DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

MASTER OF COMPUTER APPLICATIONS

TWO-YEAR PROGRAMME

CURRICULUM STRUCTURE & SYLLABI
(2023 – 25 ONWARDS)

SCHOOL OF ENGINEERING AND TECHNOLOGY
MODY UNIVERSITY OF SCIENCE AND TECHNOLOGY
LAKSHMANGARH

MASTER OF COMPUTER APPLICATIONS
Two-Year Programme
Academic Curriculum (2023 – 25 onwards)
Curriculum Component

Programme Level: Postgraduate **Duration:** Two Years (Four Semesters)

Component	**Credit**
1. University core (UC)	-
2. University Elective (UE)	-
3. Basic Science (BS) (2 course)	7
4. Engineering Science (ES)	-
5. Program Core (PC) (16 Courses)	42
6. Program Elective (PE) (2 Courses)	8
7.Project/Summer Internship Project (Proj/SIP) (3 Courses)	28
8. SEFS (Non Graded) (3 courses)	2*
Total	**85**

MASTER OF COMPUTER APPLICATIONS
Two-Year Programme
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Curriculum Component

First Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)			
			L	T	P		Hours	CW	MTE*	ETE	
Autumn Semester	CA 20.501	Programming Concepts	3	0	0	3	3	10	40	50	
	CA 20.503	Management Information System	3	0	0	3	3	10	40	50	
	CA 20.505	Data Base Management System	3	0	0	3	3	10	40	50	
	CA 20.507	Mathematical Foundation	3	1	0	4	3	10	40	50	
	CA 20.509	Programming Lab	0	0	4	2	2	20	40	40	
	CA 20.511	DBMS lab	0	0	4	2	2	20	40	40	
		Bridge Course*									
	CA 20.500	Computer Information System*	3	1	0	4	3	10	40	50	
		SEFS(Non-Graded)	-	2	-	1	2	50	-	50	
	Sub Total		**14/17***	4	**8**	17					

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration		Weightage (%)		
			L	T	P		Hours	CW	MTE	ETE	
Spring Semester	CA 20.502	Operating System	3	0	0	3	3	10	40	50	
	CA 20.504	Object Oriented Programming through Java	3	0	0	3	3	10	40	50	
	CA 20.506	Software Engineering	3	0	0	3	3	10	40	50	
	CA 20.508	Data Structure Concepts	3	1	0	4	3	10	40	50	
	CA 20.510	R Programming	3	0	*0*	*3*	3	10	40	50	
	CA 20.512	Data Structures Laboratory	0	0	*4*	*2*	2	20	40	40	
	CA 20.514	Java Programming laboratory	0	0	4	2	2	20	40	40	
	CA 20.516	R Programming laboratory	0	0	4	2	2	20	40	40	
	CA 20.518	Mini Project	0	0	0	4		100			
		SEFS (Non-Graded)	-	2	-	1	2	50	-	-	50
	Sub Total		**17**	**3**	**12**	**26**					

***** Additional bridge Courses for those students who have passed B.Sc./ B.Com./ B.A. without Computer Science at 10+2 Level or at Graduation Level . This will be an Audit course, wherein it is mandatory to pass with atleast 'D' grade. Credits will not be included in CGPA.

MASTER OF COMPUTER APPLICATIONS
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Curriculum Component

Second Year

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)			
			L	T	P		Hours	CW*	MTE**	ETE	
Autumn Semester	CA 20.603	Data Communication and Network	3	0	0	3	3	10	40	50	
	CA 20.605	Research Methodology	3	0	0	3	3	10	40	50	
	PE	Program Elective-I%	3	1	0	4	3	10	40	50	
	PE	Program Elective-II%	3	1	0	4	3	10	40	50	
	CA 20.609	Web Technology Laboratory	0	0	4	2	3	20	40	40	
	CA 20.611	Python Programming Lab	0	0	4	2	3	20	40	40	
		Summer Internship Project$	0	0	0	4		100			
	Sub Total		**11**	**2**	**8**	**22**					

	Course Code	Course Title	Contact Hours per Week			Credits	ETE Duration	Weightage (%)	
			L	T	P		Hours	Continuous Evaluation	End Term Evaluation
Spring Semester	CA 20.602	Industrial Project#	0	0	0	20	N.A.	25	75
	Sub Total					**20**			

Total credit: 85

$ After 1 year and during summer vacation, the student is expected to complete a summer Internship in organization outside the university. The work will be evaluated on the basis of presentation in autumn semester of 2nd year.

 # Student will have the option of choosing the project in an external organization.

% Program Elective-I and Program Elective-II will be offered on the basis of single track chosen by the Student.

Program Elective Tracks		
Web Designing and Digital Marketing (Track1)		
S. No.	**Course Code**	**Course Title**
1.	CA20.431	Advanced Java
2.	CA 20.432	Web Development with PHP
3.	CA 20.433	E-Commerce and E -Business
4.	CA 20.434	Social Media and Digital Marketing
5.	CA 20.435	Search Engine Optimization
AI & Data Analytics (Track 2)		
S. No.	**Course Code**	**Course Title**
1.	CA 20.282	Machine Learning with Python
2.	CA 20.381	Deep Learning
3.	CA 20.316	Artificial Intelligence
4.	CA 20.416	Predictive Modeling Analytics
5.	CA 20.418	Data Science & Analytics

Credit Distribution across all Components									
Semester	**UC**	**UE**	**BS**	**ES**	**PC**	**PE**	**SIP**	**Proj**	**Total**
First	**-**	**-**	**4**	**-**	**13**	**-**	**-**	**-**	**17**
Second	**-**	**-**	**-**	**-**	**22**	**-**	**-**	**4**	**26**
Third	**-**	**-**	**3**	**-**	**07**	**8**	**4**	**-**	**22**
Fourth	**-**	**-**	**-**	-	**-**	**-**	-	**20**	**20**
Total	**-**	**-**	**7**	**-**	**42**	**8**	**4**	**24**	**85**

CA 20.418 **Data Science & Analytics** **Total Lectures: 40**
Credit:3-1-0-4

Prerequisite(s): None.

Objective(s): To provide necessary knowledge on data manipulation and to perform analysis on the practical problems using statistical and machine learning approach.
To generate report and visualize the results in graphical form using programming tool

1. **INTRODUCTION:** Data Science: Introduction to Data Science – Digital Universe – Sources of Data – Information Commons – Data Science Project Life Cycle: OSEMN Framework **[6]**
2. **DATA PREPROCESSING and CONCEPT LEARNING:** Introduction to Data Preprocessing – Reading, Selecting, Filtering Data – Filtering Missing Values – Manipulating, Sorting, Grouping, Rearranging, Ranking Data, Formulation of Hypothesis – Probabilistic Approximately Correct Learning - VC Dimension – Hypothesis elimination – Candidate Elimination Algorithm **[10]**
3. **ESSENTIALS OF R:** R Basics - data types and objects - control structures – data frame -Feature Engineering - scaling, Label Encoding and One Hot Encoding, Reduction. **[7]**
4. **MODEL FIT USING R and VISUALIZATION**: Regression Models- Linear and Logistic Model, Classification Models – Decision Tree, Naïve Bayes, SVM and Random Forest, Clustering Models – K Means and Hierarchical clustering, Data visualization: Box plot, histogram, scatter plot, heat map – Working with Tableau – Outlier detection – Data Balancing **[10]**
5. **PERFORMANCE EVALUATION in R:** Loss Function and Error: Mean Squared Error, Root Mean Squared Error – Model Selection and Evaluation criteria: Accuracy, Precision, F1 score, Recall Score – Binary Predictive Classification – Sensitivity – Specificity, Recent Trends. **[7]**

Outcome(s): On successful completion of this course, students will be able to gain basic knowledge on data science, Convert the real time data into suitable form for analysis, Gain the insights from the data through statistical inferences and Identify the requirement and visualize the results

Text Books:

1. Ethem Alpaydin, Introduction to Machine Learning, Fourth Edition, MIT Press, 2020
2. Hadley Wickham, Garrett Grolemund, R for data science : Import, Tidy, Transform, Visualize, And Model Data Paperback, 2017

Reference Books:

1. Han, J., Kamber, M., Pei, J. Data mining concepts and techniques. Morgan Kaufmann. 2011
2. Carl Shan, Henry Wang, William Chen, Max Song. The Data Science Handbook: Advice and Insight from 25 Amazing Data Scientists. The Data Science Bookshelf. 2016

CA 20.500 **Computer Information System*** **Total Lectures: 40**
Credit: 3-0-0-3

Prerequisite(s): None.
Objective(s): To give essential knowledge about computer information system and its components.

1. **Introduction:** Evolution of Computers, Generation of Computers, Classification of Computers, Block Diagram of Digital Computers, Memory Unit, ALU,CPU, I/O Devices, Basic Bus Architecture. Software Classification, Machine Language, Assembly Languages And High Level Languages, Assembler, Compilers And Interpreters, Process of Compilation, Programming Language Generations, Introduction to Operating Systems and Role of the Operating System. **[8]**
2. **Digital Logic:** Introduction to Boolean Algebra and Logic Gates, K-map Representation and Boolean Function Simplification, Number Systems: Conversion from One Number System to Another, Binary Operations, Complement Representation of Numbers , Alphanumeric Codes, Floating Point Representation of Numbers, Floating Point Arithmetic Operations. **[6]**
3. **Digital Circuit Building Blocks:** Adders, Subtractors, Comparators, Encoders, Decoders, Multiplexers, De-Multiplexers, Latches, Flip-Flops, Master Slave Flip Flops, Shift Registers and Counters. **[10]**
4. **Internet Technologies**: Introduction to Computer Networks, Internet, WWW and E Mail, Web Browsers, Introduction to LAN,MAN, WAN, An Introduction to the Design of Web Pages, HTML tags and CSS, Web Servers, Server Scripting, XML. **[8]**
5. **Software Development:** A Systematic Approach to Program Design, Coding, Testing, and Debugging. Application of these Skills to the Construction of Robust Programs. Use of Programming Environments and Tools to Aid in the Software Development Process. **[8]**

Outcome(s): On successful completion of this course, students will be able to take specialized courses with strong fundamentals of Computer Information Systems.

Text Books:

1. P.K. Sinha, Computer Fundamentals, BPB Publications, latest Ed.
2. M. Morris Mano, Digital Logic & Computer Design, Pearson, latest Ed.
3. Roger S. Pressman, Software Engineering: A Practitioner's Approach, McGraw-Hill Higher Education, latest Ed.
4. Thomas Powell, HTML and CSS: The Complete Reference, Tata McGraw-Hill, 5th Edition, 2010.

Reference Books:

1. Andrew S.Tanenbaum, Computer Networks, Pearson Education, 5th Edition, 2013.
2. V. Rajaraman, Fundamentals of Computers, PHI, 6th Edition, 2014.

CA 20.501 **Programming Concepts** **Total Lectures: 40**
Credit: 3-0-0-3

Prerequisite(s): Nil

Objective(s):
- To learn the basics of programming skills through C-Programming language.
- To understand the fundamentals concepts like syntax, and statements with essentials of efficient compiling, running and debugging processes.

1. **Introduction:** Brief History, Library& Linking, Compilation & Execution, Data Types, Operator and Expression Identifier, Keyword and Token, Constant, Data Declaration and Definition, Operators and Expression,Precedence & Associability of Operators. [7]
2. **Control and Loop Statement:** Introduction, Selection Statements, If, The Conditional Expression, switch, Iteration Statements: for loop, while loop, do-While loop, Jump, Goto label, break and continue, exit() function. [7]
3. **Array, Function and String:** Definition, declaration and Types of Array, Operation and application of array, Brief introduction on string header files and applications of strings. Function, argument passing, scope of variable, call byreference and call by value, recursion, passing array to function. [5]
4. **Structure, Union and Pointer:** Definition, Declaration and Initialization, AccessingStructure members, Arrays of Structure, Passing Structure to function,Structure to Pointer, Union. Definition, declaration, Pointer to Pointer, NULL Pointer, De-referencing Pointer, array to pointer (1-D array ,2-D array) pointer array, function to pointer. [12]
5. **File handling and Storage Classes:** Introduction, Defining and Opening a File in read and writes mode, Closing a file and ending of file, Enumerated data types, Error Handling During I/O Operation Random Access to Files, Command Line Arguments. Storage Classes, Preprocessor Directive. [9]

Outcome(s): At the end of the course student will be able to:
- Describe the process of problem solving through C.
- Write a justifiable C program for a given algorithm.
- Trace the certain C program manually.

Text Books:
1. Scheldt Herbert, “C The Complete Reference” Tata McGraw hill Latest Ed.
2. Kernighan & Ritchie, “C Programming Language” Prentice Hall Second Edition, latest Ed

Reference Books:
1. Kanetkar Y.P., “Let us C Solutions” 10th edition, BPB publication, latest Ed.
2. Balaguruswamy E., “Programming in ANSI C “5th Edition Tata McGraw-Hill Education, latest Ed.

CA 20.502 **Operating System** **Total Lectures: 40**
Credit: 3-0-0-3

Prerequisite(s): NIL

Objective(s):

- Understand the fundamental operating system abstractions like processes, threads, files, semaphores, IPC and deadlocks.
- Understand operating system from user's perspective as well as from system's perspective.
- Understand the principles of concurrency and synchronization.
- Understand basic resource management techniques.

1. **Introduction:** Overview, Evolution, Types, operating system functions and characteristics. [3]
2. **Process Management and Memory Management:** The process concept, operating system services for process management, scheduling algorithms and multiple processor scheduling. Storage allocation methods, paging, segmentation, virtual memory concept, demand paging, page replacement algorithms and trashing. [10]
3. **Input /Output and File Systems:** Hardware organization, device scheduling policies, Functions of file systems, file access and allocation methods, directory systems, structured organizations, directory and file protection mechanisms and implementation issues. Device dependent and device independent software. [7]
4. **Deadlocks and Process Synchronization:** Characterization, prevention and avoidance, deadlock detection and recovery and practical consideration. Critical section problem, semaphores, classical process co-ordination problems and their solutions, inter process communication and message-passing mechanisms. Client-server modeling, RPC, threads. [10]
5. **Protection & Security:** Goals of Protection, Principles of Protection. Domain of protection Access Matrix, Implementation of Access Matrix. Access control, Revocation of Access Rights. Capability- Based systems, Language - Based Protection, Security problem, program threats, system and network threats cryptography as a security tool, user authentication, implementing security defenses, fire walling to protect systems. [9]

Outcome(s): By learning the course, the students will be able to,
describe, contrast and compare differing structures for operating systems
understand and analyse theory and implementation of: processes, resource control (concurrency etc.), physical and virtual memory, scheduling, I/O and files

Text Books:

1. Silberschatz A., and Galvin P.B., Operating System Concepts, John Wiley &Sons, latest Edition.
2. Tanenbaum A.S., Modern Operating Systems, Pearson Education Asia, latest Edition.

Reference Books:

1. Stallings W., Operating Systems, Pearson Education Asia, latest Edition.
2. Tanenbaum A.S. and Woodhull A. S., Operating Systems- Design and Implementation, Pearson Education Asia, latest Edition.

CA 20.503 **Management Information Systems**

Total Lectures:40
3-0-0-3

Prerequisite(s): Nil

Objective(s):

- To introduce the concept of system analysis for managing the projects
- To analyze and document systems, design new systems and implement their plans.
- Understanding paradigm shift to E-enterprise
- Applications of IS and IT to management functions of the industry

1.	**MIS and Enterprise:**Management Information System(MIS) concepts, definition, role, impact, management as a control system, MIS: A support to the management, goals, objectives and target, MIS for a digital firm, E-Business Enterprise: A digital firm-organization of business in digital firm, E-business, E-commerce, real time enterprise.	[8]
2.	**Strategic management of business performance:** Concept of corporate planning, essentiality of strategic planning, development of business strategies, types of strategies, short range planning, tools of planning,MIS: Strategic business planning.	[6]
3.	**Information andKnowledge:** Information Concepts, Classification of information,System Engineering: Analysis and Design- System concepts, system control, types of system, handling system complexity, system development model, Relationship between Information and Knowledge.	[8]
4.	**Development and implementation of MIS:** Determining the information requirement, Development and implementation of the MIS,Management of information, Quality of MIS, Business process reengineering.	[8]
5.	**Application of Management Information Systems:** Applications in manufacturing sector-personnel management, financial management, production management, raw material management, marketing management, applications in service sector, Decision support system.	[10]

Outcome(s):

By learning the course, the students will be able to

- Learn MIS and enterprise and strategic management of business performance.
- Learn management information system and its application
- Develop and implementation of MIS

Text Books:

[1] W. S.Jawadekar, Management Information Systems, , New York, Latest Ed.

Reference Books:

[1] J. A.O' Brien, Management Information Systems, McGraw-Hill, Latest Ed.
[2] Davis G. B., and Olson M. H., Management Information Systems, Tata McGraw-Hill, Latest Ed.

CA 20.504 **Object Oriented Programming through Java** **Total Lectures: 40**
Credit: 3-0-0-3

Prerequisite(s): (C-Programming)

Objective(s):

- Cover issues related to the definition, creation and usage of classes, objects and methods.
- Discuss the principles of inheritance and polymorphism.
- Provide the foundation of good programming skills by discussing key issues of the design of object- oriented software, including programming design and documentation.
- Cover the basics of API and to explore the java abstract programming interface.

1. **Overview:** Introduction to Java, importance of Java, interactive Development Environments: Eclipse/Net Beans, basics of OOP. [10]
   Data Types, Variable, and Arrays: Primitive data types, typecasting, arrays, operators and control structures, identifiers, constants and literals
2. **Classes and Objects:** Class fundamentals, declaring objects, assigning object reference variables, introducing methods, constructors, this keyword, garbage collection,the finalize()method, overloading methods, using objects as parameters and return type, introducing access control, understanding static, introducing final, introducing nested and inner classes, exploring the string class, using command-line arguments. [10]
3. **Inheritance:** Inheritance basics, using super, multilevel hierarchy, constructor inhierarchy, method overriding, dynamic method dispatch, using abstract classes, using finalin inheritance, the object class. [4]
4. **Package, Interfaces and Exception Handling:** Packages, access protection, importing packages, interfaces, exception-handling fundamentals, exception types, using try and catch, multiple catch clauses, nested try statements, throw, throws, finally, JAVA's built-in exceptions, user defined exception. [8]
5. **Multithreaded Programming:** The Java thread model, the main thread,creating multiple threads, threads priorities, managing threads, thread class built-in functions. I/O and String Handling: I/O basics, reading console input, writing console output, the print writer class, reading and writing files, string constructors, operations on string, string tokenizing, string buffer. [8]

Outcome(s): Upon completion of this course, students are able to:

- Understand the concepts of OOP as well as the purpose and usage principles of inheritance, polymorphism, encapsulation and method overloading.
- Identify classes, objects, members of a class and the relationships among them needed for a specific problem.
- Develop programs using the in-built Java API and the Java standard class library.
- Create Java application programs using sound OOP practices (e.g., interfaces and APIs) and proper program structuring (e.g., by using access control identifies, automatic documentation through comments, error exception handling).
- Use of development environment like Eclipse for collaborative programming

Text Books:
[1] H.Schildt, Java The Complete Reference, Herbert Schildt, 10th Edition, 2017.
[2] John Jukowski, Mastering Java J2SE 1.4,SYBEX, Latest Ed.

Reference Books:
[1] A.B. Downey, ThinkJ ava: How to Think Like a Computer Scientist, Latest Ed.
[2] P.Deitel and H.Deitel, Java How To Program (Early Objects),10th Edition, 2015.

CA 20.505 **Database Management Systems** **Total Lectures: 40**
Credit: 3-0-0-3

Prerequisite(s): Nil

Objective(s): The objective of this Course is to:

- Understand the fundamental concepts of database management.
- Design and Normalize databases.
- Understand transaction processing control.
- Understand basic of object concepts and object relations.
- Understand the role of the DBMS, RDBMS& ODBMS in the organization

1. **Introduction**: Databases and database users, database system concepts and architecture, data modeling using the Entity-Relationship (ER) model, Enhanced Entity Relationship model. [6]
2. **Relational Data Model**: Concepts, relational model constraints, relational database schemas, update operations, dealing with constraint violations, relational algebra operations, relational calculus, mapping ER model to relational model. [12]
   Structured Query Language (SQL): SQL data definition and data types, specifying constraints, schema change statements, basic queries, complex queries, update statements, views
3. **Database Design**: Functional dependencies and normalization of relational databases, First Normal Form (1NF), 2NF, 3NF, Boyce-Codd normal form (BCNF), multivalued dependency, 4NF. [6]
4. **TransactionProcessing**:Introduction,properties,recoverability,serializability. [8]
   Concurrency control techniques: Two phase locking protocol, database recovery techniques: Recovery concepts, recovery techniques based on deferred and immediate update
5. **Object and Object-Relational Databases**: Concepts for object databases, object database standards and design, object relational systems, object relational features, object database extensions to SQL, ODMG object model and the object definition language (ODL) [8]

Outcome(s): After completion ofthecourse, students willbe able to:

- Analyze database models & entity relationship models. Understand architecture for database development.
- Design E-R diagram
- Use Structured Query Language (SQL) with complex queries.
- Design and normalize the relations for any organization.
- Understand transaction processing control.

Understand Object Oriented databases

Text Books:

[1]R.Elmasri & S.B.Navathe, Fundamentals of Database Management Systems,7th Edition, Pearson Education, 2016.
[2] R. Ramakrishnan, Database Management Systems, Latest Edition, Tata McGraw Hill, latest Ed.

Reference Books:

[1] Korth and Schilberschatz, Database System Concepts, 6th Edition, Tata McGraw Hill, 2011.
[2] C.J. Date, Database Systems, Tata McGraw Hill, Latest Edition.

CA 20.506 **Software Engineering** **Total Lectures:40**

Credit:3-0-0-3

Prerequisite(s): NIL

Objective(s):

- To understand the basic software engineering approaches, software development process models, project planning, software size estimation, software effort and cost estimation and risk management.
- To know about software requirements specification, requirement elicitation, structured system analysis and introduction of object-oriented analysis and design, design techniques.
- To acquire knowledge on implementation issues such as modularity and coding standards.
- To learn coding style guidelines and standard and software testing, different type of testing strategies and their application in real time system.
- To study web based-system and application, software re-use, software re-engineering, agile software engineering, software engineering and testing tools.
- To develop teamwork and have project based experience.

1. **Introduction:** Software crisis, Software engineeringApproach and Challenges, Software development process models with comparison: Waterfall, Rapid Prototyping, Spiral, Iterative, V-shape and Evolutionary Model, SEI-CMM. [6]
2. **Software Processes and Requirement Analysis:** Software engineering: a layered technology requirement elicitation, requirement analysis, software requirement and specifications, data flow diagrams, data dictionaries, entity-relationship diagrams. Software Measurement, planning schedule, Risk management,Quality Assurance. [10]
3. **Software Design and Estimation Techniques:** Introduction to object-oriented design, Function and Object Oriented Design concepts, Verification and Validations, Software size and cost estimation Techniques: Size oriented Metrix, FPA and COCOMO. [8]
4. **Testing:** Software testing fundamentals, test case design, white box testing:-basis path testing, control structure testing, black box testing: boundary value analysis, equivalence class testing, decision table testing, cause effect graphing, debugging, testing tools & standards, testing for client/server architecture, [9]
5. **Special Topics:** Brief of software re-use, reverse engineering, software re-engineering, agile software engineering, CASE Tools. [7]

Outcome(s):

- Demonstrate knowledge of the distinction between critical and non-critical systems and ability to manage a project including planning, scheduling and risk assessment/management.
- Author a software requirements document and understanding of the proper contents of a software requirements document.
- Demonstrate proficiency of different life cycle models.
- Identify specific components of a software design that can be targeted for reuse.

Demonstrate proficiency in software development cost estimation, software testing plan and advanced topics of software engineering.

Text Books:

[1] R. S. Pressman, Software Engineering – A practitioner's approach,Tata-McGraw-Hill Int. Ed., 8th edition, 2014.

[2] K. K. Aggarwal, Yogesh Singh, Software Engineering, New Age International, latest edition.

Reference Books:

[1] Pankaj Jalote, An Integrated Approach to Software Engineering, Narosa Publisher, Latest edition.

[2] Rajib Mall, Fundamentals of Software Engineering, Prentice-Hall, Latest edition.

CA 20.507 **Mathematical Foundation** **Total Lectures: 40**
Credit: 3-1-0-4

Prerequisite(s): Elementary Mathematics

Objective(s): To acquire fundamental knowledge of higher Mathematics and apply in Science and engineering disciplines.

1. **Matrix Theory:** Introduction to the matrix theory, types of matrices, inverse of matrices, rank of matrices, solving system of linear equations. [10]
2. **Eigen Values:** Eigen values and Eigen vectors, Sparse matrix, diagonalization and triangulization of matrices. [6]
3. **Three-dimensional geometry and Vector calculus:** Basic concepts of three-dimensional geometry (viz. direction cosines and direction ratios), equation of aplane and of a straight line. Basic concepts of vectors, gradient, divergence and curl of a vector. [8]
4. **Calculus:** Introduction of differential and integral calculus, derivatives of various types of functions, basic idea of differential equations, solutions of ordinary differential equations with constant coefficients. [10]
5. **Complex Algebra:** Introduction to the complex algebra, complex numbers, geometrical representation of complex numbers, Argand diagram, De-Moirvre'stheorem. [6]

Outcome(s): After completion of the course, students would be able to apply fundamentals of higher mathematical knowledge in science and engineering and also solve curriculum problems.

Text Books:

1. Ramana B. V. , " Higher Engineering Mathematics", Tata McGraw – Hill Publishing Company Ltd., P 1390, Latest edition.
2. Babu Ram, "Engineering Mathematics", Pearson, New Delhi, 2010.
3. Narayan Shanti, "Analytical Solid Geometry", S Chand & Company, New Delhi, Latest edition.

Reference Books:

1. Grewal B. S. and Grewal J. S. , "Higher Engineering Mathematics" , Khanna Publishers,New Delhi, P. 1390, 40th edition,20014
2. Kreyszig Errwin, "Engineering Mathematics", John Wiley& Sons, New York, , p. 1639, Latest edition.

CA 20.508 **Data Structure Concepts** **Total Lectures: 40**
Credit: 3-0-0-3

Prerequisite(s): C Programming

Objective(s):
- To provide knowledge of ways of structuring and operating on data, the nature of some fundamental problems, methods for addressing those problems,
- To promote an analytical and empirical appreciation of the behavior of algorithms using data structures.

1. **Introduction:** Data Structure definition, Requirement of different Data Structures, Abstract Data Type, Analysis of Algorithm [3]
2. **Linear Data Structure:** One and Two-dimensional Arrays, Array Representation, Selection Sort, Bubble Sort, Quick Sort, Heap Sort and Merge Sort,SequentialSearch, Binary Search. Linked List and itsrepresentations, Operations on LinkedList, Types of Linked List, Stack and its representation, Operations on Stack,Queue and its representation, Operations on Queue, Applications of these data structures. [15]
3. **Tree :** Binary Tree and its travesals (Breadth-First, Depth-First), Expression Trees (Infix, Prefix, Postfix Traversals), Binary Search Trees, Heaps,AVL Tree [12]
4. **Graph:** Matrix Representation, List representation and applications, Minimum Spanning Tree finding algorithms, Shortest Path finding algorithms. [5]
5. **Hashing Techniques:** Hash Function, Address Calculation Techniques, Common Hashing Functions, Collision Resolution, Linear Probing, Double Hashing, Bucket Hashing, Deletion and Rehashing. [5]

Outcome(s): On the successful completion of the course, the student will be able to:
- be knowledgeable of certain abstract data types (ADT)
- be able to make a critical assessment of different implementations of an ADT
- be familiar with a number of fundamental computational problems, and be aware of real world instances of those problems

Text Books:
1. Horowitz and Sahani, “Fundamental of data structures”,Galgotia Publication, Latest Ed.
2. Lipschutz, “Data Structures Schaum’s Outline Series”, Tata Mcgraw Hills, Latest Ed.

Reference Books:
1. Tenenbaum Aaron M., Yedidyah Langsam and Moshe J. Augenstein “Data Structures through C, Tata Mcgraw Hills, Latest Ed.
2. Kruse R. etal, “Data Structures and Program Design in C”, Pearson Education,Latest Ed.

CA 20.509 **Programming Laboratory**

Credit: 0-0-4-2

Prerequisite(s): NIL

Objective(s): To learn the basics of programming skills through C-Programming language.
To understand the fundamentals concepts like syntax, and statements with essentials of efficient compiling, running and debugging processes.

Contents

1. **Testing**
   Data Types & Operators, Control Statements,Arrays,Strings,Apply logic to print different patterns(at least 5).Max and min of a given list of numbers, their sum and average, Result of a student using switch-case, Implementing matrix operations, Searching and Sorting, String Manipulations, Program to understand the decision making constructs and find the roots of a quadratic equation,Program to understand the implementation of library function.
2. **Functions, Pointers, Structure and Union**
   Function & Function Calling, Storage Classes, Function Declaration and Definition, Function call by value and call by reference,Illustration of storage classes, Pointer, Structure, Union
3. **File Handling**
   Program to Create a File & Store Information,Program to illustrate Reading of Data from a File and to delete or replace a specific Line from a Text File, Program to Create Employee Record and Update it

Outcome(s): At the end of the course student will be able to:

- Describe the process of problem solving through C.
- Write a justifiable C program for a given algorithm.
- Trace the certain C program manually.

CA 20.510 **R Programming** **Total Lectures: 40**
Credit: 3-1-0-4

Prerequisite(s): Programming Concepts (CA 20.501)

Objective(s):

- To understand and learn programming concepts of R
- To Apply R programming to solve various statistical, graphics and modeling problems

1. **Fundamentals of R** : Evolution of R, Features of R, R environmental Setup, R Script file. [6]
   Data types- Vectors, Lists, Matrices, Arrays, Factors, Data Frames, Variables, finding and deleting variables, Operators in R.
2. **Control Statements in R**: if-else statement, switch statement, Repeat loop, while loop, for loop, break statement, next statement [8]
3. **Functions, Strings and Vectors :** Function Definition , Function Components [10]
   Built-in Function, User-defined Function, Calling a Function, Lazy Evaluation of Function,Strings and Strings Manipulation, Vector creation, accessing vector elements, vector manipulation,
4. **Lists, Matrices and Arrays :** List Creation, Naming list elements, Accessing list elements, Manipulating list elements, Merging list, Converting list to Vector, Accessing elements of matrix, matrix computations, Naming row and column of array, accessing array elements, manipulating array elements, calculation across array elements. [10]
5. **Data frames, factors and packages:** Extract data from data frame, expand data frames, factors in data frames, changing the order of levels, generating factor levels, packages. [6]

Outcome(s): After completing the course the student is expected to

- be able to use and program in the R programming language
- be able to use R programming to solve statistical problems
- be able to apply R Programming concept to solve real world problems

Text Books:

1. Hadley Wickham, Garrett Grolemund, R for Data Science, O'Reilly, January 2017.
2. John Maindonald and John Braun, Data Analysis and Graphics Using R, Cambridge University Press, Cambridge, Latest Ed.

Reference Books:

1. Peter Dalgaard, Introductory Statistics with R, Springer Verlag, Latest Ed.
2. Phil Spector. Data Manipulation with R. Springer, New York, 2008.

CA 20.511 Data Base Management Systems Laboratory Credit:0-0-4-2

Pre-requisites: C-Programming, and DBMS

Objective: By the end of the practical sessions of this section, students will be able to

Create Databases using a user interface and SQL command.

- Create Integrity and constraints on databases.
- Write SQLqueries.
- Provideapracticaloverviewofadvancedconceptsliketriggers,assertion, views, etc.

Outcomes: After undergoingthislaboratorymodule, thestudentsshouldbe able to:

- Understand, appreciate and effectively explain the underlying concepts of database technologies.
- Designand implement adatabaseschemafor a given problem-domain.
- Populate and queryadatabaseusingSQLDML/DDLcommands.
- Declareandenforceintegrityconstraintsonadatabaseusingastate-of-the-art
- RDBMS.
- ProgrammingPL/SQLincludingstoredprocedures,storedfunctions,cursors, packages.

CA 20.512 **Data Structures Laboratory** **Total Hours: 26**
Credit: 0-0-4-2

Prerequisite(s): C Language

Objective(s): To develop skills to design and analyze simple linear and nonlinear data structures

Contents:

To Strengthen the ability to identify and apply the suitable data structure for the given real world problem

1. **Arrays**
   1. To implement the array concepts for matrix applications.
   2. To implement the 1-D, 2-D and 3-D array concepts for data storage and retrieval.
2. **Linked List Testing:**
   1. To implement various operations over the linked list.
   2. To implement variations of linked list e.g. Circular linked list.
   3. To implement various operations over the stack.
   4. To demonstrate applications of stack e.g. infix to prefix conversion.
3. **Queue Testing:**
   1. To implement various operations over the queue.
   2. To demonstrate variations of queue e.g. dequeue.
4. **Tree Testing:**
   - To demonstrate variations of Tree e.g. binary search tree.
   - To implement different operations on Tree (traversal,insertion,deletion).
5. **Graph Testing:**
   - To implement various traversing of Graph.
   - To demonstrate applications of Graph.
6. **Searching Testing:**
   To implement searching algorithms.
7. **Sorting Testing:**
   - Bubble Sort, Insertion Sort, Selection Sort, Heap Sort and Quick Sort.

Outcome(s): At the end of this course, the student will

Be able to design and analyze the time and space efficiency of the data structure.

Be capable to identity the appropriate data structure for given problem.

CA 20.514 **Java Programming Laboratory** **Credit:0-0-4-2**

Prerequisite: C++Programming Lab.

Objectives: The objective of this course is to:

- Become comfortable with object-oriented programming and learn to think in terms of objects.
- Provide the foundation of good programming skills by discussing key issues to the design of object-oriented software, including programming design patterns, documentation.

Contents: Lab manual based upon the theory course CA 20.504 and to achieve the listed course objectives and outcomes.

Outcomes: Upon completion of this course, students are able to:

- Understand the concepts of OOP as well as the purpose and usage principles of
- Inheritance, polymorphism, encapsulation and method overloading.
- Create Java application programs

Use of development environment like Eclipse for collaborative programming/editing

CA 20.516 **R Programming Laboratory** **Credit: 0-0-4-2**

Prerequisite(s): CA20.509 (Programming Laboratory)

Objective(s):

- To learn R programming constructs
- To learn use R for statistical analysis
- To learn R for modeling.

Contents: Lab manual based upon the theory course CA20.510 and to achieve the listed course objectives and outcomes.

Outcome(s): On successful completion of this course, the students will be able to

- Write programs using R programming
- Use R programming for statistical analysis of data
- Use R programming for data visualization
- Use R programming for problem modeling

CA 20.603 **Data Communication and Network** **Total Lectures: 40**
Credit: 3-0-0-3

Prerequisite(s): Nil

Objective(s):

- To become familiar with layered communication architectures (OSI and TCP/IP).
- To understand the client/server model and key application layer protocols.
- To construct large-scale computer networks
- To understand fundamentals of computer networks and major protocols.
- To analyze and evaluate major Internet protocols.
- To program simple network applications using socket API
- To learn and adopt newly introduced computer network technologies by themselves.

1. **Introduction to Network Model:** History and development of computer networks, categories of networks, layering and protocols. [8]
   Physical Layer: Different types of transmission media, transmission impairments, encoding schemes (NRZ, NRZI, Manchester, 4B/5B, Manchester etc.)
2. **Data Link Layer:** Framing concept, Aloha, CSMA/CA, CSMA/CD protocols, performance evaluation and characteristics, error detection (parity, CRC), sliding window, stop and wait protocols,stop performance and efficiency,packet and circuit switching. [8]
3. **Local Area Network and Network Layer:** IEEE 802.3, 802.4, 802.5, 802.11, performance evaluation.IPv4, IP address classes, classless addressing, IPv6, ARP, RARP, DHCP, ICMP, routing algorithms: distance vector, metrics, RIP, OSPF, BGP, congestion control algorithms, leaky bucket, token bucket. [10]
4. **Transport Layer:** Duties of the transport layer, connection, TCP, TCP services, TCP header, UDP, evaluating protocol such as TCP/UDP using simulator like NS2. [6]
5. **Application Layer:** DNS, FTP, HTTP, SMTP, POP, basics of network security (cryptography, digital signature and firewall). [8]

Outcome(s): On successful completion of this course, students will be able to

- Analyze computer network component and devices.
- Synthesize how communication works in a network and internet.
- Formulate the concept of topologies and their applications.
- Analyze protocol at different layers and how they play important role in network implementation.
- Identify and analyze the latest technology with existing one.
- Enumerate the layers of OSI and TCP/IP models.
- Configure network and wireless technology including client/server programming.

Text Books:

[1]Forouzan B. A., Data Communications and Networking, Tata McGraw-Hill, 5th edition, 2013

[2] Stallings W., Data and Computer Communications, Prentice-Hall of India, 10th edition, 2013.

Reference Books:

[1] Tanenbaum A. S., Computer Networks, Prentice-Hall of India, Latest Ed.

[2]Hayes J. F., Modeling and Analysis of Computer Communication Networks, Plenum Press, Latest Ed.

CA 20.605 **Research Methodology** **Total Lectures: 40**
Credit: 3-0-0-3

Prerequisite(s): Communication Skills

Objective(s):

- To understand a general definition of research design.
- To identify the overall process of designing a research study from its inception to its report.
- To be familiar with ethical issues in educational research, including those issues that arise in using quantitative and qualitative research.
- To understand the primary characteristics of quantitative research and qualitative research.
- To identify a research problem stated in a study

1. **Introduction**: Meaning of research, Objectives, Motivation for Research, Types of Research, Research Approaches, Research Process,Validity and Reliabilityi n Research. [6]
2. **Problem Formulation**: Identification, Selection and Formulation of a Research Problem, Criteria of a good Research Problem, Review of Literature, Research Gaps. [10]
3. **Research Design**: Research Framework, Meaning &Significance of Research Designs, Features of a good Research Design, Types of Research Design. [10]
4. **Data Analysis and Simulation Tool**: Types of Data, Sources of Data, Methods of Collecting Data, Data Presentation Techniques. Methods of Data Analysis, SPSS, MATLAB, Network Simulators, ETAP, Solid Works, MultiSim. [12]
5. **Report Writing**: Types of Reports, Contents, Style Manuals, Results & Findings, Contributions, Implications, Scope for future work and conclusion, Referencing Styles, Anti Plagiarism Policy. [2]

Outcome(s): On successful completion of this course, the students will be able to

- Assess critically the following methods: literature study, case study, structured surveys, interviews, focus groups, participatory approaches, narrative analysis, cost-benefit analysis, scenario methodology and technology foresight.

Text Books:

1. R.Pannershelvam, "Research Methodology" Prentice Hall India, New Delhi, 2nd Edition, 2013.
2. C.R.Kothari,"Research Methodology: Methods and Techniques",New Age International (p) Limited, Publishers New Delhi, 4ndedition,2018.

Reference Books:

1 William G.Zikmund, “Business Research Methods”, Cengage Learning New Delhi, 8th edition, 2016.
2. Mark Saunders, “Research Methods for Business Students” Pearson Education New Delhi, 7th edition, 2015.
3. Donald R Cooper, “Business Research Methods” Tata McGraw-Hill Publishing Company Limited New Delhi, 12th edition, 2013

CA 20.609 Web Technology Laboratory 0-0-4-2

Objectives: The objective of this course is to:

- Become comfortable with HTML tags
- Develop Web Pages by use of HTML tags

Contents

- Markup Tags
- Formatting Tags
- Frames
- Form Elements
- Cascading Style sheets
- Dragging
- Dropping
- Div tag.
- java Script Declaration and Expressions
- Control Structure and Functions
- Java Script: Properties and Methods
- Array Object
- Date Object
- Math Object
- String Object
- Events in java Script: Onblur, Onclick, on change, on focus.
- Form validation through JavaScript

Outcomes: Upon completion of this course, students will be:

- Able to Design web pages based on above Tags
- Able to Program for Event handling
- Able to Working with Date and Time Functions
- Able to Program for calculator

Able to Access XML document elements through program

CA 20.611 Python Programming Laboratory

Credit:0-0-4-2

Prerequisite: (CA 20.509) Programming Laboratory

Objectives: The objective of this course is to:

- Become comfortable with Python programming, starting from basics of data types to deep learning.
- Provide the foundation of to explore any expansions of Python whether it is machine learning, deep learning, web development or gaming. It will also put focus to learn various skills to design object-oriented software.

Contents:

- Code different data types and operations on list, dictionaries, sets, String etc
- Code basic programs like factorial, Fibinocci etc. to understand functions and recursions.
- Implement different built-in functions in Python like eval, exec, map, lambda etc.
- Implement the concept of class, objects, inheritance and polymorphism
- Implement constructor and self
- Code programs to implement exceptions and assertions
- Implement regular expressions
- Code programs to implement the logic for machine and deep learning

Outcomes: Upon completion of this course, students will be:

- Able to develop application in Python
- Able to develop scientific applications for machine learning
- Able to use python to implement a given logic.
- Able to use various Python IDE like Anaconda, Pycharm etc.

CA20.435 **Search Engine Optimization** **Total Lectures: 40**
Credit: 3-0-0-3

Prerequisite(s): CA20.501 (Programming Concepts), CA20.503 (Management Information System)

Objective(s): To introduce the foundational elements of how search engines work.
Discuss core SEO strategies and tactics used to drive more organic search results to specific website or set of websites.

1	**Introduction:** Choose a topic, find your target audience, set a budget, set goals, put a team together, keep up with industry news, and attend an industry conference, introduction to keyword generation, using the word tracker keyword suggestion tool, google trends tool, creating pages, optimize meta description and keyword tags, optimize images, create link and validate html.	[4]
2	**Creating Contents and Communities:** Introduction write for people, not search engines, avoid duplicate contents, keep content current, optimize non-html document, creating communities, create a blog with WordPress, blogger, tumblr.	[10]
3	**Using Google Analytics:** Introduction create account, install tracking code, exclude your IP address with filter, track external links, automate reporting, set up e-commerce tracking, tracking code in thank you page, and third-party shopping cart.	[10]
4	**Social Media Optimization:** Introduction, network with Facebook, google+, Facebook business pages, Facebook ads, microblog with twitter, network with webmaster world, paper click campaign, AdWords account, bidding strategies, PPC reports.	[8]
5	**Optimization for Search Engines:** Introduction, blogpost for Technorati, google images, exposure on ask.com, drive traffic, eBay auctions, local search and local page, media ranking, offsite ranking, SEO tools, plugins and comparison tools, WordPress SEO plugin by Yoast.	[8]

Outcome(s): On successful completion the students will be able to:

- Critique the role of advertisements and corporate funding in the development of search.
- Write their own content for a website that will improve search results
- Compare and contrast the functionality of search engine algorithms update.

Text Books:

1. Kristopher B. Jones, “Search Engine Optimization”, Wiley India Pvt. Ltd, 3rd Edition, 2013

Reference Books:

1. Eric Enge, Stephan Spencer, Rand Fishkin and Jessie C Stricchiola, “The Art of SEO: Mastering Search Engine Optimization”, O'Reilly, Latest Ed
2. Jerri L. Ledford, “SEO: Search Engine Optimization Bible”, Wiley India, Latest Ed
3. John I Jerkovic, “SEO Warrior: Essential Techniques for Increasing Web Visibility”, O'Reilly, Latest Ed

CA20.431 **Advanced Java** **Total Lectures: 40**
Credit: 3-0-0-3

Prerequisite(s): CA20.504 (Object Oriented Programming through Java)

Objective(s): This course extends the study of Web Programming Fundamentals. Advanced concepts of program design, implementation and testing will be introduced with J2EE framework. Student will learn various concept of advance Java for implementation of small to medium sized application programs that illustrate professionally acceptable coding and performance standards.

1	**Introduction:** OOPS principle, class and objects, basics of HTML, web development introduction, web framework, J2EE building blocks, web application structure	[4]
2	**Servlets:** Servlet needs, servlet request-response model, servlet life cycle (init, service, doGet, doPost), servlet configuration, scopes (session, request, page), servlet parameters, servlet context, forms processing (get, post), HTTP header processing, HTTP responses.	[10]
3	**Java Server Pages**: JSP life cycle, JSP a servlet, creating dynamic content with use of JSP elements: expressions, scriptlets& declarations, JSP composition, redirecting, forwarding, accessing default objects (request, response, session, application, config, pageContext), error processing with use of JSP, Servlets vs. JSP pages	[10]
4	**Session management**: Http session, the Http session interface session tracking: cookies, hidden fields, cookies and JSP, sending and receiving cookies.	[6]
5	**Using Beans and tag libraries**: Separating presentation and business logic, JSP actions, JavaBeans, working with properties, <jsp:useBean>, <jsp:getProperty> and <jsp:setProperty>,using form parameters with Beans, custom tags, types of tags.	[10]

Outcome(s): Upon successful completion of this course you should be able to:

- Demonstrate knowledge of the advance Java along with object oriented development process and apply this understanding to the analysis and design of solutions for small to medium scale problems.
- Implement web application using all the feature of J2EE covered in the course.

Text Books:

1. Phillip Hanna, Osborne, "JSP 2.0: The Complete Reference", McGraw-Hill, Latest Ed.
2. Martin Bond, Debbie Law, Andy Longshaw, Dan Haywood, Peter Roxburgh, "SAMS Teach Yourself J2EE in 21 Days", SAMS, Latest Ed.

Reference Books:

1. Bryan Basham, Kathy Sierra & Bert Bets, Head First Servlets and JSP, Oreilly publication, Latest Ed.

CA20.433 **E-Commerce and E-Business** **Total Lectures: 40**
Credit: 3-0-0-3

Prerequisite(s): CA20.501 (Programming Concepts),

Objective(s):

- To introduce the fundamental principles of E-Business and E-Commerce and the role of management.
- To develop an enhanced knowledge among students of the potential of information technology to enable E-Business.
- To understand the application of tools and services to the development of small-scale E-Commerce applications.

1	**Introduction to E-Commerce and E-Business:** Meaning and concept, E-Commerce vs. traditional commerce, media convergence business applications and need for E-Commerce, E-Business basics, network and electronic transactions.	[8]
2	**The Internet Environment for E-Commerce:** B2B, B2C, providers and vendors, EDI, UN/EDIFACT standard, identification and tracking tools for E-Commerce, overview of Internet bandwidth and technological issues.	[8]
3	**Security Framework:** Security concerns, security solutions, cryptography, digital signature, PKCS, protocol for secure messaging, key management, SET protocols, E-cash over the Internet.	[6]
4	**Legal Issues:** Paper document vs. electronic documents, technology for authenticating electronic document, laws for E-Commerce, EDI interchange agreement, legal issues for internet commerce, cyber security, cybercrimes.	[6]
5	**Case Study:** Designing and building E-Commerce website, managing products, database, shopping cart applications, integrating mobile E-Commerce, payment gateway, tracking orders, study of Amazon and eBay.	[12]

Outcome(s): On successful completion the students will be able to:

- Recognize the fundamental principles of E-Business and E-Commerce.
- Examine applications of E-Commerce in relation to the applied strategic.
- Explain the added value, risks and barriers in the adoption of E-Business and E-Commerce.

Text Books:

1. K K Bajaj and D Nag, "E-Commerce: The Cutting Edge of Business", 2nd edition, Tata McGraw Hill, 2009
2. H Chan, R Lee, T Dillon and E Chang, "E-Commerce: Fundamentals and Applicaiotns", Willey India, 2008

Reference Books:

1. P T Joseph, "E-Commerce – An Indian Perspective", 3rd edition, PHI, 2008
2. A Kahate, "Cryptography and Network Security", 4th edition, Tata McGraw Hill, 2008
3. J Botha and C Bothma, "Managing E-Commerce in Business", 2nd edition, Juta& Company, 2008

CA20.432 **Web Development with PHP** **Total Lectures: 40**
Credit: 3-0-0-3

Prerequisite(s): CA20.501 (Programming Concepts), CA20.504 (Object Oriented Programming through Java)

Objective(s): Build dynamic Web applications. Semantics and syntax of the PHP language, including discussion on the practical problems that PHP solves. Write server-side cross-platform HTML-embedded scripts to implement dynamic Web pages that interact with databases and files.

1	**Introduction:** Introduction to PHP, storing and retrieving data, using arrays, string manipulation and regular expressions, reusing code and writing functions.	[8]
2	**MySQL:** Designing and creating web database, accessing MySQL database from web with PHP, advanced MySQL.	[6]
3	**E-Commerce and Security:** Running an E-Commerce site, E-Commerce security issues, implementing authentication with PHP and MySQL.	[10]
4	**Advanced PHP Techniques:** Interacting with file system and server, using network and protocol functions, managing date and time, generating images, using session control in PHP.	[6]
5	**Building Practical PHP and MySQL projects:** Applying software engineering for web development, debugging, building user authentication and personalization, building a shopping cart, building web forms, generating personalized documents in PDF.	[10]

Outcome(s): After Successful completion of this course student will be able to:

- Write PHP scripts to handle HTML forms
- Write regular expressions including modifiers, operators, and meta-characters.
- Create PHP programs that use various PHP library functions, and that manipulate files and directories
- Analyze and solve various database tasks using the PHP language
- Analyze and solve common Web application tasks by writing PHP programs

Text Books:

1. Luke Welling and Laura Thomson, PHP and MySQL Web Development, Addison Wesley, 5th edition, 2017.

Reference Books:

1. Adrian W. West, Practical PHP and MySQL Website Databases, Apress, 4th edition, 2017.

CA20.434 **Social Media and Digital Marketing** **Total Lectures: 40**
Credit: 3-0-0-3

Prerequisite(s) :CA20.503 (Management Information System)

Objective(s): To examine and explore the role and importance of social media and digital marketing in today's rapidly changing business environment. It also focuses on how digital marketing can be utilized by organizations and how its effectiveness can measured.

1	**Social Media and Customer Engagement:** The social feedback cycle, the social web and engagement, the operations and marketing connections, social interactions, customer relationships, outreach and influencer relation, social business and measurement, employees as change agents.	[6]
2	**The Social Business Ecosystem:** Social profiles, social applications, using brand outposts and communities, the social ecosystem.	[4]
3	**Social Technology and Business Decisions:** Create a social business, understand the conversations that matters, social CRM and decision support, social analytics, web analytics, business analytics, best practices in social business.	[8]
4	**Social Business Building Blocks:** Engagement on the social web, engagement as a customer activity, engagement as a business activity, extend engagement, social CRM and business design, building a social CRM program, enterprise 2.0 and Internet collaboration, build on existing social objects, create new social objects, use social objects in business, use the social graph in business, measure the social graph.	[10]
5	**Digital Marketing:** Digital marketing strategy, user experience design, online advertising, affiliate marketing, video marketing, email marketing, mobile marketing, data analytics.	[12]

Outcome(s): On successful completion the students will be able to:

- Explain the role and importance of digital marketing in a rapidly changing business landscape.
- Discuss the key elements of social media marketing strategy
- Illustrate how the effectiveness of a digital marketing campaign can be measured

Text Books:

1. Dave Evans and Jake McKee, "Social Media Marketing: The Next Generation of Business Engagement", Wiley Publishing, 2010
2. Rob Stokes, "eMarketing: The Essential Guide to Marketing in a Digital World", 5th edition, Quirk Education, 2013

Reference Books:

1. McDonald Malcolm and Wilson Hugh, "E-Marketing: Improving Marketing Effectiveness in a Digital World", Prentice Hall, Latest Ed
2. Ryan Deiss and Russ Henneberry, "Digital Marketing for Dummies", Wiley, 2017

CA-20.416 **Predictive Modeling Analytics** **Total Lectures: 40**
Credit:3-0-0-3

Prerequisite(s):

Objective(s):

- To understand how analytics provided a solution to industries using real case studies
- To Explain what is analytics, the various types of analytics, and how to apply it
- To Improve efficiency, sample records, and work with sequence data
- To Integrate and collect data
- To Understand the principles of data mining

1. **Business Analytics Overview**: Analytics overview, Analytics trends, Towards a predictive enterprise, Analytics: Industry domains , Case studies and solutions.Business Intelligence and Analytics. [5]
2. **Introduction to A Predictive Analytics Platform & Data Mining**: Introduction to data mining, Working with modeler, A Data-mining tour ,Collecting initial data , Understanding your data ,Setting the unit of analysis ,Integrating data ,Deriving and reclassifying fields, Looking for relationships ,Introduction to modeling , Exercise: On the basis of all above topics. [10]
3. **Advanced data preparation**: Using functions, Data transformations, Working with sequence data, Sampling records, Improving efficiency. Exercise on the basis of all above topics. [10]
4. **Automated Data Mining**: Introduction to data mining ,The basics of using a modeler ,Reading data files , Data exploration , Automated data preparation ,Data partitioning, Predictor selection for modeling ,Automated models for categorical targets , Model evaluation , Automated models for continuous targets. [5]
5. **Deploying models Exercise :**Adding nodes and creating streams in the modeler ,Reading a data file and typing the data in the source node , Review missing values in modeler and use the data audit node on the charity data , Practice using the ADP node to prepare data for modeling ,Use a partition node to split the charity data for modeling ,Use the feature selection node to select fields and predict a response ,Using the auto classifier node to construct a model in order to predict a response, Evaluate the model created to predict the field response ,Develop a model to predict the total spending ,Use a scoring stream to make predictions [10]

Outcome(s): On the successful completion of the course, the student will be able to:

- Understand the principles of data mining
- Use the user interface of modeler to create basic program streams
- User a partition node to create training and testing data subsets
- Use a model to score new data

Text Books:

1. Frees, Edward W., Richard A. Derrig, and Glenn Meyers, eds. Predictive modeling applications in actuarial science. Vol. 1. Cambridge University Press, 2014.

Reference Books:

1. Kuhn, Max, and Kjell Johnson. Applied predictive modeling. Vol. 26. New York: Springer, 2013.
2. Siegel, Eric. Predictive analytics: The power to predict who will click, buy, lie, or die. Hoboken: Wiley, 2013.

CA-20.282 **Machine Learning with Python** **Total Lectures: 40**
Credit:3-0-0-3

Prerequisite(s): Familiarity with programming language will be beneficial

Objective(s):

- To understand the basic concepts and techniques of Machine Learning
- To develop the skills required for Machine Learning Technologies with use of Python to analyze data
- to develop the skills required for Machine Learning Technologies with use of Python to create beautiful visualizations, and problem solving using powerful machine learning algorithms

1. **Introduction to Python Programming**: Python Installation with various IDE's, Python data Types, Control Structure, Functions, Introduction of OOP's. [5]
2. **Data analysis and Exploration**: Data Analysis & visualization –using numpy, panda matplotlib, scipy etc [10]
3. **Machine learning & its Application**: Introduction to machine learning, Supervised machine learnin, Unsupervised machine learnings, Study of various machine learning algorithms including, Supervised Learning Classification. [5]
4. **Supervised Learning**:K-Nearest Neighbors , Decision Trees , Random Forests Reliability of Random Forests ,Advantages & Disadvantages of Decision Trees, Regression Algorithms, Model Evaluation,Model Evaluation: Overfitting & Underfitting [10]
5. **Unsupervised Learning:**K-Means Clustering plus Advantages & Disadvantages Hierarchical Clustering plus Advantages & Disadvantages, Density-Based Clustering, Dimensionality Reduction & Collaborative Filtering [10]

Outcome(s): On the successful completion of the course, the student will be able to:

- understand the basic concepts and techniques of Machine Learning
- understand Machine Learning Technologies
- create beautiful visualizations, and able to solve problem using powerful machine learning algorithms

Text Books:

1. Andreas C. Müller, Sarah Guido, Introduction to Machine Learning with Python. O'Reilly Media, Inc.,2016
2. P. Flach, Machine Learning: The art and science of algorithms that make sense of data, Cambridge University Press, 2012.

Reference Books:

1. William McKinney, Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, O'Reilly , 2017.
2. Manaranjan Pradhan , U Dinesh Kumar, Machine Learning using Python,Wiley, 2019.

CA 20.381 **Deep Learning** **Total Lectures: 40**
Credit: 3-0-0-3

Prerequisite(s): Nil

Objective(s):
- To understand complexity of Deep Learning algorithms and their limitations.
- To understand modern notions in data analysis oriented computing.
- To be capable of performing experiments in Deep Learning using real-world data.
- To be capable of confidently applying common Deep Learning algorithms in practice and implementing their own;

1. **Introduction to TensorFlow:** :Computational Graph, Key highlights, Creating a Graph, Regression example, Gradient Descent, TensorBoard, Modularity, Sharing Variables,Keras **Perceptrons**: What is a Perceptron, XOR Gate [7]
2. **Activation Functions and Artificial Neural Networks:** Sigmoid, ReLU, Hyperbolic Fns, Softmax, Introduction, Perceptron Training Rule, Gradient Descent Rule. [7]
3. **Gradient Descent and Backpropagation:** Gradient Descent, Stochastic Gradient Descent, Backpropagation, Some problems in ANN, Optimization and Regularization : Overfitting and Capacity, Cross Validation, Feature Selection, Regularization, Hyperparameters [5]
4. **Introduction to Convolutional and Recurrent Neural Networks:** Introduction to CNNs, Kernel filter, Principles behind CNNs, Multiple Filters, CNN applications, Introduction to RNNs, Unfolded RNNs, Seq2Seq RNNs, LSTM, RNN applications [12]
5. **Deep Learning applications:** Image Processing, Natural Language Processing, Speech Recognition, Video Analytics [8]

Outcome(s): At the end of the course student will be able to:
- Understand the concepts of TensorFlow, its main functions, operations and the execution pipeline
- Learn topics such as convolutional neural networks, recurrent neural networks, training deep networks and high-level interfaces
- Differentiate between machine learning, deep learning and artificial intelligence.

Text Books:
1. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016.

Reference Books:
1. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.
2. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
3. Golub, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013.
4. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004

CA 20.418 **Data Science & Analytics** **Total Lectures: 40**
Credit:3-1-0-4

Prerequisite(s): None.

Objective(s): To provide necessary knowledge on data manipulation and to perform analysis on the practical problems using statistical and machine learning approach.
To generate report and visualize the results in graphical form using programming tool

1. **INTRODUCTION:** Data Science: Introduction to Data Science – Digital Universe – Sources of Data – Information Commons – Data Science Project Life Cycle: OSEMN Framework **[6]**
2. **DATA PREPROCESSING and CONCEPT LEARNING:** Introduction to Data Preprocessing – Reading, Selecting, Filtering Data – Filtering Missing Values – Manipulating, Sorting, Grouping, Rearranging, Ranking Data, Formulation of Hypothesis – Probabilistic Approximately Correct Learning - VC Dimension – Hypothesis elimination – Candidate Elimination Algorithm **[10]**
3. **ESSENTIALS OF R:** R Basics - data types and objects - control structures – data frame -Feature Engineering - scaling, Label Encoding and One Hot Encoding, Reduction. **[7]**
4. **MODEL FIT USING R and VISUALIZATION**: Regression Models- Linear and Logistic Model, Classification Models – Decision Tree, Naïve Bayes, SVM and Random Forest, Clustering Models – K Means and Hierarchical clustering, Data visualization: Box plot, histogram, scatter plot, heat map – Working with Tableau – Outlier detection – Data Balancing **[10]**
5. **PERFORMANCE EVALUATION in R:** Loss Function and Error: Mean Squared Error, Root Mean Squared Error – Model Selection and Evaluation criteria: Accuracy, Precision, F1 score, Recall Score – Binary Predictive Classification – Sensitivity – Specificity, Recent Trends. **[7]**

Outcome(s): On successful completion of this course, students will be able to gain basic knowledge on data science, Convert the real time data into suitable form for analysis, Gain the insights from the data through statistical inferences and Identify the requirement and visualize the results

Text Books:

1. Ethem Alpaydin, Introduction to Machine Learning, Fourth Edition, MIT Press, 2020
2. Hadley Wickham, Garrett Grolemund, R for data science : Import, Tidy, Transform, Visualize, And Model Data Paperback, 2017

Reference Books:

1. Han, J., Kamber, M., Pei, J. Data mining concepts and techniques. Morgan Kaufmann. 2011
2. Carl Shan, Henry Wang, William Chen, Max Song. The Data Science Handbook: Advice and Insight from 25 Amazing Data Scientists. The Data Science Bookshelf. 2016

CS 23. 316 **Artificial Intelligence** **Total Lectures: 40**

3-0-0-3

Prerequisite(s):

- fundamental concepts in calculus, linear algebra and probability theory, for example, vector, matrix, Bayes' rule, differential
- Programming language

Objective(s): Presentation of artificial intelligence as a coherent body of ideas and methods to acquaint the student with the basic programs in the field and their underlying theory. Students will explore this through problem-solving paradigms, logic and theorem proving, language and image understanding, search and control methods and learning.

1 **OverviewofA.I.:**IntroductiontoAI,ImportanceofAI,AIanditsrelatedfield,AI techniques. **[6]**
Machine Learning, Natural Language Processing, Computer vision, Cognitive Computing.

2 **Problemspaceandsearch**:Definingtheproblemasastatespacesearch,Production system and its characteristics,Issues in thedesignof thesearch problem. **[8]**

3 **Heuristic search techniques** : Generate and test, hill climbing, best first search technique, problem reduction, constraintsatisfaction **[8]**

4 **GamePlaying**: Minimax, alpha-beta pruning, Predicate logic,representation of simple facts in logic, well formed formula, resolution. **[9]**

5 **Knowledge representation and Learning** : Definition and importance of knowledge, Knowledge representation, Various approaches used in knowledge representation, Issues in knowledge representation, Introduction learning,Types of learning,Introduction to neuralnetworks. **[9]**

Outcome(s): After completion of the course, students would be able to:

- Know various AI search algorithms (uninformed, informed, heuristic, constraint satisfaction, genetic algorithms)
- Demonstrate working knowledge in Lisp in order to write simple Lisp programs and explore more sophisticated Lisp code on their own.
- Ability to apply knowledge representation, reasoning, and machine learning techniques to real-world problems.

Text Books:

[1]. Rich Elaine and Knight Kevin , Artificial Intelligence, Tata McGraw – Hill, 3rd edition, 2012

Reference Books:

[1]. Russell Stuart and Norvig Peter, Artificial Intelligence: A Modern Approach, Prentice Hall; 3 edition,2009.
[2]. Patterson D.W., "Introduction to AI and Expert Systems", PHI, 1999