



K.S.R.M. COLLEGE OF ENGINEERING

(AUTONOMOUS)

Pulivendula Road, Kadapa-516 005

Andhra Pradesh, India

Approved by AICTE, New Delhi & Affiliated to JNTUA, Ananthapuramu.

An ISO 14001:2004 & 9001: 2015 Certified Institution



Artificial Intelligence & Machine Learning

Curriculum and Syllabus

B.Tech. III Sem (R20UG)

S.No.	Course Code	Course Name	Category	Hours per Week			IM 40	EM 60	Credits
				L	T	P			
1	2021303	Probability and Optimization	BSC	3	0	0	40	60	3
2	2039302	Discrete Mathematics & Graph Theory	PCC	3	0	0	40	60	3
3	2039303	Digital Systems and Computer Organization	PCC	3	0	0	40	60	3
4	2039304	Introduction to Artificial Intelligence	PCC	3	0	0	40	60	3
5	2039305	RDBMS	PCC	3	0	0	40	60	3
6	2039306	Skill Course – I (MAT Lab Programming)	SC-I	1	0	2	40	60	2
7	20MC301	Universal Human Values	HSMC	3	0	0	40	60	3
8	2039307	Digital Systems and Computer Organization Lab	PCC LAB	0	0	3	40	60	1.5
9	2039308	RDBMS Lab	PCC LAB	0	0	3	40	60	1.5
10	2039309	Exploratory Data Analysis with R	PCC LAB	0	0	3	40	60	1.5
		Total					400	600	24.5

Course Title	PROBABILITY AND OPTIMIZATION				B.Tech. III Sem (R20UG) AI & ML			
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2021303	BSC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0				
Mid Exam Duration: 90 minutes					End Exam Duration: 3Hours			
Course Objectives:								
<ul style="list-style-type: none"> To help the students in getting a thorough understanding of the fundamentals of probability. The course is intended to identify and develop operations research models, understand the mathematical tools to solve optimization problems and develop a report that describes the model, the solving techniques and analyze the results. 								
Course Outcomes: On successful completion of this course, the students will be able to								
CO 1	Understand the concepts of Probability.							
CO 2	Apply the concepts of random variables.							
CO 3	Understand various concepts of Operations research.							
CO 4	Apply linear programming to optimization techniques.							
CO 5	Analyze Transportation problem.							

UNIT I: Probability

Probability, Sample space and events, Axioms of Probability, Conditional Probability, Baye's theorem.

UNIT II: Random variables

Discrete random variables, Continuous random variables, Probability distribution function, Discrete and continuous probability distribution, Mathematical Expectation, Variance and standard deviation of probability distribution.

UNIT III: Introduction to Operations research

Introduction, Models of Operations research, Advantages of Operations research, Limitations of Operations research.

UNIT IV: Linear Programming

Linear programming, Assumptions of linear programming, Properties of linear programming, Development of LP models, Graphical method, Simplex method.

UNIT V: Transportation Problem

Transportation problem, Mathematical model for transportation problem, Types of transportation problem, Starting solutions: North- West corner rule, least cost method, Vogel's approximation method.

Text Books:

1. Probability and Statistics for Engineers and Scientists, Walpole and Myers, Seventh edition, Pearson Education Asia, 2002
2. Probability and Statistics for Engineers, Johnson, Fifth edition, Prentice Hall of India.
3. Operations Research by R. Pannerselvam, PHI Publications, 2nd Edition, 2012
4. Operations Research by N.K.Tiwari, Shishir K. Shandilya Prentice-Hall of India.

Reference Books:

1. Probability and Statistics by E. Rukmangadachari & E. Keshava Reddy, Pearson Publishers.
2. Statistical Methods by S.P.Gupta, S Chand Publications, 44th revised edition 2014.
3. Engineering Optimization by Singiresu S.Rao New Age International Publishers.
4. Engineering Mathematics by Srimanta Pal, Subodh C. Bhunia, Oxford University Press.

Course Title	DISCRETE MATHEMATICS & GRAPH THEORY				B.Tech. III Sem (R20UG) AI & ML			
Course Code	Category	Hours / Week			Credits	Maximum Marks		
2039302	PCC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
		Mid Exam Duration: 90 mins				End Exam Duration: 3Hrs		

Course Objectives:

- ❖ To introduce the concepts of mathematical logic.
- ❖ To introduce the concepts of sets, relations and functions.
- ❖ To perform the operations associated with sets, functions and relations.
- ❖ To introduce generating functions and recurrence relations.
- ❖ To use Graph Theory for solving problems

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Demonstrate knowledge on mathematical logic and Analyze truth tables, normal forms, implications, rules of inference
CO 2	Understand the basic principles of mathematical objects such as sets, relations
CO 3	Apply basic counting techniques to solve combinatorial problems
CO 4	Able to solve recurrence relations
CO 5	Demonstrate different traversal methods for trees and graphs

UNIT – I:

Mathematical Logic: Introduction, Statements and notations, Connectives, Well-formed formulas, Tautologies and contradictions, Equivalence of Formulas, duality law, Tautological Implications, Normal forms, The theory of inference for the statement calculus, rules of inference.

UNIT – II:

Relations and Ordering: Relations, Properties of Binary Relations in a Set, Equivalence Relations, operations on relations, representations of relations, Composition of Binary Relations, Compatibility Relations, Partial Ordering relations, Hasse diagram (or) Poset diagram.

UNIT – III:

Elementary Combinatorics: Basics of counting, Combinations and Permutations, Enumeration of Combinations and Permutations (without repetition), Enumerating Combinations and Permutations with repetitions.

UNIT – IV:

Recurrence Relations: Generating functions of sequences, calculating coefficients of generating functions, Recurrence relations, solving recurrence relations by substitution and characteristic roots, solutions of Inhomogeneous Linear recurrence relations.

UNIT – V:

Graphs: Basic Concepts, Isomorphism and Sub graphs, Trees and their Properties, Spanning Trees, Directed Trees, Binary Trees, Planar Graphs, Euler's Formula, Multi graphs and Euler circuits, Hamiltonian graphs, Chromatic Numbers, The Four-Colour Problem.

Text Books:

1. Discrete Mathematics and its applications, 6th edition, K.H.Rosen, TMH.
(for UNITS-I, II & V)
2. Discrete Mathematics for Computer Scientists & Mathematicians, 2/e, J.L.Mott, A.Kandel, T.P.Baker, PHI. **(for UNIT-III)**
3. Mathematical Foundations of Computer Science (Discrete Structures). Dr. D.S.C., Prism Publications **(for UNIT-IV)**
4. Elements of Discrete Mathematics- A Computer Oriented Approach,C.L.Liu,D.P. Mohapatra, 3/e, TMH.

References:

1. Discrete and Combinatorial Mathematics- An Applied Introduction, Ralph. P. Grimaldi, 5/e, Pearson Education.
2. Discrete Mathematical Structures, Mallik and Sen, Cengage Learning.
3. Discrete Mathematical Structures, BernandKolman, Robert C. Busby, SharonCutler Ross, PHI/Pearson Education.
4. Discrete Mathematics with Applications, ThomasKoshy, Elsevier.
5. Discrete Mathematics, Lovasz, Springer.

Course Title	DIGITAL SYSTEMS AND COMPUTER ORGANIZATION				B.Tech. III Sem (R20UG) AI & ML			
Course Code	Category	Hours / Week			Credits	Maximum Marks		
2039303	PCC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
		Mid Exam Duration: 90 minutes				End Exam Duration: 3Hrs		
Course Objectives:								
❖ To understand the basic theoretical concepts of digital systems like the binary system and Boolean algebra.								
❖ To express real life problem in logic design terminology.								
❖ To design logic circuits using combinational/sequential logic.								
❖ To understand the Instruction execution stages.								
❖ To explain the functions of the memory and concepts of pipelining								
Course Outcomes: On successful completion of this course, the students will be able to								
CO 1	Understand significance of number systems, conversions, binary codes (L2)							
CO 2	Apply different simplification methods for minimizing Boolean functions (L3)							
CO 3	Illustrate knowledge on design of various combinational circuits, sequential logic circuits and analyze the operation of flipflops, registers, counters (L3)							
CO 4	Discuss the basic structure and organization of computers (L2)							
CO 5	Understand the concept of Pipelining and Memory							

UNIT – I:

Binary Systems: Binary Numbers, Number base conversions, Octal and Hexadecimal Numbers, complements, Binary codes.

Boolean Algebra and Logic Gates: Basic theorems and properties of Boolean algebra, Boolean functions, canonical and standard forms, Digital logic Gates.

Gate - Level Minimization: The map method, Four-variable map, Five-variable map, Product of sums (POS) simplification, Don't-Care conditions, NAND and NOR implementation.

UNIT – II:

Combinational Logic: Combinational Circuits, Analysis of Combinational circuits, Code - converters, Binary adder-subtractor, Decimal Adder, Decoders, Encoders, Multiplexers.

Sequential Logic: Sequential circuits, Latches, Flip-Flops, State Reduction and Assignment.

UNIT – III:

Registers, Counters & Programmable Logic Devices: Registers, Shift Registers, Ripple counters, synchronous counters.

Basic Structure of Computers: Computer types, Functional units, Basic operational concepts, Bus structures.

UNIT – IV:

Basic Computer Organization and Design: Computer instructions, Instruction cycle, Memory Reference Instructions, Input – Output and Interrupt, Addressing modes.

Micro Programmed Control: Control memory, Address sequencing, Design of control unit, Hard wired control.

UNIT – V:

Memory Organization: Memory hierarchy, main memory, associative memory, cache memory, virtual memory.

Input or Output Organization: Input or output Interface, asynchronous data transfer, priority interrupt, direct memory access.

Text Books:

1. Digital Design: With an introduction to the Verlog HDL, VHDL and System Verilog – 6th edition, M. Morris Mano and Michael D. Ciletti, Pearson Education/PHI.
2. Fundamentals of digital logic design with VHDL By Stephen Brown and I Zvonko Vranesic, second edition, The McGraw-Hill.
3. Fundamentals of logic design, Roth, 5th edition, Thomson publications.
4. Computer Organization – Carl Hamacher, Zvonks Vranesic, Safea Zaky, Vth Edition, McGraw Hil.
5. Computer Systems Architecture – M. Moris Mano, III rd Edition, Pearson/PHI.

References:

1. Switching and Finite Automata Theory by Zvi. Kohavi, Tata McGraw Hill.
2. Switching and Logic Design, C.V.S. Rao, Pearson Education
3. Digital Principles and Design –Donald D. Givone, Tata McGraw Hill, Edition. 6.
4. Fundamentals of Digital Logic & Micro Computer Design, 5TH Edition, M. Rafiquzzaman John Wiley.
5. Computer Organization and Architecture – William Stallings Sixth Edition, Pearson/PHI.
6. Structured Computer Organization – Andrew S. Tanenbaum, 4th Edition, PHI/Pearson.
7. Fundamentals of Computer Organization and Design, - Sivaraama Dandamudi, Springer Int. Edition.

Course Title	INTRODUCTION TO ARTIFICIAL INTELLIGENCE				B.Tech. III Sem (R20UG) AI & ML			
Course Code	Category	Hours / Week			Credits	Maximum Marks		
2039304	PCC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
		Mid Exam Duration: 90 mins				End Exam Duration: 3Hrs		
Course Objectives:								
❖ To understand how a computer making intelligent decisions.								
❖ To understand the notions of state space representation, heuristic search methods.								
❖ To learn different knowledge representation techniques								
❖ To understand the applications of AI.								
Course Outcomes: On successful completion of this course, the students will be able to								
CO 1	Know the strength & Weakness of AI.							
CO 2	Given a search problem, analyze and formalize the problem (as a state space, graph, etc.).							
CO 3	Ability defines admissible and consistent heuristics and completeness and optimality.							
CO 4	Ability to represent knowledge using Logic.							
CO 5	Ability to understand the concept of Fuzzy logic system.							

UNIT-I:

Introduction to AI: Definition, Approaches of AI, History, Application of an AI, What is an AI Technique?

UNIT- II:

Problem, Problem Definition, Problem Space and Search, Example Problems: Tic-Tac-Toe, Water Jug problem.

UNIT -III:

Uniformed search strategies – Breadth first search, depth first Search.
Heuristic Search Techniques- Hill climbing, A*, AO* Algorithms, Problem reduction.

UNIT- IV:

Approaches to Knowledge Representation, Using Predicate Logic, Declarative Vs Procedural Knowledge.

UNIT- V:

Fuzzy Logic System: What is Fuzzy Logic ?, Applications, Example Problem.

Text Books:

1. Rich, Knight, Nair: Artificial intelligence, Tata McGraw Hill, Third Edition 2009.
2. Russell, Norvig: Artificial intelligence, A Modern Approach, Pearson Education, Second Edition. 2004.
3. Philip C Jackson, Introduction to Artificial Intelligence: Second, Enlarged Edition.
4. Saroj Kaushik. Artificial Intelligence. Cengage Learning, 2011.

References:

1. Charu C. Aggarwal, Artificial Intelligence, Springer, 2021.
2. Adelyn Zhou, Mariya Yao and Marlene Jia Applied Artificial Intelligence: A Handbook for Business Leaders, 2017.
3. Peter Norvig, Paradigms of Artificial Intelligence Programming: Case Studies in Common Lisp.
4. Dr. Dheeraj Mehrotra, Basics of Artificial Intelligence & Machine Learning
5. Chandra S.S.V, Artificial Intelligence and Machine Learning
6. Denis Rothman, Artificial Intelligence by Example

Web Links:

- https://onlinecourses.nptel.ac.in/noc22_cs56/preview
- https://www.tutorialspoint.com/artificial_intelligence/artificial_intelligence_fuzzy_logic_systems.htm

Course Title	RDBMS					B.Tech. III Sem (R20UG) AI & ML		
Course Code	Category	Hours / Week			Credits	Maximum Marks		
2039305	PCC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
		Mid Exam Duration: 90 mins				End Exam Duration: 3Hrs		

Course Objectives:

- ❖ Understanding Database Concepts, Database Storage, Entities and Relationships, Relational Data Model, Normalization, Database Design and Performance Tuning.
- ❖ To be able to Database Design and Performance Tuning, Creating Database Objects, Manipulating Data, JDBC As the Fundamental Java API, JPA as the JAVA ORM API, Database Security, Understanding Database Backup and Restore, Introduction of MySQL.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Explain the database concepts like tables and different keys, Install SQLite, MySQL and DB2
CO 2	Explain database normalization, clustered as well as non-clustered indexes, Create Indexes in database
CO 3	Understand concepts like entities, attributes, data modelling and relationship in RDBMS
CO 4	Understand the Relational Data Model in RDBMS, Understand concepts like database views and data dictionary
CO 5	Understand the Database Normalization and all the database normal forms
CO 6	Understand the tuning of database
CO 7	Understand how DDLs used to create or modify the Schema, tables index etc.
CO 8	Understand how DMLs used to store, manipulate, retrieve data from tables
CO 9	Understand on how to create Database and to connect through Java API, and CRUD operations using Java API
CO 10	Understand on how to adopt JPA from JDBC and CRUD operation using JPA
CO 11	Understand on external security threats, internal threats and the social remedies
CO 12	Understand on different backups, how to take a Database backup, restore point
CO 13	Understand how to insert, delete, select, update, where, drop, create queries in MySQL Database

UNIT – I:

Understanding Database Concepts: This chapter provides an overview on database concepts, provides details on database tables, primary keys and foreign keys. Also, it gives detailed steps on installation of SQLite and Dockerized MySQL and DB2 databases.

UNIT – II:

Understanding Database Storage: In this chapter, you will get an overview on Database normalization, Indexes and how they are used along with configuring clustered as well as non-clustered indexes in databases.

UNIT – III:

Entities and Relationships: This chapter provides an overview on entities and relationships in RDBMS and explains concepts like Domains, Relationship and Business rules, Data Modelling and Schemas etc.

UNIT – IV:

The Relational Data Model: This chapter provides an overview on Database relations, primary keys and how to represent the data relationships in RDBMS. This chapter also explains about views and Data dictionary in RDBMS.

UNIT – V:

Normalization: This chapter provides an overview on the Database Normalization and all the database normal forms (from first till sixth) and Boyce-Codd Normal form.

UNIT – VI:

Database Design and Performance Tuning: This chapter provides an overview on the performance and tuning of a database.

UNIT – VII:

Creating Database Objects: This chapter provides an overview of Data definition language and its operation.

UNIT – VIII:

Manipulating Data: This chapter provides an overview of Data manipulation language and its operation.

UNIT – IX:

JDBC As the Fundamental Java API: This chapter provides an overview on JDBC Basics.

UNIT – X:

JPA as the JAVA ORM API: This chapter provides an overview of JPA

UNIT – XI:

Database Security: This chapter provides an overview of Database Security on External Security threats, Internal threats.

UNIT – XII:

Understanding Database Backup and Restore: This chapter provides an overview of Data Backup and Restore.

UNIT – XIII:

Introduction to MySQL: This chapter provides an overview of basics of MySQL, basic queries.

Course Title	SKILL COURSE – I (MAT LAB PROGRAMMING)				B.Tech. III Sem (R20UG) AI & ML			
Course Code	Category	Hours / Week			Credits	Maximum Marks		
2039306	PCC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		1	0	2	2	40	60	100
		Mid Exam Duration: 90 mins				End Exam Duration: 3Hrs		
Course Objectives:								
❖ The main objective of the course is to make the students familiar with scripts, functions, control flow and plotting in MATLAB and use it to solve various engineering problems.								
Course Outcomes: On successful completion of this course, the students will be able to								
CO 1	Able to understand basic MATLAB features, arrays.							
CO 2	Able to analyze various control flow structures.							
CO 3	Able to solve linear equations							
CO 4	Able to plot two-dimensional graphics							

MODULE-I

Basics of MATLAB: Basic features, script M-files, code cells, arrays creation, addressing and array operations; multi-dimensional arrays, Arithmetic & Logical operators.

MODULE-II

Control Flow: control flow - if, if-else, for, while constructions

Mathematical Operations: Matrix algebra and solutions to systems of linear equations, polynomials.

MODULE-III

MATLAB Graphics & Numerical techniques: Two-dimensional graphics: plot function- line styles, Markers and colors – grids – axes box – labels - multiple plots – subplots – interactive plotting tools – specialized 2-D plots- interpolation, curve fitting.

Text books

1. Mastering MATLAB by Hanselman, Littlefield – Pearson Publications, 1st Edition, 2012.
2. MATLAB Programming by David C. Kuncicky -Prentice Hall, 2004

Course Title	UNIVERSAL HUMAN VALUES				B.Tech. III Sem (R20UG) AI & ML			
Course Code	Category	Hours / Week			Credits	Maximum Marks		
20MC301	HSMC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
		Mid Exam Duration: 90 mins				End Exam Duration: 3Hrs		

Course Objectives:

- ❖ To understand the moral values that ought to guide the Management profession and resolve the moral issues in the profession.
- ❖ To justify the moral judgment concerning the profession.
- ❖ To develop a set of beliefs, attitudes, and habits that engineers should display concerning morality.
- ❖ To create an awareness on Management Ethics and Human Values.
- ❖ To inspire Moral and Social Values and Loyalty.
- ❖ To appreciate the rights of others.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Develop appropriate technologies and management patterns to create harmony in professional and personal life.
CO 2	Ensure students sustained happiness through identifying the essentials of human values and skills
CO 3	Get awareness of types of ethical challenges and dilemmas confronting members of a range of professions (business, media, police, law, medicine, research)
CO 4	Bring to bear ethical analysis and reasoning in the light of normative ethics frameworks on a selection of ethical challenges and dilemmas across the chosen range of professions
CO 5	Relate ethical concepts and materials to ethical problems in specific professions and professionalism

UNIT I: HUMAN VALUES

Morals, Values and Ethics - Integrity - Trustworthiness - Work Ethics - Service Learning - Civic Virtue - Respect for others - Living Peacefully - Caring - Sharing - Courage - Value Time - Co-operation - Commitment - Empathy - Self-confidence - Spirituality - Character.

UNIT - II: ENGINEERING ETHICS

Senses of Engineering Ethics – Variety of Moral issues – Types of inquiry – Moral Dilemmas – Moral Autonomy – Kohlberg’s Theory – Consensus and Controversy – Professions and Professionalism – Professional ideals and virtues.

UNIT – III: ENGINEER’S RESPONSIBILITY FOR SAFETY

Safety and Risk – Assessment of Safety and Risk – Risk benefit Analysis – Reducing Risk – The Government Regulator’s Approach to Risk – Chernobyl Case and Bhopal Case studies.

UNIT- IV: VALUE EDUCATION

Self- exploration- its content and process- natural acceptance- Happiness and Prosperity- Understanding Human relations.

UNIT - V: HOLISTIC PERCEPTION OF HARMONY

Understanding the Harmony in the society- -Universal order- critical appreciation of Human values- Justice, Trust.

Text Books:

1. Mike martin and Roland Scherzinger. "Ethics in Engineering", McGraw Hill, New York 2005
2. Charles E Harris. Michael S Pritchard and Michael J Rabins. "Engineering Ethics – Concepts and Cases", Thompson Learning 2000.
3. R R Gaur, R Asthana, G P Bagaria, "A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93- 87034-47-1

References:

1. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, 1999.
2. John R Baatright. "Ethics and the Conduct of Business", Pearson Education 2003.
3. Edmund G Seeabauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University press 2001.
4. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantal, 1999.
5. A. N. Tripathi, "Human Values", New Age Intl. Publishers, New Delhi, 2004.

Course Title	DIGITAL SYSTEMS AND COMPUTER ORGANIZATION LAB				B.Tech. III Sem (R20UG) AI & ML			
Course Code	Category	Hours / Week			Credits	Maximum Marks		
2039307	PCC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		0	0	3	1.5	40	60	100
		Mid Exam Duration: 90 mins				End Exam Duration: 3Hrs		

Course Objectives:

- ❖ To study the theory of Boolean algebra and acquire the skills to manipulate and examine Boolean algebraic expressions.
- ❖ To study the design principles of combinational and sequential circuits.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Apply knowledge of binary systems, logic gates and Boolean functions to minimize and implement digital logic circuit.
CO 2	Design digital logic circuit using combinational and sequential logic to solve engineering problems.

List of Experiments:

Digital Systems:

1. (a) Study of basic gates and verify through truth table
(b) Implementation of basic gates with NAND and NOR gates
2. (a) Implementation of logic circuit for given Boolean Expression
(b) Design 3-way lamp control using min-terms and maxterms
3. (a) Design logic circuit for adders and subtractors (half adder, full adder, parallel adder, half subtractor, full subtractor and parallel subtractor)
(b) 4-bit Binary adder cum subtractor
4. (a) Design combinational logic circuit for BCD to Excess-3 code conversion
(b) Design combinational logic circuit for 4-bit Binary comparator
5. (a) Design 3x8 Decoder
(b) Design Priority Encoder
6. (a) Design 4-bit shift register
(b) Design asynchronous UP/DOWN counter
7. (a) Design Synchronous UP counter using D-flipflop
(b) Design Modulo 6 counters

Computer Organization:

1. Write ALP to accept a character and display the same character.
2. Write ALP to display a string by reading character by characters.
3. Write ALP to accept a string and display the same string.
4. Write ALP to display a string for 5 times.
5. Write ALP to convert a given character from lower case to upper case
6. Write ALP to convert a given character from upper case to lower case
7. Write ALP to print alphabets both in upper case and lower case
8. Write ALP to determine whether the given character is alphabet or not

9. Write ALP to determine whether the given string is palindrome or not.
10. Write ALP to find the reverse of a given string
11. Write ALP to accept a digit and display the same digit
12. Write ALP to find the sum of two numbers.

Text Books:

1. Digital Design: With an introduction to the Verlog HDL, VHDL and System Verilog – 6th edition, M. Morris Mano and Michael D. Ciletti, Pearson Education/PHI.
2. Fundamentals of digital logic design with VHDL By Stephen Brown and I Zvonko Vranesic, second edition, The McGraw-Hill.
3. Fundamentals of logic design, Roth, 5th edition, Thomson publica.

Reference Books:

1. Switching and Finite Automata Theory by Zvi. Kohavi, Tata McGraw Hill.
2. Switching and Logic Design, C.V.S. Rao, Pearson Education.
3. Digital Principles and Design –Donald D.Givone, Tata McGraw Hill, Edition.
4. Fundamentals of Digital Logic & Micro Computer Design by M. Rafiquzzaman John Wiley, 5TH Edition.

Course Title	EXPLORING DATA ANALYSIS WITH R				B.Tech. III Sem (R20UG) AI & ML			
Course Code	Category	Hours / Week			Credits	Maximum Marks		
2039309	PCC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		0	0	3	1.5	40	60	100
		Mid Exam Duration: 90 mins				End Exam Duration: 3Hrs		
Course Objectives:								
❖ The course enables the students to apply exploring data analysis with R on real time applications.								
Course Outcomes: On successful completion of this course, the students will be able to								
CO 1	Understanding the basic concepts of R programming							
CO 2	Apply critical R programming concepts to handle the data							
CO 3	Apply statistical concepts on real data							
CO 4	Use linear regression on given data set							
CO 5	Apply data visualization using R packages							

List of Experiments:

1. Download, install R and RStudio on windows.
2. Study of basic syntaxes in R
 - (a) Write a R program to create a sequence of numbers from 20 to 50, find the mean of numbers from 20 to 60 and sum of numbers from 51 to 91.
 - (b) Write a R program to get the first 10 Fibonacci numbers.
3. Implementation of different types of R operators.
4. Study and implementation of various control structures in R.
 - (a) Write a R program to check weather given is even or odd.
 - (b) Write a R program to find the sum of n natural numbers $[1+2+3+\dots+n]$.
 - (c) Write a R program to get all prime numbers up to a given number.
5. Write a R program to find factorial of a given number using recursive function.
6. Programs using vectors, matrix, factor and list in R,
 - (a) Write a R program to create a vector of a specified type and length. Create vector of numeric, complex, logical and character type of length 6.
 - (b) Write a R program to create a matrix taking a given vector of numbers as input and define the column and row names. Display the matrix.
 - (c) Write a R program to find the levels of factor of a given vector.
 - (d) Write a R program to create a list containing strings, numbers, vectors and a logical value.
7. Programs using statics (apply all statistical concepts using R)
8. Programs using linear regression.

Consider the “cars” dataset. Assume “cars\$dist” as the response variable and “cars\$speed” as the predictor variable. Create a model using the lm() function.
9. Write a R program to create data frame and extract specific rows and columns.
10. Study and implementation of data visualization using R packages.

Text Books:

1. Seema Acharya - "Data Analytics Using R", Jan 01, 2018, Seema Acharya-MC GRAW HILL INDIA (2018).
2. Aczel – Sounder Pandian: "Complete Business Statistics" 7th Edition Complete Business Statistics, Seventh Edition McGraw–Hill Primis.
3. Pierre Lafaye de Micheaux, Remy Drouilhet and Benoit Liquet – “The R Software Fundamentals of Programming and Statistical Analysis”, Springer.

Reference Books:

1. **Robert I. Kabacoff** "R in Action Data analysis and graphics with R" Manning Publications Co 2011.

Journals/Magazines:

1. Journal of Information Organization (JIO)
2. Open Source for You
3. PC Quest.

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc21_ma35/preview
2. <https://www.coursera.org/learn/data-analysis-r>



K.S.R.M. COLLEGE OF ENGINEERING

(AUTONOMOUS)

Pulivendula Road, Kadapa-516 005

Andhra Pradesh, India

Approved by AICTE, New Delhi & Affiliated to JNTUA, Ananthapuramu.

An ISO 14001:2004 & 9001: 2015 Certified Institution



Artificial Intelligence & Machine Learning

Curriculum and Syllabus

B.Tech. IV Sem (R20UG)									
S.No.	Course Code	Course Name	Category	Hours per Week			IM	EM	Credits
				L	T	P	40	60	
1	2021401	Business Economics and Accounting for Engineers	HSMC	3	0	0	40	60	3
2	2039402	Design and Analysis of Algorithms	PCC	3	0	0	40	60	3
3	2039403	Operating Systems	PCC	3	0	0	40	60	3
4	2039404	Data Science	PCC	3	0	0	40	60	3
5	2039405	Business Intelligence Analyst	PCC	3	0	0	40	60	3
6	2039406	Operating Systems Lab	PCC LAB	0	0	3	40	60	1.5
7	2039407	Data Science Lab	PCC LAB	0	0	3	40	60	1.5
8	2039408	Business Intelligence Analyst Lab	PCC LAB	0	0	3	40	60	1.5
9	2039409	Skill Course – II (Advanced Python Programming)	SC	1	0	2	40	60	2
10	20MC409	Mandatory Course (Constitution of India)	MC	2	1	0	40	---	0
		Total					400	540	21.5

Course Title	BUSINESS ECONOMICS AND ACCOUNTING FOR ENGINEERS				B.Tech. IV Sem (R20UG) AI & ML			
Course Code	Category	Hours / Week			Credits	Maximum Marks		
2021401	HSMC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
		Mid Exam Duration: 90 mins				End Exam Duration: 3Hrs		
Course Objectives:								
❖ To equip the budding engineering student with an understanding of concepts and tools of economic analysis.								
❖ To provide knowledge of Business economics through differential economics concepts and theories.								
❖ To make aware of accounting concepts to analyze and solve complex problems relating financial related matters in industries.								
❖ To understand professional and ethical responsibility and ability to communicate effectively.								
Course Outcomes: On successful completion of this course, the students will be able to								
CO 1	Understand the concept of Business Economics and able to apply							
CO 2	Understand the Production functions and application of Business Economics and Accounts form a king business decision.							
CO 3	To Analyze the markets conditions and determine price-output relations.							
CO 4	To understand the concepts of Accounting and able to prepare the financial statement of A business firms.							
CO 5	To evaluate, analyze and interpret the financial performance of business.							

UNIT-I: INTRODUCTION TO BUSINESSE CONOMICS

Meaning, Definition, Nature and scope of Business Economics, Demand Analysis: Concept of Demand, Determinants of demand, Law of Demand and its exceptions, Elasticity of Demand – Types, Measurement of Elasticity of Demand, Demand Forecasting – Techniques of Demand Forecasting.

UNIT-II: THEORY OF PRODUCTION AND COST ANALYSIS

Production Functions: Law of variable proportion, Isoquants and Iso cost, least cost combination of inputs, Returns to Scale and Cobb- Douglas production function. Internal and external economies of scale.

Cost Analysis: Cost concepts – Break-Even Analysis (BEA) – Break Even Point – significance and limitations of BEA.

UNIT-III: CLASSIFICATION OF MARKETS AND PRICING METHODS

Markets structures: Perfect and Imperfect competition–Features of Perfect Competition, Monopoly, Monopolistic Competition and Oligopoly. Price- Output determination under perfect competition, monopoly and monopolistic competition– Price rigidity in Oligopoly.

Methods of Pricing – cost plus pricing, marginal cost pricing, skimming pricing, penetration pricing, differential pricing and administrative pricing.

UNIT-IV: INTRODUCTION TO FINANCIAL ACCOUNTING

Definition to Accounting, objective and need for Accounting, Double Entry Book keeping – Accounting process, Journal Ledger, Trial Balance, and Final Accounts– Trading Account, Profit and Loss Account and Balance sheet with problems.

UNIT-V: FINANCIAL ANALYSIS THROUGH RATIOS

Concept of Financial Ratios, Types of Ratios– Liquidity Ratios, Turnover Ratios, Capital Structure Ratios, Profitability Ratios with problems.

Textbooks:

1. Introductory Managerial economics for BMS; Mithani DM, PEARSON
2. management science :Principles and world wide application, Salvatore Dominick. PEARSON
3. A.Ramachandra Aryasri: Managerial Economics and Financial Analysis, PEARSON
4. Varshney & Maheswari: Managerial Economics, Sultan Chand Publishers, 2009.
5. Prasad and K.V.Rao: Financial Accounting, Jai Bharath Publishers, Vijayawada.
6. A.R.Aryasri: Managerial Economics and Financial Analysis, TATA McGraw-Hill Publishing Co. Ltd.

Reference Books:

1. Managerial economics (Economics tools for today's Decision Makers), Pal G.Keat, Philip K.Y. Young, Stephen E.Erfle, Sreejata Banerjee, PEARSON
2. P.L Mehtha: Managerial Economics, Sulthan Chand Publishers
3. K K Dewett -Managerial Economics, S. Chand Publishers
4. S.P Jain & K.L Narang: Financial Accounting, Kalyani publishers.
5. M. Sugunatha Reddy: Managerial Economics and Financial Analysis, Research India Publication, NewDelhi,2013.
6. Paul A Samuleson and Williamnordhaus: Economics, Oxford University Publications.
7. M L Jhingan: Micro Economics & Macro Economics, Vrinda Publacations (P)Ltd.

Course Title	DESIGN AND ANALYSIS OF ALGORITHMS					B.Tech. IV Sem (R20UG) AI & ML		
Course Code	Category	Hours / Week			Credits	Maximum Marks		
2039402	PCC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
		Mid Exam Duration: 90 mins					End Exam Duration: 3Hrs	
Course Objectives:								
<ul style="list-style-type: none"> ❖ To understand and apply the algorithm analysis techniques. ❖ To critically analyze the efficiency of alternative algorithmic solutions for the same problem ❖ To understand different algorithm design techniques. ❖ To understand the limitations of Algorithmic power 								
Course Outcomes: On successful completion of this course, the students will be able to								
CO 1	Prove the correctness and analyze space and time complexity of an algorithm							
CO 2	Understand different algorithm design strategies							
CO 3	Analyze & Apply standard algorithms							
CO 4	Understand Graph/Tree bases applications and appropriate techniques							
CO 5	Current trends in non-Deterministic concepts							

UNIT – I:

Introduction: What is an algorithm? Algorithm Specification, **Performance Analysis:** Space complexity, Time Complexity. **Asymptotic Notations:** Big-Oh notation (O), Omega notation (Ω), Theta notation (Θ), **Elementary Data Structures:** Set and Disjoint Set (Union and Find).

UNIT- II:

Divide and Conquer: General method, Binary search, Finding the maximum and minimum, Merge sort, Quick sort, Strassen's Matrix multiplication.

Greedy Method: General method, Knapsack Problem, Job sequencing with deadlines. Minimum cost spanning trees: Prim's Algorithm, Kruskal's Algorithm.

UNIT- III:

Dynamic Programming: General method with Examples, Multistage Graphs, All Pairs Shortest Paths, Single Source Shortest Path, Optimal Binary Search Trees, 0/1 Knapsack problem, Travelling Sales Person problem.

UNIT- IV:

Search and Traversal techniques: Techniques for Binary tree, Technique for Graphs, connected components and spanning tree, Bi connected components and DFS.

Backtracking: General method, N-Queens problem, Sum of sub sets problem, Graph coloring, Hamiltonian cycles.

UNIT- V:

Branch and Bound: Travelling Sales Person problem, 0/1 Knapsack problem: LC Branch and Bound solution, FIFO Branch and Bound solution.

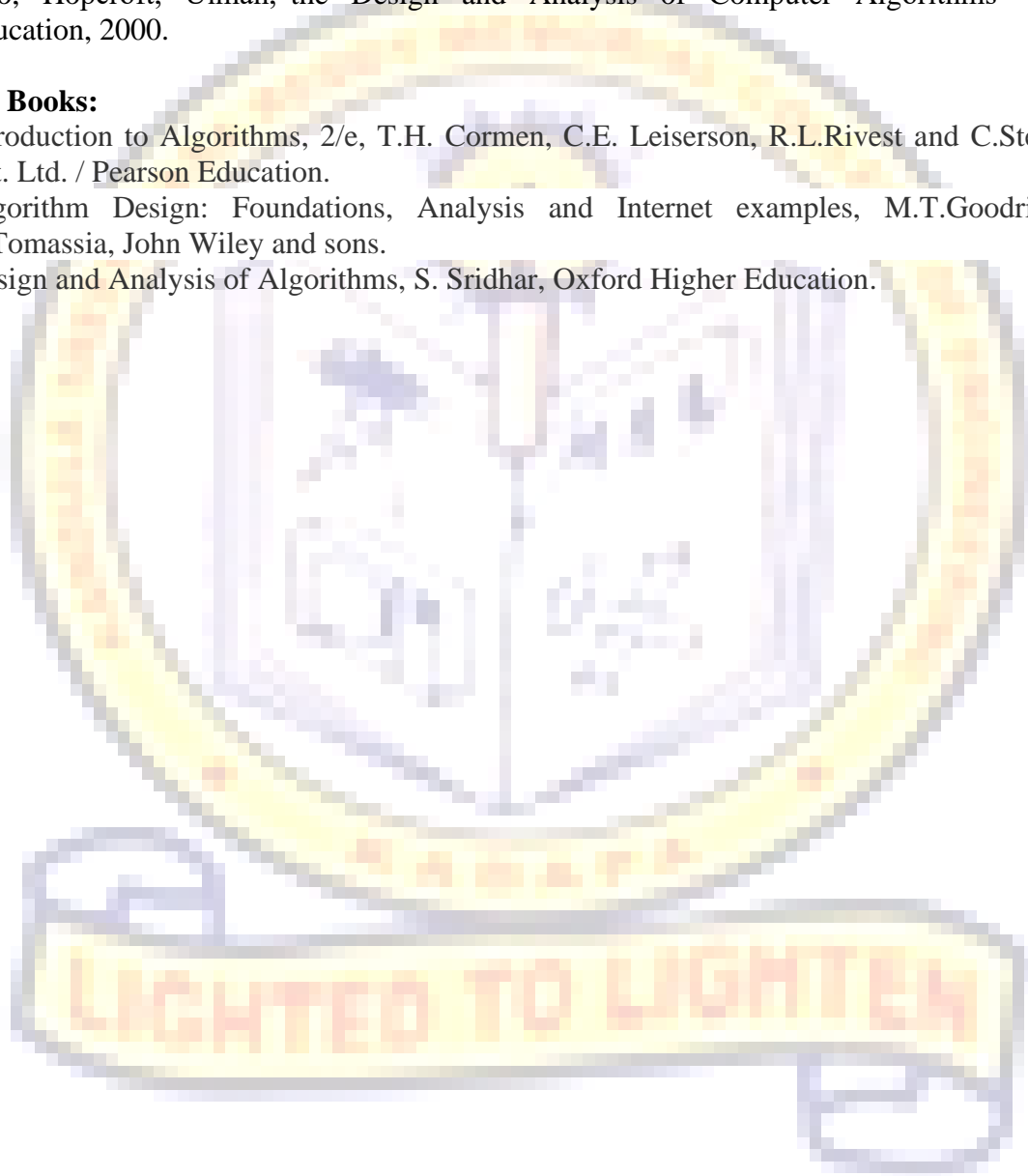
NP-Complete and NP-Hard problems: Basic concepts on-deterministic algorithms, P, NP, NP-Complete, and NP-Hard classes, cook's theorem.

Text Books:

1. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran,” Fundamentals of Computer Algorithms”, Galgotia Publications.
2. Levitin, Anany.” Introduction to the design & analysis of algorithms” Pearson Education, 2008
3. Parag H.Dave Himanshu B.Dave “Design and Analysis of Algorithms” Pearson Education 2008.
4. Aho, Hopcroft, Ulman,”the Design and Analysis of Computer Algorithms” Pearson Education, 2000.

Reference Books:

1. Introduction to Algorithms, 2/e, T.H. Cormen, C.E. Leiserson, R.L.Rivest and C.Stein, PHI Pvt. Ltd. / Pearson Education.
2. Algorithm Design: Foundations, Analysis and Internet examples, M.T.Goodrich and R.Tomassia, John Wiley and sons.
3. Design and Analysis of Algorithms, S. Sridhar, Oxford Higher Education.



Course Title	OPERATING SYSTEMS					B.Tech. IV Sem (R20UG) AI & ML		
Course Code	Category	Hours / Week			Credits	Maximum Marks		
2039403	PCC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
		Mid Exam Duration: 90 mins					End Exam Duration: 3Hrs	

Course Objectives:

- ❖ Have an overview of functions of operating systems.
- ❖ Have a thorough knowledge of process management and memory management.
- ❖ To have a thorough knowledge of how handle to deadlocks.
- ❖ Learn the concepts of files, protection and security

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the basic concepts related to the operating systems
CO 2	Analyze the various process scheduling algorithms and process synchronization mechanisms.
CO 3	Analyze the various memory management schemes.
CO 4	Understand the ways to deal the deadlocks and the basic concepts related to files in the system.
CO 5	Analyze the protection and security mechanism.

UNIT – I:

Operating Systems Basics: Operating systems functions, Overview of computer operating systems, distributed systems, operating system services and systems calls, system programs, operating system structure.

UNIT – II:

Process Management: Process concepts, scheduling-criteria, CPU scheduling algorithms, Evaluation of Scheduling Algorithms.

Concurrency: Process synchronization, the critical-section problem, Peterson’s Solution, semaphores, Classic problems of Synchronization, monitors.

UNIT – III:

Memory Management: Introduction, Swapping, contiguous memory allocation, paging, structure of the page table, segmentation, virtual memory, demand paging, page-replacement algorithms, Allocation of frames.

UNIT – IV:

Deadlocks: System model, deadlock characterization, deadlock prevention, detection and avoidance, recovery form deadlock.

Files: The concept of a file, Access Methods, File Allocation Methods, Directory structure, File system mounting, File sharing and Protection.

UNIT – V:

Protection: Protection, Goals of Protection, Principles of Protection, Domain of protection, Access Matrix, Implementation of Access Matrix.

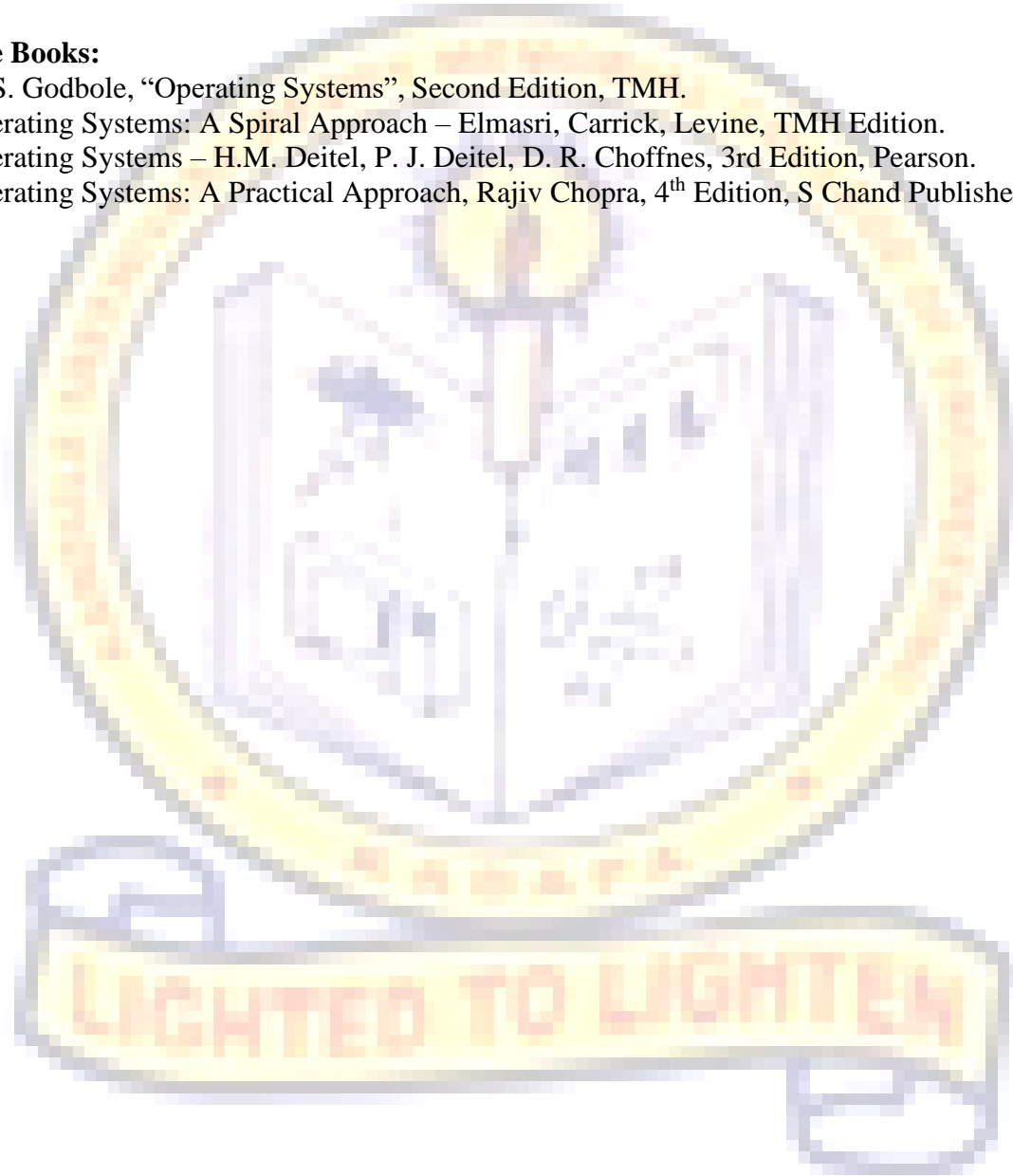
Security: The security problem, Program threats, User authentication.

Text Books:

1. Abraham Silberchatz, Peter B. Galvin, Greg Gagne, Operating System Concepts”, Eighth edition, John Wiley.
2. Andrew S Tanenbaum, “Modern Operating Systems”, Fourth Edition, Pearson Education.
3. William Stallings, “Operating Systems: Internals and Design Principles”, Sixth Edition 2009, Pearson Education.
4. D.M. Dhamdhere, “Operating Systems, A Concept based Approach”, Third Edition, TMH.

Reference Books:

1. A.S. Godbole, “Operating Systems”, Second Edition, TMH.
2. Operating Systems: A Spiral Approach – Elmasri, Carrick, Levine, TMH Edition.
3. Operating Systems – H.M. Deitel, P. J. Deitel, D. R. Choffnes, 3rd Edition, Pearson.
4. Operating Systems: A Practical Approach, Rajiv Chopra, 4th Edition, S Chand Publishers.



Course Title	DATA SCIENCE					B.Tech. IV Sem (R20UG) AI & ML		
Course Code	Category	Hours / Week			Credits	Maximum Marks		
2039404	PCC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
		Mid Exam Duration: 90 mins					End Exam Duration: 3Hrs	

Course Objectives:

- Provide you with the knowledge and expertise to become an efficient data scientist.
- R-Programming code to statistically analyze a dataset.
- Evaluating Data visualizations.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understanding how data is collected, managed and stored for data science
CO 2	Understanding the key concepts in data science
CO 3	Learning R-Programming
CO 4	Understanding social networks

UNIT- I

Introduction: What Is Data Science? Big Data and Data Science Hype, Getting Past the Hype, Why Now? The Current Landscape (with a Little History), A Data Science Profile, Thought Experiment: Meta-Definition, What Is a Data Scientist, Really?

Statistical Inference, Exploratory Data Analysis, and the Data Science Process: Statistical Thinking in the Age of Big Data, Exploratory Data Analysis, The Data Science Process, Thought Experiment: How Would You Simulate Chaos? Case Study: RealDirect

UNIT - II

Algorithms: Machine Learning Algorithms, Three Basic Algorithms : Linear Regression, k-Nearest Neighbors (k-NN), k-means.

Spam Filters, Naive Bayes, and Wrangling: Learning by Example: Why Won't Linear Regression Work for Filtering Spam? How About k-nearest Neighbors? Naive Bayes: Bayes Law, A Spam Filter for Individual Words, A Spam Filter That Combines Words: Naive Bayes, Comparing Naive Bayes to k-NN, Web APIs and Other Tools.

UNIT -III

Data Visualization and Fraud Detection: Data Visualization History, What Is Data Science, Redux? A Sample of Data Visualization Projects, Mark's Data Visualization Projects, Data Science and Risk, Data Visualization at Square, Ian's Thought Experiment Data Visualization for the Rest of Us.

UNIT - IV

R-Programming: What is R? Why use R for analytics? How to run R? First R example, functions a short Programming example, some important R data structures, vectors, matrices, lists, R programming structures.

UNIT- V

Social Networks and Data Journalism: Social Network Analysis at Morning Analytics, Social Network Analysis, Terminology from Social Networks, Thought Experiment Morningside Analytics, More Background on Social Network Analysis from a Statistical Point of View, Data Journalism.

Text Books:

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly.
2. Norman matloff ,“The art of R programming”. No Starch Press, 2009.
3. Thomas A. Runkler, “Data Analytics: Models and Algorithms for Intelligent Data Analysis”, Springer Science & Business Media, 2012.
4. Mark Gardener, “Beginning R- The Statistical Programming Language”, John Wiley & Sons, Inc.,

Reference Books:

1. Data Science, John D. Kelleher, Brendan Tierney, MIT Press.
2. R in Action Data Analysis and Graphics with R, Robert I. Kabacoff, Manning Publications, 2011.
3. Practical Statistics for Data Scientists, Peter Bruce, Andrew Bruce, O'Reilly Meida.

Course Title	BUSINESS INTELLIGENT ANALYST				B.Tech. IV Sem (R20UG) AI & ML			
Course Code	Category	Hours / Week			Credits	Maximum Marks		
2039405	PCC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
		Mid Exam Duration: 90 mins				End Exam Duration: 3Hrs		

Course Objectives:

- ❖ Basic principles of IOT.
- ❖ Various IOT platforms and application development.
- ❖ To know about Arduino board.
- ❖ To know about Raspberry pi.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	The importance of analytics and how its transforming the world today
CO 2	Understand how analytics provided a solution to industries using real case studies
CO 3	Explain what is analytics, the various types of analytics, and how to apply it
CO 4	Understand how a business analysis software works, and its architecture
CO 5	Describe a reporting application, its interface, and the different report types
CO 6	Create different types of advanced reports
CO 7	Understand Active Reports and how to create them

MODULE I: ANALYTICS OVERVIEW

Course I – Business Analytics Overview

Unit 1: Analytics Overview - This unit provides an understanding of the importance of business analytics in our world, society, and life.

Unit 2: Analytics trends: Past, present & future - This unit explains how analytics has evolved over time

Unit 3: Towards a predictive enterprise - This unit explains the effects of business analytics in the corporate world that has led to its global adoption across geographies and industries.

Unit 4: Analytics: Industry domains - This unit highlights the application of analytics across major industries.

Unit 5: Case studies and solutions - This unit covers real case studies and solutions of the adoption of business analytics across the world.

Course II – Business Intelligence and Analytics

Business Intelligence and Analytics: This course provides a collection of resources designed for participants to become familiar with business intelligence (BI) and analytics concepts. Participants will review materials to introduce themselves to terminology and practical business use cases for a high level understanding of BI and analytics. The course includes a pre-assessment for participants to measure their understanding of the content before taking the course, and a post-assessment for participants to gauge their learning after reviewing the materials

MODULE II – BUSINESS ANALYTICS FOUNDATIONS

Course I – IBM Cognos Analytics for Consumers

Business analysis solution for consumers: IBM Cognos Analytics for Consumers (v11.0) will teach IBM Cognos Analytics consumers how to access content, use reports, create dashboards, and personalize the appearance of IBM Cognos Analytics portal

MODULE III – BUSINESS INTELLIGENCE ANALYST

Course I – IBM Cognos Analytics: Author Reports Fundamentals

Unit 1: Introduction to IBM Cognos Analytics - In this unit, you will learn about IBM Cognos Analytics, different report types, how to create reports and examine personal data sources and modules.

Unit 2: Create list reports - In this unit you will learn about how to create list reports.

Unit 3: Focus reports using filters - In this unit you will learn about how to focus reports using filters.

Unit 4: Create crosstab reports - In this unit you will learn about how to create crosstab reports

Unit 5: Present data graphically - In this unit you will learn about how present data graphically.

Unit 6: Focus reports using prompts - In this unit you will learn how to focus reports using prompts.

Unit 7: Extend reports using calculations - In this unit you will learn how to extend reports using calculations.

Unit 8: Use additional report building techniques - In this unit, you will learn how to use additional report building techniques.

Unit 9: Customize reports with conditional formatting - In this unit you will learn how to customize reports using conditional formatting.

Unit 10: Drill-through definitions - In this unit you will learn how to drill-through from one report to another.

Unit 11: Enhance report layout - In this unit you will learn how to force page breaks in report, modify existing reports, apply formatting and format data and report objects.

Appendix A. Overview of IBM Cognos Analytics - In this appendix you will be introduced to IBM Cognos Analytics

Course II – IBM Cognos Analytics: Author Reports Advanced

Unit 1: Create query models - In this unit you will learn about creating query models and how to filter query data.

Unit 2: Create reports based on query relationships - In this unit, you will learn about query relationships and how to combine different queries to generate reports.

Unit 3: Create advanced dynamic reports - In this unit, you will learn how to create advanced dynamic reports.

Unit 4: Design effective prompts - In this unit, you will learn how to design effective prompts to create more efficient reports.

Unit 5: Create additional advanced reports - In this unit, you will learn how to create additional advanced reports.

Unit 6: Examine the report specification - In this unit, you will learn how to examine and modify report specification.

Unit 7: Distribute reports through bursting - In this unit, you will learn how to distribute reports through bursting and how to use burst tables

Unit 8: Enhance user interaction with HTML - In this unit, you will learn how to create interacting reports using HTML.

Course III – IBM Cognos Analytics: Author Active Reports

Unit 1: Introduction to IBM Cognos Active Reports - In this unit, you will learn about creating query models and how to filter query data.

Unit 2: Use Active Report connections - In this unit, you will use active report connections

Unit 3: Active Report charts, visualizations, and decks - In this unit, you will learn about active report charts, visualizations, and decks.

Course Title	OPERATING SYSTEMS LAB					B.Tech. IV Sem (R20UG) AI & ML		
Course Code	Category	Hours / Week			Credits	Maximum Marks		
2039406	PCC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		0	0	3	1.5	40	60	100
		Mid Exam Duration: 90 mins					End Exam Duration: 3Hrs	
Course Objectives:								
<ul style="list-style-type: none"> • Have a thorough knowledge of process management and memory management. • To have a thorough knowledge of how handle to deadlocks • Have a thorough knowledge on paging and segmentation concepts 								
Course Outcomes: On successful completion of this course, the students will be able to								
CO 1	Design, implement and analyze the various process scheduling algorithms and process synchronization mechanisms							
CO 2	Understand, implement and analyze the various memory management schemes.							
CO 3	Design, implement and analyze the ways to deal the deadlocks in the system.							
CO 4	Understand and analyze the paging and segmentation schemes.							
CO 5	Understand and analyze the File Allocation Techniques.							

List of Experiments:

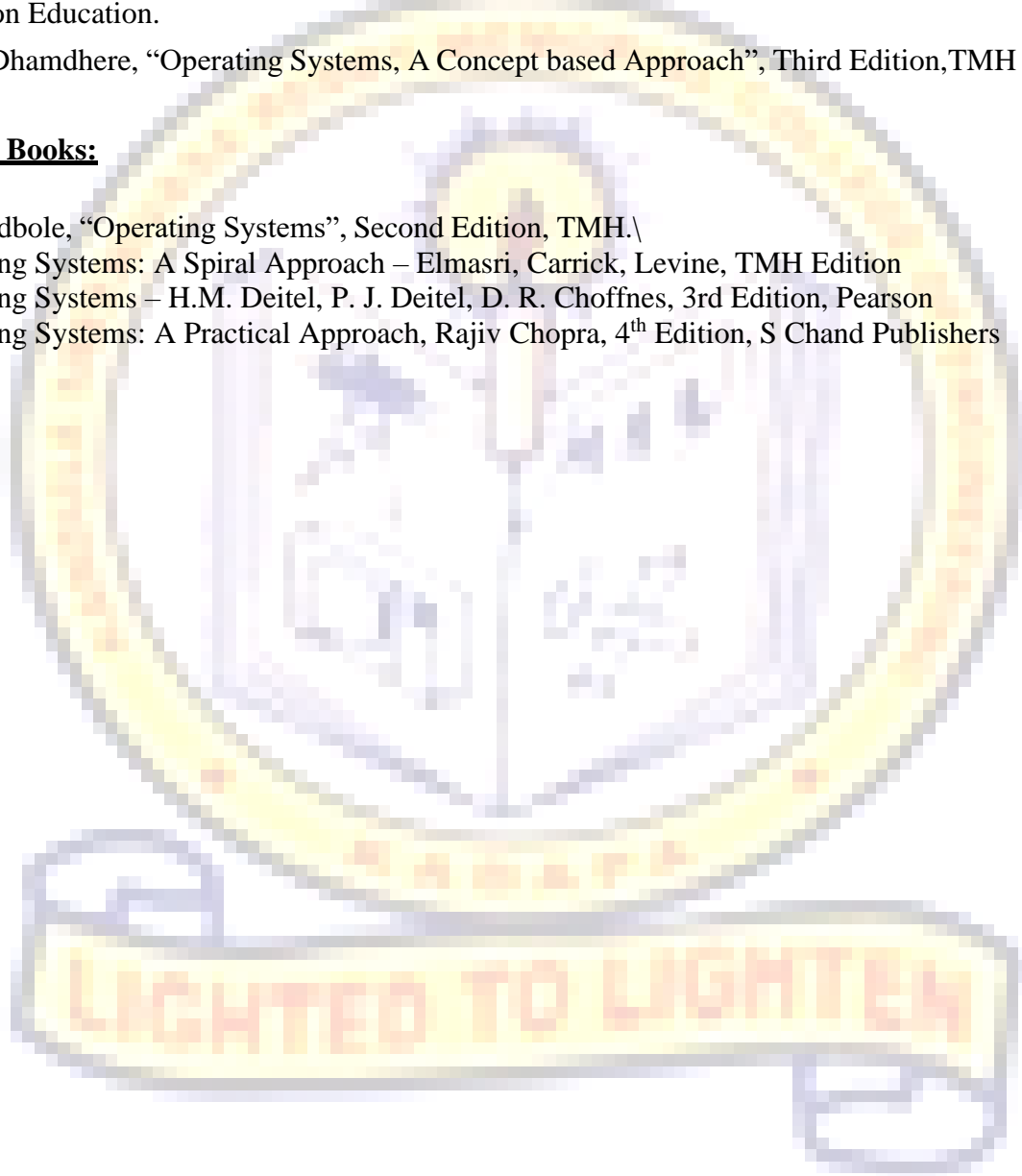
- Write a C/C++ program to simulate the following CPU scheduling algorithms to find the average turnaround time and average waiting time of process.
 - First Come First Serve
 - Shortest Job First
 - Priority
 - Round Robin Scheduling
- Write a C/C++ Program to simulate Producer Consumer Problem.
- Write a C program to simulate the concept of Dining-Philosophers problem.
- Write a C/C++ program to simulate the following contiguous memory allocation techniques
 - First Fit
 - Best Fit
 - Worst Fit
- Write a C/C++ program to simulate the following page replacement algorithms to find the total number of page faults for given page reference string.
 - First In First Out
 - Least Recently Used
 - Optimal
- Write a C/C++ program to simulate the paging and segmentation concepts.
- Write a C program to simulate the following:
 - Deadlock avoidance
 - Deadlock detection
- Write a C/C++ program to simulate the following file allocation
 - Sequential
 - Indexed
 - Linked

Text Books:

1. Abraham Silberchatz, Peter B. Galvin, Greg Gagne, “Operating System Concepts”, Eighth edition, John Wiley.
2. Andrew S Tanenbaum, “Modern Operating Systems”, Fourth Edition, Pearson Education
3. William Stallings, “Operating Systems: Internals and Design Principles”, Sixth Edition 2009, Pearson Education.
4. D.M.Dhamdhare, “Operating Systems, A Concept based Approach”, Third Edition, TMH

Reference Books:

1. A.S.Godbole, “Operating Systems”, Second Edition, TMH.\
2. Operating Systems: A Spiral Approach – Elmasri, Carrick, Levine, TMH Edition
3. Operating Systems – H.M. Deitel, P. J. Deitel, D. R. Choffnes, 3rd Edition, Pearson
4. Operating Systems: A Practical Approach, Rajiv Chopra, 4th Edition, S Chand Publishers



Course Title	DATA SCIENCE LAB					B.Tech. IV Sem (R20UG) AI & ML		
Course Code	Category	Hours / Week			Credits	Maximum Marks		
2039407	PCC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		0	0	3	1.5			
		Mid Exam Duration: 90 mins					End Exam Duration: 3Hrs	
Course Objectives:								
<ul style="list-style-type: none"> • Provide you with the knowledge and expertise to become an efficient data scientist. • Python Programming code to statistically analyze a dataset. • Evaluating Data visualizations. 								
Course Outcomes: On successful completion of this course, the students will be able to								
CO 1	Understanding how data is collected, managed and stored for data science							
CO 2	Understanding the key concepts in data science							
CO 3	Learning Python Programming							
CO 4	Understanding social networks							
CO 5	Understanding how data is collected, managed and stored for data science							

List of Experiments:

1. Implement on Python Environment setup to work with Data science
2. Write a program on NumPy: Arithmetic Operations on Arrays
3. Generate Pseudo Random numbers using various methods in NumPy
4. Write a program on Pandas: Program to deal with missing data by reading data from a file.
5. Implement on data wrangling functions on raw data
6. Write a program on Matplotlib: Visualize data by plotting a scatter plot.
7. Write a Program to visualize data using pie and bar graphs.
8. Implement programs on Date and Time Data Types
9. Implement Binomial distribution of variable.
10. Implement ANNOVA Tests.
11. Implement Chi-Square Tests
12. Write a program to Find the Normal distribution of a variable.

Text Books:

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly.
2. Norman matloff, "The art of R programming". No Starch Press, 2009.
3. Thomas A. Runkler, "Data Analytics: Models and Algorithms for Intelligent Data Analysis", Springer Science & Business Media, 2012.
4. Mark Gardener, "Beginning R- The Statistical Programming Language", John Wiley & Sons, Inc.,

Reference Books:

1. Data Science, John D. Kelleher, Brendan Tierney, MIT Press.
2. R in Action Data Analysis and Graphics with R, Robert I. Kabacoff, Manning Publications, 2011.
3. Practical Statistics for Data Scientists, Peter Bruce, Andrew Bruce, O'Reilly Meida.



Course Title	SKILL COURSE – II (ADVANCED PYTHON PROGRAMMING)					B.Tech. IV Sem (R20UG) AI & ML		
Course Code	Category	Hours / Week			Credits	Maximum Marks		
2039409	PCC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		1	0	2	2	40	60	100
		Mid Exam Duration: 90 mins					End Exam Duration: 3Hrs	

Course Objectives:

- Python is a very powerful programming language used for many different applications. Over time, the huge community around this open-source language has created quite a few tools to efficiently work with Python.
- The course enables the students to learn various python libraries starting from Numpy arrays, Pandas Data Frames, Matplotlib.
- Along the way, they'll learn about data cleaning, feature extraction and object oriented concepts using python.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understanding the basic concepts on Numpy arrays and performs calculations on givendata.
CO 2	Apply critical pandas concepts to handle the data frames.
CO 3	Apply data visualization using matplotlib packages.
CO 4	Analyze object oriented concepts for data reusability.
CO 5	Use data cleaning methods and feature extraction for data science applications.

List of Experiments:

Week-1: Study and implementation of various Basic Slicing and Advanced Indexing operations of NumPy arrays using Python over example data series?

Week-2: Implement the program using python Aggregations like Min, Max, and etc.?

Example: Consider the heights of all US presidents and find the Average Height of prime ministers of America? This data is available in the file "*president_heights.csv*".

Week-3: Write a python Program using Numpy Comparisons, Masks, and Boolean Logic?

Example: Consider the series of data that represents the amount of precipitation each day for a year in a given city and count the Rainy Days.

Week-4: Write a python Program using Numpy Fancy Indexing in single and multiple dimensions by selecting Random Points?

Week-5: Study and implementation of various Pandas operations on

- | | | |
|--------------|-----------------|--------------------|
| i. Data sets | ii. Data Frames | iii. Crosstab |
| iv. Group by | v. Filter | vi. Missing values |

Week-6: Implement the python program using pandas

- Program to Combining Datasets using Merge.
- Program to Combining Datasets using joins.

Week-7: Implement the python program using pandas

- Program using Pandas on Pivot Tables.
- Program using Pandas to Vectorized String Operations.

Week-8: Program using Pandas to Working with Time Series.
Example: Visualizing Seattle Bicycle Counts data set.

Week-9: Implement the python program for the following matplotlib features

i. Color bars	ii. Annotation	iii. Matplotlib to Text.
iv. Histograms	v. Scatter Plots	vi. Box plot

Week 10: Write the python program to implement various sub packages of Scipy.

Week 11: Write a Python program to create a parent class and child class along with their own methods. Access parent class members in child class to implement the following sceneries.

- a) Constructors & destructors
- b) Polymorphism

Example: Create a class ATM and define ATM operations to create account, deposit, check_balance, withdraw and delete account. Use constructor to initialize members.

Week-12: Implement the various data cleaning steps of example data sets using python numpy and pandas

Week 13: Implement the feature selection of data set using appropriate sklearn libraries.

Text Books:

1. Robert Johansson, "Numerical Python: A Practical Techniques Approach for Industry" published by Apress.
2. Daniel Y. Chen, "Pandas for Everyone: Python Data Analysis", First Edition by Addison-Wesley Professional
3. Alvaro Fuentes, "Become a Python Data Analyst" by Packt publishing
4. Paul Barry, "Head First Python a Brain Friendly Guide", O'Reilly, 2nd Edition, 2016.

Reference Books:

1. Advanced Python Programming By Dr. Gabriele Lanaro, Quan Nguyen, Sakis Kasampalis by Packt publishing
2. Advanced Python Development: Using Powerful Language Features in Real World Applications By Matthew Wilkes Apress July 2020
3. Expert Python Programming - Fourth Edition By Michal Jaworski and Tarek Ziade Packt Publishing May 2021
4. Modern Python Cookbook - Second Edition By Steven F. Lott Packt Publishing July 2020.

Course Title	MANDATORY COURSE (CONSTITUTION OF INDIA)					B.Tech. IV Sem (R20UG) AI & ML		
Course Code	Category	Hours / Week			Credits	Maximum Marks		
20MC409	PCC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		2	1	0	0	40	--	40
		Mid Exam Duration: 90 mins					End Exam Duration: 3Hrs	
Course Objectives:								
<ul style="list-style-type: none"> To realize the significance of the constitution of India to students from all walks of life and help them to understand the basic concepts of Indian constitution. To identify the importance of fundamental rights as well as fundamental duties. To understand the functioning of Union, State and Local Governments in the Indian federal system. To learn procedure and effects of emergency, composition and activities of election commission and amendment procedure. 								
Course Outcomes: On successful completion of this course, the students will be able to								
CO 1	Describe the historical background of the constitution making and its importance for building a democratic India							
CO 2	Explain the functioning of three wings of the government i.e., executive, legislative and judiciary.							
CO 3	Explain the value of the fundamental rights and duties for becoming good citizen of India							
CO 4	Analyze the decentralization of power between central, state and local self government.							
CO 5	Apply the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy							

UNIT-I

Introduction to Indian Constitution: Constitution meaning of the term, Indian Constitution – Sources and constitutional history, Features – Citizenship, Fundamental Rights and Duties, Directive Principles of State Policy.

UNIT – II

Union Government and its Administration Structure of the Indian Union: Center- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha, The Supreme Court and High Court: Powers and Functions.

UNIT – III

State Government and its Administration Governor – Role and Position – CM and Council of ministers, State Secretariat: Organization, Structure and Functions.

UNIT – IV

Local Administration: District's Administration Head – Role and Importance, Municipalities – Mayor and role of Elected Representative – Zilla Panchayat, Elected officials and their roles, CEO

Zilla Panchayat: Block level Organizational Hierarchy – (Different departments), Village level – Role of Elected and Appointed officials.

UNIT – V

Election Commission: Election Commission- Role of Chief Election Commissioner and Election Commissioner State Election Commission, Functions of Commissions for the welfare of SC/ST/OBC and women.

Text Books:

1. M.V.Pylee, “Introduction to the Constitution of India”, 4th Edition, Vikas publication, 2005.
2. Durga Das Basu (DD Basu), “Introduction to the constitution of India”, (Student Edition), 19th edition, Prentice-Hall EEE, 2008.

Reference Books:

1. Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall of India Pvt. Ltd., New Delhi
2. Subhash Kashyap, Indian Constitution, National Book Trust
3. J.A. Siwach, Dynamics of Indian Government & Politics
4. D.C. Gupta, Indian Government and Politics
5. H.M. Seervai, Constitutional Law of India, 4th edition in 3 volumes (Universal Law Publication)
6. J.C. Johari, Indian Government and Politics Hans
7. J. Raj Indian Government and Politics
8. M.V. Pylee, Indian Constitution Durga Das Basu, Human Rights in Constitutional Law, Prentice – Hall of India Pvt. Ltd., New Delhi
9. Noorani, A.G., (South Asia Human Rights Documentation Centre), Challenges to Civil Right), Challenges to Civil Rights Guarantees in India, Oxford University Press 2012.



LIGHTED TO LIGHTEN