
3.	22MCA303	Software Engineering	3-0-0	3
4.	22MCA304	Elective-I	3-0-0	3
5.	22MCA305	Elective-II	3-0-0	3
PRACTICAL				
1.	22MCA306(P)	Design and Analysis of Algorithms Lab	0-0-1	1
2.	22MCA307(P)	Personality Development and soft skills Lab	0-0-1	1
3.	22MCA308(P)	Data Processing and Visualization Lab	0-0-1	1
4.	22MCA309(P)	Advanced JAVA	0-0-2	2
5.	22MCA310(P)	Minor Project	0-0-4	4
			TOTAL	**24**

Semester-4: Spring Semester (January to May)

Sl. No.	Course Code	Course Title	L-T-P	Total credit
1.	22MCA401	Elective-III/**MOOC's**	3-0-0	3
2.	22MCA402	Elective-IV/ **MOOC's**	3-0-0	3
PRACTICAL				
1.	22MCA403(P)	Major Project	0-0-9	9
			TOTAL	**15**

Note:

I. **Major Project-** 90-120 days project work by students in different companies. Can be an extension of the minor project (of 3rd semester).

Elective papers for 3rd and 4th Semesters

Elective-I

Sl.No.	Course Code	Course Title
1.	22MCA304(A)	Artificial Intelligence
2.	22MCA304(B)	Information Security
3.	22MCA304(C)	Wireless Sensor Network
4.	22MCA304(D)	Software Testing

Elective-II

Sl.No.	Course Code	Course Title
1.	22MCA305(A)	Data Warehousing and Business Intelligence
2.	22MCA305(B)	Vulnerability Assessment and Penetration Testing (VAPT)
3.	22MCA305(C)	Cloud Computing
4.	22MCA305(D)	Mobile Application Development

Elective-III

Sl.No.	**Course Code**	**Course Title**
1.	22MCA401(A)	Machine Learning
2.	22MCA401(B)	Block Chain Technology
3.	22MCA401(C)	Internet of Things
4.	22MCA401(D)	Software Project Management

Elective-IV

Sl.No.	**Course Code**	**Course Title**
1.	22MCA402(A)	Big Data Analytics
2.	22MCA402(B)	Digital Forensics
3.	22MCA402(C)	Mobile Computing
4.	22MCA402(D)	E-Commerce and Knowledge Management

Minor Project- 45-60 days project work during 3rd semester by students looking to the employability factor of industry.

i. A project item shall carry 300 Marks (4 credits).

ii. At the end of 2nd semester MCA programme, a student has to take up Minor Project (Institute level) during the summer vacation as provisioned in the approved curriculum.

iii. After end of the project, students will submit a report and deliver a presentation about the project and appear for a viva-voce before the faculty members of their department.

Evaluation of Minor Project

i. Evaluation of a project will be done on following Marks

Understanding the relevance scope and dimension of the project	30
Relation to literature/application	30
Methodology	30
Quality of Analysis and Results	30
Interpretations and Conclusions	60
Report and defense	120
	300 Marks

ii. The evaluation shall be done by a Committee of teachers to be constituted by the Principal in respective specializations where the Internal Supervisor shall be a member.

iii. Minimum score for a pass in project item is 50 percentage points.

Major Project- 90-120 days project work by students in different companies / Institutes can be an extension of the minor project (of 3rd semester). The major project shall be evaluated though a **Comprehensive Viva--** (Grand Viva to testify the learning on all the subjects).

Syllabus for MCA 2 yrs. Programme

Semester-1: Autumn Semester (August to December)

Semester-1: Autumn Semester (August to December)

Sl. No.	Course Code	Course Title	L-T-P	Total credit
6.	22MCA101	Discrete Mathematics	3-0-0	3
7.	22MCA102	Problem Solving and Programming Language	3-0-0	3
8.	22MCA103	Business Communication	3-0-0	3
9.	22MCA104	Computer System Architecture	3-0-0	3
10.	22MCA105	Database Management Systems	3-0-0	3
PRACTICAL				
2.	22MCA106(P)	Programming Using C Lab	0-0-1	1
2.	22MCA107(P)	Language and communication skills Lab	0-0-1	1
3.	22MCA108(P)	DMS using Oracle Lab	0-0-1	1
4.	22MCA109(P)	Emerging Technology Lab-I (Python Programming)	0-0-2	2
			TOTAL	**20**

Semester	Course Code	Discrete Mathematics	L-T-P	Credits	Hours	Marks
1st	22MCA101		3-0-0	3	30	150

Objectives	The objective of this course is to familiarize the students with mathematical logic, counting techniques and abstract structures like groups, Boolean algebra andgraphs.
Pre-Requisites	Basic knowledge of sets and matrices is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions areplanned to be interactive with focus on problem solving activities.

Evaluation Scheme

Teacher Assessment		Written Assessment		Total
Quiz	Assignment	Mid term	End term	
10	20	20	100	150

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Propositional Calculus and Predicate Calculus, Rules of inference. Proofs and proof strategies, Summation of sequences, Mathematical induction.	**10 Hours**
Module-2	Basics of counting techniques, Recurrence relation and its solutions, Principleof inclusion and exclusion and its applications. Set Theory, Relation, Equivalence relation and Partial Order relation, Hasse-Diagram.	**10 Hours**
Module-3	Graphs, paths and connectivity in a graph, planar graph, Trees. Binary operation, semi group, monoid, group and ring, group codes.	**10 Hours**
	Total	**30 Hours**

Books	Name of The Books/References	Publishers
Text Book :	***T1. Discrete Mathematics and its Application,*** K. H. Rosen ***T2.Elements of Discrete Mathematics,*** C. L. Liu	1. Tata McGraw-Hill 2. Tata McGraw-Hill
Reference Book :	***Discrete Mathematical Structures with Applications to ComputerScience***, Indian Edition, J. P. Tremblay and R. Manohar	Tata McGraw-Hill
Online Resources	1. https://nptel.ac.in/courses/111/105/111105035/ 2. https://nptel.ac.in/courses/122/104/122104017/ 3. https://nptel.ac.in/courses/122/102/122102009/ 4. http://freevideolectures.com/Course/2267/Mathematics-I/22 5. https://nptel.ac.in/courses/111106086/	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Define & describe various logical connectives and expressions along with rules of inferences.
CO2	Apply various methods of proofs and proof strategies.
CO3	Construct various counting techniques using recurrence relations, generating functions forfuture applications.
CO4	Interpret the knowledge on sets, relations and functions.
CO5	Develop the concepts and applications of graphs.
CO6	Identify & define algebraic structures like group, ring, Boolean algebra and its applications.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements
PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains.
PO3	Design applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects
PO4	Ability to invoke the research skills by conducting experiments, interpreting data and providing well informed conclusions.
PO5	Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.
PO7	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	3	2	3	2		1						2
CO2	3	3	2	3	2		1						3
CO3	3	3	2	3	3		2						2
CO4	3	2	3	2	2		2						2
CO5	3	2	3	3	1		2						2
CO6	3	3	2	3	2		1						3

Semester	Code	Problem Solving & Programming	L-T-P	Credits	Hours	Marks
1st	22MCA102		3-0-0	3	30	150

Objectives	The course aims to provide exposure to problem-solving through programmingand train the students on the basic concepts of the C-programming language.
Pre-Requisites	Basic analytical and logical understanding including basic knowledge and usage of computers is required for this course. Prior experience with any other programming language will be beneficial.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities.

Evaluation Scheme

Teacher Assessment		Written Assessment		Total
Quiz	Assignment	Mid term	End term	
10	20	20	100	150

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction to computers and computing, basic organization of a computer, algorithm, flowchart, structure of C program, character set, identifier, keywords, constants, variables, data types, expression, statements, operators, operator precedence and associativity, type conversion; Decision making and branching: if, if-else, nested if-else, else-if ladder, switch statement; Loop constructs: while, for, do-while, nested loops, jump statements (break, continue, goto), exit statement. Functions: monolithic vs modular programming, user defined function vs library function, introduction to function, function prototype, function definition, function call, parameter passing, recursion, storage classes (auto, register, static, extern);	**12 Hours**
Module-2	Arrays: declaration and initialization of arrays, accessing array elements, basic operation on arrays, multidimensional array, array and function. String: declaration and initialization, manipulation; Pointers: concepts of pointer, declaration and initialization of pointer variable, accessing variable through pointer, pointer arithmetic, pointer expression, using pointer with arrays and string, array of pointers, pointer to an array, pointer as function argument, function returning pointer, pointer to function.	**10 Hours**
Module-3	Structures: declaration and definition, initialization, accessing members of structure, copying and comparing structure variables, nested structures, array of structure, structure and function, pointer to structure, self-referential structure, union; Dynamic Memory Management using the malloc, calloc, realloc and free functions. File Handling: concept of files, text vs binary file, data file manipulation, file opening and closing, standard and formatted input/output operation on files; Command-line arguments, typedef, enumerated data type, pre- processor directives;	**08 Hours**
	Total	**30 Hours**

Books	Name of The Books/References	Publishers
Text Book :	***T1. PrograMMing in ANSI C,*** E. Balagurusamy ***T2. Let Us C,*** Y. Kanetker	Tata McGraw-Hill BPB Publications
Reference Book :	R1. B. W. Kernighan and D. M. Ritchie, ***The C PrograMMing Language*** R2. H. Schildt, ***C: The CoMplete Reference***	PHI Tata McGraw-Hill.
Online Resources	1. http://www.princeton.edu/~achaney/tmve/wiki100k/docs/C %28programming language%29.html 2. http://www.stat.cmu.edu/~hseltman/c/CTips.html 3. http://www.c-faq.com/ 4. http://www.learn-c.org/ 5. https://www.javatpoint.com/c-programming-language-tutorial	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Understand the types of number system and number system conversion. Also the learners should be able to understand the key elements for developing a program.
CO2	Develop simple C programs using data types, variables, operators and control transfer statements.
CO3	Design C programs to handle similar data items using arrays and construct modular programs.
CO4	Use string and pointer to design efficient C programs for manipulating real life situations.
CO5	Manipulate memory during run time and handle heterogeneous data items using structure and union.
CO6	Design C programs to create and manipulate files. Write efficient C programs using command line arguments, macros and pre-processor directives.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Ability to identify critically analyzes and formulates complex computing problems using fundamentals of computer science and application domains.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO7	Recognize the need, and have the ability to engage in independent learning for continual development as a computing professional.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	2	2		1		2			1			2

CO2	3	3	2		2		3			3			2
CO3	3	3	3		3		2			3			3
CO4	3	3	2		3		1			3			2
CO5	3	3	3		3		2			2			2
CO6	3	3	3		2		2			3			3

Semester	Code	Business Communication	L-T-P	Credits	Hours	Marks
1st	22MCA103		3-0-0	3	30	150

Objectives	To develop the students' communication proficiency with an emphasis on Language Skills, make them aware of the importance of cross–cultural communication, help them read and comprehend texts of different genres, andcompose effective business messages with the correct use of English Grammar.
Pre-Requisites	Basic knowledge of English grammar and the ability to read and write using theEnglish language.
Teaching Scheme	Regular classroom lectures with use of PPTs as and when required; sessions are planned to be interactive with a focus on improving spoken and written communication skills in English.

Evaluation Scheme

Teacher Assessment		Written Assessment		Total
Quiz	Assignment	Mid term	End term	
10	20	20	100	150

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Communication Process and Types; Process and factors involved: code, channel, message, context, feedback; Importance of communication; differences between General and Technical communication; Communication across cultures; Barriers to effective communication; Verbal and Non-verbal communication.	08 Hours
Module-2	Language Skills and Usage: Four skills of language (L, S, R, W); Importance of communication through English; Language functions (Speech Acts); Art of Public Speaking: Styles and techniques (assertiveness, convincing, argumentation, negotiation); Presentation skills: The four Ps' (Plan, Prepare, Practice, Present), Contentdevelopment, Clarity of speech, Non-verbal gestures. Sounds of English: An introduction to English phonology; Consonants; Vowels and Diphthongs; Consonant clusters and Problem sounds; Phonemic Transcriptions; Syllabic Division; Stress; Intonation.	12 Hours
Module-3	Reading Skills: Importance of reading; Sub Skills of Reading; Reading Comprehension; Techniques of Summarizing and Note making; Introduction to genres of short stories; Short Stories 1 – 4; Critical analysis of the prescribed texts. Effective Formal Writing Skills: Difference between Speech and Writing; Elements of effective Business Writing; Basic understanding of the English Verb system; Identifying the common errors; Process Writing; Writing a paragraph; Writing an essay: descriptive, informative; Letter writing: formal and informal; Memo and email; Report Writing.	10 Hours
	Total	30 Hours

Books	Name of The Books/References	Publishers
Text Book :	***T1.Effective Technical CoMMunication,*** M. A. Rizvi ***T2. Technical CoMMunication: Principles and Practice,*** M. Raman, S. Sharma	Tata McGraw-Hill Oxford University Press
Reference Book :	R1: S. Samantray, ***Business CoMMunication and CoMMunicative English***, S. Chand. R2: J. Seeley, ***The Oxford Guide to Writing and Speaking***, Oxford University Press.	S. Chand Oxford University Press
Online Resources	1. http://www.cambridgeindia.org 2. http://www.cambridgeenglish.org/exams/business-certificates/business 3. https://steptest.in 4. https://www.coursera.org/specializations/business-english 5. http://www.academiccourses.com/Courses/English/Business-English	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Understand the process and types of communication, and the nuances of communication across cultures.
CO2	Understand and apply the skills of language in day-to-day communication as well as in public speaking.
CO3	Understand the sounds of the English language and be able to check their pronunciation through phonemic transcriptions in order to speak with a neutral accent.
CO4	Enhance their reading skills and be able to critically analyse texts of various kinds.
CO5	Compose different types of business correspondences effectively with a proper use of grammar.
CO6	Identifying the common errors at the time of writing, process of writing any text.

Program Outcomes Relevant to the Course:

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	Function effectively in the workplace both as a team leader and team member on multi-disciplinary projects demonstrating computing and management skills
PO9	Communicate effectively with the computing community as well as society by being able to comprehend effective documentations and presentations
PO11	Ability to work as a member or leader in diverse teams in multidisciplinary environment

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1						3	3	2	1		1		3
CO2						3	3	3	3		3		3
CO3						3	3	1	3		2		3
CO4						3	2	2	3		2		2
CO5						3	3	2	2		2		3
CO6						3	3	3	2		3		3

Semester	Code	Computer System Architecture	L-T-P	Credits	Hours	Marks

1st	22MCA104		3-0-0	3	30	150

Objectives	The objective of this course is to familiarize students about hardware design including logic design, basic structure and behaviour of the various functional modules of the computer and how they interact to provide the processing needs of the user.
Pre-Requisites	Knowledge of Basic Digital Electronics and computer fundamentals.
Teaching Scheme	Regular classroom lectures with use of ICT wherever required, and planned interactive sessions with focus on problem solving activities.

Evaluation Scheme

Teacher Assessment		Written Assessment		Total
Quiz	Assignment	Mid term	End term	
10	20	20	100	150

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Basic structure of Computer: Functional Units & Operation concepts, Bus Structures, Performance, Multiprocessors and Multi computers, Memory Location and Address, Memory Operations, Basic Instruction Types, Addressing Modes,Basic I/O Operation, Subroutines. Binary Arithmetic: Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of positive numbers, Signed Operand Multiplication, Integers Division, Floating–Point numbers representation, Floating – Point numbers operations.	**12 Hours**
Module-2	Memory System: Basic Concepts, Semiconductor RAM memories, ROM, Speed size and cost, Cache Memory concepts, Cache Memory mapping techniques, Performance consideration, Virtual Memory concepts, Translation Look-aside Buffer, Replacement techniques, Secondary Storage.	**08 Hours**
Module-3	Basic Processing Unit: Fundamental Concepts, Execution of Complete Instruction, Multi-bus Organization, Hardwired control, Micro-programmed control. I/O Interface, Isolated vs Memory Mapped I/O, Mode of transfer: Programmed I/O, interrupt I/O, DMA. Pipelining: Basic Concepts, Parallel Processing, Pipeline Hazards, Data Hazard, Structural Hazard, Control Hazard	**10 Hours**
	Total	**30 Hours**

Books	Name of The Books/References	Publishers
Text Book :	T1.C. Hamacher, Z. Vranesic, and S. Zaky, ***CoMputer Organization*** T2. M. M. Mano, ***CoMputer System Architecture***	TMH PHI
Reference Book :	R1. B. Govindarajalu, ***CoMputer Architecture and Organization*** R2. N. Carter, ***SchauM's Outline of CoMputer Architecture***	TMH TMH
Online Resources	1. https://nptel.ac.in/courses/106/103/106103068/ 2. https://nptel.ac.in/courses/106/106/106106166/	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Identify and describe the functionality of various functional units of digital computer. Compare different addressing modes, instruction formats and their implementation in programming.
CO2	Perform various binary arithmetic operations using different techniques. Represent floating point numbers and perform various operations on them.
CO3	Describe the working principle of Main Memory, Cache Memory and Virtual Memory organization and solve numerical problems based on memory management.
CO4	Understand the functions of Translation Look-aside Buffer, Memory replacement techniques
CO5	Identify the components of single & multi bus organization and describe execution of complete instruction. Compare different modes of data transfer techniques.
CO6	Describe the working principle of pipeline and identify various pipeline hazards. Explain the principle behind super scalar operation.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements.
PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains
PO3	Design applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects
PO4	Ability to invoke the research skills by conducting experiments, interpreting data and providing well informed conclusions
PO5	Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations
PO7	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	2	3	3	3	1		1						3
CO2	2	2	2	3	1		1						3
CO3	3	3	3	2	1		1						2
CO4	3	3	2	1	2		2						2
CO5	3	2	3	3	1		2						3
CO6	3	3	3	2	1		1						1

Semester	Code	Database Management Systems	L-T-P	Credits	Hours	Marks
1st	22MCA105		3-0-0	3	30	150

Objectives	The objective of this course is to learn principles of systematically designing and using large scale database management systems for various real-world applications.
Pre-Requisites	Basic knowledge of data structures and algorithms is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required; sessions areplanned to be interactive with focus on problem solving & analysis.

Evaluation Scheme

Teacher Assessment		Written Assessment		Total
Quiz	Assignment	Mid term	End term	
10	20	20	100	150

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction to Database Systems, 3-level schema architecture, Database System Architecture; Data Models: Entity Relationship Model, Network and Object Oriented data models, Extended Entity Relationship Model, Mapping of E-R model to Relational schema.	**10 Hours**
Module-2	Database Design: Functional dependency, Normalization, Normal forms: 1NF, 2NF, 3NF & BCNF, Multi-valued Dependencies, 4NF & 5NF; Query Processing and Optimization: Evaluation of Relational Algebra expressions, Query Optimization, Query Cost Estimation.	**10 Hours**
Module-3	Query Language: Relational Algebra, Tuple & Domain Relational Calculus; Storage Strategies: File Organizations & Indexes, Ordered Indexes, B+ Tree Index Files, Hashing. Transaction Processing and Concurrency Control: Transaction concepts, ACID properties of transaction, Serializability; Concurrency Control Schemes: Locking and Timestamp schemes, Deadlock detection and recovery.	**10 Hours**
	Total	**30 Hours**

Books	Name of The Books/References	Publishers
Text Book :	T1. A. Silberschatz, H. F. Korth, and S. Sudarshan, ***Database System Concepts*** T2. R. Elmasri and S. B. Navathe, ***FundaMentals of Database Systems***	McGraw-Hill Pearson Education
Reference Book :	R1. R. Ramakrishnan and J. Gekhre, ***Database Management Systems*** R2. R. P. Mahapatra and G. Verma, ***Database Management Systems***	McGraw-Hill Khanna Publishing
Online Resources	1. https://nptel.ac.in/courses/106106093/ 2. https://nptel.ac.in/courses/106105175/ 3. https://cs145-fa18.github.io/	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Understand the concept and application of Database Management System. The learner also able to understand the Database Architecture and different level of Architecture,
CO2	Analyze the significance of data base management system in an organization and explore its various functional components and design E-R model for real life problems.
CO3	Construct queries using Relational Algebra and Relational Calculus. Investigate storage architecture, and access methods using Order Indices, B+ Tree & Hashing.
CO4	Create effective database designs using different normalization techniques and devise optimal query execution strategies.
CO5	Understand transaction processing concepts and Solve the concurrent access problems by using various on currency control mechanisms.
CO6	Explore various data base recovery techniques and advance database concepts like Distributed Database. Compare between centralized and distributed databases.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements
PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains
PO4	Ability to invoke the research skills by conducting experiments, interpreting data and providing well informed 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 practices
PO7	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional
PO8	Function effectively in the workplace both as a team leader and team member on multi-disciplinary projects demonstrating computing and management skills.
PO11	Ability to work as a member or leader in diverse teams in multidisciplinary environment

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	3		2	2	1	2	2			1		3
CO2	3	3		2	3	1	3	3			2		3
CO3	3	3		2	3	2	1	1			2		2
CO4	3	3		3	2	2	3	2			2		3
CO5	3	3		3	3	2	3	2			3		3
CO6	3	3		3	1	1	2	3			2		3

Semester	Code	Programming Using C Lab	L-T-P	Credits	Hours	Marks
1st	22MCA106(P)		0-0-1	1	30	150

Objectives	Formulate problems and implement algorithms using C programming language. The students will be able to enhance their analyzing and problem solving skills and use the same for writing programs in C.
Pre-Requisites	Basic knowledge of computers and knowledge of C programming language.
Teaching Scheme	Regular laboratory classes conducted under supervision of the teacher. The experiments shall comprise of programming assignments.

Evaluation Scheme

Practical Assessment		
Lab Test	**End Term Practical Test**	**Total**
50	**100**	**150**

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Compilation and execution of simple C programs. Programs using arithmetic operators, relational and logical operators.
2	Formulate problems on Decision making statements using if-else and nested if-else.
3	Implement decision making statements using switch-case. Implement loop-control structures using while construct and do-while construct.
4	Programs on loop-control structures using for loops and nested loops.
5	Develop Programs for 1-Dimensional array operations and 2-Dimensional array operations.
6	Operations on Array using Pointer. Programs on functions using call by value and call by reference.
7	Develop programs on functions using recursion and storage classes. Programs on creating and using strings.
8	Programs on creating and using simple structures. Programs on array of structures and nested structures.
9	Programs on use of pointers to structures. Passing Array and structure to user defined functions. Programs on creating and using unions.
10	Formulate problems on dynamic memory management using malloc() and calloc(). Formulate problems on dynamic memory management using realloc() and free(). Programs on passing parameters through command-line arguments.
11	Programs on pre-processor directives. Programs on use of enumeration.
12	Programs for opening of files in different modes and closing of file. Programs on read and write operations on text file. Programs on random access operations on text file.

Books	Name of The Books/References	Publishers
Text Book :	T1. E. Balagurusamy, ***ProgramMing in ANSI C***	McGraw-Hill Education
	T2. M. Sprankle, ***ProgramMing and Problem Solving***	Pearson Education
Reference Book :	R1. B. W. Kernighan and D. M. Ritchie, ***The C ProgramMing Language***	PHI
	R2. H. M. Deitel and P. J. Deitel, ***C How to Program***	Pearson Education Asia
	R3. H. Schildt, ***C: The Complete Reference***	McGraw-Hill Education
Online Resources	1. http://www.princeton.edu/~achaney/tmve/wiki100k/docs/C %28programming language%29.html 2. http://www.stat.cmu.edu/~hseltman/c/CTips.html 3. http://www.c-faq.com/ 4. http://www.learn-c.org/ 5. https://www.javatpoint.com/c-programming-language-tutorial	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Construct C programs for mathematical operations using control statements.
CO2	Develop C programs for Array and String manipulation.
CO3	Construct modular programs for better maintenance and reusability.
CO4	Manipulate heterogeneous data using structure & union and apply dynamic memory management techniques to solve different problems.
CO5	Understand the concept of preprocessor directives and its importance.
CO6	Create and manipulate files using C programs and develop the programs using command line arguments.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements
PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains
PO5	Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations
PO7	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	2			2		2						3
CO2	3	2			2		2						2
CO3	3	3			2		3						3
CO4	3	3			3		2						2
CO5	3	3			3		2						2
CO6	3	2			2		2						3

Semester	Code	Language & Communication Skills Lab	L-T-P	Credits	Hours	Marks
1st	22MCA107(P)		0-0-1	1	30	150

Objectives	This laboratory course is designed to make students effective communicators, by addressing issues like speaking inhibitions. This is accomplished by individual and team activities based on the four skills of language (LSRW).
Pre-Requisites	Basic knowledge of English grammar and the ability to speak, read and writeusing the English language is required.
Teaching Scheme	Various tasks designed to facilitate communication through pair work, group/team work, individual and group presentations, discussions, role plays, listening to audios, watching videos, business writing and vocabulary enhancement.

Evaluation Scheme

Practical Assessment		
Lab Test	**End Term Practical Test**	**Total**
50	**100**	**150**

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	JAM: Just-A-Minute sessions to develop fluency in speaking using various topics of discussion.
2	Chart-work or Poster presentation on the Process of Communication.
3	Non-verbal Communication: Conducting role plays to understand the practicalapplications of non-verbal cues and body language.
4	Cross-cultural Communication: dealing with the nuances of this communication typethrough case studies, videos and discussions.
5	Listening Comprehension: Listening for specific information, ear training and for pronunciation practices.
6	Sounds of English: practice sessions on vowels, consonants and diphthongs; problemsounds and consonant clusters.
7	Transcriptions: the use of IPA symbols for transcribing words.
8	Stress and Syllable Division: Word stress, sentence stress, contrastive stress, rules ofstress & syllable division through practice sessions and use of dictionaries.
9	Sentence Rhythm: through recitation of poems, read-aloud sessions andpronunciation practices.
10	Oral presentation: Power-point presentations on selected technical or non-technicaltopics of relevance.
11	Reading Comprehension: reading of various business & non-technical passages ofrelevance.
12	Writing Practice-I: memo, letters and report writing

Books	Name of The Books/References	Publishers
Text Book :	T1. M. A. Rizvi, ***Effective Technical COMMunication*** T2. T. Balasubramaniam, ***English Phonetics for Indian Students*** T3. M. Raman and S. Sharma, ***Technical COMMunication: Principles and Practice***	McGraw-Hill Education Macmillan Publishers

		Oxford University Press
Reference Book :	R1. S. Samantray, ***Business CoMMunication and CoMMunicative English*** R2. J. Seeley, ***The Oxford Guide to Effective Writing and Speaking*** R3. B. K. Mitra, ***CoMMunication Skills for Engineers***,	Sultan Chand. Oxford University Press Oxford University Press
Online Resources	1. https://nptel.ac.in/courses/109104031/ 2. https://www.youtube.com/watch?v=XZZ-kNcy9aM 3. https://www.youtube.com/watch?v=aR3hfaFYP2I	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Develop listening comprehension and overcome their inhibitions to speak in public.
CO2	Communicate properly as an engineer in cross-cultural contexts.
CO3	Develop their English pronunciation skills through practice.
CO4	Work effectively as a team member or as a leader of the team.
CO5	Develop reading Comprehension of various business relevance.
CO6	Develop writing skills for effective communication in corporate environment.

Program Outcomes Relevant to the Course:

PO6	Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional computing practices.
PO8	Function effectively in the workplace both as a team leader and team member on multi-disciplinary projects demonstrating computing and management skills
PO9	Communicate effectively with the computing community as well as society by being able to comprehend effective documentations and presentations
PO11	Ability to work as a member or leader in diverse teams in multidisciplinary environment.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1						2		3	2		1		3
CO2						3		3	3		2		1
CO3						3		3	3		3		3
CO4						2		2	2		3		3
CO5						3		3	3		3		2
CO6						3		2	3		2		3

Semester	Code	Database Management Systems using Oracle Lab	L-T-P	Credits	Hours	Marks
1st	22MCA108(P)		0-0-1	1	30	150

Objectives	The objective of this lab course is to provide a hands-on practice on database design, creation, data storage, and data manipulation including advanced database programming concepts to groom the students into well-informed database programmers and data-driven application developers.
Pre-Requisites	Basic analytical skills and knowledge of programming language are required.
Teaching Scheme	Regular laboratory classes conducted under supervision of the teacher. The experiments shall comprise of programming assignments.

Evaluation Scheme

Practical Assessment		
Lab Test	**End Term Practical Test**	**Total**
50	**100**	**150**

Detailed Syllabus

Experiment-#	Assignment/Experiment
1.	Introduction to Oracle databases, simple queries for data retrieval. Using single-row functions and group function in SQL queries for data retrieval.
2.	Writing complex queries using sub-queries
3.	Use DDL and various constraints for design of tables
4.	Data manipulation using various DML statements.
5.	Retrieve data from multiple tables using various types of JOIN operations.
6.	Create, alter, and manage Views from single & multiple base tables.
7.	Create and use other data base objects like sequence, indexes, and synonyms.
8.	Introduction to PL/SQL, identifiers, literals, and keywords
9.	Write PL/SQL block by using conditional statements and expressions.
10.	Using different types of Loops in a PL/SQL block.
11.	Implement Exception Handling in a PL/SQL block.
12.	Write PL/SQL block to retrieve data using CURSORs

Books	Name of The Books/References	Publishers
Text Book :	T1. K. Loney, ***Oracle Database 11g - The Complete Reference (Oracle Press)*** T2. I. Bayross, ***Teach Yourself SQL/PL SQL Using Oracle 8i and 9i with SQLJ***	McGraw-Hill Education BPB Publications
Reference Book :	R1. S. Feuerstein, ***Oracle PL/SQL Programming*** R2. A. Silberschatz, H. F. Korth, and S. Sudarshan, ***Database System Concepts***	O'Reilly McGraw-Hill Education
Online Resources	1. https://docs.oracle.com/cd/E11882 01/server.112/e40402.pdf 2. https://docs.oracle.com/cd/B28359 01/server.111/b28286/toc.htm 3. https://www.tutorialspoint.com/oracle sql/index.asp 4. https://www.javatpoint.com/oracle-tutorial	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Construct queries using SQL and retrieve data from a database using single/multi-row functions, and sub-queries.
CO2	Design relational tables imposing integrity constraints, operate on table using DDL/DML statements and share data using join.
CO3	Understand the multiple table joining in a Database System.
CO4	Create other data base objects like views, sequences and indices.
CO5	Write PL/SQL programs including control structures, and loops for real-world applications.
CO6	Implement the techniques using exception handling Procedures, and Functions, Parameters in PL/SQL.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements
PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains.
PO3	Design applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects
PO5	Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations
PO7	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.
PO11	Ability to work as a member or leader in diverse teams in multidisciplinary environment

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	2	3		3		2				3		3
CO2	3	3	3		3		2				3		3
CO3	2	3	3		3		3				2		2
CO4	3	2	2		3		2				2		1
CO5	3	3	3		3		3				3		3
CO6	2	1	2		3		2				3		3

Semester	Code	Emerging Technology Lab-I (Python Programming Lab)	L-T-P	Credits	Hours	Marks
1st	22MCA109(P)		0-0-2	2	30	150

Objectives	The objective of the course is to give the students hands-on practice on Using Python programming language from fundamentals to advanced programming and solving problems using the Python programming language.
Pre-Requisites	Basic analytical and logical understanding including basic knowledge of Python is required.
Teaching Scheme	Regular laboratory classes conducted under supervision of the teacher. The experiments shall comprise of programming assignments.

Evaluation Scheme

Practical Assessment		
Lab Test	**End Term Practical Test**	**Total**
50	**100**	**150**

Detailed Syllabus

Experiment-#	**Assignment/Experiment**
1	Compilation and execution of simple python programs.
2	Programs using data types and operators.
3	Formulate problems using Sting handling operators and functions.
4	Programs using Input and Output statements.
5	Programs on decision making using if else, nested if else and else if ladder.
6	Implement loop-control structures using for and while loops.
7, 8	Programs using python built in data structures (List, Dictionary, tuple, set).
9	Develop programs using functions.
10	Programs using recursive function.
11	Formulate problems and write programs using modules.
12	Develop programs using random and time module.
13	Develop programs using Packages.
14, 15	Programs on creating and using Class and Object.
16, 17	Formulate problems on Inheritance and write programs.
18	Programs on Exception Handling.
19	Formulate problems on file handling and develop programs.
20	Write programs to perform file Input/Output operations.
21	Programs on database Connectivity.
22	Programs on Regular expression.
23	Develop programs using CGI.
24	Develop GUI programs using Tkinter.

Books	**Name of The Books/References**	**Publishers**
Text Book :	T1. P. Barry, ***Head First Python*** T2. A. B. Downey, ***Think Python: How to Think Like a CoMputer Scientist***	O'Reilly Media O'Reilly Media

Reference Book :	R1. J. Zelle, ***Python PrograMMing: An Introduction to CoMputer Science*** R2. L. Ramalho, ***Fluent Python***, 1st Edition, O'Reilly Media, 2015. R3. A. Downey, ***PrograMMing Python***, 4th Edition, O'Reilly Media, 2011.	Franklin, Beedle & Associates O'Reilly Media O'Reilly Media
Online Resources	1. https://nptel.ac.in/courses/106105166/26 2. https://nptel.ac.in/courses/117106113/34 3. https://help.uis.cam.ac.uk/service/help support/training/downloads/course-files/programming-student-files/python-courses/	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Develop simple real life application in python using operators and control statements.
CO2	Use python data structure and function to develop application.
CO3	Develop simple real life application in Python using decision making statement.
CO4	Interpret object orient concept and use it for software development.
CO5	Conveniently use file handling and data base connectivity concept.
CO6	Become familiar with CGI and develop real-life web application.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements.
PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains
PO3	Design applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Ability to invoke the research skills by conducting experiments, interpreting data and providing well informed conclusions
PO5	Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations
PO7	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional
PO12	Identifying and pursuing opportunities by using innovative ideas, to create value and wealth for the betterment of the individual and society.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	2	3	2	2		2					3	3
CO2	2	3	2	3	2		3					3	3
CO3	3	3	3	3	2		3					2	3
CO4	3	2	2	1	1		2					3	2
CO5	2	3	2	2	2		3					2	3
CO6	3	3	3	3	2		2					3	3

Semester-2: Spring Semester (January to May)

Sl. No.	Course Code	Course Title	L-T-P	Total credit
1.	22MCA201	Probability and Statistics	3-0-0	3
2.	22MCA202	Data Structure	3-0-0	3
3.	22MCA203	Object Oriented Programming Systems	3-0-0	3
4.	22MCA204	Operating System	3-0-0	3
5.	22MCA205	Universal Human Values	3-0-0	3
PRACTICAL				
1.	22MCA206(P)	Data Structure Using C Lab	0-0-1	1
2.	22MCA207(P)	Object Oriented Programming Systems using JAVA Lab	0-0-1	1
3.	22MCA208(P)	Operating System Lab	0-0-1	1
4.	22MCA209(P)	Advance Python Programming	0-0-1	1
5.	22MCA210(P)	Emerging Technology Lab-II (Internet and web technology Lab)	0-0-2	2
			Total	**21**

Semester	Code	Probability & Statistics	L-T-P	Credits	Hours	Marks
2nd	22MCA201		3-0-0	3	30	150

Objectives	The objective of this course is to learn the basic concepts of probability and statistics including various methods of estimations & statistical testing useful for analysis of data.
Pre-Requisites	Basic knowledge of sets, coordinate geometry, and calculus is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required; sessions are planned to be interactive with focus on problem solving activities.

Evaluation Scheme

Teacher Assessment		Written Assessment		Total
Quiz	Assignment	Mid term	End term	
10	20	20	100	150

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Probability, Random variables and Probability Distributions: Probability, Conditional Probability, Bayes' Rule, Concept of a random variable, Discrete and Continuous probability distribution functions, Discrete & Continuous Probability Distributions: Binomial distribution, Poisson distribution, Hyper geometric distribution, Normal distribution, Uniform distribution, Joint distribution. **Statistics:** Data, type of data, scope of data analysis, importance; different types of statistics	**12 Hours**
Module-2	Descriptive Statistics; Central tendency, dispersion, Fundamental Sampling Distributions and Data Description: Random sampling, Single sample – estimation of mean and variance, Two samples – estimating the difference between two means and ratio of two variances.	**08 Hours**
Module-3	Hypothesis Testing: One and two tailed test, Single sample – test concerning single mean, two means, test of single and two proportions, Goodness of fit test. Simple Linear Regression and Correlation: Least square method, Correlation, Multiple linear regression, Analysis of variance.	**10 Hours**
	Total	**30 Hours**

Books	Name of The Books/References	Publishers
Text Book :	R. E. Walpole, R. H. Myers, S. L. Myers, and K. E. Ye, ***Probability & Statistics for Engineers &Scientists***	Pearson Education
Reference Book :	R1. W. Mendenhall, R. J. Beaver, and B. M. Beaver, ***Probability and Statistics*** R2. R. A. Johnson, I. Miller, and J. E. Freund, ***Probability and Statistics for Engineers***	CengageLearning Pearson Education
Online Resources	1. https://nptel.ac.in/courses/111105041/ 2. https://nptel.ac.in/courses/111105090/ 3. https://www.khanacademy.org/math/statistics-probability 4. https://stattrek.com/	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Solve problems on probability of discrete nature.
CO2	Solve problems on probability of continuous nature.
CO3	Understand the sampling distribution and data description.
CO4	Infer on mean and variance of a dataset.
CO5	Categorize the distribution type of a data set.
CO6	Fit a curve using regression model.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements
PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains
PO3	Design applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects
PO5	Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations
PO9	Communicate effectively with the computing community as well as society by being able to comprehend effective documentations and presentations
PO10	to understand and assess the impact of system solutions in a contemporary, global, economic, environmental, and societal context for sustainable development

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	2	1		1				2	3			1
CO2	3	2	1		1				2	3			1
CO3	3	3	2		1				1	2			2
CO4	3	3	3		2				2	3			1
CO5	3	3	2		2				3	1			2
CO6	3	2	3		2				2	2			1

Semester	Code	Data Structures	L-T-P	Credits	Hours	Marks
2nd	22MCA202		3-0-0	3	30	150

Objectives	To understand abstract data types, solve problems using data structures such as linear lists, stacks, queues, hash tables, binary trees, binary search trees, and graphs.
Pre-Requisites	Knowledge of programming using the C language is essential.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required; sessions are planned to be interactive with focus on problem solving & analysis.

Evaluation Scheme

Teacher Assessment		Written Assessment		Total
Quiz	Assignment	Mid term	End term	
10	20	20	100	150

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction to data structures, classification of data structures, Abstract data types, Arrays - introduction, basic operations, row and column-major representation, sparse matrix. Linked list- single linked list, double linked list, circular linked list. Stack- representation using array and linked list, basic operations, applications - recursion, polish notation. Queue- representation using array and linked list, basic operations, circular queue	**10 Hours**
Module-2	Tree - terminology, representation, binary tree - tree traversal algorithms. Binary Search Tree (BST), Height balanced tree (AVL tree), Graph- terminology, representation, path matrix, graph traversal (BFS, DFS), all pair shortest path, and topological sort.	**10 Hours**
Module-3	Searching and sorting techniques: linear and binary search, bubble sort, insertion sort, selection sort. Hashing- hash functions and hashing techniques. collision resolution techniques - linear probing, quadratic probing, chaining.	**10 Hours**
	Total	**30 Hours**

Books	Name of The Books/References	Publishers
Text Book :	T1. A. Tenenbaum, ***Data Structures Using C***	Pearson Education
	T2. E. Horowitz, S. Sahni, and S. Anderson-Freed, ***Fundamentals of Data Structures in C***	University Press
Reference Book :	R1. M. Weiss, ***Data Structures and Algorithm Analysis in C***	Pearson Education
	R2. J. P. Tremblay and P. G. Sorenson, ***An Introduction to Data Structures with Applications***	Tata McGraw-Hill
Online Resources	1. http://nptel.ac.in/courses/106102064/1 2. http://www.nptelvideos.in/2012/11/programming-and-data-structure.html 3. https://www.tutorialspoint.com/data structures algorithms/index.htm 4. https://www.coursera.org/learn/data-structures	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Explain and analyze complexities of algorithms and apply divide & conquer strategy for sorting problems.
CO2	Compare different sorting algorithms and use dynamic programming technique for solving optimization problems.
CO3	Apply various algorithm design techniques such as greedy, backtracking, and branch-and-bound in real life problems.
CO4	Understand the concept of the Disjoint sets and its operations
CO5	Model an engineering problem using graphs and develop algorithms to solve the problem.
CO6	Compare various pattern matching algorithms, understand NP complete problems ,and design approximation algorithms for some of these problems.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements.
PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains
PO3	Design applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Ability to invoke the research skills by conducting experiments, interpreting data and providing well informed conclusions
PO6	Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional computing practices.
PO8	Effectively in the workplace both as a team leader and team member on multi-disciplinary projects demonstrating computing and management skills.
PO10	Ability to understand and assess the impact of system solutions in a contemporary, global, economic, environmental, and societal context for sustainable development

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	3	3	3		2		1		3			1
CO2	3	3	2	3		3		2		3			1
CO3	3	2	3	2		3		2		2			2
CO4	3	2	1	2		2		3		3			2
CO5	3	3	2	3		2		3		3			2
CO6	3	3	2	2		3		2		2			1

Semester	Code	Object Oriented Programming Systems	L-T-P	Credits	Hours	Marks
2nd	22MCA203		3-0-0	3	30	150

Objectives	The objective of this course is to introduce the key concepts of object-oriented programming (OOP) using Java as the programming language.
Pre-Requisites	Basic analytical and logical understanding including basic knowledge and usage of computers is required for this course. Prior experience with a programming language will be beneficial.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities.

Evaluation Scheme

Teacher Assessment		Written Assessment		Total
Quiz	Assignment	Mid term	End term	
10	20	20	100	150

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Object oriented concepts: Object oriented systems development life cycle, Unified Modeling Language, UML class diagram, Use-case diagram; Java Overview: Java Virtual Machine, Java buzz words, Data types, Operators, Control statements, Class fundamentals, Objects, Methods, Constructors, Overloading, Access modifiers.	**12 Hours**
Module-2	Inheritance: Basics of Inheritance, using super and final keyword, method overriding, Abstract classes, defining and importing packages, access protection, interfaces; Exception handling: Exception fundamentals, types, understanding different keywords (try, catch, finally, throw, throws), User defined exception handling.	**08 Hours**
Module-3	Input/Output: Files, stream classes, reading console input; Threads: thread model, use of Thread class and Runnable interface, thread synchronization, multithreading, inter thread communication. String manipulation: Basics of String handling, String class, String Builder, String Buffer, String Tokenizer.	**10 Hours**
	Total	**30 Hours**

Books	Name of The Books/References	Publishers
Text Book :	T1. H. Schildt, ***Java: The Complete Reference*** T2. Y. D. Liang, ***Introduction to Java Programming***	McGraw-Hill Pearson Education
Reference Book :	R1. B. Bates, K. Sierra, ***Head First Java*** R2. T. Budd, ***An Introduction to Object-Oriented Programming*** R3. I. Horton, ***Beginning Java***	O'Reilly Media Pearson Education Wrox Publications
Online Resources	1. https://nptel.ac.in/courses/106105191/ 2. https://docs.oracle.com/javase/tutorial/ 3. http://www.javatpoint.com/java-tutorial 4. http://www.w3schools.in/java/	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Understand the Object Oriented system concept and its development life cycle and importance of Object Oriented Programs.
CO2	Apply object oriented principles in software design process to develop Java programs for real life applications
CO3	Employ inheritance and exception handling techniques for developing robust and reusable software.
CO4	Develop programs using stream classes for various I/O operations and design concurrent programs using threads to maximize the use of processing power.
CO5	Design applications for text processing using String class and develop user interactive applications using event handling.
CO6	Understand the concept of string manipulation methods.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements.
PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains.
PO3	Design applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Ability to invoke the research skills by conducting experiments, interpreting data and providing well informed 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 practices
PO10	Ability to understand and assess the impact of system solutions in a contemporary, global, economic, environmental, and societal context for sustainable development

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	3	2	3	3	1				2			2
CO2	3	2	3	2	3	2				3			3
CO3	3	2	3	3	3	2				2			3
CO4	3	3	2	3	2	3				3			3
CO5	3	1	3	2	3	2				2			2
CO6	3	2	3	3	2	2				3			2

Semester	Code	Operating Systems	L-T-P	Credits	Hours	Marks
2nd	22MCA204		3-0-0	3	30	150

Objectives	The objective of this course is to introduce the fundamentals of operating systems, services, processes, process scheduling and synchronization, principles of primary, secondary and virtual memory management, and basics of structure & organization of file system & disk scheduling methods.
Pre-Requisites	Fundamentals of computer, data structures, programming knowledge in C orC++ is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required; sessions are planned to be interactive with focus on problem solving activities.

Evaluation Scheme

Teacher Assessment		Written Assessment		Total
Quiz	Assignment	Mid term	End term	
10	20	20	100	150

Detailed Syllabus

Module-#	Topics	Hours
Module-1	**Introduction**: concept of operating system, origin and evolution, types, resources managed, services provided, system calls and their types, system structure of operating system. **Process Management**: process concepts, states, PCB, types of schedulers, operations on process, inter-process communication, concept of buffering, thread overview, user & kernel threads, multi-threading models, issues with multi-threading; CPU Scheduling: scheduling criteria, scheduling algorithms: FCFS, SJF, SRTF, RR, Priority Scheduling, MLQ, MLQ with Feedback Scheduling.	12 Hours
Module-2	**Inter-Process Synchronization**: Bounded-buffer problem, shared-memory solution to producer-consumer problem; Critical section problem: Peterson's solution, synchronization hardware, Semaphores; Classical problems of synchronization: Bounded-Buffer problem, Readers-Writers Problem, Dining-Philosophers Problem, Sleeping Barber problem, monitors, Deadlock: characterization, prevention, avoidance, Banker's algorithm, deadlock detection and recovery.	08 Hours
Module-3	**Memory Management**: Logical and physical address space, dynamic loading and linking, swapping, contiguous memory allocation, dynamic storage allocation problem, paging and segmentation; Virtual Memory Management: Demand paging, page fault, Page Replacement Algorithms: FIFO, OPT, LRU, LFU, MFU, Thrashing. **Secondary Storage Structure**: Disk structure; Disk Scheduling: FCFS, SSTF, SCAN, C-SCAN, LOOK, C-LOOK, RAID structure; File System: access methods, directory structure, access control list.	10 Hours
	Total	30 Hours

Books	Name of The Books/References	Publishers
Text Book :	T1. A. Silberschatz, P. B Galvin, and G Gagne, ***Operating Systems Principles*** T2. M. Milenkovic, ***Operating Systems: Concepts & Design***	Wiley India McGraw-Hill Education
Reference Book :	R1. A. S. Tanenbaum, ***Modern Operating Systems*** R2. P. B. Prasad, ***Operating Systems and System PrograMMing***	PHI Learning SciTech Publishers
Online Resources	1. https://nptel.ac.in/courses/106106144/ 2. https://nptel.ac.in/courses/106108101/ 3. http://web.stanford.edu/~ouster/cgi-bin/cs140-spring14/lectures.php 4. https://www.cl.cam.ac.uk/teaching/1011/OpSystems/os1a-slides.pdf	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Explore principles behind various types of operating systems, system components, system calls, protection mechanisms and services.
CO2	Understand the benefits of thread over process, importance of inter-process communication, analyze various CPU scheduling algorithms and design new scheduling algorithms.
CO3	Understand the significance of process synchronization and get acquainted with various deadlock handling mechanisms.
CO4	Understand the different memory allocation mechanism and principles.
CO5	Describe the working principle of main memory, cache memory & virtual memory, and solve memory allocation related problems.
CO6	Acquire knowledge on secondary storage management, performance of disk scheduling algorithms; identify issues in file structures, and protection & security mechanisms.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements
PO3	Design applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects
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 practices.
PO10	Ability to understand and assess the impact of system solutions in a contemporary, global, economic, environmental, and societal context for sustainable development
PO11	Ability to work as a member or leader in diverse teams in multidisciplinary environment.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3		2		3	2				2	3		3
CO2	3		3		3	3				2	2		2
CO3	3		2		3	2				3	3		2
CO4	3		2		2	3				3	3		3
CO5	3		3		3	3				2	2		2
CO6	3		2		3	2				2	2		2

Semester	Code	Universal Human Values	L-T-P	Credits	Hours	Marks
2nd	22MCA205		3-0-0	3	30	150

Objectives	To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
Pre-Requisites	Understanding Human Being, Nature and Existence
Teaching Scheme	Regular classroom lectures with use of ICT as and when required; sessions are planned to be interactive with problem solving activities.

Evaluation Scheme

Teacher Assessment		Written Assessment		Total
Quiz	Assignment	Mid term	End term	
10	20	20	100	150

Detailed Syllabus

Module-#	Topics	Hours
Module-1	**Introduction-Basic Human Aspiration, its fulfillment through All-encompassing Resolution:** The basic human aspirations and their fulfillment through Right understanding and Resolution, Right understanding and Resolution as the activities of the Self, Self being central to Human Existence; All-encompassing Resolution for a Human Being, its details and solution of problems in the light of Resolution. **Understanding Human Being:** Understanding the human being comprehensively as the first step and the core theme of this course; human being as co-existence of the self and the body; the activities and potentialities of the self; Basis for harmony/contradiction in the self	**10 Hours**
Module-2	**Right Understanding (Knowing)- Knower, Known & the Process:** The domain of right understanding starting from understanding the human being (the knower, the experiencer and the doer) and extending up to understanding nature/existence – its interconnectedness and co-existence; and finally understanding the role of human being in existence (human conduct). **Understanding Nature and Existence:** A comprehensive understanding (knowledge) about the existence, Nature being included; the need and process of inner evolution (through self-exploration, self-awareness and self-evaluation), particularly awakening to activities of the Self: Realization, Understanding and Contemplation in the Self (Realization of Co-Existence, Understanding of Harmony in Nature and Contemplation of Participation of Human in this harmony/ order leading to comprehensive knowledge about the existence).	**12 Hours**
Module-3	**Understanding Human Conduct, All-encompassing Resolution & Holistic Way of Living:** Understanding Human Conduct, different aspects of All-encompassing Resolution (understanding, wisdom, science etc.), Holistic way of living for Human Being with All-encompassing Resolution covering all four dimensions of human endeavor viz., realization, thought, behavior and work (participation in the larger order) leading to harmony at all levels from Self to Nature and entire Existence	**08 Hours**
	Total	**30 Hours**

Books	Name of The Books/References	Publishers
Text Book :	R R Gaur, R Asthana, G P Bagaria, 2019 (2nd Revised Edition), A Foundation Course inHuman Values and Professional Ethics.	Excel Books
Reference Book :	R1: E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered R2: A N Tripathy, 2003, Human Values	Blond & Briggs, Britain. New Age International Publishers.
Online Resources	1. https://www.youtube.com/watch?v=9LSEBK03CiY&list=PLysZquKdjuWSv87TaE7pByn5TE_e46O2C 2. https://www.youtube.com/watch?v=21DGIyCykCI&list=PLysZquKdjuWSv87TaE7pByn5TE_e46O2C&index=2 3. https://www.youtube.com/watch?v=OEEwyXGb8I&list=PLysZquKdjuWSv87TaE7pByn5TE_e46O2C&index=3 4. https://www.youtube.com/watch?v=iCthALD53DE&list=PLysZquKdjuWSv87TaE7pByn5TE_e46O2C&index=4	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Evaluate the significance of value inputs in formal education and start applying them in their life and profession
CO2	Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.
CO3	Analyze the value of harmonious relationship based on trust and respect in their life and profession
CO4	Examine the role of a human being in ensuring harmony in society and nature.
CO5	Understand and associate the holistic perception of harmony at all levels of existence.
CO6	Apply the understanding of ethical conduct to formulate the strategy for ethical life and profession.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements.
PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains.
PO3	Design applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Ability to invoke the research skills by conducting experiments, interpreting data and providing well informed conclusions.
PO5	Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.
PO7	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.
PO8	Function effectively in the workplace both as a team leader and team member on multi-disciplinary projects demonstrating computing and management skills.
PO10	Ability to understand and assess the impact of system solutions in a contemporary, global, economic, environmental, and societal context for sustainable development.
PO11	Ability to work as a member or leader in diverse teams in multidisciplinary environment.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	1			2		2	1			1		1
CO2	3	2			3		2	2		2	1		2
CO3	3	3	3	3	3		3	3		2	2		3
CO4	3	3	3	2	2		1	2		3	2		3
CO5	3	3	3	3	2		2	3		3	1		2
CO6	3	3	3	2	2		2	2		3	1		3

Semester	Code	Data Structure Using C Lab	L-T-P	Credits	Hours	Marks
2nd	22MCA206(P)		0-0-1	1	30	150

Objectives	Formulate problems and implement algorithms using the C programming language, to enhance their analysis and problem-solving skills and use the same for developing C programs for the computer.
Pre-Requisites	Basic knowledge of computers and knowledge of C programming language.
Teaching Scheme	Regular laboratory classes conducted under supervision of the teacher. The experiments shall comprise of programming assignments.

Evaluation Scheme

Practical Assessment		
Lab Test	**End Term Practical Test**	**Total**
50	**100**	**150**

Detailed Syllabus

Experiment-#	Assignment/Experiment
1.	Design, develop and implement insert, delete operation on array
2.	Develop a program for triplet representation and transpose of sparse matrix
3.	Develop programs on structure, pointer and dynamic memory allocation
4.	Create a single linked-list and perform different operations on single linked-list
5.	Create a double linked-list and perform different operations on double linked-list
6.	Create a circular linked-list and perform different operations on circular linked-list
7.	Develop a program to implement polynomial addition using linked-list
8.	Design, develop and implement stack using array and linked list
9.	Write programs to implement different applications of stack
10.	Develop program to implement of queue using array and Linked List
11.	Write a program for implementation of circular queue
12.	Design, develop and implement graph traversal algorithms

Books	Name of The Books/References	Publishers
Text Book :	T1: A. Tenenbaum, **Data Structures Using C**, T2. E. Horowitz, S. Sahni, S. Anderson-Freed, **Fundamentals of Data Structures in C**,	Pearson Education Universities Press
Reference Book :	R1. M.Weiss, **Data Structures and Algorithm Analysis in C** R2. J. P. Tremblay and P. G. Sorenson, **An Introduction to Data Structures with Applications**	Pearson Education Tata McGraw-Hill,
Online Resources	1. http://nptel.ac.in/courses/106102064/1 2. http://www.nptelvideos.in/2012/11/programming-and-data-structure.html 3. https://www.tutorialspoint.com/data structures algorithms/index.htm 4. https://www.coursera.org/learn/data-structures	

Online Resources:

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Implement various operations on array and Sparse matrix.
CO2	Design functions to implement basic operations on stack and Queue. Apply the concept of stack and queue for solving real world problems.
CO3	Implement various operations of single, double and circular linked list and apply them in various real life applications.
CO4	Construct binary search tree and perform traversal, insertion, deletion, and search operations on it.
CO5	Compare between BFS and DFS traversal operations in a graph and implement various sorting and searching techniques.
CO6	Apply practical knowledge on the applications of data structures

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements.
PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains.
PO3	Design applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects.
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 practices.
PO7	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.
PO10	Ability to understand and assess the impact of system solutions in a contemporary, global, economic, environmental, and societal context for sustainable development.
PO12	Identifying and pursuing opportunities by using innovative ideas, to create value and wealth for the betterment of the individual and society.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	2	3		2	1	1			3		2	3
CO2	3	3	3		2	1	1			2		2	2
CO3	3	3	2		3	2	1			3		3	3
CO4	3	2	2		3	1	2			3		3	2
CO5	3	3	3		3	2	1			3		3	3
CO6	3	3	3		2	2	2			2		3	3

Semester	Code	Object Oriented Programming Systems Using Java Lab	L-T-P	Credits	Hours	Marks
2nd	22MCA207(P)		0-0-1	1	30	150

Objectives	The objective of the course is to apply object oriented programming principlesand implement object oriented programming using JAVA language.
Pre-Requisites	Basic analytical and logical understanding including basic knowledge and usage of computers is required for this course. Prior experience with any other object oriented programming language will be beneficial.
Teaching Scheme	Regular laboratory classes with the use of ICT whenever required, demonstration through practical simulation of code using IDE.

Evaluation Scheme

Practical Assessment		
Lab Test	**End Term Practical Test**	**Total**
50	**100**	**150**

Detailed Syllabus

Experiment-#	Assignment/Experiment
13.	Understanding Java platform, compilation, and execution of a java program.
14.	Use of class, use of control statements, data types, operators.
15.	Implement class, object, constructor, methods, and other OOP features.
16.	Inheritance Basics, more uses of constructor, method overriding, use of final.
17.	Object class, practical use of abstract class.
18.	Using Interface for achieving multiple inheritance, implementation of package.
19.	Exception handing fundamentals, java built-in exceptions, Use of Scanner class forconsole input, use of own Exception subclass.
20.	Java thread life cycle model and implementation approach, thread priority,implementation of synchronization.
21.	I/O Basics, byte stream and character streams, reading and writing files.
22.	Applet life cycle implementation, text processing using Java predefined String,StringBuilder and StringBuffer classes.
23.	GUI basics and Window fundamentals, working with different Component, Containerand Layout Managers.
24.	Java database connectivity using JDBC, steps and use of different drive types.

Books	Name of The Books/References	Publishers
Text Book :	T1:H. Schildt, ***Java: The Complete Reference*** T2. Y. D. Liang, ***Introduction to Java Programming***	McGraw-Hill Pearson Education
Reference Book :	R1. B. Bates, K. Sierra, ***Head First Java*** R2. T. Budd, ***An Introduction to Object-Oriented Programming***,	O'Reilly Media Pearson Education
Online Resources	5. https://nptel.ac.in/courses/106105191/ 6. https://docs.oracle.com/javase/tutorial/ 7. http://www.javatpoint.com/java-tutorial 8. http://www.w3schools.in/java/ 9. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-00-introduction-to-computer-science-and-programming-fall-2008/video-lectures/lecture-14/	

Online Resources:

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Apply object oriented principles in software design process and develop Java programs for real-life applications.
CO2	Employ inheritance and exception handling techniques for developing robust, reusable software.
CO3	Understand the concept of constructor, method overloading and overriding
CO4	Develop programs using stream classes for various I/O operations and design concurrent programs using threads to maximize the use of processing power.
CO5	Design applications for text processing using String class and develop user interactive applications using event handling.
CO6	Design data base driven GUI applications using AWT, Swing and JDBC.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements.
PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains.
PO3	Design applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects.
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 practices.
PO7	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.
PO10	Ability to understand and assess the impact of system solutions in a contemporary, global, economic, environmental, and societal context for sustainable development.
PO12	Identifying and pursuing opportunities by using innovative ideas, to create value and wealth for the betterment of the individual and society.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	2	3		2	1	1			3		2	3
CO2	3	3	3		2	1	1			2		2	2
CO3	3	3	2		3	2	1			3		3	3
CO4	3	2	2		3	1	2			3		3	2
CO5	3	3	3		3	2	1			3		3	3
CO6	3	3	3		2	2	2			2		3	3

Semester	Code	Operating Systems Lab	L-T-P	Credits	Hours	Marks
2nd	22MCA208(P)		0-0-2	1	30	150

Objectives	The objectives of this course is to introduce the students to Linux programming environment & UNIX shell scripts, and practical experience of designing & implementing concepts of operating systems using C programming language.
Pre-Requisites	Knowledge of data structures, analysis of algorithms, and programming in C or C++ is required.
Teaching Scheme	Regular laboratory classes conducted under supervision of the teacher. The experiments shall comprise of programming assignments.

Evaluation Scheme

Practical Assessment		
Lab Test	**End Term Practical Test**	**Total**
50	**100**	**150**

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Introduction to Linux OS and basic VI editor commands.
3	Introduction to UNIX Shell Script: Arithmetic Expressions, Relational & Conditional Operators.
4	UNIX Shell Script: Looping, Case structure.
5	Process Creation, process handing, process signaling through fork(), exec().
6	CPU Scheduling (Non-Pre-emptive) FCFS, SJF, Priority.
7	CPU Scheduling (Pre-emptive) SRTF, RR, Priority-based preemptive scheduling
8	Multi-Threaded application using POSIX threads.
9	Synchronization using Semaphore (Producer- Consumer, Reader-Writer).
10	Message passing: Pipe and Signals.
11	Deadlock implementation: Banker's Algorithm.
12	Implementation of different Page Replacement Algorithms.

Books	Name of The Books/References	Publishers
Text Book :	T1. V. Mukhi, ***The C Odyssey: UNIX***	BPB Publications
	T2. A. Silberschatz, P. B Galvin, and G Gagne, ***Operating Systems Principles***	Wiley India
Reference Book :	R1. A. S. Tanenbaum, ***Modern Operating Systems***	PHI Learning
	R2. P. B. Prasad, ***Operating Systems and System PrograMMing***	SciTech Publishers
Online Resources	1. https://nptel.ac.in/courses/106106144/ 2. https://nptel.ac.in/courses/106108101/ 3. http://web.stanford.edu/~ouster/cgi-bin/cs140-spring14/lectures.php 4. https://www.cl.cam.ac.uk/teaching/1011/OpSystems/os1a-slides.pdf	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Carry out basic and advanced UNIX commands for system administration as well as writeshell scripts for real life applications.
CO2	Simulate various CPU scheduling algorithms like FCFS, RR, SJF, Priority and Multilevel Queue etc.
CO3	Implement various programs on process creation, inter-process communication and synchronization.
CO4	Execute Banker's algorithm for handling situations of deadlock.
CO5	Implement different page replacement algorithms like FIFO, LRU, LFU and OPTIMAL etc.
CO6	Implement different page replacement algorithms like FIFO,LRU,LFU and OPTIMAL etc.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements.
PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains.
PO3	Design applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Ability to invoke the research skills by conducting experiments, interpreting data and providing well informed conclusions.
PO5	Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.
PO8	Function effectively in the workplace both as a team leader and team member on multi-disciplinary projects demonstrating computing and management skills.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	2	3	3	3			2					3
CO2	3	3	2	2	3			2					2
CO3	3	2	3	2	2			3					2
CO4	3	3	3	3	3			3					1
CO5	3	3	2	3	3			3					3
CO6	3	2	3	3	3			2					3

Semester	Code		L-T-P	Credits	Hours	Marks
2nd	22MCA209(P)	**Advance Python Programming Lab**	0-0-2	1	30	150

Objectives	The objective of this laboratory course is to prepare the students solve data science problems using python.
Pre-Requisites	Knowledge of programming and basic problem solving skills.
Teaching Scheme	Regular laboratory classes conducted under supervision of the teacher. The experiments shall comprise of programming assignments.

Evaluation Scheme

Practical Assessment		
Lab Test	**End Term Practical Test**	**Total**
50	**100**	**150**

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Create, access, modify, and sort multidimensional NumPy arrays (nd arrays)
3	Use slicing, boolean indexing, and set operations to select or change subsets of an nd array
4	Perform element-wise operations on nd arrays and solve system of linear equations.
5	Creating data frame, read data from CSV, excel file, reshaping & filtering.
6	Summarizing and Computing descriptive statistics, find Correlation and covariance
7	Perform data aggregation and group operations.
8	Prepare data for machine learning model, split data into train-test set using Scikit-learn library
9	Encoding categorical features using Scikit-learn
10	Training and running a linear model using Scikit-Learn

Books	Name of The Books/References	Publishers
Text Book :	T1. W. McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Ipython T2. Jake VanderPlas, Python Data Science Handbook-Essential tools for working with data	O'Reilly Media O'Reilly Media
Reference Book :	R1. J. Avila, T. Hauck, Scikit-Learn Cookbook	Packt Publishing
Online Resources	1. https://numpy.org/doc/stable/user/basics.html 2. https://www.kaggle.com/learn/pandas 3. https://scikit-learn.org/stable/modules/preprocessing.html?highlight=categorical#encoding-categorical-features	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Carry out basic and advanced UNIX commands for system administration as well as writeshell scripts for real life applications.
CO2	Simulate various CPU scheduling algorithms like FCFS, RR, SJF, Priority and Multilevel Queue etc.
CO3	Implement various program on process creation, inter-process communication and synchronization.
CO4	Execute Banker's algorithm for handling situations of deadlock.
CO5	Implement different page replacement algorithms like FIFO, LRU, LFU and OPTIMAL etc.
CO6	Implement different page replacement algorithms like FIFO, LRU, LFU and OPTIMAL etc.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements.
PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains.
PO3	Design applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Ability to invoke the research skills by conducting experiments, interpreting data and providing well informed conclusions.
PO5	Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.
PO8	Function effectively in the workplace both as a team leader and team member on multi-disciplinary projects demonstrating computing and management skills.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	2	3	3	3			2					3
CO2	3	3	2	2	3			2					2
CO3	3	2	3	2	2			3					2
CO4	3	3	3	3	3			3					1
CO5	3	3	2	3	3			3					3
CO6	3	2	3	3	3			2					3

Semester	Code	Emerging Technology Lab-II (Internet and Web Technology Lab)	L-T-P	Credits	Hours	Marks
2nd	22MCA209(P)		0-0-2	2	30	100

Objectives	The objective of this course is to provide hands-on exposure and practice on building modern full stack web applications compatible with mobile devices and multiple screen resolutions.
Pre-Requisites	Knowledge of HTML, CSS, and Java Script along with concepts of PHP andMySQL taught in the theory class are required for the experiments.
Teaching Scheme	Regular laboratory classes conducted under supervision of the teacher. Theexperiments shall comprise of programming assignments.

Evaluation Scheme

Practical Assessment		
Lab Test	**End Term Practical Test**	**Total**
50	**100**	**150**

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Configuration of Development Environment and Server Configuration, XAMPP Tool.
2	Write a Simple Hello Program in PHP by Installing and Configuring XAMPP.
3	Study of Basic Building Blocks In PHP, Study of Control Structure & Loops In PHP.
4	Study of Array and Function In PHP.
5	Study of Form handling In PHP.
6	Study of Server Side Validation and Page Redirection In PHP.
7	Date and Time, Strings & Patterns.
8	Study of Cookies And Sessions In PHP.
9	OOP Concepts: Classes and objects, Constructor & Destructor, Inheritance.
10	Static methods and properties, Methods overloading, Abstract Class & Interface.
11	Study of MYSQL DDL, DML, DCL Commands.
12	Study of PHP Data Base Connectivity with MYSQL.
13	Study of MYSQL Data Base Operation.
14	Study of File Handling and Image Uploading in PHP.
15	JavaScript and the DOM Elements.
16	jQuery core features, using jQuery for interactive front-ends.
17	DOM manipulation, event handling
18	AJAX Call, How to handle an AJAX HTTP request to a server and the response.
19	Working with JSON.
20	Angular JS Basics and Implementation.
21	MVC Architecture and Implementation.
22	CodeIgniter Framework, Simple Crud Operation(CREATE, READ, UPDATE, DELETE, SEARCH).
23	API basics, Web Services, Creating REST Services.

24	Project Work: Each group of 3-4 students shall develop one complete web application as per the given assignment from start to finish using all the tools, technologies, and concepts taught and demonstrate the working web application.

Books	Name of The Books/References	Publishers
Text Book :	T1. S. Holzner, ***The PHP CoMplete Reference*** T2. L. Beighley and M. Morrison, ***Head First PHP & MySQL***	McGraw Hill Education O'Reilly Media
Reference Book :	R1. D. Reiersol, C.Shiflett, and M. Baker, ***PHP in Action: Objects, Design, Agility*** R2. S. K. Patel, ***Developing Responsive Web Applications with AJAX and jQuery***	Manning Publications Packt Publishing
Online Resources	1. https://www.php.net/manual/en/langref.php: PHP Language Reference 2. https://dev.mysql.com/doc/refman/8.0/en/: MySQL Reference Manual 3. https://www.w3schools.com/php/: W3Schools PHP Tutorials 4. https://api.jquery.com/: jQuery Documentation 5. https://codeigniter.com/user_guide/index.html: CodeIgniter User Guide 6. https://angular.io/guide/architecture: Angular JS Documentation	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Setup & configure the XAMPP server software.
CO2	Understand web server setup and develop server side web application using PHP programming
CO3	Apply Object-oriented concepts to develop reusable object libraries for complex web applications.
CO4	Design n-Tier database driven web applications with file processing, uploads and downloads.
CO5	Use AJAX programming techniques to develop rich internet applications.
CO6	Design and develop 3rd party framework- based scalable web applications for the real world.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements.
PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains.
PO3	Design applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Ability to invoke the research skills by conducting experiments, interpreting data and providing well informed 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 practices.
PO7	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.
PO9	Communicate effectively with the computing community as well as society by being able to comprehend effective documentations and presentations.
PO10	Ability to understand and assess the impact of system solutions in a contemporary, global, economic, environmental, and societal context for sustainable development.
PO11	Ability to work as a member or leader in diverse teams in multidisciplinary environment.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	2	1				1						2
CO2	3	3	2	1			2		3				3
CO3	3	3	2	2	2	1	2		2	2	3		3
CO4	3	3	2	2	3	2	3		2	2	2		2
CO5	3	2	3	3	3	1	3		3	3	3		3
CO6	3	3	2	3	2	1	2		3	3	2		3

Part II

2nd Year MCA

Curriculum Structure

Semester-3: Autumn Semester (August to December)

Sl. No.	Course Code	Course Title	L-T-P	Total credit
1.	22MCA301	Design and Analysis of Algorithms	3-0-0	3
2.	22MCA302	Computer Network	3-0-0	3
3.	22MCA303	Software Engineering	3-0-0	3
4.	22MCA304	Elective-I	3-0-0	3
5.	22MCA305	Elective-II	3-0-0	3
PRACTICAL				
6.	22MCA306(P)	Design and Analysis of Algorithms Lab	0-0-1	1
7.	22MCA307(P)	Personality Development and soft skills Lab	0-0-1	1
8.	22MCA308(P)	Data Processing and Visualization Lab	0-0-1	1
9.	22MCA309(P)	Advanced Java Programming Lab	0-0-2	2
10.	22MCA310(P)	Minor Project	0-0-4	4
			TOTAL	**24**

Semester-4: Spring Semester (January to May)

Sl. No.	Course Code	Course Title	L-T-P	Total credit
1.	22MCA401	Elective-III/**MOOC's**	3-0-0	3
2.	22MCA402	Elective-IV/ **MOOC's**	3-0-0	3
PRACTICAL				
1.	22MCA403(P)	Major Project	0-0-9	9
			TOTAL	**15**

Note:

I. A student may be given an option to complete the MOOC's course in the elective papers during 4th semester
II. Major Project- 90-120 days project work by students in different companies/ Institutes can be an extension of the minor project (of 3rd semester).

List of Electives

Elective-I

Sl. No.	Course Code	Course Title
1)	22MCA304(A)	Artificial Intelligence
2)	22MCA304(B)	Information Security
3)	22MCA304(C)	Wireless Sensor Network
4)	22MCA304(D)	Software Testing

Elective-II

Sl. No.	Course Code	Course Title
1)	22MCA305(A)	Data Warehousing and Business Intelligence
2)	22MCA305(B)	VA & PT
3)	22MCA305(C)	Cloud Computing
4)	22MCA305(D)	Mobile Application Development

Elective-III

Sl. No.	Course Code	Course Title
1)	22MCA401(A)	Machine Learning
2)	22MCA401(B)	Block Chain Technology
3)	22MCA401(C)	IOT
4)	22MCA401(D)	Software Project Management

Elective-IV

Sl. No.	Course Code	Course Title
1)	22MCA402(A)	Big Data Analytics
2)	22MCA402(B)	Digital Forensics
3)	22MCA402(C)	Mobile Computing
4)	22MCA402(D)	E-Commerce and Knowledge Management

Semester	Code	Design and Analysis of Algorithms	L-T-P	Credits	Hours	Marks
2nd	22MCA301		3-0-0	3	30	150

Objectives	The objective of this course is to study the classic algorithms in various domains, techniques for designing efficient algorithms, apply different algorithm design techniques to solve complex problems, and analyze the complexities of the solutions.
Pre-Requisites	Knowledge of Discrete Mathematics and Data Structures is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required; sessions are planned to be interactive with focus on problem solving & analysis.

Evaluation Scheme

Teacher Assessment		Written Assessment		Total
Quiz	Assignment	Mid term	End term	
10	20	20	100	150

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction, Definition, Characteristics of algorithms, Growth of Functions, Asymptotic analysis, Standard notations and common functions, Recurrences, Solution of recurrences by iterative, Recursion tree, Substitution and Master method; Algorithm design techniques, Divide and conquer strategy, Merge Sort, Quick Sort. Heaps, Types of Heap, Maintaining the heap property, Building a Heap, The Heap-sort algorithm,	**10 Hours**
Module-2	Priority Queue; Lower bounds of sorting; Dynamic Programming, Elements of dynamic programming, Matrix chain multiplication, Longest Common Subsequence, Assembly-Line Scheduling. Greedy algorithms, Elements of Greedy strategy, Fractional Knapsack problem, Huffman codes; Backtracking and Branch &Bound techniques (n-Queen, Knapsack and Travelling Salesman Problem);Data structure for disjoint sets, Disjoint set operations.	**10 Hours**
Module-3	Graph algorithms and their characteristics, Breadth-first and Depth-first search, Minimum spanning trees, Kruskal and Prim's algorithms, Single-source shortest path algorithms (Bellman-Ford, Dijkstra), All-pair shortest path algorithm (Floyd-Warshall) ; Maximum flow problem, Ford-Fulkerson algorithm and its analysis.String matching algorithms (Naive, Rabin-Karp, NP completeness (Polynomial time, Polynomial time verification, NP completeness and reducibility),	**10 Hours**
	Total	**30 Hours**

Books	Name of The Books/References	Publishers
Text Book :	T1. T. H.Cormen, C. E.Leiserson, R. L.Rivest, and C. Stein, ***Introduction to Algorithms***	PHILearning
	T2. E. Horowitz, S. Sahni, and S. Rajasekaran, ***Fundamentals of Computer Algorithms***	University Press
Reference Book :	R1. J. Kleinberg and E. Tardos, ***Algorithm Design***	Pearson Education
	R2. M. T. Goodrich and R. Tamassia, ***Algorithm Design : Foundations, Analysis, and Internet Examples***	John Wiley & Sons

Online Resources	1. https://nptel.ac.in/courses/106101060/ 2. https://nptel.ac.in/courses/106106131/ 3. http://www.cs.virginia.edu/~robins/CS_readings.html 4. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-042j-mathematics- for-computer-science-fall-2010/video-lectures/	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Explain and analyze complexities of algorithms and apply divide & conquer strategy for sorting problems.
CO2	Compare different sorting algorithms and use dynamic programming technique for solving optimization problems.
CO3	Apply various algorithm design techniques such as greedy, backtracking, and branch-and-bound in real life problems.
CO4	Understand the concept of the Disjoint sets and its operations
CO5	Model an engineering problem using graphs and develop algorithms to solve the problem.
CO6	Compare various pattern matching algorithms, understand NP complete problems, and design approximation algorithms for some of these problems.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements.
PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains
PO3	Design applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Ability to invoke the research skills by conducting experiments, interpreting data and providing well informed conclusions
PO6	Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional computing practices.
PO8	Effectively in the workplace both as a team leader and team member on multi-disciplinary projects demonstrating computing and management skills.
PO10	Ability to understand and assess the impact of system solutions in a contemporary, global, economic, environmental, and societal context for sustainable development

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	3	3	3		2		1		3			1
CO2	3	3	2	3		3		2		3			1
CO3	3	2	3	2		3		2		2			2
CO4	3	2	1	2		2		3		3			2
CO5	3	3	2	3		2		3		3			2
CO6	3	3	2	2		3		2		2			1

Semester	Code	Computer Networks	L-T-P	Credits	Hours	Marks
3rd	22MCA302		3-0-0	3	30	150

Objectives	The objective of this course are to develop an understanding of modern network architectures from a design and performance perspective, introduce the major concepts involved in WANs, LANs, and WLANs, and provide fundamental knowledge on network programming & WLAN measurement.
Pre-Requisites	Basic knowledge of Computer Organization, Operating Systems, and programming using C language is required.
Teaching Scheme	Regular classroom lectures with use of PPTs as and when required; sessions are planned to be interactive with focus on problem solving and programming.

Evaluation Scheme

Teacher Assessment		Written Assessment		Total
Quiz	Assignment	Mid term	End term	
10	20	20	100	150

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Data communication Components: Representation of data and its flow Networks , Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division; Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC;	**10 Hours**
Module-2	Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple Access Protocols. Pure ALOHA, CSMA, CSMA- CD and CSMA-CA. Network Layer: Switching, Logical addressing – IPV4, IPV6; Error reporting and Management protocols: ICMP, IGMP. Address mapping – ARP, RARP, Bootstrap protocol and DHCP–Delivery, Forwarding and Unicast Routing protocols.	**10 Hours**
Module-3	Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket algorithm. Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), World Wide Web, HTTP, SNMP. Basic concepts of Bluetooth, Firewalls.	**10 Hours**
Total		**30 Hours**

Books	Name of The Books	Publishers
Text Book :	T1. B. A. Forouzan, ***Data COMMunication and Networking***	Tata McGraw–Hill
	T2. L. L. Peterson and B. S. Davie, ***COmputer Networks: A Systems Approach***	Morgan Kaufmann Publishers
Reference Book :	R1. J. F. Kurose and K. W. Ross, ***COmputer Networking - A Top-Down Approach Featuring the Internet***	Pearson Education
	R2. Y. D Lin, R. H Hwang, and F.Baker, ***COmputer Networks: An Open Source Approach***	McGraw-Hill
Online Resources	1. https://nptel.ac.in/courses/106105081/ 2. http://intronetworks.cs.luc.edu/current/ComputerNetworks.pdf 3. https://www.geeksforgeeks.org/computer-network-tutorials	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Understand the various data representation & various types of connectivity.
CO2	Correlate the functionalities of the different layers of OSI and TCP/IP model.
CO3	Design functional blocks of Wide- Area Networks (WANs), Local Area Networks (LANs) & Wireless LANs (WLANs) and define the functions of each block.
CO4	Classify the routing protocols and assign the IP addresses for a given network using static and dynamic addressing techniques.
CO5	Simulate different transport layer protocols using network programming and develop client-server applications.
CO6	Analyze the features and operations of various application layer protocols such as HTTP, FTP, DHCP, RTP, SMTP and others.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements.
PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains.
PO3	Design applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Ability to invoke the research skills by conducting experiments, interpreting data and providing well informed conclusions.
PO5	Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.
PO8	Function effectively in the workplace both as a team leader and team member on multi-disciplinary projects demonstrating computing and management skills.
PO9	Communicate effectively with the computing community as well as society by being able to comprehend effective documentations and presentations.
PO10	Ability to understand and assess the impact of system solutions in a contemporary, global, economic, environmental, and societal context for sustainable development.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	3	3	2	2			2		2			3
CO2	3	2	3	2	3			2	2	2			3
CO3	3	3	2	3	3			1	2	3			3
CO4	3	3	3	2	2			2	2	2			2
CO5	3	2	3	2	3			3	3	2			3
CO6	3	3	3	2	3			2	2	3			2

Semester	Code	Software Engineering	L-T-P	Credits	Hours	Marks
2nd	22MCA303		3-0-0	3	30	150

Objectives	The objective of this course is to provide fundamentals of software engineering, software development life cycle & project management, object-oriented software design, development, testing and quality assurance.
Pre-Requisites	Knowledge of computers, logical & analytical ability, exposure to procedural and object oriented programming languages is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required; sessions are planned to be interactive with problem solving activities.

Evaluation Scheme

Teacher Assessment		Written Assessment		Total
Quiz	Assignment	Mid term	End term	
10	20	20	100	150

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction to Software Engineering: Evolution and Emergence of Software Engineering; Software Life Cycle Models: Classical Waterfall Model, Iterative Waterfall Model, Prototyping Model, Incremental Development Model, Evolutionary Model, RAD model, Agile development models & Spiral model. Software Project Management: Project Planning, Metrics for Project Size Estimation, Project Estimation Techniques, COCOMO model.	**10 Hours**
Module-2	Requirements Analysis & Specification: Requirements Gathering and Analysis, SRS, Formal System Specification. Software Design: Overview of the Design Process, Cohesion and Coupling, Layered Arrangement of Modules, Approaches to Software Design; FOD: SA/SD Methodology, DFD, Structured Design and Detailed Design.	**10 Hours**
Module-3	Object Modelling Using UML: Object-Orientation Concepts, Unified Modelling Language (UML); UML Models: Use Case Model, Class Diagram, Interaction Diagrams, Activity Diagram, Coding & Code Review; Testing: Basic Concepts, Black-box and White-box Testing, Debugging, Integration Testing, Testing Object-Oriented Programs, Integration Testing, System Testing;	**10 Hours**
	Total	**30 Hours**

Books	Name of The Books/References	Publishers
Text Book :	T1. R. Mall, ***FundaMentals of Software Engineering*** T2. C. Larman, ***Applying UML and Patterns***	PHI Learning Pearson Education
Reference Book :	R1. I. Somerville, ***Software Engineering*** R2. R. S. Pressman, ***Software Engineering - A Practitioner's Approach***	Pearson Education McGraw Hill Education
Online Resources	1. https://nptel.ac.in/courses/106105182/: by Prof. Rajib Mall, IIT Kharagpur. 2. https://nptel.ac.in/courses/106101061/: by Prof. N. L. Sharda, IIT Bombay. 3. https://www.tutorialspoint.com/software engineering/software engineering tutorial.pdf	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Describe fundamentals of software engineering and life cycle models.
CO2	Conduct requirements analysis, estimation, planning, scheduling, and other software project management activities.
CO3	Create high-level & detail-level design of software using various design methodologies.
CO4	Visualize object oriented approach for software design using Unified Modeling Language.
CO5	Code, review, test and maintain software products confirming to quality standards.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements.
PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains.
PO3	Design applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Ability to invoke the research skills by conducting experiments, interpreting data and providing well informed conclusions.
PO5	Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.
PO7	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.
PO8	Function effectively in the workplace both as a team leader and team member on multi-disciplinary projects demonstrating computing and management skills.
PO10	Ability to understand and assess the impact of system solutions in a contemporary, global, economic, environmental, and societal context for sustainable development.
PO11	Ability to work as a member or leader in diverse teams in multidisciplinary environment.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	1			2		2	1			1		1
CO2	3	2			3		2	2		2	1		2
CO3	3	3	3	3	3		3	3		2	2		3
CO4	3	3	3	2	2		1	2		3	2		3
CO5	3	3	3	3	2		2	3		3	1		2
CO6	3	3	3	2	2		2	2		3	1		3

Semester	Code	Design and Analysis of Algorithm Lab	L-T-P	Credits	Hours	Marks
3rd	22MCA306(P)		0-0-1	1	30	150

Objectives	The objective of this course is To implement various algorithms under different categories, analyze algorithms & their complexities, and implement approximation algorithms for NP hard problems
Pre-Requisites	Basic knowledge of C Programming and Data Structures is required.
Teaching Scheme	Regular laboratory classes conducted under supervision of the teacher. The experiments shall comprise of programming assignments.

Evaluation Scheme

Practical Assessment		
Lab Test	**End Term Practical Test**	**Total**
50	**100**	**150**

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Design C programs using structure to implement insertion, deletion, BST.
2	Sort a given set of elements using the Quick-sort method and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted.
3	Implement Merge Sort algorithm to sort a given set of elements and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted.
4	Implement Heap Sort algorithm to sort a given set of elements and determine the time required to sort the elements.
5	Obtain the Topological ordering of vertices in a given digraph.
6	Implement 0/1 Knapsack problem using Dynamic Programming.
7	Implement BFS algorithm in a diagraph and check whether a given graph is connected or not using DFS method.
8	Implement Dijkstra's algorithm to find the shortest path in weighted connected graph.
9	Find Minimum Cost Spanning Tree of a given undirected graph using Kruskal's Algorithm.
10	Find Minimum Cost Spanning Tree of a given undirected graph using Prim's algorithm.
11	Implement All-Pairs Shortest Paths Problem using Floyd's algorithm. Parallelize this Algorithm.
12	Implement N Queen's problem using Back Tracking..

Books	Name of The Books/References	Publishers
Text Book :	T1. T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, **Introduction to Algorithms** T2. A. Levitin, **Introduction to the Design and Analysis of Algorithms**	PHI Learning, Pearson Education
Reference Book :	R1. A. V. Aho, J. E. Hopcroft, and J. D. Ullman, **Data Structures and Algorithms** R2. D. E. Knuth, **The Art of Computer Programming**	Pearson Education Pearson Education
Online Resources	1. https://nptel.ac.in/courses/106101060/ 2. https://nptel.ac.in/courses/106106131/ 3. http://www.cs.virginia.edu/_robins/CS readings.html 4. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-042j-mathematicsfor-computer-science-fall-2010/video-lectures/	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Design C programs using structure to implement insertion, deletion, searching of a BST.
CO2	Implement comparison-based sorting algorithms and computing the time required.
CO3	Construct C programs for algorithms based on Divide & Conquer, Dynamic Programming and Greedy techniques.
CO4	Design C program for Graph traversal algorithms.
CO5	Implement N-Queen using Backtracking.
CO6	Implement a scheme to find the solution of Travelling Salesman Problem.

Program Outcomes Relevant to the Course:

PO6	Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional computing practices.
PO7	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.
PO8	Function effectively in the workplace both as a team leader and team member on multi-disciplinary projects demonstrating computing and management skills.
PO9	Communicate effectively with the computing community as well as society by being able to comprehend effective documentations and presentations.
PO10	Ability to understand and assess the impact of system solutions in a contemporary, global, economic, environmental, and societal context for sustainable development.
PO11	Ability to work as a member or leader in diverse teams in multidisciplinary environment.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1						1	2	2		2	3		3
CO2						1				1	2		2
CO3						2	1	1			1		3
CO4						1	2	3	2	2	3		3
CO5						1	2	2	2	3	1		3
CO6						2	2	3	3	2	2		3

Semester	Code	Personality development and soft skills lab	L-T-P	Credits	Hours	Marks
3rd	22MCA307(P)		0-0-1	1	30	150

Objectives	The objective of this course is to help students work on their personality development through an understanding of Soft skills, participate in Group Discussions (GD), present their views in public, perform well in Personal Interviews, and become successful in a corporate scenario.
Pre-Requisites	Basic knowledge of English grammar and the ability to speak, read and write using the English language is required.
Teaching Scheme	Ample tasks designed to facilitate communication through pair work, group/team work, individual and group presentations, discussions, role plays, listening to audios, watching videos, business writing and vocabulary enhancement.

Evaluation Scheme

Practical Assessment		
Lab Test	**End Term Practical Test**	**Total**
50	**100**	**150**

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Introduction to Group Discussions (GD)
2	Mock GD 1.
3	Mock GD 2.
4	Mock GD 3.
5	Interview skills: Preparing for interviews through mock interview session.
6	Writing a good and effective C.V. and SWOC presentation.
7	Assertiveness and EI: Theory inputs and activities.
8	Conducting Mock Interviews.
9	Team work activity: building blocks of a team - discussion & activity.
10	Panel Discussion.
11	Verbal Ability – I: synonyms, antonyms, homonyms, one word substitutes.
12	Verbal Ability – II: jumbled paragraphs, error corrections.
13	Summarizing and note making: techniques and important tips.
14	Personality assessment: conducting an MBTI (Myers Bigiggs Type Indicator) test, self-assessment and discussion.

Books	Name of The Books/References	Publishers
Text Book :	T1. M. A. Rizvi, ***Effective Technical COMMunication*** T2. T. Balasubramaniam, ***English Phonetics for Indian Students*** T3. M. Raman and S. Sharma, ***Technical COMMunication: Principles and Practice***	McGraw-Hill Education Macmillan Publishers Oxford University Press
Reference Book :	R1. S. Samantray, ***Business COMMunication and COMMunicative English*** R2. J. Seeley, ***The Oxford Guide to Effective Writing and Speaking*** R3. B. K. Mitra, ***COMMunication Skills for Engineers***	Sultan Chand. Oxford University Press Oxford University Press
Online Resources	1. https://nptel.ac.in/courses/109104107/ 2. https://nptel.ac.in/courses/109104031/	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Participate effectively in Group Discussions.
CO2	Work on their own personality through self-assessment by SWOC and MBTI.
CO3	Perform well in Personal Interviews.
CO4	Develop team work activity.
CO5	Develop Vocabulary Skills.
CO6	Work effectively both as a team leader and a team member.

Program Outcomes Relevant to the Course:

PO6	Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional computing practices.
PO7	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.
PO8	Function effectively in the workplace both as a team leader and team member on multi-disciplinary projects demonstrating computing and management skills.
PO9	Communicate effectively with the computing community as well as society by being able to comprehend effective documentations and presentations.
PO10	Ability to understand and assess the impact of system solutions in a contemporary, global, economic, environmental, and societal context for sustainable development.
PO11	Ability to work as a member or leader in diverse teams in multidisciplinary environment.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1						1	2	2		2	3		3
CO2						1				1	2		2
CO3						2	1	1			1		3
CO4						1	2	3	2	2	3		3
CO5						1	2	2	2	3	1		3
CO6						2	2	3	3	2	2		3

Semester	Code	Data Processing and Visualization Lab	L-T-P	Credits	Hours	Marks
3rd	22MCA308(P)		0-0-1	1	30	150

Objectives	This course aims to enable the students to learn how to use various data processing techniques. It also emphasizes on the use of popular libraries to create interactive plots for better storytelling with data.
Pre-Requisites	Knowledge of python basics
Teaching Scheme	Regular laboratory classes conducted under supervision of the teacher. The experiments shall comprise of programming assignments.

Evaluation Scheme

Practical Assessment		
Lab Test	**End Term Practical Test**	**Total**
50	**100**	**150**

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Read a dataset and identifying values for data cleanup.
2	Finding the duplicate records and cleaning.
3	Normalizing and Standardizing column Data.
4	Perform various missing value imputations.
5	Concatenate and Join multiple datasets.
6	Plot the data using matplotlib library.
7	Plot a line chart to visualize trends over time.
8	Create bar chart and heatmap using seaborn library.
9	Create histograms and density plots.
10	Making a scatter chart with Bokeh.

Books	Name of The Books/References	Publishers
Text Book :	T1. Jacqueline Kazil & Katharine Jarmul, **Data Wrangling with Python**	O'Reilly
Reference Book :	R1. Ashwin Pajankar, **Practical Python Data Visualization**	Apress
Online Resources	1. https://www.kaggle.com/learn/data-visualization 2. https://realpython.com/tutorials/data-viz/ 3. https://matplotlib.org/stable/tutorials/index.html 4. https://seaborn.pydata.org/ 5. https://docs.bokeh.org/en/latest/docs/gallery.html	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Explain principles of visual perception.
CO2	Apply core skills for visual analysis.
CO3	Apply visualization techniques for various data analysis tasks.
CO4	Design information dashboard.
CO5	Develop skills to both design and critique visualizations
CO6	Implement the components involved in visualization design

Program Outcomes Relevant to the Course:

PO6	Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional computing practices.
PO7	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.
PO8	Function effectively in the workplace both as a team leader and team member on multi-disciplinary projects demonstrating computing and management skills.
PO9	Communicate effectively with the computing community as well as society by being able to comprehend effective documentations and presentations.
PO10	Ability to understand and assess the impact of system solutions in a contemporary, global, economic, environmental, and societal context for sustainable development.
PO11	Ability to work as a member or leader in diverse teams in multidisciplinary environment.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1						1	2	2		2	3		3
CO2						1				1	2		2
CO3						2	1	1			1		3
CO4						1	2	3	2	2	3		3
CO5						1	2	2	2	3	1		3
CO6						2	2	3	3	2	2		3

Semester	Code	Advanced Java Programming Lab	L-T-P	Credits	Hours	Marks
3rd	22MCA309(P)		0-0-2	2	30	150

Objectives	To create a fully functional window based applications. To develop GUI applications like Calculator, Notepad, Simple user forms, and Designing and implementing Component based application and also designing of server side pages, client server interactions with TCP.
Pre-Requisites	Basic analytical and logical understanding including basic knowledge and usage of computers is required for this course. Prior experience with any other object oriented programming language will be beneficial.
Teaching Scheme	Regular laboratory classes with the use of ICT whenever required, demonstration through practical simulation of code using IDE.

Evaluation Scheme

Practical Assessment		
Lab Test	**End Term Practical Test**	**Total**
50	**100**	**150**

Detailed Syllabus

Experiment-#	Assignment/Experiment
25.	Working with IDE AND Servers: Eclipse IDE/Netbeans IDE/Myeclipse IDE, and Apache Tomcat / Glassfish Server / JBoss Server / Weblogic Server
26.	To connect/store data of standalone/web application in database or to retrieve the data from it using JDBC, steps and use of different drive types.
27.	Understanding web technology: Extensible Markup Language (XML)
28.	Common Gateway Interface, Understanding Environment variables
29.	Java Servlets, Servlet Life cycle Working with basics of Servlet,
30.	Servlet request, collaboration, config, attribute
31.	Filter, Authentication filter, Filter config
32.	Java Server Pages (JSP) in Eclipse and other IDE's, scripting elements
33.	JSP: implicit objects, directive elements
34.	Use of JavaBeans, characteristics, properties and methods
35.	Exception Handling, Action elements in JSP
36.	Understanding MVC in JSP, JSP Standard Tag Library (JSTL)
37.	JSP Expression Language, Life cycle of JSP
38.	Introduction to JQuery, Validation using JQuery, JQuery Forms, JQuery Examples
39.	Introduction to AJAX, Servlet and JSP with AJAX

Books	Name of The Books/References	Publishers
Text Book :	T1: Herbert schildt,**Java; The complete reference**, 7th editon, T2..D.Liang,**Introduction to Java Programming**	Tata McGraw-Hill, Pearson Education

Reference Book :	R1.R.A. Johnson, **An introduction to Java programming and object oriented application development** R2.Marty Hall and Larry Brown, **Core Servlets and Java Server pages volume1**	Thomson Pearson
Online Resources	10. https://nptel.ac.in/courses/106105191/ 11. https://docs.oracle.com/javase/tutorial/ 12. http://www.javatpoint.com/java-tutorial 13. http://www.w3schools.in/java/ 14. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-00-introduction-to-computer-science-and-programming-fall-2008/video-lectures/lecture-14/	

Online Resources:

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Apply object oriented principles in software design process and develop Java programs for real-life applications.
CO2	Develop and Designing of window based applications.
CO3	Applying programs to create a client and server communication using net package.
CO4	Develop programs using stream classes for various I/O operations and design concurrent programs using threads to maximize the use of processing power. Able to design reusable software components using java beans.
CO5	DesignapplicationsfortextprocessingusingStringclassanddevelopuserinteractiveapplicationsusingevent handling.
CO6	Design data base driven GUI applications using AWT, Swing and JDBC.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements.
PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains.
PO3	Design applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects.
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 practices.
PO7	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.
PO10	Ability to understand and assess the impact of system solutions in a contemporary, global, economic, environmental, and societal context for sustainable development.
PO12	Identifying and pursuing opportunities by using innovative ideas, to create value and wealth for the betterment of the individual and society.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3:High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	2	3		2	1	1			3		2	3
CO2	3	3	3		2	1	1			2		2	2
CO3	3	3	2		3	2	1			3		3	3
CO4	3	2	2		3	1	2			3		3	2
CO5	3	3	3		3	2	1			3		3	3
CO6	3	3	3		2	2	2			2		3	3

Semester	Code	Artificial Intelligence	L-T-P	Credits	Hours	Marks
3rd	22MCA304(A)		3-0-0	3	30	150

Objectives	The objective of the course is to present an insight of Artificial Intelligence (AI) concepts, principles and approaches used to develop intelligent agents for various computer applications.
Pre-Requisites	Knowledge of computer programming, data structures & algorithms, discrete mathematics and probability theory are required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with problem solving activities.

Evaluation Scheme

Teacher Assessment		Written Assessment		Total
Quiz	Assignment	Mid term	End term	
10	20	20	100	150

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Artificial Intelligence: Introduction, Intelligent Agents - Agents and Environment, Good Behavior, Nature of Environments, Structure of Agents; Problem Solving: Solving Problems by Searching, Problem-Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Searching with Partial Information. Informed Search and Exploration: Informed (Heuristic) Search Strategies, Heuristic Functions, Local Search Algorithms & Optimization Problems;	**10 Hours**
Module-2	Constraint Satisfaction Problems (CSPs): Introduction, Backtracking Search for CSPs, Local Search for CSPs; Adversarial Search: Games, Optimal Decisions in Games, Alpha-Beta Pruning. Knowledge & Reasoning: Knowledge-Based Agents, The Wumpus World; Logic: Propositional Logic & Reasoning Patterns; First-Order Logic: Syntax and Semantics, Using FOL, Knowledge Engineering in FOL; Inference in FOL: Propositional vs. FOL, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution; Knowledge Representation: Ontological Engineering, Categories & Objects, Semantic Networks, Frames.	**10 Hours**
Module-3	Planning: The Planning Problem, Planning with State-Space Search, Partial-Order Planning, Planning Graphs; Uncertain Knowledge & Reasoning: Acting under Uncertainty, Basic Probability Notations, Bayes' Rule and its use; Probabilistic Reasoning: Representing Knowledge in an Uncertain Domain, Semantics of Bayesian Networks. Learning: Learning from Observations, Forms of Learning, Inductive Learning, Learning Decision Trees; Statistical Learning Methods: Instance Based Learning, Neural Networks.	**10 Hours**
	Total	**30 Hours**

Books	Name of The Books/References	Publishers
Text Book :	T1. S. J. Russell and P. Norvig, ***Artiflcial Intelligence - A Modern Approach*** T2. D. W. Patterson, ***Introduction to Artiflcial Intelligence & Expert Systems***	Pearson Education Pearson Education
Reference Book :	R1. E. Rich, K. Knight, and S. B. Nair, ***Artiflcial Intelligence*** R2. G. F. Luger, ***Artiflcial Intelligence*** R3. M. Negnevitsky, ***Artiflcial Intelligence: A Guide to Intelligent Systems***	McGraw Hill Pearson Education Pearson Education
Online Resources	1. https://nptel.ac.in/courses/106105077/: by Prof. S. Sarkar & Prof. A. Basu, IIT Kharagpur 2. https://nptel.ac.in/courses/106105079/: by Prof. P. Mitra, IIT Kharagpur 3. https://nptel.ac.in/courses/106106140/: by Prof. D. Khemani, IIT Madras	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Explore agents and working environments with utilization of uninformed techniques in state space search.
CO2	Apply search techniques for Game playing and solving constraint satisfaction problems.
CO3	Explore knowledge-based agent & develop knowledge engineering in first order logic.
CO4	Interpret logic & inference rules for decision making & knowledge representation.
CO5	Apply planning and reasoning to handle uncertainty in real life problems.
CO6	Use learning to solve complex real-life problems and design of expert systems.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements.
PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains.
PO3	Design applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Ability to invoke the research skills by conducting experiments, interpreting data and providing well informed conclusions.
PO5	Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.
PO7	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.
PO10	Ability to understand and assess the impact of system solutions in a contemporary, global, economic, environmental, and societal context for sustainable development.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	3	3	3	3					1			2
CO2	2	3	2	3	2					2			3
CO3	3	2	2	3	2		2			2			3
CO4	3	2	2	3	3		3			1			3
CO5	3	2	2	2	3		3			2			2
CO6	3	3	2	2	3		2			2			3

Semester	Code	Information Security	L-T-P	Credits	Hours	Marks
3rd	22MCA304(B)		3-0-0	3	30	150

Objectives	The objective of this course is to study different security goals and mechanisms with primary focus on cryptography techniques used to protect from various security threats in computer networks and Internet.
Pre-Requisites	Knowledge of computer networks and internet technologies are required for this course.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with problem solving activities.

Evaluation Scheme

Teacher Assessment		Written Assessment		Total
Quiz	Assignment	Mid term	End term	
10	20	20	100	150

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction to Security, Computer Crime, Security Mechanisms, Cyber Crimes, Information Technology ACT, Cryptography, Substitution Ciphers, Transpositions Cipher, Block Cipher, Symmetric Key, Asymmetric Key, Data Encryption Standard (DES) Algorithm, Advanced Encryption Standard (AES), Public Key Cryptography: RSA, Diffie-Hellman Key Exchange, Hash Function, Digital Signatures, Digital Certificates	**12 Hours**
Module-2	Program Security, Program Errors, Malicious Codes, Virus, Trapdoors, Salami Attacks, Threats, Control Against program, Program Security issues, Protecting Programs. Protection in OS: Memory and Address Protection, Access Control, File protection, User Authentication.	**08 Hours**
Module-3	Database Security, Requirements, Reliability, Integrity, Sensitive Data, Inference, Multilevel Security, Protecting data. Security in Networks, Threats in Networks, Security Controls, Firewall, Intrusion Detection, E-mail security: PGP, S/MIME, Risk Analysis, Policy Security at the Transport Layer: SSL/TLS, Security at Network Layer: IPSec,.	**10 Hours**
	Total	**30 Hours**

Books	Name of The Books/References	Publishers
Text Book :	T1. W. Stallings, ***Cryptography and Network Security : Principle and Practice***	Pearson Education
Reference Book :	R1. B. A. Forouzan and D. Mukhopadhaya, Cryptography and Network Security R2. C. P. Pfleeger, S. L. Pfleeger, and J. Margulies, Security in CoMputing R3. C. Kaufman, R. Perlman, and M. Speciner, Network Security : Private CoMMunication in a Public World	McGraw Hill PHI PHI
Online Resources	1. https://nptel.ac.in/courses/106/105/106105031/: by Dr. D. Mukhopadhyay, IIT Kharagpur 2. https://nptel.ac.in/courses/106/105/106105162/: by Prof. S. Mukhopadhyay, IIT Kharagpur	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Describe the security objectives and security threats that affect our sensitive data.
CO2	Acquire a mathematical foundation of cryptography through modular arithmetic, number theory, integer factorization, and discrete logarithms.
CO3	Analyze and compare traditional and modern symmetric key cryptography algorithms.
CO4	Understand the block cipher Principle and standard data encryption.
CO5	Explain public key cryptography algorithms and their applications and use of hash functions in message integrity and authentication.
CO6	Apply cryptography techniques for securing data on the Internet and realize the need of firewall & IDS technology.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements.
PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains.
PO3	Design applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects.
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 practices.
PO7	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.
PO10	Ability to understand and assess the impact of system solutions in a contemporary, global, economic, environmental, and societal context for sustainable development.
PO12	Identifying and pursuing opportunities by using innovative ideas, to create value and wealth for the betterment of the individual and society.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	2	2	1		1	2	2			2		1	3
CO2	3	3	1		1	3	1			2		1	3
CO3	3	3	2		2	3	2			3		2	3
CO4	3	3	3		2	3	3			2		3	2
CO5	2	3	3		3	3	2			3		2	3
CO6	1	3	3		2	3	2			3		2	3

Semester	Code	Wireless Sensor Networks	L-T-P	Credits	Hours	Marks
3rd	22MCA304(C)		3-0-0	3	30	150

Objectives	The objective of this course is to provide concepts & unique design challenges presented by wireless sensor networks (WSNs), and introduction to programming for WSNs at the system, network, and application levels.
Pre-Requisites	Knowledge of computer networks and wireless communication is required.
Teaching Scheme	Regular classroom lectures with use of ICT as required, sessions are planned tobe interactive with focus on examples, applications, and latest research.

Evaluation Scheme

Teacher Assessment		Written Assessment		Total
Quiz	Assignment	Mid term	End term	
10	20	20	100	150

Detailed Syllabus

Module-#	Topics	Hours
Module-1	**Introduction**: Overview of WSN & its technology, motivation & applications, Taxonomy of WSN technologies, Traditional layered stack, Cross-layer designs, Sensor network architecture. **Sensor Node Technology**: Overview, Hardware & software, Sensor taxonomy, Wireless network trends, Wireless transmission technology & systems, Radio technology primer, Available wireless technologies, Medium access control protocols for WSN.	**10 Hours**
Module-2	Fundamentals of MAC protocols, MAC protocols for WSNs, Sensor-MAC case study, IEEE 802.15.4 LR-WPANs Standard case study, MAC protocols analysis using Markov Chain. **Routing Protocols**: Data dissemination & gathering, Routing challenges, design issues, and strategies; Transport Control Protocols: Design issues, Resource aware routing, Data-centric routing, Geographic routing, and Opportunistic routing.	**10 Hours**
Module-3	**WSN Middleware**: Principles, Architecture, Existing middleware, Network management - requirements, traditional models, design issues; Security issues of WSN: Possible attacks, Countermeasures, Static & dynamic key distribution. **WSN Platforms & Tools**: Sensor node Hardware, Berkeley Motes, Programming challenges, Node-level software platforms, Node-level simulators, State-centric programming; Applications of WSNs: Ultra wide band radio communication, Wireless fidelity systems, Future directions, Home automation, Smart metering applications.	**10 Hours**
	Total	**30 Hours**

Books	Name of The Books/References	Publishers
Text Book :	T1. W. Dargie and C. Poellabauer, ***FundaMentals of Wireless Sensor Networks - Theory and Practice*** T2. K. Sohraby, D. Minoli, and T. Znati, ***Wireless Sensor Networks - Technology, Protocols, andApplications***	Wiley, 2010. Wiley Inter Science
Reference Book :	R1. T. Hara, V. I. Zadorozhny, and E. Buchmann, ***Wireless Sensor Network - Technologies for theInforMation Explosion Era*** R2. B. Krishnamachari, ***Networking Wireless Sensors***	Springer Cambridge University Press
Online Resources	1. https://nptel.ac.in/courses/106/105/106105160/: by Prof. S. Misra, IIT Kharagpur 2. https://www.csd.uoc.gr/~hy539/lectures/20140408_hy439_sensor_nets_part1.pdf	

	3. http://pages.di.unipi.it/bonuccelli/sensori.pdf: Lecture slides by Prof. K. M. Sivalingam, Universityof Maryland, Baltimore, USA

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Understand the concept of sensor network and know about the technologies.
CO2	Describe different types of wireless networks, their architecture and supporting protocols.
CO3	Explain the hardware & software of WSNs and MAC layer protocols to address media accessing.
CO4	Analyze the network & transport layer protocols to address issues like addressing, route optimization, handover, and reliability.
CO5	Explain architecture of WSN middleware, identify security issues and apply necessary counter measures.
CO6	Apply various WSN platforms and tools to design real world applications.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements.
PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains.
PO3	Design applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects.
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 practices.
PO8	Function effectively in the workplace both as a team leader and team member on multi-disciplinary projects demonstrating computing and management skills.
PO10	Ability to understand and assess the impact of system solutions in a contemporary, global, economic, environmental, and societal context for sustainable development.
PO12	Identifying and pursuing opportunities by using innovative ideas, to create value and wealth for the betterment of the individual and society.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	2									1		2	1
CO2	2	2	2			2				2		3	1
CO3	2	3	2		3	3				3		2	1
CO4	2	2	3		3	3				3		2	2
CO5	2	3	3		3	3				2		3	2
CO6	2	3	2		3	3				3		2	2

Semester	Code	Software Testing	L-T-P	Credits	Hours	Marks
3rd	22MCA304(D)		3-0-0	3	30	150

Objectives	The objective of this course is to introduce the fundamental concepts, processes, and systematic methodologies of Software Testing and their implications on different stages of software development & maintenance.
Pre-Requisites	Basic programming knowledge, understanding of databases / data modelingand adequate knowledge of software engineering are required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with examples and case-study activities.

Evaluation Scheme

Teacher Assessment		Written Assessment		Total
Quiz	Assignment	Mid term	End term	
10	20	20	100	150

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction: Testing as an Engineering Activity, Role of Process in Software Quality, Testing as a Process, TMM Overview, Basic Definitions, Software Testing Principles - The Tester's Role, Origins of Defects, Defect Classes, The Defect Repository and Test Design Defect Examples, Developer/Tester Support for Developing a Defect Repository. Test Case Design: Testing Design Strategies, The Smarter Tester, Test- Case Design Strategies, Using Black-Box Approach to Test-Case Design, Random Testing, Boundary Value Analysis, Decision Tables, Requirements based Testing, Positive and Negative Testing, Compatibility Testing, User Documentation Testing, Domain Testing, Using the White Box Approach to Test Design, Coverage and Control Flow Graphs, Covering Code Logic, Paths Testing, Data Flow and White Box Test Design, Loop Testing, Mutation Testing.	**13 Hours**
Module-2	Levels of Testing: The Need for Levels of Testing, Unit Test - Functions, Procedures, Classes, and Methods as Units, The Need for Preparation, Unit Test Planning, Designing the Unit Tests, The Class as a Testable Unit, The Test Harness, Running the Unit Tests and Recording Results; Integration Test - Goals, Integration Strategies for Procedures, Functions, and Classes, Designing Integration Tests, Integration Test Planning; System Test - Functional Testing, Performance Testing, Stress Testing, Configuration Testing, Security Testing, Recovery Testing, Regression Testing, Alpha, Beta, and Acceptance Tests.	**09 Hours**
Module-3	Test Management: People Issues in Testing, Organization structures for Testing Teams (Single Product and Multi-Product Companies), Testing Services Organization, Test Planning, Test Plan Components, Test Management, Test Process, Test Reporting, Software test automation, Skills needed for Automation, Scope of Automation, Design and Architecture for Automation, Requirements for a Test Tool, and Challenges in Automation. Control, Monitoring, and Quality Assurance: Measurements and Milestones.	**08 Hours**
	Total	**30 Hours**

Books	Name of The Books/References	Publishers
Text Book :	T1. I. Burnstein, ***Practical Software Testing*** T2. S. Desikan and G. Ramesh, ***Software Testing - Principles and Practices***	Springer Pearson
Reference Book :	R1. A. P. Mathur, ***Foundations of Software Testing***	Pearson Education
Online Resources	1. https://nptel.ac.in/courses/106/105/106105150/: by Prof. R. Mall, IIT Kharagpur 2. https://nptel.ac.in/courses/106101163/: by Prof. M. D'Souza, IIIT Bangalore. 3. https://www.softwaretestingmaterial.com/manual-testing-tutorial/ 4. https://www.guru99.com/software-testing.html	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Understand the importance of testing & know the testing principles.
CO2	Describe the relevance of testing as an engineering activity and realize the defects that are inherent to software applications.
CO3	Explain different testing strategies and select appropriate strategy for software testing.
CO4	Analyze different levels of testing in the perspective of product requirements and delivery.
CO5	Develop understanding of the test management procedures & create test plans for test automation.
CO6	Practice quality aspects, standards & models required to deliver software of assured quality.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements.
PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains.
PO3	Design applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects.
PO5	Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.
PO7	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.
PO8	Function effectively in the workplace both as a team leader and team member on multi-disciplinary projects demonstrating computing and management skills.
PO11	Ability to work as a member or leader in diverse teams in multidisciplinary environment.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	2					2				1		2
CO2	3	1	2		2		3	2			2		2
CO3	2	2	3		3		3	2			2		3
CO4	2	3	3		3		3	3			3		3
CO5	3	3	3		2		3	2			3		3
CO6	2	2	2		3		3	2			3		3

Semester	Code	Data Warehousing & BusinessIntelligence	L-T-P	Credits	Hours	Marks
3rd	22MCA305(A)		3-0-0	3	30	150

Objectives	The objective of this course is to critically assess the methodologies and techniques pertaining to implementing data warehouse and business intelligence solutions in order to develop effective decision support strategies in disparate business contexts.
Pre-Requisites	Basic knowledge of database management systems and algorithms is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required; sessions are planned to be interactive with focus on problem solving & analysis.

Evaluation Scheme

Teacher Assessment		Written Assessment		Total
Quiz	Assignment	Mid term	End term	
10	20	20	100	150

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Data warehousing: Introduction, Difference between operational databases and data warehouses, Three tier architecture of data warehouse, Data marts, Data staging area, Metadata. OLAP in the Data Warehouse: Demand for online analytical processing, need for multidimensional analysis, fast access and powerful calculations, OLAP definitions and rules, OLAP characteristics, major features and functions, general features, Dimensional analysis, Hypercubes, Drill-down and Roll-up, Slice-and-dice or Rotation, OLAP models, MOLAP and ROLAP models.	12 Hours
Module-2	Data Mining Basics: Introduction, application areas in data mining, KDD process, Getting to know your data: Data Objects and Attributes types, Data Pre-processing: Why pre-process data? Data cleaning, Data integration, Data transformation and Reduction. Mining Frequent Patterns, Associations and Correlations: Introduction, Market Basket Analysis, Frequent Item-set Generation using Apriori algorithm, Rule generation, Alternative methods for generating Frequent Item-sets using FP-Growth Algorithm.	10 Hours
Module-3	Business Intelligence: Definition, Business Intelligence Decision Support Initiative, Development approaches, Engineering stages and the development steps, Business Intelligence project team structure, managing a Business Intelligence project, Project planning activities, Deliverables, General business requirements, the interviewing process, Data analysis, Data cleaning.	08 Hours
	Total	**30 Hours**

Books	Name of The Books/References	Publishers
Text Book :	T1. R. Thareja, ***Data Warehousing***	Oxford University Press
	T2. E. Turban, R. Sharda, and D. Delen, ***Decision Support and Business Intelligence Systems***	Pearson Education
Reference Book :	R1. A. Berson and S. J. Smith, ***Data Warehousing, Data Mining & OLAP***	McGraw HillEducation
	R2. P. Ponniah, ***Data Warehousing FundaMentals***	Willey India
Online Resources	1. https://nptel.ac.in/courses/106/105/106105174/: by Prof. P. Mitra, IIT Kharagpur 2. http://infolab.stanford.edu/~ullman/mining/2003.html: notes by Stanford University	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Explain the need of data warehousing and the building blocks of a data warehouse.
CO2	Know the architecture of data warehousing and concept of meta data.
CO3	Apply the different models of multidimensional data analysis.
CO4	Examine and pre-process, transform, integrate and reduce the data as per the needs.
CO5	Generate frequent item-sets for pattern mining and frame association rules.
CO6	Comprehend the significance of business intelligence and decision support systems.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements.
PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains.
PO3	Design applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects.
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 practices.
PO7	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.
PO9	Communicate effectively with the computing community as well as society by being able to comprehend effective documentations and presentations.
PO10	Ability to understand and assess the impact of system solutions in a contemporary, global, economic, environmental, and societal context for sustainable development

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	2	2		1	1	3		2	2			3
CO2	3	2	1		1	2	2		2	1			2
CO3	3	3	3		2	3	2		3	2			3
CO4	3	3	3		2	2	3		2	2			3
CO5	3	2	2		1	3	2		2	3			3
CO6	3	3	3		2	3	2		3	2			3

Semester	Code	VA & PT	L-T-P	Credits	Hours	Marks
3rd	22MCA305(B)		3-0-0	3	30	150

Objectives	The objective of this course is to study the Ethical Hacking Process and to Get familiarized with Tools and Techniques of Ethical Hacking
Pre-Requisites	Basic Understanding of Network Security & Threat Mechanisms are essential for this course.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with examples and case-study activities.

Evaluation Scheme

Teacher Assessment		Written Assessment		Total
Quiz	Assignment	Mid term	End term	
10	20	20	100	150

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Understanding the importance of security, Concept of ethical hacking and essential Terminologies Threat, Attack, Vulnerabilities, Target of Evaluation, Exploit. Phases involved in hacking. Foot printing - Introduction to foot printing, Understanding the information gathering methodology of the hackers, Tools used for the reconnaissance phase. Port Scanning - Introduction, using port scanning tools, ping sweeps, Scripting Enumeration-Introduction, Enumerating windows OS & Linux OS.	10 Hours
Module-2	Aspect of remote password guessing, Role of eavesdropping , Various methods of password cracking, Keystroke Loggers, Understanding Sniffers , Comprehending Active and Passive Sniffing, ARP Spoofing and Redirection, DNS and IP Sniffing, HTTPS Sniffing. Web application vulnerabilities, application coding errors, SQL injection into Back-end Databases, cross-site scripting, cross-site request forging, authentication bypass,	10 Hours
Module-3	Web services and related flaws, protective http headers Understanding Session Hijacking, Phases involved in Session Hijacking, Types of Session Hijacking and Session Hijacking Tools. Introduction to 802.11, Role of WEP, Cracking WEP Keys, Sniffing Traffic, and Wireless DOS attacks, WLAN Scanners, WLAN Sniffers, Hacking Tools, and Securing Wireless Networks.	10 Hours
	Total	**30 Hours**

Books	Name of The Books/References	Publishers
Text Book :	T1. CEH official Certfied Ethical Hacking Review Guide T2. Bill Nelson, Amelia Phillips, Christopher Steuart, "Guide to Computer Forensics and Investigations"	Wiley India Edition Delmar Cengage Learning
Reference Book :	R1. Kimberly Graves, "Certified Ethical Hacker" R2. Michael T. Simpson, "Hands-on Ethical Hacking & Network Defense" R3. Rajat Khare, "Network Seuciryt and Ethical Hacking"	Wiley India Pvt Ltd Course Technology Luniver Press
Online	1. https://nptel.ac.in/courses/106/105/106105167/: by Prof. S. K. Ghosh, IIT Kharagpur. 2. https://nptel.ac.in/courses/106/104/106104182/: by Prof. R. Misra, IIT Kanpur.	

Resources	3. https://www.coursera.org/learn/cloud-computing: Prof. Indranil Gupta, Department of ComputerScience, University of Illinois at Urbana-Champaign. 4. http://web.mit.edu/6.897/www/readings.html: by Prof. Hari Balakrishnan, MIT

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Understand the importance of security & concept of ethical hacking.
CO2	Understand the information gathering methodology of the hackers &Tools used for the investigation.
CO3	Generate the remote password & know the various methods of password cracking.
CO4	Maintain the back-end databases in a secure manner.
CO5	Detect the web services errors & its rectification.
CO6	Understand the types of Hijacking and different Hijacking tools.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements.
PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains.
PO3	Design applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects.
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 practices.
PO7	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.
PO8	Function effectively in the workplace both as a team leader and team member on multi-disciplinary projects demonstrating computing and management skills.
PO10	Ability to understand and assess the impact of system solutions in a contemporary, global, economic, environmental, and societal context for sustainable development.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	1	2	1		2	3		2		3			3
CO2	2	2	3		3	3	1	2		2			2
CO3	3	3	2		3	3	1	3		2			3
CO4	3	2	3		3	3	2	2		3			3
CO5	3	3	3		3	3	3	2		3			2
CO6	2	3	3		2	3	2	3		2			3

Semester	Code	Cloud Computing	L-T-P	Credits	Hours	Marks
3rd	22MCA305(C)		3-0-0	3	30	150

Objectives	The objective of this course is to study the fundamental concepts of cloud computing along with a broad coverage of the cloud platforms, security issues, and performance of applications on the cloud.
Pre-Requisites	Knowledge of computer networking, client-server concepts, internet & web technologies are essential for this course.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with examples and case-study activities.

Evaluation Scheme

Teacher Assessment		Written Assessment		Total
Quiz	Assignment	Mid term	End term	
10	20	20	100	150

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction: Client/Server systems, Thin & Thick Clients, Centralized Computing, Parallel & Distributed Computing, Amdahl's Law, P2P Computing, Cluster Computing, Grid Computing, Utility Computing, Autonomic Computing, Hosting, Data Center, Convergence of Technologies, Cloud Computing, NIST definition, Characteristics, Service Models, Deployment Models, Cloud Service Examples, Cloud-based Services & Applications. Cloud Concepts & Technologies: Virtualization, Load Balancing, Scalability & Elasticity, Deployment, Replication, Monitoring, Software Defined Networking (SDN), Network Function Virtualization, Map Reduce, Identity & Access Management, Service Level Agreements (SLA), Billing.	**12 Hours**
Module-2	Cloud Services & Platforms: Compute Services, Storage Services, Database Services, Application Services, Content Delivery Services, Analytics Services, Deployment & management Services, Identity & Access Management Services, Open Source Private Cloud Software - CloudStack, Eucalyptus, OpenStack.	**6 Hours**
Module-3	Cloud Application Design: Considerations for scalability, reliability, availability, security, maintenance and upgradation, performance; Reference Architecture for Cloud Applications, Cloud Application Design Methodologies, Data Storage Approaches; Cloud Application Benchmarking & Tuning, Workload Characteristics, Application Performance Metrics, Benchmarking Tools, Deployment Prototyping, Load Testing & Bottleneck Detection. Cloud Security: Introduction, Security Issues in the Cloud, Components of Security, Attacks & classes of Threats, CSA Security Architecture, Authentication, Authorization, Identity & Access Management, Infrastructure Security, Data Security, Key Management, Auditing & Compliance.	**12 Hours**
	Total	**30 Hours**

Books	Name of The Books/References	Publishers
Text Book :	T1. A. Bahga and V. Madisetti, ***Cloud CoMputing : A Hands-On Approach*** T2. K. Hwang, G. C. Fox, and J. J. Dongarra, ***Distributed and Cloud CoMputing - FroM ParallelProcessing to the Internet of Things*** T3. T. Mather, S. K. Swamy, and S. Latif, ***Cloud Security and Privacy : An Enterprise Perspective onRisks and CoMpliance***	Orient Blackswan 1st Edition, Elsevier O'Reilly Media
Reference Book :	R1. A. T. Velte, T. J. Velte, and R. Elsenpeter, ***Cloud CoMputing : A Practical Approach*** R2. B. Sosinsky, ***Cloud CoMputing Bible***, 1st Edition R3. T. Erl, Z. Mahmood, and R. Puttini, ***Cloud CoMputing : Concepts, Technology & Architecture***	McGraw Hill Education Wiley-India Pearson India Education
Online Resources	1. https://nptel.ac.in/courses/106/105/106105167/: by Prof. S. K. Ghosh, IIT Kharagpur. 2. https://nptel.ac.in/courses/106/104/106104182/: by Prof. R. Misra, IIT Kanpur. 3. https://www.coursera.org/learn/cloud-computing: Prof. Indranil Gupta, Department of ComputerScience, University of Illinois at Urbana-Champaign. 4. http://web.mit.edu/6.897/www/readings.html: by Prof. Hari Balakrishnan, MIT	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Understand the concept of client-server system & mechanism of centralized computing.
CO2	Describe computing paradigms and explain standard cloud computing models.
CO3	Explain key concepts along with the enabling technologies of cloud computing.
CO4	Appreciate various types of cloud computing services and user-access management.
CO5	Visualize design principles and methodologies for developing applications on the cloud.
CO6	Assess the importance of security & privacy of data in cloud environment.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements.
PO3	Design applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects.
PO6	Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional computing practices
PO7	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.
PO8	Function effectively in the workplace both as a team leader and team member on multi-disciplinary projects demonstrating computing and management skills.
PO10	Ability to understand and assess the impact of system solutions in a contemporary, global, economic, environmental, and societal context for sustainable development.
PO11	Ability to work as a member or leader in diverse teams in multidisciplinary environment.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	1		1				2	2		3	2		1
CO2	2		2			2	2	2		2	2		2
CO3	2		2			3	3	3		3	3		1
CO4	2		3			3	2	3		3	2		2
CO5	2		3			2	2	2		2	2		2
CO6	2		3			3	3	2		2	2		2

Semester	Code	Mobile Application Development	L-T-P	Credits	Hours	Marks
3rd	22MCA305(D)		3-0-0	3	30	150

Objectives	The objective of this course is to learn about design and development of mobile applications with focus on Android operating system.
Pre-Requisites	Knowledge of Java programming language & IDE tools is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with design and programming activities.

Evaluation Scheme

Teacher Assessment		Written Assessment		Total
Quiz	Assignment	Mid term	End term	
10	20	20	100	150

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction to mobile applications – Embedded systems, Market and business drives for mobile applications, Publishing and delivery of mobile applications, Requirements gathering and validation for mobile applications. Basic Design - Embedded OS, Design constraints for mobile applications (hardware and software); Architecting mobile applications: User interfaces for mobile applications, Touch events and gestures; Achieving quality constraints: performance, usability, security, availability and modifiability.	**12 Hours**
Module-2	Introduction to Android OS, Android Studio, Establishing the development environment, Android architecture, Activities and views, Interacting with UI, Persisting data using SQLite, Packaging and deployment, Design patterns for mobile applications.	**08 Hours**
Module-3	Designing applications with multimedia and web access capabilities, Integration with GPS and social media applications, Accessing applications hosted in the cloud, Interaction with server side applications, Using Google Maps. Working with Bluetooth and WiFi, Threads and Thread Handlers – Introduction to Threads, Worker threads; Working with Graphics and Animation.	**10 Hours**
	Total	**30 Hours**

Books	Name of The Books/References	Publishers
Text Book :	T1. R. Meier, ***Professional Android™4 Application Development*** T2. P. Kothari, ***Android Application Development Black Book***,	John Wiley & Sons Kogent Learning Solutions, DreamTech Press
Reference Book :	R1. C. Collins, M. Galpin, and M. Ka¨ppler, ***Android in Practice*** R2. A. Pradhan, A. V. Despande, ***Composing Mobile Apps (Learn, Explore, Apply) using AndroidTM*** R3. J. McWherter and S. Gowell, ***Professional Mobile Application Development***	DreamTech Press Wiley Wrox (John Wiley & Sons)
Online Resources	*1.* https://developer.android.com/guide: Android Developers' Guide by *Google*	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Explain mobile applications and platforms from technical and business point of views.
CO2	Design simple mobile applications considering performance, usability, and security.
CO3	Learn about architecture and usability of Android OS.
CO4	Use IDE tools to create mobile applications on Android platform.
CO5	Develop feature-rich mobile applications and integrate them with other useful services.
CO6	Implement various advanced UI and connectivity features in mobile applications.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements.
PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains.
PO3	Design applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Ability to invoke the research skills by conducting experiments, interpreting data and providing well informed conclusions.
PO7	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.
PO8	Function effectively in the workplace both as a team leader and team member on multi-disciplinary projects demonstrating computing and management skills.
PO9	Communicate effectively with the computing community as well as society by being able to comprehend effective documentations and presentations.
PO11	Ability to work as a member or leader in diverse teams in multidisciplinary environment.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	3	3	3				2	2		2		3
CO2	3	2	3	3			2	1	3		2		3
CO3	2	3	2	3			3	3	3		3		2
CO4	3	3	3	2			3	2	2		3		2
CO5	3	2	3	3			2	3	3		2		3
CO6	3	2	2	2			3	2	3		3		3

Semester	Code	Machine Learning	L-T-P	Credits	Hours	Marks
4th	22MCA401(A)		3-0-0	3	30	150

Objectives	The objective of this course is to introduce fundamental concepts and methodsfor machine learning along with analysis of large data sets.
Pre-Requisites	Basic knowledge of probability and statistics is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with problem solving activities.

Evaluation Scheme

Teacher Assessment		Written Assessment		Total
Quiz	Assignment	Mid term	End term	
10	20	20	100	150

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Overview of supervised learning, K-nearest neighbor, Multiple linear regression, Shrinkage methods (Ridge regression, Lasso regression), Subset selection, Linear Discriminant Analysis, Logistic regression.	**10 Hours**
Module-2	Bias, Variance, and model complexity, Cross-validation, Bootstrap methods, Regression and classification trees, Boosting methods, AdaBoost and Random forest. Generative model for discrete data (Bayesian concept learning, Naive Bayesclassifier), SVM for classification, Reproducing Kernels, SVM for regression.	**10 Hours**
Module-3	Clustering (K-means, spectral clustering), Feature Extraction (Principal Component Analysis (PCA), kernel based PCA, Independent Component Analysis (IDA), Non-negative matrix factorization). Introduction to Reinforcement learning, Single State Case: K-Armed Bandit, Elements of Reinforcement Learning, Model-Based Learning (Value Iteration, Policy Iteration).	**10 Hours**
	Total	**30 Hours**

Books	Name of The Books/References	Publishers
Text Book :	T1. T. Hastie, R. Tibshirani, and J. Friedman, ***The Elements of Statistical Learning - Data Mining,Inference, and Prediction***	Springer
	T2. S. Haykin, ***Neural Networks and Learning Machines***	Pearson Education
Reference Book :	R1. Y. G. James, D. Witten, T. Hastie, and R. Tibshirani, ***An Introduction to Statistical Learning withApplications in R***	Springer
	R2. T. M. Mitchell, ***Machine Learning***	McGraw Hill Education
	R3. C. M. Bishop, ***Pattern Recognition and Machine Learning***	Springer
Online Resources	1. https://nptel.ac.in/courses/106/105/106105152/: by Prof. S. Sarkar, IIT Kharagpur. 2. https://nptel.ac.in/courses/106/106/106106139/: by Prof. B. Ravindran, IIT Madras. *3.* https://nptel.ac.in/courses/106/106/106106202/: by Prof. C. G. Jansson, IIT Madras.	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Apply supervised learning to solve related real-life problems.
CO2	Analyze a problem and select the most suitable supervised model for the same.
CO3	Apply classification & regression models such as SVM and decision models.
CO4	Preform clustering of given data with extraction of important features.
CO5	Apply the concepts of reinforcement learning to solve relevant real-life problems.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements.
PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains.
PO3	Design applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Ability to invoke the research skills by conducting experiments, interpreting data and providing well informed conclusions.
PO7	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional
PO10	Ability to understand and assess the impact of system solutions in a contemporary, global, economic, environmental, and societal context for sustainable development.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	3	3	2			3			3			2
CO2	3	3	3	2			3			2			3
CO3	3	2	3	3			2			2			3
CO4	3	3	3	3			3			3			3
CO5	2	3	2	3			3			3			3
CO6	3	3	2	2			3			3			3

Semester	Code	Block Chain Technology	L-T-P	Credits	Hours	Marks
4th	22MCA401(B)		3-0-0	3	30	150

Objectives	The objective of this course is to introduce the students to the Block chain technology and its applications in various domains. The primary focus will be on Block chain basics, consensus protocols, smart contracts, and security issues.
Pre-Requisites (if any)	Basic knowledge of cryptography, computer networks, and programming.

Evaluation Scheme

Teacher Assessment		Written Assessment		Total
Quiz	Assignment	Mid term	End term	
10	20	20	100	150

Detailed Syllabus

Module #	Topics	Hours
Module 1	Introduction to Bitcoin and Blockchain, Basic Cryptographic primitives used in Blockchain – Secure, Collison-resistant hash functions, Merkle Tree, digital signature, public key cryptosystems, zero-knowledge proof systems. Bitcoin blockchain, the challenges, and solutions, proof of work, Proof of stake, alternatives to Bitcoin consensus, Byzantine Models of fault tolerance, Bitcoin scripting language and their use	**14 Hours**
Module 2	Ethereum and Smart Contracts, The Turing Completeness of Smart Contract Languages and verification challenges, Using smart contracts to enforce legal contracts, comparing Bitcoin scripting vs. Ethereum Smart Contracts. Hyperledger fabric, the plug and play platform and mechanisms in permissioned blockchain	**12 Hours**
Module 3	Pseudo-anonymity vs. anonymity, Zcash and Zk-SNARKS for anonymity preservation, attacks on Blockchains – such as Sybil attacks, selfish mining, 51% attacks and prevention (algorand and Sharding based consensus algorithms)	**10 Hours**
	Total	**36 Hours**

Books	Name of The Books/References	Publishers
Text Book :	T1. S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, ***Blockchain Technology: Cryptocurrency and Applications***	Oxford University Press
	T2. Josh Thompson, ***Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming***	Create Space Independent Publishing Platform
Reference Book :	R1. William Stallings, ***Cryptography and Network Security: Principles and Practice***	Pearson
	R2. Alfred J. Menezes, Paul C. van Oorschot, Scott A. Vanstone, ***Handbook of Applied Cryptography***	CRC press
Online Resources	1. https://blockchain.cse.iitk.ac.in/slides-NPTEL-BlockchainTechnologyApplications.pdf 2. https://nvlpubs.nist.gov/nistpubs/ir/2018/nist.ir.8202.pdf 3. https://www.sans.org/ 4. https://www.cryptool.org/en/	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Understand the concept of Bitcoin and Blockchain & Basic Cryptographic primitives used in Block chain platforms.
CO2	Analyse public key cryptosystems & zero-knowledge proof systems.
CO3	Understand how to create a Blockchain network, how to deploy it to real-world applications,
CO4	Know about scripting language and their usability.
CO5	Apply plug and play platform and mechanisms in block chain.
CO6	Understand the multiple aspects of the advantages, mechanisms, and structures of Blockchain technology.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements.
PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains.
PO3	Design applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects.
PO5	Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.
PO7	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.
PO8	Function effectively in the workplace both as a team leader and team member on multi-disciplinary projects demonstrating computing and management skills.
PO10	Ability to understand and assess the impact of system solutions in a contemporary, global, economic, environmental, and societal context for sustainable development.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	2	2	3				2	2		3			3
CO2	3	3	3				3	3		2			3
CO3	3	3	2		2		3	3		2			3
CO4	3	2	2		3		2	2		3			2
CO5	2	3	3		3		2	3		3			2
CO6	3	3	3		2		3	2		3			3

Semester	Code	Internet of Things	L-T-P	Credits	Hours	Marks
4th	22MCA401(C)		3-0-0	3	30	150

Objectives	The objective of this course is to study different security goals and mechanisms with primary focus on cryptography techniques used to protect from various security threats in computer networks and Internet.
Pre-Requisites	Basic knowledge of computer networks, sensor network, micro-processor and micro-controllers is required for this course.
Teaching Scheme	Regular classroom lectures with use of ICT as needed, sessions are planned to be interactive with examples, programming, and idea generation activities.

Evaluation Scheme

Teacher Assessment		Written Assessment		Total
Quiz	Assignment	Mid term	End term	
10	20	20	100	150

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction to IoT: Definition, Characteristic, Components of IoT, Design of IoT systems, Technology and systems implementing IoT, Levels of IoT, Sensors, Actuators, Power Supply.	**10 Hours**
Module-2	IoT Network Model: OSI reference model, Layers in IoT; Protocols: MAC based Protocols, IP based Protocols, Simple Network Management Protocol (SNMP), NetConf, Yang. M2M: IoT vs M2M, Software Defined Networking, Network Function Virtualization;	**10 Hours**
Module-3	IoT Platform Design: IoT Design Methodology, Resource Management in IoT, Data Synchronization. Devices: Zigbee, Bluetooth, Wi-fi, RFID, Cloud Computing, Big Data. Case Studies: IoT in Smart Home, Smart Grid, Agriculture, Healthcare, Smart Industry, Environment, Smart Cities.	**10 Hours**
	Total	**30 Hours**

Books	Name of The Books/References	Publishers
Text Book :	T1. A. Bahga, V. Madisetti, ***Internet of Things : A Hands-on Approach***	University Press
	T2. O. Hersent, D. Boswarthick, and O. Elloumi, ***The Internet of Things : Key Applications and Protocols***	Student Edition, Wiley
Reference Book :	R1. D. Uckelmann, M. Harrison, and F. Michahelles, ***Architecting the Internet of Things***	Springer
	R2. R. Buyya and A. V. Dastjerdi, ***Internet of Things : Principles and Paradigms***	Elsevier,
Online Resources	1. https://nptel.ac.in/courses/106/105/106105166/: by Prof. S. Misra, IIT Kharagpur 2. https://nptel.ac.in/courses/108/108/108108098/: by Prof. T. V. Prabhakar, IISc Bangalore	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Describe basic concepts of IoT, its architecture and system design.
CO2	Visualize the communication mechanisms between sensors and systems using various protocols and network models.
CO3	Explain IoT with respect to machine to machine and design IoT systems with data synchronization and resource manipulation.
CO4	Describe advanced IoT concepts applied in various devices prevalent in the market.
CO5	Envisage and compare real-world applications of IoT in different domains.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements.
PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains.
PO3	Design applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects.
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 practices.
PO7	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.
PO8	Function effectively in the workplace both as a team leader and team member on multi-disciplinary projects demonstrating computing and management skills.
PO10	Ability to understand and assess the impact of system solutions in a contemporary, global, economic, environmental, and societal context for sustainable development.
PO12	Identifying and pursuing opportunities by using innovative ideas, to create value and wealth for the betterment of the individual and society.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	1			1	2						2	3
CO2	3	3	2		3	3		1		1		1	3
CO3	3	3	2		3	3	2	2		2		2	2
CO4	3	3	3		2	2	2	3		3		3	3
CO5	3	2	2		3	2	3	3		3		2	3
CO6	3	3	2		3	3	3	2		2		2	3

Semester	Code	Software Project Management	L-T-P	Credits	Hours	Marks
4th	22MCA401(D)		3-0-0	3	30	150

Objectives	The objective of this course is to introduce various activities involved in managing software projects including product life cycle, umbrella activities like project planning, quality assurance, risk management, tracking, closure and various other activities during different phases of software development.
Pre-Requisites	Knowledge of software engineering and programming languages is required.
Teaching Scheme	Regular classroom lectures with use of ICT as required and interactive sessionswith focus on case studies & different scenarios faced by project managers.

Evaluation Scheme

Teacher Assessment		Written Assessment		Total
Quiz	Assignment	Mid term	End term	
10	20	20	100	150

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction: Product Life Cycle - Idea generation, Prototype Development Phase, Alpha Phase, Beta Phase, Production and Maintenance Phase. Project Life Cycle Models - Water fall Model, Prototype Model, RAD and Spiral Model. Process Models. Umbrella Activities: Metrics – roadmap, Strategy, Targets and tracking, Acting on data; Software Configuration Management - Process and activities of SCM, Configuration audit, Metrics in SCM, Tools and automation; Software Quality Assurance - Quality Control and Assurance, Cost and benefits of quality, Tools and automation, SQA role;	**10 Hours**
Module-2	Risk Management - Risk Management Cycle, Risk Identification, Quantification, Monitoring, Mitigation, Metrics in Risk Management. Project Management Processes and Activities: Project Life Cycle In- Stream activities, Project initiation - Activities, Outputs, Quality Records, Completion criteria, Project Planning and Tracking - Components, Activities specific to project tracking, Project Closure - Effective closure Process, Issues, Metrics for Project Closure. Engineering Activities in Project Lifecycle: Software requirement gathering- Inputs and start criteria, Dimensions, Steps, Output and Quality records, Skill sets, Challenges, Metrics for Requirement Phase.	**10 Hours**
Module-3	Estimation –Three Phases of Estimation, Methodology, Formal models for size estimation, Challenges, Metrics for Estimation Process. Design and Development Phases– Features, Reusability, Testability and Maintainability. Project Management in Testing and Maintenance Phases. Emerging Trends: Globalization Issues in Project management - Evolution, Challenges and Models. Impact of the internet on Project Management - Effect of internet on Project Management, Managing project for internet, Effects on Project Management activities. People Focused Process Models - People centric models, P-CMM, Other people focused models.	**10 Hours**
	Total	**30 Hours**

Books	Name of The Books/References	Publishers
Text Book :	T1. R. Gopalaswamy, ***Managing Global Software Projects*** T2. B. Hughes and M. Cotterell, ***Software Project Management***	McGraw-Hill Education Tata McGraw-Hill
Reference Book :	R1. R. S. Pressman, ***Software Engineering - A Practitioner's Approach*** R2. R. Mall, ***Fundamentals of Software Engineering***	McGraw-Hill Education PHI Learning
Online Resources	1. https://nptel.ac.in/courses/106/105/106105218/: by Prof. R. Mall, IIT Kharagpur. 2. https://www.tutorialspoint.com/software engineering/software project management.htm 3. https://www.stellman-greene.com/about/applied-software-project-management/applied- software-project-management-slides/	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Explain Product Life Cycle Phases and Project Life Cycle Models like Water fall Model, Prototype Model, RAD and Spiral Model.
CO2	Analyze and plan various umbrella Activities like Metrics target setting and tracking, Software Configuration Management.
CO3	Develop the Software Quality Assurance and Risk Management.
CO4	Model Project Management Processes such as Project Life Cycle In-Stream activities, Project Planning and Tracking and Project Closure.
CO5	Execute Project Management activities in Software requirement gathering, Estimation, Design, Development, Testing and Maintenance Phases.
CO6	Realize the Emerging Trends in Project Management like Globalization Issues, Impact of the internet on Project Management, People Focused Process Models and P-CMM.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements.
PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains.
PO3	Design applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Ability to invoke the research skills by conducting experiments, interpreting data and providing well informed 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 practices.
PO7	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.
PO8	Function effectively in the workplace both as a team leader and team member on multi-disciplinary projects demonstrating computing and management skills.
PO9	Communicate effectively with the computing community as well as society by being able to comprehend effective documentations and presentations.
PO10	Ability to understand and assess the impact of system solutions in a contemporary, global, economic, environmental, and societal context for sustainable development.
PO11	Ability to work as a member or leader in diverse teams in multidisciplinary environment.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	1	3	3	1	2	2	2	1	1	1	1		1
CO2	2	1	2	1	3	1	3	1	1	2	1		1
CO3	2	2	1	2	3	1	3	2	2	2	1		2
CO4	3	2	1	3	2	2	2	2	1	1	2		2
CO5	2	2	2	1	3	1	2	2	1	1	1		1
CO6	1	1	1	2	3	1	2	1	1	1	1		2

Semester	Code	Big Data Analytics	L-T-P	Credits	Hours	Marks
4th	22MCA402(A)		3-0-0	3	30	150

Objectives	The objective of the course is to study different techniques to find similar items, mining data streams, link analysis, clustering techniques, recommendation systems, and collaborative filtering used for Big Data, along with the concepts of batch processing, Hadoop, MapReduce & Spark.
Pre-Requisites (if any)	Knowledge of basics of data mining & algorithm design is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities.

Evaluation Scheme

Teacher Assessment		Written Assessment		Total
Quiz	Assignment	Mid term	End term	
10	20	20	100	150

Detailed Syllabus

Module #	Topics	Hours
Module 1	Overview of Big data, History, Structure, Elements, Advantages, Use, Distributed and Parallel Computing for Big Data, Cloud Computing and Big Data, In-memory computing technology for Big data, Understanding Big Data Technology Foundations, Storing Data in Databases and Data Warehouses.	**10 Hours**
Module 2	Understanding Hadoop Ecosystem, Hadoop Distributed File System: Architecture, concepts of Blocks, Name nodes and Data nodes, CLI, using HDFS files, Hadoop specific file system types, HDFS commands, HDFS high availability, Features. Hadoop YARN, Introduction to Hbase and Hive,	**10 Hours**
Module 3	Understanding MapReduce Fundamentals and HBase: MapReduce Framework, Techniques to optimize MapReduce jobs, Uses of MapReduce, Role of HBase in Big Data processing, Processing Data with MapReduce, Customizing MapReduce Execution and Implementing MapReduce program.	**10 Hours**
	Total	**30 Hours**

Books	Name of The Books/References	Publishers
Text Book :	T1. DT Editorial Services, BIG DATA BLACK BOOK T2. J. Leskovec, A. Rajaraman, and J. D. Ullman, *Mining of Massive* Dofesefs	Dreamtech Press Cambridge University Press
Reference Book :	R1: J. Han, M. Kamber, and J. Pei, Dole *Mining* Concepts *and Techniques* R2: T. M. Mitchell, *Machine Learning*	Morgan Kaufman Publications McGraw-Hill Education
Online Resources	1. https://nptel.ac.in/courses/106/106/106106142/: by Prof. J. Augustine, IIT Madras 2. https://nptel.ac.in/courses/106/104/106104189/: by Dr. R. Misra, IIT Patna 3. http://www.mmds.org: Material on Mining of Massive Data Sets 4. http://1intool.github.com/MapReduceA1gorithms/index.html	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Understand Big Data and its analytics in the real world
CO2	Analyze the Big Data framework like Hadoop and NOSQL to efficiently store and process Big Data to generate analytics
CO3	Design of Algorithms to solve Data Intensive Problems using Map Reduce Paradigm
CO4	Design and Implementation of Big Data Analytics using pig and spark to solve data intensive problems and to generate analytics
CO5	Implement Big Data Activities using Hive
CO6	Apply Machine Learning Techniques using R/Python

Program Outcomes Relevant to the Course:

PO1	Knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements.
PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains.
PO3	Design applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects.
PO5	Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.
PO9	Communicate effectively with the computing community as well as society by being able to comprehend effective documentations and presentations.
PO10	Ability to understand and assess the impact of system solutions in a contemporary, global, economic, environmental, and societal context for sustainable development.
PO12	Identifying and pursuing opportunities by using innovative ideas, to create value and wealth for the betterment of the individual and society.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	1	2	2		3				2	2			2
CO2	2	2	2		2				1	3		2	2
CO3	3	2	3		3				1	2		2	2
CO4	3	3	3		3				2	2		2	3
CO5	2	2	3		2				2	2		2	3
CO6	2	2	3		2				1	2		2	3

Semester	Code	Digital Forensics	L-T-P	Credits	Hours	Marks
4th	22MCA402(B)		3-0-0	3	30	150

Objectives	The objective of this course is to provide an in-depth study of computer forensics, knowledge required to investigate, detect and prevent digital crimes, digital forensics legislations, forensics processes and procedures, investigating operating systems and file systems, network forensics, art of steganography and mobile device forensics.
Pre-Requisites	Knowledge of computer networks, network security, and idea on cybercrime and information warfare are required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities.

Evaluation Scheme

Teacher Assessment		Written Assessment		Total
Quiz	Assignment	Mid term	End term	
10	20	20	100	150

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Digital Forensics Science: Forensics science, computer forensics, and digital forensics. Computer Crime: Criminalistics as it relates to the investigative process, analysis of cyber-criminalistics area, holistic approach to cyber- forensics. Cyber Crime Scene Analysis: Discuss the various court orders etc., methods to search and seizure electronic evidence, retrieved and un-retrieved communications, discuss the importance of understanding what court documents would be required for a criminal investigation.	12 Hours
Module-2	Evidence Management & Presentation: Create and manage shared folders using operating system, importance of the forensic mindset, define the workload of law enforcement, explain what the normal case would look like, define who should be notified of a crime, parts of gathering evidence, define and apply probable cause. Computer Forensics: Prepare a case, begin an investigation, understand computer forensics workstations and software, conduct an investigation, complete a case, critique a case;	10 Hours
Module-3	Mobile Forensics: Mobile forensics techniques and tools; Legal Aspects of Digital Forensics: IT Act 2000, amendment of IT Act 2008; Recent Trends in Mobile Forensics: technique and methods to search and seizure, electronic evidences.	08 Hours
	Total	30 Hours

Books	Name of The Books/References	Publishers
Text Book :	T1. B. Nelson, A. Phillips, F Enfinger, C Steuart, ***Guide to CoMputer Forensics and Investigations***	Course Technology
Reference Book :	R1. J. Sammons, ***The Basics of Digital Forensics*** R2. J. Vacca, ***CoMputer Forensics: CoMputer CriMe Scene Investigation***	Elsevier Laxmi Publications
Online Resources	1. http://www.cftco.com/: Computer Forensic Training Center Online 2. http://www.computerforensicsworld.com/: Computer Forensics World 3. http://www.computer-forensic.com/: Computer Forensic Services 4. http://www.digitalforensicsmagazine.com/: Digital Forensic Magazine 5. http://www.jdfsl.org/: The Journal of Digital Forensics, Security and Law	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Understand relevant legislation and codes of ethics.
CO2	Investigate computer forensics and digital detective and various processes ,policies and procedures data acquisition and validation, e-discovery tools.
CO3	Analyze E-discovery, guide lines and standards, E-evidence, tools and environment.
CO4	Understand the computer forensics workstations and software for investigation.
CO5	Apply the under lying principles of Email, web and network forensics to handle real life problems.
CO6	Use IT Acts and apply mobile forensics techniques.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements.
PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains.
PO3	applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects.
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 practices.
PO9	Communicate effectively with the computing community as well as society by being able to comprehend effective documentations and presentations.
PO10	Ability to understand and assess the impact of system solutions in a contemporary, global, economic, environmental, and societal context for sustainable development.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3	2	3		3	2			1	1			2
CO2	3	2	2		2	2			1	1			3
CO3	2	3	3		2	3			2	2			3
CO4	2	3	3		3	3			1	2			2
CO5	2	3	2		2	3			2	2			2
CO6	3	3	2		1	2			2	3			3

Semester	Code	Mobile Computing	L-T-P	Credits	Hours	Marks
4th	22MCA402(C)		3-0-0	3	30	150

Objectives	The objective of the course is to study the concepts and technologies for transmission of various types of data over wireless mediums and introduce computing on mobile devices.
Pre-Requisites	Fundamental knowledge of networking and signal transmission are required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions areplanned to be interactive with problem solving activities.

Evaluation Scheme

Teacher Assessment		Written Assessment		Total
Quiz	Assignment	Mid term	End term	
10	20	20	100	150

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction to Personal Communication System (PCS), Evolution of Wireless Technologies, Signals and Frequency, Cellular system – Structure, Cluster, Frequency Reuse and Splitting, MAC mechanisms - SDMA, TDMA, CDMA, GSM Technology - Architecture, Channels & Bands, GSM Architecture, Mobility Management, Handover Detection and Management; GPRS - Architecture, Interfaces, Network Protocols. WLAN IEEE 802.11 System Architecture, Ad-Hoc and Infrastructural Mode, MAC Frame format.	**10 Hours**
Module-2	, Bluetooth - Introduction, Piconet, Scatternet, Protocol stack, Profile; WAP - Architecture and Components, WAP Gateway and Protocol stack; WML Script - Variables, Control structure and Functions, IMT 2000 standards, WCDMA and CDMA 2000. MobileIP - Goals, Requirements, Entities, Agent Advertisement and Discovery, Registration, IP packet Delivery, Tunneling and Encapsulation; IPv6, DHCP, ICMP, Routing, Introduction to Wireless Local Loop (WLL), Wireless Enterprise Networks.	**10 Hours**
Module-3	Satellite Network Technology - Global Mobile Satellite system (HEO, LEO, MEO), Satellite system architecture, satellite constellation for satellite phone, Case studies: Iridium, GLOBALSTAR, GLONASS; Virtual Private Network - Features and Goals, Remote Access VPN, Site to Site VPN, VPN Protocol and Requirements, Security Issues in Mobile Computing, Algorithms and Implementation. VoIP and Real Time protocols, Multimedia content delivery in Mobile Network.	**10 Hours**
	Total	**30 Hours**

Books	Name of The Books/References	Publishers
Text Book :	T1. J. Schiller, ***Mobile CoMMunication*** T2. A. K. Talukder, H. Ahmed, and R. Yavagal, ***Mobile CoMputing*** T3. Y-B. Lin, I. Chlamtac, ***Wireless and Mobile Network Architectures***	Pearson Education McGraw Hill

		1st Edition, Wiley
Reference Book :	R1. V. K. Garg, ***Wireless COMMunication and Networks*** R2. U. Hansmann, L. Merk, M. Nicklous, and T. Stober, ***Principles of Mobile COMputing***	Pearson Education Springer, 2006.
Online Resources	1. http://alphace.ac.in/downloads/notes/cse/10cs831.pdf 2. https://www.tutorialspoint.com/mobile_computing/mobile_computing_overview.htm	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Explain current technological implementation in GSM network.
CO2	Assess the capabilities of GSM and wireless technologies in network design and operation.
CO3	Evaluate network protocols, routing algorithms, connectivity methods and characteristics.
CO4	Develop the Bluetooth infrastructure and its implementation in different areas.
CO5	Describe wireless network topologies, wireless connectivity and characteristics, and the significance of security & Internet communications.
CO6	Apply appropriate wireless technologies in commercial & enterprise applications.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing, mathematics, and domain knowledge appropriate for conceptualization of computing models from defined problems and requirements.
PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains.
PO3	Design applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Ability to invoke the research skills by conducting experiments, interpreting data and providing well informed conclusions.
PO5	Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.
PO7	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.
PO9	Communicate effectively with the computing community as well as society by being able to comprehend effective documentations and presentations.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1	3			2	2				1				3
CO2	2	1		2	3		1		1				3
CO3	1		2	1	2		2		1				2
CO4	1	2	2	3	1		3		1				3
CO5	3	3	3	2	2		2		2				3
CO6	2	2	1	1	2		2		2				3

Semester	Code	E-Commerce & Knowledge Management	L-T-P	Credits	Hours	Marks
4th	22MCA402(D)		3-0-0	3	30	150

Objectives	The objective of this course is to introduce the fundamentals of e-commerce and its impact, infrastructure, business strategies, revenue models, building web presence, hardware and software technologies for e-commerce and knowledgemanagement.
Pre-Requisites	Basic knowledge of Internet Web Technology, World Wide Web, Databases and Client-Server technologies is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required; sessions are planned to be interactive with problem solving activities.

Evaluation Scheme

Teacher Assessment		Written Assessment		Total
Quiz	Assignment	Mid term	End term	
10	20	20	100	150

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction to E-Commerce: E-Commerce and E-Business, Introduction to Business Models and Revenue Models, Business Processes, Impacts, Advantages and Disadvantages of E-Commerce, International Nature of E-Commerce; Technology Infrastructure: The Internet and the World Wide Web, Internet Protocols, Markup Languages, Intranets and Extranets; The Environment of E-Commerce: Legal, Ethical, and Tax Issues. Revenue Models in detail, Revenue Models in Transition, Revenue Strategy Issues, Creating an Effective Web Presence, Web Site Usability, Connecting with Customers.	**10 Hours**
Module-2	Marketing on the Web: Web Marketing Strategies, Communicating with Different Market Segments, Beyond Market Segmentation: Customer Behavior and Relationship Intensity, Advertising On The Web, E-Mail Marketing, Technology-Enabled CRM, Creating and Maintaining Brands on the Web, Search Engine Positioning and Domain Names. Business-to-Business Activities: Purchasing, Logistics, and Support Activities, Electronic Data Interchange, Supply Chain Management Using Internet Technologies, Electronic Marketplaces and Portals, Social Networking, Mobile Commerce, and Online Auctions.	**10 Hours**
Module-3	Web Server Hardware and Software: Web Server Basics, Software for Web Servers, E-Mail, Web Server Hardware. Electronic Commerce Software: Web Hosting, Basic and advanced Functions of Electronic Commerce Software, Electronic Commerce Software for Small, Midsize and Large Companies, Knowledge Management, Knowledge Management technologies and Software.	**10 Hours**
	Total	**30 Hours**

Books	Name of The Books/References	Publishers
Text Book :	T1. G. P. Schneider, ***Electronic CoMMerce***	Cengage Learning
Reference Book :	R1. R. Kalakota, A. B. Whinston, ***Frontiers of Electronic CoMMerce*** R2. C. V. S Murthy, ***E-coMMerce: Concepts, Models & Strategies***	Addision Wesley Himalaya Publishing
Online Resources	1. https://nptel.ac.in/courses/110105083/: by Prof. M. Jenamani, IIT Kharagpur.	

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Describe the fundamentals of e-commerce and its relevance to society.
CO2	Understand about the various technologies & infrastructure are needed for E-commerce.
CO3	Explain various e-commerce revenue models and online marketing strategies.
CO4	Discuss B2 B activities, Electronic Data Interchange, Supply Chain Management, Mobile Commerce and e-Logistics.
CO5	Explain technical aspects of e-commerce with respect to Hardware and Software components.
CO6	Compare available e-commerce solutions and knowledge management technologies.

Program Outcomes Relevant to the Course:

PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentals of computer science and application domains.
PO3	Design applications for complex computing problems with appropriate considerations for any specific need on societal and environmental aspects.
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 practices.
PO9	Communicate effectively with the computing community as well as society by being able to comprehend effective documentations and presentations.
PO10	Ability to understand and assess the impact of system solutions in a contemporary, global, economic, environmental, and societal context for sustainable development.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
CO1		2	2		2	2			2	3			2
CO2		3	2		1	3			3	2			3
CO3		2	1		2	2			3	2			3
CO4		2	2		3	2			2	1			3
CO5		3	2		3	3			3	2			3
CO6		2	2		3	2			3	2			1

Curriculum and Syllabus

of

2 Yrs Master in Computer Application (MCA)

(Effective from Admission Batch : 2023-24)

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