Curriculum and Syllabus

Of

2 Years MCA

(Effective from Admission Batch 2025-26)

Table of Contents

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 endeavor has led to a vibrant industry with concurrent rapid change in technology. Thus, the challenge in designing a curriculum is to identify here as 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 13CoreCourses

2.1.3 12Practical papers

2.1.4 04Elective papers

2.1.5 02Project (Minor projects and Major projects)

2.1.6 Minimum 2 Value Added Courses

2.1.7 Add-on, non-credit course, Experiential Learning through Summer Internship, Industry visits, Activity based self-Learning, and Live projects

2.2 Programmed Ration:

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 behavior** 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 mathematics, programming logic and coding fundamentals for solution architecture and problem solving
PO2	Identify, review, formulate and analyze problems for primarily focusing on customer requirements using critical thinking frameworks.
PO3	Design, develop and investigate problems with as an innovative approach for solutions incorporating ESG/SDG goals
PO4	Select, adapt and apply modern computational tools such as development of algorithms with an understanding of the limitations including human biases.
PO5	Function and communicate effectively as an individual or a team leader in diverse and multidisciplinary groups. Use methodologies such as agile.
PO6	Use the principles of project management such as scheduling, work breakdown structure and be conversant with the principles of Finance for profitable project management
PO7	Commit to professional ethics in managing software projects with financial aspects. Learn to use new technologies for cyber security and insulate customers from malware
PO8	Change management skills and the ability to learn, keep up with contemporary technologies and ways of working
PSO1	Understand the relevance of sustainable development and its significance, as well as the impact of expert engineering solutions in social and environmental contexts
PSO2	Apply fundamental knowledge of computer applications and exhibit practical competencies in a broad range of programming languages and software platforms that are required to become a successful computer professional.

Scheme of Credit Distribution

Semester	Specifications	Credits	Total Credits
1st	04 Theory papers 02 Theory paper 04 Practical paper 01 Practical paper	04 X @ 3 credits per paper = 12 02 X @ 2 Credits per paper = 04 04 X @ 1 credits per paper = 04 01 X @ 2 credits per paper = 02	22
2nd	05 Theory papers 01 Theory Paper 01 Theory Paper 06 Practical paper 01 Practical paper	05 X @ 3 credits per paper = 15 01 X @ 2 credits per paper = 02 01 X @ 1 credit per paper = 01 06 X @ 1credits per paper = 06 01 X @ 2 credits per paper = 02	26
3rd	03 Theory Paper	03 X @ 3credits per paper = 09	24
	01 Theory paper of Elective - I	01 X @ 3credits per paper = 03	
	01Theory paper of Elective - II	01 X @ 3 credits per paper = 03	
	03 Practical / Lab paper/Internship	04X @1 credits per paper = 04	
	01 Minor Project	01 X @ 3 credits per paper = 03	
	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	13
	01Theory papers of Elective - IV	01 X @ 3 credits per paper = 03	
	01Major project	01 X @ 7 credits per paper = 07	
Grand total			**85**

Programme Structure Analysis

Semester	Core papers	Electives	Practical		Project	Total
			IT Lab	Communication Lab		
1st	06	-	03	01		10
2nd	07	-	05	-		12
3rd	03	02	03	01	01	10
4th		02			01	03
	16	**04**	**10**	**02**	**02**	**35**

Sl. No.	Category of Papers	Number of papers	Credits
i.	Core papers	16	44
ii.	Electives	04	12
iii.	Practical	13	16
iv.	Project	02	13
		Total Papers = 35	**Total Credits = 85**

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.

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 provide 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.

4.1.1 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.

4.1.2 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.

4.1.3 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. Todevelopastrongintellectualandethicalhumancapitalbasewithafocusonindustry and services sector
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:

Case-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 cases and problems 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 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.
- Careers cope in various areas of electives
- Basicsoffundamentalsubjectsasaprerequisitebeforelearningthecoresubjectsofcomputerapplications
- 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.	Universal Human Values-Introduction	5-0-0	0	05

Semester-1: Autumn Semester (August to December)

Sr. No	Course Code	Course Title	L-T-P	Credit
1	25MCA101	Probability and Statistics	3-0-0	3
2	25MCA102	Problem Solving & Programming Language	3-0-0	3
3	25MCA103	Business Communication	2-0-0	2
4	25MCA104	Computer System Architecture	3-0-0	3
5	25MCA105	Database Management System	3-0-0	3
6	25MCA106	Entrepreneurship Development	2-0-0	2
PRACTICAL				
1	25MCA107(P)	Problem solving & programming Lab	0-0-2	1
2	25MCA108(P)	Communication skill and Language Lab	0-0-2	1
3	25MCA109(P)	DBMS Lab	0-0-2	1
4	25MCA110(P)	Emerging Technology Lab-I(Python Programming)	0-0-4	2
TOTAL				**21**

Semester-2: Spring Semester (January to May)

Sr. No	Course Code	Course Title	L-T-P	Credit
1	25MCA201	Discrete Mathematics	3-0-0	3
2	25MCA202	Data Structure	3-0-0	3
3	25MCA203	Object Oriented Programming Systems	3-0-0	3
4	25MCA204	Operating System	3-0-0	3
5	25MCA205	Universal Human Values	2-0-0	2
6	25MCA206	Indian Knowledge System	1-0-0	1
7	25MCA207	Computer Network	3-0-0	3
PRACTICAL				
1	25MCA207(P)	Data Structure Lab	0-0-2	1
2	25MCA208(P)	Object Oriented Programming Lab	0-0-2	1
3	25MCA209(P)	Operating System Lab	0-0-2	1
4	25MCA210(P)	Advance Python Programming	0-0-2	1
5	25MCA211(P)	Emerging Technology Lab-II (Internet & Web Technology)	0-0-4	2
6	25MCA212(P)	Personality Development Lab	0-0-2	1
7	25MCA213(P)	Tech Industry Interface Programme II	0-0-4	2
TOTAL				**27**

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.	25MCA301	Design and Analysis of Algorithms	3-0-0	3
2.	25MCA302	Theory of Computation	3-0-0	3
3.	25MCA303	Software Engineering	3-0-0	3
4.	25MCA304	Elective-I	3-0-0	3
5.	25MCA305	Elective-II	3-0-0	3
PRACTICAL				
1.	25MCA306(P)	Design and Analysis of Algorithms Lab	0-0-2	1
2.	25MCA307(P)	Personality Development and soft skills Lab	0-0-2	1
3.	25MCA308(P)	Data Processing and Visualization Lab	0-0-2	1
4.	25MCA309(P)	Advanced JAVA	0-0-4	2
5.	25MCA310(P)	Minor Project	0-0-4	2
6.	25MCA311(P)	Internship	0-0-2	1
TOTAL				**23**

Semester-4: Spring Semester (January to May)

Sl. No.	Course Code	Course Title	L-T-P	Total credit
1.	25MCA401	Elective-III/**MOOC's**	3-0-0	3
2.	25MCA402	Elective-IV/**MOOC's**	3-0-0	3
PRACTICAL				
1.	25MCA403(P)	Major Project	0-0-16	8
TOTAL				**14**
GRAND TOTAL				**85**

Note: Major Project- 60-90 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)	Computer and Network 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. Aprojectitemshallcarry100percentagepoints.

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.

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. Marks obtained out of 300 (4 credit).

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. TheevaluationshallbedonebyaCommitteeofteacherstobeconstitutedbythePrincipalinrespective specializations where the Internal Supervisor shall be a member.

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

Major Project- 60-90 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)

Sr. No	Course Code	Course Title	L-T-P	Credit
1	25MCA101	Probability and Statistics	3-0-0	3
2	25MCA102	Problem Solving & Programming Language	3-0-0	3
3	25MCA103	Business Communication	2-0-0	2
4	25MCA104	Computer System Architecture	3-0-0	3
5	25MCA105	Database Management System	3-0-0	3
6	25MCA106	Entrepreneurship Development	2-0-0	2
PRACTICAL				
1	25MCA106(P)	Problem solving & programming Lab	0-0-2	1
2	25MCA107(P)	Communication skill and Language Lab	0-0-2	1
3	25MCA108(P)	DBMS Lab	0-0-2	1
4	25MCA109(P)	Emerging Technology Lab-I(Python Programming)	0-0-4	2
TOTAL				**21**

Syllabus

Semester	Code		Credits	L-T-P	Hours	Marks
1st	25MCA101	Probability and Statistics	3	3-0-0	30Hrs	100

Introduction:

The course "Mathematical Foundation for Computer Applications-I" provides essential mathematical tools and concepts foundational to computer science. It covers topics like set theory, logic, combinatory and graph theory, which are crucial for understanding algorithms, data structures, and programming languages. By bridging theoretical mathematics with practical applications, this course equips students with the analytical skills needed to solve complex problems in computer science effectively.

Objectives	The objective of this course is familiarize students with mathematical logic counting techniques and abstract structures like groups, Boolean algebra and graphs.
Pre-Requisites	Basic knowledge on Sets and Matrices is required.
Teaching Scheme	Regular class room 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

Modules	Topics	Hours
Module-I	**Logic & Proofs:** Propositions and Logical Operations, Laws of equivalence, Inference Theory, Predicate Calculus, Direct and Indirect proof, Inductive proof. **Counting:** Basics of Counting Techniques, Principle of Inclusion & Exclusion, Pigeonhole Principle, and Recurrence Relations.	**10 Hours**
Module-II	**Relation:** Properties of Relations, Equivalence Relations and Equivalence Class, Matrix representation of relations, Closure operations on relations, Warshall's Algorithm, Partial Ordering Relations, Hasse Diagram, Lattices, Properties of Lattices, Introduction to Boolean Algebra.	**10Hours**
Module-III	**Graph & Trees:** Graph Terminology and Special Types of Graphs, Havel-Hakimi Theorem, Representing Graphs and Graph Isomorphism, Paths and Circuits, Connectivity, Cut-Sets, Euler and Hamiltonian Paths, Trees, Properties of Trees, Binary Tree, Binary expression tree. **Group & Group Code:** Algebraic Structures, Semi Groups, Monoid, Groups, Abelian group and their properties, Subgroup, Codes and Group-codes, Error detection and correction using Group codes, Hamming Code.	**10 Hours**

Referred Books

Books	Name of The Books/References	Publishers
TextBook:	T1. K. H. Rosen, Discrete Mathematics and its Application, 7th Edition T2. C. L. Liu, Elements of Discrete Mathematics, 2nd Revised Edition	McGraw-Hill Tata McGraw-Hill
Reference Book:	R1. J. P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science R2. J. R. Mott, A. Kandel, and T. P. Baker, Discrete Mathematics for Computer Scientists and Mathematicians	McGraw-Hill Education Pearson Education India,
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:

	Course Outcomes	Levels of learning *(based on bloom's taxonomy)*
CO1	Define & describe various logical connectives and expressions along with rules of inferences.	Level 1 (Remember)
CO2	Apply various methods of proofs and proof strategies.	Level 2 (Understand)
CO3	Construct various counting techniques using pigeon-hole principle and recurrence relations for future applications.	Level 3 (Apply)
CO4	Interpret the knowledge on sets and relations.	Level 4 (Analyze)
CO5	Develop the concepts and applications of graphs.	Level 5 (Evaluate)
CO6	Identify & define algebraic structures like semi-group, monoid and group.	Level 6 (Create)

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of mathematics, programming logic and coding fundamentals for solution architecture and problem solving
PO2	Identify, review, formulate and analyze problems for primarily focusing on customer requirements using critical thinking frameworks.
PO3	Design, develop and investigate problems with as an innovative approach for solutions incorporating ESG/SDG goals
PO4	Select, adapt and apply modern computational tools such as development of algorithms with an understanding of the limitations including human biases.
PO5	Function and communicate effectively as an individual or a team leader in diverse and multidisciplinary groups. Use methodologies such as agile.
PO6	Use the principles of project management such as scheduling, work breakdown structure and be conversant with the principles of Finance for profitable project management
PO7	Commit to professional ethics in managing software projects with financial aspects. Learn to use new technologies for cyber security and insulate customers from malware
PO8	Change management skills and the ability to learn, keep up with contemporary technologies and ways of working
PSO1	Understand the relevance of sustainable development and its significance, as well as the impact of expert engineering solutions in social and environmental contexts
PSO2	Apply fundamental knowledge of computer applications and exhibit practical competencies in a broad range of programming languages and software platforms that are required to become a successful computer professional.

CO – PO Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	3	2	2	2	1	1	1	2	1	2
CO2	3	3	2	2	3	2	2	3	2	2
CO3	3	3	3	2	2	2	2	1	1	3
CO4	3	3	2	2	3	1	1	2	1	2
CO5	3	3	3	2	3	2	2	1	1	2
CO6	3	3	3	2	2	2	2	2	1	2

Semester	Code	Problem Solving & Programming Language	Credits	L-T-P	Hours	Marks
1st	25 MCA102		3	3-0-0	30Hrs	100

Introduction

It is a foundational course that equips students with the skills needed to approach and solve computational problems using programming. This course introduces the basic principles of problem-solving, algorithm design, and logical thinking, alongside learning a programming language to implement solutions. Students will explore key programming concepts such as variables, control structures, functions and data structures by developing the ability to translate problems into executable code.

Objectives	The course aims to provide exposure to problem-solving through programming and 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	10	20	60	100

Detailed Syllabus

Modules	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 associatively, 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, go to), 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);	**12Hours**
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.	**10Hours**
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, typed, enumerated data type, pre- processor directives;	**08Hours**

Referred Books

Books	**Name of The Books / References**	**Publishers**
Text Book:	**Programming in ANSIC,** E. Balagurusamy **Let Use C,** Y.Kanetker	Tata Mc Graw-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 Mc Graw-Hill.
Online Resources	http://www.princeton.edu/~achaney/tmve/wiki100k/docs/C %28programminglanguage%29.html http://www.stat.cmu.edu/~hseltman/c/CTips.html http://www.c-faq.com/ http://www.learn-c.org/ https://www.javatpoint.com/c-programming-language-tutorial	

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

	Course Outcomes	**Levels of learning** ***(based on bloom's taxonomy)***
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.	Level 1 (Remember)
CO2	Develop simple C programs using data types, variables, operators and control transfer statements.	Level 2 (Understand)
CO3	Design C programs to handle similar data items using arrays and construct modular programs.	Level 3 (Apply)
CO4	Use string and pointer to design efficient C programs for manipulating real life situations.	Level 4 (Analyze)
CO5	Manipulate memory during run time and handle heterogeneous data items using structure and union.	Level 5 (Evaluate)
CO6	Design C programs to create and manipulate files. Write efficient C programs using command line arguments, macros and pre-processor directives.	Level 6 (Create)

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of mathematics, programming logic and coding fundamentals for solution architecture and problem solving
PO2	Identify, review, formulate and analyze problems for primarily focusing on customer requirements using critical thinking frameworks.
PO3	Design, develop and investigate problems with as an innovative approach for solutions incorporating ESG/SDG goals
PO4	Select, adapt and apply modern computational tools such as development of algorithms with an understanding of the limitations including human biases.
PO5	Function and communicate effectively as an individual or a team leader in diverse and multidisciplinary groups. Use methodologies such as agile.
PO6	Use the principles of project management such as scheduling, work breakdown structure and be conversant with the principles of Finance for profitable project management
PO7	Commit to professional ethics in managing software projects with financial aspects. Learn to use new technologies for cyber security and insulate customers from malware
PO8	Change management skills and the ability to learn, keep up with contemporary technologies and ways of working
PSO1	Understand the relevance of sustainable development and its significance, as well as the impact of expert engineering solutions in social and environmental contexts
PSO2	Apply fundamental knowledge of computer applications and exhibit practical competencies in a broad range of programming languages and software platforms that are required to become a successful computer professional.

CO – PO Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	3	2	2	2	1	1	1	2	1	2
CO2	3	3	2	2	3	2	2	3	2	2
CO3	3	3	3	2	2	2	2	1	1	2
CO4	3	3	2	2	3	1	1	2	1	2
CO5	3	3	3	2	3	2	2	1	1	2
CO6	3	3	3	2	2	2	2	2	1	2

Semester	Code		Credits	L-T-P	Hours	Marks
1st	25MCA103	Business Communication	2	2-0-0	20Hrs.	100

Introduction

Business Communication is essential for organizational success, involving the clear and effective exchange of information within and outside a company. It encompasses various forms, including verbal, non-verbal, written, and digital communication, and plays a crucial role in decision-making, problem-solving, and relationship-building. Mastery of business communication enhances your ability to convey messages persuasively and professionally in diverse business contexts, making it a vital skill for navigating today's global and digital business environment. This course will equip you with the necessary tools to communicate effectively in any business setting.

Objectives	To Develop students' communication proficiency with an emphasis on language skills. To Raise awareness of the importance of cross-cultural communication to enhance the ability to read and comprehend texts of different genres.
Pre-Requisites	BasicknowledgeofEnglishgrammarandtheabilitytoreadandwriteusingtheEnglishlanguage.
Teaching Scheme	Regular classroom lectures with the 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	10	20	60	100

Detailed Syllabus

Modules	Topics	Hours
Module I	**Basics of Communication** Introduction to Communication, Definition, and importance of communication. Communication process: code, channel, message, context, feedback. Factors involved in the communication process. **Activities:** Interactive discussion on the importance of communication. Group activity to identify key components of effective communication. **Communication Across Cultures** Importance of cross-cultural communication. Barriers to effective communication in a multicultural environment. Verbal and non-verbal communication. **Activities:** Case studies on cross-cultural communication scenarios. Role-playing exercises to practice overcoming communication barriers. **Effective Verbal Communication** Techniques for clear and effective verbal	**08 Hours**

	communication. Active listening skills. Articulation and clarity. **Activities:** Listening and speaking exercises. Group discussions to practice active listening. **Non-Verbal Communication** Understanding body language and gestures. Importance of eye contact and facial expressions. Role of posture and personal space. **Activities:** Exercises to interpret and use non-verbal cues. Video analysis of effective non-verbal communication.	
Module II	**Professional Communication in Business Contexts** **Business Communication:** Essentials of business communication. Formal and informal communication. Professional etiquette in communication. **Activities:** Role-playing business meetings and discussions. Peer feedback on communication etiquette. **Art of Public Speaking:** Styles and techniques of public speaking: assertiveness, convincing, argumentation, negotiation. Overcoming stage fright. **Activities:** Students prepare and deliver short speeches. Peer feedback on presentations. **Presentation Skills:** The four Ps of presentations: Plan, Prepare, Practice, Present. Creating effective presentation content. Use of visual aids. **Activities:** Students create and deliver presentations. Feedback and discussion on presentation techniques. **Writing Skills for Multinational Companies:** Writing effective emails and business documents. Elements of a clear and concise business email. Importance of tone and professionalism in writing. **Activities:** Practice writing emails and business memos. Peer review and feedback.	**08 Hours**
Module III	**Advanced Business Communication** Meeting and Negotiation Skills, Conducting effective business meetings. Strategies for successful negotiations, Building consensus and managing conflicts. **Activities:** Simulated business meetings and negotiation exercises. Group activities to practice conflict resolution. **Report Writing** Basics of report writing. Structure and format of reports. Importance of clarity and conciseness. **Activities:** Report writing exercises. Presentation and discussion of reports.	**04Hours**

Referred Books

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	Levels of learning *(based on bloom's taxonomy)*
CO1	Understand the process and types of communication, and the nuances of communication across cultures.	Level 1 (Remember)
CO2	Understand and apply the skills of language in day-to-day communication as well as in public speaking.	Level 2 (Understand)
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.	Level 3 (Apply)
CO4	Enhance their reading skills and be able to critically analyse texts of various kinds.	Level 4 (Analyze)
CO5	Compose different types of business correspondences effectively with a proper use of grammar.	Level 5 (Evaluate)
CO6	Identifying the common errors at the time of writing, process of writing any text.	Level 6 (Create)

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of mathematics, programming logic and coding fundamentals for solution architecture and problem solving
PO2	Identify, review, formulate and analyze problems for primarily focusing on customer requirements using critical thinking frameworks.
PO3	Design, develop and investigate problems with as an innovative approach for solutions incorporating ESG/SDG goals
PO4	Select, adapt and apply modern computational tools such as development of algorithms with an understanding of the limitations including human biases.
PO5	Function and communicate effectively as an individual or a team leader in diverse and multidisciplinary groups. Use methodologies such as agile.
PO6	Use the principles of project management such as scheduling, work breakdown structure and be conversant with the principles of Finance for profitable project management
PO7	Commit to professional ethics in managing software projects with financial aspects. Learn to use new technologies for cyber security and insulate customers from malware
PO8	Change management skills and the ability to learn, keep up with contemporary technologies and ways of working
PSO1	Understand the relevance of sustainable development and its significance, as well as the impact of expert engineering solutions in social and environmental contexts
PSO2	Apply fundamental knowledge of computer applications and exhibit practical competencies in a broad range of programming languages and software platforms that are required to become a successful computer professional.

CO – PO Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	3	2	2	2	1	1	1	2	1	2
CO2	3	3	2	2	3	2	2	3	2	2
CO3	3	3	3	2	2	2	2	1	1	2
CO4	3	3	2	2	3	1	1	2	1	2
CO5	3	3	3	2	3	2	2	1	1	2
CO6	3	3	3	2	2	2	2	2	1	2

Semester	Code	Computer System Architecture	Credits	L-T-P	Hours	Marks
1st	25MCA104		3	3-0-0	30Hrs.	100

Introduction

This subject covers the principles of how computers process information, from the basic building blocks like processors and memory to complex systems like multi-core processors and parallel computing. Understanding computer system architecture is crucial for optimizing performance, designing efficient systems, and solving complex computational problems. This course will provide you with a deep understanding of how computers work at a fundamental level, preparing you for advanced topics in computer science and engineering.

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	10	20	60	100

Detailed Syllabus

Modules	Topics	Hours
Module I	Basic structure of Computer: Functional Units & Operation concepts, Bus Structures, Performance, Multi processors 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 Oper and Multiplication, Integers Division, Floating– Point numbers representation, Floating–Point numbers operations.	**12 Hrs**
Module II	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 Hrs**
Module - III	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 Hrs**

Referred Books

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***	TMHPHI
Reference Book:	R1.B. Govindarajalu, ***Computer architecture and organization*** R2.N.Carter,***SchauM'sOutlineofCoMputerArchitecture***	TMHTMH
Online Resources	1.https://nptel.ac.in/courses/106/103/106103068/ 2.https://nptel.ac.in/courses/106/106/106106166/	

	Course Outcomes	Levels of learning *(based on bloom's taxonomy)*
CO1	Identifyanddescribethefunctionalityofvariousfunctionalunitsofdigitalcomputer.Comparedifferent addressing modes, instruction formats and their implementation in programming.	Level 1 (Remember)
CO2	Performvariousbinaryarithmeticoperationsusingdifferenttechniques.Representfloatingpoint Numbers and perform various operations on them.	Level 2 (Understand)
CO3	DescribetheworkingprincipleofMainMemory,CacheMemoryand VirtualMemoryorganizationandsolvenumericalproblemsbasedonmemorymanagement	Level 3 (Apply)
CO4	UnderstandthefunctionsofTranslationLookasideBuffer,Memory replacement techniques	Level 4 (Analyze)
CO5	Identifythecomponentsofsingle&multibusorganizationanddescribeexecutionofcompleteinstruction.Comparedifferentmodesofdatatransfertechniques.	Level 5 (Evaluate)
CO6	Describetheworkingprincipleofpipelineandidentifyvariouspipelinehazards.Explaintheprinciplebehindsuperscalaroperation.	Level 6 (Create)

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of mathematics, programming logic and coding fundamentals for solution architecture and problem solving
PO2	Identify, review, formulate and analyze problems for primarily focusing on customer requirements using critical thinking frameworks.
PO3	Design, develop and investigate problems with as an innovative approach for solutions incorporating ESG/SDG goals
PO4	Select, adapt and apply modern computational tools such as development of algorithms with an understanding of the limitations including human biases.
PO5	Function and communicate effectively as an individual or a team leader in diverse and multidisciplinary groups. Use methodologies such as agile.
PO6	Use the principles of project management such as scheduling, work breakdown structure and be conversant with the principles of Finance for profitable project management
PO7	Commit to professional ethics in managing software projects with financial aspects. Learn to use new technologies for cyber security and insulate customers from malware
PO8	Change management skills and the ability to learn, keep up with contemporary technologies and ways of working
PSO1	Understand the relevance of sustainable development and its significance, as well as the impact of expert engineering solutions in social and environmental contexts
PSO2	Apply fundamental knowledge of computer applications and exhibit practical competencies in a broad range of programming languages and software platforms that are required to become a successful computer professional.

CO – PO Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	3	3	2	2	x	x	x	x	x	3
CO2	3	3	2	2	x	x	x	x	x	3
CO3	3	2	2	3	x	x	x	x	3	x
CO4	3	2	2	3	x	x	x	x	3	x
CO5	3	3	2	3	x	x	x	x	x	3
CO6	3	2	2	3	x	x	x	x	3	x

Semester	Code	Database Management System	Credits	L-T-P	Hours	Marks
1st	25MCA105		3	3-0-0	30Hrs.	100

Introduction

Database Management System (DBMS) is a critical field in computer science focused on the design, implementation, and management of databases, which are systems that store, retrieve, and manage data efficiently. A DBMS provides the tools and methodologies to handle vast amounts of data, ensuring that it is organized, accessible, secure, and consistent. This subject covers key concepts such as data modeling, query languages, database design, and transaction management. Mastering DBMS is essential for developing robust applications, making informed decisions based on data, and managing information in today's data-driven world. This course will equip you with the skills needed to design and manage databases effectively in various environments.

Objectives	The objective of this course is to learn principles of systematically designing andusinglargescaledatabasemanagementsystemsforvariousreal-worldapplications
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 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	10	20	60	100

Detailed Syllabus

Modules	Topics	Hours
Module I	Introduction to Database Systems, 3-level schema architecture &**Data Independence**, Data base System Architecture and **Data Dictionary**. Data Models: Entity Relationship Model, Network and Object-Oriented data models, Extended Entity Relationship Model, Mapping of E-R model to Relational schema.	**12 Hrs**
Module II	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.	**08 Hrs**
Module - III	Query Language: Relational Algebra, Tuple & Domain Relational Calculus; Transaction Processing and Concurrency Control: Transaction concepts, **transaction state**, ACID properties of transaction, Serializability; Concurrency Control Schemes: Locking and Time stamp schemes, Dead lock Detection and recovery. Storage Strategies: File Organizations &Indexes, Ordered Indexes, B+ Tree Index Files, Hashing.	**10 Hrs**

Referred Books

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. Nava the, ***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*** R3.Desai,B, **An Introduction to Data base Concepts**	McGraw-HillKhanna Publishing Galgotia Publication
Online Resources	1. https://nptel.ac.in/courses/106106093/ 2. https://nptel.ac.in/courses/106105175/ 3. https://cs145-fa18.github.io/	

	Course Outcomes	**Levels of learning** ***(based on bloom's taxonomy)***
CO1	Understand the concept and application of Data base Management System. The learner also able to understand the Data base Architecture and different level of Architecture,	Level 1 (Remember)
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.	Level 2 (Understand)
CO3	Construct queries using Relational Algebra and Relational Calculus. Investigate storage architecture and access methods using Order Indices, B+ Tree & Hashing.	Level 3 (Apply)
CO4	Create effective data base designsusingdifferentnormalizationtechniquesanddeviseoptimalqueryexecutionstrategies.	Level 4 (Analyze)
CO5	Understand transaction processing concepts and solve theconcurrentaccessproblemsbyusingvariousoncurrencycontrolmechanisms.	Level 5 (Evaluate)
CO6	Explorevariousdatabaserecoverytechniquesandadvancedatabaseconceptslike DistributedDatabase.Comparebetweencentralizedanddistributeddatabases.	Level 6 (Create)

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of mathematics, programming logic and coding fundamentals for solution architecture and problem solving
PO2	Identify, review, formulate and analyze problems for primarily focusing on customer requirements using critical thinking frameworks.
PO3	Design, develop and investigate problems with as an innovative approach for solutions incorporating ESG/SDG goals
PO4	Select, adapt and apply modern computational tools such as development of algorithms with an understanding of the limitations including human biases.
PO5	Function and communicate effectively as an individual or a team leader in diverse and multidisciplinary groups. Use methodologies such as agile.
PO6	Use the principles of project management such as scheduling, work breakdown structure and be conversant with the principles of Finance for profitable project management
PO7	Commit to professional ethics in managing software projects with financial aspects. Learn to use new technologies for cyber security and insulate customers from malware
PO8	Change management skills and the ability to learn, keep up with contemporary technologies and ways of working
PSO1	Understand the relevance of sustainable development and its significance, as well as the impact of expert engineering solutions in social and environmental contexts
PSO2	Apply fundamental knowledge of computer applications and exhibit practical competencies in a broad range of programming languages and software platforms that are required to become a successful computer professional.

CO-PO Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	2	3	3	2	2	x	x	2	3	2
CO2	3	3	2	2	3	x	x	3	2	3
CO3	3	3	3	2	1	x	x	1	3	2
CO4	3	3	3	3	2	x	x	2	1	3
CO5	3	3	3	3	3	x	x	2	2	3
CO6	3	2	2	3	2	x	x	3	3	3

Semester	Code		Credits	L-T-P	Hours	Marks
1st	25MCA106 (P)	Problem solving & programming Lab	1	0-0-2	20Hrs.	100

Introduction

The "Programming using C - Lab" course provides hands-on experience in coding with the C programming language, focusing on developing fundamental programming skills. Through practical exercises and projects, you'll learn to write, debug, and optimize C programs, gaining a deep understanding of core concepts such as variables, data types, control structures, functions, pointers, and memory management. This lab course is designed to reinforce theoretical knowledge with practical application, preparing you to solve real-world problems and build a strong foundation in programming. By the end of the course, you'll be proficient in using C to develop efficient and effective software solutions.

Objectives	Formulate problems and implement algorithms using C programming language. The studentswillbeabletoenhancetheiranalyzingandproblemsolvingskillanduse 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

Lab Test	End term Practical Test	Total
40	60	100

Detailed Syllabus

Experiment	Assignment/Experiment
1	Compilation and execution of simple C programs. Programs using arithmetic c 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. Implementloop-controlstructuresusingwhileconstructanddo-whileconstruct.
4	Programs on loop-control structures using for loops and nested loops.
5	Develop Programs for 1-Dimensionalarray operationsand2-Dimensional array operations.
6	OperationsonArrayusingPointer.Programsonfunctionsusingcallbyvalueandcallbyreference.
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	Programsonuseofpointerstostructures.PassingArrayandstructuretouserdefinedfunctions. 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	ProgramsforopeningoffilesindifferentmodesandclosingoffilePrograms on read and write operations on text file. Programs on random access operations on text file.

Referred Books

Books	Name of The Books/References	Publishers
Text Book:	T1.E.Balagurusamy, programming in an sic T2.M.Sprankle, programming and Problem Solving	McGraw-Hill Education Pearson Education
Reference Book:	R1.B.W.KernighanandD.M.Ritchie,TheC Programming Language R2.H.M.DeitelandP.J.Deitel, CHowto Program R3.H.Schildt,C:The Complete reference	PHI Pearson Education Asia McGraw-Hill Education
Online Resources	1. http://www.princeton.edu/~achaney/tmve/wiki100k/docs/C%28programminglanguage%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	**Levels of learning** ***(based on bloom's taxonomy)***
CO1	ConstructCprogramsformathematicaloperationsusingcontrolstatements.	Level 1 (Remember)
CO2	Develop C programs for Array and String manipulation.	Level 2 (Understand)
CO3	Construct modular programs for better maintenance and reusability.	Level 3 (Apply)
CO4	Manipulateheterogeneousdatausingstructure&unionandapplydynamicmemorymanagement techniques to solve different problems.	Level 4 (Analyze)
CO5	Understandtheconceptof preprocessor directivesanditsimportance.	Level 5 (Evaluate)
CO6	CreateandmanipulatefilesusingCprogramsanddeveloptheprogramsusingcommandline arguments.	Level 6 (Create)

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of mathematics, programming logic and coding fundamentals for solution architecture and problem solving
PO2	Identify, review, formulate and analyze problems for primarily focusing on customer requirements using critical thinking frameworks.
PO3	Design, develop and investigate problems with as an innovative approach for solutions incorporating ESG/SDG goals
PO4	Select, adapt and apply modern computational tools such as development of algorithms with an understanding of the limitations including human biases.
PO5	Function and communicate effectively as an individual or a team leader in diverse and multidisciplinary groups. Use methodologies such as agile.
PO6	Use the principles of project management such as scheduling, work breakdown structure and be conversant with the principles of Finance for profitable project management
PO7	Commit to professional ethics in managing software projects with financial aspects. Learn to use new technologies for cyber security and insulate customers from malware
PO8	Change management skills and the ability to learn, keep up with contemporary technologies and ways of working
PSO1	Understand the relevance of sustainable development and its significance, as well as the impact of expert engineering solutions in social and environmental contexts
PSO2	Apply fundamental knowledge of computer applications and exhibit practical competencies in a broad range of programming languages and software platforms that are required to become a successful computer professional.

CO PO Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	3	2	x	x	2	x	2	x	x	3
CO2	3	2	x	x	2	x	2	x	x	2
CO3	3	3	x	x	2	x	3	x	x	3
CO4	3	3	x	x	3	x	2	x	x	2
CO5	3	3	x	x	3	x	2	x	x	2
CO6	3	2	x	x	2	x	2	x	x	3

Semester	Code	Communication skill and Language Lab	Credits	L-T-P	Hours	Marks
1st	25MCA107 (P)		1	0-0-2	20Hrs.	100

Introduction

The "Language and Communication Skills Lab" is designed to enhance your proficiency in English and develop essential communication skills for personal and professional success. This lab course focuses on practical exercises that improve listening, speaking, reading, and writing abilities. Through interactive sessions, you'll practice articulation, pronunciation, and presentation skills, while also refining your grammar and vocabulary. Additionally, the course emphasizes the development of effective interpersonal communication, group discussions, and public speaking. By the end of this lab, you will be more confident in your language abilities and better equipped to communicate effectively in various contexts.

Objectives	Formulate problems and implement algorithms using C programming language. The studentswillbeabletoenhancetheiranalyzingandproblemsolvingskillanduse 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

Internal assessment	End term Test	Total
40	60	150

Detailed Syllabus

Session	Assignments / Practical
1	Chart work or Poster presentation on the Process of Communication.
2	JAM: Just-A-Minute sessions to develop fluency in speaking using various topics of discussion
3	Non-verbal Communication: Conducting role plays to understand the practical applications of non-verbal cues and body language.
4	Cross-cultural Communication: dealing with the nuances of this communication type through case studies, videos, and discussions.
5	Listening Comprehension: Listening for specific information, ear training, and pronunciation practices.
6	Improve speaking fluency: Practice speaking on impromptu topics for 2-3 minutes. Reading aloud exercises with a focus on intonation and stress. Pair activities where students engage in brief, spontaneous dialogues
7	Enhance pronunciation and reduce accent: Introduction to phonetic symbols and sounds. Pronunciation drills focusing on vowels, consonants, and diphthongs. Individual practice and feedback using recording and playback.

8	Oral Presentations: PowerPoint presentations on technical and non-technical topics. Students prepare and deliver oral presentations. Combine listening and speaking skills. Listening to audio clips and discussing them in pairs or small groups. Role-playing exercises based on audio content. Practice responding to questions and making comments.
9	Business Meeting Simulations: Conducting and participating in business meetings. Simulated business meeting exercises.
10	Oral presentation: PowerPoint presentations on selected technical or non-technical topics of relevance.
11	Reading Comprehension: reading of various business & non-technical passages of relevance.
12	Professional Email Writing: Writing clear and concise business emails. Practice writing professional emails.
13	Report Writing: Basics of professional report writing. Practice writing business reports.
14	Feedback and Improvement: Techniques for giving and receiving constructive feedback. Peer review sessions and feedback exercises.
15	Cross-Cultural Communication Skills: Effective communication in a multicultural environment. Role-playing exercises and case studies.
16	Non-Verbal Communication Skills: Importance of non-verbal cues in communication. Exercises to interpret and use non-verbal communication effectively.
17	Individual Speaking Practice (2 hours): Focus on individual speaking skills. Each student prepares and delivers a short speech or presentation. Feedback from peers and instructor on delivery and content. Recording and self-assessment for personal improvement
18	Comprehensive Review**:** Review of all topics covered; practice and feedback session
19	Final Presentations and Assessments: Synthesis of all learned skills into final presentations. Students prepare and deliver final presentations. Assessment and feedback on overall performance.

Referred Books

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
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,***CommunicationSkillsforEngineers***	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	

At the end of the Course the students will able to learn: -

	Course Outcomes	**Levels of learning** ***(based on bloom's taxonomy)***
CO1	Developlisteningcomprehensionandovercometheirinhibition stospeakinpublic.	Level 1 (Remember)
CO2	Communicate properly as an engineer in cross-cultural contexts.	Level 2 (Understand)
CO3	Develop their English pronunciation skills through practice.	Level 3 (Apply)
CO4	Workeffectivelyasateammemberorasaleaderoftheteam.	Level 4 (Analyze)
CO5	DevelopreadingComprehensionofvariousbusinessrelevanc e.	Level 5 (Evaluate)
CO6	Developwritingskillsforeffectivecommunicationincorporatee nvironment.	Level 6 (Create)

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of mathematics, programming logic and coding fundamentals for solution architecture and problem solving
PO2	Identify, review, formulate and analyze problems for primarily focusing on customer requirements using critical thinking frameworks.
PO3	Design, develop and investigate problems with as an innovative approach for solutions incorporating ESG/SDG goals
PO4	Select, adapt and apply modern computational tools such as development of algorithms with an understanding of the limitations including human biases.
PO5	Function and communicate effectively as an individual or a team leader in diverse and multidisciplinary groups. Use methodologies such as agile.
PO6	Use the principles of project management such as scheduling, work breakdown structure and be conversant with the principles of Finance for profitable project management
PO7	Commit to professional ethics in managing software projects with financial aspects. Learn to use new technologies for cyber security and insulate customers from malware
PO8	Change management skills and the ability to learn, keep up with contemporary technologies and ways of working
PSO1	Understand the relevance of sustainable development and its significance, as well as the impact of expert engineering solutions in social and environmental contexts
PSO2	Apply fundamental knowledge of computer applications and exhibit practical competencies in a broad range of programming languages and software platforms that are required to become a successful computer professional.

CO PO Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	1	2	1	1	3	1	1	1	1	1
CO2	1	2	1	1	3	2	2	1	2	2
CO3	1	2	1	1	2	1	1	1	1	2
CO4	1	2	1	1	3	2	2	2	2	2
CO5	1	2	1	1	2	3	2	1	2	2
CO6	1	2	1	1	2	3	2	2	2	2

Semester	Code	DBMS Lab	Credits	L-T-P	Hours	Marks
1st	25MCA108 (P)		1	0-0-2	20Hrs.	100

Introduction

The "DMS Using Oracle Lab" course provides practical experience in managing and manipulating data using Oracle Database Management System (DBMS). This lab focuses on the implementation of database concepts such as SQL queries, data modeling, and transaction management using Oracle's powerful DBMS platform. Through hands-on exercises, you'll learn to create, query, and maintain databases, as well as develop skills in database design, normalization, and optimization. This course will equip you with the technical expertise to efficiently manage and utilize Oracle databases, preparing you for real-world applications in data management and analysis.

Objectives	The objectiveofthis labcourseistoprovideahands-onpractice ondatabase design, creation, data storage, and data manipulation including advanced databaseprogrammingconceptstogroomthestudentsintowell-informed database programmers anddata-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 assignment	Lab Assignment	Total
40	60	100

Detailed Syllabus

Experiment	Assignment/Experiment
1.	Introduction to Oracle data bases, 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 database 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

Referred Books

Books	Name of The Books/References	Publishers
Text Book:	T1.K.Loney,***OracleDatabase11g-The Complete Reference (Oracle Press)*** T2. I. Bayross, ***Teach Yourself SQL/PLSQL Using Oracle 8i and 9i with SQLJ***	McGraw-Hill Education BPB Publications
Reference Book:	R1.S.Feuerstein,***OraclePL/SQL Programming*** R2.A.Silberschatz,H.F.Korth,andS.Sudarshan,***DatabaseSystem Concepts***	O'Reilly McGraw-Hill Education
Online Resources	https://docs.oracle.com/cd/E1188201/server.112/e40402.pdf https://docs.oracle.com/cd/B2835901/server.111/b28286/toc.htm. https://www.tutorialspoint.com/oraclesql/index.asp https://www.javatpoint.com/oracle-tutorial	

At the end of the Course the students will able to learn:-

	Course Outcomes	Levels of learning *(based on bloom's taxonomy)*
CO1	ConstructqueriesusingSQLandretrievedatafromadatabaseusingsingle/multi-rowfunctionsandsub-queries.	Level 1 (Remember)
CO2	Designrelationaltablesimposingintegrityconstraints,operateontableusingDDL/DMLstatementsandshare data usingjoin.	Level 2 (Understand)
CO3	UnderstandthemultipletablejoininginaDatabaseSystem.	Level 3 (Apply)
CO4	Createotherdatabaseobjectslikeviews, sequencesandindices.	Level 4 (Analyze)
CO5	WritePL/SQLprogramsincludingcontrolstructuresandloopsforreal – worldapplications.	Level 5 (Evaluate)
CO6	ImplementthetechniquesusingexceptionhandlingProceduresandFunctions, ParametersinPL/SQL.	Level 6 (Create)

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of mathematics, programming logic and coding fundamentals for solution architecture and problem solving
PO2	Identify, review, formulate and analyze problems for primarily focusing on customer requirements using critical thinking frameworks.
PO3	Design, develop and investigate problems with as an innovative approach for solutions incorporating ESG/SDG goals
PO4	Select, adapt and apply modern computational tools such as development of algorithms with an understanding of the limitations including human biases.

PO5	Function and communicate effectively as an individual or a team leader in diverse and multidisciplinary groups. Use methodologies such as agile.
PO6	Use the principles of project management such as scheduling, work breakdown structure and be conversant with the principles of Finance for profitable project management
PO7	Commit to professional ethics in managing software projects with financial aspects. Learn to use new technologies for cyber security and insulate customers from malware
PO8	Change management skills and the ability to learn, keep up with contemporary technologies and ways of working
PSO1	Understand the relevance of sustainable development and its significance, as well as the impact of expert engineering solutions in social and environmental contexts
PSO2	Apply fundamental knowledge of computer applications and exhibit practical competencies in a broad range of programming languages and software platforms that are required to become a successful computer professional.

CO – PO Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	3	2	2	2	2	1	1	1	1	3
CO2	3	2	2	2	2	2	2	2	2	3
CO3	3	2	2	2	2	1	1	1	1	3
CO4	3	2	2	2	2	1	1	1	1	3
CO5	3	2	2	2	2	1	1	1	1	3
CO6	3	2	2	2	2	1	1	1	1	3

Semester	Code	Emerging Technology Lab – I (Python Programming)	Credits	L-T-P	Hours	Marks
1st	25MCA109 (P)		2	0-0-4	40Hrs.	100

Introduction

The "DMS Using Oracle Lab" course provides practical experience in managing and manipulating data using Oracle Database Management System (DBMS). This lab focuses on the implementation of database concepts such as SQL queries, data modeling, and transaction management using Oracle's powerful DBMS platform. Through hands-on exercises, you'll learn to create, query, and maintain databases, as well as develop skills in database design, normalization, and optimization. This course will equip you with the technical expertise to efficiently manage and utilize Oracle databases, preparing you for real-world applications in data management and analysis.

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 assignment	Lab Assignment	Total
40	60	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Compilation and execution of simple python programs.
2	Programs using data types and operators.
3	Formulate problems using string 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.

Referred Books

Books	Name of The Books/References	Publishers
Text Book:	T1.P.Barry,***HeadFirstPython*** 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,***FluentPython***,1st Edition,O'ReillyMedia,2015. R3.A.Downey,***PrograMMingPython***,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/	

At the end of the Course the students will able to learn:-

	Course Outcomes	Levels of learning *(based on bloom's taxonomy)*
CO1	Developsimplereallifeapplicationinpythonusingoperatorsandcontrol statements.	Level 1 (Remember)
CO2	Use python data structure and function to develop application.	Level 2 (Understand)
CO3	Develop simple real-life application in Python using decision making statement.	Level 3 (Apply)
CO4	Interpret object orient concept and use it for software development.	Level 4 (Analyze)
CO5	Conveniently use file handling and database connectivity concept.	Level 5 (Evaluate)
CO6	Become familiar with CGI and develop real-life web application.	Level 6 (Create)

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of mathematics, programming logic and coding fundamentals for solution architecture and problem solving
PO2	Identify, review, formulate and analyze problems for primarily focusing on customer requirements using critical thinking frameworks.
PO3	Design, develop and investigate problems with as an innovative approach for solutions incorporating ESG/SDG goals
PO4	Select, adapt and apply modern computational tools such as development of algorithms with an understanding of the limitations including human biases.
PO5	Function and communicate effectively as an individual or a team leader in diverse and multidisciplinary groups. Use methodologies such as agile.
PO6	Use the principles of project management such as scheduling, work breakdown structure and be conversant with the principles of Finance for profitable project management
PO7	Commit to professional ethics in managing software projects with financial aspects. Learn to use new technologies for cyber security and insulate customers from malware
PO8	Change management skills and the ability to learn, keep up with contemporary technologies and ways of working
PSO1	Understand the relevance of sustainable development and its significance, as well as the impact of expert engineering solutions in social and environmental contexts
PSO2	Apply fundamental knowledge of computer applications and exhibit practical competencies in a broad range of programming languages and software platforms that are required to become a successful computer professional.

CO – PO Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	3	2	3	2	2	x	2	x	3	3
CO2	2	3	2	3	2	x	3	x	3	3
CO3	3	3	3	3	2	x	3	x	2	3
CO4	3	2	2	1	1	x	2	x	3	2
CO5	2	3	2	2	2	x	3	x	2	3
CO6	3	3	3	3	2	x	2	x	3	3

Syllabus for MCA 2 yrs. Programme

Semester-2: Spring Semester (January to July)

Semester-2: Spring Semester (January to May)

Sr. No	Course Code	Course Title	L-T-P	Credit
1	25MCA201	Discrete Mathematics	3-0-0	3
2	25MCA202	Data Structure	3-0-0	3
3	25MCA203	Object Oriented Programming Systems	3-0-0	3
4	25MCA204	Operating System	3-0-0	3
5	25MCA205	Universal Human Values	2-0-0	2
6	25MCA206	Indian Knowledge System	1-0-0	1
7	25MCA207	Computer Network	3-0-0	3
PRACTICAL				
1	25MCA207(P)	Data Structure Lab	0-0-2	1
2	25MCA208(P)	Object Oriented Programming Lab	0-0-2	1
3	25MCA209(P)	Operating System Lab	0-0-2	1
4	25MCA210(P)	Advance Python Programming	0-0-2	1
5	25MCA211(P)	Emerging Technology Lab-II (Internet & Web Technology)	0-0-4	2
6	25MCA212(P)	Personality Development Lab	0-0-2	1
7	25MCA213(P)	Tech Industry Interface Programme	0-0-4	2
TOTAL				**27**

Semester	Code	Discrete Mathematics	Credits	L-T-P	Hours	Marks
2nd	25MCA201		3	3-0-0	30Hrs	100

Introduction

The course "Mathematical Foundation for Computer Applications-II" provides essential mathematical tools and concepts foundational to computer science. It covers topics like set theory, logic, combinatory and graph theory, which are crucial for understanding algorithms, data structures, and programming languages. By bridging theoretical mathematics with practical applications, this course equips students with the analytical skills needed to solve complex problems in computer science effectively.

Objectives	Theobjectiveofthiscourseistolearnthebasicconceptsofprobabilityand statisticsincludingvariousmethodsofestimations&statisticaltesting useful for analysis of data.
Pre-Requisites	Basic knowledge of Sets, Combinatorics and calculus is required.
Teaching Scheme	Regular class room 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	10	20	60	100

Detailed Syllabus

Modules	Topics	Hours
Module-I	Probability: Introduction, Sample space and events, Addition rule & Multiplication rule, Conditional probability, Bayes' rule, Random variable, Discrete and Continuous probability distribution, Joint probability distribution, Mathematical expectation and properties, Variance and co-variance of random variables, Mean and co-variance of linear combination of random variables. Discrete Probability Distribution: Discrete Uniform, Binomial and Poisson distribution. Continuous Probability Distribution: Normal and Exponential Distribution.	**12Hours**
Module-II	Sampling: Population vs. Sample, Sampling, Sampling Distributions. Estimation of parameter: methods of estimation, Standard error, Estimating the mean of a single sample, Prediction interval, Estimating the difference between means of two samples, Estimating proportion and variance of a single sample, Estimating the difference between two proportions and variances of two samples, maximum likelihood estimation. Test of hypothesis: one and two tailed test, test concerning single mean and two means ,test of single and two proportions ,One and two sample test for variance. $\chi 2$ test for goodness of fit and test for independence and ANOVA.	**12Hours**

Module-III	Regression and Correlation: Correlation Coefficient, Simple regression models, Method of least square, Properties of least square estimators, Inferences concerning the regression coefficients.	**6Hours**

Referred Books

Books	Name of The Books/References	Publishers
Text Book:	Ronald E. **Walpole**, Raymond H. Myers, Sharon L. Myers & Keying Ye, "*Probability & Statistics for Engineers & Scientists*"	Pearson Education Inc., New Delhi.
Reference Book:	R1. William Mendenhall, Robert J. Beaver, Barbara M. Beaver, *"Probability abd Statistics"* R2. *R.A.Johnson,I.Miller,andJ.E. Freund,ProbabilityandStatisticsforEngineers*	CENGAGE Learning India Private Ltd., New Delhi Pearson Education India,
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/	

At the end of the Course the students will able to learn:-

	Course Outcomes	**Levels of learning** ***(based on bloom's taxonomy)***
CO1	Solve problems on probability of discrete nature.	Level 1 (Remember)
CO2	Solve problems on probability of continuous nature.	Level 2 (Understand)
CO3	Understand the sampling distribution and data description.	Level 3 (Apply)
CO4	Infer on mean and variance of a dataset.	Level 4 (Analyze)
CO5	Categorize the distribution type of a dataset.	Level 5 (Evaluate)
CO6	Fit a curve using regression model.	Level 6 (Create)

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	Understand and assess the impact of system solutions in a contemporary, global, economic, environmental, and societal context for sustainable development.

CO – PO Matrix

	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 Structure	L-T-P	Credit	Hour	Mark
2nd	25MCA202		3-0-0	3	30	100

Introduction:

Understanding these basic data structures and their operations will give you a solid foundation for solving many programming problems efficiently. Each structure has its own strengths and is suited to different types of tasks, so selecting the right one is crucial for performance.

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 class room 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	Midterm	End term	
10	10	20	60	100

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 re presentation, 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	16 Hours
Module-2	Tree-terminology,representation,binarytree-treetraversalalgorithms.BinarySearchTree(BST),Heightbalancedtree(AVLtree),Graph-terminology,representation,pathmatrix,graphtraversal(BFS,DFS),allpairshortestpath,andtopologicalsort.	12Hours
Module-3	Searching and sorting techniques: linear and binary search, bubble sort, insertionsort,selectionsort.Hashing-hashfunctionsandhashingtechniques.Collisionresolutiontechniques- linear probing, quadratic probing, chaining.	12 Hours
Total		30 Hours

BOOKS

Books	Name of The Books/References	Publishers
Text Book:	T1.A.Tenenbaum,***DataStructuresUsingC*** T2.E.Horowitz, S.Sahni, and S.Anderson-Freed, ***Fundamentals of Data Structures in C***	Pearson Education University Press
Reference Book: Online Resources:	R1.M.Weiss,***DataStructuresand Algorithm Analysis in C*** R2.J. P. Tremblay and P. G. Sorenson, ***An Introduction to Data Structures with Applications*** 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/datastructuresalgorithms/index.htm 4. https://www.coursera.org/learn/data-structures	Pearson Education Tata McGraw-Hill

CO1	Implement basic data structures such as arrays, strings and linked lists
CO2	Study linear data structures such as stacks and queues and understand their difference.
CO3	Describe the hash function and concepts of collision and its resolution methods.
CO4	Understand the concept of memory management.
CO5	Study tree, heap and graphs along with their basic operations.
CO6	Study different techniques for solving problems like sorting and searching

Program Outcome

PO1	Apply knowledge of mathematics, programming logic and coding fundamentals for solution architecture and problem solving.
PO2	Identify, review, formulate and analyze problems for primarily focusing on customer requirements using critical thinking frameworks.
PO3	Design, develop and investigate problems with as an innovative approach for solutions incorporating ESG/SDG goals.
PO4	Select, adapt and apply modern computational tools such as development of algorithms with an understanding of the limitations including human biases.
PO5	Function and communicate effectively as an individual or a team leader in diverse and multidisciplinary groups. Use methodologies such as agile.
PO6	Use the principles of project management such as scheduling, work breakdown structure and be conversant with the principles of Finance for profitable project management.

PO7	Commit to professional ethics in managing software projects with financial aspects. Learn to use new technologies for cyber security and insulate customers from malware
PO8	Change management skills and the ability to learn, keep up with contemporary technologies and ways of working.
PSO1	Understand the relevance of sustainable development and its significance, as well as the impact of expert engineering solutions in social and environmental contexts.
PSO2	Apply fundamental knowledge of computer applications and exhibit practical competencies in a broad range of programming languages and software platforms that are required to become a successful computer professional.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	3	3	3	3	2	2	1	1	1	3
CO2	3	3	3	3	1	1	1	1	1	3
CO3	3	3	3	2	1	1	1	1	1	2
CO4	3	3	3	2	1	1	1	2	1	3
CO5	3	3	3	3	1	1	1	1	1	2
CO6	3	3	3	3	1	1	1	2	1	3

Semester	Code	Object Oriented Programming	L-T-P	Credits	Hours	Marks
2nd	25MCA203		3-0-0	3	30	100

Introduction:

Object-Oriented Programming (OOP) is a programming paradigm centered around the concept of "objects," which can contain both data and methods. It is designed to improve code reusability, scalability, and maintainability. OOP organizes software design around objects and their interactions, rather than functions and logic.

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 class room 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	Midterm	End term	
10	10	20	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Objectorientedconcepts:Objectorientedsystemsdevelopmentlifecycle,UnifiedModelingLanguage,UMLclassdiagram,Use-casediagram;JavaOverview:JavaVirtual Machine, Java buzz words, Data types, Operators, Control statements,Classfundamentals,Objects,Methods,Constructors,Overloading,Access-modifiers.	**10Hours**
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.	**10Hours**
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, StringBuilder, StringBuffer, StringTokenizer.	**10Hours**
Total		**30Hours**

Books	Name of The Books/ References	Publishers
Text Book:	T1.H.Schildt,***Java:TheCoMpleteReference***T2.Y.D.Liang,***IntroductiontoJavaPrograMMing***	McGraw-HillPearsonEducation
Reference Book:	R1.B.Bates,K.Sierra,***HeadFirstJava*** R2.T.Budd,***AnIntroductiontoObject-OrientedPrograMMing***R3.I.Horton,***BeginningJava***	O'ReillyMedia 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/	

CO1	Understand the Object Oriented system concept and its development lifecycle 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 mathematics, programming logic and coding fundamentals for solution architecture and problem solving.
PO2	Identify, review, formulate and analyze problems for primarily focusing on customer requirements using critical thinking frameworks.
PO3	Design, develop and investigate problems with as an innovative approach for solutions incorporating ESG/SDG goals.
PO4	Select, adapt and apply modern computational tools such as development of algorithms with an understanding of the limitations including human biases.
PO5	Function and communicate effectively as an individual or a team leader in diverse and multidisciplinary groups. Use methodologies such as agile.
PO6	Use the principles of project management such as scheduling, work breakdown structure and be conversant with the principles of Finance for profitable project management.

PO7	Commit to professional ethics in managing software projects with financial aspects. Learn to use new technologies for cyber security and insulate customers from malware
PO8	Change management skills and the ability to learn, keep up with contemporary technologies and ways of working.
PSO1	Understand the relevance of sustainable development and its significance, as well as the impact of expert engineering solutions in social and environmental contexts.
PSO2	Apply fundamental knowledge of computer applications and exhibit practical competencies in a broad range of programming languages and software platforms that are required to become a successful computer professional.

CO-PO Matrix:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	3	2	2	2	2	1	1	1	2	3
CO2	3	3	2	2	2	2	2	1	2	3
CO3	2	3	2	2	2	1	2	1	1	2
CO4	2	2	2	3	3	3	2	1	2	3
CO5	1	2	1	1	2	2	1	1	3	2
CO6	2	1	1	1	2	2	1	1	3	3

Semester	Code		L-T-P	Credits	Hours	Marks
2nd	25MCA204	Operating Systems	3-0-0	3	30	100

Introduction:

An Operating System is the interface between the computer hardware and the end-user. Processing of data, running applications, file management and handling the memory is all managed by the computer OS. Windows, Mac, Android etc. Are examples of Operating systems which are generally used nowadays.

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 or C++ 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.

Teacher Assessment		Written Assessment		Total
Quiz	Assignment	Mid term	End term	
10	10	20	60	100

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.	12Hours
Module-2	**Inter-ProcessSynchronization**:Bounded-bufferproblem,shared-memorysolutiontoproducer-consumerproblem;Criticalsectionproblem:Peterson'ssolution,synchronizationhardware,Semaphores;Classicalproblems ofsynchronization:Bounded-Bufferproblem,Readers-WritersProblem,Dining-PhilosophersProblem,SleepingBarberproblem,monitors,Deadlock:characterization, prevention, avoidance, Banker's algorithm, deadlock detection and recovery.	08Hours

Module-3	**Memory Management**: Logical and physical address space, dynamic loadingandlinking,swapping,contiguousmemoryallocation,dynamicstorageallocation problem, paging and segmentation; Virtual Memory Management:Demandpaging,pagefault,PageReplacementAlgorithms:FIFO, OPT,LRU, LFU,MFU, Thrashing. **SecondaryStorageStructure**:Diskstructure;DiskScheduling:FCFS,SSTF, SCAN, C-SCAN, LOOK, C-LOOK,RAID structure; File System: access methods, directory structure, access control list.	**10Hours**
Total		**30Hours**

Books	**Name of The Books/References**	**Publishers**
Text Book:	T1.A.Silberschatz,P.B Galvin, and G Gagne , ***Operating Systems Principles*** T2.M.Milenkovic,***OperatingSystems:Concepts&Design***	Wiley India McGraw-Hill Education
Reference Book:	R1.A.S.Tanenbaum,***ModernOperatingSystems*** R2.P.B.Prasad,***OperatingSystemsandSystem 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 mechanism

Program Outcomes Relevant to the Course:

PO/PSO	**Description**
PO1:	Apply knowledge of mathematics, programming logic, and coding fundamentals for solution architecture and problem solving.
PO2:	Identify, review, formulate, and analyze problems, primarily focusing on customer requirements using critical thinking frameworks.

PO3:	Design, develop, and investigate problems with an innovative approach for solutions incorporating ESG/SDG goals.
PO4:	Select, adapt, and apply modern computational tools, such as the development of algorithms, with an understanding of the limitations including human biases.
PO5:	Function and communicate effectively as an individual or a team leader in diverse and multidisciplinary groups. Use methodologies such as agile.
PO6:	Use the principles of project management, such as scheduling, work breakdown structure, and be conversant with the principles of finance for profitable project management.
PO7:	Commit to professional ethics in managing software projects with financial aspects. Learn to use new technologies for cyber security and insulate customers from malware.
PO8:	Develop change management skills and the ability to learn, keep up with contemporary technologies, and ways of working.
PSO1:	Understand the relevance of sustainable development and its significance, as well as the impact of expert engineering solutions in social and environmental contexts.
PSO2:	Apply fundamental knowledge of computer applications and exhibit practical competencies in a broad range of programming languages and software platforms that are required to become a successful computer professional.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	3	2	3	2	x	x	x	2	3	3
CO2	3	3	3	3	x	x	x	2	2	2
CO3	3	2	3	2	x	x	x	3	3	2
CO4	3	2	2	3	x	x	x	3	3	3
CO5	3	3	3	3	x	x	x	2	2	2
CO6	3	2	3	2	x	x	x	2	2	2

Semester	Code	Universal Human Values	Credits	L-T-P	Hours	Marks
2nd	25MCA205		2	2-0-0	20Hrs	100

Introduction

Universal Human Values (UHV) encompass core principles like love, compassion, truth, integrity, respect, dignity, peace, non-violence, responsibility, accountability, justice, and fairness. These values are fundamental to human well-being and transcend cultural, religious, and national boundaries, promoting harmony, cooperation, and ethical behavior in society. Emphasizing these values fosters a more just, peaceful, and compassionate world, where individuals and communities can thrive in mutual respect and understanding.

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	10	20	100	100

Detailed Syllabus

Modules	Topics	Hours
Module-I	**Introduction-Basic Human Aspiration, its fulfillment through All- encompassing Resolution:** The basic human aspirations and their fulfillment hroughRightunderstandingandResolution,RightunderstandingandResolution as the activities of the Self, Self being central to Human Existence; All-encompassingResolutionforaHumanBeing,itsdetailsandsolutionofproblems 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 asco-existenceoftheselfandthebody;theactivitiesandpotentialitiesoftheself;Basisforharmony/contradictioninthe self.	**10Hours**
Module-II	**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)	**12Hours**

	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 HarmonyinNatureandContemplationofParticipationofHumaninthisharmony/orderleadingtocomprehensiveknowledgeaboutthe existence).	
Module-III	**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	**08Hours**

Referred Books

Books	Name of The Books / References	Publishers
Text Book:	RRGaur, R Asthana, GPBagaria,2019(2ndRevised Edition), A Foundation Course in Human 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:ANTripathy,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=21DGlyCykCI&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	

At the end of the Course the students will able to learn:-

	Course Outcomes	**Levels of learning** ***(based on bloom's taxonomy)***
CO1	Evaluate the significance of value inputs informal education and start applying them in their life and profession	Level 1 (Remember)
CO2	Distinguish between values and skills, happiness and accumulation of physical facilities the Self and the Body, Intention and Competence of an individual, etc.	Level 2 (Understand)
CO3	Analyze the value of harmonious relationship based on trust and respect in their life and profession	Level 3 (Apply)
CO4	Examine the role of a human being in ensuring harmony in society and nature.	Level 4 (Analyze)

CO5	Understand and associate the holistic perception of harmony at all levels of existence.	Level 5 (Evaluate)
CO6	Apply the understanding of ethical conduct to formulate the strategy for ethical life and profession.	Level 6 (Create)

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of mathematics, programming logic and coding fundamentals for solution architecture and problem solving
PO2	Identify, review, formulate and analyze problems for primarily focusing on customer requirements using critical thinking frameworks.
PO3	Design, develop and investigate problems with as an innovative approach for solutions incorporating ESG/SDG goals
PO4	Select, adapt and apply modern computational tools such as development of algorithms with an understanding of the limitations including human biases.
PO5	Function and communicate effectively as an individual or a team leader in diverse and multidisciplinary groups. Use methodologies such as agile.
PO6	Use the principles of project management such as scheduling, work breakdown structure and be conversant with the principles of Finance for profitable project management
PO7	Commit to professional ethics in managing software projects with financial aspects. Learn to use new technologies for cyber security and insulate customers from malware
PO8	Change management skills and the ability to learn, keep up with contemporary technologies and ways of working
PSO1	Understand the relevance of sustainable development and its significance, as well as the impact of expert engineering solutions in social and environmental contexts
PSO2	Apply fundamental knowledge of computer applications and exhibit practical competencies in a broad range of programming languages and software platforms that are required to become a successful computer professional.

CO – PO Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	3	1	x	x	2	x	2	1	1	1
CO2	3	2	x	x	3	x	2	2	1	2
CO3	3	3	3	3	3	x	3	3	2	3
CO4	3	3	3	2	2	x	1	2	2	3
CO5	3	3	3	3	2	x	2	3	1	2
CO6	3	3	3	2	2	x	2	2	1	3

Semester	Code	Indian Knowledge Systems	Credits	L-T-P	Hours	Marks
2nd	25MCA206		1	1-0-0	10Hrs	100

Introduction

This course is an effort to bring snippets of the Indian Knowledge System (IKS) by providing a fresh relook at the corpus and culling out relevant portions that may generate renewed interest in the subject and motivate several to engage in a deeper study of the knowledge repository of India.

Objectives	To understand the evolution of management thought in ancient India and its relevance in modern times. To examine the ethical and moral values, leadership qualities, and strategic management lessons derived from the Ramayana, the Mahabharata and the Bhagavad Gita. To explore the management and economic principles elucidated in Kautilya'sArtha Sastra and the Jain texts.
Pre-Requisites	Basic information about Indian knowledge system and its application in student's life.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are Planned to be interactive with more focus on real life examples.

Evaluation Scheme

Teacher Assessment		Written Assessment		Total
Quiz	Assignment	Mid term	End term	
10	10	20	60	150

Detailed Syllabus

Modules	Topics	Hours
Module-I	**Foundations of Indian Knowledge** **Introduction to Indian Knowledge Systems:** Overview of ancient Indian knowledge systems and their contributions to the evolution of management thought. The six **Vedangas — Siksha, Vyakarana, Chandas, Nirukta, Jyotisha,** and **Kalpa.** Other streams of Indian Knowledge System such as **Ayurveda, Sthapatya, Natyasastra, Dharmasastra, Arthasastra,** etc. **Para Vidya** and **Apara Vidya.** Concept of **Rita** and **Dharma.** Preservation of culture, tradition, and Dharma through education. **Svadhyaya** and **Pravachana.**	**05Hours**
Module-II	**Art and Science of Indian Knowledge system** Cultural Evolution: Historical perspective — Aryans & Vedas, advent of Jainism and Buddhism. **Indian Fine Arts:** *Natyasastra* on the nature and purpose of fine arts. Indian textiles, agriculture technologies, architecture, medicine, etc. **Self-Study:** Principles and practice of governance of a state and of a corporation.	**03Hours**

Module-III	**IKS and Management Ethical** and Strategic Management in the **Ramayana** Leadership and Conflict Resolution in the **Mahabharata and Bhagavad Gita Salient features of the Indian numeral system -** Importance of decimal representation - The discovery of zero and its importance - Unique approaches to represent numbers. **Kautilya's Artha Shastra:** Examination of Kautilya's economic thought and its relevance to modern management and corporate governance	**02Hours**

Referred Books

Books	Name of the Books	Publisher
Text books	Management Practices and Thoughts in Ancient India, Khandelwal and Mohanty, Himalaya Publishing House	Himalaya Publishing House
	Relevance of Ramayana in Contemporary Times, Gupta, Agrawal and Sharma, IBA publications	IBA publications
	"The Mahabharata: A Modern Rendering" by Ramesh Menon Vol-1 & Vol-2, iuniverse-2006. "The Bhagavad Gita" (translated by Eknath Easwaran), Nilagir Press, 2007	Nilagir Press, 2007
	Mahadevan, B. Bhat VinayakRajat, NagendraPavana R.N. (2022), "Introduction to Indian Knowledge System; Concepts and Applications", PHI Learning Private Ltd. Delhi.	PHI Learning Private Ltd.
Reference books	INDIAN ART AND CULTURE, Nitin Singhania, 5E 5th Edition, TMH Publication	TMH Publication

At the end of the Course the Students will able to understand

COs	Course Outcomes	Levels of Learning based on Bloom's Taxonomy
CO1	Recall the fundamental definitions and classifications of the Indian Knowledge System (IKS), including its unique aspects and historical significance.	Level 1 (Remember)
CO2	Explain the distinctive features of the Vedic corpus, Indian philosophical systems, and the historical development of Indian astronomy.	Level 2 (Understand)
CO3	Illustrate the practical applications of ancient Indian frameworks for establishing valid knowledge in contemporary society.	Level 3 (Apply)
CO4	Compare and contrast different Indian numeral systems, focusing on the importance of decimal representation and the discovery of zero.	Level 4 (Analyze)
CO5	Assess the governance and public administration concepts from ancient Indian texts like Arthasastra and their relevance to modern administrative practices.	Level 5 (Evaluate)
CO6	Develop a comprehensive overview of the historical and philosophical aspects of IKS.	Level 6 (Create)

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of mathematics, programming logic and coding fundamentals for solution architecture and problem solving
PO2	Identify, review, formulate and analyze problems for primarily focusing on customer requirements using critical thinking frameworks.
PO3	Design, develop and investigate problems with as an innovative approach for solutions incorporating ESG/SDG goals
PO4	Select, adapt and apply modern computational tools such as development of algorithms with an understanding of the limitations including human biases.
PO5	Function and communicate effectively as an individual or a team leader in diverse and multidisciplinary groups. Use methodologies such as agile.
PO6	Use the principles of project management such as scheduling, work breakdown structure and be conversant with the principles of Finance for profitable project management
PO7	Commit to professional ethics in managing software projects with financial aspects. Learn to use new technologies for cyber security and insulate customers from malware
PO8	Change management skills and the ability to learn, keep up with contemporary technologies and ways of working
PSO1	Understand the relevance of sustainable development and its significance, as well as the impact of expert engineering solutions in social and environmental contexts
PSO2	Apply fundamental knowledge of computer applications and exhibit practical competencies in a broad range of programming languages and software platforms that are required to become a successful computer professional.

CO-PO Matrix

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

Semester	Code	Computer Networks	L-T-P	Credits	Hours	Marks
2nd	25MCA207		3-0-0	3	30	150

Objectives	The **objective of this course** is 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** and **WLAN measurement**.
Pre-Requisites	Basic knowledge of **Computer Organization**, **Operating Systems**, and **programming using C language** is required.
Teaching Scheme	Regular classroom lectures with the use of **PPTs** as and when required; sessions are planned to be **interactive**, with a focus on **problem-solving** and **programming**.

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 SubLayer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC;	**10Hours**
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.	**10Hours**
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.	**10Hours**
Total		**30Hours**

Books	Name of The Books	Publishers
Text Book :	T1.B.A.Forouzan,***DataCoMMunicationandNetworking***	Tata McGraw–Hill
	T2.L.L.PetersonandB.S.Davie,***CoMputerNetworks:ASystemsApproach*** .	Morgan Kaufmann Publishers
ReferenceBook :	R1.J.F.KuroseandK.W.Ross,***CoMputerNetworking-ATop- Down Approach Featuring the Internet***	Pearson Education
	R2.Y.DLin,R.HHwang,andF.Baker,***CoMputerNetworks:AnOpenSource 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) & WirelessLANs (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 dynamicaddressing 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 ofcomputing 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 needon 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 complexcomputing 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	Data Structure Lab	L-T-P	Credits	Hours	Marks
2nd	25MCA206(P)		0-0-2	1	20	100

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**
40	**60**	**100**

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 **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**,	Pearson Education
	T2.E.Horowitz,S.Sahni,S.Anderson-Freed,**FundamentalsofDataStructures in C**,	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/datastructuresalgorithms/index.htm 4. https://www.coursera.org/learn/data-structures	

Course outcome

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:

PO/PSO	Description
PO1:	Apply knowledge of mathematics, programming logic, and coding fundamentals for solution architecture and problem solving.
PO2:	Identify, review, formulate, and analyze problems, primarily focusing on customer requirements using critical thinking frameworks.
PO3:	Design, develop, and investigate problems with an innovative approach for solutions incorporating ESG/SDG goals.
PO4:	Select, adapt, and apply modern computational tools, such as the development of algorithms, with an understanding of the limitations including human biases.
PO5:	Function and communicate effectively as an individual or a team leader in diverse and multidisciplinary groups. Use methodologies such as agile.
PO6:	Use the principles of project management, such as scheduling, work breakdown structure, and be conversant with the principles of finance for profitable project management.
PO7:	Commit to professional ethics in managing software projects with financial aspects. Learn to use new technologies for cybersecurity and insulate customers from malware.
PO8:	Develop change management skills and the ability to learn, keep up with contemporary technologies, and ways of working.
PSO1:	Understand the relevance of sustainable development and its significance, as well as the impact of expert engineering solutions in social and environmental contexts.
PSO2:	Apply fundamental knowledge of computer applications and exhibit practical competencies in a broad range of programming languages and software platforms that are required to become a successful computer professional.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	3	2	3	2	3	x	x	x	x	3
CO2	3	2	3	2	3	x	x	x	x	3
CO3	3	2	3	2	3	x	x	x	x	3
CO4	3	2	3	2	3	x	x	x	x	3
CO5	3	3	3	3	3	x	x	x	x	3
CO6	3	3	3	3	3	x	x	x	x	3

Semester	Code		L-T-P	Credits	Hours	Marks
2nd	24MCA207(P)	Object Oriented Programming Lab	0-0-2	1	20	100

Objectives	The objective of the course is to apply object-oriented programming principles and 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**
40	**60**	**100**

Details Syllabus

Experiment-#	Assignment/Experiment
1.	Understanding Java platform, compilation, and execution of a Java program.
2.	Use of class, use of control statements, data types, operators.
3.	Implement class, object, constructor, methods, and other OOP features.
4.	Inheritance basics, more uses of constructor, method overriding, use of final.
5.	Object class, practical use of abstract class.
6.	Using interface for achieving multiple inheritance, implementation of package.
7.	Exception handling fundamentals, Java built-in exceptions, use of Scanner class for console input, use of own exception subclass.
8.	Java thread lifecycle model and implementation approach, thread priority, implementation of synchronization.
9.	I/O basics, byte stream and character streams, reading and writing files.
10.	Applet lifecycle implementation, text processing using Java predefined String, StringBuilder and StringBuffer classes.
11.	GUI basics and window fundamentals, working with different component, container and layout managers.
12.	Java database connectivity using JDBC, steps and use of different driver types.

Books	Name of The Books/References	Publishers
Text Book:	T1:H.Schildt,***Java:TheCoMpleteReference*** T2.Y.D.Liang,***IntroductiontoJavaPrograMMing***	McGraw-Hill Pearson Education
Reference Book:	R1.B.Bates,K.Sierra,***HeadFirstJava*** R2.T.Budd,***AnIntroductiontoObject-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/	

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 database-driven GUI applications using AWT, Swing and JDBC.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of mathematics, programming logic and coding fundamentals for solution architecture and problem solving.
PO2	Identify, review, formulate and analyze problems for primarily focusing on customer requirements using critical thinking frameworks.
PO3	Design, develop and investigate problems with as an innovative approach for solutions incorporating ESG/SDG goals.
PO4	Select, adapt and apply modern computational tools such as development of algorithms with an understanding of the limitations including human biases.
PO5	Function and communicate effectively as an individual or a team leader in diverse and multidisciplinary groups. Use methodologies such as agile.
PO6	Use the principles of project management such as scheduling, work breakdown structure and be conversant with the principles of Finance for profitable project management.
PO7	Commit to professional ethics in managing software projects with financial aspects. Learn to use new technologies for cyber security and insulate customers from malware

PO8	Change management skills and the ability to learn, keep up with contemporary technologies and ways of working.
PSO1	Understand the relevance of sustainable development and its significance, as well as the impact of expert engineering solutions in social and environmental contexts.
PSO2	Apply fundamental knowledge of computer applications and exhibit practical competencies in a broad range of programming languages and software platforms that are required to become a successful computer professional.

CO-PO Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	3	3	2	3	3	2	1	3	3	3
CO2	3	3	3	2	3	1	3	3	2	3
CO3	3	2	1	1	2	1	1	3	3	2
CO4	3	3	2	2	2	1	2	2	2	3
CO5	3	2	2	3	2	1	1	2	3	2
CO6	3	3	3	3	3	2	2	3	3	3

Semester	Code		L-T-P	Credits	Hours	Marks
2nd	25MCA208(P)	Operating System Lab	0-0-2	1	20	100

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**
40	**60**	**100**

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 handling, 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	NameofTheBooks/References	Publishers
Text Book:	T1.V.Mukhi,***TheCOdyssey:UNIX***	BPB Publications
	T2. A. Silberschatz,P. BGalvin, andG Gagne, ***Operating Systems Principles***	Wiley India

Reference Book:	R1.A. S.Tanenbaum, ***Modern Operating Systems*** R2.P.B.Prasad,***OperatingSystemsandSystemProgramming***	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	CarryoutbasicandadvancedUNIXcommandsforsystemadministrationaswellaswriteshellscriptsforreallife 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 mathematics, programming logic and coding fundamentals for solution architecture and problem solving.
PO2	Identify, review, formulate and analyze problems primarily focusing on customer requirements using critical thinking frameworks.
PO4	Select, adapt and apply modern computational tools such as development of algorithms with an understanding of the limitations including human biases.
PO5	Functionandcommunicateeffectivelyasanindividualorateamleaderindiverseandmultidisciplinarygroups.Usemethodologiessuchasagile.
PO7	Committoprofessionalethicsinmanagingsoftwareprojectswithfinancialaspects.Learntousenewtechnologiesforcybersecurityandinsulatecustomersfrommalware
PO8	Changemanagementskillsandtheabilitytolearn,keepupwithcontemporarytechnologiesandwaysofworking
PSO2	Apply fundamental knowledge of computer applications and exhibit practical competencies in a broad range of programming languages and software platforms that are required to become a successful computer professional.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	3	3	x	3	3	x	3	2	x	3
CO2	3	3	x	3	3	x	2	2	x	2
CO3	3	2	x	2	2	x	2	3	x	1
CO4	3	3	x	3	3	x	3	3	x	2
CO5	3	3	x	3	3	x	2	3	x	3
CO6	3	2	x	3	3	x	3	2	x	3

Semester	Code		L-T-P	Credits	Hours	Marks
2nd	25MCA209(P)	Advance Python Programming Lab	0-0-2	2	40	100

Objectives	The objective of this laboratory course is to prepare the students to 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**
40	**60**	**100**

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Create, access, modify, and sort multidimensional NumPy arrays (ndarrays).
3	Use slicing, boolean indexing, and set operations to select or change subsets of an ndarray.
4	Perform element-wise operations on ndarrays and solve system of linear equations.
5	Create DataFrame, read data from CSV, Excel file, reshaping & filtering.
6	Summarize and compute 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	Encode categorical features using Scikit-learn.
10	Train and run a linear model using Scikit-learn.

Books	Nameof TheBooks/References	Publishers
Text Book:	T1.W.McKinney,PythonforDataAnalysis:DataWranglingwithPandas,NumPy, andI python	O'Reillyc Media
	T2. JakeVanderPlas,PythonDataScienceHandbook-Essential Tools forworking with data	O'Reilly Media
Reference Book:	R1.J.Avila,T.Hauck, Scikit-LearnCookbook	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	Create, access, modify, and sort multidimensional NumPy arrays using various indexing and slicing techniques.
CO2	Perform element-wise operations, set operations, and solve systems of linear equations using NumPy.
CO3	Create and manipulate DataFrames by reading data from external sources (CSV, Excel), reshaping, filtering, and summarizing data using pandas.
CO4	Compute descriptive statistics, correlation, and covariance, and perform data aggregation and group operations.
CO5	Prepare datasets for machine learning by splitting data, encoding categorical features, and applying preprocessing techniques using Scikit-learn.
CO6	Train, evaluate, and implement a linear model for predictive analysis using Scikit-learn.

Program Outcomes Relevant to the Course:

PO/PSO	Description
PO1:	Apply knowledge of mathematics, programming logic, and coding fundamentals for solution architecture and problem solving.
PO2:	Identify, review, formulate, and analyze problems, primarily focusing on customer requirements using critical thinking frameworks.
PO3:	Design, develop, and investigate problems with an innovative approach for solutions incorporating ESG/SDG goals.
PO4:	Select, adapt, and apply modern computational tools, such as the development of algorithms, with an understanding of the limitations including human biases.
PO5:	Function and communicate effectively as an individual or a team leader in diverse and multidisciplinary groups. Use methodologies such as agile.
PO6:	Use the principles of project management, such as scheduling, work breakdown structure, and be conversant with the principles of finance for profitable project management.
PO7:	Commit to professional ethics in managing software projects with financial aspects. Learn to use new technologies for cyber security and insulate customers from malware.
PO8:	Develop change management skills and the ability to learn, keep up with contemporary technologies, and ways of working.
PSO1:	Understand the relevance of sustainable development and its significance, as well as the impact of expert engineering solutions in social and environmental contexts.
PSO2:	Apply fundamental knowledge of computer applications and exhibit practical competencies in a broad range of programming languages and software platforms that are required to become a successful computer professional.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	3	2	3	3	3	x	x	2	3	x
CO2	3	3	2	2	3	x	x	2	x	2
CO3	3	2	3	2	2	x	x	3	x	2
CO4	3	3	3	3	3	x	x	3	1	x
CO5	3	3	2	3	3	x	x	3	3	x
CO6	3	2	3	3	3	x	x	2	x	3

Semester	Code	Emerging Technology Lab-II (Internet and Web Technology Lab)	L-T-P	Credits	Hours	Marks
2nd	25MCA209(P)		0-0-4	2	40	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 JavaScript along with concepts of PHP and MySQL taught in the theory class are required for the experiments.
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	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 DataBase Connectivity with MYSQL.
13	Study of MYSQL DataBase 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	CodeIgniterFramework,SimpleCrudOperation(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,***ThePHPCoMpleteReference*** T2.L.BeighleyandM.Morrison,***HeadFirstPHP&MySQL***	McGraw Hill Education O'Reilly Media
Reference Book :	R1.D.Reiersol,C.Shiflett,andM.Baker,***PHPinAction:Objects,Design ,Agility*** R2.S.K.Patel,***DevelopingResponsiveWebApplicationswithAJAXandjQuery***	Manning Publications Packt Publishing
Online Resources	1. https://www.php.net/manual/en/langref.php:PHPLanguageReference 2. https://dev.mysql.com/doc/refman/8.0/en/:MySQLReferenceManual 3. https://www.w3schools.com/php/:W3SchoolsPHPTutorials 4. https://api.jquery.com/:jQueryDocumentation 5. https://codeigniter.com/userguide/index.html:CodeIgniterUserGuide 6. https://angular.io/guide/architecture:AngularJSDocumentation	

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 appropriatefor 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 tocomplex 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

-------x-------x-------x-------

Syllabus for MCA 2 yrs. Programme

Semester-3: Autumn Semester (August to December)

Semester-3: Autumn Semester (August to December)

Sl. No.	Course Code	Course Title	L-T-P	Total credit
1.	25MCA301	Design and Analysis of Algorithms	3-0-0	3
2.	25MCA302	Theory of Computation	3-0-0	3
3.	25MCA303	Software Engineering	3-0-0	3
4.	25MCA304	Elective-I	3-0-0	3
5.	25MCA305	Elective-II	3-0-0	3
PRACTICAL				
1.	25MCA306(P)	Design and Analysis of Algorithms Lab	0-0-2	1
2.	25MCA307(P)	Personality Development and soft skills Lab	0-0-2	1
3.	25MCA308(P)	Data Processing and Visualization Lab	0-0-2	1
4.	25MCA309(P)	Advanced JAVA	0-0-4	2
5.	25MCA310(P)	Minor Project	0-0-4	2
6.	25MCA311(P)	Internship	0-0-2	1
TOTAL				**23**

Semester	Code		L-T-P	Credits	Hours	Marks
3rd	25MCA301	Design and Analysis of Algorithms	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.

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

Evaluation Scheme

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.	**10Hours**
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),	**10Hours**
	Total	**30Hours**

Books	Name of The Books/References	Publishers
Text Book :	T1.T.H.Cormen,C.E.Leiserson,R.L.Rivest,andC.Stein,***Introductiont o AlgorithMs*** T2.E.Horowitz,S.Sahni,andS.Rajasekaran,***FundaMentalsofCoMpute r AlgorithMs***	PHILearning University Press
Reference Book :	R1.J.KleinbergandE.Tardos,***AlgorithMDesign*** R2.M.T.GoodrichandR.Tamassia,***AlgorithMDesign:Foundations,Analysis,andInternetExaMples***	Pearson EducationJohn Wiley&Sons

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 solvingoptimization 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)

	PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO7	PO 8	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	Theory of Computation	Credits	L-T-P	Hours	Marks
3rd	25MCA302		3	3-0-0	30Hrs	100

Introduction

The course *Theory of Computation* covers formal languages, automata theory, grammars, computability, and decidability. It provides a simple, elegant understanding of computational machines, useful in areas such as circuit design, compiler construction, search algorithms, cryptography, and optimization. The theory is also foundational for research in computer science.

Objectives	To give an overview of the theoretical foundations of computer science from the perspective of formal languages. To illustrate finite state machines to solve problems in computing. To explain the hierarchy of problems in computer science. To familiarize students with regular grammars and context-free grammars.
Pre-Requisites	Basic knowledge of discrete mathematics, sets, and functions is recommended.
Teaching Scheme	Regular classroom lectures supplemented with examples and problem-solving sessions. ICT tools and interactive teaching methods may also be employed.

Evaluation Scheme

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

Detailed Syllabus

Modules	Topics	Hours
Module-I	**Finite Automata, Regular Expressions & Regular Grammars**: Introduction to Finite Automata (FA): DFA — formal definition, notations (state transition diagram, table), language of DFA; NFA — definition & language, equivalence of DFA & NFA, epsilon-transitions, elimination of epsilon, minimization of DFA, Moore & Mealy machines and inter-conversion. **Regular Expressions (RE):** Identities, DFA ↔ RE conversions, applications. **Regular Grammars (RG):** Definitions, FA ↔ RG conversions, non-regular languages (pumping lemma), closure properties of regular languages.	**10 Hours**
Module-II	**Context-Free Grammars, Pushdown Automata & Turing Machines**: **Context-Free Grammars (CFG):** Derivation trees, sentential forms, rightmost & leftmost derivations, ambiguity, minimization, CNF & GNF, pumping lemma for CFLs, properties of CFLs. **Pushdown Automata (PDA):** Definition, model, acceptance by final state & empty stack, equivalence of PDA & CFG. **Turing Machines (TM):** Definition & behavior, TM languages, TM as acceptor & integer function computer, types of TMs.	**10Hours**
Module-III	**Recursive & Undecidable Problems, Chomsky Hierarchy & Advanced Topics**: Properties of recursive & recursively enumerable languages, Universal TM, Halting problem, undecidable problems about TMs. Context-sensitive languages, linear bounded automata (LBA), Chomsky hierarchy, Post's correspondence problem (PCP), un-decidability of PCP.	**10 Hours**

Referred Books

Books	Name of The Books/References	Publishers
Text Book:	T1. *Introduction to Automata Theory, Languages and Computation*, John Jeffrey D. Ullman, 3rd Ed.	Pearson Education
Reference Book:	R1. *Theory of Computer Science – Automata, Languages & Computation*, K. L. P. Mishra, N. Chandrashekaran, 2nd Ed.	Prentice Hall of India
Online Resources	1. https://nptel.ac.in/courses/106/104/106104028/ 2. https://nptel.ac.in/courses/106/104/106104072/ 3. https://nptel.ac.in/courses/111/106/111106086/	

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

	Course Outcomes	Levels of learning *(based on bloom's taxonomy)*
CO1	Use basic concepts of formal languages and finite automata techniques. (*Remember*)	Level 1 (Remember)
CO2	Design finite automata for regular expressions and languages. (*Understand*)	Level 2 (Understand)
CO3	Construct context-free grammars for various languages. (*Apply*)	Level 3 (Apply)
CO4	Solve problems using normal forms and Pushdown Automata. (*Analyze*)	Level 4 (Analyze)
CO5	Demonstrate understanding of Turing Machines and solve undecidable problem scenarios. (*Evaluate*)	Level 5 (Evaluate)
CO6	Participate effectively in competitive exams (GATE, PGECET, etc.) and advanced studies. (*Create*)	Level 6 (Create)

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of mathematics and logic for problem solving.
PO2	Identify and analyze computing problems critically.
PO3	Innovate solutions aligned with ESG/SDG goals.
PO4	Apply modern computational tools effectively.
PO5	Work effectively in teams and communicate clearly.
PO6	Manage projects considering financial & scheduling aspects.
PO7	Uphold professional ethics and cyber security.
PO8	Adapt to changing technologies and practices.
PSO1	Understand the relevance of sustainable development and the impact of engineering solutions in social and environmental contexts.
PSO2	Apply fundamental knowledge of computer applications and exhibit practical competencies in programming languages and software platforms.

CO – PO Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2
CO1	3	2	2	2	1	1	1	2	1	2
CO2	3	3	2	2	3	2	2	3	2	2
CO3	3	3	3	2	2	2	2	1	1	3
CO4	3	3	2	2	3	1	1	2	1	2
CO5	3	3	3	2	3	2	2	1	1	2
CO6	3	3	3	2	2	2	2	2	1	2

Semester	Code		L-T-P	Credits	Hours	Marks
3rd	25MCA303	Software Engineering	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.	10Hours
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.	10Hours
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, System Testing.	10Hours
	Total	30Hours

Books	Name of The Books/References	Publishers
Text Book :	T1.R.Mall,***FundaMentalsofSoftwareEngineering*** T2.C.Larman,***ApplyingUMLandPatterns***	PHI Learning Pearson Education

ReferenceBook:	R1.I.Somerville,***SoftwareEngineering*** R2.R.S.Pressman,***SoftwareEngineering-APractitioner'sApproach***	Pearson Education McGraw Hill Education
Online Resources	1. https://nptel.ac.in/courses/106105182/:byProf.RajibMall,IITKharagpur. 2. https://nptel.ac.in/courses/106101061/: byProf. N.L.Sharda,IITBombay. 3. https://www.tutorialspoint.com/softwareengineering/softwareengineeringtutorial.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	Createhigh-level&detail-leveldesignofasoftwareusingvariousdesignmethodologies.
CO4	VisualizeobjectorientedapproachforsoftwaredesignusingUnifiedModelingLanguage.
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 forconceptualization of computing models from defined problems and requirements.
PO2	Ability to identify, critically analyze and formulate complex computing problems using fundamentalsof 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 tocomplex 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		L-T-P	Credits	Hours	Marks
3rd	25MCA306(P)	Design and Analysis of Algorithm Lab	0-0-2	1	20	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 usingKruskal'sAlgorithm.
10	Find Minimum Cost Spanning Tree of a given undirected graph using Prim'salgorithm.
11	Implement All-Pairs Shortest Paths Problem using Floyd's algorithm. Parallelize thisAlgorithm.
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**	**PHILearning,** **Pearson Education**

	T2.A. Levitin, Introduction to the Design and Analysis of Algorithms	
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 Programmingand 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 andsoft skills lab	L-T-P	Credits	Hours	Marks
3rd	25MCA307(P)		0-0-2	1	20	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/teamwork, 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	Teamwork activity: Building blocks of a team - discussion and 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-Briggs Type Indicator) test, self-assessment and discussion

Books	Name of The Books/References	Publishers
Text Book :	T1.M.A.Rizvi,***EffectiveTechnicalCoMMunication*** T2.T.Balasubramaniam,***EnglishPhoneticsforIndianStudents*** T3.M.RamanandS.Sharma,***TechnicalCoMMunication:Principles andPr actice***	McGraw-Hill Education Macmillan Publishers Oxford University Press

Reference Book :	R1.S.Samantray,***BusinessCoMMunicationandCoMMunicativeEnglish*** R2.J.Seeley,***TheOxfordGuidetoEffectiveWritingandSpeaking*** R3.B.K.Mitra,***CoMMunicationSkillsforEngineers***	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 theCourse:

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		L-T-P	Credits	Hours	Marks
3rd	25MCA308(P)	Data Processing and Visualization Lab	0-0-2	1	20	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.AshwinPajankar, **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	Implementthe 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		L-T-P	Credits	Hours	Marks
3rd	25MCA304(A)	Artificial Intelligence	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.	**10Hours**
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.	**10Hours**
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.	**10Hours**
	Total	**30Hours**

Books	Name of The Books/References	Publishers
Text Book :	T1.S.J.RussellandP.Norvig,***Artiflcial Intelligence - A Modern Approach*** T2.D.W.Patterson,***Introductionto Artificial Intelligence & Expert Systems***	Pearson Education Pearson Education
Reference Book :	R1.E.Rich,K.Knight,andS.B.Nair,***ArtiflcialIntelligence*** R2.G.F.Luger,***ArtiflcialIntelligence*** R3.M.Negnevitsky,***ArtiflcialIntelligence:AGuidetoIntelligentSystems***	McGraw Hill Pearson Education Pearson Education
Online Resources	1. https://nptel.ac.in/courses/106105077/: byProf.S.Sarkar&Prof. A.Basu,IITKharagpur 2. https://nptel.ac.in/courses/106105079/:byProf.P.Mitra,IITKharagpur 3. https://nptel.ac.in/courses/106106140/:byProf.D.Khemani,IITMadras	

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 usingfundamentals 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		L-T-P	Credits	Hours	Marks
3rd	25MCA304(B)	Information Security	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	Knowledgeofcomputernetworksandinternettechnologiesarerequiredforthiscourse.
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 Computer Security Concepts, Security Attacks, Security Services and Mechanisms, Symmetric Cipher model, Cryptography & Cryptanalysis, Substitution Techniques: Caesar cipher, Monoalphabetic cipher, Playfair cipher, Hill Cipher, Polyalphabetic ciphers: Vigenere cipher, Vernam cipher, Transposition cipher. Integer and Modular Arithmetic, Euclidean and Extended Euclidean Algorithms, Concept of groups, rings, and fields, Difference between GF(p) and GF(2m).	**12Hours**
Module-2	Block cipher principles, Data Encryption Standard (DES), Advanced Encryption Standard (AES). Fermat's and Euler's Theorem, Chinese Remainder Theorem, Integer factorization, Discrete Logarithms, Public Key Cryptography: RSA, ElGamal, Diffie-Hellman Key Exchange, Elliptic Curve Cryptography: Introduction to elliptic curve, arithmetic, application.	**10Hours**
Module-3	Message Integrity and Authentication, Cryptographic Hash Functions: MD5, SHA family, Digital Signature and applications - ElGamal, Key Distribution, Certificate Authority, X.509, Kerberos, E-mail security: PGP, S/MIME, Security at the Transport Layer: SSL/TLS, Security at Network Layer: IPSec, Malicious Software, Firewall, Intrusion Detection.	**08Hours**
	Total	**30Hours**

Books	Name of The Books/References	Publishers
Text Book :	T1.W.Stallings,***CryptographyandNetworkSecurity:PrincipleandPractice***	Pearson Education
Reference Book :	R1. B. A. Forouzan and D. Mukhopadhaya, Cryptography and NetworkSecurity R2. C. P. Pfleeger, S. L. Pfleeger, and J. Margulies, Security inCoMputing 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/:byDr.D.Mukhopadhyay,IITKharagpur 2. https://nptel.ac.in/courses/106/105/106105162/:byProf.S.Mukhopadhyay,IITKharagpur	

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 usingfundamentals 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		L-T-P	Credits	Hours	Marks
3rd	25MCA304(C)	Wireless Sensor Networks	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 to be 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.	**10Hours**
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.	**10Hours**
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 wideband radio communication, Wireless fidelity systems, Future directions, Home automation, Smart metering applications.	**10Hours**
	Total	**30Hours**

Books	Name of The Books/References	Publishers
Text Book :	T1.W. Dargie and C. Poellabauer, ***FundaMentals of Wireless SensorNetworks - Theory and Practice*** T2.K.Sohraby,D.Minoli,andT.Znati,***WirelessSensorNetworks-Technology, Protocols, and Applications***	Wiley,2010. WileyInter Science

Reference Book :	R1.T.Hara,V.I.Zadorozhny,andE.Buchmann,WirelessSensorNetw ork-TechnologiesfortheInforMationExplosionEra R2.B.Krishnamachari,NetworkingWirelessSensors	Springer CambridgeUniversityPress
Online Resources	1. https://nptel.ac.in/courses/106/105/106105160/:byProf.S.Misra,IITKharagpur 2. https://www.csd.uoc.gr/~hy539/lectures/20140408hy439sensornetspart1.pdf 3. http://pages.di.unipi.it/bonuccelli/sensori.pdf:LectureslidesbyProf.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, routeoptimization, 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 usingfundamentals 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, andnorms 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 wealthfor 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		L-T-P	Credits	Hours	Marks
3rd	25MCA304(D)	Software Testing	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 modeling and 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.	**13Hours**
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.	**09Hours**
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.	**08Hours**
	Total	**30 Hours**

Books	Name of The Books/References	Publishers
Text Book :	T1.I.Burnstein,***PracticalSoftwareTesting*** T2.S.DesikanandG.Ramesh,***SoftwareTesting-Principles and Practices***	Springer Pearson
Reference Book :	R1.A.P.Mathur,***FoundationsofSoftwareTesting***	Pearson Education
Online Resources	1. https://nptel.ac.in/courses/106/105/106105150/:byProf.R.Mall,IITKharagpur 2. https://nptel.ac.in/courses/106101163/:byProf.M.D'Souza,IIITBangalore. 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 anyspecific need on societal and environmental aspects.
PO5	Create, select, adapt and apply appropriate techniques, resources, and modern computing toolsto 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 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		L-T-P	Credits	Hours	Marks
3rd	25MCA305(A)	Data Warehousing & Business Intelligence	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 and 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.	12Hours
Module-2	**Data Mining Basics**: Introduction, application areas in data mining, KDD process. **Getting to Know Your Data**: Data objects and attribute 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.	10Hours
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.	08Hours
	Total	30Hours

Books	Name of The Books/References	Publishers
Text Book :	T1.R.Thareja,***DataWarehousing*** T2.E.Turban,R.Sharda,andD.Delen,***DecisionSupportandBusinessIntelligenceSystems***	OxfordUniversityPress PearsonEducation
Referenc eBook :	R1.A.BersonandS.J.Smith,***DataWarehousing,DataMining&OLAP*** R2.P.Ponniah,***DataWarehousingFundaMentals***	McGrawHillEducation WilleyIndia
Online Resources	1. https://nptel.ac.in/courses/106/105/106105174/:byProf.P.Mitra,IITKharagpur 2. http://infolab.stanford.edu/~ullman/mining/2003.html:notesbyStanfordUniversity	

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 usingfundamentals 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 toolsto complex computing activities, with an understanding of the limitations.
PO6	Understand and commit to professional ethics and cyber regulations, responsibilities, andnorms 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		L-T-P	Credits	Hours	Marks
3rd	25MCA305(B)	VA & PT	3-0-0	3	30	150

Objectives	The objective of this course is to study the Ethical Hacking Process and to Getfamiliarized with Tools and Techniques of Ethical Hacking
Pre-Requisites	Basic Understanding of Network Security & Threat Mechanisms are essential for thiscourse.
Teaching Scheme	Regular classroom lectures with the 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.	10Hours
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,	10Hours
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.	10Hours
	Total	**30Hours**

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
	R1.Kimberly Graves, "Certified Ethical Hacker"	Wiley India

Reference Book :	R2.Michael T. Simpson, "Hands-on Ethical Hacking & NetworkDefense" R3.RajatKhare, "Network Seuciryt and Ethical Hacking"	Pvt Ltd Course Technology Luniver Press
Online Resources	https://nptel.ac.in/courses/106/105/106105167/:byProf.S.K.Ghosh,IITKharagpur. https://nptel.ac.in/courses/106/104/106104182/:byProf.R.Misra,IITKanpur. https://www.coursera.org/learn/cloud-computing:Prof.IndranilGupta,DepartmentofComputerScience,UniversityofIllinoisatUrbana- Champaign. http://web.mit.edu/6.897/www/readings.html:byProf.HariBalakrishnan,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 anyspecific need on societal and environmental aspects.
PO5	Create, select, adapt and apply appropriate techniques, resources, and modern computing toolsto 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		L-T-P	Credits	Hours	Marks
3rd	25MCA305(C)	Cloud Computing	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 the 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, CentralizedComputing,Parallel&DistributedComputing,Amdahl'sLaw,P2PComputing,ClusterComputing,GridComputing,UtilityComputing,Autonomic Computing, Hosting, Data Center, Convergence of Technologies,CloudComputing,NISTdefinition,Characteristics,ServiceModels,DeploymentModels,CloudServiceExamples,Cloud-basedServices&Applications. CloudConcepts&Technologies:Virtualization,LoadBalancing,Scalability&Elasticity,Deployment,Replication,Monitoring,SoftwareDefinedNetworking(SDN),NetworkFunctionVirtualization,MapReduce,Identity&AccessManagement,Service Level Agreements(SLA),Billing.	**12Hours**
Module-2	CloudServices&Platforms:ComputeServices,StorageServices,DatabaseServices, Application Services, Content Delivery Services, Analytics Services,Deployment&managementServices,Identity&AccessManagementServices, Open Source Private Cloud Software – Cloud Stack, Eucalyptus, Open Stack.	**6Hours**
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 and tuning; Workload characteristics; Application performance metrics; Benchmarking tools; Deployment prototyping; Load testing and bottleneck detection. **Cloud Security:** Introduction; Security issues in the cloud; Components of security; Attacks and classes of threats; CSA (Cloud Security Alliance) security architecture; Authentication, authorization, identity and access management; Infrastructure security; Data security; Key management; Auditing and compliance.	**12Hours**
	Total	**30Hours**

Books	Name of The Books/References	Publishers
Text Book :	T1.A. Bahga and V. Madisetti, ***Cloud CoMputing :A Hands-OnApproach*** T2.K.Hwang,G.C.Fox,andJ.J.Dongarra,***DistributedandCloudCoM puting-FroMParallelProcessingtotheInternetofThings*** T3.T.Mather,S.K.Swamy,andS.Latif,***CloudSecurityandPrivacy:AnE nterprisePerspectiveonRisks and CoMpliance***	Orient Blackswan 1stEdition, Elsevier O'ReillyMedia
Reference Book :	R1.A. T. Velte,T. J. Velte,and R. Elsenpeter,***Cloud CoMputing :A Practical Approach*** R2.B.Sosinsky,***CloudCoMputingBible***,1stEdition R3.T.Erl,Z.Mahmood,andR.Puttini,***CloudCoMputing:Concepts,Te chnology&Architecture***	McGrawHillEdu cation Wiley-India PearsonIndiaEducation
Online Resources	1. https://nptel.ac.in/courses/106/105/106105167/:byProf.S.K.Ghosh,IITKharagpur. 2. https://nptel.ac.in/courses/106/104/106104182/:byProf.R.Misra,IITKanpur. 3. https://www.coursera.org/learn/cloud-computing:Prof.IndranilGupta,DepartmentofComputerScience,UniversityofIllinoisatUrbana-Champaign. 4. http://web.mit.edu/6.897/www/readings.html:byProf.HariBalakrishnan,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, andnorms 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		L-T-P	Credits	Hours	Marks
3rd	25MCA305(D)	Mobile Application Development	3-0-0	3	30	150

Objectives	The objective of this course is to learn about the design and development of mobile applications with a focus on the Android operating system.
Pre-Requisites	Knowledge of Java programming language and 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	This module introduces mobile applications by covering embedded systems, market and business drivers for mobile applications, publishing and delivery of mobile applications, and requirements gathering and validation for mobile applications. It also discusses the basics of design including embedded operating systems and the design constraints for mobile applications in terms of both hardware and software. The module then explains the architecture of mobile applications with emphasis on user interfaces, touch events, and gestures, and concludes with strategies for achieving quality constraints such as performance, usability, security, availability, and modifiability.	**12Hours**
Module-2	The second module focuses on the Android operating system, beginning with an introduction to Android OS and Android Studio, along with setting up the development environment. It describes the Android architecture, the use of activities and views, interaction with the user interface, and data persistence using SQLite. The module also covers packaging and deployment of Android applications and explores commonly used design patterns for mobile application development.	**08Hours**
Module-3	The final module addresses the design of applications with multimedia and web access capabilities, and explores integration with GPS and social media applications. It discusses accessing applications hosted in the cloud, interacting with server-side applications, and using Google Maps. The module also covers working with Bluetooth and WiFi, introduces the concept of threads and worker threads using thread handlers, and ends with techniques for working with graphics and animation.	**10Hours**
	Total	**30 Hours**

Books	Name of The Books/References	Publishers
Text Book :	T1.R.Meier,***ProfessionalAndroid™4ApplicationDevelopMent*** T2.P.Kothari,***AndroidApplicationDevelopMentBlackBook***,	John Wiley &Sons Kogent Learning S olutions, Dream Tech Press

Referen ceBook :	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:AndroidDevelopers' Guideby *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 usingfundamentals of computer science and application domains.
PO3	Design applications for complex computing problems with appropriate considerations for anyspecific 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

Syllabus for MCA 2 yrs. Programme

Semester-4: Spring Semester (January to July)

Semester-4: Spring Semester (January to May)

Sl. No.	Course Code	Course Title	L-T-P	Total credit
1.	25MCA401	Elective-III/**MOOC's**	3-0-0	3
2.	25MCA402	Elective-IV/**MOOC's**	3-0-0	3
PRACTICAL				
1.	25MCA403(P)	Major Project	0-0-16	8
TOTAL				**14**

Semester	Code		L-T-P	Credits	Hours	Marks
4th	25MCA401(A)	Machine Learning	3-0-0	3	30	150

Objectives	The objective of this course is to introduce the fundamental concepts and methods of machine learning, along with techniques for the analysis of large datasets. The course emphasizes both theoretical understanding and practical application of various machine learning algorithms and models.
Pre-Requisites	Basic knowledge of probability and statistics is required to understand and apply machine learning concepts effectively.
Teaching Scheme	Regular classroom lectures with the use of ICT as and when required. Sessions are planned to be interactive, with a focus on problem-solving activities and practical examples to reinforce the learning of concepts.

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 including Ridge regression and Lasso regression, Subset selection, Linear Discriminant Analysis, Logistic regression.	**10Hours**
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 including Bayesian concept learning and Naive Bayes classifier, Support Vector Machines (SVM) for classification, Reproducing kernels, SVM for regression.	**10Hours**
Module-3	Clustering techniques including K-means and spectral clustering, Feature extraction methods such as Principal Component Analysis (PCA), kernel-based PCA, Independent Component Analysis (IDA), and Non-negative Matrix Factorization. Introduction to reinforcement learning, Single-state case: K-Armed Bandit, Elements of reinforcement learning, Model-based learning approaches including Value Iteration and Policy Iteration.	**10Hours**
	Total	**30Hours**

Books	Name of The Books/References	Publishers
Text Book :	T1.T.Hastie,R.Tibshirani,andJ.Friedman,***TheElementsofStatisticalLearning-DataMining,Inference,andPrediction*** T2.S.Haykin,***NeuralNetworksandLearningMachines***	Springer PearsonEducation
Reference Book :	R1.Y.G.James,D.Witten,T.Hastie,andR.Tibshirani,***AnIntroductiontoStatisticalLearningwithApplicationsinR*** R2.T.M.Mitchell,***MachineLearning*** R3.C.M.Bishop,***PatternRecognitionandMachineLearning***	Springer McGrawHillEducation 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 techniques to solve related real-life problems.
CO2	Analyze a problem and select the most suitable supervised learning model.
CO3	Apply classification and regression models such as Support Vector Machines (SVM) and decision tree-based models.
CO4	Perform clustering on given data along 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 usingfundamentals 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		L-T-P	Credits	Hours	Marks
4th	25MCA401(B)	Block chain Technology	3-0-0	3	30	150

Objectives	The objective of this course is to introduce the students to the Block chain technologyand 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. Bitcoinblockchain, 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 anonymitypreservation, 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*** T2. Josh Thompson, ***Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming***	Oxford University Press Create Space Independent Publishing Platform
Referen ceBook :	R1. William Stallings, ***Cryptography and Network Security: Principles and Practice*** R2. Alfred J. Menezes, Paul C. van Oorschot, Scott A. Vanstone, ***Handbook of Applied Cryptography***	Pearson CRC press
Online Resourc es	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 Blockchain 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 usingfundamentals 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		L-T-P	Credits	Hours	Marks
4th	25MCA401(C)	Internet of Things	3-0-0	3	30	150

Objectives	The objective of this course is to study different security goals and mechanisms, with a primary focus on cryptographic techniques used to protect against various security threats in computer networks and the Internet.
Pre-Requisites	Basic knowledge of computer networks, sensor networks, microprocessors, and microcontrollers is required for this course.
Teaching Scheme	Regular classroom lectures with the 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),Net Conf, Yang. M2M:IoTvsM2M,SoftwareDefinedNetworking,NetworkFunctionVirtualization;	**10Hours**
Module-3	IoT Platform Design: IoT Design Methodology, ResourceManagementinIoT,DataSynchronization.Devices:Zigbee,Bluetooth,Wi -fi, RFID,Cloud Computing, BigData. CaseStudies:IoTinSmartHome,SmartGrid,Agriculture,Healthcare,SmartIndustry ,Environment, Smart Cities.	**10Hours**
	Total	**30Hours**

Books	Name of The Books/References	Publishers
Text Book :	T1.A.Bahga,V.Madisetti,***InternetofThings:AHands-onApproach***	University Press
	T2.O.Hersent,D.Boswarthick,andO.Elloumi,***TheInternetofThings:Ke y Applications and Protocols***	Student Edition, Wiley
Reference Book :	R1.D. Uckelmann,M. Harrison,and F. Michahelles, ***Architecting the Internet of Things***	Springer
	R2.R.BuyyaandA.V.Dastjerdi,***InternetofThings:PrinciplesandPa radigms***	Elsevier,
Online Resources	1. https://nptel.ac.in/courses/106/105/106105166/:byProf.S.Misra,IITKharagpur 2. https://nptel.ac.in/courses/108/108/108108098/:byProf.T.V.Prabhakar,IIScBangalore	

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 communication and design IoT systems with data synchronization and resource manipulation.
CO4	DescribeadvancedIoTconceptsappliedinvariousdevicesprevalentinthemarket.
CO5	EnvisageandcomparereaI-worldapplicationsofIoTindifferentdomains.

Program Outcomes (POs) 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 andnorms 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 wealthfor 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	25MCA401(D)		3-0-0	3	30	150

Objectives	The objective of this course is to introduce the various activities involved in managing software projects, including understanding the product life cycle, and umbrella activities such as project planning, quality assurance, risk management, tracking, closure, and other activities carried out during different phases of software development.
Pre-Requisites	Knowledge of software engineering principles and proficiency in programming languages is required.
Teaching Scheme	Regular classroom lectures with the use of ICT as required, and interactive sessions with a focus on case studies and 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 – Waterfall Model, Prototype Model, RAD Model, Spiral Model, and Process Models. **Umbrella Activities**: Metrics – Roadmap, Strategy, Targets and Tracking, Acting on Data. Software Configuration Management (SCM) – Process and Activities of SCM, Configuration Audit, Metrics in SCM, Tools and Automation. Software Quality Assurance (SQA) – Quality Control and Assurance, Cost and Benefits of Quality, Tools and Automation, Role of SQA.	**10Hours**
Module-2	**Risk Management**: Risk Management Cycle – Identification, Quantification, Monitoring, Mitigation, and Metrics in Risk Management. **Project Management Processes and Activities**: Project Life Cycle In-Stream Activities. Project Initiation – Activities, Outputs, Quality Records, and 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, Outputs, Quality Records, Skill Sets, Challenges, Metrics for Requirement Phase.	**10Hours**
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 – Effects on Project Management Activities, Managing Projects for Internet. **People-Focused Process Models**: People-Centric Models, P-CMM, and Other People-Focused Models.	**10Hours**
	Total	**30Hrs**

Books	Name of The Books/References	Publishers
Text Book :	T1.R.Gopalaswamy,***ManagingGlobalSoftwareProjects*** T2.B.HughesandM.Cotterell,***SoftwareProjectManagement***	McGraw-HillEducation TataMcGraw-Hill
ReferenceBook :	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/:byProf.R.Mall,IITKharagpur. 2. https://www.tutorialspoint.com/softwareengineering/softwareprojectmanagement.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 computerscience and application domains.
PO3	Design applications for complex computing problems with appropriate considerations for any specific need onsocietal and environmental aspects.
PO4	Ability to invoke the research skills by conducting experiments, interpreting data and providing well informedconclusions.
PO5	Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complexcomputing activities, with an understanding of the limitations.
PO6	Understand and commit to professional ethics and cyber regulations, responsibilities and norms of professionalcomputing practices.
PO7	Recognize the need, and have the ability, to engage in independent learning for continual development as acomputing professional.
PO8	Function effectively in the workplace both as a team leader and team member on multi-disciplinary projectsdemonstrating computing and management skills.
PO9	Communicate effectively with the computing community as well as society by being able to comprehend effectivedocumentations 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		L-T-P	Credits	Hours	Marks
4th	25MCA402(A)	Big Data Analytics	3-0-0	3	30	150

Objectives	The objective of the course is to study different tecluiiques 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 plannedto be interactive with focus on problem solving activities.

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

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 Map Reduce Fundamentals and HBase: Map Reduce Framework, Techniques to optimize Map Reduce jobs, Uses of Map Reduce, Role of HBase in Big Data processing, Processing Data with Map Reduce, Customizing Map Reduce Execution and Implementing Map Reduce 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
Referen ceBook :	R1: J. Han, M. Kamber, and J. Pei, Dole *Mining* Concepts *andTechniques* R2: T. M. Mitchell, *Machine Learning*	Morgan Kaufman Publications McGraw-Hill Education
Online Resourc es	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
CO3	Data to generate analytics
CO4	Design of Algorithms to solve Data Intensive Problems using Map Reduce Paradigm
CO5	Design and Implementation of Big Data Analytics using pig and spark to solve data intensive problems and to generate analytics
CO6	Implement Big Data Activities using Hive

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 usingfundamentals 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 wealthfor 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		L-T-P	Credits	Hours	Marks
4th	25MCA402(B)	Digital Forensics	3-0-0	3	30	150

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

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

Module-#	Topics	Hours
Module-1	**Digital Forensics Science**: Introduction to forensic science, computer forensics, and digital forensics. **Computer Crime**: Understanding criminalistics as it relates to the investigative process, analysis of cyber-criminalistics areas, and adopting a holistic approach to cyber-forensics. **Cyber Crime Scene Analysis**: Methods for searching and seizing electronic evidence, handling retrieved and unretrieved communications, and the importance of understanding court documents and legal requirements in a criminal investigation.	12Hours
Module-2	**Evidence Management & Presentation**: Creating and managing shared folders using operating systems, importance of the forensic mindset, defining the workload of law enforcement, identifying normal case flow, determining who should be notified of a crime, and steps in gathering evidence including the concept of probable cause. **Computer Forensics**: Preparing a case, initiating an investigation, understanding computer forensics workstations and software, conducting an investigation, completing a case, and critiquing a case.	10Hours
Module-3	**Mobile Forensics**: Techniques and tools used in mobile forensics investigations. **Legal Aspects of Digital Forensics**: Overview of the IT Act 2000 and the amendments in the IT Act 2008, with relevance to digital crimes and investigations. **Recent Trends in Mobile Forensics**: Emerging techniques and methods for search, seizure, and analysis of electronic evidence specific to mobile devices.	08Hours
	Total	30Hours

Books	Name of The Books/References	Publishers
Text Book :	T1.B.Nelson,A.Phillips,FEnfinger,CSteuart,***GuidetoCoMputerForensicsand Investigations***	Course Technology
Reference Book :	R1.J.Sammons,***TheBasicsofDigitalForensics*** R2.J.Vacca,***CoMputer Forensics: CoMputer CriMeScene Investigation***	Elsevier Laxmi Publications

Online Resources	http://www.cftco.com/:ComputerForensicTrainingCenterOnline http://www.computerforensicsworld.com/:ComputerForensicsWorld http://www.computer-forensic.com/:ComputerForensicServices http://www.digitalforensicsmagazine.com/:DigitalForensicMagazine http://www.jdfsl.org/:TheJournalofDigitalForensics,SecurityandLaw	

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		L-T-P	Credits	Hours	Marks
4th	25MCA402(C)	Mobile Computing	3-0-0	3	30	150

Objectives	Theobjectiveofthecourseistostudytheconceptsandtechnologiesfortransmission of various types of data over wireless mediums and introduce computing on mobile devices.
Pre-Requisites	Fundamentalknowledgeofnetworkingandsignaltransmissionarerequired.
Teaching Scheme	RegularclassroomlectureswithuseofICTasandwhenrequired,sessionsareplannedtobeinteractive with problem solving activities.

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

Module-#	Topics	Hours
Module-1	**Introduction to Personal Communication Systems (PCS):** Overview, evolution of wireless technologies, signals and frequency. **Cellular Systems:** Structure, clusters, frequency reuse and cell splitting. **MAC Mechanisms:** Space Division Multiple Access (SDMA), Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA). **GSM Technology:** Architecture, channels and bands, mobility management, handover detection and management. **GPRS:** Architecture, interfaces, and network protocols. **WLAN (IEEE 802.11):** System architecture, ad-hoc and infrastructure modes, MAC frame format..	**10Hours**
Module-2	**Bluetooth:** Introduction, piconet, scatternet, protocol stack, and profiles. **WAP (Wireless Application Protocol):** Architecture and components, WAP gateway and protocol stack. **WML Script:** Variables, control structures, and functions. **IMT-2000 Standards:** WCDMA and CDMA2000. **Mobile IP:** Goals, requirements, entities, agent advertisement and discovery, registration, IP packet delivery, tunneling, and encapsulation. **Networking Protocols:** IPv6, DHCP, ICMP, routing. **Wireless Local Loop (WLL):** Introduction and applications. **Wireless Enterprise Networks:** Overview.	**10Hours**
Module-3	**Satellite Network Technology:** Global Mobile Satellite System (HEO, LEO, MEO), satellite system architecture, satellite constellations for satellite phones. **Case Studies:** Iridium, GLOBALSTAR, GLONASS. **Virtual Private Network (VPN):** Features and goals, remote access VPN, site-to-site VPN, VPN protocols and requirements, security issues in mobile computing, algorithms and implementation. **VoIP and Real-Time Protocols:** Overview, multimedia content delivery in mobile networks.	**10Hours**
	Total	**30Hours**

Books	Name of The Books/References	Publishers
Text Book :	T1.J.Schiller,***MobileCoMMunication*** T2.A.K.Talukder,H.Ahmed,andR.Yavagal,***MobileCoMputing*** T3.Y-B.Lin,I.Chlamtac,***WirelessandMobileNetworkArchitectures***	Pearson Education McGraw Hill 1stEdition,Wiley
Reference Book :	R1.V.K.Garg,***WirelessCoMMunicationandNetworks*** R2.U.Hansmann,L.Merk,M.Nicklous,andT.Stober,***PrinciplesofMobileC oMputing***	Pearson Education Springer,2006.
Online Resources	http://alphace.ac.in/downloads/notes/cse/10cs831.pdf https://www.tutorialspoint.com/mobilecomputing/mobilecomputingoverview.html	

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 usingfundamentals 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 toolsto complex computing activities, with an understanding of the limitations.
PO7	Recognize the need, and have the ability, to engage in independent learning for continualdevelopment 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		L-T-P	Credits	Hours	Marks
4th	25MCA402(D)	E-Commerce & Knowledge Management	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 knowledge management.
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, Introductionto Business Models and Revenue Models, Business Processes, Impacts,Advantages and Disadvantages of E-Commerce, International Nature ofE-Commerce; Technology Infrastructure: The Internet and the World WideWeb, Internet Protocols, Markup Languages, Intranets and Extranets; TheEnvironment ofE-Commerce:Legal,Ethical, andTaxIssues. RevenueModelsindetail,RevenueModelsinTransition,RevenueStrategy Issues, Creating an Effective Web Presence, Web Site Usability,ConnectingwithCustomers.	**10Hours**
Module-2	MarketingontheWeb:WebMarketingStrategies, Communicating with DifferentMarket Segments, Beyond MarketSegmentation:CustomerBehaviorandRelationshipIntensity,AdvertisingO n The Web, E-Mail Marketing, Technology-Enabled CRM, Creating andMaintaining Brands on the Web, Search Engine Positioning and DomainNames. Business-to-BusinessActivities:Purchasing,Logistics,andSupportActivities,ElectronicData Interchange, SupplyChainManagementUsing Internet Technologies, Electronic Marketplaces and Portals, SocialNetworking,MobileCommerce,andOnlineAuctions.	**10Hours**
Module-3	WebServerHardwareandSoftware:WebServerBasics,SoftwareforWebServers,E-Mail,WebServerHardware. Electronic Commerce Software: Web Hosting, Basic and advanced Functionsof Electronic Commerce Software, Electronic Commerce Software for Small,MidsizeandLargeCompanies,KnowledgeManagement,KnowledgeManagementtechnologiesandSoftware.	**10Hours**
	Total	**30Hours**

Books	Name of The Books/References	Publishers
Text Book :	T1.G.P.Schneider,***ElectronicCoMMerce***	CengageLearning
Referenc eBook :	R1.R.Kalakota,A.B.Whinston,***FrontiersofElectronicCoMMerce*** R2.C.V.SMurthy,***E-coMMerce:Concepts,Models&Strategies***	AddisionWesley HimalayaPublishing
Online Resources	1. https://nptel.ac.in/courses/110105083/:byProf.M.Jenamani,IITKharagpur.	

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 anyspecific need on societal and environmental aspects.
PO5	Create, select, adapt and apply appropriate techniques, resources, and modern computing toolsto 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 Cost of 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