R.M.D. ENGINEERING COLLEGE
(An Autonomous Institution)
REGULATIONS 2021
CHOICE BASED CREDIT SYSTEM

B.Tech. COMPUTER SCIENCE AND BUSINESS SYSTEMS

I. PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

1. **PEOI:** To ensure graduates will be proficient in utilizing the fundamental knowledge of basic sciences, mathematics, Computer Science and Business systems for the applications relevant to various streams of Engineering and Technology.

2. **PEO2:** To enrich knowledge of Common Business Principles and enable graduates with the core competencies necessary for understanding contemporary technology.

3. **PEO3:** To enable graduates to gain employment in organizations and establish themselves as professionals and entrepreneurs by applying their technical skills and leadership qualities to solve real world problems and meet the diversified needs of industry, academia and research.

II. PROGRAM OUTCOMES (POs)

ENGINEERING GRADUATES WILL BE ABLE TO:

1 **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2 **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3 **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4 **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5 **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6   **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7   **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8   **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9   **Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10 **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11 **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12 **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

III. PROGRAM SPECIFIC OUTCOMES (PSOs)

After the successful completion of the program, the graduates will be able to:

PSO1: To create appropriate modern engineering and business tools of cutting edge technologies and develop solutions for the betterment of the society.

PSO2: To identify, understand and communicate economic, legal, global, and ethical aspects of business.

PSO3: To set their career path applying all the technologies and business skills as an unique individual.

B.Tech. COMPUTER SCIENCE AND BUSINESS SYSTEMS
CHOICE BASED CREDIT SYSTEM
CURRICULUM AND SYLLABI FOR SEMESTERS I TO VIII
SEMESTER I

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	21MA102	Discrete Mathematics	BS	3	3	0	0	3
2.	21MA103	Introduction to Statistics, Probability and Calculus	BS	3	3	0	0	3
3.	21GE102	Fundamentals of Computer Science + Lab	ES	6	2	2	2	4
4.	21GE104	Principles of Electrical Engineering + Lab	ES	5	3	0	2	4
5.	21PH103	Fundamentals of Physics + Lab	BS	5	3	0	2	4
6.	21EL102	Business Communication and Value Sciences – I	HS	6	2	2	2	4
		Induction Program (Non Credit)	MC	3 Weeks				
TOTAL				28	16	4	8	22

SEMESTER II

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	21MA202	Linear Algebra	BS	5	3	2	0	4
2.	21MA203	Statistical Methods + Lab	BS	5	3	0	2	4
3.	21CB201	Data Structures and Algorithms + Lab	PC	6	2	2	2	4
4.	21EC241	Principles of Electronics Engineering + Lab	ES	5	3	0	2	4
5.	21CB202	Fundamentals of Economics	PC	2	2	0	0	2
6.	21EL202	Business Communication and Value Sciences - II	HS	6	2	2	2	4
7.	21CH201	Environmental Science and Engineering (Non Credit)	MC	3	3	0	0	0
TOTAL				32	18	6	8	22

SEMESTER III

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	21MA304	Computational Statistics + Lab	BS	5	3	0	2	4
2.	21CB301	Formal Language and Automata Theory	PC	7	3	2	2	5
3.	21CB302	Computer Organization and Architecture	PC	5	3	0	2	4
4.	21CB303	Object Oriented Programming + Lab	PC	5	3	0	2	4
5.	21CB304	Software Engineering + Lab	PC	7	3	2	2	5
6.	21CB305	Financial Management	PC	3	3	0	0	3
7.	21CB306	Indian Constitution (Non-Credit)	MC	2	2	0	0	0
8.	21CS313	Aptitude and Coding Skills – I (Non-Credit)	EEC	2	0	0	2	0
TOTAL				36	20	4	12	25

SEMESTER IV

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	21CB401	Operating Systems + Lab (Unix)	PC	5	3	0	2	4
2.	21CB402	Database Management Systems + Lab	PC	5	3	0	2	4
3.	21CB403	Software Design with UML + Lab	PC	5	3	0	2	4
4.	21CB404	Introduction to Innovation, IP Management and Entrepreneurship	EEC	3	3	0	0	3
5.	21EL401	Business Communication and Value Science – III	HS	6	2	0	4	4
6.	21CB405	Operations Research + Lab	PC	4	2	0	2	3
7.	21CB406	Marketing Research & Marketing Management	PC	3	3	0	0	3
8.	21CB407	Essence of Indian Traditional Knowledge (Non-Credit)	MC	2	2	0	0	0
9.	21CS414	Aptitude and Coding Skills – II (Non-Credit)	EEC	2	0	0	2	0
10.	21GE301	Universal Human Values 2: Understanding Harmony (Non-Credit)	MC	4	2	2	0	0
TOTAL				39	23	2	14	25

SEMESTER V

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	21CB501	Design And Analysis of Algorithms	PC	4	2	2	0	3
2.	21CB502	Compiler Design + Lab	PC	5	3	0	2	4
3.	21CB503	Business Strategy	PC	3	3	0	0	3
4.	21CB504	Design Thinking	PC	4	2	2	0	3
5.		Professional Elective I +Lab	PE	5	3	0	2	4
6.	21CB511	Mini Project	EEC	2	0	0	2	1
7.	21CS512	Advanced Aptitude and CodingSkills – I	EEC	2	0	0	2	1

			SEMESTER – VI						
S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY COURSES AND LAB INTEGRATED COURSES								
1	21CB601	Computer Networks + Lab	PC	5	3	0	2	4
2	21CB602	Information Security + Lab	PC	5	3	0	2	4
3	21CB603	Artificial Intelligence + Lab	PC	5	3	0	2	4
4		Professional Elective II + Lab	PE	5	3	0	2	4
5		Professional Elective III	PE	3	3	0	0	3
6	21CS614	Advanced Aptitude and CodingSkills –II	EEC	2	0	0	2	1
			TOTAL	25	15	0	10	20
		TOTAL		25	13	4	18	19

			SEMESTER – VII						
S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY COURSES AND LAB INTEGRATED COURSES								
1.	21CB701	Usability Design of Software Applications + Lab	PC	5	3	0	2	4
2.	21CB702	IT Workshop Scilab + Lab	PC	7	3	0	4	5
3.	21CB703	IT Project Management + Lab	PC	5	3	0	2	4
4.		Professional Elective IV + Lab	PE	3	3	0	0	3
5.		Professional Elective V	PE	5	3	0	2	4
PRACTICAL COURSE								
	21CB711	Project Work	EEC	2	0	0	2	1
			TOTAL	27	15	0	12	21

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		SEMESTER – VIII						
S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY COURSES AND LAB INTEGRATED COURSES								
1.	21CB811	Project Work	EEC	16	0	0	16	8
			TOTAL	**16**	**0**	**0**	**16**	**8**

		PROFESSIONAL ELECTIVE - I						
S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY COURSES AND LAB INTEGRATED COURSES								
1.	21CB901	Conversational Systems + Lab	PE	5	3	0	2	4
2.	21CB902	Cloud, Microservices & Application + Lab	PE	5	3	0	2	4
3.	21CB903	Machine Learning + Lab	PE	5	3	0	2	4
4.	21CB917	Advanced Social, Text and Media Analytics + Lab	PE	5	3	0	2	4

		PROFESSIONAL ELECTIVE - II						
S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY COURSES AND LAB INTEGRATED COURSES								
1.	21CB907	Robotics and Embedded Systems + Lab	PE	5	3	0	2	4
2.	21CB908	Modern Web Applications+ Lab	PE	5	3	0	2	4
3.	21CB909	Data Mining and Analytics + Lab	PE	5	3	0	2	4

PROFESSIONAL ELECTIVE - III								
S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY COURSES AND LAB INTEGRATED COURSES								
1.	21CB904	Behavioral Economics	PE	3	3	0	0	3
2.	21CB905	Computational Finance &Modeling	PE	3	3	0	0	3
3.	20CB910	Modern Enterprise Systems	PE	3	3	0	0	3
4.	20CB911	Advance Finance	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE - IV								
S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY COURSES AND LAB INTEGRATED COURSES								
1.	20CB913	Introduction to Cognitive Science + Lab	PE	5	3	0	2	4
2.	20CB914	Introduction to IoT + Lab	PE	5	3	0	2	4
3.	20CB915	Cryptology + Lab	PE	5	3	0	2	4
4.	20CB918	Mobile Computing + Lab	PE	5	3	0	2	4

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C

PROFESSIONAL ELECTIVE - V								
S. No	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY COURSES AND LAB INTEGRATED COURSES								
1.	21CB916	Quantum Computation & Quantum Information	PE	3	3	0	0	3
2.	21CB912	Image Processing and Pattern Recognition	PE	3	3	0	0	3
3.	21CB906	Industrial Psychology	PE	3	3	0	0	3
4.	21CB920	Financial & Cost Accounting	PE	3	3	0	0	3
OPEN ELECTIVES								
S. No	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY COURSES AND LAB INTEGRATED COURSES								
1.	21CB001	Formal Language and AutomataTheory	OE	3	3	0	0	3
2.	21CB002	Object Oriented Programming	OE	3	3	0	0	3
3.	21CB003	Compiler Design	OE	3	3	0	0	3
4.	21CB004	Business Strategy	OE	3	3	0	0	3
5.	21CB005	Design Thinking	OE	3	3	0	0	3

MINOR DEGREE –WEB DEVELOPMENT								
S. No	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY COURSES AND LAB INTEGRATED COURSES								
1.	21CB924	Software Development Practices	PEC	5	3	0	2	4
2.	21CB925	Front-end development using React	PEC	5	3	0	2	4
3.	21CB926	Server side programming with Ruby on Rails	PEC	5	3	0	2	4
4.	21CB927	Capstone Project	EEC	12	0	0	12	6
			TOTAL	27	9	0	18	18

**MINOR DEGREE OFFERED TO THE STUDENTS OF
B.TECH. COMPUTER SCIENCE AND BUSINESS SYSTEMS
<mark>MINOR DEGREE IN INTERNET OF THINGS</mark>**

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	21EC901	Introduction to Internet of Things	PE	3	3	0	0	3
2	21EC902	Sensors and Actuator Devices	PE	3	3	0	0	3
3	21EC903	Image and Video Analytics	PE	3	3	0	0	3
4	21EC904	Robot Operating Systems	PE	3	3	0	0	3
5	21EC905	Capstone project	PE	12	0	0	12	6
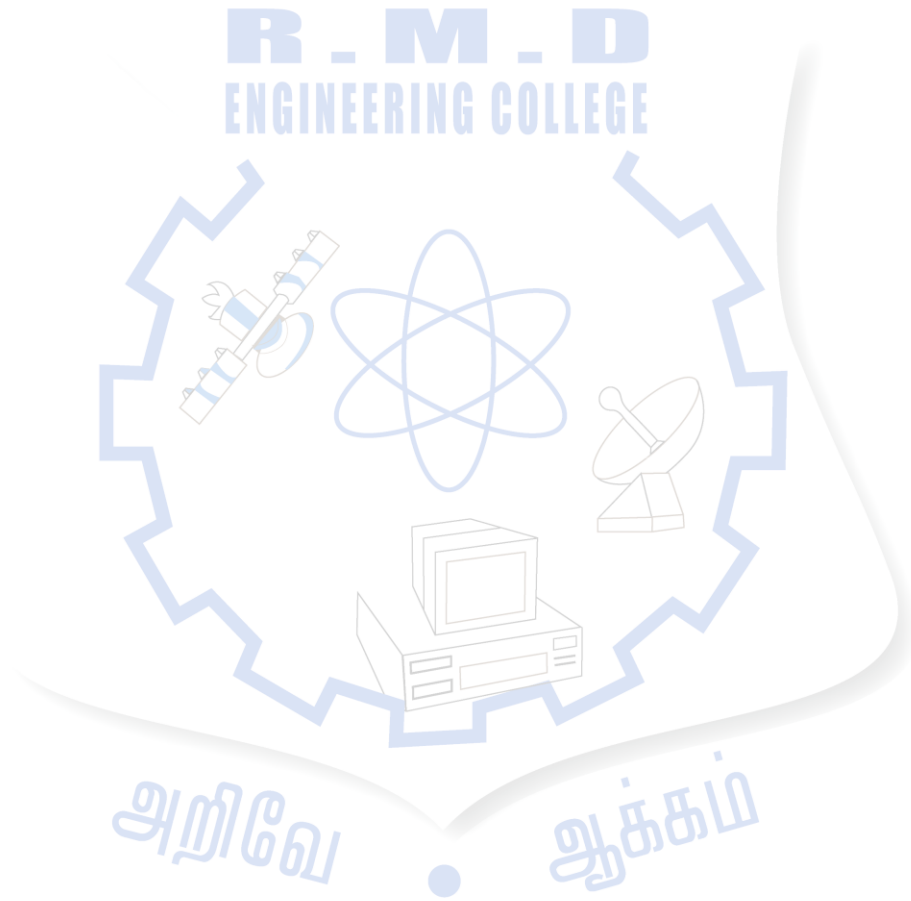
COURSE CODE	DISCRETE MATHEMATICS	L	T	P	C
21MA102	(For B.Tech - CSBS)	3	0	0	3

OBJECTIVES:

The syllabus is designed to:

- Check the validity of arguments by using basic connective and valid rules of inference.
- Impart knowledge on basics of counting, solving recurrence relations.
- Teach Boolean algebra, basic properties, and Karnaugh's maps.
- Explain functions, relations and group theory.
- Know the nomenclature of graphs, isomorphism of graphs, paths, cycles and circuits.
- Acquaint with the concept of trees, tree traversals, information storage and retrieval.

UNIT I   LOGIC   9

Propositional calculus - propositions and connectives, syntax; Semantics – truth assignments and truth tables, validity and satisfiability, tautology; Adequate set of connectives; Equivalence and normal forms; Compactness and resolution; Formal reducibility - natural deduction system and axiom system; Soundness and completeness.

UNIT II   BOOLEAN ALGEBRA   9

Introduction of Boolean algebra, truth table, basic logic gate, basic postulates of Boolean algebra, principle of duality, canonical form, Karnaugh map.

UNIT III   ABSTRACT ALGEBRA   9

Set, relation, group, ring, field.

UNIT IV   COMBINATORICS   9

Basic counting, balls and bins problems, generating functions, recurrence relations. Proof techniques, principle of mathematical induction, pigeon hole principle.

Graphs and digraphs, complement, isomorphism, connectedness and reachability, adjacency matrix, Eulerian paths and circuits in graphs and digraphs, Hamiltonian paths and circuits in graphs and tournaments, trees; Planar graphs, Euler's formula, dual of a planer graph, independence number and clique number, chromatic number, statement of Four-color theorem.

TOTAL: 45 PERIODS

OUTCOMES:

After the successful completion of the course, the students will be able to:

- Check the validity of the arguments
- Analyze various proof techniques and application of principles
- Construct truth tables and optimize logic by maps
- Define various algebraic structures, axioms and properties
- Apply graph theory techniques to solve real life problems.

TEXT BOOKS:

1. **J. P. Trembly** & **Manohar**, Discrete Mathematical Structures with applications to computer science, 1st Edition, McGraw Hill Education, 2017.
2. **N. Herstein**, Topics in Algebra, 2nd Edition, John Wiley and Sons,1975
3. **M. Morris Mano**, Digital Logic & Computer Design, 1st Edition, Pearson, 2004.
4. **J. A. Bondy** and **U. S. R. Murty**, Graph Theory with Applications, 5th Edition, Macmillan Press, London, 1982.

REFERENCES:

1. **Gilbert Strang**, Introduction to linear algebra, 4th Edition, Wellesley-Cambridge Press, 2009.
2. **R.A. Brualdi**, Introductory Combinatorics, 1st Edition, North-Holland, New York, 1977.
3. **N. Deo**, Graph Theory with Applications to Engineering and Computer Science, 1st Edition, Prentice Hall, Englewood Cliffs, 2016.

COURSE CODE	INTRODUCTION TO STATISTICS,	L	T	P	C
	PROBABILITY AND CALCULUS				
21MA103	(For B.Tech - CSBS)	3	0	0	3

OBJECTIVES:

The syllabus is designed to:

- Acquaint the students with the fundamental concept of statistics, probability and distributions.
- Impart the knowledge on basic concepts of differential calculus, integral calculus and multiple integrals.

UNIT I   INTRODUCTION TO STATISTICS   9

Definition of Statistics. Basic objectives. Applications in various branches of science with examples. Collection of Data: Internal and external data, Primary and secondary Data. Population and sample, Representative sample. Descriptive Statistics: Classification and tabulation of univariate data, graphical representation, Frequency curves. Central tendency (Mean, Median and Mode) and dispersion (S.D, M.D, Q.D and Range). Bivariate data: Summarization, marginal and conditional frequency distribution.

UNIT II   PROBABILITY   9

Concept of experiments – sample space – event – Definition of Combinatorial Probability – Conditional Probability – Baye's Theorem – Expected values and moments – mathematical expectation and its properties – Moments (including variance) and their properties – interpretation – Moment generating function.

UNIT III   DISCRETE PROBABILITY DISTRIBUTIONS   9

Binomial – Poisson – Geometric distributions.

UNIT IV   CONTINUOUS PROBABILTY DISTRIBUTIONS   9

Uniform – exponential – normal – chi-square – student - t – F distributions.

Basic concepts of differential calculus: Derivatives – product rule – quotient rule, Basic concepts of integral calculus: Definition of definite and indefinite integrals – substitution method – Integration by parts – Double integral – Area of a Double integral – Triple integral – Volume of a solids.

TOTAL: 45 PERIODS

OUTCOMES:

After the successful completion of the course, the students will be able to:

- Apply the concepts of basic statistics, find mean, median, mode, standard deviation, mean deviation, quartile deviation and range for a given data.
- Make use of probability concepts in problems of uncertainty.
- Identify and apply the discrete and continuous distributions concepts in real life problems.
- Evaluate the area and volume by using multiple integrals.

TEXT BOOKS:

1. **S.M. Ross**, Introduction of Probability Models, 10th Edition, Academic Press, New York, 2010.
2. **A. Goon, M. Gupta** and **B. Dasgupta**, Fundamentals of Statistics, volume I & II, 1st Edition, World Press, 2013.
3. **B.S. Grewal**, Higher Engineering Mathematics, 44th Edition, Khanna Publication, Delhi, 2018.

REFERENCES:

1. **S.M. Ross**, A first course in Probability, 8th Edition, Prentice Hall, 2010.
2. **I.R. Miller, J.E. Freund** and **R. Johnson**, Probability and Statistics for Engineers, 9th Edition, PHI, 2017.
3. **A.M. Mood, F.A. Graybilland, D.C. Boos**, Introduction to the Theory of Statistics, 3rd Edition McGraw Hill Education, 1973.
4. **Peter V.O'Neil**, Advanced Engineering Mathematics, 7th Edition, Thomson Learning, 2011.
5. **M.D. Greenberg**, Advanced Engineering Mathematics, 2nd Edition, Pearson Education, 2002.

COURSE CODE	FUNDAMENTALS OF COMPUTER SCIENCE + LAB (For B.Tech. CSBS)	L	T	P	C
21GE102		2	2	2	4

OBJECTIVES:

- To understand the problem solving concepts
- To understand syntax and constructs of C Language
- To develop structured programs using basic programming constructs
- To understands pointers and arrays in C
- To understand UNIX system interface
- To understand and apply programming methods

UNIT I   GENERAL PROBLEM SOLVING CONCEPTS AND INTRODUCTION TO C

6+6

General problem Solving concepts: Algorithm, and Flowchart for problem solving with Sequential Logic Structure, Decisions and Loops. Imperative languages: Introduction to imperative language; syntax and constructs of a specific language (ANSI C). Types Operator and Expressions with discussion of variable naming and Hungarian Notation: Variable Names, Data Type and Sizes (Little Endian Big Endian), Constants, Declarations, Arithmetic Operators, Relational Operators, Logical Operators, Type Conversion, Increment Decrement Operators, Bitwise Operators, Assignment Operators and Expressions, Precedence and Order of Evaluation, proper variable naming and Hungarian Notation. Control Flow with discussion on structured and unstructured programming: Statements and Blocks, If- Else-If, Switch, Loops – while, do, for, break and continue, goto labels, structured and un- structured programming.

UNIT II   FUNCTION AND PROGRAM STRUCTURES   6+6

Functions and Program Structure: Basics of functions, parameter passing and returning type, C main return as integer, External, Auto, Local, Static, RegisterVariables, Scope Rules,

Block structure, Initialisation, Recursion, Pre-processor,Standard Library Functions and return types, Standard Library.

UNIT III   POINTER AND ARRAYS   6+6

Pointers and Arrays: Pointers and address, Pointers and Function Arguments, Pointers and Arrays, Address Arithmetic, character Pointers and Functions, Pointer Arrays, Pointer to Pointer, Multi-dimensional array and Row/column major formats, Initialisation of Pointer Arrays, Command line arguments, Pointer to functions.

UNIT IV   STRUCTURES AND I/O   6+6

Structures: Basic Structures, Structures and Functions, Array of structures, Pointer of structures, Self-referral structures, Table look up, typedef, unions, Bit-fields.

Input and Output: Standard I/O, Formatted Output – printf, Formated Input – scanf,Variable length argument list, file access including FILE structure, fopen, stdin,sdtout and stderr, Error Handling including exit, perror and error.h, Line I/O.

UNIT V   UNIX SYSTEM INTERFACE AND PRORAMMING METHOD   6+6

Unix system Interface: File Descriptor, Low level I/O – read and write, open, create, close and unlink, Random access – lseek, Discussions on Listing Directory, Storage allocator.

Programming Method: Debugging, Macro, User Defined Header, User Defined Library Function, makefile utility.

TOTAL: 60 PERIODS

LIST OF EXPERIMENTS:

1. Algorithm and flowcharts of small problems like GCD

2. Structured code writing with:

     i.   Small but tricky codes

     ii.   Proper parameter passing

     iii. Command line Arguments

     iv.   Variable parameter

v.	Pointer to functions
vii.	User defined header
vii.	Make file utility
viii.	Multi file program and user defined libraries
ix.	Interesting substring matching / searching programs
x.	Parsing related assignments

TOTAL: 30 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

- Apply problem solving techniques to simple computational problems

- Understand the syntax and constructs of C language

- Develop structured programs using basic constructs in C

- Understand pointers and arrays in C

- Understand Unix system interface

- Apply various programming methods

TEXT BOOKS:

1. **Brian W Kernighan and Dennis M Ritchie,** The C Programming Language, 2nd Edition, PearsonEducation India, 2015.
2. **Anita Goel and Ajay Mittal,** Computer Fundamentals and Programming in C, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.

REFERENCES:

1. **B. Gottfried,** Programming with C, Fourth Edition, Schaum Outline Series, 2018
2. **Herbert Schildt,** C: The Complete Reference, Fourth Edition, McGraw Hill, 2017
3. **Yashavant Kanetkar**, Let Us C, 16th Edition, BPB Publications, 2018.

COURSE CODE	PRINCIPLES OF ELECTRICAL ENGINEERING + LAB (For B.Tech. CSBS)	L	T	P	C
21GE104		3	0	2	4

OBJECTIVES:

- Study the basic concepts of electrical engineering.

- Study the basic DC and AC networks used in electrical circuits.

- Demonstrate the concepts of electrical statics and electro-mechanics.

- Acquaint the knowledge about the measurement of electrical quantities.

- Demonstrate the concepts of electrical wiring and safety.

UNIT I INTRODUCTION 9

Concept of Potential difference, voltage, current, Fundamental linear passive and active elements to their functional current-voltage relation, Terminology and symbols in order to describe electric networks, voltage source and current sources, ideal and practical sources, concept of dependent and independent sources, Kirchhoff-s laws and applications to network solutions using mesh and nodal analysis, Concept of work, power, energy, and conversion of energy.

UNIT II DC CIRCUITS 9

Current-voltage relations of the electric network by mathematical equations to analyze the network (Thevenin's theorem, Norton's Theorem, Maximum Power Transfer theorem) Simplifications of networks using series-parallel, Star/Delta transformation, Superposition theorem.

UNIT III AC CIRCUITS 9

AC waveform definitions, form factor, peak factor, study of R-L, R-C,RLC series circuit, R-L-C parallel circuit, phasor representation in polar and rectangular form, concept of impedance, admittance, active, reactive, apparent and complex power, power factor, 3 phase Balanced AC Circuits (Y-Δ & Y-Y).

UNIT IV ELECTROSTATICS AND ELECTRO-MECHANICS **9**

Electrostatic field, electric field strength, concept of permittivity in dielectrics, capacitor composite, dielectric capacitors, capacitors in series and parallel, energy stored in capacitors, charging and discharging of capacitors, Electricity and Magnetism, magnetic field and Faraday's law, self and mutual inductance, Ampere's law, Magnetic circuit, Single phase transformer, principle of operation, EMF equation, voltage ratio, current ratio, KVA rating, efficiency and regulation, Electromechanical energy conversion.

UNIT V MEASUREMENTS AND SENSORS **9**

Introduction to measuring devices/sensors and transducers (Piezoelectric and thermo-couple) related to electrical signals, Elementary methods for the measurement of electrical quantities in DC and AC systems (Current & Single-phase power). Electrical Wiring and Illumination system: Basic layout of the distribution system, Types of Wiring System &Wiring Accessories, Necessityof earthing, Types of earthing, Safetydevices & system.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS:

1. Familiarization of electrical Elements, sources, measuring devices and transducers related to electrical circuits.
2. Determination of resistance temperature coefficient
3. Verification of Network Theorem (Superposition, Thevenin, Norton, Maximum Power Transfer theorem)
4. Simulation of R-L-C series circuits for XL>XC , XL< XC
5. Simulation of Time response of RCcircuit
6. Verification of relation in between voltage and current in three phase balanced star and delta connected loads.
7. Demonstration of measurement of electrical quantities in DC and ACsystems.

TOTAL: 30 PERIODS

OUTCOMES:

After successful completion of the course, the students will be able to:

- Summarize the behavior electrical circuits
- Solve the DC circuits using network theorems
- Interpret the concepts of AC circuits
- Discuss the electrostatic and magnetic fields with circuit laws and analyze the performance of transformers
- Explain the various sensors and demonstrate electric wiring

TEXT BOOKS:

1. **A. E. Fitzgerald, Kingsely Jr Charles, D. Umans Stephen,** Electric Machinery, Sixth Edition, Tata McGraw Hill, 2017.

2. **B. L. Theraja,** A Textbook of Electrical Technology, (vol. I), Chand and Company Ltd., New Delhi, 2004.

3. **V. K. Mehta,** Basic Electrical Engineering, Sixth Edition, S. Chand and Company Ltd, New Delhi, 2020.

4. **J.Nagrath and Kothari,** Theory and problems of Basic Electrical Engineering, Second Edition, Prentice Hall of India Pvt. Ltd, 2016.

REFERENCES:

1. **T. K. Nagsarkar and M. S. Sukhija,** Basic Electrical Engineering, Third Edition, Oxford University Press, 2017.

2. **D. J. Griffiths,** Introduction to Electrodynamics, Fourth Edition, Cambridge University Press, 2017.

3. **William H. Hayt & Jack E Kemmerly,** Engineering Circuit Analysis, Eighth Edition, McGraw-Hill Book Company Inc, 2010.

4. **Smarjith Ghosh,** Fundamentals of Electrical and Electronics Engineering, Second Edition, Prentice Hall (India) Pvt. Ltd., 2010.

COURSE CODE 21PH103	FUNDAMENTALS OF PHYSICS + LAB (For CSBS)	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To impart the fundamental concepts of physics and apply this knowledge to both scientific and engineering problems.
- To illustrate the fundamentals of oscillatory systems and the analogy of mechanical and electrical systems.
- To explain various light concepts like interference, diffraction and polarization.
- To impart knowledge related to the importance of EM waves and quantum mechanics
- To introduce concepts of crystallography, band structure and thermodynamics
- To give idea of basic lasing action, various types of lasers and fiber optics

UNIT I WAVES AND OSCILLATIONS   9

Oscillation: Periodic motion-simple harmonic motion-characteristics of simple harmonic motion-vibration of simple spring-mass system. Resonance- definition, damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor, forced oscillation and resonance in mechanical and electrical oscillators.

UNIT II OPTICS   9

Interference-principle of superposition-Young's experiment: Theory of interference fringes-types of interference-Fresnel's prism-Newton's ring, Diffraction-Two kinds of diffraction-Difference between interference and diffraction. Fraunhofer diffraction at single slit-plane diffraction grating, Temporal and Spatial Coherence. Polarization of light: Polarization - Concept of production of polarized beam of light from two SHM

acting at right angle; plane, elliptical and circularly polarized light, Brewster's law, double refraction.

UNIT III ELECTROMAGNETISM AND QUANTUM MECHANICS 9

Basic Idea of Electromagnetism: Continuity equation for current densities, Maxwell's equation in vacuum and non-conducting medium. Quantum Mechanics: Introduction-Planck's quantum theory- Matter waves, de-Broglie wavelength, Heisenberg's Uncertainty principle, time independent and time dependent Schrödinger's wave equation, Physical significance of wave function, Particle in a one dimensional potential box.

UNIT IV CRYSTALLOGRAPHY AND THERMODYNAMICS 9

Crystallography: Basic terms-types of crystal systems, Bravais lattices, miller indices, d spacing, Atomic packing factor for SC, BCC, FCC and HCP structures, X-ray diffraction. Semiconductor Physics: Conductor, Semiconductor and Insulator; Origin of Band Theory, Basic concept of Band theory. Thermodynamics: Zeroth law of thermodynamics, first law of thermodynamics, brief discussion on application of 1st law, second law of thermodynamics and concept of Engine, entropy, change in entropy in reversible and irreversible processes.

UNIT V LASER AND FIBER OPTICS 9

Laser and Fiber optics: Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: Ruby Laser, CO_2 and Neodymium YAG (Neodymium-doped Yttrium Aluminum Garnet); Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, laser speckles, applications of lasers in engineering, Fiber optics and applications, types of optical fibers.

TOTAL:45 PERIODS

LIST OF EXPERIMENTS:

1. Magnetic field along the axis of current carrying coil – Stewart and Gee
2. Determination of Hall coefficient of semi-conductor
3. Determination of Planck's constant
4. Determination of wave length of light by Laser diffraction method
5. Determination of wave length of light by Newton's Ring method
6. Determination of laser and optical fiber parameters
7. Determination of Stefan's Constant

TOTAL: 30 PERIODS

OUTCOMES:

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

- Obtain solution of the oscillator using differential equation.
- Analyze the intensity variation of light due to Polarization and interference
- Explain fundamentals of electromagnetism and quantum mechanics and apply it in engineering problems
- Find solution to thermal and electrical problems faced in computer devices.
- Analyze working principle of lasers and to summarize its applications

TEXT BOOKS:

1. **A Beiser**, Concepts of Modern Physics, 5th Edition, McGraw Hill International.
2. **Ajoy Ghatak**, Optics, 5th Edition, Tata McGraw Hill, 2012
3. **Sears and Zemansky** , University Physics- (Addison-Wesley)
4. **Jenkins and White**, Fundamentals of Optics, 3rd Edition, McGraw-Hill.
5. **M.N. Avadhanulu and P.G. Kshirsagar**, A textbook of Engineering Physics, S. Chand and Company, New Delhi, 2014.
6. **R.K. Gaur and S.L. Gupta**, Engineering Physics, DhanpatRai Publications(P) Ltd., 8th Edition, New Delhi, 2001.

REFERENCES:

1. **Halliday, Resnick and Walker**, Fundamentals of Physics, 9th Edition, John Wiley and sons, 2011.

2. **Richard P. Feynman**, The Feynman Lectures on Physics - Vol. I, II and III: The New Millennium Edition, 2012.

3. **Neil W Aschroft and N David Mermin**, Solid State Physics, Harcourt College Publishers, 1976

4. **S. O. Pillai**, Solid state physics, New Age International, 2015.

5. **M A Wahab**, Solid State Physics, 3rd Edition, Narosa Publishing House Pvt. Ltd., 2015

6. **Garcia,N. and Damask,A.** Physics for Computer Science Students, Springer-Verlag, 2012.

7. **Rogers, B., Adams,J and Pennathur, S.**, Nanotechnology, Understanding Small System", CRC Press, 2014

COURSE CODE	BUSINESS COMMUNICATION AND VALUE SCIENCES-I	L	T	P	C
21EL102	(FOR CSBS)	2	2	2	4

OBJECTIVES:

- Define the key concepts of Values and life skills

- Equip the learners to identify and understand what life skills are and their importance in leading a happy and well-adjusted life

- Motivate students to look within and Create a better version of self

- Illustrate the tenets of business communication

- Apply the basic communication practices

- Augment the learners to understand self-awareness, confidence and communication

UNIT I   **6+6**

Overview of LOL (include activity on introducing self), Class activity – presentation on favorite cricket captain in IPL and the skills and values they demonstrate, Self-work with immersion – interview a maid, watchman, sweeper, cab driver, beggar and narrate what you think are the values that drive them, Overview of business communication, Activity: Write a newspaper report on an IPL match, Activity: Record a conversation between a celebrity and an interviewer, Self-awareness – identity, body awareness, stress management.

UNIT II   **6+6**

Essential Grammar – I: Refresher on Parts of Speech – Listen to an audio clip and note down the different parts of speech followed by discussion, Tenses: Applications of tenses in Functional Grammar, Sentence formation (general & Technical), Common errors, Voices. Show sequence from film where a character uses wrong sentence structure (e.g. Zindagi Na MilegiDobara where the characters use 'the' before every word).

UNIT III   6+6

Communication Skills: Overview of Communication Skills, Barriers of communication, Effective communication, Types of communication- verbal and non – verbal – Role-play based learning, Importance of Questioning, Listening Skills: Law of nature- Importance of listening skills, Difference between listening and hearing, Types of listening, expressing self, connecting with emotions, visualizing and experiencing purpose.

UNIT IV   6+6

Email writing: Formal and Informal emails, activity,: Verbal communication Pronunciation, clarity of speech, Vocabulary Enrichment: Exposure to words from General Service List (GSL) by West, , significant abbreviations formal business vocabulary – Read Economic Times, Reader's Digest, National Geographic and take part in a GD, using the words you learnt/liked from the articles. Group discussion using Academic word list (AWL) technical specific terms related to the field of technology, phrases, idioms words learnt, Written Communication: Summary writing, story writing, Build your CV – start writing your comprehensive CV including every achievement in your life, no format, no page limit, Project: Create a podcast on a topic that will interest college students, Life skill: Stress management, working with rhythm and balance, colours, and teamwork, Project: Create a musical using the learnings from unit

UNIT V   6+6

Understanding Life Skills: Movie based learning   – The Pursuit of Happyness, Introduction to life skills What are the critical life skills, Multiple Intelligences Embracing diversity – Activity on appreciation of diversity, Life skill: Community service – work with an NGO and make a presentation, Life skill: Join a trek – Values to be learned: Leadership, teamwork, dealing with ambiguity, managing stress, motivating people, creativity, result orientation

TOTAL: 60 PERIODS

PRACTICAL SESSIONS:

1. Write a newspaper report on an IPL match.
2. Interview a maid, watchman, sweeper, cab driver, beggar and narrate what you think are the values that drive them
3. Record a conversation between a celebrity and an interviewer.
4. Skit based on communication skills.
5. Listen to recording and answer questions based on them.
6. Group Discussion.
7. Write your comprehensive CV including every achievement in your life, no format, no page limit.

LIST OF PROJECTS:

1. Create a podcast on a topic that will interest college students
2. Apply the basic communication practices in different types of communication: Create a musical
3. Life skill: Community service – work with an NGO and make apresentation
4. Life skill: Join a trek – Values to be learned: Leadership, teamwork, dealing with ambiguity, managing stress, motivating people, creativity, result orientation

TOTAL: 30 PERIODS

OUTCOMES:

After completion of the course, the students will be able to:

- Recognize the need for life skills andvalues.
- Recognize own strengths and opportunities.
- Apply the life skills to different situations.
- Understand the basic tenets of communication.
- Apply the basic communication practices in different types ofcommunication.
- Evaluate the importance of self-awareness, confidence and communication.

REFERENCES:

1. **Alan Mc'carthy and O'dell**, English vocabulary in use, Cambridge University Press, 3rdEdition, 2017.
2. APAART: Speak Well 1 (English language and communication)
3. APAART: Speak Well 2 (Soft Skills)
4. **Dr. Saroj Hiremath**, Business Communication, Nirali Prakashan, 2017.

WEB REFERENCES:

1. Train your mind to perform under pressure- Simon sinek
   https://curiosity.com/videos/simon-sinek-on-training-your-mind-to-perform-under-pressure-capture-your-flag/
2. Brilliant way one CEO rallied his team in the middle of layoffs
   https://www.inc.com/video/simon-sinek-explains-why-you-should-put-people-before-numbers.html
3. Will Smith's Top Ten rules for success
   https://www.youtube.com/watch?v=bBsT9omTeh0

ONLINE RESOURCES:

1. https://www.coursera.org/learn/learning-how-to-learn
2. https://www.coursera.org/specializations/effective-business-communication

COURSE CODE	LINEAR ALGEBRA	L	T	P	C
21MA202	(For B.Tech - CSBS)	3	2	0	4

OBJECTIVES:

The syllabus is designed to:

- Introduce the concepts of matrices and determinants.
- Impart the knowledge of vectors, linear combinations, vector space and linear transformations.
- Implement the concept of linear combinations in image processing and Machine learning.

UNIT I   MATRICES AND DETERMINANTS   9+6

Introduction to Matrices and Determinants – Solution of Linear Equations – Cramer's rule – Inverse of a Matrix.

UNIT II   VECTORS AND LINEAR COMBINATIONS   9+6

Vectors and linear combinations – Rank of a matrix – Gaussian elimination – LU Decomposition–Solving Systems of Linear Equations using LU Decomposition method.

UNIT III   VECTOR SPACE   9+6

Vector space – Dimension – Basis – Orthogonality – Projections – Gram-Schmidt orthogonalization and QR decomposition.

UNIT IV   LINEAR TRANSFORMATIONS   9+6

Linear transformations – Eigenvalues and Eigenvectors – Positive definite matrices – Hermitian and unitary matrices.

UNIT V   APPLICATIONS OF MATRICES   9+6

Singular value decomposition and Principal component analysis–Introduction to their applications in Image Processing and Machine Learning.

TOTAL: 75 PERIODS

OUTCOMES:

After the successful completion of the course, the students will be able to:

- Solve the system of linear equations using Cramer's rule.
- Solve the system of equations using LU Decomposition method.
- Compute QR decomposition for a given matrix.
- Represent the linear transformations in matrix and to find eigen values and eigen vectors.
- Apply the concept of linear combinations in image processing and Machine learning.

TEXT BOOKS:

1. **B.S. Grewal**, Higher Engineering Mathematics, 43rd Edition, Khanna Publishers, New Delhi 2014.
2. **A.H. Friedberg, A.J. Insel** and **L. Spence**, Linear Algebra, Prentice Hall of India, New Delhi, 2004.

REFERENCES:

1. **Peter V.O'Neil**, Advanced Engineering Mathematics, 7th Edition, Cengage Learning,
2. **Michael. D. Greenberg**, Advanced Engineering Mathematics, 2nd Edition, Pearson.
3. **Gilbert Strang**, Introduction to linear algebra, 5th Edition, Wellesley-Cambridge Press.
4. **P.N. Wartikar & J.N. Wartikar**, Applied Mathematics, Volume I & II, 7th Edition, Pune Vidyarthi Griha Prakashan, 1994.
5. **R.C. Gonzalez** and **R.E. Woods**, Digital Image Processing, 3rd Edition, Pearson Education International.
6. https://machinelearningmastery.com/introduction- matrices-machine-learning/
7. **M.P. Deisenroth, A.A. Faisal**, and **C. S. Ong**, Mathematics for Machine Learning, Published by Cambridge University Press, 2020.

COURSE CODE	STATISTICAL METHODS + LAB	L	T	P	C
21MA203	(For B.Tech - CSBS)	3	0	2	4

OBJECTIVES:

The syllabus is designed to:

- Explain the fundamental concepts of random sampling and Test of hypothesis.
- Develop an understanding on the principles of estimation theory.
- Introduce the concepts of linear statistical models and non-parametric test.
- Impart the knowledge of time series analysis & forecasting.

UNIT I   SAMPLING DISTRIBUTION   9

Sampling Techniques – Random sampling – Sampling from finite and infinite populations – Estimates and standard error (sampling with replacement and sampling without replacement) – Sampling distribution of sample mean – stratified random sampling.

UNIT II   THEORY OF ESTIMATION   9

Estimation – Point estimation – criteria for good estimates (un-biasedness, consistency) – Methods of estimation including maximum likelihood estimation. Sufficient Statistic – Concept & examples – complete sufficiency and their application in estimation. Test of hypothesis – Concept & formulation –Type I and Type II errors – Neyman Pearson lemma – Procedures of testing.

UNIT III   LINEAR STATISTICAL MODELS   9

Linear Statistical Models – Scatter diagram – Linear regression and correlation – Least squares method – Rank correlation – Multiple regression & multiple correlation – Analysis of variance (one way, two way with as well as without interaction).

UNIT IV   NON-PARAMETRIC TEST   9

Non-parametric Inference – Comparison with parametric inference – Use of order statistics – Sign test – Wilcoxon signed rank test – Mann-Whitney test – Run test – Kolmogorov-Smirnov test – Spearman's and Kendall's test – Tolerance region.

Basics of Time Series Analysis & Forecasting – Stationary – ARIMA Models – Identification – Estimation and Forecasting.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS:

R statistical programming language – Introduction to R – Functions – Control flow and Loops, Working with Vectors and Matrices – Reading in Data – Writing Data – Working with Data –Manipulating Data – Simulation – Linear model – Data Frame – Graphics in R.

Data Source:

- www.rbi.org.in

TOTAL: 30 PERIODS

OUTCOMES:

After the successful completion of the course, the students will be able to:

- Find the standard error and sample mean of the sampling distributions.
- Identify and evaluate the unbiased estimators.
- Compute correlation and regression curve.
- Apply testing of hypothesis in real life problems.
- Analyse ARIMA model and apply in real life situations.

TEXT BOOKS:

1. **I.R. Miller, J.E. Freund** and **R. Johnson**, Probability and Statistics for Engineers, 4th Edition, Prentice Hall India Learning Private Limited, 2012.
2. **A. Goon, M. Gupta** and **B. Dasgupta**, Fundamentals of Statistics, Volume I & II, World Press.
3. **Chris Chatfield**, The Analysis of Time Series: An Introduction, Chapman & Hall/CRC, 6th Edition, 2004.

REFERENCES:

1. **D.C. Montgomery** and **E. Peck**, Introduction to Linear Regression Analysis, Wiley-Inter science.

2. **A.M. Mood, F.A. Graybill** and **D.C. Boes**, Introduction to the Theory of Statistics, McGraw Hill.

3. **N. Draper** and **H. Smith**, Applied Regression Analysis, Wiley-Inter science.

4. **R. Garrett Grolemund**, Hands-on Programming with R, O'Reilly.

5. **Jared P. Lander**, R for Everyone: Advanced Analytics and Graphics, 2nd Edition, Addison-Wesley Professional..
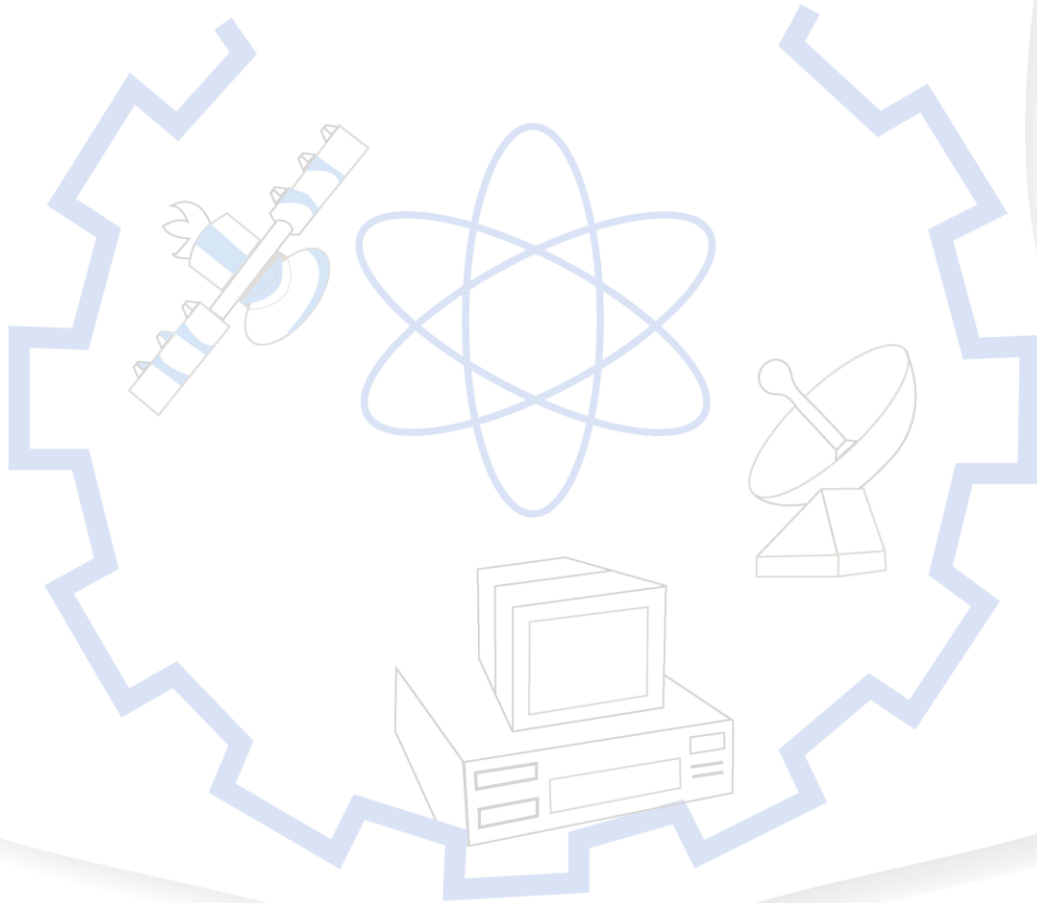
21CB201   DATA STRUCTURES AND ALGORITHMS + LAB   L   T   P   C
**   2   2   2   4**

OBJECTIVES:

- To learn linear and non-linear data structures.
- To recognize and distinguish the applications of various linear and non-lineardata structures.
- To analyse the concepts of tree and graph data structures.
- To be able to incorporate various searching and sorting techniques in realtime scenarios.
- To understand the concept of files and its operations.

UNIT I INTRODUCTION TO ALGORITHM & DATA ORGANISATION   6+6

Algorithm specification, Recursion, Performance analysis, Asymptotic Notation - The Big-O, Omega and Theta notation, Programming Style, Refinement of Coding **-** Time-Space Trade Off, Testing, Data Abstraction

UNIT II LINEAR DATA STRUCTURE   6+6

Array, Stack, Queue, Linked-list and its types, Various Representations, Operations& Applications of Linear Data Structures

UNIT III NON LINEAR DATA STRUCTURES   6+6

Trees (Binary Tree, Threaded Binary Tree, Binary Search Tree, B & B+ Tree, AVL Tree, Splay Tree), Operations & Applications of Non-Linear Data Structures

UNIT IV GRAPHS AND FILES   6+6

Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis. **File**: Organisation (Sequential, Direct, Indexed Sequential, Hashed) and various types of accessing schemes.

UNIT V SEARCHING AND SORTING   6+6

Sequential Search, Binary Search, Comparison Trees, Breadth First Search, Depth First Search Insertion Sort, Selection Sort, Shell Sort, Divide and Conquer Sort, Merge Sort, Quick Sort, Heap sort, Introduction to Hashing

TOTAL: 60 PERIODS

LIST OF EXPERIMENTS:

1. Towers of Hanoi using user defined stacks.
2. Reading, writing, and addition of polynomials.
3. Line editors with line count, word count showing on the screen.
4. Trees with all operations.
5. All graph algorithms.
6. Saving / retrieving non-linear data structure in/from a file

TOTAL: 30 PERIODS

OUTCOMES:

On completion of the course, students will be able to:

- Analyse the various data structure concepts.
- Apply the different linear data structures to problem solutions.
- Apply the different non-linear data structures to problem solutions.
- Critically analyse the various sorting algorithms.
- Exemplify the concept of files and its operations.
- Understand files accessing mechanisms.

TEXT BOOKS:

1. Fundamentals of Data Structures, E. Horowitz, S. Sahni, S. A-Freed, Universities Press.
2. Data Structures and Algorithms, A. V. Aho, J. E. Hopperoft, J. D. UIlman, Pearson.

REFERENCES:

1. The Art of Computer Programming: Volume 1: Fundamental Algorithms,DonaldE. Knuth.

2. Introduction to Algorithms, Thomas, H. Cormen, Charles E. Leiserson, Ronald

   L. Rivest, Clifford Stein, The MIT Press.

3. Open Data Structures: An Introduction (Open Paths to Enriched Learning),(Thirty First Edition), Pat Morin, UBC Press.
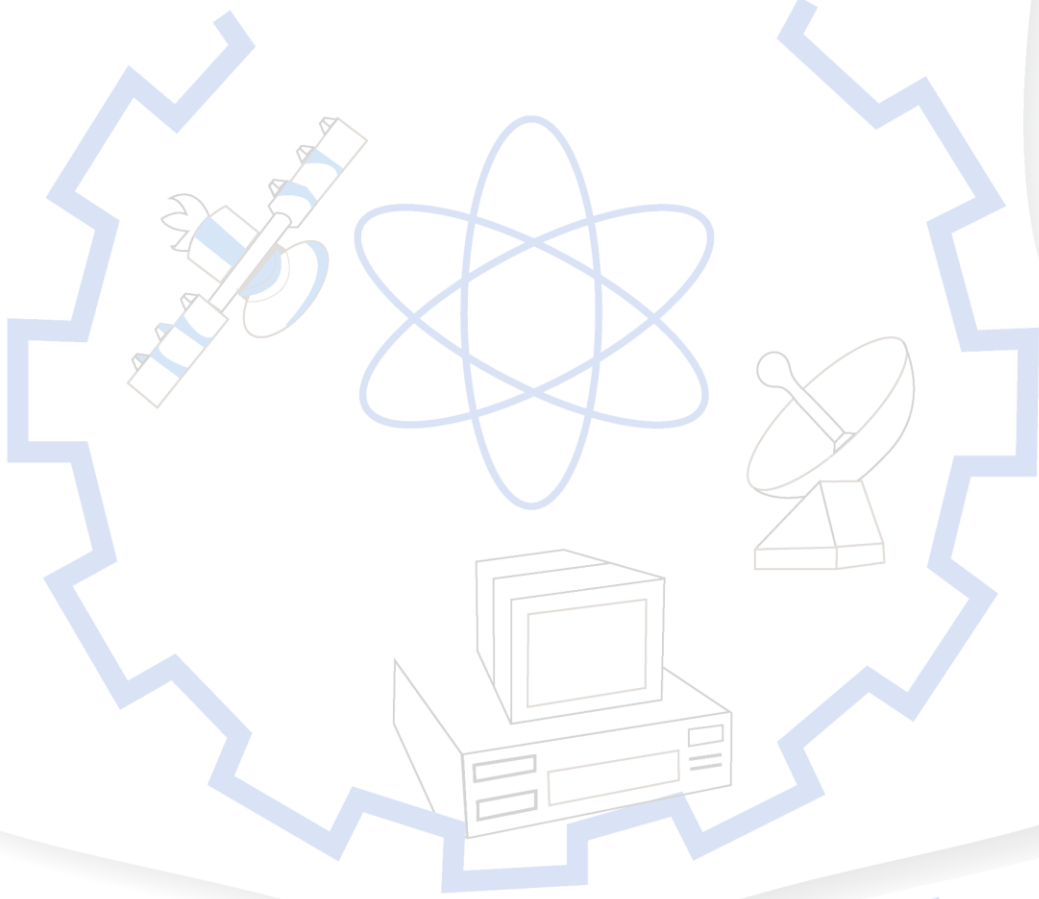
COURSE CODE		L	T	P	C
21EC241	**PRINCIPLES OF ELECTRONICS ENGINEERING + LAB**	3	0	2	4

OBJECTIVES:

- To study the operation of semiconductor diodes and their characteristics
- To acquire knowledge about the operation and characteristics of BJT under various configurations
- To introduce the structure and terminal characteristics of FET and MOSFET
- To understand the concepts of feedback and operational amplifiers with its applications
- To gain knowledge about digital logic circuits.

UNIT I: SEMICONDUCTOR DIODES AND CIRCUITS 9

Semiconductors: Crystalline material: Mechanical properties, Energy band theory, Fermi levels; Conductors, Semiconductors & Insulators: electrical properties, band diagrams. Semiconductors: intrinsic & extrinsic, energy band diagram, P&N-type semiconductors, drift & diffusion carriers.

Diodes and Diode Circuits: Formation of P-N junction, energy band diagram, built-in-potential, forward and reverse biased P-N junction, formation of depletion zone, V-I characteristics, Zener breakdown, Avalanche breakdown and its reverse characteristics; Junction capacitance and Varactor diode. Simple diode circuits, load line, linear piecewise model; Rectifier circuits: half wave, full wave, PIV, DC voltage and current, ripple factor, efficiency, idea of regulation.

UNIT II: BIPOLAR JUNCTION TRANSISTORS 9

Formation of PNP / NPN junctions, energy band diagram; transistor mechanism and principle of transistors, CE, CB, CC configuration, transistor characteristics: cut-off active and saturation mode, transistor action, injection efficiency, base transport factor and current amplification factors for CB and CE modes. Biasing and Bias stability: calculation of stability factor

UNIT III: FIELD EFFECT TRANSISTORS 9

Concept of Field Effect Transistors (channel width modulation), Gate isolation types, JFET Structure and characteristics, MOSFET Structure and characteristics, depletion and enhancement type; CS, CG, CD configurations; CMOS: Basic Principles

UNIT IV: FEEDBACK AMPLIFER AND OPERATIONAL AMPLIFIERS 9

Concept (Block diagram), properties, positive and negative feedback, loop gain, open loop gain, feedback factors; topologies of feedback amplifier; effect of feedback on gain, output impedance, input impedance, sensitivities (qualitative), bandwidth stability; effect of positive feedback: instability and oscillation, condition of oscillation, Barkhausen criteria. Introduction to integrated circuits, operational amplified and its terminal properties; Application of operational amplifier; inverting and non-inverting mode of operation, Adders, Subtractors, Constant-gain multiplier, Voltage follower, Comparator, Integrator, Differentiator

UNITV: DIGITAL ELECTRONICS FUNDAMENTALS 9

Difference between analog and digital signals, Logic ICs, half and full adder/subtractor, multiplexers, demultiplexers, flip-flops, shift registers, counters.

TOTAL:45 PERIODS

LIST OF EXPERIMENTS:

1. Semiconductor Diodes and application,

    a. Characteristics of PN junction diode

    b. Zener diode characteristics & Regulator using Zener diode

    c. Clipper. clamper & FWR

2. Transistor circuits

    a. Common Emitter Input Output characteristics

    b. Common Base Input Output characteristics

3. JFET, oscillators and amplifiers.

    a. FET characteristics

    b. Characteristics of amplifier

    c. Design of basic oscillator circuits

4. Opamp based experiments (Analysis using Simulation Spice)

    a. Opamp as inverting amplifier, non-inverting amplifier, voltage follower

    b. Opamp applications-summer, subtractor

    c. Opamp applications-Differentiator and Integrator

5. Digital experiments

    a. Simplification, realization of Boolean expressions using logic gates/Universal gates.

    b. Realization of Half/Full adders and Half/Full Subtractors using logic gates.

    c. Construction of simple Decoder & Multiplexer circuits using logic gates.

    d. Realization of Synchronous Up/Down counter.

TOTAL: 30 PERIODS

OUTCOMES:

On completion of the course, students will be able to:

- Explain the characteristics of diode
- Describe the equivalence circuits of transistors
- Acquire the knowledge on feedback amplifiers and operational amplifiers.
- Describe the simple digital logic circuits

TEXT BOOKS:

1. Microelectronics Circuits, Adel SSedra and Kenneth Carless Smith, Oxford University Press.
2. Millman's Integrated Electronics, Jacob Millman, Christos Halkias, Chetan Parikh, McGraw Hill Education.
3. Digital Logic & Computer Design, M. Morris Mano, Pearson
4. Salivahanan S ,Sureshkumar N, and A.Vallavaraj Electronic Devices and Circuits, McGraw Hill Education, Fourth Edition, 2017.

REFERENCES:

1. Electronic Devices and Circuit Theory, Robert L. Boylestad, Louis Nashelsky.
2. Solid State Electronic Devices, 6th Edition, Ben Streetman, Sanjay Banerjee
3. Electronic Principle, Albert Paul Malvino.
4. Electronics Circuits:Discrete& Integrated, D Schilling C Belove T Apelewicz R Saccardi.
5. Microelectronics, Jacob Millman, Arvin Grabel.
6. Electronics Devices & Circuits, S. Salivahanan, N. Suresh Kumar, A. Vallavaraj

21CB202	FUNDAMENTALS OF ECONOMICS	L	T	P	C
		2	0	0	2
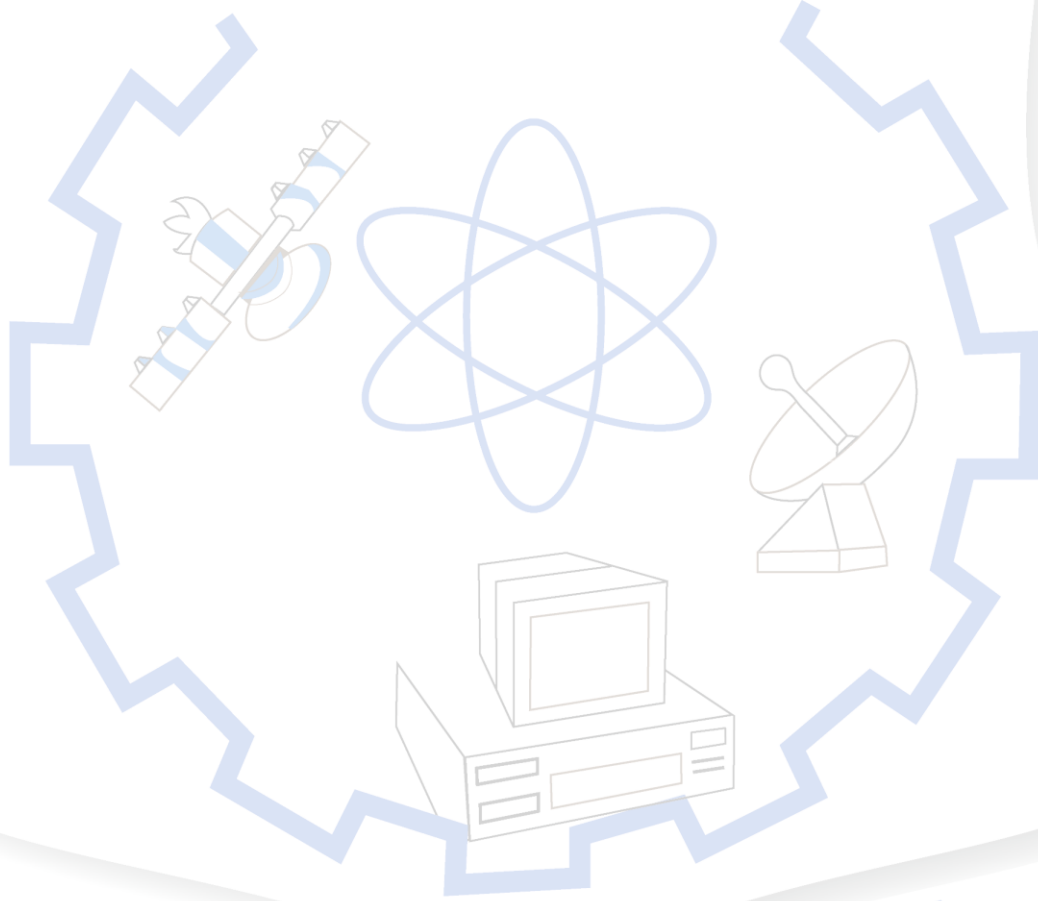
OBJECTIVES:

- To explain the fundamental principles of micro economics relevant to managing an organization.
- To describe the fundamental principles of macroeconomics to have the understanding of economic environment of business.
- To understand the various aspects of India's economy.

UNIT I INTRODUCTION   6

Principles of Demand and Supply - Supply Curves of Firms ------- Elasticity of Supply; Demand Curves of Households - Elasticity of Demand; Equilibrium and Comparative Statics (Shift of a Curve and Movement along the Curve).

UNIT II CONSUMER ANALYSIS   6

Welfare Analysis - Consumers' and Producers' Surplus--------Price Ceilings and Price Floors; Consumer Behaviour - Axioms of Choice - Budget Constraints and Indifference Curves; Consumer's Equilibrium---------------------Effects of a Price Change, Income and Substitution Effects Derivation of a Demand Curve;

UNIT III PRODUCTION AND COSTING   6

Applications - Tax and Subsidies - Intertemporal Consumption   Suppliers' Income Effect; Theory of Production - Production Function and Iso-quants - Cost Minimization; Cost Curves - Total, Average and Marginal Costs --------Long Run andShort Run Costs; Equilibrium of a Firm Under Perfect Competition; Monopoly and Monopolistic Competition

UNIT IV MACROECONOMIC REFORMS   6

National Income and its Components ------GNP, NNP, GDP, NDP; Consumption Function; Investment; Simple Keynesian Model of Income Determination and the

Keynesian Multiplier; Government Sector - Taxes and Subsidies; External Sector - Exports and Imports; Money - Definitions; Demand for Money -Transactionary and Speculative Demand; Supply of Money - Bank's Credit Creation Multiplier; Integrating Money and Commodity Markets - IS, LM Model.

UNIT V POLICY GOVERANCE   **6**

Business Cycles and Stabilization - Monetary and Fiscal Policy Central Bank and the Government; The Classical Paradigm - Price and Wage Rigidities---------- Voluntary and Involuntary Unemployment

TOTAL: 30 PERIODS

OUTCOMES:

On completion of the course, students will be able to:

- Become familiar with both principles of micro and macroeconomics.
- Understand about approaches to consumer behaviour and relation between production and cost function.
- Describe and discuss on interaction of product and factor market.
- Get awareness about importance and development of Indian economy andeconomic reforms.
- Have thorough knowledge in the areas of inflation, unemployment, monetarypolicy, fiscal policy and international trade.

TEXT BOOKS:

1. Microeconomics, Pindyck, Robert S., and Daniel L. Rubinfeld.
2. Macroeconomics, Dornbusch, Fischer and Startz.
3. Economics, Paul Anthony Samuelson, William D. Nordhaus.

REFERENCES:

1. Intermediate Microeconomics: A Modern Approach, Hal R, Varian.
2. Principles of Macroeconomics, N. Gregory Mankiw.

COURSE CODE	BUSINESS COMMUNICATION AND VALUE SCIENCES-II (For CSBS)	L	T	P	C
21EL202		2	2	2	4

OBJECTIVES

- Strengthen the reading skills.

- Enhance effective writing, presentation and group discussion skills

- Identify personality traits and help learners evolve as a better team player.

- Provide the learners with an introduction to the key concepts of

    a) Morality

    b) Behavior and beliefs

    c) Diversity & Inclusion

UNIT I   6+6

Use tools of structured written communication: Good and Bad Writing. Common errors, punctuation rules, use of words. Research, read and generate a report on a social issue. Understand tools for Lucid writing: Catherine Morris and Joanie McMahon's writing techniques. SATORI – Participants share the personal take away acquired from GD, writing and reading skills activities. Use electronic/social media to share concepts and ideas: Launch an E Magazine.

UNIT II   6+6

Understand the basics of presentation- Introduction to basic presentation skills & ORAI app. Speed Reading session: Introduction to skimming and scanning. Develop materials to create an identity for an organization dedicated to a social cause. Create Vision, Mission, Value statement, tagline and Design a logo. Introduction to basic presentation skills & ORAI app. Prepare and publish the Second episode of the E Magazine. Speed Reading session: Introduction to skimming and scanning

UNIT III   **6+6**

Create communication material to share concepts and ideas. Ad campaign- Brain storming session discuss and explore the means of articulating and amplifying the social issue their NGOs are working for. Use electronic/social media to share concepts and ideas. Design a skit- a) write the script articulating the message of their respective NGOs. Read out the script. Promote the play through a social media and gather your audience. Discussion and Theory :Identify individual personality types and role in a team. (1) Theory to find out from the participants their views, observations and experiences of working in a team(2) Intro of Dr. Meredith Belbin and his research on team work and how individuals contribute. (3) Belbin's 8 Team Roles and Lindgren's Big 5 personality traits.(4) Belbin's 8 team player styles.

UNIT IV   **6+6**

Identify individual personality types and role in a team: (1) Team Falcon Practical to identify individual personality traits with Belbin's 8 team player styles(2) Similar personality types to form groups (3) Groups present their traits - Use the electronic/social media to share concepts and ideas. Basic concepts of Morality and Diversity: Ten minutes of your time – a short film on diversity. Play the video. Theory to connect the key take away of the film to the concept of empathy.

UNIT V   **6+6**

Basic concepts of Morality and Diversity. Research on a book, incident or film based on the topic of your respective NGO- Write a review in a blog. Diversity & Inclusion- Different forms of Diversity in our society. Discussion on TCS values, Respect for Individual and Integrity. Use tools of structured written communication to generate awareness for a cause

TOTAL: 60 PERIODS

PRACTICAL SESSIONS:

1. Group Practical – As a group, they will work on the social issue identified by them. Research, read and generate a report based on the findings. Plan and design an EMagazine.

2. Each group will form an NGO. Create Vision, Mission, Value statement, tagline and Design a logo. individual write up to be written and evaluated for the E- magazine. Prepare and publish the Second episode of the E Magazine.

3. Design a skit- a) write the script articulating the message of their respective NGOs. Read out the script. (Skit time-5 minutes). Promote the play through a social media and gather your audience. Prepare and publish the third episode of the E Magazine.

4. Groups to create a story – 10 minutes of a person's life affected by the social issue groups are working on. Narrate the story in first person.

5. Research on a book, incident or film based on the topic of your respective NGO and Write a review in a blog on the topic.

6. Teams to video record interviews of people from diverse groups (Ask 5 questions). Share the recordings in YouTube.

7. Prepared speech- Every student will narrate the challenges faced by a member of a diverse group in 4 minutes (speech in first person).Prepare and publish the final episode of the E Magazine.

8. Revisit your resume Include your recent achievements in your resume.

LIST OF PROJECTS:

1. Each team to look for an NGO/ social group in the city which is working on the issuetheir college group is supporting.

2. Spend a day with the NGO/ social group to understand exactly how they work and the challenges they face.

3. Render voluntary service to the group for one day.

4. Invite the NGO/ social group to address their university students for couple of hours. Planthe entire event, decide a suitable venue in the university, gather audience, invite faculty members etc. (they need to get their plan ratified their professor). Outcome-- Host an interactive session with the NGO spokesperson.

5. The groups to present their experience of a day with the NGO and inspire students to work for the cause.

TOTAL: 30 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

*   Understand and use tools of structured written communication
*   Use electronic/social media to share concepts and ideas
*   Understand the basics of presentation and apply effective techniques to make presentations
*   Apply the basic concept of speed reading, skimming and scanning.
*   Identify individual personality types and role in a team.
*   Understand the basic concepts of Morality and Diversity and argue on a topic based on morality and diversity
*   Articulate opinions on a topic with the objective of influencing others.

REFERENCES:

1. **Dr. A.P.J Abdul Kalam and Arun Tiwari**, Guiding Souls : Dialogues on the purpose of life, Prabhat Prakashan, 1st Edition, 2005
2. **Dr. A.P.J Abdul Kalam and Acharya Mahapragya**, The Family and the Nation, HarperCollins Publishers India, 2015
3. **Dr. A.P.J Abdul Kalam and Y.S.Rajan,** The Scientific India: A twenty First Century Guide to the World around Us, Penguin Books India Pvt. Ltd, 2011
4. **Dr. A.P.J Abdul Kalam**, Forge Your Future: Candid, Forthright, Inspiring, Penguin Books India Pvt. Ltd, 2014.
5. **Peter H. Diamandis and Steven Kotler**, Abundance: The Future is Better Than You Think, Free Press, 2012.
6. **Simon Sinek**, Start with Why: How Great Leaders Inspire Everyone to Take Action, Penguin Books India Pvt. Ltd, 2011.
7. **Sandra Moriarty, Nancy D. Mitchell and William D. Wells**, Advertising & IMC: Principles and Practice, Pearson Education India , 2016.

WEB REFERENCES:

1. Ethics Fundamentals And Approaches To Ethics

    https://www.eolss.net/Sample-Chapters/C14/E1-37-01-00.pdf

2. A Framework for Making Ethical Decisions

3. https://www.brown.edu/academics/science-and-technology-studies/framework-making-ethical-decisions

4. Five Basic Approaches to Ethical Decision-

    http://faculty.winthrop.edu/meelerd/docs/rolos/5_Ethical_Approaches.pdf

ONLINE RESOURCES:

1. https://youtu.be/CsaTslhSDI
2. https://m.youtube.com/watch?feature=youtu.be&v=IIKvV8_T95M
3. https://m.youtube.com/watch?feature=youtu.be&v=e80BbX05D7Y
4. https://m.youtube.com/watch?v=dT_D68RJ5T8&feature=youtu.be
5. https://m.youtube.com/watch?v=7sLLEdBgYYY&feature=youtu.be
6. https://www.coursera.org/specializations/effective-business-communication

COURSE CODE 21CH201	ENVIRONMENTAL SCIENCE AND ENGINEERING (Common to All Branches)	L	T	P	C
		3	0	0	3

OBJECTIVES:

The goal of this course is to enlighten and sensitize the students on environmental conservation and social issues. The course is designed to:

- Appreciate the natural resources of environment, which are inherently created for supporting life.
- Learn scientific and technological solutions to current day pollution issues.
- Study the interrelationship between living organisms and environment
- Understand the integrated themes of biodiversity.
- Appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its values.

UNIT I   NATURAL RESOURCES   11

Introduction – scope and importance of environment – need for public awareness. **Forest resources** – Use and over – exploitation, deforestation – timber extraction, mining, dams and its effects on forests and tribal people. **Water resources** – Use and over – utilization of surface and ground water, conflicts over water, dams –benefits and problems. **Mineral resources** – Use and exploitation, environmental effects of extracting and using mineral resources. **Food resources** – World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer – pesticide problems, water logging, salinity. **Energy resources** – Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. **Land resources** – Land as a resource, land degradation, soil erosion and desertification – role of an individual in conservation of natural resources – case studies.

UNIT II   POLLUTION AND ITS MANAGEMENT   11

Pollution – causes, effects and control measures – Air pollution – Water pollution – Soil pollution – Marine pollution – Noise pollution – Thermal pollution – nuclear hazards – nuclear accidents and holocaust – role of an individual in prevention of pollution – case studies. **Waste management** – causes, effects and control measures of municipal solid wastes, E-waste, plastic waste.

UNIT III   **ECOSYSTEMS AND BIODIVERSITY**   **9**

Introduction to ecosystems – structure and function of an ecosystem – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – types, characteristic features, structure and functions of –Forest ecosystem – Grassland ecosystem – Desert ecosystem – Aquatic ecosystems (lakes, oceans) **Introduction to biodiversity** – types (genetic, species and ecosystem diversity) – values of biodiversity – threats to biodiversity – endangered and endemic species – conservation of biodiversity (in-situ and ex-situ conservation) – India as a mega – diversity nation – hot-spots of biodiversity in India

UNIT IV   **SOCIAL ISSUES AND THE ENVIRONMENT**   **8**

Sustainable development – sustainable development goals – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation – consumerism and waste products, value education. **Disaster management** – floods, drought, earthquake, Tsunami, cyclone and landslides – case studies. **Environmental ethics** – issues and possible solutions – environment protection act – air (prevention and control of pollution) act – water (prevention and control of pollution) act – wildlife protection act – forest conservation act.

UNIT V   **HUMAN POPULATION AND THE ENVIRONMENT**   **6**

Introduction – population growth, variation among nations, population explosion, familywelfare programme – women and child welfare – environment and human health – endemic/epidemic/pandemic, COVID – 19, HIV / AIDS – role of information technology in environment and human health – environmental impact assessment –case studies.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

- Illustrate the importance and conservation of natural resources.
- Assess the impact of various pollutants and suggest appropriate pollution control methods.

- Explain the basic structure of ecosystem and the conservation of biodiversity.
- Analyze the social issues related to environment and recommend suitable solutions.
- Investigate the trends in population explosion and assess its impact.

TEXT BOOKS:

1. **Anubha Kaushik and C. P. Kaushik**, "Perspectives in environmental studies", 6th Edition, New Age International, 2018.

2. **Benny Joseph**, "Environmental Science and Engineering", 1st Edition, Tata McGraw-Hill, New Delhi, 2017.

3. **Gilbert M. Masters, Wendell P. Ela**, "Introduction to Environmental Engineering and Science", 3rd Edition, Pearson Education, 2015.
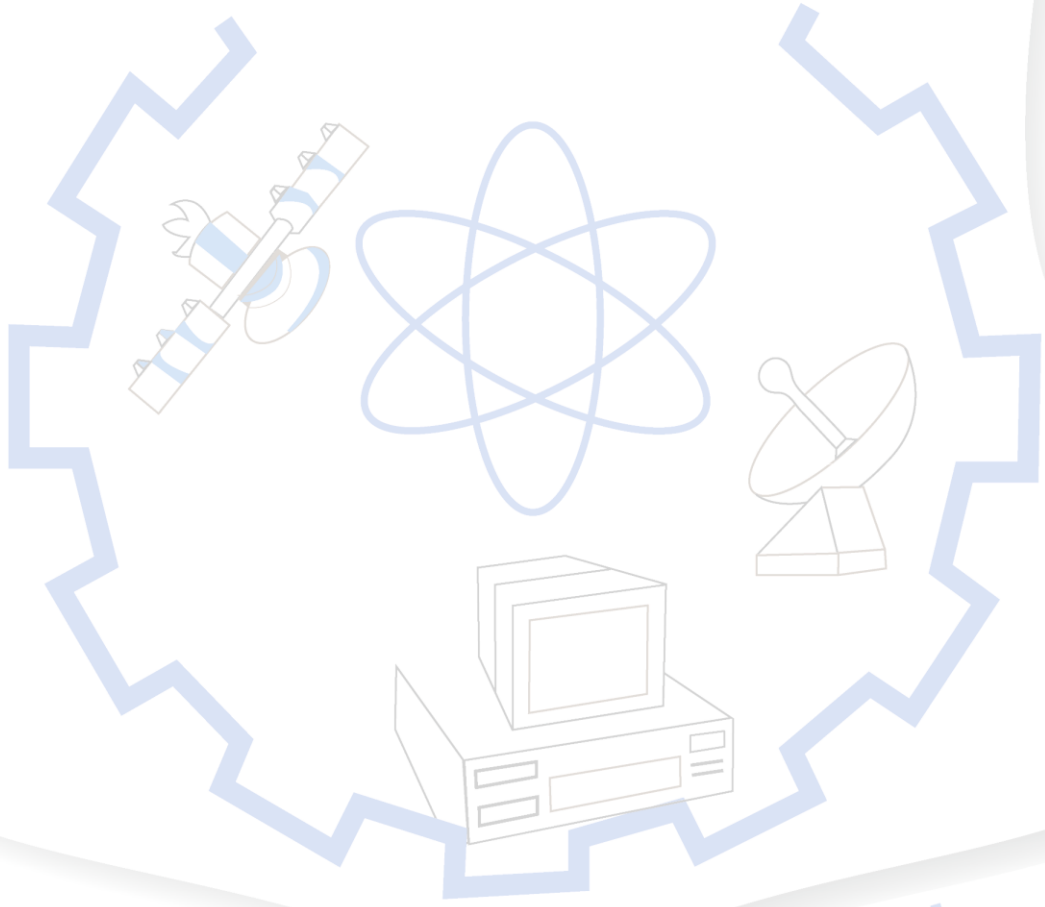
REFERENCES:

1. **William P. Cunningham and Mary Ann Cunningham**, "Environmental Science: A Global Concern", 14th Edition, McGraw Hill, 2017.

2. **G. Tyler Miller and Scott E. Spoolman**, "Environmental Science", 14th Edition, Cengage Learning India Pvt. Ltd., Delhi, 2014.

3. **Erach Bharucha**, "Textbook of Environmental Studies", 2nd Edition, Universities Press Pvt. Ltd., Hyderabad, 2015.

		L	**T**	**P**	**C**
21MA304	**COMPUTATIONAL STATISTICS + LAB**	**3**	**0**	**2**	**4**

OBJECTIVES:
 The Course will enable learners to:

- Extend the knowledge of multivariate normal distribution and multiple regression model.
- Describe the multivariate regression models.
- Discuss the concepts of discriminant, component, factor and cluster analysis.

UNIT I   MUTIVARIATE NORMAL DISTRIBUTION AND MULTIPLE LINEAR REGRESSION MODEL   **9**

Multivariate Normal Distribution: Multivariate Normal Distribution Functions– Conditional Distribution and its relation to regression model–Estimation of parameters.

Multiple Linear Regression Model: Standard multiple regression models with emphasis on detection of collinearity–outliers–non-normality and autocorrelation– Validation of model assumptions.

UNIT II   MULTIVARIATE REGRESSION   **9**

Multivariate Regression: Assumptions of Multivariate Regression Models–Parameter estimation–Multivariate Analysis of variance and covariance.

UNIT III   DISCRIMINANT ANALYSIS AND PRINCIPAL COMPONENT ANALYSIS   **9**

Discriminant Analysis: Statistical background – linear discriminant function analysis– Estimating linear discriminant functions and their properties.

Principal Component Analysis: Principal components–Algorithm for conducting principal component analysis–deciding on how many principal components to retain– H-plot.

UNIT IV   FACTOR ANALYSIS   **9**

Factor Analysis: Factor analysis model–Extracting common factors–determiningnumber of factors–Transformation of factor analysis solutions–Factor scores.

UNIT V   CLUSTER ANALYSIS   **9**

Cluster Analysis: Introduction–Types of clustering–Correlations and distances– clustering by partitioning methods–hierarchical clustering–overlapping clustering–K- Means Clustering-Profiling and Interpreting Clusters.

LIST OF EXERCISES:

- Python Concepts, Data Structures, Classes: Interpreter–Program Execution– Statements– Expressions–Flow Controls–Functions–Numeric Types– Sequences and Class Definition– Constructors–Text & Binary Files - Reading and Writing.

- Visualization in Python: Matplotlib package–Plotting Graphs–Controlling Graph– Adding Text–More Graph Types–Getting and setting values–Patches.

- Multivariate data analysis: Multiple regression–multi variate regression– analysis with various algorithms–factor analysis–PCA and linear discriminant analysis–Various datasets should be used for each topic.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

- CO1: Analyse the multiple linear regression models.
- CO2: Estimate the multivariate analysis of variance and covariance.
- CO3: Distinguish discriminant and component analysis.
- CO4: Apply the factor analysis techniques in data analysis.
- CO5: Correlate the concepts of cluster analysis in data analytics.

TEXT BOOKS:

1. T.W. Anderson, "An Introduction to Multivariate Statistical Analysis", 3rd Edition, John wiley & sons, New Jersy, 2003.
2. J.D. Jobson, "Applied Multivariate Data Analysis", Vol I & II, 1st Edition, Springer Science + Business Media, LLC, New York, 1992.
3. H. Kris, "Statistical Tests for Multivariate Analysis", Springer, New York, 2011.
4. M. Lutz, "Programming Python", 4th Edition, O'Reilly Media, 2010.
5. Tim Hall and J.P Stacey, "Python 3 for Absolute Beginners", 1st Edition, Apress, 2009.

21CB301	FORMAL LANGUAGE AND AUTOMATA THEORY	L	T	P	C
		3	2	2	5

OBJECTIVES:

The Course will enable learners to:

- Understand the Chomsky language hierarchy, to construct automata for any given pattern and find its equivalent regular expressions.
- Design CFG for any given language and prove its equivalence
- Design CSG for any given language and prove its equivalence
- Understand the need for Turing machines and their capability
- Understand undecidable problems

UNIT I   AUTOMATA FUNDAMENTALS   REGULAR   EXPRESSION   9+6+6
ANDLANGUAGES AND FINITE AUTOMATA

Introduction: Alphabet - languages and grammars - productions and derivation- Chomsky hierarchy of languages - Regular expressions and languages - deterministic finite automata (DFA) and equivalence with regular expressions - nondeterministic finite automata (NFA) and equivalence with DFA - regular grammars and equivalence with finite automata - properties of regular languages - Kleene's theorem - pumping lemma for regular languages - Myhill-Nerode theorem and its uses - minimization of finite automata.

UNIT II   CONTEXT- FREE LANGUAGES AND PUSHDOWN AUTOMATA   9+6+6

Context-free grammars (CFG) and languages (CFL) - Chomsky and Greibach normal forms - nondeterministic pushdown automata (PDA) and equivalence with CFG - parse trees - ambiguity in CFG - pumping lemma for context-free languages - deterministic pushdown automata - closure properties of CFLs.

UNIT III   CONTEXT- SENSITIVE LANGUAGES   9+6+6

Context-sensitive grammars (CSG) and languages - linear bounded automata and equivalence with CSG.

UNIT IV   TURING MACHINES   9+6+6

The basic model for Turing machines (TM) - Turing recognizable (recursively enumerable) and Turing-decidable (recursive) languages and their closure properties
- variants of Turing machines, nondeterministic TMs and equivalence with deterministic TMs - unrestricted grammars and equivalence with Turing machines - TMs as enumerators.

UNIT V   UNDECIDABILITY AND COMPLEXITY   9+6+6

Undecidability: Church-Turing thesis - universal Turing machine - the universal and diagonalization languages - reduction between languages and Rice s theorem - undecidable problems about languages.

Basic Introduction to Complexity: Introductory ideas on Time complexity of deterministic and nondeterministic Turing machines - P and NP - NP- completeness - Cook's Theorem - other NP - Complete problems.

TOTAL: 105 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Construct automata, regular expression for any pattern

CO2: Write Context free grammar for any construct

CO3: Design Turing machines for any language.

CO4: Propose computation solutions using Turing machines.

CO5: Derive whether a problem is decidable or not.

TEXT BOOKS:

1. Introduction to Automata Theory, Languages, and Computation John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, 2008.

2. Elements of the Theory of Computation, Harry R. Lewis and Christos H. Papadimitriou, 2010.

REFERENCES:

1. Automata and Computability, Dexter C. Kozen.

2. Introduction to the Theory of Computation, Michael Sipser.

3. Introduction to Languages and the Theory of Computation, John Martin.

4. Computers and Intractability: A Guide to the Theory of NP Completeness, M. R. Garey and D. S. Johnson

21CB302	COMPUTER ORGANIZATION AND ARCHITECTURE	L	T	P	C
		3	0	2	4

OBJECTIVES:

The Course will enable learners to:

- Know the basic principles and operations of digital computers.

- Design Arithmetic and Logic Unit for various fixed- and floating-point operations.

- Develop pipeline architectures for RISC Processors.

- Understand Parallel Processor and Various Memory systems

- Understand the peripheral devices and their characteristics

**UNIT I   BASIC STRUCTURE OF COMPUTERS & MACHINE   9+6
            INSTRUCTIONS**

Functional blocks of a computer: CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU: Registers, instruction execution cycle,RTL interpretation of instructions, addressing modes, instruction set. Outlining instruction sets of some common CPUs.

UNIT II DATA REPRESENTATION & COMPUTER ARITHMETIC 9+6

Data representation: Signed number representation, fixed and floating-point representations, character representation.

Computer arithmetic: Integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication – shift-and-add, Booth multiplier, carry save multiplier, etc. Division restoring and non-restoring techniques, floating point arithmetic, IEEE 754 format.

UNIT III BASIC PROCESSING & CONTROL UNIT 9+6

CPU control unit design: Hardwired and micro-programmed design approaches, design of a simple hypothetical CPU. Pipelining: Basic concepts of pipelining, throughput and speedup, pipeline hazards.

UNIT IV PARALLEL PROCESSING & MEMORY 9+6

Parallel Processors: Introduction to parallel processors, Concurrent access to memory and cache coherency.

Memory system design: Semiconductor memory technologies, memory organization.

Memory organization: Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policies.

UNIT V I/O SYSTEMS 9+6

Peripheral devices and their characteristics: Input-output subsystems, I/O device interface, I/O transfers – program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes – role of interrupts in process state transitions, I/O device interfaces – SCSI, USB

TOTAL: 75 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to:

CO1: Understand the basic principles and operations of digital computers.

CO2: Design Arithmetic and Logic Unit.

CO3: Perform fixed- and floating-point operations

CO4: Develop pipeline architectures for RISC Processors.

CO5: Understand Parallel Processor Architectures

CO6: Understand Various Memory systems & I/O interfacings.

TEXT BOOKS:

1. Computer System Architecture M. M. Mano:, 3rd ed., Prentice Hall of India, New Delhi, 2017.

2. Computer Organization and Design: The Hardware/Software Interface, David A. Patterson and John L. Hennessy, 2007

3. Computer Organization and Embedded Systems, Carl Hamacher, 2012.

REFERENCES:

1. Computer Architecture and Organization, John P. Hayes.

2. Computer Organization and Architecture: Designing for Performance, William Stallings.

3. Computer System Design and Architecture, Vincent P. Heuring and Harry F. Jordan.

21CB303	OBJECT ORIENTED PROGRAMMING + LAB	L	T	P	C
		3	0	2	4

OBJECTIVES:
The Course will enable learners to:

- Understand & represent any given business problem statement in object- oriented notation.

- Understand Object Oriented programming concepts like data abstraction, encapsulation and basics of Java.

- Analyse inheritance and polymorphism.

- Understand and collections in Java.

- Employ multithreaded programming.

UNIT I   INTRODUCTION   9

Procedural programming, An Overview of C: Types Operator and Expressions, Scope and Lifetime, Constants, Pointers, Arrays, and References, Control Flow, Functions and Program Structure, Namespaces, error handling, Input and Output (*C*- way), Library Functions (*string*, *math*, *stdlib*), Command line arguments, Pre-processor directive
Some difference between C and Java: Local variable declaration within function scope, function declaration, function overloading, stronger type checking, Reference variable, parameter passing – value vs reference, Operator new and delete Single line comments, JavaDoc, Characteristics of Java, The Java Environment, Java Source File -Structure.

UNIT II   OBJECT ORIENTED PROGRAMMING FUNDAMENTALS   9
The Fundamentals of Object-Oriented Programming: Necessity for OOP, Data Hiding, Data Abstraction, Encapsulation, Class and Object, Scope of Class, Member Function of a Class, private,

protected and public access specifier, this keyword, Constructors and Destructors.

UNIT III INHERITANCE AND POLYMORPHISM 9

Inheritance — Single and Multiple, Class Hierarchy, super classes- sub classes – Protected members — constructors in sub classes — abstract classes and methods- final methods and classes, Polymorphism through dynamic binding, overriding. Interfaces — defining an interface, implementing interface, differences between classes and interfaces and extending interfaces

UNIT IV ARRAYS, COLLECTIONS AND EXCEPTION 9

Arrays – One & Multi-Dimensional, Object Class and cloning, equals and hashcode methods, Collections-List(ArrayList,LinkedList,Vector,Stack),Properties,

Set(HashSet,TreeSet,LinkedHashSet), Map(Treemap,hashmap,treemap), Queue (Priority Queue, DeQueue), Iteration, Ordering using Comparable & Comparator, Generics –Compile Time Type Safety, Upper and Lower Bounded, and with wild cardsException Handling – Checked and Un-Checked Exception, Custom Exception, Throws and Throw Keywords, Try-Catch-Finally, Try with Resources, Exception vs Runtime exception vs Throwable vs Error

UNIT V MULTI-THREADING & IO 9

Differences between multi-threading and multitasking, thread life cycle, creating threads, synchronizing threads, Inter-thread communication, Fork and Join, wait, sleep, notify & yield. Concurrent locks, Synchronized Collections(Concurrent Map, synchronized List, synchronized Map, synchronized Set, synchronized SortedSet) Atomic data types (Atomic Integer, Atomic Long, Atomic IntegerArray), CountDown Latch, Blocking Queue

Java IO – Files, Pipes, Streams, Byte and Char arrays, Readers & Writers, Input and Output Stream, Byte Array Input and Output, Buffer Input and output

TOTAL: 45 PERIODS

LIST OF EXERCISES:

1. Develop a Java application to generate Electricity bill. Create a class with the following members: Consumer no., consumer name, previous month reading, current month reading, type of EB connection (i.e domestic or commercial). Compute the bill amount using the following tariff.

   If the type of the EB connection is domestic, calculate the amount to be paid as follows:

   - First 100 units – Rs. 1 per unit
   - 101-200 units – Rs. 2.50 per unit
   - 201 -500 units – Rs. 4 per unit
   - > 501 units – Rs. 6 per unit

If the type of the EB connection is commercial, calculate the amount to be paid as follows:

- First 100 units – Rs. 2 per unit
- 101-200 units – Rs. 4.50 per unit
- 201 -500 units – Rs. 6 per unit
- > 501 units – Rs. 7 per unit

2. Develop a java application to implement currency converter (Dollar to INR, EURO to INR, Yen to INR and vice versa), distance converter (meter to KM, miles to KM and vice versa), time converter (hours to minutes, seconds and vice versa) using packages.

3. Develop a java application with Employee class with Emp_name, Emp_id, Address, Mail_id, Mobile_no as members. Inherit the classes, Programmer, Assistant Professor, Associate Professor and Professor from employee class. Add Basic Pay (BP) as the member of all the inherited classes with 97% of BP as DA, 10 % of BP as HRA, 12% of BP as PF, 0.1% of BP for staff club fund. Generate pay slips for the employees with their gross and net salary.

4. Design a Java interface for ADT Stack. Implement this interface using array. Provide necessary exception handling in both the implementations.

5. Write a program to perform string operations using Array List. Write functions for the following

      a. Append – add at end
      b. Insert – add at particular index
      c. Search
      d. List all string starts with given letter

6. Write a Java Program to create an abstract class named Shape that contains two integers and an empty method named print Area(). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of the classes contains only the method print Area () that prints the area of the given shape.

7. Write a Java program to implement user defined exception handling.

8. Write a Java program that reads a file name from the user, displays information about whether the file exists, whether the file is readable, or writable, the type of file and the length of the file in bytes.

9. Write a java program that implements a multi-threaded application that has three threads. First thread generates a random integer every 1 second and if the value is even, second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of cube

of the number.

10.Write a java program to find the maximum value from the given type of elements using a generic function

TOTAL: 30 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Design and Develop application in OOD & Principles

CO2: Apply Object Oriented programming concepts like Data Abstraction,

Encapsulation in Java.

CO3: Analyse and apply different types of inheritance and polymorphis

CO4: Use collections for solving real-time problems.

CO5: Develop multi-threaded applications in Java.

TEXT BOOKS*:*

1. Herbert Schildt, "Java The complete reference", 8th Edition, McGraw Hill Education, 2011.
2. Cay S. Horstmann, Gary cornell, "Core Java Volume –I Fundamentals", 9th Edition, Prentice Hall, 2013.

REFERENCES:

1. Paul Deitel, Harvey Deitel, "Java SE 8 for programmers", 3rd Edition, Pearson, 2015.
2. Steven Holzner, "Java 2 Black book", Dreamtech press, 2011.

		L	**T**	**P**	**C**
21CB304	**SOFTWARE ENGINEERING + LAB**	**3**	**2**	**2**	**5**

OBJECTIVES:

The Course will enable learners to:

▪ Understand the different models and milestones in a software project

▪ Understand fundamental concepts of software project management

▪ Understand the various software design methodologies

▪ Learn various testing and maintenance measures

▪ Understand knowledge driven development

UNIT I   INTRODUCTION   **9+6**

Programming in the small vs. programming in the large; software project failures and importance of software quality and timely availability; engineering approach to software development; role of software engineering towards successful execution of large software projects; emergence of software engineering as a discipline. Basic concepts of life cycle models – different models and milestones. **Software Quality and Reliability:** Internal and external qualities; process and product quality; principles to achieve software quality; introduction to different software quality models like McCall, Boehm, FURPS / FURPS+, Dromey, ISO – 9126; introduction to Capability Maturity Models (CMM and CMMI); introduction to software reliability, reliability models and estimation

UNIT II SOFTWARE PROJECT MANAGEMENT 9+6

Software project planning –identification of activities and resources; concepts of feasibility study; techniques for estimation of schedule and effort; software cost estimation models and concepts of software engineering economics; techniques of software project control and reporting; introduction to measurement of software size; introduction to the concepts of risk and its mitigation; configuration management.

UNIT III SOFTWARE REQUIREMENTS ANALYSIS, DESIGN AND 9+6 CONSTRUCTION

Introduction to Software Requirements Specifications (SRS) and requirement elicitation techniques; techniques for requirement modelling – decision tables, event tables, state transition tables, Petri nets; Requirements documentation through use cases; Introduction to UML, introduction to software metrics and metrics based control methods; measures of code and design quality.

UNIT IV SOFTWARE TESTING 9+6

Introduction to faults and failures; basic testing concepts; concepts of verification and validation; black box and white box tests; white box test coverage – code coverage, condition coverage, branch coverage; basic concepts of black-box tests – equivalence classes, boundary value tests, usage of state tables; testing use cases; transaction- based testing; testing for non-functional requirements – volume, performance and efficiency; concepts of inspection.

UNIT V OBJECT ORIENTED ANALYSIS, DESIGN AND CONSTRUCTION 9+6

Concepts - the principles of abstraction, modularity, specification, encapsulation and information hiding; concepts of abstract data type; Class Responsibility Collaborator (CRC) model; quality of design; design measurements; concepts of design patterns; Refactoring; object-oriented construction principles; object-oriented metrics.

TOTAL: 45 PERIODS

LIST OF EXERCISES:

Development of requirements specification, function-oriented design using SA/SD, object-oriented design using UML, test case design, implementation using C++ and testing. Use of appropriate CASE tools and other tools such as configuration management tools, program analysis tools in the software life cycle

- Develop the software project start-up, prototype model, using software engineering methodology and object-oriented design using UML for at least two real time scenarios

- Problem Analysis and Project Planning -Thorough study of the problem – Identify Project scope, Objectives and Infrastructure

  Software Requirement Analysis –Describe the individual Phases/modules of the project and Identify deliverables. Identify functional and non-functional requirements.

- Data Modeling –Use work products –data dictionary.

- Software Designing -Develop use case diagrams and activity diagrams, build and test class diagrams, sequence diagrams and add interface to class diagrams.

- Prototype model –Develop the prototype of the product.

TOTAL: 30 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to:

CO1: Understand engineering approach to software development, software quality and reliability.

CO2: Manage project schedule, estimate project cost and effort required.

CO3: Summarize the concepts of software requirement analysis and design.

CO4: Identify the need for software metrics and measure of code and design quality.

CO5: Compare and contrast various testing methodologies.

CO6: Analyze problem space understanding and Knowledge driven development.

TEXT BOOKS:

1. Software Engineering, Ian Sommerville

2. Fundamentals of Software Engineering, Carlo Ghezzi, Jazayeri Mehdi, Mandrioli Dino

3. Software Requirements and Specification: A Lexicon of Practice, Principles and Prejudices, Michael Jackson

REFERENCES:

1. Software Metrics: A Rigorous and Practical Approach, Norman E Fenton, Shari Lawrence Pfleeger

2. Software Engineering: Theory and Practice, Shari Lawrence Pfleeger and Joanne M. Atlee

	L	T	P	C
21CB305 **FINANCIAL MANAGEMENT**	3	0	0	3

OBJECTIVES:

The Course will enable learners to:

- Understand the fundamental concepts of financial management
- Understand valuation of securities.
- Analyse operating and financial leverages.
- Comprehend and apply the concepts of capital budgeting.
- Understand cash management.

UNIT I   **INTRODUCTION**   **9**

Introduction: Introduction to Financial Management Goals of the firm Financial Environments.

Time Value of Money: Simple and Compound Interest Rates, Amortization, Computing more that once a year, Annuity Factor.

UNIT II   **VALUATION OF SECURITIES**   **9**

Valuation of Securities: Bond Valuation, Preferred Stock Valuation, Common Stock Valuation, Concept of Yield and YTM. **Risk & Return:** Defining Risk and Return,Using Probability Distributions to Measure Risk, Attitudes Toward Risk, Risk and Return in a Portfolio Context, Diversification, The Capital Asset Pricing Model (CAPM)

UNIT III   **OPERATING & FINANCIAL LEVERAGE**   **9**

Operating & Financial Leverage: Operating Leverage, Financial Leverage, Total Leverage, Indifference Analysis in leverage study. **Cost of Capital**: Concept, Computation of Specific Cost of Capital for Equity - Preference – Debt, Weighted Average Cost of Capital – Factors affecting Cost of Capital 4L

UNIT IV   **CAPITAL BUDGETING**   9

Capital Budgeting: The Capital Budgeting Concept & Process An Overview, Generating Investment Project Proposals, Estimating Project, After Tax Incremental Operating Cash Flows, Capital Budgeting Techniques, Project Evaluation and Selection - Alternative Methods.

Working Capital Management: Overview, Working Capital Issues, Financing Current Assets (Short Term and Long Term- Mix), Combining Liability Structures and Current Asset Decisions, Estimation of Working Capital.

UNIT V   **CASH MANAGEMENT**   **9**

Cash Management: Motives for Holding cash, Speeding Up Cash Receipts, Slowing Down Cash Payouts, Electronic Commerce, Outsourcing, Cash Balances to maintain, Factoring.

Accounts Receivable Management: Credit & Collection Policies, Analyzing the Credit Applicant, Credit References, Selecting optimum Credit period.

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to:
CO1: Understand the fundamental concepts of financial management
CO2: Apply valuation of securities and calculate the risk & return in portfolio management.
CO3: Analyse the cost structure of a company using operating and financial leverages.
CO4: Develop capital budgets and to estimate working capital.
CO5: Apply cash management in business.

TEXT BOOK:
1. Chandra, Prasanna - Financial Management - Theory & Practice, Tata McGraw Hill, 2007.

2. Srivastava, Misra: Financial Management, OUP, 2011

REFERENCES:

1. Van Horne and Wachowicz : Fundamentals of Financial Management, Prentice Hall/ Pearson Education.

2. Financial Management: Theory & Practice: by Brigham and Ernhardt, 14th edition, Cengage, 2015

3. M.Y. Khan and P.K.Jain Financial management, Text, Problems and cases Tata McGraw Hill, 6th edition, 2011.

4. M. Pandey Financial Management, Vikas Publishing House Pvt. Ltd., 10th edition, 2012

INDIAN CONSTITUTION	**L**	**T**	**P**	**C**
(Non Credit)	**2**	**0**	**0**	**0**

OBJECTIVES:
The Course will enable learners to:

- Have some knowledge about Indian Constitution.

UNIT I   INTRODUCTION   6

Meaning and Importance of Constitution, Preamble and Salient Features of the Constitution.

UNIT II   FUNDAMENTAL RIGHTS   6

Fundamental Rights, Right to Equality, Right to Freedom, Right against exploitation, Right to freedom of religion, Cultural and Educational Rights, Right to Constitutional Remedies and Duties, Directive Principles of State Policy.

UNIT III   LOK SABHA AND RAJYA SABHA   6

Union Government – Lok Sabha and Rajya Sabha Composition, Powers and functions: The President, The Prime Minister and Supreme Court: Role Position and Powers/ functions.

UNIT IV   LEGISLATIVE ASSEMBLY AND LEGISLATIVE COUNCIL   6

State Government Legislative Assembly and Legislative Council: Composition, Powers and functions: The Governor, Chief Minister and High Court: Role, Position and Powers/ functions.

UNIT V   LOCAL SELF GOVERNMENT   6

Local self-Government, Panchayat Raj System in India; Election Commission; Public Service Commissions, Role, powers and function

TOTAL: 30 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to:

CO1: Have the knowledge on Indian Constitution.

TEXT BOOKS:
 1. Introduction to the constitution of India – M V Pylee, Vikas publishing house Pvt Ltd.
REFERENCES:

1. Introduction to the constitution of India – Dr. Durga das Basu, 19th edition Reprint 2007.

	L	**T**	**P**	**C**

**APTITUDE AND
CODING SKILLS – I**
 (Non Credit)

L	**T**	**P**	**C**
0	**0**	**2**	**0**

OBJECTIVES:
The Course will enable learners to:

- Develop vocabulary for effective communication and reading skills.

- Build the logical reasoning and quantitative skills.

- Develop error correction and debugging skills in programming.

List of Exercises:

1. English – Phase I

Vocabulary: Synonyms, Antonyms, Grammar: Subject-Verb Agreement, Tenses and Articles, Prepositions and Conjunctions, Speech and Voices, Comprehension: Inferential and Literal Comprehension, Contextual Vocabulary, Comprehension ordering

2. Logical Reasoning – Phase I

Deductive Reasoning: Coding deductive logic, Directional sense, Blood relations, Objective Reasoning, Selection decision tables, Puzzles, Inductive reasoning: Coding pattern and Number series pattern recognition, Analogy and Classification pattern recognition, Abductive Reasoning: Logical word sequence, Data sufficiency

3. Quantitative Ability - Phase I

Basic Mathematics: Divisibility, HCF and LCM, Numbers, decimal fractions and power, Applied Mathematics: Profit and Loss, Simple and Compound Interest, Time, Speed and Distance, Engineering Mathematics: Logarithms, Permutation and Combinations, Probability

4. Automata Fix – Phase I

Logical, Compilation and Code reuse

OUTCOMES:
Upon completion of the course, the students will be able to:
CO1: Develop vocabulary for effective communication and reading skills.

CO2: Build the logical reasoning and quantitative skills.

CO3: Develop error correction and debugging skills in programming.

SEMESTER IV

21CB401	OPERATING SYSTEMS + LAB	L	T	P	C
		3	0	2	4

OBJECTIVES:
The Course will enable learners to:

- Understand the basic concepts of operating systems.

- Understand Processes and Threads

- Analyse various CPU Scheduling algorithms.

- Understand the concept of Deadlocks.

- Analyse various memory management schemes.

- Understand I/O management and File systems.

UNIT I   INTRODUCTION TO OPERATING SYSTEMS AND PROCESS   9

Introduction: Concept of Operating Systems (OS), Generations of OS, Types of OS, OS Services, Interrupt handling and System Calls, Basic architectural concepts of an OS, Concept of Virtual Machine, Resource Manager view, process view and hierarchical view of an OS.

Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching.

UNIT II   PROCESS MANAGEMENT AND THREADS   9

Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time.

Scheduling algorithms: Pre-emptive and non-pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.

Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads.

UNIT III   PROCESS SYNCHRONISATION AND DEADLOCKS   9

Inter-process Communication: Concurrent processes, precedence graphs, Critical Section, Race

Conditions, Mutual Exclusion, Hardware Solution, Semaphores, Strict Alternation, Peterson's Solution, The Producer / Consumer Problem, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem, Barber's shop problem.

Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.

Concurrent Programming: Critical region, conditional critical region, monitors, concurrent languages, communicating sequential process (CSP); Deadlocks prevention, avoidance, detection and recovery.

UNIT IV   MEMORY MANAGEMENT   9

Memory Management: Basic concept, Logical and Physical address maps, Memory allocation: Contiguous Memory allocation – Fixed and variable partition– Internal and External fragmentation and Compaction.

Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page allocation, Partitioning, Paging, Page fault, Working Set, Segmentation, Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).

UNIT V   FILE MANAGEMENT   9

I/O Hardware: I/O devices, Device controllers, Direct Memory Access, Principles of I/O.

File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance.

Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks.

TOTAL: 45   PERIODS

LIST OF EXERCISE:

- Basic Unix file system commands such as ls, cd, mkdir, rmdir, cp, rm, mv, more, lpr, man, grep, sed, etc.
- UNIX Filters
- Shell programming
- Programming with the standard I/O
- UNIX system calls

TOTAL: 30 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to:
CO1: Implement the various System calls

CO2: Understand the concepts of Processes

CO3: Apply various processor scheduling algorithms and thread mechanism

CO4: Analyse process synchronization and deadlock problems

CO5: Apply various memory management techniques to given situation

CO6: Apply various file management techniques

TEXT BOOKS:

1. Operating System Concepts Essentials. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, 2009.

2. Operating Systems: Internals and Design Principles. William Stallings.

3. Operating System: A Design-oriented Approach. Charles Patrick Crowley.
REFERENCES:

1. Operating Systems: A Modern Perspective. Gary J. Nutt.

2. Design of the Unix Operating Systems. Maurice J. Bach.

3. Understanding the Linux Kernel, Daniel Pierre Bovet, Marco Cesati.

		L	**T**	**P**	**C**
21CB402	**DATABASE MANAGEMENT SYSTEMS + LAB**	**3**	**0**	**2**	**4**

OBJECTIVES:

The Course will enable learners to:

- Understand the basic concepts of Database, why its required and what its benefits & advantage

- Apply effective relational database design concepts.

- Know the fundamental concepts of transaction processing, concurrency control techniques and recovery procedure.

- How to efficiently model and design various database objects and entities

- Implement efficient data querying and updates, with needed configuration

UNIT I   INTRODUCTION   9

Introduction: Introduction to Database. Hierarchical, Network and Relational Models.
Database system architecture: Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML). **Data models**: Entity- relationship model, network model, relational and object oriented data models, integrity constraints, data manipulation

operations.

UNIT II   RELATIONAL QUERY LANGUAGE   9

Relational query languages: Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS MYSQL, ORACLE, DB2, SQL server. **Relational database design**: Domain and data dependency, Armstrong's axioms, Functional Dependencies, Normal forms, Dependency preservation, Lossless design.

UNIT III   QUERY PROCESSING AND STORAGE   9

Query processing and optimization: Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms. **Storage strategies**: Indices, B-trees, Hashing.

UNIT IV   TRANSACTION PROCESSING   9

Transaction processing: Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi-version and optimistic Concurrency Control schemes, Database recovery.

UNIT V   DATA BASE SECURITY AND ADVANCED DATABASES   9

Database Security: Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection. Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and data mining.

TOTAL: 45 PERIODS

LIST OF EXERCISES:

Case Study using real life database applications, Perform the following task.

- Build Entity Model diagram. The diagram should align with the business and functional goals stated in the application.

- Apply Normalization rules in designing the tables in scope.

- Prepared applicable views, triggers (for auditing purposes), functions for enabling enterprise grade features.

- Build PLSQL / Stored Procedures for Complex Functionalities, ex EOD Batch Processing for calculating the EMI for Gold Loan for each eligible Customer.

- Ability to show case ACID Properties with sample queries with appropriate settings

TOTAL: 30PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Able to design and deploy an efficient & scalable data storage node for varied kind of application requirements

CO2: Map ER model to Relational model to perform database design effectively

CO3: Write queries using normalization criteria and optimize queries

CO4: Compare and contrast various indexing strategies in different databasesystems

CO5: Appraise how advanced databases differ from traditional databases.

TEXT BOOKS:

1. Abraham Silberschatz, Henry F.Korth, S. System 6 th Edition, Tata McGraw Hill,2011.

2. Elmasri R. and S. Navathe, Database Systems: Models, Languages, Design and Application Programming, Pearson Education, 2013.

REFERENCES:

1. Principles of Database and Knowledge – Base Systems, Vol 1 by J. D. Ullman.

2. Foundations of Databases. Serge Abiteboul, Richard Hull, Victor Vianu.

21CB403	SOFTWARE DESIGN WITH UML + Lab	L T P C
		3 0 2 4

OBJECTIVES:

The Course will enable learners to:

- Understand the fundamentals of object-oriented modelling
- Capture the requirements specification for an intended software system
- Translate the analysis phase to design modeling
- Understand the concept of UML modeling
- Design with static UML diagrams.
- Design with the UML dynamic and implementation diagrams.

UNIT I   INTRODUCTION TO AN OBJECT-ORIENTED   9
TECHNOLOGIES AND THE UML METHOD.

Software development process: The Waterfall Model vs. The Spiral Model---- The

Software Crisis, description of the real world using the Objects Model---- Classes, inheritance and multiple configurations. -Quality software characteristics----Description of the Object Oriented Analysis process vs. the Structure Analysis Model.

Introduction to the UML Language. Standards   Elements of the language ---General

description of various models The process of Object Oriented software development.

-Description of Design Patterns Technological Description of Distributed Systems.

UNIT II   REQUIREMENTS ANALYSIS USING CASE MODELING   9

Analysis of system requirements. -Actor definitions. -Writing a case goal-----Use Case Diagrams. Use Case Relationships. Use case Modeling – Relating Use cases – include, extend and generalization – When to use Use-cases

UNIT III   INTERACTION DIAGRAMS   9

Description of goal. -Defining UML Method, Operation, Object Interface, Class -- Sequence Diagram. -Finding objects from Flow of Events   Describing the process of finding objects using a Sequence Diagram. - Describing the process of finding objects using a Collaboration Diagram

UNIT IV   STATIC STRUCTURE DIAGRAMS   9

The Class Diagram Model--Attributes descriptions   Operations descriptions Connections descriptions in the Static Model. - Association, Generalization, Aggregation, Dependency, Interfacing, Multiplicity. **Package Diagram Model.** - Description of the model. · White box, black box Connections between packagers Interfaces------Create Package Diagram. Drill Down.

UNIT V   DYNAMIC STRUCTURE DIAGRAMS   9

Description of the State Diagram---Events Handling Description of the Activity Diagram. Exercise in State Machines. **Component Diagram Model.** - Physical Aspect. - Logical Aspect.- Connections and Dependencies-----User face Initial DB design in a UML environment. **Deployment Model.-** Processors----Connections Components. -Tasks. -Threads Signals and Events.

TOTAL: 45 PERIODS

LIST OF EXERCISES

Draw standard UML diagrams using an UML modelling tool for a given case study and map design to code and implement a 3 layered architecture. Test the developed code and validate whether the SRS is satisfied

1. Identify a software system that needs to be developed.
2. Document the Software Requirements Specification (SRS) for the identified system.
3. Identify use cases and develop the Use Case model.
4. Identify the conceptual classes and develop Class Diagram

5. Using the identified scenarios, find the interaction between objects and represent them using UML Sequence Diagrams

6. Draw relevant State Chart and Activity Diagrams for the same system.

7. Implement the system as per the detailed design

8. Test the software system for all the scenarios identified as per the usecase diagram

TOTAL: 30 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Express software design with UML diagrams

CO2: Design software applications using OO concepts.

CO3: Identify various scenarios based on software requirements

CO4: Covert the analysis phase to design modelling

CO5: Analyse the static structure diagrams

CO6: Analyse the dynamic structure diagrams

TEXT BOOK:

1. Object-Oriented Software Engineering: using UML, Patterns, and Java. Bernd Bruegge and Allen H. Dutoit.

2. Design Patterns: Elements of Reusable Object-Oriented Software. Erich Gamma, Richard Helm, Ralph Johnson, and John M. Vlissides.

REFERENCES:

1. Erich Gamma, a n d Richard Helm, Ralph Johnson, John Vlissides, ―Design patterns: Elements of Reusable Object-Oriented Software‖, Addison-Wesley, 1995.

2. Martin Fowler, ―UML Distilled: A Brief Guide to the Standard Object Modeling Language‖, Third edition, Addison Wesley, 2000

3. Craig Larman, ―Applying UML and Patterns: An Introduction to Object- Oriented Analysis and Design and Iterative Development‖, Third Edition, Pearson Education, 2005.

4. Ali Bahrami - Object Oriented Systems Development - McGraw Hill International Edition - 1999

21CB404	INTRODUCTION TO INNOVATION, IP MANAGEMENT & ENTREPRENEURSHIP	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Course will enable learners to:

- Develop mindsets to pursue entrepreneurship.

- Understand the basics of Innovation and Entrepreneurship

- Create, protect, assetize and commercialize intellectual property?

- Identify and discover market needs

- Manage an innovation program

- Understand opportunities and challenges for entrepreneurs through Startup Models

UNIT I INNOVATION

9

Innovation Types of Innovation Incremental, disruptive, Lifecycle of Innovation (idea, literature survey, PoT, PoC, etc.) , Challenges in Innovation (time, cost, data, infrastructure, etc.)

UNIT II IPR

9

Types of IPR (patents, copyrights, trademarks, GI, etc.) Lifecycle of IP (creation, protection, assetization, commercialization), Balancing IP Risks and Rewards (Right Access and Right Use of Open Source and 3rd party products, technology transfer and licensing)

UNIT III ENTREPRENEURSHIP 9

Opportunity Identification in Technology Entrepreneurship (customer pain points, competitive context) Market Research, Segmentation and Sizing Product Positioning, Pricing, and Go-To-Market Strategy IP Valuation (methods, examples, limitations)

UNIT IV TYPES OF STARTUP BUSINESS MODEL 9

Startup Business Models (fund raising, market segments, channels, etc.) Co- innovation and Open Innovation (academia, startups, corporates) Technology Innovation: Two Case Studies

UNIT V PROCESSES IN STARTUP BUSINESS MODEL 9

Innovation, Incubation and Entrepreneurship in Corporate Context Technology-driven Social Innovation and Entrepreneurship Manage Innovation, IP and Entrepreneurship Programs – Processes, Governance and Tools

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Understand the basics of Innovation and Entrepreneurship

CO2: Manage an innovation program

CO3: Create, protect, assetize and commercialize intellectual property

CO4: Understand opportunities and challenges for entrepreneurs

CO5: Developing mindsets to pursue entrepreneurship.

CO6: Identify and discover market needs

TEXT BOOKS:

1. Jugaad Innovation: Think Frugal, Be Flexible, Generate Breakthrough Growth Navi Radjou,Jaideep Prabhu, Simone Ahuja , John Wiley & Sons

REFERENCES:

1. Identifying Entrepreneurial Opportunities: Cognition and Categorization in Nascent Entrepreneurs, Matthew J. Karlesky

2. http://www.businessdictionary.com/definition/entrepreneurship.

3. https://www.infoentrepreneurs.org/en/guides/use-innovation-to-grow-your- business/

4. http://sourcesofinsight.com/innovation-life-cycle/

5. https://www.investottawa.ca/

6. https://www.Lead-innovation.com

21CB405	OPERATIONS RESEARCH + LAB	L	T	P	C
		2	0	2	3

OBJECTIVES:

The Course will enable learners to:

- Provide knowledge and training in using optimization techniques under limited resources for the engineering and business problems.
- Solve real-time problems
- Handled balanced and unbalanced transportation problems
- Manage inventory control
- Use queuing techniques

UNIT I   **INTRODUCTION**   **6+6**

Introduction to OR: Origin of OR and its definition. Concept of optimizing performance

measure, Types of OR problems, Deterministic vs. Stochastic optimization, Phases of OR problem approach – problem formulation, building mathematical model, deriving solutions, validating model, controlling and implementing solution.

UNIT II   LINEAR PROGRAMMING   6+6

Linear Programming: Linear programming – Examples from industrial cases, formulation & definitions, Matrix form. Implicit assumptions of LPP. Linear algebra – Vectors, Matrices, Linear Independence / Dependence of vectors, Rank, Basis, System of linear eqns., Hyperplane, Convex set, Convex polyhedron, Extreme points, Basic feasible solutions. Geometric method: 2-variable case, Special cases – infeasibility, unboundedness, redundancy & degeneracy, Sensitivity analysis. Simplex Algorithm – slack, surplus & artificial variables, computational details, big-M method, identification and resolution of special cases through simplex iterations. Duality – formulation, results, fundamental theorem of duality, dual-simplex and primal-dual algorithms.

UNIT III   TRANSPORTATION AND ASSIGNMENT PROBLEMS   6+6

Transportation and Assignment problems: TP - Examples, Definitions – decision variables, supply & demand constraints, formulation, Balanced & unbalanced situations, Solution methods – NWCR, minimum cost and VAM, test for optimality (MODI method), degeneracy and its resolution.

AP - Examples, Definitions – decision variables, constraints, formulation, Balanced & unbalanced situations, Solution method – Hungarian, test for optimality (MODI method), degeneracy & its resolution. **PERT – CPM:** Project definition, Project scheduling techniques – Gantt chart, PERT & CPM, Determination of critical paths,

Estimation of Project time and its variance in PERT using statistical principles, Concept of project crashing/time-cost trade-off.

UNIT IV   INENTORY CONTROL   6+6

Inventory Control: Functions of inventory and its disadvantages, ABC analysis, Concept of inventory costs, Basics of inventory policy (order, lead time, types), Fixed order-quantity models – EOQ, POQ & Quantity discount models. EOQ models for discrete units, sensitivity analysis and Robustness, Special cases of EOQ models for safety stock with known / unknown stock out situations, models under prescribed policy, Probabilistic situations.

UNIT V   QUEUING THEORY   **6+6**

Definitions – queue (waiting line), waiting costs, characteristics (arrival, queue, service discipline) of queuing system, queue types (channel vs. phase). Kendall's notation, Little's law, steady state behaviour, Poisson's Process & queue, Models with examples

- M/M/1 and its performance measures; M/M/m and its performance measures; brief description about some special models. **Simulation Methodology**: Definition and steps of simulation, random number, random number generator, Discrete Event System Simulation – clock, event list, Application in Scheduling, Queuing systems and Inventory systems.

TOTAL: 60 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to:

CO1: Understand the characteristics of different types of decision-making environments

CO2: Use the optimization techniques for use engineering and Business problems

CO3: Build and solve Transportation Models and Assignment Models

CO4: Manage inventory control

CO5: Apply queuing theory for solving real world problems

TEXT BOOKS:

1. Operations Research: An Introduction, 10th Edition. Hamdy A. Taha, University of Arkansas. 2017, Pearson

2. Linear Programming. K.G. Murthy.

REFERENCES:

1. Linear Programming. G. Hadley.

2. Principles of OR with Application to Managerial Decisions. H.M. Wagner.

3. Introduction to Operations Research. F.S. Hiller and G.J. Lieberman.

4. Elements of Queuing Theory. Thomas L. Saaty.

5. Operations Research and Management Science, Hand Book: Edited By A. Ravi Ravindran.

6. Management Guide to PERT/CPM. Wiest & Levy.

7. Modern Inventory Management. J.W. Prichard and R.H. Eagle.

21CB406	MARKETING RESEARCH AND MARKETING MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Course will enable learners to:

- Understand basic marketing concepts
- Comprehend the dynamics of marketing.
- Leverage marketing concepts for effective decision making
- Understand basic concepts and application of statistical tools in Marketing research
- Apply Internet marketing strategies.

UNIT I INTRODUCTION 9

Marketing Concepts and Applications: Introduction to Marketing & Core Concepts, Marketing Services, Importance of marketing in service sector. **Marketing Planning & Environment:** Elements of Marketing Mix, analyzing needs & trends in Environment - Macro, Economic, Political, Technical & Social **Understanding the consumer:** Determinants of consumer behav Factors influencing consumer behavior

UNIT II MARKET SEGMENTATION AND PRODUCTION MANAGEMENT 9

Market Segmentation: Meaning & Concept, Basis of segmentation, selection of segments, Market Segmentation strategies, Target Marketing, Product Positioning **Product Management:** Product Life cycle concept, New Product development & strategy, Stages in New Product development, Product decision and strategies, Branding & packaging

UNIT III PRICING, PROMOTION AND DISTRIBUTION STRATEGY 9

Pricing, Promotion and Distribution Strategy: Policies & Practices – Pricing Methods & Price determination Policies. Marketing Communication – The promotion mix, Advertising & Publicity, 5 M's of Advertising Management. Marketing Channels, Retailing, Marketing Communication, Advertising.

UNIT IV MARKETING RESEARCH 9

Marketing Research: Introduction, Type of Market Research, Scope, Objectives & Limitations Marketing Research Techniques, Survey Questionnaire design & drafting, Pricing Research, Media Research, Qualitative Research **Data Analysis**: Use of various statistical tools – Descriptive & Inference Statistics, Statistical Hypothesis Testing, Multivariate Analysis Discriminant Analysis, Cluster Analysis, Segmenting and Positioning, Factor Analysis

UNIT V INTERNET MARKETING 9

Internet Marketing: Introduction to Internet Marketing. Mapping fundamental concepts of Marketing (7Ps, STP); Strategy and Planning for Internet Marketing **Business to Business Marketing:** Fundamental of business markets. Organizational buying process. Business buyer needs. Market and sales potential. Product in business markets. Price in business markets. Place in business markets. Promotion in business markets. Relationship, networks and customer relationship management. Business to Business marketing strategy.

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to:
CO1: Understand the marketing concepts and its evolution
CO2: Analyze the market based on segmentation, targeting and positioning

CO3: Leverage marketing concepts for decision making on product, price, promotion mix and distribution

CO4: Apply the concepts of market research and analyse data using statistical tools

CO5: Apply internet marketing strategies for businesses

TEXT BOOKS:

1. Marketing Management (Analysis, Planning, Implementation & Control) – Philip Kotler

2. Fundamentals of Marketing – William J. Stanton & Others

3. Marketing Management – V.S. Ramaswamy and S. Namakumari

4. Marketing Research – Rajendra Nargundkar

5. Market Research – G.C. Beri

6. Market Research, Concepts, & Cases – Cooper Schindler

REFERENCES:

1. Marketing Management – Rajan Saxena

2. Marketing Management – S.A. Sherlekar

3. Service Marketing – S.M. Zha

4. Journals – The IUP Journal of Marketing Management, Harvard Business Review

5. Research for Marketing Decisions by Paul Green, Donald, Tull

6. Business Statistics, A First Course, David M Levine at al, Pearson Publication

21EL406	BUSINESS COMMUNICATION & VALUE	L	T	P	C
	SCIENCE – III	2	0	4	4

OBJECTIVES:

The Course will enable learners to:

- Improve their technical writing skills.

- Apply self-analysis techniques like SWOT & TOWS.

- Identify the key concepts of:

    - Pluralism & cultural spaces

    - Cross-cultural communication

    - Science of Nation-building

- Develop vocabulary of a general kind and enhance their grammatical accuracy.

UNIT I   STRATEGIC PLANNING   6+12

Reunion- Recap activity on the earlier learning after a 6 months break- SWOT and Life Positions-Meet Dananjaya- Debrief on the video-How it relates to SWOT- Motivational Stories- YouTube videos on Maslow's Theory. Practical: Create your SWOT- SWOT Vs. TOWS (The Balancing Act)- Research on TOWS and find out how you can turn your threat into an opportunity.

UNIT II   CROSS-CULTURAL COMMUNICATION   6+12

Rivers of India – Group activity- Learn and Exchange-Awareness and respect for pluralism in cultural spaces- Global, glocal, translocational- Cross-cultural communication - Group discussion on the implications of cross-cultural communication. Practical: Presentation on what are the strengths identified, to survive in the VUCA World.- Present their findings and approaches as groups. They need to explain the idea of motivation with the help of examples.

UNIT III   VERBAL AND NON-VERBAL COMMUNICATION   6+12

Gender awareness- Verbal and non-verbal communication - Role of science in nation- building - Introduce the topic and discuss the role of scientists and mathematicians from ancient India- Groups present their findings- Role of science post-independence. Practical/Discussion: Cross- cultural communication A. Verbal and non-verbal communication (approach is through videos). B. Let participants have a group discussion on the implications of cross-cultural communication- Culture shock.

UNIT IV   THE FUTURE OF HUMAN COMMUNICATION   6+12

Voice of the Future - AI in Everyday Life - Communicating with machines- Ted talk videos- Debate in the presence of an external moderator. **Practical:** AI in Everyday Life- Design your college inthe year 2090.

UNIT V   TECHNICAL WRITING   6+12

Introduction to technical writing - Basic rules of technical writing through examples- Dr Bimal Ray's videos. **Practical:** Each group will make a presentation on the following: 1. Sell Analytics and Insight to the local tea seller.2. Explain the concept of Cloud to your 87-year-old grandmother.3.

Introduce the concept of friendly robots to a class 3 kid.

TOTAL: 90 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Apply SWOT in real-life scenarios.

CO2: Differentiate between the different cultures of India.

CO3: Identify the common mistakes made in cross-cultural communication. CO4:

Summarize the role of science in nation-building.

CO5: Recognize the importance of AI.

CO6: Identify and apply the best practices of technical writing.

REFERENCES:
1. Anderson, Paul V. Technical Communication, Cengage Learning Pvt. Ltd. New Delhi, 2007.
2. Budinski, Kenneth G. Engineer's Guide to Technical Writing, ASM International, 2001.
3. Samson T, et al. Effective Business Communication. Cambridge University Press India Pvt. Ltd., New Delhi, 2020.
4. Smith-Worthington, D. & Jefferson, S. Technical Writing for Success. 3rd Edition, South- Western Cengage Learning, USA, 2011.
5. Examples of Technical Writing for Students https://freelance-writing.lovetoknow.com/kinds-technical-writing
6. 11 Skills of a Good Technical Writer https://clickhelp.com/clickhelp-technical-writing-blog/11-skills-of-a-good-technical-writer/
7. 13 benefits and challenges of cultural diversity in the workplace https://www.hult.edu/blog/benefits-challenges-cultural-diversity-workplace/
8. https://youtu.be/CsaTslhSDI
9. https://m.youtube.com/watch?feature=youtu.be&v=IIKvV8_T95M
10. https://m.youtube.com/watch?feature=youtu.be&v=e80BbX05D7Y
11. https://m.youtube.com/watch?v=dT_D68RJ5T8&feature=youtu.be
12. https://m.youtube.com/watch?v=7sLLEdBgYYY&feature=youtu.be

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ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE

(Non -Credit)

L	T	P	C
2	0	0	0

OBJECTIVES:
The Course will enable learners to:

- Facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.

- Make the students understand the traditional knowledge and analyse it and apply it to their day-to-day life

UNIT I   INTRODUCTION TO TRADITIONAL KNOWLEDGE   6

Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge

UNIT II   PROTECTION OF TRADITIONAL KNOWLEDGE   6

The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

UNIT III   LEGAL FRAMEWORK AND TK   6

The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016.

UNIT IV   TRADITIONAL KNOWLEDGE AND INTELLECTUAL PROPERTY   6

Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge

UNIT V   TRADITIONAL KNOWLEDGE IN DIFFERENT SECTORS   6

Traditional knowledge and engineering, Traditional medicine system, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK

TOTAL: 30 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to:

CO1: Facilitate the students with the concepts of Indian traditional knowledge.

CO2: Analyse and apply traditional knowledge to their day-to-day life.

TEXT BOOK:
1. Knowledge System in India, by Amit Jha, 2009.

REFERENCES:
1. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002.
2. Knowledge Traditions and Practices of India Kapil Kapoor, Michel Danino.
3. https://www.youtube.com/watch?v=LZP1StpYEPM
4. http://nptel.ac.in/courses/121106003/

	L	T	P	C
UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY *(Non -Credit)*	2	2	0	0

OBJECTIVES:

The Course will enable learners to:

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.

- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence

- Strengthening of self-reflection.

- Development of commitment and courage to act.

COURSE TOPICS:

The course has 28 lectures (2 lecture hours) and 14 practice sessions (2 Tutorial hour) in 5 Units:

UNIT I   COURSE INTRODUCTION - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION

1. Purpose and motivation for the course, recapitulation from Universal HumanValues-I

2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration

3. Continuous Happiness and Prosperity- A look at basic Human Aspirations

4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correct priority

5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario

6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking

UNIT II   UNDERSTANDING HARMONY IN THE HUMAN BEING – HARMONY IN MYSELF!

1. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
2. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
4. Understanding the characteristics and activities of 'I' and harmony in 'I'
5. 'Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
6. Programs to ensure Sanyam and Health.

   Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

UNIT III   UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY-HARMONY IN HUMAN-HUMAN RELATIONSHIP

1. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
2. Understanding the meaning of Trust; Difference between intention and competence
3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
4. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
5. Visualizing a universal harmonious order in society- Undivided Society, Universal Order-from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

UNIT IV UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE - WHOLE EXISTENCE AS COEXISTENCE

1. Understanding the harmony in the Nature

2. Interconnectedness and mutual fulfilment among the four orders of nature-recyclability and self regulation in nature

3. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space

4. Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance innature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

UNIT V IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS

1. Natural acceptance of human values

2. Definitiveness of Ethical Human Conduct

3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order

4. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.

5. Case studies of typical holistic technologies, management models and production systems.

6. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations

7. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

TOTAL:60 PERIODS

OUTCOMES:
  Upon completion of the course, the students will be able to:

CO1: Would become more aware of themselves, and their surroundings (family, society, nature);

CO2: Would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.

CO3: Would have better critical ability.

CO4: Would become sensitive to their commitment towards what they have understood (human values, human relationship and human society).

CO5: Would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

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TEXTBOOKS:

  1.Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, ExcelBooks, NewDelhi, 2010

REFERENCES:

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.

2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

3. The Story of Stuff (Book).

4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi

5. Small is Beautiful-E. F Schumacher.

6. Slow is Beautiful-Cecile Andrews

7. Economy of Permanence - J C Kumarappa

8. Bharat Mein Angreji Raj – Pandit Sunderlal

9. Rediscovering India – by Dharampal

10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi

11. India Wins Freedom – Maulana Abdul Kalam Azad

12. Vivekananda-Romain Rolland (English)

13. Gandhi-Romain Rolland (English)

APTITUDE AND CODING SKILLS – II
(Non -Credit)

	L	T	P	C
	0	0	2	0

List of Exercises*:*

The Course will enable learners to:

- Develop advanced vocabulary for effective communication and reading skills.
- Build an enhanced level of logical reasoning and quantitative skills.
- Develop error correction and debugging skills in programming.
- Apply data structures and algorithms in problem solving.

1.English – Phase II

Vocabulary: Synonyms, Antonyms, Grammar: Subject-Verb Agreement, Tenses and Articles, Prepositions and Conjunctions, Speech and Voices, Comprehension: Inferential and Literal Comprehension, Contextual Vocabulary, Comprehension ordering

2 .Logical Reasoning – Phase II

Deductive Reasoning: Coding deductive logic, Directional sense, Blood relations, Objective Reasoning, Selection decision tables, Puzzles, Inductive reasoning: Coding pattern and Number series pattern recognition, Analogy and Classification pattern recognition, Abductive Reasoning: Logical word sequence, Data sufficiency

3.Quantitative Ability - Phase II

Basic Mathematics: Divisibility, HCF and LCM, Numbers, decimal fractions and power, Applied Mathematics: Profit and Loss, Simple and Compound Interest, Time, Speed and Distance, Engineering Mathematics: Logarithms, Permutation and Combinations, Probability

4.Automata Fix – Phase II

Logical, Compilation and Code reuse

5. Automata - Phase II

Data Structure Concepts: Array and Matrices, Linked list, String processing and manipulation, Stack/Queue, Sorting and Searching

Advanced Design and Analysis Techniques: Greedy Algorithms, Minimum Spanning Trees, String Matching, Divide and Conquer, Computational Geometry

TOTAL: 30 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Develop advanced vocabulary for effective communication and reading skills.

CO2: Build an enhanced level of logical reasoning and quantitative skills.

CO3: Develop error correction and debugging skills in programming.

CO4: Apply data structures and algorithms in problem solving.

SEMESTER V

21CB501	DESIGN AND ANALYSIS OF ALGORITHMS	L	T	P	C
		2	2	0	3

OBJECTIVES:
The Course will enable learners to:

- Illustrate brute force and divide and conquer design techniques.

- Explain dynamic programming and greedy technique for solving various problems.

- Apply iterative improvement technique to solve optimization problems.

- Examine the limitations of algorithmic power and handling it in different problems.

- Critically analyse the efficiency of alternative algorithmic solutions for the same

- problem.

UNIT I   INTRODUCTION   6+6

Characteristics of Algorithm. Analysis of Algorithm: Asymptotic analysis of Complexity Bounds — Best, Average and Worst-Case behavior; Performance Measurements of Algorithm, Time and Space Trade-Offs, Analysis of Recursive Algorithms through Recurrence Relations: Substitution Method, Recursion Tree Method and Masters' Theorem.

UNIT II   FUNDAMENTAL ALGORITHMIC STRATEGIES   6+6

Brute-Force, Heuristics, Greedy, Dynamic Programming, Branch and Bound and Backtracking methodologies; Illustrations of these techniques for Problem-Solving, BinPacking, Knapsack, Travelling Salesman Problem.

UNIT III   GRAPH AND TREE ALGORITHMS   6+6

Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.

UNIT IV   **TRACTABLE AND INTRACTABLE PROBLEMS**   **6+6**

Computability of Algorithms, Computability classes – P,NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques

UNIT V   **ADVANCED TOPICS**   **6+6**

Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE, Introduction to Quantum Algorithms.

TOTAL: 60 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Analyse the efficiency of recursive and non-recursive algorithms mathematically

CO2: Analyse the efficiency of brute force, divide and conquer, decrease and conquer, Transform and conquer algorithmic techniques.

CO3: Implement and analyse the problems using dynamic programming and greedy technique algorithmic techniques.

CO4: Solve the problems using iterative improvement technique for optimization.

CO5: Compute the limitations of algorithmic power and solve the problems using backtracking and branch and bound technique.

TEXT BOOKS:

1. Anany Levitin, Introduction to the Design and Analysis of Algorithms, Third Edition, Pearson Education, 2012.

2. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, Computer Algorithms/ C++, Second Edition, Universities Press, 2019.

REFERENCES:

1. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, Introduction to Algorithms, Third Edition, PHI Learning Private Limited, 2012.

2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, Data Structures and Algorithms, Pearson Education, Reprint 2006.

21CB502 **COMPILER DESIGN + LAB** | **L** **T** **P** **C**
                                        | **3** **0** **2** **4**

OBJECTIVES:

The Course will enable learners to:

- Design the front end of the compiler, scanner, parser, intermediate code generator, object code generator, and the parallel compilation strategies

- Be exposed to compiler writing tools.

- Learn to implement the different Phases of compiler

- Be familiar with control flow and data flow analysis

- Learn simple optimization techniques

UNIT I   INTRODUCTION   9

Phases of compilation and overview. Lexical Analysis (scanner): Regular languages, finite automata, regular expressions, relating regular expressions and finite automata, scanner generator (lex, flex).

UNIT II   SYTNAX ANALYSIS   9

(Parser): Context-free languages and grammars, push-down automata, LL(1) grammars and top-down parsing, operator grammars, LR(O), SLR(1), LR(1), LALR(1) grammars and bottom-up parsing, ambiguity and LR parsing, LALR(1) parser generator (yacc, bison)

UNIT III   SEMANTIC ANALYSIS AND SYMBOL TABLE   9

Semantic Analysis: Attribute grammars, syntax directed definition, evaluation and flow of attribute in a syntax tree

Symbol Table: Basic structure, symbol attributes and management. Run-time

environment: Procedure activation, parameter passing, value return, memory allocation, scope**.**

UNIT IV   CODE GENERATION   9

Intermediate Code Generation: Translation of different language features, different types of intermediate forms.

Code Improvement (optimization): control-flow, data-flow dependence etc.; local optimization, global optimization, loop optimization, peep-hole optimization etc.

UNIT V   ARCHITECTURE DEPENDENT CODE IMPROVEMENT   9

Architecture dependent code improvement: instruction scheduling (for pipeline), loop optimization (for cache memory) etc. Register allocation and target code generation.

Advanced topics: Type systems, data abstraction, compilation of Object Oriented

features and non-imperative programming languages.

LIST OF EXPERIMENTS:

1. Develop a lexical analyzer to recognize a few patterns in C. (Ex. identifiers, constants, comments, operators etc.)

2. Implementation of Lexical Analyzer using Lex Tool

3. Generate YACC specification for a few syntactic categories

    a. Program to recognize a valid arithmetic expression that uses operator +, − , * and /.

    b. Program to recognize a valid variable which starts with a letter followed by any number of letters or digits.

4. Implementation of Calculator using LEX

5. Implementation of Calculator using YACC

TOTAL: 30 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:
CO1: Understand about the regular expressions and finite automata

CO2: Implement the different Phases of compiler using tools

CO3: Analyze the control flow and data flow of a typical program

CO4: Optimize a given program

CO5: Generate an assembly language program equivalent to a source language program

TEXT BOOKS:

1. Alfred V Aho, Monica S. Lam, Ravi Sethi and Jeffrey D Ullman, Compilers − Principles, Techniques and Tool, Pearson Education, Second Edition, 2013.

2. Levine R. John, Tony Mason and Doug Brown ,Lex &Yacc, O'Reilly Media, 1992.

REFERENCES:

1.D. Grune, H.E. Bal, C.J.H. Jacobs, K.G. Langendoen, Modern Compiler Design, Wiley, 2008.
2.Steven S. Muchnick, Advanced Compiler Design and Implementation, , Morgan Kaufmann publishers, First Edition, 2003.

21CB503	BUSINESS STRATEGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Course will enable learners to:
- Determine the concept and process of strategic management.
- Analyze the internal and external environment.
- Formulation of strategies, implementation and evaluation of strategies.
- The course will cover case studies and latest business events.

UNIT I   INTRODUCTION TO STRATEGIC MANAGEMENT   9

Importance of Strategic Management - Vision and Objectives - Schools of thought inStrategic Management - Strategy Content, Process, and Practice - Fit Concept and Configuration Perspective in Strategic Management

UNIT II   INTERNAL ENVIRONMENT OF FIRM- RECOGNIZING A FIRM'S   9
INTELLECTUAL ASSETS

Core Competence as the Root of Competitive Advantage - Sources of Sustained Competitive Advantage - Business Processes and Capabilities-based Approach to Strategy

UNIT III   EXTERNAL ENVIRONMENTS OF FIRM- COMPETITIVE STRATEGY   9

Five Forces of Industry Attractiveness that Shape Strategy - The concept of Strategic Groups, and Industry Life Cycle - Generic Strategies - Generic Strategies and the Value Chain

UNIT IV   CORPORATE STRATEGY, AND GROWTH STRATEGIES   9

The Motive for Diversification - Related and Unrelated Diversification - Business ortfolio Analysis - Expansion, Integration and Diversification - Strategic Alliances, Joint Ventures, and Mergers & Acquisitions.

UNIT V   STRATEGY IMPLEMENTATION: STRUCTURE AND SYSTEMS   9

The 7S Framework - Strategic Control and Corporate Governance

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Become familiar with both internal and external environment. They would also become familiar with corporate and growth strategies, appreciate implementation of such strategies

CO2: Learn the fundamental concepts of strategic management to analyse business situations

and apply these concepts to solve business problems.

CO3: Understand the fundamental principles of and interrelationships among business functions such as: R&D, production, marketing, finance, and HR and information technology.

CO4: Apply the inter-relationships of business to individuals, other organizations, government and society.

CO5: Analyze complex, unstructured qualitative and quantitative problems, using appropriate tools.

TEXT BOOKS:

1. Robert M. Grant, Contemporary Strategic Management, Blackwell, 7th Edition, 2012.

2. D N Dwivedi, Managerial Economics, 8th Edition, Vikas Publishing House, 2018.

REFERENCES:

1. Richard Rumelt, Competitive Advantage, 2011.

2.Kazmi, Azhar, Business Policy and Strategic Management, Third Edition, Tata McGrawhill, New Delhi, 2008.

21CB504	DESIGN THINKING	L	T	P	C
		2	2	0	3

OBJECTIVES:

The Course will enable learners to:

- Familiarize design thinking and its phases.

- Perform immersion activity in empathize phase of design thinking.

- Create problem statements in the define phase of design thinking.

- Ideate and find solutions to the problem defined.

- Develop a prototype and perform testing.

UNIT I   INTRODUCTION   **6+6**

Introduction to design thinking - Importance of design thinking for business – Phases of design thinking – Experiential activity – Case study.

UNIT II   EMPATHIZE PHASE   **6+6**

Empathize phase - Steps involved - Immersion activity- Questionnaire – Empathy

mapfor case study

UNIT III   DEFINE PHASE   **6+6**

Creation of personas in define phase – steps in problem statement creation - problem

statement definition – Examples – Key problem statements.

UNIT IV   IDEATION PHASE   **6+6**

Ideation phase steps – Ideation games – Ideate to find solutions –
Doodling –Storytelling in presenting ideas and prototypes.

UNIT V   PROTOTYPE AND TESTING   **6+6**

Importance of prototype in design thinking –Guidelines - Prototyping the idea – Value
proposition statement – Testing in design thinking – Prototype testing – Documentation
– Design thinking in functional work – Mapping design thinking to agile methodologies.

TOTAL: 60PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:
CO1: Understand the phases of design thinking process..

CO2: Conduct an immersion activity to create an empathy map

CO3: Define the key problems of the personas created.

CO4: Apply the ideation phase steps to present the prototype ideas
CO5: Create a prototype with value propositions and test the prototype

TEXT BOOKS:

1. Christian Müller-Roterberg, "Handbook of Design Thinking", Kindle Direct

Publishing, November 2018.

2. Dan Senor and Saul Singer, "Start-Up Nation", Grand Central Publishing, Twelfth

Edition, 2009.

REFERENCES:

1.Nir Eyal and Ryan Hoover, "Hooked: How to Build Habit-Forming Products",
Library of Congress, 2014.
2 Corral, Luis & Fronza, Ilenia, "Design Thinking and Agile Practices for Software
Engineering: An Opportunity for Innovation", 2018.

21CS512   **ADVANCED APTITUDE AND CODING SKILLS - I**

L	T	P	C
0	0	2	1

OBJECTIVES:
- To develop vocabulary for effective communication and reading skills.
- To build the logical reasoning and quantitative skills.
- To develop error correction and debugging skills in programming.

LIST OF EXERCISES:

1. English –   Phase I Advanced

Vocabulary: Synonyms, Antonyms, Grammar: Subject-Verb Agreement, Tenses and Articles, Prepositions and Conjunctions, Speech and Voices, Comprehension: Inferential and Literal Comprehension, Contextual Vocabulary, Comprehension ordering

2. Logical Reasoning – Phase I Advanced

Deductive Reasoning: Coding deductive logic, Directional sense, Blood relations, Objective Reasoning, Selection decision tables, Puzzles, Inductive reasoning: Coding pattern and Number series pattern recognition, Analogy and Classification pattern recognition, Abductive Reasoning: Logical word sequence, Data sufficiency

3. Quantitative Ability - Phase I Advanced

Basic Mathematics: Divisibility, HCF and LCM, Numbers, decimal fractions and power, Applied Mathematics: Profit and Loss, Simple and Compound Interest, Time, Speed and Distance, Engineering Mathematics: Logarithms, Permutation and Combinations, Probability

4. Automata Fix – Phase I Advanced

Logical, Compilation and Code reuse

TOTAL: 30   PERIODS

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

CO1: Develop vocabulary for effective communication and reading skills.

CO2: Build the logical reasoning and quantitative skills.

CO3: Develop error correction and debugging skills in programming.

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21CB601

COMPUTER NETWORKS + LAB

L	T	P	C
3	0	2	4

OBJECTIVES:

The Course will enable learners to:

- Understand the concepts of data communications and networking.

- Understand the need for multiplexing and spread spectrum.

- Understand data link layer and its various services.

- Learn the functions of network layer and various routing protocols.

- Familiarize the functions and protocols of the transport layer.

- Understand various application layer services and the network security

UNIT I   INTRODUCTION   9

Computer networks and distributed systems, Classifications of computer networks,

Preliminaries of layered network structures.

Data communication Components: Representation of data and its flow, Various

Connection Topology, Protocols and Standards, OSI model, Transmission Media.

LAN: Wired LAN, Wireless LAN, Virtual LAN.

Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time
division and Wave division, Concepts on spread spectrum.

UNIT II   DATA LINK LAYER AND MEDIUM ACCESS SUBLAYER   9

Fundamentals of Error Detection and Error Correction, Block coding, Hamming Distance, CRC;

Flow Control and Error control protocols - Stop and Wait, Go-back–N ARQ, Selective Repeat

ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols - Pure ALOHA,

Slotted ALOHA, CSMA/CD, CDMA/CA.

UNIT III   NETWORK LAYER   9

Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP
and DHCP–Delivery, Forwarding and Unicast Routing protocols.

UNIT IV   TRANSPORT LAYER   9

Process to Process Communication, User Datagram Protocol (UDP), Transmission

Control Protocol (TCP), SCTP Congestion Control; Quality of Service (QoS), QoS improving

techniques - Leaky Bucket and Token Bucket algorithms.

UNIT V   APPLICATION LAYER   9

DNS, DDNS, TELNET, EMAIL, FTP, WWW, HTTP, SNMP, Bluetooth, Firewalls.
Network Security: Electronic mail, directory services and network management, Basic concepts of Cryptography. analyzer and examine.

TOTAL:45 PERIODS

LIST OF EXPERIMENTS:
1. Learn to use commands like tcpdump, netstat, ifconfig, nslookup and traceroute capture ping and traceroute PDUs using a network protocol

2. Write a HTTP web client program to download a web page using TCP sockets.

3. Applications using TCP sockets like:

   a) Echo client and echo server

   b) Chat

   c) File Transfer

4. Simulation of DNS using UDP sockets.

5. Write a code simulating ARP /RARP protocols.

6. Study of Network simulator (NS) and Simulation of Congestion ControlAlgorithms

   using NS.

7. Study of TCP/UDP performance using Simulation tool.

8. Simulation of Distance Vector/ Link State Routing algorithm.

9. Performance evaluation of Routing protocols using Simulation tool.

10. Simulation of error correction code (like CRC).

TOTAL:30 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Understand the classification of computer networks, basic layers and its functions,

protocols and transmission media in computer networks

CO2: Examine the performance of different types of networks and techniques for bandwidth

utilization.

CO3: Inspect the functionalities of data link and media access control protocols.

CO4: Examine different routing algorithms.

CO5: Identify appropriate protocol to be used at the transport layer.
CO6: Explain the working of various application layer protocols and network security.
TEXT BOOKS:
1. Behrouz A. Forouzan, Data Communications and Networking, The McGraw-Hill Companies, Inc. 5th Edition, 2013.
2. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach,

Morgan Kaufmann Publishers Inc., 5th Edition 2012.

REFERENCES:
1.William Stallings, Data and Computer Communications,PearsonEducation,10th
   Edition, 2013.
 2. Andrew S. Tanenbaum, Computer Networks, Prentice Hall, 5th Edition, 2011.

21CB602	INFORMATION SECURITY + LAB	L T P C
		3 0 2 4

OBJECTIVES:
The Course will enable learners to:

- Understand the role of information security and its parameters.

- Understand various access control models and security policies.

- Understand importance of system design.

- Understand logic-based system design.

- Understand Unix system interface.

- Understand Unix programming methods.

UNITI   OVERVIEW OF SECURITY PARAMETERS   9

Confidentiality, integrity and availability; Security violation and threats; Security policy
and procedure; Assumptions and Trust; Security Assurance, Implementation and Operational Issues;
Security Life Cycle.

UNITII   ACCESS CONTROL MODELS AND SECURITY POLICIES   9

Access Control Models: Discretionary, mandatory, roll-based and task-based models, unified

models, access control algebra, temporal and spatio-temporal models.

Security Policies: Confidentiality policies, integrity policies, hybrid policies, non-

interference and policy composition, international standards.

UNIT III   SYSTEMS DESIGN   9

Design principles, representing identity, control of access and information flow,
confinement problem. Assurance: Building systems with assurance, formal methods, evaluating
systems.

UNITIV   LOGIC-BASED SYSTEM   9

Malicious logic, vulnerability analysis, auditing, intrusion detection. Applications: Network

security, operating system security, user security, program security. Special Topics: Data privacy,

introduction to digital forensics, enterprise security specification.

UNITV   UNIX SYSTEM INTERFACE AND PRORAMMING METHOD   9

Operating Systems Security: Security Architecture, Analysis of Security in Linux/Windows.

Database Security: Security Architecture, Enterprise security, Database auditing.

TOTAL:45PERIODS

LIST OF EXPERIMENTS:

1. Analysis of security in Unix/Linux.
2.Administration of users, password policies, privileges and roles

TOTAL:30PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

   CO1: Implement of information security and its parameters.
   CO2: Implement various access control models and security policies.

   CO3: Implement the system design effectively.

   CO4: Implement logic-based system design effectively.

   CO5: Capable to work with UNIX system calls.

   CO6: Student will be able to work with UNIX programming by various methods.

TEXTBOOKS:

   1.M. Bishop, "Computer Security: Art and Science", 2nd Edition, Pearson
      Education, 2019
   2.Ross Anderson, "Security Engineering: A Guide to Building Dependable
      Distributed Systems", Third Edition, Wiley, 2021.

REFERENCES:

   1.C.P. Pfleeger, S.L. Pfleeger, J. Margulies, "Security in Computing", 5th Edition,
   Prentice Hall, 2015.

   2.M. Stamp, "Information Security: Principles and Practice", 2nd Edition, Wiley,
   2011.

21CB603   ARTIFICIAL INTELLIGENCE + LAB   **L T P C**
                                                              3 0 2 4

OBJECTIVES:
The Course will enable learners to:

- Understand the main approaches to artificial intelligence.

- Explore areas of application such as knowledge representation,
  naturallanguage processing and expert systems.

- Develop abilities to apply, build and modify decision models to solve realproblems.

- Design good evaluation functions and strategies for game playing

- Discuss the core concepts and algorithms of searching

UNITI   INTRODUCTION   9

Problems of AI, AI technique, Tic - Tac - Toe problem. Intelligent Agents, Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents.

Problem Solving, Problems, Problem Space & search:
Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.

UNITII   SEARCH TECHNIQUES   9

Problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies. Heuristic search strategies Greedy best-first search, A* search, AO* search, memory bounded heuristic search: local search algorithms & optimization

problems: Hill climbing search, simulated annealing search, local beam search

UNIT III   CONSTRAINT SATISFACTION PROBLEMS   9

Local search for constraint satisfaction problems. Adversarial search, Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening.

UNITIV   KNOWLEDGE & REASONING   9

Knowledge representation issues, representation & mapping, approaches to knowledge representation. Using predicate logic, representing simple fact in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction. Representing knowledge using rules, Procedural verses declarative knowledge, logic programming, forward verses backward reasoning, matching, control knowledge.

UNIT V   PROBABILISTIC REASONING   9

Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Planning Overview, components of a planning system, Goal stack planning, Hierarchical planning, other planning techniques. Expert Systems: Representing and using domain knowledge, expert system shells, and knowledge acquisition.

TOTAL:45PERIODS

LIST OF EXPERIMENTS:

1. Implement heuristics, optimal search, and graph heuristics.

2. Constraint satisfaction problems

3. k-nearest neighbors

4. Decision trees.

TOTAL:30PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Demonstrate fundamental understanding of artificial intelligence (AI) and itsproblem solving techniques

CO2:Explain how Artificial Intelligence enables capabilities that are beyondconventional technology

CO3:Implement and execute searching in AI

CO4:Understand how to represent the knowledge and its approaches

CO5:Acquaint the Artificial Intelligence techniques for building well-engineered and efficient intelligent systems.

TEXTBOOKS:

1 Stuart J. Russell, Peter Norwig , "Artificial Intelligence –A Modern approach", 3rd Pearson Education, 2016

2. Ritch & Knight, "Artificial Intelligence", Third Edition, Tata McGraw Hill, 2009

REFERENCES:

1. Patterson, "Introduction to Artificial Intelligence & Expert Systems", First Edition, Pearson, 2015

.

2. Saroj Kaushik, "Logic & Prolog Programming", First Edition, New Age International, 2008.

21CS614	ADVANCED APTITUDE AND CODING SKILLS - II	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

OBJECTIVES:
- To develop advanced vocabulary for effective communication and reading skills.
- To build an enhanced level of logical reasoning and quantitative skills.
- To develop error correction and debugging skills in programming.
- To apply data structures and algorithms in problem solving.

LIST OF EXERCISES:

1. English – Phase II Advanced

Vocabulary: Synonyms, Antonyms, Grammar: Subject-Verb Agreement, Tenses and Articles, Prepositions and Conjunctions, Speech and Voices, Comprehension: Inferential and Literal Comprehension, Contextual Vocabulary, Comprehension ordering

2. Logical Reasoning – Phase II Advanced

Deductive Reasoning: Coding deductive logic, Directional sense, Blood relations, Objective Reasoning, Selection decision tables, Puzzles, Inductive reasoning: Coding pattern and Number series pattern recognition, Analogy and Classification pattern recognition, Abductive Reasoning: Logical word sequence, Data sufficiency

3. Quantitative Ability - Phase II Advanced

Basic Mathematics: Divisibility, HCF and LCM, Numbers, decimal fractions and power, Applied Mathematics: Profit and Loss, Simple and Compound Interest, Time, Speed and Distance, Engineering Mathematics: Logarithms, Permutation and Combinations, Probability

4. Automata Fix – Phase II Advanced

Logical, Compilation and Code reuse

5. Automata - Phase II Advanced

Data Structure Concepts: Array and Matrices, Linked list, String processing and manipulation, Stack/Queue, Sorting and Searching Advanced Design and Analysis Techniques: Greedy Algorithms, Minimum Spanning Trees, String Matching, Divide and Conquer, Computational Geometry

TOTAL: 30 PERIODS

OUTCOMES:
At the end of this course, the students will be able to:
CO1: Develop advanced vocabulary for effective communication and reading skills.
CO2: Build an enhanced level of logical reasoning and quantitative skills.
CO3: Develop error correction and debugging skills in programming.
CO4: Apply data structures and algorithms in problem solving.

21CB901   CONVERSATIONAL SSTEMS + LAB   **L T P C**
                                                          3 0 2 4

OBJECTIVES:
The Course will enable learners to:

- Enable attendees to acquire knowledge on chatbots and its terminologies

- Work with ML Concepts and different algorithms to build custom ML Model

- Better understand on Conversational experiences and provide better customer experiences

UNITI   FUNDAMENTALS OF CONVERSATIONAL SYSTEMS   9

Introduction: Overview, Case studies, Explanation about different modes of engagement for a human being, History and impact of AI. Underlying technologies: Natural Language Processing, Artificial Intelligence and Machine Learning, NLG, Speech-To-Text, Text- To-Speech, Computer Vision etc. Introduction to Top players in Market — Google, MS, Amazon &Market trends. Messaging Platforms (Facebook, WhatsApp) and Smart speakers —— Alexa, Google Home and other new channels. Ethical and Legal Considerations in AI Overview

UNITII   FOUNDATIONAL BLOCKS FOR PROGRAMMING AND   9
**   NATURAL LANGUAGE PROCESSING**

Introduction: Brief history, Basic Concepts, Phases of NLP, Application of chat bots etc. General chatbot architecture, Basic concepts in chatbots: Intents, Entities, Utterances, Variables and Slots, Fulfillment. Lexical Knowledge Networks (WordNet, Verbnet,

PropBank, etc). Lexical Analysis, Part-of-Speech Tagging, Parsing/Syntactic analysis

Semantic Analysis, Word Sense Disambiguation.Information   Extraction, Sentiment Analysis

UNIT III   BUILDING A CHAT BOT / CONVERSATIONAL AI SYSTEMS   9

Fundamentals of Conversational Systems (NLU, DM and NLG) - Chatbot framework & Architecture, Conversational Flow & Design, Intent Classification (ML and DL based techniques), Dialogue Management Strategies, Natural Language Generation. UX design, APIs and SDKs, Usage of Conversational Design Tools. Introduction to popular chatbot frameworks —— Google Dialog flow, Microsoft Bot Framework, Amazon Lex, RASA Channels: Facebook Messenger, Google Home, Alexa, WhatsApp, Custom Apps. Overview of CE Testing techniques, A/B Testing, Introduction to TestingFrameworks - Botium /Mocha ,Chai. Security & Compliance — Data Management, Storage, GDPR, PCI

**UNIT IV   ROLE OF ML/AI IN CONVERSATIONAL TECHNOLOGIES AND   9
CONTACT CENTERS**

Brief Understanding on how Conversational Systems uses ML technologies in ASR, NLP, Advanced Dialog management, Language Translation, Emotion/Sentiment Analysis, Information extraction ,etc. to effectively converse, Introduction to Contact centers – Impact & Terminologies. Case studies & Trends, How does a Virtual Agent/Assistant fit in here?

UNIT V   CONVERSATIONAL ANALYTICS AND FUTURE   9

Conversation Analytics : The need of it - Introduction to Conversational Metrics - Summary, Robots and Sensory Applications overview - XR Technologies in Conversational Systems , XR-Commerce - What to expect next? —— Future technologies and market innovations overview

TOTAL:45 PERIODS

LIST OF EXPERIMENTS:

1.   A python program to identify morphological features of a word by analysing it.
2.   A python program to generate word forms from root and suffix information.
3.   A python program to do sentiment analysis for the given dataset and to classify sentences based on their categories.
4.   A python program to know the importance of context and size of training corpus in learning Parts of Speech and understand the concept of chunking and get familiar with the basic chunk tagset.
5.   A python program to build a Neural Network to recognize handwritten digits using MNIST dataset.
6.   Project 1: Case Study to build a learning chatbot
7.   Project 2: Case Study to build a ML Model using LSTM/any RNN and integrate with chatbot
8.   Project 3: Building a user friendly Chatbot with many features.

TOTAL:30 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Familiarize in the NLTK tool kit and the pre-processing techniques of natural language processing.

CO2: Familiarize with the basic technologies required for building a conversational system.

CO3: Build a Chabot for any application and deploy it

CO4: Involve AI in building conversational system and build advanced systems that can be cognitively inclined towards human behaviour.

CO5: Build a real time working conversational system for social domain that can intelligently process inputs and generate relevant replies.

TEXTBOOKS:
1 . Michael McTear, "Conversational AI: Dialogue Systems, Conversational Agents, and Chatbots", Second Edition, Moran and Claypool Publishers, 2020.
2. Cathy Pearl, "Designing Voice User Interfaces: Principles of Conversational Experiences", O'REILLY, 2016.

21CB902	CLOUD, MICROSERVICES & APPLICATION+ LAB	L T P C
		3 0 2 4

OBJECTIVES:
The Course will enable learners to:

- Know basic components and fundamentals of cloud computing

- Develop an application using various services in cloud

- Understand how to design the web application development in cloud
- Learn the basic and important concepts of python to implement in an application

- Understand the issues and solutions for cloud security and cloud monitoring

UNITI   INTRODUCTION   9

Cloud Fundamentals-Cloud Service Components-Cloud Service, Deployment Models- Cloud components-Guiding principle with respect to utilization, Security, Pricing- Application of Cloud Computing. Case Study: Design and Implementation of Public and Private Cloud Environments ─ Open Stack and AWS.

UNITII   CLOUD BASED APPLICATIONS DEVELOPMENT   9

Application Architectures-Monolithic & Distributed, Microservice Fundamental and Design Approach-Cloud Native Applications-12 Factors App-Application Integration Process and APIfication Process- API Fundamental-Microservice and API Management- Spring Boot Fundamental and Design of Microservice - API Tools - Developer Portal Applications of Microservice and APIfication.

UNIT III   WEB DEVELOPMENT TECHNIQUES   9

Devops fundamentals - Devops Role and Responsibility-Tools and Applications- Containerization Process and Application-Evolution of APP Deployment- Docker Fundamentals - Docker

Architecture- Docker Commands. Case study Orchestration, Kubernetes, Docker Container.

UNITIV   CLOUD SECURITY AND MONITORING TOOL   9

Cloud Security-Cloud Security Shared Responsibility Architecture-Security By Design Principles-Identity And Access Management-Cloud Security Layers Illustration-Cloud Network, Host And Data Security Concepts-Security Operations and Major Cloud Service Provider Tools-Security Compliance and Regulations-Cloud Monitoring-Benefits of Cloud Monitoring-Overview of Cloud Monitoring Tools.

UNITV   BUILDING AN APPLICATION USING PYTHON   9

Developing and Deploying an Application in the Cloud- Building a python project based on Design-Development Testing-Deployment of an application in the cloud using adevelopment framework and deployment platform. Case Study: Python Use case and Python Framework

TOTAL:45PERIODS

LIST OF EXPERIMENTS:

1. Find procedure to run the virtual machine of different configuration using virtual-manager.

2. Virtualize a machine and check how many virtual machines can be utilized at a particular time.

3. Create a VM Clone and attach virtual block to the cloned virtual machine and check whether it holds the data even after the release of the virtual machine.

4. Create a Snapshot of a VM at a given point in time and test the snapshot by restoring the VM to that time. (Note: Testing can be done by installing an application and then restore it.)

5. Develop a simple application to understand the concept of PAAS using GAE/Amazon Elastic Beanstalk/IBM Blue Mix and launch it.

6. Test how a SaaS applications scales in response to demand.

7. Find the procedure to launch a Cloud instance using a Public IaaS cloud like AWS/GCP. 8 Setup a Private Cloud by performing the procedure using a Single node OPENSTACK implementation.

8. Find the procedure to develop a DevSecOps – Cloud (AWS, GCP, Azure).

9. Find the procedure to develop a DevSecOps – Cluster (Kubernetes).

10. Find the procedure to develop a Container (Docker).

11. To Build and Test Your Docker Images in the Cloud with Docker commands.

12. Perform the installation steps and configure Google App Engine.

13. Find the Procedure to develop a SalesForce application in cloud.

14. Create an Application in SalesForce.com using Apex programming Language.

TOTAL:30PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Demonstrate the main concepts of cloud, its characteristics, advantages, key technologies and its various delivery and deployment models.

CO2: Develop and design an application using various tools in cloud environment

CO3: Acquire the basic and important design concepts and issues of web application development techniques in cloud.

CO4: Structure simple python program for developing an application in cloud

CO5: Analyze the issue of cloud such as security, energy efficiency and interoperability, and provide an insight into future prospects of computing in the cloud monitoring.

TEXTBOOKS:

1 . Thomas Erl, Zaigham Mahmood, and Ricardo Puttini, "Cloud Computing Concepts, Technology & Architecture", Prentice Hall, 2013.

2. Guo Ning Liu, Qiang Guo Tong, Harm Sluiman, Alex Amies, "Developing and Hosting Applications on the Cloud", IBM Press, 2012.

REFERENCES:

1. Kai Hwang, Geoffery C. Fox and Jack J. Dongarra, "Distributed and CloudComputing:Clusters,Grids, Clouds and the Future of Internet", First Edition, Morgan Kaufman Publisher, an Imprint of Elsevier, 2012..

2. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, "Cloud Computing: Principles and Paradigms", Wiley, 2011.

21CB903	**MACHINE LEARNING + LAB**	**L T P C**
		3 0 2 4

OBJECTIVES:
The Course will enable learners to:

- Have a thorough understanding of the existing machine learning techniques.

- Know the basic concepts of supervised learning techniques

- Study the working of neural networks and similar models

- Familiarize with unsupervised learning algorithms

- Understand the concepts of mining and applications based on it

UNIT I   INTRODUCTION   9

Introduction to Machine Learning (ML); Relationship between ML and human learning; A quick survey of major models of how machines learn; Example applications of ML

UNIT II   SUPERVISED LEARNING ALGORITHMS   9

Model evaluation (precision, recall, F1-mesure, accuracy, area under curve); Statistical decision theory including discriminant functions and decision surfaces; Bayesian networks; Decision Tree and Random Forests; k-Nearest neighbour classification; Support Vector Machines; Regression: Multi-variable regression; Least squares regression.

UNIT III   CLASSIFICATION AND TEMPORAL MODELS   9

Artificial neural networks including backpropagation; Applications of classifications; Ensembles of classifiers including bagging and boosting. Model evaluation; Least squares regression; Regularization; LASSO; Applications of regression. Naive Bayes classification, - Hidden Markov Models (HMM) with forward-backward and Viterbi algorithms; Sequence classification using HMM; Conditional random fields.

UNIT IV   UNSUPERVISED LEARNING ALGORITHMS   9

 Clustering: Average linkage; Ward's algorithm; Minimum spanning tree clustering; K-nearest neighbours clustering; BIRCH; CURE; DBSCAN.

UNIT V   INFORMATION MINING   9

Association rule mining algorithms including apriori - Expectation-Maximization (EM)

Algorithm for unsupervised learning anomaly and outlier detection methods.

Applications of sequence classification such as part-of-speech tagging.

TOTAL:45PERIODS

LIST OF EXPERIMENTS:

1. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.

2. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Readthe training data from a .CSV file. A python program to implement decision tree

3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

4. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Python ML libraries.

5. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.

6. Assuming a set of documents that need to be classified, use the support vector Classifier model to perform this task. Python can be used to write the program. Calculate the accuracy, precision, and recall for your data set.

7. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Python ML libraries can be used for this problem.

8. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.

9. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

10. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Python ML API in the program.

11. Implementation of a mini project – Stock prices predictor/ Sports predictor/ Sentiment analyzer/ Healthcare predictor.

TOTAL:30PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Distinguish between, supervised, unsupervised and semi-supervised learning.

CO2: Modify existing machine learning algorithms to improve classification efficiency.

CO3: Build a basic neural network for real-time data.

CO4: Use unsupervised models for clustering data.

CO5: Design a system that uses the information mining models of machine learning.

TEXTBOOKS:

1 R.O. Duda, P.E. Hart, D.G. Stork, "Pattern Classification", Second Edition, Wiley, 2001

2. C. Bishop,"Pattern Recognition and Machine Learning", Springer, 2007.

REFERENCES:

1. E. Alpaydin, "Introduction to Machine Learning", Third Edition, Prentice-Hall, 2014.

2. A. Webb, "Statistical Pattern Recognition", Third Edition, Wiley, 2011.

20CB916	ADVANCED SOCIAL,TEXTANDMEDIA ANALYTICS+ Lab	L T P C 3 0 2 4

OBJECTIVES:

The Course will enable learners to

- To learn the fundamentals of text mining analysis.

- To be able to use various tools for text mining and carry out pattern discovery, predictive modeling.

- Explore the use of social network analysis to understand the growing connectivity and complexity.

- Perform social network analysis to identify important network properties in social media sites.

- Analysing interactions between people, and determine structural patterns in such interactions in real time application.

UNIT I   INTRODUCTION TO TEXT MINING   9

Text Mining: Introduction, Core text mining operations, Preprocessing techniques, Categorization, Clustering, Information extraction, Probabilistic models for information extraction, Text mining applications. Methods & Approaches: Content Analysis; Natural Language Processing; Clustering &

Topic Detection; Simple Predictive Modeling; Sentiment Analysis; Sentiment Prediction.

UNIT II   CLUSTERING AND INFORMATION EXTRACTION   9

Information extraction –Introduction, Historical evolution, Examples, Architecture of IE systems, Anaphora Resolution, Inductive algorithms, Structural IE. Probabilistic models for information extraction- Hidden Markov Models, Stochastic Context Free Grammars, Maximal entropy 138odeling, Maximal entropy Markov Models, Conditional Random Fields. Text mining applications.

UNIT III   TEXT MINING METHODS & APPROACHES   9

Content Analysis; Natural Language Processing; Clustering & Topic Detection; Simple Predictive Modelling; Sentiment Analysis; Sentiment Prediction.

UNIT IV   WEB ANALYTICS   9

Web analytics tools, Clickstream analysis, A/B testing, online surveys; Web search and retrieval, Search engine optimization, Web crawling and Indexing, Ranking algorithms, Web traffic models

UNIT V   SOCIAL MEDIA ANALYTICS   9

Social network and web data and methods. Graphs and Matrices. Basic measures for individuals and networks. Information visualization; Making connections: Link analysis. Random graphs and network evolution. Social contexts: Affiliation and identity; Social network analysis

TOTAL:45PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Perceive the trends in recent years on online social networks.

CO2: Draw the graphical relation between the community.

CO3: Know various social network algorithms related to predictive modelling and pattern discovery.

CO4: Determine the relation between the participants of various social media.

 CO5: Understand Social Network Mining Tools and apply in real time problems.

Home Assignments:

Language Analysis: Students are expected to analyze the language of a category of text (e.g., literary, academic, social media) of their selection. Based on the analysis, students are expected to provide a critical description of the texts involved and possibly distinguishing them from other texts and/or

uncovering relationships or concepts communicated by the text authors. Students are required Perform sentiment analysis using Twitter. Students will be required to use off the-shelf software and/or code of their own to detect sentiment/emotion in the data and write a description of the methods they use and the results.

TEXTBOOKS:

1. Ronen Feldman and James Sanger, "The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data", Cambridge University Press, 2016.

2. Hansen, Derek, Ben Sheiderman, Marc Smith. Analyzing Social Media Networks with NodeXL: Insights from a Connected World, Morgan Kaufmann,2019

3. Avinash Kaushik. Web Analytics 2.0: The Art of Online Accountability. 2019

4. Hanneman, Robert and Mark Riddle. Introduction to Social Network Method.2005

5. Ronen Feldman and James Sanger, "The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data", Cambridge University Press, 2016.

REFERENCES:

1. Wasserman, S. & Faust, K. Social network analysis: Methods and applications. New York: Cambridge University Press. 1994

2. Monge, P. R. & Contractor, N. S. Theories of communication networks. New York: Oxford University Press. http://nosh.northwestern.edu/vita.html, 2013

PROFESSIONAL ELECTIVE II

21CB907	ROBOTICS AND EMBEDDED SYSTEMS+ LAB	L T P C
		3 0 2 4

OBJECTIVES:
The Course will enable learners to

- Understand the concept of Industry 4.0 and technologies for cognitive robotics
- Understand the fundamentals of robotics operating systems
- Understand the role of AI in cognitive robotics
- Understand and demonstrate the role of Data Science and their working principles in robotics
- Demonstrate the concepts of cloud computing with robot on various real time applications

UNIT I   INTRODUCTION   9

Introduction to Modern Day Robotics and their industrial applications: Industry 4.0 Concept: Background and Overview-Industry 4.0 technologies: implementation patterns in manufacturing companies-Evolution of Industrial Robots and their Applications- Advancements in Robotics and Its Future Uses-Types of robotics in various fields for applications

Technologies essential for Cognitive Robotics: Computer systems and Technologies relevant to modern day robotics-Robotic Process Automation: Overview of RPA and its applications-RPA, AI, and Cognitive Technologies for Leaders- Introduction to Robotics: Analysis, Control, Applications

UNIT II   ROBOTIC OPERATING SYSTEM   9

ROS for beginners an overview- Introduction to the Robot Operating System (ROS) Middleware - Secure communication for the Robot Operating System - An Introduction to Robot Operating System: The Ultimate Robot Application Framework by Adnan Quality of Service and Cybersecurity Communication Protocols -Analysis for the Robot Operating System. Robotics systems communication- Threat modelling using ROS

UNIT III   AI IN THE CONTEXT OF COGNITIVE ROBOTICS AND ROLE OF AI   9
IN ROBOTICS

Foundation for Advanced Robotics and AI- A Concept for a Practical Robot Design Process- Demo to train A Robot Using AI - Deep learning core applications-Deep learning business applications

UNIT IV   DATA SCIENCE AND BIG DATA IN THE CONTEXT OF   9
COGNITIVE ROBOTICS

Cognitive Technologies: The Next Step Up for Data and Analytics in robotics-Cognitive Deep Learning Technology for Big Data Cognitive Assistant Robots for Reducing Variability in Industrial Human-Robot Activities

Artificial Intelligence and Robotics - The Review of Reliability Factors Related to Industrial Robots -Failure analysis of mature robots in automated production- Data Analytics for Predictive Maintenance of Industrial Robots - Failure Is an Option: How the Severity of Robot Errors Affects Human-Robot Interaction

UNIT V   CLOUD PLATFORMS AND IT APPLICATIONS IN ROBOTICS   9

Learning Cloud Computing: Core Concepts - Cloud Computing: Private Cloud Platforms -Robot as a Service in Cloud Computing -Cloud Computing Technology and Its Application in Robot Control - A Comprehensive Survey of Recent Trends in Cloud.

Robotics Architectures and Applications - Google's cloud robotics and high computing needs of industrial automation and systems-The role of cloud and open source software in the future of

robotics-The Power of Cloud Robotics by Robotics Industry Association

LIST OF EXPERIMENTS:

1. Build a Self-Driving Robot that can automatically follow a line
2. Build a basic obstacle-avoiding robot and improve the design to help it avoid getting stuck
3. Build a Humanoid Robot
4. Autonomous Robot Navigation using Computer Vision for exhaustive path- finding
5. A Mobile Autonomous Chemical Detecting Robot
6. Build a voice controlled robot
7. Web-Controlled Mobile Video-Enabled Robotic Litter Collection Device
8. Utilizing Artificial Neural Networks to Create a Learning Robot
9. Hospital Sanitizing Robot
10. Autonomous Robotic Vehicle: Saving lives, preventing accidents one at a time
11. Build a robot with Python and 3D Printed Robotic Arm
12. Build an Intelligent Irrigation Control System
13. AI-powered Hearing Aid
14. Fire Extinguishing Robot
15. Remote Operated Spy Robot Circuit

TOTAL: 30 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:
CO1: Develop skills of using advanced software for solving practical problems in robotics pertaining to various industries.
CO2: Understand the basics of Robotic operating systems and communication system.
CO3: Understand basic concepts and technological advancements in AI and robotics.
CO4: Understand and apply several statistical analysis techniques, business analytics for cognitive robotics and programming of robots using python and R languages.
CO5: Understand and apply the cloud computing concepts in robotics.

TEXTBOOKS:

1.Saeed Benjamin Niku, "Introduction to Robotics: Analysis, Control, Applications",

Wiley Publishers, 2nd edition,2011.

2.Simon J. D. Prince, "Computer Vision: Models, Learning, and Inference", Cambridge University Press, 2012.

REFERENCES:

1.Francis X. Govers," Artificial Intelligence for Robotics: Build Intelligent Robots that Perform Human Tasks Using AI Techniques", Packt publishing,2018.

2.Krishnendu Kar, "Mastering Computer Vision with TensorFlow 2.x: Build Advanced Computer Vision Applications Using Machine Learning and DeepLearning Techniques",Packt publishing,2020.

		L T P C
21CB908	**MODERN WEB APPLICATIONS + LAB**	**3 0 2 4**

OBJECTIVES:

The Course will enable learners to

- Understand various forms of web applications.
- Understand the usage of HTML.
- Understand the usage of CSS.
- Understand the need for java script.
- Understand front end framework
- Understand back-end technologies.

UNIT I   INTRODUCTION   9

Concept of website, its need and purpose, Types of websites: Static and dynamic website, Introduction to HTML, XML, JSON, Web Browsers, − Web Servers, Uniform Resource Locator, Tools and Web Programming Languages. Web Standards, Tiered Architecture: Client Server Model, Three Tier Model, Service Oriented Architectures, REST services

UNIT II   HYPERTEXT MARK UP LANGUAGE   9

Languages used for website development, HTML5: basic tags, formatting tags, Adding images, Lists, Embedding multimedia in Web pages, Inserting tables, Internal and External Linking, Frames, Forms

UNIT III   CASCADING STYLE SHEETS (CSS3)   9

Basics of Cascading Style sheets, Advantages of CSS, External Style sheet, Internal style sheet, Inline style sheet, CSS Syntax, color, background, Font, images

UNIT IV   JAVA SCRIPT   9

Features of JavaScript, extension of JavaScript, Syntax of JavaScript: data types, operators, variables, tag,Document Object Model (DOM)withJavaScript, Selection Statement using if and Switch, Iterative statement: for, for/in, while, do while, break and continue.

UNIT V   FRONT END FRAMEWORK AND BACK END   9

74

TECHNOLOGIES

Front End Framework: Introduction to jQuery - Syntax, Selectors, Events, Traversing, AJAX ;

Introduction to Bootstrap — Basics, Grids, Themes ; Angular JS — Expressions, Modules,

Data Binding, Scopes, Directives & Events, Controllers, Filters, Services, Validation.

Back End Technologies: Introduction to RESTful services, Resources, Messages (Request, Response), Addressing, Methods – (GET, POST, PUT, DELETE)

TOTAL:45PERIODS

LIST OF EXPERIMENTS:

1. Develop a web application development exercise covering all the units. This exercise can be also done in group of 2-3 students.

2. Student can define the suitable web application example to implement as per their choice. It should cover followings:

3. Application should cover **C**reate, **R**ead, **U**pdate, **D**elete scenarios of data.

4. Front end to be developed covering all the technologies (HTML5, CSS3,jQuery, AngularJS)

5. Back end connectivity to be established through RESTful services and must have database connectivity.

6. Student can choose any backend technologies and database for developing REST services required for the application development. RESTful services should be developed using technologies already familiar. E.g. Java OR C# OR Python etc.

TOTAL: 30 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:
  CO1: Implement various forms of web applications.
  CO2: Implement various features of HTML.
  CO3: Implement various features of CSS.
  CO4: Implement scripts using java script and HTML.
  CO5: Implement front end framework for web pages.
  CO6: Implement back-end technologies for web pages.

TEXTBOOKS:

1. Deitel P. J., Deitel H. M. and Deitel A., "Internet and World Wide Web: How to Program", Fifth Edition, Pearson Prentice Hall, 2012.

2. Jon Duckett, "HTML & CSS: Design and Build Websites", First Edition, John Wiley & Sons, 2011.

REFERENCES:

1. Sebesta R. W.," Programming the World Wide Web", Eight Edition, Pearson, 2014.

2. Pressman R. and Lowe D.," Web Engineering: a practitioner's approach", First Edition, Mc GrawHill, 2008.

21CB909	DATA MINING AND ANALYTICS + LAB	L	T	P	C
		3	0	2	4

OBJECTIVES:

The Course will enable learners to:

- Understand basic concepts and techniques of Data Mining

- Develop skills of using data mining software for solving practical problems

- Understand and apply several statistical analysis techniques: regression, ANOVA, data reduction.

UNITI   INTRODUCTION TO DATA MINING   9

Introduction to Data Mining: What is data mining? Related technologies - Machine Learning, DBMS, OLAP, Statistics, Stages of the Data Mining Process, Data Mining Techniques, Knowledge Representation Methods, Applications. Data mining knowledge representation: Task relevant data, Background knowledge, Representing input data and output knowledge, Visualization techniques

UNIT II   DATA PREPROCESSING   9

Data preprocessing: Data cleaning, Data transformation, Data reduction, Discretization and generating concept hierarchies, Installing Weka 3 Data Mining System, Experiments with Weka - filters, discretization Attribute-oriented analysis: Attribute generalization, Attribute relevance, Class comparison, Statistical measures

UNIT III   ASSOCIATION AND MINING   9

Data mining algorithms - **Association rules:** Motivation and terminology, Example: mining weather data, Basic idea: item sets, Generating item sets and rules efficiently, Correlation analysis

Data mining algorithms - Classification: Basic learning/mining tasks, Inferring rudimentary rules: 1R, algorithm, Decision trees, covering rules

Data mining algorithms – Prediction: The prediction task, Statistical (Bayesian) classification, Bayesian networks, Instance-based methods (nearest neighbor), linear models

UNIT IV   LINEAR AND NONLINEAR MODELS   9

Descriptive analytics: Data Modeling, Trend Analysis, Simple Linear Regression Analysis

Forecasting models: Heuristic methods, predictive modeling and pattern discovery, Logistic Regression: Logit transform, ML estimation, Tests of hypotheses, Wald test, LR test, score test, test for overall regression, multiple logistic regression, forward, backward method, interpretation of

parameters, relation with categorical data analysis. Interpreting Regression Models, Implementing Predictive Models

Generalized Linear model: link functions such as Poisson, binomial, inverse binomial, inverse Gaussian, Gamma.

Non Linear Regression (NLS): Linearization transforms, their uses & limitations, examination of non-linearity, initial estimates, iterative procedures for NLS, grid search, Newton-Raphson, steepest descent, Marquardt's methods. Introduction to semi parametric regression models, additive regressionmodels. Introduction to nonparametric regression methods

UNIT V   TIME SERIES ANALYSIS   9

Time Series Analysis: Auto - Covariance, Auto-correlation and their properties. Exploratory time series analysis, Test for trend and seasonality, Exponential and moving average smoothing, Holt — Winter smoothing, forecasting based on smoothing **Linear time series models:** Autoregressive, Moving Average, Autoregressive Moving Average and Autoregressive Integrated Moving Average models; Estimation of ARMA models such as Yule-Walker estimation for AR Processes, Maximum likelihood and least squares estimation for ARMA Processes, Forecasting using ARIMA models

Prescriptive Analytics: Mathematical optimization, Networks modeling-Multi-objective optimization- Stochastic modeling, Decision and Risk analysis, Decision trees.

TOTAL:45 PERIODS

LIST OF EXPERIMENTS:

1. Installing Weka and exploring a dataset.
2. Loading a dataset and visualizing the Data
3. Preprocessing a dataset from a real domain (Medical/Retail/Banking)
4. Building a classifier- Run Decision Tree, Naïve Bayesian Classifier, NNclassifier and SVM.
5. Mining Association Rules- Run Apriori Algorithm.
6. Building a statistical model using a sample dataset — preprocessing, hypothesis building, model fitting, model validation and interpretation of results.
7. Implementation of linear regression technique for statistical modelbuilding.
8. Implementation of Non-linear regression technique for statistical model building

TOTAL: 30 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Understand the fundamentals of data mining and datarepresentation.

CO2: Perform preprocessing tasks for the data set.
CO3: Apply association rules and predictive methods for data mining.
CO4: Build data models using linear and non-linear regression techniques.
CO5: Gain knowledge on time series analysis and prescriptive analysis.

TEXTBOOKS:

1. Jiawei Han and Micheline Kamber, "Data Mining: Concepts and Techniques", Morgan Kaufmann Publishers, 3rd ed, 2010.

2. LiorRokach and Oded Maimon, "Data Mining and Knowledge Discovery Handbook", Springer, 2nd edition, 2010

REFERENCES:

1.Box, G.E.P and Jenkins G.M. Time Series Analysis, Forecasting and Control, Holden-Day, 1970.

2. Draper, N. R. and Smith, H. Applied Regression Analysis (John Wiley) Third Edition, 1998.

PROFESSIONAL ELECTIVE III

		L T P C
21CB904	**BEHAVIORAL ECONOMICS**	**3 0 0 3**

OBJECTIVES:

The Course will enable learners to:

- Understand the concept and theory of economics.

- Acquire knowledge on the choices and behavior of firms, households and other economics entities.

- Learn the behavioral science perspective in economics.

- Know the current ideas and concepts regarding decision making in economics.

- Study the intertemporal choice in economics.

UNITI   INTRODUCTION   9

The neoclassical/standard model and behavioral economics in contrast; historical background; behavioral economics and other social sciences; theory and evidence in the social sciences and in behavioral economics; applications ⎯ gains and losses, money illusion, charitable donation.

UNIT II   BASICS OF CHOICE THEORY   9

Revisiting the neoclassical model; utility in economics and psychology; models of rationality; connections with evolutionary biology and cognitive neuroscience; policy analysis — consumption and addiction, environmental protection, retail therapy; applications – pricing, valuation, public goods, choice anomalies.

UNIT III   BELIEFS, HEURISTICS AND BIASES   9

Revisiting rationality; causal aspects of irrationality; different kinds of biases and beliefs; self-evaluation and selfprojection; inconsistent and biased beliefs; probability estimation; trading applications – trade in counterfeit goods, financial trading behavior, trade in memorabilia, policy analysis – norms and markets, labor markets, market clearing, public goods; applications – logic and knowledge, voluntary contribution, compensation design.

UNIT IV   CHOICE UNDER UNCERTAINTY   9

Background and expected utility theory; prospect theory and other theories; reference points; loss aversion; marginal utility; decision and probability weighting; applications — ownership and trade, income and consumption, performance in sports. Strategic choice-

Review of game theory and Nash equilibrium – strategies, information, equilibrium in pure and mixed strategies, iterated games, bargaining, signalling, learning; applications – competitive sports, bargaining and negotiation, monopoly and market entry.

UNITV   INTERTEMPORAL CHOICE   8

Geometric discounting; preferences over time; anomalies of inter-temporal decisions; hyperbolic discounting; instantaneous utility; alternative concepts — future projection, mental accounts, heterogeneous selves, procedural choice; policy analysis — mobile calls, credit cards, organization of government; applications – consumption and savings, clubs and membership, consumption planning. Individual preferences; choice anomalies and inconsistencies; social preferences; altruism; fairness; reciprocity; trust; learning; communication; intention; demographic and cultural aspects; social norms; compliance and punishment; inequity aversion

TOTAL:45PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Understand and apply various concepts in traditional and modernMicroeconomics.

CO2: Focus on decision making, and develop a holistic understanding of these concepts and their interconnections.

CO3: Explore the knowledge on behavioural science perspective in Economics.

CO4: Understand current ideas and concepts regarding decision making in Economics.

CO5: Students will be able to understand the intertemporal choice in Economics.

TEXTBOOKS:
1. N. Wilkinson and M. Klaes , "An Introduction to Behavioral Economics", 2017.
2. Paul A. Samuelson, William D. Nordhaus, Sudip Chaudhuri and AnindyaSen, "Economics", 19th Edition, Tata McGraw Hill, 2010.

REFERENCES:
1.M.L.Trivedi, "Managerial Economics:Theory & Applications", Tata McGraw-Hill Education, 4th Edition, 2002.
2. Robert H. Frank, "Microeconomics and Behaviour", McGraw-Hill, 9th Edition, 2014.

21CB905	COMPUTATIONAL FINANCE & MODELING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Course will enable learners to:

- Understand existing financial models in a quantitative and mathematical way.
- Apply these quantitative tools to solve complex problems in the areas of portfolio management, risk management and financial engineering.
- Explain the approaches required to calculate the price of options.
- Identify the methods required to analyse information from financial data and trading systems.

UNITI   INTRODUCTION   9

Numerical methods relevant to integration, differentiation and solving the partial differential equations of mathematical finance: examples of exact solutions including Black Scholes and its relatives, finite difference methods including algorithms and question of stability and convergence, treatment of near and far boundary conditions, the connection with binomial models, interest rate models, early exercise, and the corresponding free boundary problems, and a brief introduction to numerical methodsfor solving multi-factor models.

UNITII   BLACK-SCHOLES FRAMEWORK   9

Black-Scholes framework: Black-Scholes PDE: simple European calls and puts; put-call parity. The PDE for pricing commodity and currency options. Discontinuous payoffs Binary and Digital options. The Greeks: theta, delta, gamma, vega&rho and their role in hedging. The mathematics of early exercise - American options: perpetual calls and puts;

optimal exercise strategy and the smooth pasting condition. Volatility considerations actual, historical, and implied volatility; local vol and volatility surfaces.

Simulation including random variable generation, variance reduction methods and statistical analysis of simulation output. Pseudo random numbers, Linear congruential generator, Mersenne twister RNG. The use of Monte Carlo simulation in solving applied problems on derivative pricing discussed in the current finance literature. The technical topics addressed include importance sampling, Monte Carlo integration, Simulation of Random walk and approximations to diffusion processes, martingale control variables, stratification, and the estimation of the "Greeks. "

UNIT III   FINANCIAL PRODUCTS AND MARKETS   9

Financial Products and Markets: Introduction to the financial markets and the products which are traded in them: Equities, indices, foreign exchange, and commodities. Options contracts and strategies for speculation and hedging.

UNIT IV   APPLICATION AREAS   9

Application areas include the pricing of American options, pricing interest rate dependent claims, and credit risk. The use of importance sampling for Monte Carlo simulation of VaR for portfolios of options.

UNIT V   STATISTICAL ANALYSIS OF FINANCIAL RETURNS   9

Statistical Analysis of Financial Returns: Fat-tailed and skewed distributions, outliers, stylized facts of volatility, implied volatility surface, and volatility estimation using high frequency data. Copulas, Hedging in incomplete markets, American Options, Exotic options, Electronic trading, Jump Diffusion Processes, High-dimensional covariance matrices, Extreme value theory, Statistical Arbitrage.

TOTAL:45PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Understand existing financial models in a quantitative and mathematical way.

CO2: Apply these quantitative tools to solve complex problems in the areas ofportfolio management, risk management and financial engineering.

CO3: Explain the approaches required to calculate the price of options.

CO4: Identify the methods required to analyse information from financial data and trading systems.

CO5: Understand the various statistical methods to analyse the financial data

TEXTBOOKS:

1.. R. Seydel: Tools for Computational Finance, 2nd edition, Springer-Verlag, New York, 2004.

2.. P. Glasserman: Monte Carlo Methods in Financial Engineering, Springer-Verlag, New York,2004.

REFERENCES:

1. W. Press, S. Teukolsky, W. Vetterling and B. Flannery, Numerical Recipes in C: The Art of Scientific Computing, 1997. Cambridge University Press, Cambridge,UK. Available on-line at: http://www.nr.com/

2. A. Lewis:Option Valuation under Stochastic Volatility, Finance Press, NewportBeach,California, 2000.

21CB910	MODERN ENTERPRISE SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Course will enable learners to:

- Understand the components of an ERP system.

- Know the implementation stages and processes of an ERP system.

- Understand the process of integrating legacy systems and other currentITsystems with an ERP system.

- Understand the infrastructure of ERP systems.
- Understand and know the modern Enterprise Information Systems

UNITI   INTRODUCTION   9

Introduction to Modern Enterprise Systems: Introduction to enterprise systems. Elements of enterprise systems —— Business Information system, Decision support systems, Knowledge management systems, Financial and human resource systems. Kinds of Enterprise systems- B2C and B2B models. **Components of Enterprise systems:** Channels (Mobile, web, desktop, partner integration), Data management, workflow, Controlling and Auditing, Accounting etc. **Sample Enterprise systems:** ERP, SCM, CRM, Product Life cycle management (PLM), HR Systems (HRM), GL systems.

UNIT II   ENTERPRISE SYSTEMS ARCHITECTURE,KEY   9
CHARACTERISTICS, APPLICATIONS

Key characteristics Enterprise systems: Distributivity, Managed redundancy, Exception processing, Collaboration, Data transformation.

Enterprise System architectures: Batch processing, Monolithic, client server, ecommerce, service oriented, microservice, and cloud architectures

.**Introduction to Enterprise Application architectures:** Layer Architecture, Event driven

Architecture, Service oriented Architecture, Microservice architecture, Plug-in architecture.

UNIT III ARCHITECTURE PATTERNS, INTEGRATION TECHNIQUES 9

Application architecture Patterns: Layering, Organizing domain logic, Mapping to database, Web Presentation, Concurrency. Enterprise Application Integration: Introduction to Enterprise Integration, different integration styles. Elements of messaging-based Integration. Enterprise Integration patterns: Modern service integrationtechniques. Introduction to WSDL, SOAP. Introduction RESTFulwebservices integration. Differences between SOAP and REST.

UNIT IV CLOUD COMPUTING IN ENTERPRISE SYSTEMS 9

Deployment of Enterprise applications: Key requirements in deployment - Stability, capacity, Security, availability, Network, Availability, and Transparency (Basic Introduction only).**Concepts of Cloud computing, cloud platforms and their role in Enterprise systems:** Core Concepts ⸺ Types of Cloud: Private, public, and Hybrid clouds. Advantage of cloud computing ⸺ Scaling, Availability, and cost. Disadvantages – Technology overload, Security, Monitoring and troubleshooting, Testing, Latency etc. Cloud service models: - Infrastructure, platform, Software as a Service in Cloud Computing. Major public clouds: Google cloud, AWS, Azure.

UNITV CLOUD APPLICATION DEVELOPMENT AND DEPLOYMENT 9

Application development and deployment in cloud – Dockers, micro services,Kubernetes, Serverless. Continuous Integration/Continuous Delivery **Introduction toEnterprise Architecture**: Importance of Enterprise Architecture. Enterprise architecture models.Zachman Framework, TOGAF Framework

Enterprise Architecture Case study: Implementing EA in secret service systems, Health care organization, Manufacturing Company, case study of University, case study of midsized municipal government

TOTAL:45PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:
CO1: Understand basic elements of Enterprise systems
CO2: Develop skills in understanding architecture and non-functional requirements in developing Enterprise system development and their deployment

 CO3: Understand Enterprise Patterns
 CO4:To Develop enterprise applications
 CO5: Understand future trends in Enterprise architectures.

TEXTBOOKS:

 1.Martin Fowler et al, "Pattern of Enterprise Application Architecture", Addison-Wesley, 2012
 2. Mark Richards, Software Architecture patterns, 2015, O'Reilly.

REFERENCES:

1.Ravi Shankar & S. Jaiswal, Galgotia, "Enterprise Resource Planning", 1 st Edition, 1999.

2.. Alexis Leon, "Enterprise Resource Planning", Tata McGraw Hill, 3rd Edition, 2017.

21CB911	ADVANCE FINANCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Course will enable learners to:

- Imbibe knowledge about the decisions and decision variables involved with financial activities of the firm.

- Develop skills for interpretation business information and application of financial theory in corporate investment decisions, with special emphasis on working capital management.

- Familiarizing the students with the corporate and financial restructuring.

UNIT I   SOURCE OF FUNDS   9

Sources of Funds (including regulatory framework) Types of securities- Issuing the capital in market- Pricing of issue - Valuation of Stocks and bonds Dividend Decisions: Traditional Approach, Dividend Relevance Model, Miller and Modigliani Model, Stability of Dividends, Forms of Dividends, Issue of bonus shares, Stock Split.

UNIT II   EVALUATION OF LEASE CONTRACTS   9

Evaluation of Lease Contracts- Corporate Restructuring -Mergers and Acquisitions- Types of Mergers, Evaluation of Merger Proposal-Take-over-Amalgamation-Leverage buy-out-Management buy-out-Corporate Failure and Liquidation.

UNIT III   FINANCIAL RESTRUCTURING   9

Share Split – Consolidation -Cancellation of Paid-up Capital -Other Mechanisms

UNIT IV   WORKING CAPITAL MANAGEMENT   9

Working Capital Planning- Monitoring and Control of Working Capital-Working CapitalFinancing - Managing the Components of Working Capital- Cash Management- Receivable Management -Inventory Management.

UNITV   INTRODUCTION TO DERIVATIVES   9

Basics of Futures, Forwards, Options, Swaps -Interest rate Payoff Diagrams, Pricing of Futures, Put Call Parity, Option Pricing using Binomial Model and Black Scholes Model -Use of Derivatives for Risk-Return Management- Credit Default Swaps

TOTAL:45PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Understand the sources of funds including regulatory framework.

CO2: Understand the Corporate Restructuring.

CO3: Develop skills for the interpretation of business information and application of financial theory in corporate investment decisions.

CO4: Predict the working capital requirements of a concern.

CO5: Understand Basics of Derivatives

TEXTBOOKS:

1. John.C.Hull, Options, "Futures and other Derivative Securities", PHI Learning, 9 th Edition, 2012.

2. Fred Weston, Kwang S Chung, Susan E Hoag Mergers, "Restructuring And Corporate Control", Pearson Education, 4 th Edition.

REFERENCES:

1. I.M.Pandey, "Financial Management", Vikas Publishing House Pvt. Ltd., 9 th Edition, 2014.

2. Stulz, "Risk Management and Derivatives", Cengage Learning, 2 nd Edition, 2011.

OPEN ELECTIVES OFFERED TO OTHER DEPARTMENTS

21CB001	FORMAL LANGUAGE AND AUTOMATA THEORY	L	T	P	C
		3	0	0	3

OBJECTIVES:
The Course will enable learners to:

- Understand the Chomsky language hierarchy, to construct automata for any given pattern and find its equivalent regular expressions.

- Design CFG for any given language and prove its equivalence

- Design CSG for any given language and prove its equivalence

- Understand the need for Turing machines and their capability

- Understand undecidable problems

UNIT I	AUTOMATA FUNDAMENTALS REGULAREXPRESSION AND LANGUAGES AND FINITE AUTOMATA	9

Introduction: Alphabet - languages and grammars - productions and derivation- Chomsky hierarchy of languages - Regular expressions and languages---deterministic finite automata (DFA) and equivalence with regular expressions---nondeterministic finite automata (NFA) and equivalence with DFA---regular grammars and equivalence with finite automata - properties of regular languages - Kleene's theorem----pumping lemma for regular languages - Myhill-Nerode theorem and its uses---minimization of finite automata.

UNIT II   CONTEXT- FREE LANGUAGES AND PUSHDOWN AUTOMATA   9

Context-free grammars (CFG) and languages (CFL)---Chomsky and Greibach normal forms - nondeterministic pushdown automata (PDA) and equivalence with CFG--- parse trees - ambiguity in CFG - pumping lemma for context-free languages--deterministic pushdown automata------closure properties of CFLs.

UNIT III   CONTEXT- SENSITIVE LANGUAGES   9

Context-sensitive grammars (CSG) and languages linear bounded automata and equivalence with CSG.

UNIT IV   TURING MACHINES   9

The basic model for Turing machines (TM) - Turing recognizable (recursively enumerable) and Turing-decidable (recursive) languages and their closure properties - variants of Turing machines, nondeterministic TMs and equivalence with deterministic TMs - unrestricted grammars and equivalence with Turing machines - TMs as enumerators.

UNIT V   UNDECIDABILITY AND COMPLEXITY   9

Undecidability: Church-Turing thesis - universal Turing machine - the universal and diagonalization languages - reduction between languages and Rice s theorem - undecidable problems about languages.

Basic Introduction to Complexity: Introductory ideas on Time complexity of deterministic and nondeterministic Turing machines - P and NP - NP- completeness - Cook's Theorem - other NP -Complete problems.

TOTAL:45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Construct automata, regular expression for any pattern

CO2: Write Context free grammar for any construct

CO3: Design Turing machines for any language.

CO4: Propose computation solutions using Turing machines.

CO5: Derive whether a problem is decidable or not.

TEXTBOOKS:

1. Introduction to Automata Theory, Languages, and Computation John E. Hopcroft,Rajeev Motwani and Jeffrey D. Ullman, 2008.

2. Elements of the Theory of Computation, Harry R. Lewis and Christos H. Papadimitriou, 2010.

| | | **L** | **T** | **P** | **C** |
21CB002 **OBJECT ORIENTED PROGRAMMING**

L T P C
3 0 0 3

OBJECTIVES:
The Course will enable learners to:

- Understand & represent any given business problem statement in object- oriented notation.

- Understand Object Oriented programming concepts like data abstraction, encapsulation and basics of Java.
- Analyse inheritance and polymorphism.

- Understand and collections in Java.

- Employ multithreaded programming
  .

UNITI   INTRODUCTION   9

Procedural programming, An Overview of C: Types Operator and Expressions, Scope and Lifetime, Constants, Pointers, Arrays, and References, Control Flow, Functions and Program Structure, Namespaces, error handling, Input and Output (*C*- way), Library Functions (*string*, *math*, *stdlib*), Command line arguments, Pre-processor directive.

Some difference between C and Java: Local variable declaration within function scope, function declaration, function overloading, stronger type checking, Reference variable, parameter passing — value vs reference, Operator new and delete Single line comments, Java Doc, Characteristics of Java, The Java Environment, Java Source File -Structure.

UNIT II   OBJECT ORIENTED PROGRAMMING FUNDAMENTALS   9

The Fundamentals of Object-Oriented Programming: Necessity for OOP, Data Hiding, Data Abstraction, Encapsulation, Class and Object, Scope of Class, Member Function of a Class, private, protected and public access specifier, this keyword, Constructors and Destructors.

UNIT III   INHERITANCE AND POLYMORPHISM   9

Inheritance — Single and Multiple, Class Hierarchy, super classes- sub classes – Protected members — constructors in sub classes — abstract classes and methods- final methods and classes, Polymorphism through dynamic binding, overriding. Interfaces — defining an interface, implementing interface, differences between classes and interfaces and extending interfaces

UNIT IV   ARRAYS, COLLECTIONS AND EXCEPTION   9

Arrays — One & Multi-Dimensional, Object Class and cloning, equals and hashcodemethods,Collections-List (ArrayList,LinkedList,Vector,Stack),Properties, Set(HashSet,TreeSet,LinkedHashSet), Map(Treemap,hashmap,treemap),Queue (Priority Queue, DeQueue), Iteration, Ordering using Comparable & Comparator, Generics –Compile Time

Type Safety, Upper and Lower Bounded, and with wild cards

Exception Handling – Checked and Un-Checked Exception, Custom Exception, Throws and Throw Keywords, Try-Catch-Finally, Try with Resources, Exception vs Runtime exception vs Throwable vs Error

UNIT V   MULTI-THREADING & IO   9

Differences between multi-threading and multitasking, thread life cycle, creating threads, synchronizing threads, Inter-thread communication, Fork and Join, wait, sleep, notify & yield. Concurrent locks, Synchronized Collections(Concurrent Map, synchronized List, synchronized Map, synchronized Set, synchronized Sorted Set) Atomic data types (Atomic Integer, Atomic Long, AtomicIntegerArray), Countdown Latch, Blocking Queue

Java IO – Files, Pipes, Streams, Byte and Char arrays, Readers & Writers, Input and Output Stream, Byte Array Input and Output, Buffer Input and output.

TOTAL: 45PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Design and Develop application in OOD & Principles

CO2: Apply Object Oriented programming concepts like Data Abstraction, Encapsulation in Java.

CO3: Analyse and apply different types of inheritance and polymorphism

CO4: Use collections for solving real-time problems.

CO5: Develop multi-threaded applications in Java.

TEXTBOOKS:

1. Herbert Schildt, "Java The complete reference", 8th Edition, McGraw Hill Education, 2011.
2. Cay S. Horstmann, Gary cornell, "Core Java Volume –I Fundamentals", 9th Edition, Prentice Hall, 2013.

REFERENCES:

1. Paul Deitel, Harvey Deitel, "Java SE 8 for programmers", 3rd Edition, Pearson, 2015.
2. Steven Holzner, "Java 2 Black book", Dreamtech press, 2011.

	L	**T**	**P**	**C**

21CB003   **COMPILER DESIGN**

L T   P   C
3 0   0   3

OBJECTIVES:
The Course will enable learners to:

- Design the front end of the compiler, scanner, parser, intermediate code generator, object code generator, and the parallel compilation strategies

- Be exposed to compiler writing tools.

- Learn to implement the different Phases of compiler

- Be familiar with control flow and data flow analysis

- Learn simple optimization techniques

UNITI   **INTRODUCTION**   **9**

Phases of compilation and overview. Lexical Analysis (scanner): Regular languages, finite automata, regular expressions, relating regular expressions and finite automata, scanner generator (lex, flex).

UNIT II   **SYTNAX ANALYSIS**   **9**

(Parser): Context-free languages and grammars, push-down automata, LL(1) grammars and top-down parsing, operator grammars, LR(O), SLR(1), LR(1), LALR(1) grammars and bottom-up parsing, ambiguity and LR parsing, LALR(1) parser generator (yacc, bison)

UNIT III   **SEMANTIC ANALYSIS AND SYMBOL TABLE**   **9**

Semantic Analysis: Attribute grammars, syntax directed definition, evaluation and flow of attribute in a syntax tree

Symbol Table: Basic structure, symbol attributes and management. Run-time environment: Procedure activation, parameter passing, value return, memory allocation, scope.

UNIT IV   **CODE GENERATION**   **9**

Intermediate Code Generation: Translation of different language features, different types of intermediate forms.

Code Improvement (optimization): control-flow, data-flow dependence etc.; local optimization, global optimization, loop optimization, peep-hole optimization etc.

UNIT V   ARCHITECTURE DEPENDENT CODE IMPROVEMENT   **9**

Architecture dependent code improvement: instruction scheduling (for pipeline), loop optimization (for cache memory) etc. Register allocation and target code generation.

Advanced topics: Type systems, data abstraction, compilation of Object Oriented features and non-imperative programming languages.

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Understand about the regular expressions and finite automata

CO2: Implement the different Phases of compiler using tools

CO3: Analyze the control flow and data flow of a typical program

CO4: Optimize a given program

CO5: Generate an assembly language program equivalent to a source language program

TEXTBOOKS:

1. Alfred V Aho, Monica S. Lam, Ravi Sethi and Jeffrey D Ullman, Compilers – Principles, Techniques and Tool, Pearson Education, Second Edition, 2013.

2. Levine R. John, Tony Mason and Doug Brown ,Lex &Yacc, O'Reilly Media, 1992.

REFERENCES:

1. D. Grune, H.E. Bal, C.J.H. Jacobs, K.G. Langendoen, Modern Compiler Design, Wiley, 2008.

2.Steven S. Muchnick, Advanced Compiler Design and Implementation, , Morgan Kaufmann publishers, First Edition, 2003.

21CB004	BUSINESS STRATEGY	L	T	P	C
		3	0	0	3

OBJECTIVES:
The Course will enable learners to:
- Determine the concept and process of strategic management.
- Analyze the internal and external environment.
- Formulation of strategies, implementation and evaluation of strategies.
- The course will cover case studies and latest business events.

UNIT I   INTRODUCTION TO STRATEGIC MANAGEMENT   9

Importance of Strategic Management - Vision and Objectives - Schools of thought in Strategic Management - Strategy Content, Process, and Practice - Fit Concept and Configuration Perspective in Strategic Management

**UNIT II   INTERNAL ENVIRONMENT OF FIRM- RECOGNIZING A   9
                  FIRM'S INTELLECTUAL ASSETS**

Core Competence as the Root of Competitive Advantage - Sources of Sustained Competitive

Advantage - Business Processes and Capabilities-based Approach to Strategy

UNIT III   EXTERNAL ENVIRONMENTS OF FIRM- COMPETITIVE   9
**   STRATEGY**

Five Forces of Industry Attractiveness that Shape Strategy - The concept of Strategic

Groups, and Industry Life Cycle - Generic Strategies - Generic Strategies and the ValueChain

UNIT IV   CORPORATE STRATEGY, AND GROWTH STRATEGIES   9

The Motive for Diversification - Related and Unrelated Diversification - Business Portfolio

Analysis - Expansion, Integration and Diversification - Strategic Alliances, Joint Ventures, and

Mergers & Acquisitions.

UNITV   STRATEGY IMPLEMENTATION: STRUCTURE AND   9
**   SYSTEMS**
The 7S Framework - Strategic Control and Corporate Governance

TOTAL:45PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to:

CO1: Become familiar with both internal and external environment. They would also become

familiar with corporate and growth strategies, appreciate implementation of such strategies

CO2: Learn the fundamental concepts of strategic management to analyse business situations and

apply these concepts to solve business problems.

CO3: Understand the fundamental principles of and interrelationships among business functions

such as: R&D, production, marketing, finance, and HR and information technology.

CO4: Apply the inter-relationships of business to individuals, other organizations, government and
society.
CO5: Analyze complex, unstructured qualitative and quantitative problems, using appropriate tools.

TEXTBOOKS:
1.Robert M. Grant, Contemporary Strategic Management, Blackwell, 7th Edition,
2012.
2.D N Dwivedi, Managerial Economics, 8th Edition, Vikas Publishing House, 2018.

REFERENCES:
1.Richard Rumelt, Competitive Advantage, 2011.

2.Kazmi, Azhar, Business Policy and Strategic Management, Third Edition, Tata
McGrawhill, New Delhi, 2008. 21CB

21CB005   **DESIGN THINKING**

L T P C
3 0 0 3

OBJECTIVES:

The Course will enable learners to:

- Familiarize design thinking and its phases.

- Perform immersion activity in empathize phase of design thinking.

- Create problem statements in the define phase of design thinking.

- Ideate and find solutions to the problem defined

- Develop a prototype and perform testing.

UNITI   INTRODUCTION   **9**

Introduction to design thinking - Importance of design thinking for business – Phases of design thinking – Experiential activity – Case study.

UNITII   EMPATHIZE PHASE   **9**

Empathize phase - Steps involved - Immersion activity- Questionnaire – Empathy mapfor case study

UNITIII   DEFINE PHASE   **9**

Creation of personas in define phase – steps in problem statement creation - problem statement definition – Examples – Key problem statements.

UNITIV   IDEATION PHASE   **9**

Ideation phase steps –— Ideation games –— Ideate to find solutions –— Doodling –——Storytelling in presenting ideas and prototypes.

UNITV   PROTOTYPE AND TESTING   **9**

Importance of prototype in design thinking –Guidelines - Prototyping the idea – Value proposition

statement – Testing in design thinking – Prototype testing – Documentation

– Design thinking in functional work – Mapping design thinking to agile methodologies.

TOTAL:45PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Understand the phases of design thinking process..

CO2: Conduct an immersion activity to create an empathy map

CO3: Define the key problems of the personas created.

CO4: Apply the ideation phase steps to present the prototype ideas
CO5: Create a prototype with value propositions and test the prototype

TEXTBOOKS:

1. Christian Müller-Roterberg, "Handbook of Design Thinking", Kindle Direct Publishing, November 2018.

2. Dan Senor and Saul Singer, "Start-Up Nation", Grand Central Publishing, Twelfth Edition, 2009.

REFERENCES:

1. Nir Eyal and Ryan Hoover, "Hooked: How to Build Habit-Forming Products", Library of Congress, 2014.

2. Corral, Luis & Fronza, Ilenia, "Design Thinking and Agile Practices for Software Engineering: An Opportunity for Innovation", 2018.

21CB921	PYTHONFOR DATA ANALYTICS (Lab Integrated)	L	T	P	C
		3	0	2	4

OBJECTIVES:

The Course will enable learners to:
- Learn the fundamentals of Data Analytics
- Acquire skills in data preparatory and preprocessing steps
- Learn the tools and packages in Python for Data Analytics
- Understand the various Excel Function to solve Data Analytics Problem
- Acquire knowledge in data interpretation and visualization techniques

UNIT I   INTRODUCTION   9

Need for data analytics– benefits and uses of Data analyticsand Big Data – facets of data – data analyticsprocess – setting the research goal – retrieving data – cleansing, integrating, and transforming data – exploratory data analysis – build the models – presenting and building applications

List of Exercise/Experiments:

1. Download, install and explore the features of R/Python for data analytics

   Installing Anaconda

   Basic Operations in Jupiter Notebook

   Basic Data Handling

UNIT II   NUMPY FOR DATA SCIENCE   9+8

Introduction to Numpy- The Basics of NumpyArrays- Universal Functions-Aggregation-Computation on Arrays- Comparisons,Masks and Boolean Logic-Fancy Indexing – Sorting Arrays – Structured Data :Numpy's Structured array

List of Exercise/Experiments:
1. Creation of numpy array using the tuple
2. Determine the size,shape and dimension of the array
3. Manipulation with array Attributes
4. Creation of Sub array
5. Perform the reshaping of the array along the row vector and column vector
6. Create Two arrays and perform the concatenation among the arrays

7. Perform the Statistics operation for the data (the sum, product, median,minimum and maximum,quantiles,arg min,arg max etc.).
8. Use any data set compute the mean ,standard deviation, Percentile.

UNITIII   MANIPULATION WITH PANDAS   9+8

Data manipulation with Pandas – Data Indexing and Selection – Handling missing data – Hierarchical indexing – Combining datasets – Aggregation and Grouping – Stringoperations – Working with time series – High performance Pandas.

List of Exercise/Experiments:
1.Perform the fundamental Pandas data structures operations: the Series, DataFrame , and Index.
2.Implement the Data Selection Operations
3.Implement the Data indexing operations like: loc, iloc, and ix
4. From the given sample data set perform the operations of handling the missing datalike None, Nan.
5.Manipulate on the operation of Null Vaues (is null(), not null(), dropna(), fillna())

UNITIV   DATA ANALYTICSIN SPREADSHEET   9+6

Importing Data into Excel from Different Data Source –Data Cleansing and Preliminary Data Analysis-Correlations andthe importance of Variables TechnicalRequirements- Implementing Time Series

List of Exercise/Experiments:
1.Explore the Basic functions in Excel
2. Perform the task of importing the data in to Excel from data set
3.Do the data processing operations like data cleansing, data preparation

UNITV   DATA VISUALIZATION   9+8

Importing Matplotlib – Simple line plots – Simple scatter plots – visualizing errors – density andcontour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn.

List of Exercise/Experiments:
1. Exploring the Data Visualization using Excel
2.Basic plots using Matplotlib .
3.   Implementation of Scatter Plot.
4. Construction of Histogram,bar plot, Subplots,Line Plots.
5.Implement the three dimensional potting

TOTAL:75PERIODS

OUTCOMES:

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

CO1: Apply the Skillset in data Processing

CO2: Interpreting the various uses of libraries

CO3: Understand the real-world data and information.

CO4: Apply data analyticsusing excel& Python

CO5: Interpret data using visualization tools in Python

TEXTBOOKS:

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science",Manning Publications, 2016. (first two chapters for Unit I)
2. Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016
3. Julio Cesar Rodriguez Martino, "Hands-on Machine Learning with Microsoft Excel",Packt Publication, 2019

REFERENCES:

1.1.Roger D. Peng, R Programming for Data Science, Lulu.com, 2016

2.Laura Igual, Santi Seguí, "Introduction to Data Science: A Python Approach toConcepts, Techniques and Applications", 1st Edition, Springer, 2017

3.Peter Bruce, Andrew Bruce, "Practical Statistics for Data Scientists: 50 EssentialConcepts", 3rd Edition, O'Reilly, 2017

4. Hector Guerrero, "Excel Data Analysis: Modelling and Simulation", Springer International Publishing, 2nd Edition, 2019

21CB922	BUSINESS INTELLIGENCE AND ANALYTICS	L	T	P	C
	(Lab Integrated)	3	0	2	4

OBJECTIVES:

The Course will enable learners to:
- To understand the business intelligence (BI) methodology and concepts.
- To learn about descriptive, inferential statistics and data warehousingoperations.
- To analyze wide range of applications of data mining.
- To analyze the various prescriptive analytics methods.
- To develop and deploy Business Analytic Models.

UNITI   OVERVIEW OF BUSINESS INTELLIGENCE   9+6

Evolution of Computerized Decision Support to Analytics- A Framework for Business Intelligence - Analytics Overview - Analytics Examples- Introduction to Big Data Analytics- Overview of the Analytics Ecosystem.

List of Exercise/Experiments:

1. Perform Customer Segmentation Classification using customer data of a certain organization. Analyze the data from the standpoint of paying capacity and purchasing pattern similarities among the company's clients.

2.Build a data model by taking an available data for a certain company and create a series of analysis and visualizations on various metrics related to the products of that company.

UNITII   DESCRIPTIVE ANALYTICS   9+6

The Nature of Data- Data Preprocessing- Statistical Modeling for Business Analytics- Regression Modeling for Inferential Statistics- Business Reporting- Data Visualization- Types of charts and graphs- The Emergence of Visual Analytics- Information Dashboards- Business Intelligence and Data Warehousing- Data Warehousing Process - Data Warehousing architecture - Data Integration and the Extraction, Transformation, and Load (ETL) Processes- Data Warehouse Development.

List of Exercise/Experiments:

1. Consider Groceries dataset for Market Basket Analysis and investigate customer's historical transactions. Focus on descriptive analytics of customer's purchase behavior, revealing interesting combinations of products that are frequently bought together, and creating valuable suggestions for the company.

2.Given Life Expectancy (WHO) dataset that provides information on both life expectancyand GDP per capita by year for different countries and regions, Explore and visualize the data using appropriate plots, and develop meaningful insights.

UNITIII   PREDICTIVE ANALYTICS   9+6

Text Analytics and Text Mining – NLP – Applications – Process – Sentiment Analysis –Web Mining – Search Engines – Web Analytics – Social Analytics

List of Exercise/Experiments:

1. 1 Perform Customer Review Sentiment Analysis with text data extracted from customer reviews of a certain company and explore it using specialized statistical and linguistic toolsto identify positive, negative, and neutral experiences and their strength and subjectivity.

2.Using Microsoft Stock Data/Amazon Stock Data or INTEL Stock Data, Explore the company's historical stock performance and find insights about the future.

UNITIV   PRESCRIPTIVE ANALYTICS   9+6

Model-based Decision Making – Structure of Mathematical Models for Decision Support – Certainty, Uncertainty and Risk – Decision Modelling – Multiple Goals, Sensitivity Analysis, WhatIf Analysis and Goal Seeking – Decision Analysis – Introduction to Simulation – Location-based Analytics for Organizations – Impacts of Analytics in Organization. Case study: prepare a detailed report on applications of analytics in different industries.

List of Exercise/Experiments:

1. Perform Retail Price Optimization using dataset of price data for a retail company containing information such as product names, historical prices, product categories and characteristics, volume of sales, and time and geographic notations. Calculate the optimal selling prices for the products to create efficient, data-driven recommendations for the company.

2.Perform Credit Card Fraud Detection using online transactions dataset and analyze it for suspicious operations using statistical methods.

UNITV   BUSINESS ANALYTICS MODEL   9+6

Overview of Business Analytics Model – Deployment of BA Model – Business Analytics at the Strategy Level – Link between Strategy and Deployment – Strategy and BA – Priority – Development and Deployment- Case Study: Specification of Requirements, Technical support - Establishing Business Processes – New Business Processes – Optimizing Existing Business Processes.

List of Exercise/Experiments:

1. Consider Sales Product Dataset and analyze sales data from various aspects. Extract key performance indicators (KPIs) that will enable you to make data-driven decisions and improve company's business.

2. Perform Customer Churn Prediction and analyze a company's data to identify customers

who are likely to churn based on a variety of factors, such as the number of calls to customer service and the total charge for calls.

TOTAL:45+30 = 75 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to:

CO1: Understand the business intelligence (BI) methodology and concepts.
CO2: Learn about descriptive, inferential statistics and data warehousing operations.
CO3: Analyze wide range of applications of data mining.
CO4: Analyze the various prescriptive analytics methods.
CO5: Develop and deploy Business Analytic Models.

TEXTBOOKS:

1. Ramesh Sharda, DursunDelen, Efraim Turban, "Business Intelligence, Analytics,and Data Science: A Managerial Perspective", Pearson, 4th Edition, 2018.
2. JesperThorlund&Gert H.N. Laursen, "Business Analytics for Managers: TakingBusiness Intelligence beyond Reporting, Wiley, 2010.

REFERENCES:

1. Shmueli, Patel, and Bruce: Wiley, Data Mining for Business Intelligence, Concepts,Techniques and Applications, Wiley, 2010
2. R.N.Prasad and Seema Acharya, "Fundamentals of Business Analytics", 2ndEdition, Wiley, 2016.

LIST OF EQUIPMENTS:

1. Jupyter Notebook
2. Tableau / Power BI

21CB923	COGNITIVE SCIENCE AND ANALYTICS	L	T	P	C
		4	0	0	4

OBJECTIVES:
- To explain cognitive computing
- To know about design principles and Natural Language Processing.
- To distinguish between Big Data and Cognitive computing.
- To discuss application of cognitive computing in business.
- To illustrate various applications of cognitive computing.

UNIT I   FOUNDATIONS OF COGNITIVE SCIENCE   12

Foundation of Cognitive Computing: cognitive computing as a new generation-the uses of cognitive systems-system cognitive-gaining insights from data-Artificial Intelligence as thefoundation of cognitive computing- understanding cognition.

UNIT II   DESIGN PRINCIPLES FOR COGNITIVE SYSTEMS AND   12
NLP INCOGNITIVE SYSTEMS

Components of a cognitive system-   building the corpus- bringing   data   into   cognitive system-machine learning- hypotheses generation and scoring- presentation and visualization services. Natural Language Processing in support of a Cognitive System: Role of NLP in a cognitive system- semantic web- Applying Natural language technologies to Business problems.

UNIT III   BIG DATA Vs COGNITIVE COMPUTING   12

Relationship between Big Data and Cognitive Computing: Dealing with human-generated data- defining big data- architectural foundation- analytical data warehouses- Hadoop- data in motionand streaming data- integration of big data with traditional data.

UNIT IV   THE BUSINESS IMPLICATIONS OF COGNITIVE COMPUTING   12

Preparing for change- advantages of new disruptive models- knowledge meaning to business- difference with a cognitive systems approach- meshing data together differently- using business knowledge to plan for the future- answering business questions in new ways- building business specific solutions- making cognitive computing a reality- cognitive application changing the market- IBM Watson as a cognitive system.

UNIT V   APPLICATIONS OF COGNITIVE COMPUTING   12

Build a cognitive health care application- Build a cognitive application on Smarter cities-Applicate Cognitive Computing principle in building an Government related application.

TOTAL: 60 PERIODS

OUTCOMES:
At the end of this course, the students will be able to:
CO1: Explain cognitive computing.
CO2: Understand the design principles and learn about NLP in cognitive computing
CO3: Apply advanced analytics to cognitive computing.
CO4: Discuss application of cognitive computing in business
CO5: Illustrate various applications of cognitive computing
.
TEXT BOOKS:
1. Judith H Hurwitz, Marcia Kaufman, Adrian Bowles, "Cognitive computing and Big Data
   Analytics" , Wiley, 2015.

REFERENCES:

1. Vijay Raghvan,   VenuGovindaraju, C.R. Rao, "CognitiveComputing: Theory
    andApplications", Elsevier publications, North Holland Publication, 1st Edition, 2016.

2. Mallick, Pradeep Kumar, Borah, Samarjeet,"Emerging Trends and Applications in
    CognitiveComputing", IGI Global Publishers, 2019.

	L	**T**	**P**	**C**
21CB924 **SOFTWARE DEVELOPMENT PRACTICES**	**3**	**0**	**2**	**4**

OBJECTIVES:

The Course will enable learners to:
- To discuss the essence of agile development methods.
- To set up and create a GitHub repository.
- To create interactive websites using HTML
- To design interactive websites using CSS.
- To develop dynamic web page using Java script.

UNIT I   AGILE SOFTWARE DEVELOPMENT AND Git and GitHub   9+6

Software Engineering Practices – Waterfall Model - Agility – Agile Process – Extreme Programming - Agile Process Models – Adaptive Software Development – Scrum – Dynamic Systems Development Method – Crystal – Feature Driven Development – Lean Software Development – Agile Modeling – Agile Unified Process – Tool set for Agile Process. Introduction to Git –Setting up a Git Repository - Recording Changes to the Repository - Viewing the Commit History - Undoing Things - Working with Remotes -Tagging - GitAliases - Git Branching - Branches in a Nutshell - Basic Branching and Merging - Branch Management - Branching Workflows - Remote Branches - Rebasing. Introduction to GitHub — Set up and Configuration - Contribution to Projects, Maintaining a Project – Scripting GitHub.
-

List of Exercise/Experiments:

1. Form a Team, Decide on a project:
   a) Create a repository in GitHub for the team.
   b) Choose and follow a Git workflow

   - Each team member can create a StudentName.txt file with contents about themselves and the team project
   - Each team member can create a branch, commit the file with a proper commit message and push the branch to remote GitHub repository.
   - Team members can now create a Pull request to merge the branch to master branch or main development branch.
   - The Pull request can have two reviewers, one peer team member and one faculty. Reviewers can give at least one comment for Pull Request updating.
   - Once pull request is reviewed and merged, the master or main development branch will have files created by all team members.
2. Create a web page with at least three links to different web pages. Each of the web pages is to be designed by a team member. Follow Git workflow, pull request and peer reviews.
3. Form a Team, Decide on a project:
   c) Create a repository in GitHub for the team.
   d) Choose and follow a Git workflow

   - Each team member can create a StudentName.txt file with contents about themselves and the team project
   - Each team member can create a branch, commit the file with a proper commit message and push the branch to remote GitHub repository.
   - Team members can now create a Pull request to merge the branch to master branch or main development branch.
   - The Pull request can have two reviewers, one peer team member and one faculty.

Reviewers can give at least one comment for Pull Request updation.
- Once pull request is reviewed and merged, the master or main development branch will have files created by all team members.

4. Create a web page with at least three links to different web pages. Each of the web pages is to be designed by a team member. Follow Git workflow, pull request and peer reviews.

UNIT II   HTML   9+6
Introduction – Web Basics – Multitier Application Architecture – Cline-Side Scripting versus Server-side Scripting – HTML5 – Headings – Linking – Images – Special Characters and Horizontal Rules – Lists – Tables – Forms – Internal Linking – metaElements – Form input Types – input and datalist Elements – Page-Structure Elements.

List of Exercise/Experiments:
1. Create web pages using the following:
   - Tables and Lists
   - Image map
   - Forms and Form elements
   - Frames

UNIT III   CSS   9+6

Inline Styles – Embedded Style Sheets – Conflicting Styles – Linking External Style Sheets – Positioning Elements – Backgrounds – Element Dimensions – Box Model and Text Flow – Media Types and Media Queries – Drop-Down Menus – Text Shadows – Rounded Corners – Colour – Box Shadows – Linear Gradients – Radial Gradients – Multiple Background Images – Image Borders – Animations – Transitions and Transformations – Flexible Box Layout Module – Multicolumn Layout.

List of Exercise/Experiments:
1. Apply Cascading style sheets for the web pages created.

UNIT IV   JAVASCRIPT BASICS   9+6
Introduction to Scripting – Obtaining user input – Memory Concepts – Arithmetic – Decision Making: Equality and Relational Operators – JavaScript Control Statements – Functions – Program Modules – Programmer-defined functions – Scope rules – functions – Recursion – Arrays – Declaring and Allocating Arrays – References and Reference Parameters – Passing Arrays to Functions – Multidimensional arrays.

List of Exercise/Experiments:
1. Form Validation (Date, Email, User name, Password and Number validation) using JavaScript.

UNIT V   JAVASCRIPT OBJECTS   9+6
Objects – Math, String, and Date, Boolean and Number, document Object – Using JSON to Represent objects – DOM: Objects and Collections – Event Handling.

List of Exercise/Experiments:
1. Implement Event Handling in the web pages.

Mini Projects-Develop any one of the following web applications (not limited to one) using

above technologies.
   a. Online assessment system
   b. Ticket reservation system
   c. Online shopping
   d. Student management system
   e. Student result management system
   f. Library management
   g. Hospital management
   h. Attendance management system
   i. Examination automation system
   j. Web based chat application

TOTAL: 75 PERIODS

OUTCOMES:

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

CO1: Apply agile development methods in software development practices.
CO2: Set up and create a GitHub repository.
CO3: Develop static and dynamic webpages using HTML.
CO4: Design interactive personal or professional webpages using CSS.
CO5: Develop web pages using Java script with event-handling mechanism.

TEXT BOOK:

1. Roger S. Pressman, "Software Engineering: A Practitioner's Approach", McGraw Hill International Edition, Nineth Edition, 2020.
2. Scott Chacon, Ben Straub, "Pro GIT", Apress Publisher, 3rd Edition, 2014.
3. Deitel and Deitel and Nieto, "Internet and World Wide Web - How to Program", Pearson, 5th Edition, 2018.

REFERENCES:

1. Roman Pichler, "Agile Product Management with Scrum Creating Products that Customers Love", Pearson Education, 1 st Edition, 2010.
2. Jeffrey C and Jackson, "Web Technologies A Computer Science Perspective",Pearson Education, 2011.
3. Stephen Wynkoop and John Burke, "Running a Perfect Website", QUE, 2nd Edition, 1999.
4. Chris Bates, "Web Programming – Building Intranet Applications", 3rd Edition, Wiley Publications, 2009.
5. Gopalan N.P. and Akilandeswari J., "Web Technology", Second Edition, Prentice Hall of India, 2014.
6. https://infyspringboard.onwingspan.com/web/en/app/toc/ lex_auth_013382690411003904735_shared/overview
7. https://infyspringboard.onwingspan.com/web/en/app/ toc/lex_auth_013094421427470336209_shared/overview

LIST OF EQUIPMENTS:

Systems with either Netbeans or Eclipse

Java/JSP/ISP Webserver/Apache Tomcat /

MySQL / Dreamweaver or

Equivalent/ Eclipse, WAMP/XAMP

	L T P	C
21CB925   **FRONT END DEVELOPMENT USING REACT**   **3 0 2   4**

OBJECTIVES:

The Course will enable learners to:

- To understand web semantics and related tools and framework
- Able to get hands on latest JS based web frameworks
- To develop a scalable and responsive web application
- To develop an industry ready application web enterprise feature

UNIT I   ADVANCED JAVASCRIPT   9+6

Introduction to HTML5 and CSS3, Media Queries, JS, DOM, BootStrap, Variables, Loops, Operators, Scope, Hoisting, Arrays, Spread, REST, DeStructuring

List of Exercise/Experiments

1) Create a JS Object for Bank Account (w attributes like à customer name, account type, balance, data of creation, bank name, branch name, pan card number). Using JS Object keyword, try to perform following activities
   - List down all the entries of the bank object
   - Check the existence of a key
   - If key found, get the value for the key
2) Spread Operator
   - Merge Customer and Account Arrays
   - Update the Customer Object with the new values
   - Develop a function that takes an Spread Argument and calculates total balance.

UNIT II   INTRODUCTION TO REACTJS   9+6

Class-Inheritance, Methods, Extended Class-Map, filter and Reduce Functions, Functions - Arrow Functions, Lambda Expressions , REST - Introduction, Why JSX, Hello World Apps, Project Structure

List of Exercise/Experiments

1) Create a list of Bank Objects (same kind of object you used in above lab, but in a array format)
   - Display the banks where balance is greater than 200
   - deduct 10% of the Bank account balance, as part of monthly service fees
   - Display the banks where balance is greater than 200 and branch code is "Chennai"
   - Add a new Bank to the given array
   - Delete a bank from the array (use splice operator)
   - Calculate the total balance of all bank accounts
2) Develop a Scientific calculator that does following operations
   - Rounded Value
   - Area of Circle
   - Calculating of Sin, Cos and Tan functions
   - Permiter of an Rectangle
   - Employ Arrow functions
   - Employ HOC

UNIT III   REACT COMPONENTS

Class vs Functional Components,React Class Based Components — component DidMount, WillUpdate, shouldupate, didcatchetc - State - UseState, UseRef, USeEffect,UseHistory Usage and Props(difference, when to use what, mutable or immutabilty,direction of flow), PropTypes, Auxillary Components, Controlled and Uncontrolled Components,Component Interaction (Parent to Child and Child to Parent), Iteration & Conditional Response

List of Exercise/Experiments

1) Create a collection of Customer by using
   - Weak Map and Map Collection in JS
   - Show Case the different feature set of the same.
2) Add Login Page, Dash Board Page, Admin Page
   - Enable React Routing
   - Add React Protected Route, for authorization

UNIT IV   REACT LIBRARY - I   9+6

Event Bubbleup - Component Wrapper - Integration of CSS Modules - Forms Validations(YUP, Formik, Standard), Events Handling, Data Binding

List of Exercise/Experiments

1) Develop a React application that has User Registration Form w field level validations, data submission to a rest api end point, boot strap for responsive.
   - Use YUP or Formik to implement the same

UNIT V   REACT HOOKS   9

Custom Hooks, HTTP - Fetch, Axios, Services,Behaviour Subjects - StateLess, StateFulll and Container Components, Error Handling - Build, Env, CORS, Unit Testing w ReactTesting Library - Introduction to react-native - Introduction to StoryBook

List of Exercise/Experiments

1) Employ back end api for Login Page functionality (authentication). Post login, store the user context (received from the back end server) in browser's session storage as objects. And use the same as creds during protected route verification
   - On the dashboard page, have a grid of Students. The data has to be bought from back end api
   - Employ useref, useeffect&usestate, and useHistory
2) Enable Exception Handling
3) Enable HOC and Aux Components
4) Implement React-Testing Library

Business Use Case Implementations

1) Student Management System
2) Retail Bank System
3) eCommerce System
4) Student LMS Management System

TOTAL:40+30= 75 PERIODS

OUTCOMES:

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

CO1: Personalize web pages using text formatting, graphics, audio, and video.

CO2: Hands on knowledge on Rest API , propTypes

CO3: Able to develop a web application using latest React Framework

CO4: Apply various React features including functions, components, and services.

CO5: Able to develop application using ReactJshooks ..

TEXT BOOK:

1) JAVASCRIPT THE DEFINITIVE GUIDE 7/ED Paperback – 15 June 2020
   2. Full-Stack React, TypeScript, and Node: Build cloud-ready web applications using React 17 with Hooks and GraphQL Paperback – Import, 18 December 2020
   3) Advanced Web Development with React Paperback – 1 January 2020

REFERENCES:

1.PARENTAL WEBSITE - https://reactjs.org/

2.The Road to Learn React: Your journey to master plain yet pragmatic React.js by Robin Wieruch

3.Learning React: Functional Web Development with React and Redux by Alex Banks and Eve Porcello

4.Learning React by KirupaChinnathambi

5."React Up & Running" by StoyanStefanov

6.https://www.edureka.co/reactjs-redux-certification-training

ONLINE LEARNING PLATFORMS :

- ➢ CodePen,
- ➢ CodeSandbox (ß Preferred)
- ➢ Stackblitz.

LIST OF EQUIPMENTS:

- NodeJS (v9.11.2)
- Github as code repository
- Visual studio code as IDE
- RTL as unit testing framework
- Responsive design w bootstrap
- ReactJS installation (v17)
- Chrome / FIreFox Browsers (latest)
- Responsive using Media Queries & Bootstrap Material&Antdesign
- Design based Apps

21CB926	SERVER SIDE PROGRAMMING WITH RUBY ON RAILS	L	T	P	C
		3	0	2	4

OBJECTIVES:

The Course will enable learners to:

- To build web applications using the Rubyon Rails framework
- To manipulate data using both imperative and functional programming techniques.
- To develop web applications using object oriented design
- To store and retrieve data from database using ActiveRecord

UNIT I   INTRODUCTION TO RUBY   9+6

Introduction to Ruby – The Ruby Ecosystem - Comments - Variables -Datatypes-

Operators - Control Statements - Looping - Arrays - Key value pairs -Functions

List of Exercise/Experiments

3) You have a certain number of 100 rupee notes, 10 rupee notes and 1 rupee notes with you.There is an item you want to buy whose price is given to you.Write a program in Ruby to find if the item is affordable, that is the price of the item is less than or equal to the current money you have. Get the number of notes and price as input from the user.

4) Create an application in Ruby which gets number inputs until the input is -1. Store the input in the array and check for duplicate values. Remove the duplicate values and display the elements of the array in descending order.

UNIT II   OBJECT ORIENTED PROGRAMMING WITH RUBY   9+6

Object Oriented Programming - Classes - Objects - Methods - Instance Variables - Constructor - Access Control - Inheritance - Method Overriding - Operator Overloading - Exceptions - Multithreading - Modules - Libraries - Files - Ruby Tools

List of Exercise/Experiments

3) Create a Hospital class which acts as a super class for In_Patient. There is another one class Bill which is a sub class of In_Patient. Get necessary inputs about the patients and on analyzing their medical record generate a bill using Ruby.

4) For the above example expand the code to generate the bill and save the bill details along with the patient detail and medical report in a text file.

UNIT III   RUBY ERB AND USER AUTHENTICATION   9+6

Ruby ERB - Layout building using HTML and CSS - Designing with CSS - Classes and Specifiers in CSS - Box Layout - Flex Box Layout - HTML Forms - ERB Templates - **User Authentication** - Token Verification - Authenticity - Cross Site Request Forgery (CSRF) - CSRF attacks

List of Exercise/Experiments

3) Create a web application for student management. It should get the details of the students using forms and generate a printable resume for them using the obtained details.

4) Create a web application for conducting online quiz. The user will be answering the multiple choice questions by clicking the radio button. Generate the score after submission.

UNIT IV   INTRODUCTION TO RUBY ON RAILS   9+6

Ruby on Rails - Introduction - Framework - MVC - Active Records - Rails Migration - Rails Controllers - Rails View - Asset Pilpeline- ActiveRecord Migration - ActiveRecord Association - Cookies - Session - ActionDispatch - ActiveRecord Validation

List of Exercise/Experiments

2) Create a to-do list web application using Ruby on Rails.

3) Create a simple calculator using Ruby on Rails.

UNIT V   DATABASE CONNECTIVITY AND BACK END DEVELOPMENT   9+6

Database Connectivity - Ruby DBI - Architecture of DBI application - Database Connection - Manipulation Operations - Transactions - RubyGems - PostgreSQL - Create database and table using PostgreSQL - Connect PostgreSQL to Rails application - **Back End Development** - AJAX - File Uploader - Action Mailer

List of Exercise/Experiments

5) Create a web application using Ruby on Rails to manage comments for the post from the users

6) . Create an online ecommerce marketplace web application using Ruby on Rails.

OUTCOMES:

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

CO1: Build web applications using Rails.

CO2: Model real-world systems using object-oriented design.

CO3: Write HTML & CSS to create elegant web pages.

CO4: Manipulate data using both imperative and functional programming techniques.

CO5: Use ActiveRecord to store and retrieve information from a database.

TEXTBOOKS:

1.John Elder, "Intro To Ruby Programming: Beginners Guide Series", Paperback – Import, 10 May 2016

2.John Elder, "Learn Ruby On Rails For Web Development: Learn Rails The Fast And Easy Way!", Paperback – Import, 19 January 2015

3.Simon St. Laurent, EddDumbill, "Learning Rails", O'Reilly Media, Inc., November 2008, ISBN: 9780596554217

REFERENCES:

1. Yukihiro Matsumoto, David Flanagan, "The Ruby Programming Language: Everything You Need to Know", O'Reilly Media, Inc., January 2008

2. Dave Thomas, David Heinemeier Hansson, and Sam Ruby, " Agile Web Development with Rails 5",

3. Sandi Metz, Obie Fernandez,"Practical Object Oriented Design in Ruby - An Agile Primer", Addison-Wesley Professional Ruby, 1st Edition

4. Akshat Paul, Peter Philips, DánielSzabó, "The Ruby Workshop", Packt Publishing, October 2019

5. Peter Cooper, "Beginning Ruby from Novice to Professional", Third Edition, Apress

6. Kevin C. Baird, "Ruby By Example - Concepts and Code", No Starch Press, 2007

ONLINE LEARNING PLATFORMS :

> https://www.learnrubyonline.org
> https://www.udemy.com/course/ruby-for-absolute-beginners/
> https://gorails.com

LIST OF EQUIPMENTS:

- Visual studio code as IDE
- Ruby LSP extension in VS Code