



**R.M.D. ENGINEERING COLLEGE**  
**(An Autonomous Institution)**  
**B.TECH COMPUTER SCIENCE AND BUSINESS SYSTEMS**  
**REGULATIONS – 2021**  
**CHOICE BASED CREDIT SYSTEM**

**PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)**

**PEO 1:** To ensure graduates are 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.

**PEO 2:** To enrich knowledge of common business principles and enable graduates with the core competencies necessary for understanding contemporary technology.

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

**PEO 4:** To enable graduates to enrich knowledge in the management and establish themselves as an entrepreneur by applying their leadership and management qualities.

**PEO 5:** To be a professional with ethical , social responsibility by enriching the human values

**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.

## **II. 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.

## MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the programme objective and the outcomes is given in the following table

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	1	2	3	4	5	6	7	8	9	10	11	12
1	3	2	1	1								
2	3	3	3	3	2	1	2	1			2	2
3			3	3	3	2	2	1	1	1	2	3
4			3	3	3	2	3	2	1	1	2	3
5				3		2	2	3	3	2	2	2

## MAPPING OF PROGRAM SPECIFIC OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the Program Specific Objectives and the outcomes is given in the following table

PROGRAMME SPECIFIC OBJECTIVES	PROGRAMME OUTCOMES											
	1	2	3	4	5	6	7	8	9	10	11	12
1	3	3	3	3	2	1	2	1			2	2
2			3	3	3	2	3	2	1	1	2	3
3				3		2	2	3	3	2	2	2

Contribution

1: Reasonable

2: Significant

3: Strong

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**CHOICE BASED CREDIT SYSTEM**  
**I - VIII SEMESTER CURRICULUM AND SYLLABI**  
**(For the Students admitted from the Academic Year 2021-22 onwards)**

<b>SEMESTER – I</b>								
<b>Sl. No.</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Category</b>	<b>Contact Periods</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
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				
<b>TOTAL</b>				<b>28</b>	<b>16</b>	<b>4</b>	<b>8</b>	<b>22</b>

<b>SEMESTER – II</b>								
<b>Sl. No.</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Category</b>	<b>Contact Periods</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
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
		Environmental Science and Engineering (Non Credit)	MC	3	3	0	0	0
<b>TOTAL</b>				<b>32</b>	<b>18</b>	<b>6</b>	<b>8</b>	<b>22</b>

<b>SEMESTER – III</b>								
<b>Sl. No.</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Category</b>	<b>Contact Periods</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
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
<b>TOTAL</b>				<b>36</b>	<b>20</b>	<b>4</b>	<b>12</b>	<b>25</b>

SEMESTER – IV								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
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
<b>TOTAL</b>				<b>39</b>	<b>23</b>	<b>2</b>	<b>14</b>	<b>25</b>

SEMESTER – V								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
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 Coding Skills - I	EEC	2	0	0	2	1
<b>TOTAL</b>				<b>25</b>	<b>13</b>	<b>4</b>	<b>8</b>	<b>19</b>

SEMESTER – VI								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
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 Coding Skills - II	EEC	2	0	0	2	1
<b>TOTAL</b>				<b>25</b>	<b>15</b>	<b>0</b>	<b>10</b>	<b>20</b>



SEMESTER – VII								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
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	5	3	0	2	4
5.		Professional Elective V	PE	3	3	0	0	3
6.	21CB711	Project Work	EEC	2	0	0	2	1
<b>TOTAL</b>				<b>27</b>	<b>15</b>	<b>0</b>	<b>12</b>	<b>21</b>

SEMESTER – VIII								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	21CB811	Project Work	EEC	16	0	0	16	8
<b>TOTAL</b>				<b>16</b>	<b>0</b>	<b>0</b>	<b>16</b>	<b>8</b>

PROFESSIONAL ELECTIVE – I								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
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								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
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
4.	21CB919	Services Science & Service Ops Management	PE	5	3	0	2	4

PROFESSIONAL ELECTIVE – III								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	21CB910	Modern Enterprise Systems	PE	3	3	0	0	3
2.	21CB911	Advance Finance	PE	3	3	0	0	3
3.	21CB904	Behavioral Economics	PE	3	3	0	0	3
4.	21CB905	Computational Finance & Modeling	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – IV								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	21CB913	Introduction to Cognitive Science + Lab	PE	5	3	0	2	4
2.	21CB914	Introduction to IoT + Lab	PE	5	3	0	2	4
3.	21CB915	Cryptology + Lab	PE	5	3	0	2	4
4.	21CB918	Mobile Computing + Lab	PE	3	3	0	2	3

PROFESSIONAL ELECTIVE – V								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	21CB916	Quantum Computation and 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 and Cost Accounting	PE	3	3	0	0	3
5.	21CB921	Organizational Behaviour	PE	3	3	0	0	3
6.	21IT713	Professional Readiness for Innovation, Employability and Entrepreneurship	PE	6	0	0	6	3

OPEN ELECTIVES OFFERED TO OTHER DEPARTMENTS								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	21CB001	Formal Language and Automata Theory	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

### SUMMARY OF CREDIT DISTRIBUTION

Sl. No.	Category	Credits Per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	HS	4	4		4					12
2	BS	10	8	4						22
3	ES	8	4							12
4	PC		6	21	18	13	12	13		83
5	PE					4	7	7		18
6	EEC				3	2	1	1	8	15
7	MC	√	√	√	√					
	<b>Total</b>	<b>22</b>	<b>22</b>	<b>25</b>	<b>25</b>	<b>19</b>	<b>20</b>	<b>21</b>	<b>8</b>	<b>162</b>

HS - Humanities and Social Sciences; BS - Basic Science; ES - Engineering Science; PC - Professional Core; PE - Professional Elective; EEC - Employability Enhancement Course; MC - Mandatory Courses

### R2021

### CURRICULUM OF B.E (HONOURS) IN COMPUTER SCIENCE AND BUSINESS SYSTEMS WITH SPECIALIZATION IN BUSINESS ANALYTICS

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	21CB921	Python for Data Analytics	PEC	5	3	0	2	4
2.	21CB922	Business Intelligence and Analytics	PEC	5	3	0	2	4
3.	21CB923	Cognitive Science and Analytics	PEC	4	4	0	0	4
4.	21CB927	Capstone Project	PEC	12	0	0	12	6
TOTAL				26	10	0	16	18

### R2021 B.TECH. COMPUTER SCIENCE AND BUSINESS SYSTEMS WITH MINOR DEGREE

S. No.	Minor Degree	Offering Department
1	Internet of Things	Electronics and Communication Engineering
2	Full Stack Engineering	Information Technology

**R2021**  
**MINOR DEGREE – ADVANCED WEB DEVELOPMENT CURRICULUM OFFERED BY**  
**DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS**  
**(FOR OTHER B.E. / B.TECH PROGRAMMES)**

<b>Sl. No.</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Category</b>	<b>Contact Periods</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
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.	21CB928	Capstone Project	EEC	12	0	0	12	6
<b>TOTAL</b>				<b>27</b>	<b>9</b>	<b>0</b>	<b>18</b>	<b>18</b>



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:**

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

- CO1: Check the validity of the arguments
- CO2: Analyze various proof techniques and application of principles
- CO3: Construct truth tables and optimize logic by maps
- CO4: Define various algebraic structures, axioms and properties
- CO5: Apply graph theory techniques to solve real life problems.

**TEXT BOOKS:**

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

**REFERENCES:**

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

<b>21MA103</b>	<b>INTRODUCTION TO STATISTICS, PROBABILITY AND CALCULUS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

**The Course will enable learners 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 PROBABILITY DISTRIBUTIONS 9**

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

**UNIT V CALCULUS 9**

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.



**OUTCOMES:**

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

CO1: Apply the concepts of basic statistics, find mean, median, mode, standard deviation, mean deviation, quartile deviation and range for a given data.

CO2: Make use of probability concepts in problems of uncertainty.

CO3: Identify and apply the discrete and continuous distributions concepts in real life problems.

CO4: Evaluate the area and volume by using multiple integrals.

**TEXT BOOKS:**

1. Introduction of Probability Models, S.M. Ross, 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, 1965.

**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. Graybill and, 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.

<b>21GE102 FUNDAMENTALS OF COMPUTER SCIENCE + LAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>2</b>	<b>2</b>	<b>2</b>	<b>4</b>

## **OBJECTIVES:**

**The Course will enable learners to:**

- Understand the problem-solving concepts
- Understand syntax and constructs of C Language
- Develop structured programs using basic programming constructs
- Understands pointers and arrays in C
- Understand UNIX system interface
- 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, Register Variables, 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
  - vi. 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:

- CO1: Apply problem solving techniques to simple computational problems
- CO2: Understand the syntax and constructs of C language
- CO3: Develop structured programs using basic constructs in C
- CO4: Understand pointers and arrays in C
- CO5: Understand Unix system interface
- CO6: Apply various programming methods

## TEXT BOOKS:

1. Brian W Kernighan and Dennis M Ritchie, The C Programming Language, Pearson Education India, 2nd Edition, 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, Schaum Outline Series, Fourth Edition, 2018
2. Herbert Schildt, C: The Complete Reference, McGraw Hill, Fourth Edition, 2017
3. Yashavant Kanetkar, Let Us C, BPB Publications, 16th Edition, 2018.

<b>21GE104</b>	<b>PRINCIPLES OF ELECTRICAL ENGINEERING + LAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>

## OBJECTIVES:

The Course will enable learners to:

- 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- $\Delta$  & 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, Necessity of earthing, Types of earthing, Safety devices & 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  $X_L > X_C$  ,  $X_L < X_C$
5. Simulation of Time response of RC circuit
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 AC systems.

**TOTAL: 30 PERIODS**

**OUTCOMES:**

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

CO1: Summarize the behavior electrical circuits

CO2: Solve the DC circuits using network theorems

CO3: Interpret the concepts of AC circuits

CO4: Discuss the electrostatic and magnetic fields with circuit laws and analyze the performance of transformers

CO5: Explain the various sensors and demonstrate electric wiring

**TEXT BOOKS:**

1. Electric Machinery, (Sixth Edition) A. E. Fitzgerald, Kingsely Jr Charles, D. Umans Stephen, Tata McGraw Hill.
2. A Textbook of Electrical Technology, (vol. I), B. L. Theraja, Chand and Company Ltd., New Delhi.
3. Basic Electrical Engineering, V. K. Mehta, S. Chand and Company Ltd., New Delhi.
4. Theory and problems of Basic Electrical Engineering, (Second Edition), J. Nagrath and Kothari, Prentice Hall of India Pvt. Ltd.

## REFERENCES:

1. Basic of Electrical Engineering, T. K. Nagsarkar and M. S. Sukhija, Oxford University Press. 2011
2. Introduction to Electrodynamics, D. J. Griffiths, (Fourth Edition), Cambridge University Press.
3. Engineering Circuit Analysis, William H. Hayt & Jack E. Kemmerly, McGraw-Hill Book Company Inc.
4. Fundamentals of Electrical and Electronics Engineering, Smarjith Ghosh, Prentice Hall (India) Pvt. Ltd.

<b>21PH103</b>	<b>FUNDAMENTALS OF PHYSICS + LAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>

## OBJECTIVES:

### The Course will enable learners to:

- Impart the fundamental concepts of physics and apply this knowledge to both scientific and engineering problems.
- Illustrate the fundamentals of oscillatory systems and the analogy of mechanical and electrical systems.
- Explain various light concepts like interference, diffraction and polarization.
- Impart knowledge related to the importance of EM waves and quantum mechanics
- Introduce concepts of crystallography, band structure and thermodynamics
- 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<sub>2</sub> 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 Plank 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:**

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

CO1: Obtain solution of the oscillator using differential equation.

CO2: Analyze the intensity variation of light due to Polarization and interference

CO3: Explain fundamentals of electromagnetism and quantum mechanics and apply it in engineering problems

CO4: Find solution to thermal and electrical problems faced in computer devices.

CO5: Analyze working principle of lasers and to summarize its applications

**TEXT BOOKS:**

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

**REFERENCES:**

1. Halliday, Resnick and Walker, Fundamentals of Physics, 9th Ed., John Wiley & sons (2011).

2. Richard P. Feynman, The Feynman Lectures on Physics - Vol. I, II and III: The New Millennium Edition (2012).
3. Neil W Ascroft 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", 3<sup>rd</sup> Edition, Narosa Publishing House Pvt. Ltd., 2015
6. Garcia,N.& Damask,A. "Physics for Computer Science Students" Springer-Verlag,2012.
7. Rogers, B., Adams,J & Pennathur, S., "Nanotechnology: Understanding Small System", CRC Press, 2014

<b>21EL102</b>	<b>BUSINESS COMMUNICATION AND VALUE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>SCIENCE – I</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>4</b>

**OBJECTIVES:**

**The Course will enable learners to:**

- 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 a presentation
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:**

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

- CO1: Recognize the need for life skills and values.
- CO2: Recognize own strengths and opportunities.
- CO3: Apply the life skills to different situations.
- CO4: Understand the basic tenets of communication.
- CO5: Apply the basic communication practices in different types of communication.
- CO6: Evaluate the importance of self-awareness, confidence and communication.

**REFERENCES:**

1. Alan Mc'carthy and O'dell, English vocabulary in use, Cambridge University Press, 3<sup>rd</sup> Edition, 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>

## SEMESTER II

21MA202

LINEAR ALGEBRA

L	T	P	C
3	2	0	4

### OBJECTIVES:

The Course will enable learners 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:

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

- CO1: Solve the system of linear equations using Cramer's rule.
- CO2: Solve the system of equations using LU Decomposition method.
- CO3: Compute QR decomposition for a given matrix.

CO4: Represent the linear transformations in matrix and to find eigen values and eigen vectors.

CO5: Apply the concept of linear combinations in image processing and Machine learning.

**TEXT BOOKS:**

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43<sup>rd</sup> Edition, 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", Cengage Learning, 7<sup>th</sup> Edition.
2. Michael. D. Greenberg, "Advanced Engineering Mathematics", Pearson, 2<sup>nd</sup> Edition.
3. Gilbert Strang, "Introduction to linear algebra", Wellesley-Cambridge Press, 5<sup>th</sup> Edition.
4. P.N. Wartikar & J.N. Wartikar, "Applied Mathematics", Volume I & II, Pune Vidyarthi Griha Prakashan, 7<sup>th</sup> Edition, 1994.
5. R.C. Gonzalez and R.E. Woods, "Digital Image Processing", Pearson Education International, 3<sup>rd</sup> Edition.
6. <https://machinelearningmastery.com/introduction-matrices-machine-learning/>

**21MA203**

**STATISTICAL METHODS + LAB**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>

**OBJECTIVES:**

**The Course will enable learners 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.





## OUTCOMES:

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

CO1: Find the standard error and sample mean of the sampling distributions.

CO2: Identify and evaluate the unbiased estimators.

CO3: Compute correlation and regression curve.

CO4: Apply testing of hypothesis in real life problems.

CO5: 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", Prentice Hall India Learning Private Limited, 4<sup>th</sup> Edition, 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, 6<sup>th</sup> 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 Grolemond, "Hands-on Programming with R", O'Reilly.
5. Jared P. Lander, "R for Everyone: Advanced Analytics and Graphics", Addison-Wesley Professional, 2<sup>nd</sup> Edition.

<b>21CB201</b>	<b>DATA STRUCTURES AND ALGORITHMS + LAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>2</b>	<b>2</b>	<b>4</b>

## OBJECTIVES:

The Course will enable learners to:

- Explore algorithm performance analysis
- Learn linear and non-linear data structures.
- Recognize and distinguish the applications of various linear and non-linear data structures.
- Analyse the concepts of tree and graph data structures.
- Understand the concept of files and its operations.
- Able to incorporate various searching and sorting techniques in real time scenarios.

**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, Heapsort, 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:**

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

- CO1: Analyse the various data structure concepts.
- CO2: Apply the different linear data structures to problem solutions.
- CO3: Apply the different non-linear data structures to problem solutions.
- CO4: Exemplify the concept of files and its operations.
- CO5: Understand files accessing mechanisms.
- CO6: Critically analyse the various sorting algorithms.

## **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. Ullman, Pearson.

## **REFERENCES:**

1. The Art of Computer Programming: Volume 1: Fundamental Algorithms, Donald E. 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.

**21EC241 PRINCIPLES OF ELECTRONICS ENGINEERING + L T P C**  
**LAB**  
**3 0 2 4**

## **OBJECTIVES:**

**The Course will enable learners to:**

- Study the operation of semiconductor diodes and their characteristics
- Acquire knowledge about the operation and characteristics of BJT under various configurations
- Introduce the structure and terminal characteristics of FET and MOSFET
- Understand the concepts of feedback and operational amplifiers with its applications
- Gain knowledge about digital logic circuits.



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 logicgates.
  - c. Construction of simple Decoder & Multiplexer circuits using logic gates.
  - d. Realization of Synchronous Up/Down counter.

**TOTAL: 30 PERIODS**

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

- CO1: Explain the characteristics of diode
- CO2: Describe the equivalence circuits of transistors
- CO3: Acquire the knowledge on feedback amplifiers and operational amplifiers.
- CO4: Describe the simple digital logic circuits

**TEXT BOOKS:**

1. Microelectronics Circuits, Adel S. Sedra 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

**REFERENCES:**

1. Electronic Devices and Circuit Theory, Robert L. Boylestad, Louis Nashelsky.
2. Solid State Electronic Devices, 6<sup>th</sup> 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

<b>21CB202</b>	<b>FUNDAMENTALS OF ECONOMICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**OBJECTIVES:****The Course will enable learners to:**

- Explain the fundamental principles of micro economics relevant to managing an organization.
- Describe the fundamental principles of macroeconomics to have the understanding of economic environment of business.
- Understand the various aspects of India's economy.

<b>UNIT I</b>	<b>INTRODUCTION</b>	<b>6</b>
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).		
<b>UNIT II</b>	<b>CONSUMER ANALYSIS</b>	<b>6</b>
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;		
<b>UNIT III</b>	<b>PRODUCTION AND COSTING</b>	<b>6</b>
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 and Short Run Costs; Equilibrium of a Firm Under Perfect Competition; Monopoly and Monopolistic Competition		
<b>UNIT IV</b>	<b>MACROECONOMIC REFORMS</b>	<b>6</b>
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.		
<b>UNIT V</b>	<b>POLICY GOVERNANCE</b>	<b>6</b>
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:**

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

CO1: Become familiar with both principles of micro and macroeconomics.

CO2: Understand about approaches to consumer behaviour and relation between production and cost function.

CO3: Describe and discuss on interaction of product and factor market.

CO4: Get awareness about importance and development of Indian economy and economic reforms.

CO5: Have thorough knowledge in the areas of inflation, unemployment, monetary policy, 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.

<b>21EL202</b>	<b>BUSINESS COMMUNICATION AND VALUE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>SCIENCES – II</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>4</b>

## **OBJECTIVES:**

### **The Course will enable learners to:**

- 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 E Magazine.
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 issue their 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. Plan the 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:**

CO1: Understand and use tools of structured written communication  
CO2: Use electronic/social media to share concepts and ideas

CO3: Understand the basics of presentation and apply effective techniques to make presentations

CO4: Apply the basic concept of speed reading, skimming and scanning.  
CO5: Identify individual personality types and role in a team.

CO6: Understand the basic concepts of Morality and Diversity and argue on a topic based on morality and diversity

CO7: 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, Harper Collins 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](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](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](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>

<b>ENVIRONMENTAL SCIENCE AND ENGINEERING (Non Credit Course )</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>

#### 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 value.

## **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 their 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, family welfare 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:**

CO1: Illustrate the importance and conservation of natural resources.

CO2: Assess the impact of various pollutants and suggest appropriate pollution control methods.

CO3: Explain the basic structure of ecosystem and the conservation of biodiversity.

CO4: Analyze the social issues related to environment and recommend suitable solutions.

CO5: Investigate the trends in population explosion and assess its impact.

### **TEXT BOOKS:**

1. Anubha Kaushik and C. P. Kaushik, "Perspectives in environmental studies", New Age International, 6th edition, 2018.
2. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2017.
3. Gilbert M. Masters, Wendell P. Ela "Introduction to Environmental Engineering and Science", 3<sup>rd</sup> edition, Pearson Education, 2015.

**REFERENCES:**

1. William P. Cunningham and Mary Ann Cunningham, "Environmental Science: A Global Concern", McGraw Hill, 14<sup>th</sup> edition, 2017.
2. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India Pvt. Ltd., Delhi, 14<sup>th</sup> edition, 2014.
3. Erach Bharucha, "Textbook of Environmental Studies", Universities Press Pvt. Ltd., Hyderabad, 2<sup>nd</sup> edition, 2015.





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

**TOTAL: 45 PERIODS**

**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: 30 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", 3<sup>rd</sup> Edition, John Wiley & Sons, New Jersey, 2003.
2. J.D. Jobson, "Applied Multivariate Data Analysis", Vol I & II, 1<sup>st</sup> 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", 4<sup>th</sup> Edition, O'Reilly Media, 2010.
5. Tim Hall and J.P Stacey, "Python 3 for Absolute Beginners", 1<sup>st</sup> Edition, Apress, 2009.
6. Magnus Lie Hetland, "Beginning Python: From Novice to Professional", 1<sup>st</sup> Edition, Apress, 2005.

**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 AND LANGUAGES AND FINITE AUTOMATA 9+6+6**

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

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 interfacing.

## 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.

<b>21CB303</b>	<b>OBJECT ORIENTED PROGRAMMING + LAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>

## 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 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 SortedSet) Atomic data types (AtomicInteger, AtomicLong, AtomicIntegerArray), CountdownLatch, BlockingQueue

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 ArrayList. 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 polymorphism
- 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.

<b>21CB304</b>	<b>SOFTWARE ENGINEERING + LAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>2</b>	<b>2</b>	<b>5</b>

**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 Object Oriented Analysis Design and Construction.

## **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 CONSTRUCTION**

**9+6**

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: 75 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: Identify the need and importance of Object-Oriented Analysis, Design and Construction.

**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

<b>21CB305</b>	<b>FINANCIAL MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**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 BOOKS:**

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  
(Non Credit)**

L	T	P	C
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.



## **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

**TOTAL: 30 PERIODS**

## **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, Dining 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.

21CB402	DATABASE MANAGEMENT SYSTEMS + LAB	L	T	P	C
		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: 30 PERIODS**

### **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 database systems

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.

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

## 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 TECHNOLOGIES AND THE UML METHOD. 9**

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



## **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 BOOKS:**

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>

**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 INVENTORY 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.

<b>21CB406</b>	<b>MARKETING RESEARCH AND MARKETING MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### 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 of 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 behavior, 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

<b>21EL401</b>	<b>BUSINESS COMMUNICATION &amp; VALUE SCIENCE – III</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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 in the 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=IKvV8\\_T95M](https://m.youtube.com/watch?feature=youtu.be&v=IKvV8_T95M)
10. <https://m.youtube.com/watch?feature=youtu.be&v=e80BbX05D7Y>
11. [https://m.youtube.com/watch?v=dT\\_D68RJ5T8&feature=youtu.be](https://m.youtube.com/watch?v=dT_D68RJ5T8&feature=youtu.be)
12. <https://m.youtube.com/watch?v=7sLLEdBgYYY&feature=youtu.be>

## 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 BOOKS:**

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/>

**21GE301 UNIVERSAL HUMAN VALUES 2:  
UNDERSTANDING HARMONY  
(Non -Credit)**

**L T P C**  
**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.

**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.

**TEXT BOOKS:**

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)

**OBJECTIVES:****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.

**List of Exercises:****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:

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

### 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, Bin Packing, 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.

<b>21CB502</b>	<b>COMPILER DESIGN + LAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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 SYNTAX 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.

**TOTAL: 45 PERIODS**

**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**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
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 FIRM'S INTELLECTUAL ASSETS 9**

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 Portfolio Analysis - Expansion, Integration and Diversification - Strategic Alliances, Joint Ventures, and Mergers & Acquisitions.

**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**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
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 map for 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: 60 PERIODS****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.

## SEMESTER VI

<b>21CB601 COMPUTER NETWORKS + LAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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.

**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 analyzer and examine.
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 Control Algorithms 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, Pearson Education, 10th Edition, 2013.
2. Andrew S. Tanenbaum, Computer Networks, Prentice Hall, 5th Edition, 2011.

**21CB602 INFORMATION SECURITY + LAB**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
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.

**UNIT I 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.

**UNIT II 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.

**UNIT IV 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.

**UNIT V 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: 45 PERIODS****LIST OF EXPERIMENTS:**

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

**TOTAL: 30 PERIODS****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.

**TEXT BOOKS:**

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.

<b>21CB603 ARTIFICIAL INTELLIGENCE + LAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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, natural language processing and expert systems.
- Develop abilities to apply, build and modify decision models to solve real problems.
- Design good evaluation functions and strategies for game playing
- Discuss the core concepts and algorithms of searching

**UNIT I 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.

**UNIT II 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.

**UNIT IV 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: 45 PERIODS**

**LIST OF EXPERIMENTS:**

1. Implement heuristics, optimal search, and graph heuristics.
2. Constraint satisfaction problems
3. k-nearest neighbors
4. Decision trees.

**TOTAL: 30 PERIODS**

**OUTCOMES:**

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

- CO1: Demonstrate fundamental understanding of artificial intelligence (AI) and its problem solving techniques
- CO2: Explain how Artificial Intelligence enables capabilities that are beyond conventional 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.

**TEXT BOOKS:**

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.

<b>21CS614</b>	<b>ADVANCED APTITUDE AND CODING SKILLS - II</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**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..

## SEMESTER VII

<b>21CB701</b>	<b>USABILITY DESIGN OF SOFTWARE APPLICATIONS + LAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>

### OBJECTIVES:

- To learn the fundamentals of User Centered Design, their relevance and contribution to businesses.
- To study the principles of heuristic evaluation for interactive design.
- To understand the appreciation of user research, solution conceptualization and validation as interwoven activities in the design and development lifecycle.
- To familiarize the facets of User Experience (UX) Design, particularly as applied to the digital artefacts.
- To implement complex mobile/web applications.

### **UNIT I INTRODUCTION TO USER CENTRED DESIGN 9**

Basics of User Centred Design-Elements-Models and approaches-User Centred Design Principles-Usability-UCD Process-Analysis tools: personas, scenarios, and essential use cases with examples-User-Centred Design and Agile aspects of User Centred Design.

### **UNIT II INTERACTIVE DESIGN EVALUATION 9**

Introduction to Interactive Design process - Interactive design in practice - Introducing evaluation - Evaluation: Inspection, Analysis and Models - Inspection: Heuristic Evaluation: 10 Heuristic Principles, Examples.

### **UNIT III DEVELOPMENT OF APPLICATION 9**

Case Study: Development of any application like mobile or web based on User Centred Design – Design lifecycle: Establishing Requirements, Design, Prototyping and Construction.

### **UNIT IV UX RESEARCH 9**

Understanding users, their goals, context of use, environment of use. Research Techniques: Contextual Enquiry, User Interviews, Competitive Analysis for UX.

### **UNIT V ITERATIVE PRODUCT DEVELOPMENT 9**

The Problem with Complexity - Iterative Product Development - Scenarios and Persona Technique, Design Thinking Technique: Discovery and brainstorming - Concept Development –

Prototyping Techniques : Paper, Electronic, Prototyping Tools - Review and feedback.

**TOTAL: 45 PERIODS**

### Lab Exercises

1. Product Appreciation Assignment – Evaluating the product from User Centred Design aspects such as functionality, ease of use, ergonomics, and aesthetics.
2. Heuristic Evaluation: Group Assignment initiation (Website and App) Evaluation for key tasks of the app or website for heuristic principles, severity, recommendations.
3. Students will identify a project in the given domain (Healthcare, E-Commerce, Online Learning Platforms, Gaming, Point-of-Sale, Smart Things) and its related website or mobile app to redesign. They will take this redesign project through the design lifecycle:
  - Discovery
  - Define
  - Design
  - Implement (Design Prototype)
  - Usability TestingThe below design methods and techniques will be imparted w.r.t. the group project selected by the students.

4. Presentation of Persona for the group project.
5. Task flow detailing for the project.
6. Project Prototyping Iteration 1.
7. Project Prototyping Iteration 2.
8. Final presentation of solution (Mobile or Web Application).

**TOTAL: 30 PERIODS**

**OUTCOMES:**

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

**CO1:** Understand the fundamentals and importance of User-Centred design.

**CO2:** Perform design evaluation by applying the heuristic principles.

**CO3:** Develop an application focusing on the design aspects.

**CO4:** Do research on understanding user requirement.

**CO5:** Perform iterative product development using prototyping technique.

**TEXT BOOK:**

1. Jenny Preece, Helen Sharp and Yvonne Rogers, Interaction Design: Beyond Human-Computer Interaction, 4th Edition, 2019
2. Alan Cooper and Robert Reimann. About Face, 4th Edition, 2022

**REFERENCES:**

1. Elizabeth Goodman, Mike Kuniavsky, Andra Moed, Observing the User Experience, Second Edition: A Practitioner's Guide to User Research. 2019
2. Jesse James Garrett, The Elements of User Experience: User-Centered Design for the Web and Beyond. 2nd Edition, 2019
3. Lean, and Agile - Jonny Schneider, Understanding Design Thinking, 2020

**21CB702**

**IT WORKSHOP SCILAB + LAB**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>4</b>	<b>5</b>

**OBJECTIVES:**

- To introduce the students with the basic features of MATLAB/Scilab for problem solving.
- To introduce the students about the Mathematical functions like matrix generation.
- To introduce the students about the Mathematical functions like Plotting with multiple data sets, line styles and colors.
- To introduce the students about the Array operations and solving Linear equations in MATLAB/Scilab.
- To introduce the students about the control flow and operators using if-end structures and loops.

**UNIT I**

**INTRODUCTION TO MATLAB**

**9**

**Introduction to MATLAB:** History, basic features, strengths and weaknesses, good programming practices and plan your code.

**Working with variables, workspace and miscellaneous commands:** Creating MATLAB variables, overwriting variable, error messages, making corrections, controlling the hierarchy of operations or precedence, controlling the appearance of floating point number, managing the workspace, keeping track of your work session, entering multiple statements per line, miscellaneous commands.

**UNIT II**

**MATRIX, ARRAY AND BASIC MATHEMATICAL FUNCTIONS**

**9**

Matrix generation, entering a vector, entering a matrix, matrix indexing, colon operator, linear spacing, creating a sub-matrix, dimension, matrix operations and functions matrix



generators, special matrices, array and array operations, solving linear equations, other mathematical functions.

**UNIT III BASIC PLOTTING 9**

Overview, creating simple plots, adding titles, axis labels, and annotations, multiple data sets in one plot, specifying line styles and colours.

**UNIT IV INTRODUCTION TO PROGRAMMING 9**

**Introduction to programming:** Introduction, M-File Scripts, script side-effects, M-File functions, anatomy of a M-File function, input and output arguments, input to a script file, output commands.

**Control flow and operators:** "if ... end" structure, relational and logical operators, "for ... end" loop, "while ... end" loop, other flow structures, operator precedence, saving output to a file.

**UNIT V DEBUGGING M-FILES 9**

Debugging process, preparing for debugging, setting breakpoints, running with breakpoints, examining values, correcting and ending debugging, correcting an M-file.

**TOTAL: 45 PERIODS**

**Lab Exercises (Implementation of various Image Processing Algorithms)**

1. Programs using mathematical, relational expressions and the operators.
2. Vectors and Matrices: Programs using array operations and matrix operations (such as matrix multiplication).
3. Programs on input and output of values.
4. Selection Statements: Experiments on if statements, with else and elseif clauses and switch statements.
5. Loop Statements and Vectorizing Code: Programs based on the concepts of counted (for) and conditional (while) loops.
6. Programs based on scripts and user-defined functions.
7. Programs on Built-in text manipulation functions and conversion between string and number types.
8. Programs based on two main data structures: cell arrays and structures.
9. Programs based on Data Transfer.
10. Programs based on Advanced Functions.
11. Introduction to Object-Oriented Programming and Graphics.
12. Programs based on Advanced Plotting Techniques.
13. Programs based on sound files and image processing.
14. Programs based on Advanced Mathematics.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

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

**CO1:** Write fundamental programs in MATLAB/Scilab, creating variables and mathematical functions.

**CO2:** Understand how to program matrix operations, array operations and how to solve the system of linear equations.

**CO3:** Program the fundamentals concepts of basic Plotting consisting of simple and multiple data sets in one plot.

**CO4:** Understand how to program M-file scripts, M- file functions, Input -output Arguments and program control flow operators, loops, flow structures.

**CO5:** Use the debugging process and debugging M-files.

**TEXT BOOK:**

1. Digital Image Processing using MATLAB. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, Pearson Education, Inc., 2020.
2. MATLAB: A Practical Introduction to Programming and Problem Solving. Stormy Attaway, Butterworth-Heinemann, 2019

**REFERENCE BOOKS:**

1. <https://www.mathworks.com/content/dam/mathworks/mathworks-dot-com/moler/exm/book.pdf>
2. [https://www.mathworks.com/help/releases/R2014b/pdf\\_doc/matlab/getstart.pdf](https://www.mathworks.com/help/releases/R2014b/pdf_doc/matlab/getstart.pdf)

<b>21CB703</b>	<b>IT PROJECT MANAGEMENT + LAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>

**OBJECTIVES:**

- To gain knowledge on fundamental concepts of project and project scheduling.
- To understand Project Cost Control, Scheduling and Management Features.
- To obtain knowledge on Agile Project Management.
- To know about the Scrum framework in detail.
- To obtain knowledge on DevOps and its related concepts.

**UNIT I PROJECT OVERVIEW AND PROJECT SCHEDULING 9**

Project Overview and Feasibility Studies: Identification, Market and Demand Analysis, Project Cost Estimate, Financial Appraisal- Project Scheduling: Project Scheduling, Introduction to PERT and CPM, Critical Path Calculation, Precedence Relationship, Difference between PERT and CPM, Float Calculation and its importance, Cost reduction by Crashing of activity.

**UNIT II COST CONTROL, SCHEDULING AND MANAGEMENT FEATURES 9**

Cost Control and Scheduling: Project Cost Control (PERT/Cost), Resource Scheduling & Resource Leveling - Project Management Features: Risk Analysis, Project Control, Project Audit and Project Termination.

**UNIT III AGILE PROJECT MANAGEMENT 9**

Agile Project Management: Introduction, Agile Principles, Agile methodologies, Relationship between Agile Scrum, Lean, DevOps and IT Service Management (ITIL). Other Agile Methodologies: Introduction to XP, FDD, DSDM, Crystal.

**UNIT IV SCRUM 9**

Scrum: Various terminologies used in Scrum (Sprint, product backlog, sprint backlog, sprint review, retro perspective), various roles (Roles in Scrum), Best practices of Scrum, Case Study.

**UNIT V DEVOPS 9**

DevOps: Overview and its Components, Containerization Using Docker, Managing Source Code and Automating Builds, Automated Testing and Test Driven Development, Continuous Integration, Configuration Management, Continuous Deployment, Automated Monitoring, Case Study.

**TOTAL: 45 PERIODS**

## **Lab Exercises**

A mini-project to be identified in the given domain (Crowd Source System, Day Book, Smart Transport System, Resume Builder, E-Commerce, Expert System, Puzzle Corner) to apply the IT Project Management Principles.

1. Estimation of project cost and control activity using open-source tools.
2. Scheduling of project with PERT and CPM techniques to estimate the

- completion time.
3. Assessment of IT Project Risk Analysis using open-source tools.
  4. Perform IT Project Audit and generate a report using open-source tools.
  5. Study of Agile project management tools.
  6. Application of Scrum practices in the project.
  7. Design and perform automated testing.

**TOTAL: 30 PERIODS**

**OUTCOMES:**

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

**CO1:** Learn to effectively plan, and schedule projects within time and cost targets.

**CO2:** Have Knowledge in Cost Control, Scheduling and Management Features.

**CO3:** Be aware of different Agile Project Methodologies.

**CO4:** Know in detail about Scrum.

**CO5:** Obtain good knowledge in DevOps.

**TEXT BOOK:**

1. Mike Cohn, Succeeding with Agile: Software Development Using Scrum, Addison Wesley Signature Series, 2019

**REFERENCE BOOKS:**

1. Roman Pichler, Agile Product Management with Scrum, Addison-Wesley Signature Series, 2020
2. Ken Schwaber, Agile Project Management with Scrum (Microsoft Professional)

<b>21CB704</b>	<b>HUMAN RESOURCE MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

- To understand the basic concepts, functions and processes of human resource management
- To enable students to learn the skills of talent acquisition practices
- To describe corporate training & development methods
- To develop conceptual understanding of compensation management system and career concepts.
- To develop practical insights and problem solving capabilities for effectively managing the organisational appraisal and control practices
- To integrate the knowledge of HR concepts to take correct business decisions

**UNIT I HUMAN RESOURCE MANAGEMENT 9**

Concept and Challenges, HR Philosophy, Policies, Procedures and Practices.

**UNIT II HUMAN RESOURCE SYSTEM DESIGN 9**

HR Profession, and HR Department, Line Management Responsibility in HRM, Measuring HR, Human resources accounting and audit; Human resource information system

**UNIT III FUNCTIONAL AREAS OF HRM 9**

Recruitment and staffing, benefits, compensation, employee relations, HR compliance, organizational design, training and development, human resource information systems (H.R.I.S.) and payroll.

**UNIT IV HUMAN RESOURCE PLANNING 9**

Demand Forecasting, Action Plans- Retention, Training, Redeployment & Staffing,  
Succession Planning

## **UNIT V STRATEGIC MANAGEMENT OF HUMAN RESOURCES**

**9**

SHRM, relationship between HR strategy and overall corporate strategy, HR as a Factor of Competitive Advantage, Managing Diversity in the Workplace

**TOTAL: 45 PERIODS**

### **OUTCOMES:**

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

**CO1:** Understand the object basic principles of Human Resource Management

**CO2:** Identify effective management of its human resources

**CO3:** familiarize the basic concepts, roles, functional areas and activities of HR

**CO4:** Demonstrate the knowledge of HR concepts to take appropriate business decisions

**CO5:** Understand organization's employees, their interest, motivation and satisfaction and their belief of fair treatment

### **TEXT BOOK:**

1. Gary Dessler, Human Resource Management, Pearson India, 2019

### **REFERENCES:**

1. Pravin Durai, Human Resource Management, Pearson India Education Services, 2016
2. Nipun Sharma, Human Resource Management Theory and Practice, R.C. Sharma, Sage Publications India PVT., Ltd., 2018

## PROFESSIONAL ELECTIVE I

<b>21CB901</b>	<b>CONVERSATIONAL SYSTEMS + LAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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

### **UNIT I 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

### **UNIT II FOUNDATIONAL BLOCKS FOR PROGRAMMING AND NATURAL LANGUAGE PROCESSING 9**

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 Testing Frameworks - Botium /Mocha ,Chai. Security & Compliance – Data Management, Storage, GDPR, PCI

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

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.

**TEXT BOOKS:**

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.

<b>21CB902</b>	<b>CLOUD, MICROSERVICES &amp; APPLICATION+ LAB</b>	<b>L</b> 3	<b>T</b> 0	<b>P</b> 2	<b>C</b> 4
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**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

**UNIT I 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.

**UNIT II 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.

### **UNIT IV 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.

### **UNIT V 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 a development framework and deployment platform. Case Study: Python Use case and Python Framework.

**TOTAL: 45 PERIODS**

#### **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: 30 PERIODS**

## 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.

## TEXT BOOKS:

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 Cloud Computing: 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.

<b>21CB903</b>	<b>MACHINE LEARNING + LAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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-measure, 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: 45 PERIODS**

### **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. Read the 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: 30 PERIODS**

**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.

**TEXT BOOKS:**

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.

		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>21CB917</b>	<b>ADVANCED SOCIAL, TEXT AND MEDIA ANALYTICS</b>	<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>

**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 modeling, Maximal entropy Markov Models, Conditional Random Fields. Text mining applications.

<b>UNIT-III</b>	<b>TEXT MINING METHODS &amp; APPROACHES</b>	<b>9</b>
Content Analysis; Natural Language Processing; Clustering & Topic Detection; Simple Predictive Modelling; Sentiment Analysis; Sentiment Prediction.		
<b>UNIT-IV</b>	<b>WEB ANALYTICS</b>	<b>9</b>
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		
<b>UNIT-V</b>	<b>SOCIAL MEDIA ANALYTICS</b>	<b>9</b>
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		
		<b>. TOTAL: 45 PERIODS</b>

**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.

**Exercise:**

**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.

**TOTAL: 30 PERIODS**

**Text Books:**

1. Ronen Feldman and James Sanger, "The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data", Cambridge University Press, 2016.
2. Hansen, Derek, Ben Shneiderman, 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.

**Reference Books:**

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	<b>ROBOTICS AND EMBEDDED SYSTEMS + LAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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

### **UNIT – II**

**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 IN ROBOTICS 9**

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 COGNITIVE ROBOTICS 9**

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 opensource software in the future of robotics-The Power of Cloud Robotics by Robotics Industry Association

**TOTAL: 45 PERIODS**

### 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.

**TEXT BOOKS:**

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 Deep Learning Techniques", Packt publishing, 2020.



**21CB908 MODERN WEB APPLICATIONS + LAB**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
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) with JavaScript, 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 TECHNOLOGIES 9**

**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: 45 PERIODS**

### **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 **Create, Read, Update, Delete** 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.

### **TEXT BOOKS:**

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. Sebasta 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.

<b>21CB909</b>	<b>DATA MINING AND ANALYTICS + LAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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

**UNIT I 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 semiparametric regression models, additive regression models. 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, NN classifier 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 model building.
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 data representation.
- 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.

### **TEXT BOOKS:**

1. Jiawei Han and Micheline Kamber, "Data Mining: Concepts and Techniques", Morgan Kaufmann Publishers, 3rd ed, 2010.
2. Lior Rokach 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.

21CB919	<b>SERVICES SCIENCE &amp; SERVICE OPS MANAGEMENT + LAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		3	0	2	4

**OBJECTIVES:**

**The Course will enable learners to:**

- Understand concepts about Services and distinguish it from Goods
- Able to identify characteristics and nature of Services
- Comprehend ways to design Services and evaluate them using Service qualities
- Understand how various methods can be used to operate and manage Service businesses
- Understand how innovation can be approached from Services point of view

**UNIT I INTRODUCTION 9**

Introduction: Introduction to the course, Introduction to service operations, Role of service in economy and society, Introduction to Indian service sector

Nature of Services and Service Encounters: Differences between services and operations, Service package, characteristics, various frameworks to design service operation system, Kind of service encounter, importance of encounters

Service-Dominant Logic: From Goods-Dominant logic to Service-Dominant logic, Value Co-creation

**UNIT II SERVICE STRATEGY AND COMPETITIVENESS 9**

Service Strategy and Competitiveness: Development of Strategic Service Vision (SSV), Data Envelopment Analysis

New Service Development: NSD cycle, Service Blueprinting, Elements of service delivery system

Service Design: Customer Journey and Service Design, Design Thinking methods to aid Service Design

Locating facilities and designing their layout: models of facility locations (Huff's retail model), Role of service-scape in layout design

Service Quality: SERVQUAL, Walk through Audit, Dimensions of Service quality & other quality tools

**UNIT III SERVICE GUARANTEE & SERVICE RECOVERY 9**

Service Guarantee & Service Recovery: How to provide Service guarantee? How to recover from Service failure

**UNIT IV FORECASTING 9**

Forecasting Demand for Services: A review of different types of forecasting methods for demand forecasting.

Managing Capacity and Demand: Strategies for matching capacity and demand, Psychology of waiting, Application of various tools used in managing waiting line in services.

Managing Facilitating Goods: Review of inventory models, Role of inventory in services

Managing service supply relationship: Understanding the supply chain/hub of service, Strategies for managing suppliers of service

Vehicle Routing Problem: Managing after sales service, Understanding services that involve transportation of people and vehicle, Techniques for optimizing vehicle routes

## **UNIT V SERVICE INNOVATION**

9

Service Innovation: Services Productivity, Need for Services Innovation

**TOTAL: 45 PERIODS**

### **LIST OF EXPERIMENTS:**

1. Option 1: Choose any service organization around and present it from the perspective of: nature of service, classification of service, blueprint or service design analysis, service quality, and any additional perspective you would like to add.
2. Option 2: Choose any latest research paper in services and explain your understanding and feedback on the same.

**TOTAL: 30 PERIODS**

### **OUTCOMES:**

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

CO1: Understand concepts about Services and distinguish it from Goods.

CO2: Able to identify characteristics and nature of Services.

CO3: Comprehend ways to design Services and evaluate them using Service qualities.

CO4: Understand how various methods can be used to operate and manage Service businesses.

CO5: Understand how innovation can be approached from Services point of view.

### **TEXT BOOKS:**

1. Fitzsimmons & Fitzsimmons, Service Management: Operations, Strategy, Information Technology, McGraw Hill publications (7th edition)

### **REFERENCES:**

1. Wilson, A., Zeithaml, V. A., Bitner, M. J., & Gremler, D. D. (2012). Services marketing: Integrating customer focus across the firm. McGraw Hill.
2. Lovelock, C. (2011). Services Marketing, 7/e. Pearson Education India

### PROFESSIONAL ELECTIVE III

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 current IT systems with an ERP system.
- Understand the infrastructure of ERP systems.
- Understand and know the modern Enterprise Information Systems

#### UNIT I 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 CHARACTERISTICS, APPLICATIONS 9

**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 integration techniques. Introduction to WSDL, SOAP. Introduction RESTful webservices 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.

#### UNIT V CLOUD APPLICATION DEVELOPMENT AND DEPLOYMENT 9

**Application development and deployment in cloud** – Docker, micro services, Kubernetes, Serverless. Continuous Integration/Continuous Delivery **Introduction to Enterprise 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: 45 PERIODS**

**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.

**TEXT BOOKS:**

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.

<b>21CB911</b>	<b>ADVANCE FINANCE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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 Capital Financing -Managing the Components of Working Capital- Cash Management- Receivable Management -Inventory Management.

**UNIT V 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: 45 PERIODS****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

**TEXT BOOKS:**

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.

<b>21CB904 BEHAVIORAL ECONOMICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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.

**UNIT I 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.

**UNIT V INTERTEMPORAL CHOICE 9**

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: 45 PERIODS**

**OUTCOMES:**

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

- CO1: Understand and apply various concepts in traditional and modern Microeconomics.
- 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.

**TEXT BOOKS:**

1. N. Wilkinson and M. Klaes , “An Introduction to Behavioral Economics”, 2017.
2. Paul A. Samuelson, William D. Nordhaus, Sudip Chaudhuri and AnindyaSen, “Economics”, 19<sup>th</sup> Edition, Tata McGraw Hill, 2010.

**REFERENCES:**

1. M.L.Trivedi, “Managerial Economics:Theory & Applications”, Tata McGraw-Hill Education, 4<sup>th</sup> Edition, 2002.
2. Robert H. Frank, “Microeconomics and Behaviour”, McGraw-Hill, 9<sup>th</sup> Edition, 2014.

<b>21CB905</b>	<b>COMPUTATIONAL FINANCE &amp; MODELING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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.

**UNIT I 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 methods for solving multi-factor models.

**UNIT II 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.

**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 of portfolio 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.

**TEXT BOOKS:**

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, Newport Beach, California, 2000.

## PROFESSIONAL ELECTIVE IV

21CB913	INTRODUCTION TO COGNITIVE SCIENCE	L	T	P	C
		3	0	2	4

### OBJECTIVES:

#### The Course will enable learners to:

- Know Introduction to Cognitive Science, Psychology, Nervous system and brain.
- Understand Brain and sensory motor information, Representation of sensory information
- Analyse From Sensation to Cognition; Roots of Cognitive Science
- Develop Language and Embodiment
- Implement Affordances in biological and artificial systems, Cognitive Development
- Make Attention, Learning, Memory, Reasoning, Social Cognition.

### UNIT I INTRODUCTION TO THE STUDY OF COGNITIVE SCIENCES 9

Introduction to the study of cognitive sciences - A brief history of cognitive science - Methodological concerns in philosophy - Artificial intelligence and psychology - Structure and constituents of the brain - Brief history of neuroscience - Mathematical models - Looking at brain signals - Processing of sensory information in the brain.

### UNIT II COGNITIVE MODELS 9

Brain Imaging - FMRI, MEG - PET, EEG - Multisensory integration in cortex - Information fusion - From sensation to cognition - Cybernetics - From physics to meaning, Analog vs. Digital: Code duality..

### UNIT III LINGUISTIC KNOWLEDGE 9

Linguistic knowledge: Syntax, semantics, (and pragmatics) - Generative linguistic - Brain and language - Language disorders - Lateralization - The great past tense debate - Cognitivist and emergent stand points - A robotic perspective

### UNIT IV AFFORDANCES 9

Direct perception - Ecological Psychology - Affordance learning in robotics - Child and robotic development - Attention and related concepts - Human visual attention - Computational models of attention - Applications of computational models of attention

### UNIT V CATEGORIES AND CONCEPTS 9

Logic; Machine learning - Constructing memories - Explicit vs. implicit memory - Information processing (three-boxes) model of memory - Sensory memory; Short term memory — Long term memory; Rationality - Bounded rationality; Prospect theory; Heuristics and biases - Reasoning in computers - Key points in social cognition - Context and social judgment; Schemas; Social signals.

## List of Experiments

1. Overview and practice Cognitive Science and its methodology concerns in philosophy.
2. Experimental approach to studying the working human brain and body. How to use Brain Voyager Brain Tutor. How to use the BESA dipole simulator.
3. Experimental approach to processing sensory information in the brain using python.
4. Overview and practice: Written materials needed to get a Cog Neuro research study with human subjects off the ground: Run sheets, SOPs, questionnaires, informed consent forms.
5. Introduction to EEG recordings. Theory, physiology, practical aspects of recording and analyzing scalp recorded brain potentials.
6. EEG analysis: How to get from the raw recording to specific brain waves. An example analysis.
7. Perform stemming operation in python using NLTK
8. Perform lemmatization in python using NLTK
9. Perform parts of speech tagging in python using NLTK
10. Writing and running Robot programs - Activity of PICK and Place of an object.
11. Make simulation model using Rockwell ARENA 11.0 to show the functions / predictions for a manufacturing work cell.
12. Simulation modeling of four machine system using Rockwell ARENA 11.0.
13. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
14. Evaluating ML algorithm with balanced and unbalanced datasets Comparison of Machine Learning algorithms.
15. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same dataset for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

**TOTAL: 30 PERIODS**

### **OUTCOMES:**

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

CO1: Construct automata, regular expression for any pattern

CO2: Understand brain and sensory motor information, representation of sensory information.

CO3: Analyse from sensation to cognition; Roots of Cognitive Science.

CO4: Implement affordances in biological and artificial systems, cognitive development.

CO5: Make attention, learning, memory, reasoning, social cognition

**TEXT BOOKS:**

1. Pradeep Kumar Mallick, Samarjeet Borah," Emerging Trends and Applications in Cognitive Computing", IGI Global Publishers, 2019.
2. Jose Luis Bermudez, "Cognitive Science: An Introduction to the Science of the Mind", Cambridge University Press, New York, 2020.

**REFERENCES:**

1. Stuart J. Russell, Peter Norwig , "Artificial Intelligence -A Modern approach", 3rd Pearson Education, 2016.
2. Draper, N. R. and Smith, H. Applied Regression Analysis (John Wiley) Third Edition. Hosmer, D. W. and Lemeshow, S. Applied Logistic Regression (Wiley), 1998.

<b>21CB914</b>	<b>INTRODUCTION TO IOT + LAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>

**OBJECTIVES:**

**The Course will enable learners to:**

- Understand basic principles and concepts of Internet-of-Things use cases, applications, architecture and technologies.
- An overview of an end to end IoT system encompassing the edge, cloud and application tiers.
- Build upon the foundations created in the pre-requisite courses and will equip the students to architect a complete IoT application on their own.
- Hands-on experiments that will lead to building an IoT application end-to-end.
- Expected to research and present their findings in a seminar format.

**UNIT I INTRODUCTION TO IOT AND USE CASES 9**

Understanding basic concepts of IoT- Consumer IoT vs Industrial Internet-Fundamental building blocks-Use Cases of IoT in various industry domains.

**UNIT II ARCHITECTURE 9**

IoT reference architectures, Industrial Internet Reference Architecture, Edge Computing, IoT Gateways, Data Ingestion and Data Processing Pipelines, Data Stream Processing

**UNIT III SENSORS AND INDUSTRIAL SYSTEMS 9**

Introduction to sensors and transducers, integrating sensors to sensor processing boards, introduction to industrial data acquisition systems, industrial control systems and their functions.

**UNIT IV NETWORKING AND COMMUNICATION FOR IOT 9**

Recap of OSI 7 layer architecture and mapping to IoT architecture, Introduction to proximity networking technologies (ZigBee, Bluetooth, Serial Communication), Industrial network protocols (Modbus, CANbus), Communicating with cloud applications ,web services, REST, TCP/IP and UDP/IP sockets, MQTT, WebSockets, protocols. Message encoding (JSON, Protocol Buffers)

Time Series Data and their characteristics, time series databases, basic time series analytics, data summarization and sketching, dealing with noisy and missing data, anomaly and outlier detection.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

- CO1: Understand basic principles and concepts of Internet-of-Things use cases, applications, architecture and technologies
- CO2: Get an overview of an end to end IoT system encompassing the edge, cloud and application tiers.
- CO3: Build upon the foundations created in the pre-requisite courses and will equip the students to architect a complete IoT application on their own.
- CO4: Build upon the foundations created in the pre-requisite courses and will equip the students to architect a complete IoT application on their own.
- CO5: Apply the concept to do research.

**Lab Exercises**

1. Setting up the Arduino Development Environment, connecting analog sensors to an Arduino Boarding and reading analog sensor data
2. Digital Input and Output reading using and Arduino board and Arduino Development Environment
3. Integrate an Arduino Board to a Raspberry Pi computer and send sensor data from Arduino to the R Pi
4. Setup Python on the R Pi and run sample R Pi programs on the R Pi. Read the data from Arduino using Python language
5. Connect a R Pi Camera module to the Raspberry Pi and using Python programming capture still images and video
6. Set up TCP/IP socket server on a PC. Send a message from the R Pi to the PC using socket communication
7. Set up a MQTT broker on the PC. Send data from R Pi to PC using MQTT protocol. Receive data from PC to R Pi using MQTT protocol
8. Connect LED lights to an Arduino. Connect the Arduino to the R Pi. Send Message from PC to R Pi via MQTT protocol. On receipt of the message , toggle the LED lights on the Arduino
9. Set up an account in a cloud service (such as Google / AWS or Azure). Set up a simple Http server using a language of your choice. Push the image captured from the R Pi camera to this web service. On receiving the image, store the image in a database or file
10. Develop a mobile application to view the images captured by the R Pi camera



**TEXT BOOKS:**

1. Samuel Greengard, The Internet of Things- Essential Knowledge Series, Samuel Greengard, MIT Press, 2019.

**REFERENCES:**

1. Industrial Internet Reference Architecture - <http://www.iiconsortium.org/IIRA.html>
2. World Economic Forum Report on Industrial Internet of Things - <https://www.weforum.org/reports/industrial-internet-things>
3. 50 Sensor Applications for a Smarter World - [http://www.libelium.com/resources/top\\_50\\_iot\\_sensor\\_applications\\_ranking/](http://www.libelium.com/resources/top_50_iot_sensor_applications_ranking/)
4. Ben Fry, Visualizing Data-Exploring and Explaining Data with the Processing Environment, Publisher: O'Reilly Media, 2020
5. Andrew K Dennis, Raspberry Pi Computer Architecture Essentials, Packt Publishing Limited, 2018
6. M. Banzi, Getting Started with Arduino, O Reilly Media, 2018
7. GSMA IoT Security Guidelines & Assessment - <https://www.gsma.com/iot/future-iot-networks/iot-security-guidelines/>

<b>21CB915</b>	<b>CRYPTOLOGY + LAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>

**OBJECTIVES:**

**The Course will enable learners to:**

- To understand the Basics of Number Theory.
- To be able to secure a message over an insecure channel by various means.
- To use a variety of public key cryptosystems and authentication methods.
- To gain a better understanding of the different security applications.
- To acquire a deeper insight of quantum computing on cryptography and security.

<b>UNIT I</b>	<b>INTRODUCTION</b>	<b>9</b>
Introduction to Cryptography: Elementary number theory, Pseudo-random bit generation, Elementary cryptosystems. Basic security services: confidentiality, integrity, availability, non-repudiation, privacy		
<b>UNIT II</b>	<b>SYMMETRIC KEY CRYPTOSYSTEMS</b>	<b>9</b>
Stream Cipher: Basic Ideas, Hardware and Software Implementations, Examples with some prominent ciphers: A5/1, Grain family, RC4, Salsa and ChaCha, HC128, SNOW family, ZUC; Block Ciphers: DES, AES, Modes of Operation; Hash Functions; Authentication		
<b>UNIT III</b>	<b>PUBLIC KEY CRYPTOSYSTEMS &amp; AUTHENTICATION</b>	<b>9</b>
Public Key Cryptosystems: RSA, ECC; Digital signatures		
<b>UNIT IV</b>	<b>SECURITY APPLICATIONS</b>	<b>9</b>
Electronic commerce (anonymous cash, micro-payments), Key management, Zero-knowledge protocols, Cryptology in Contact Tracing Applications, Issues related to Quantum Cryptanalysis		

## **UNIT V QUANTUM CRYPTANALYSIS & POST-QUANTUM CRYPTOGRAPHY 9**

Quantum cryptography, quantum encryption, Issues related to Quantum Cryptanalysis. Post-Quantum Cryptography: Lattice-based cryptography: NTRU, Hash-based cryptography: SPHINCS, Multivariate cryptography: Rainbow.

**TOTAL: 45 PERIODS**

### **List of Exercises:**

1. Program for the Implementation of Encryption using CAESAR CIPHER
2. Program for the Implementation of Decryption using CAESAR CIPHER
3. Program for the Implementation of One time Pad .
4. Hill cipher [ Implementation of Hill Cipher (Mini Project)]
5. Program for the Implementation of Double Transposition Cipher
6. Program for the Implementation of Transposition Cipher.
7. Program for the Implementation of Stream Cipher RC4.
8. Program for the Implementation of Diffie Hellman Algorithm
9. Program for the Implementation of RSA Algorithm .
10. Program for the Implementation of El-Gamal Cryptographic Algorithm
11. Mini Project Topics :
  1. Implementation of Hill Cipher
  2. Implementation of DES
  3. Implementation of POLYALPHABETIC CIPHER

**TOTAL: 30 PERIODS**

### **COURSE OUTCOMES:**

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

- CO1: Understand and apply the various concepts of basics of Number Theory.  
CO2: Secure a message over an insecure channel by numerous symmetric key cryptosystem.  
CO3: Apply diverse Public Key Cryptosystem & Authentication.  
CO4: Implement varied security applications.  
CO5: Understand the implications of quantum computing on cryptography and security.

### **TEXT BOOKS:**

1. Douglas R. Stinson, "Cryptography, Theory and Practice", CRC Press, 3rd Edition, 2018.
2. Stallings William, "Cryptography and Network Security - Principles and Practice", Pearson, Seventh Edition, 2017.
3. Handbook of Applied Cryptography. A. J. Menezes, P. C. van Oorschot, and S. A. Vanstone, CRC Press, 2019

### **REFERENCES:**

1. N. Koblitz, A course in number theory and cryptography. GTM, Springer, 2016
2. W. Stallings, Cryptography and Network Security. Prentice Hall, 2016
3. R. Anderson, Security Engineering, Wiley, 2017
4. G. Paul and S. Maitra, RC4 Stream Cipher and Its Variants. CRC Press, Taylor & Francis Group, A Chapman & Hall Book, 2012
5. C. S. Mukherjee, D. Roy, S. Maitra, Design & Cryptanalysis of ZUC - A Stream Cipher in Mobile Telephony. Springer 2020

6. P. Chakraborty, S. Maitra, M. Nandi, S. Talnikar, Contact Tracing in Post-Covid World - A Cryptologic Approach. Springer 2020
7. Presskil Lecture notes: Available online: <http://www.theory.caltech.edu/~preskill/ph229/>

<b>21CB918</b>	<b>MOBILE COMPUTING + LAB</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>

**OBJECTIVES:**

- To learn about the mobile infrastructure, radio resource management, overview of generation 1G to 5G.
- To illustrate the location management involved in GSM, Mobile IP.
- To illustrate the transmission, transaction technology involved in mobile.
- To explore the wireless network in mobile.
- To discover the cognitive radio networks in mobile.

**UNIT I INTRODUCTION 9**

Overview of wireless and mobile infrastructure; Preliminary concepts on cellular architecture; Design objectives and performance issues; Radio resource management and interface; Propagation and path loss models; Channel interference and frequency reuse; Cell splitting; Channel assignment strategies; Overview of generations:- 1G to 5G.

**UNIT II LOCATION AND HANDOFF MANAGEMENT 9**

Introduction to location management (HLR and VLR); Mobility models characterizing individual node movement (Random walk, Fluid flow, Markovian, Activity based); Mobility models characterizing the movement of groups of nodes (Reference point based group mobility model, Community based group mobility model); Static (Always vs. Never update, Reporting Cells, Location Areas) and Dynamic location management schemes (Time, Movement, Distance, Profile Based); Terminal Paging (Simultaneous paging, Sequential paging); Location management and Mobile IP; Overview of handoff process; Factors affecting handoffs and performance evaluation metrics; Handoff strategies; Different types of handoffs (soft, hard, horizontal, vertical)

**UNIT III WIRELESS TRANSMISSION FUNDAMENTALS 9**

Introduction to narrow and wideband systems; Spread spectrum; Frequency hopping; Introduction to MIMO; MIMO Channel Capacity and diversity gain; Introduction to OFDM; MIMO-OFDM system; Multiple access control (FDMA, TDMA, CDMA, SDMA); Wireless local area network; Wireless personal area network (Bluetooth and ZigBee).

**UNIT IV MOBILE AD-HOC NETWORKS AND WIRELESS SENSOR NETWORKS 9**

Characteristics and applications; Coverage and connectivity problems; Routing in MANETs. Concepts, basic architecture, design objectives and applications; Sensing and communication range; Coverage and connectivity; Sensor placement; Data relaying and aggregation; Energy consumption; Clustering of sensors; Energy efficient Routing (LEACH).

**UNIT V COGNITIVE RADIO NETWORKS AND D2D COMMUNICATIONS IN 5G CELLULAR NETWORKS 9**

Fixed and dynamic spectrum access; Direct and indirect spectrum sensing; Spectrum sharing; Interoperability and co-existence issues; Applications of cognitive radio

networks. Introduction to D2D communications; High level requirements for 5G architecture; Introduction to the radio resource management, power control and mode selection problems; Millimeter wave communication in 5G.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

**CO1:** Understand and apply the various concepts of Basics of Number Theory

**CO2:** Secure a message over an insecure channel by numerous symmetric key cryptosystem

**CO3:** Apply diverse Public Key Cryptosystem & Authentication

**CO4:** Implement varied Security Applications

**CO5:** Understand the implications of quantum computing on cryptography and security

**TEXT BOOKS:**

1. Jochen Schiller, Mobile Communications, Pearson Education, 2019
2. Andrea Goldsmith, Wireless Communications., Cambridge University Press, 2018

**REFERENCES:**

1. Theodore Rappaport, Wireless Communications: Principles and Practice., Pearson Education, 2020
2. Ezio Biglieri, Wireless Communications. MIMO, Cambridge University Press., 2016
3. Ivan Stojmenovic, Handbook of Wireless Networking and Mobile Computing. Wiley., 2019
4. James Cowling, Dynamic Location Management in Heterogeneous Cellular Networks. 2020
5. MIT Thesis. <http://people.csail.mit.edu/cowling/hons/jcowling-dynamic-Nov04.pdf>

## PROFESSIONAL ELECTIVE V

21CB916	QUANTUM COMPUTATION AND QUANTUM INFORMATION	L	T	P	C
		3	0	0	3

### The Course will enable learners to:

- To learn about Quantum information Design CFG for any given language and prove its equivalence
- To gain knowledge about Quantum algorithms.
- To understand and learn about Quantum random number generators.
- To study the basis of Post-Quantum cryptography.

### UNIT-I INTRODUCTION TO QUANTUM INFORMATION 9

States, Operators, Measurements, Quantum Entanglement: Quantum Teleportation, Super-dense coding, CHSH Game, Quantum gates and circuits.

### UNIT-II QUANTUM ALGORITHMS 9

Deutsch-Jozsa, Simon, Grover, Shor, Implication of Grover's and Simon's algorithms towards classical symmetric key cryptosystems, Implication of Shor's algorithm towards factorization and Discrete Logarithm based classical public key cryptosystems.

### UNIT-III QUANTUM TRUE RANDOM NUMBER GENERATORS 9

Detailed design and issues of quantum Ness, Commercial products and applications.

### UNIT-IV QUANTUM KEY DISTRIBUTION 9

BB84, Ekert, Semi-Quantum QKD protocols and their variations, Issues of Device Independence, Commercial products.

### UNIT-V INTRODUCTORY TOPICS IN POST-QUANTUM CRYPTOGRAPHY 9

API-Public-key Signatures, Key Encapsulation Mechanism (KEM), Digital Signature standard, Pair-Wise Key Establishment-Discrete Logarithm Cryptography, Integer Factorization Cryptography.

**TOTAL: 45 PERIODS**

### Text Book:

1. M. A. Nielsen and I. L. Chuang, "Quantum Computation and Quantum Information", Cambridge University Press, 10th Edition, 2019.
2. Presskil Lecture notes: Available online: <http://www.theory.caltech.edu/~preskill/ph229/>

### Reference Books :

1. P. Kaye, R. Laflamme, and M. Mosca, "An Introduction to Quantum Computing". Oxford University Press, New York, 2018
2. N. David Mermin, "Quantum Computer Science", Cambridge University Press. 2019
3. Quantum Cryptography. D. Unruh:, Available online: [https://courses.cs.ut.ee/all/MTAT.07.024/2017\\_fall/uploads/](https://courses.cs.ut.ee/all/MTAT.07.024/2017_fall/uploads/)
4. SAPV Tharmashastha, D. Bera, A. Maitra and S. Maitra, "Quantum Algorithms for Cryptographically Significant Boolean Functions - An IBMQ Experience", Springer, 2020.

5. Quantum Algorithm Zoo. <https://quantumalgorithmzoo.org/>
6. A. J. Menezes, P. C. van Oorschot, and S. A. Vanstone, "Handbook of Applied Cryptography", CRC Press, 2018

<b>21CB912</b>	<b>IMAGE PROCESSING AND PATTERN RECOGNITION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		3	0	0	3

**OBJECTIVES:**

**The Course will enable learners to:**

- Learn the fundamentals of image formation and formats.
- Understand the intensity transformations and filtering techniques.
- Acquire knowledge on image segmentation operations.
- Learn the feature extraction and image registration process.
- Understand the components of colour image processing.

**UNIT I INTRODUCTION AND IMAGE FORMATION 9**

Introduction - Image processing systems and its applications - Basic image file formats. Image formation: Geometric and photometric models; Digitization - sampling, quantization; Image definition and its representation, neighborhood metrics.

**UNIT III INTENSITY TRANSFORMATIONS AND SPATIAL FILTERING 9**

Enhancement, contrast stretching, histogram specification, local contrast enhancement; Smoothing, linear and order statistic filtering, sharpening, spatial convolution, Gaussian smoothing, DoG, LoG. Morphological Filtering Basics - Dilation and Erosion Operators, Top Hat Filters.

**UNIT III IMAGE SEGMENTATION 9**

Pixel classification; Grey level thresholding, global/local thresholding; Optimum thresholding - Bayes analysis, Otsu method; Derivative based edge detection operators, edge detection/linking, Canny edge detector; Region growing, split/merge techniques, line detection, Hough transform.

**UNIT IV FEATURE EXTRACTION AND IMAGE REGISTRATION 9**

Textural features - gray level co-occurrence matrix; Moments; Connected component analysis; Convex hull; Distance transform, medial axis transform, skeletonization/thinning, shape properties. Mono-modal/multimodal image registration; Global/local registration; Transform and similarity measures for registration; Intensity/pixel interpolation.

**UNIT V COLOUR IMAGE PROCESSING 9**

Fundamentals of different Colour models - RGB, CMY, HSI, YCbCr, Lab; False Colour; Pseudo Colour; Enhancement.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

- CO1: Be familiar with the fundamentals of image formation and formats.
- CO2: Perform image transformation functions and filtering operations.
- CO3: Apply the segmentation techniques on the images.
- CO4: Extract the features of an image and perform image registration.
- CO5: Able to do colour image processing and conversion operations.

**TEXT BOOKS:**

1. R. C. Gonzalez and R. E. Woods, "Digital Image Processing", Pearson, 4 th Edition, 2018.
2. Maria Petrou and Panagiota Bosdogianni, "Image Processing: The Fundamentals", John Wiley & Sons, Ltd, 2 nd Edition , 2010.

**REFERENCES:**

1. K. R. Castleman, "Digital Image Processing", Prentice Hall, Englewood Cliffs, 1 st Edition, 1995.
2. A. N. Netravali and B. G. Haskell, "Digital Pictures", Plenum Press, 2nd Edition, 1995

<b>21CB906 INDUSTRIAL PSYCHOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	3	0	0	3

**OBJECTIVES:**

**The Course will enable learners to:**

- Introduces students to the content areas of industrial psychology and the application of psychological theory to organizational issues.
- Topics include employment law, job analysis, recruitment and selection, training, performance appraisal and discipline, employee motivation, and workplace safety.
- Using an applied approach, this course will help prepare students for their roles as employees and managers.

**UNIT I INTRODUCTION 9**

Research Methods, Statistics, and Evidence-based Practice, Introduction & Legal Context of Industrial Psychology, Job Analysis & Competency Modeling, Job Evaluation & Compensation, Job Design & Employee Well-Being, Recruitment.

**UNIT II TEST AND MEASTURES 9**

Identifying Criteria & Validating Tests and Measures, Screening Methods, Intensive Methods.

**UNIT III PERFORMANCE 9**

Performance Goals and Feedback, Performance Coaching and Evaluation, Evaluating Employee Performance.

**UNIT IV EMPLOYEE MOTIVATION 9**

Employee Motivation, Satisfaction and Commitment, Fairness and Diversity.

**UNIT V LEADERSHIP 9**

Leadership, Organizational Climate, Culture, and Development, Teams in Organizations, The Organization of Work Behavior, Stress Management: Demands of Life and Work.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

CO1: Become conversant about the major content areas of Industrial Psychology.

CO2: Gain further comfort with statistical concepts in the context of making personnel decisions.

CO3: Gain practical experience by completing a series of hands-on projects involving job analysis, selection decisions, training programs, and employee well-being.

CO4: Deepen your understanding of tests and measurements so that you can collect accurate information and make sound data-based decisions.

CO5: Prepare for other focused seminar courses in Industrial/Organizational Psychology or Human Resource Management.

**TEXT BOOKS:**

1. Elmes, D., Kantowitz, B., & Roediger, H, "Research methods in psychology", Cengage Learning, 9<sup>th</sup> Edition, 2011.
2. Landy, F. J. and Conte, J. M, "Work in the 21st Century", Oxford: Blackwell Publishing, 4<sup>th</sup> Edition, 2013.

**REFERENCES:**

1. TV.Rao, "Performance Management towards Organizational Excellence", Sage, 2<sup>nd</sup> Edition, 2016.
2. Stephen Robbins, Tim Judge, Neharika Vohra, "Organizational Behaviour", Pearson, 18<sup>th</sup> Edition, 2019.

**21CB920 FINANCIAL AND COST ACCOUNTING**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
2	2	0	3

**OBJECTIVES:**

**The Course will enable learners to:**

- Create an awareness about the importance and usefulness of the accounting concepts and their managerial implications
- Develop an understanding of the financial statements and the underlying principles and learn to interpret financial statements
- Create an awareness about cost accounting, different types of costing and cost management

**UNIT I ACCOUNTING CONCEPT**

**6+6**

Introduction, Techniques and Conventions, Financial Statements- Understanding & Interpreting Financial Statements

**UNIT II ACCOUNTING PROCESS**

**6+6**

Book Keeping and Record Maintenance, Fundamental Principles and Double Entry Journal, Ledger, Trial Balance, Balance Sheet, Final Accounts, Cash Book and Subsidiary Books, Rectification of Errors

**UNIT III FINANCIAL STATEMENT**

**6+6**

Form and Contents of Financial Statements, Analyzing and Interpreting Financial Statements, Accounting Standards. Class Discussion: Corporate Accounting Fraud- A Case Study of Satyam.



**UNIT IV CASH FLOW AND FUND FLOW TECHNIQUES****6+6**

Introduction, How to prepare cash flow and fund flow, Difference between them. **Costing Systems:** Elements of Cost, Cost Behavior, Cost Allocation, OH Allocation Unit Costing, Process Costing, Job Costing, Absorption Costing, Marginal Costing, Cost Volume Profit Analysis, Budgets, ABC Analysis, Class Discussion: Application of costing concepts in the Service Sector.

**UNIT V COMPANY ACCOUNTS AND ANNUAL REPORTS****6+6**

Audit Reports and Statutory Requirements, Directors Report, Notes to Accounts, Pitfalls.

**TOTAL: 60 PERIODS****OUTCOMES:**

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

- CO1: Understand the theories, concept, and evolution of management.
- CO2: Demonstrate the ability to employ the management way of thinking.
- CO3: Understand how organizations work and find it easier to grasp the intricacies of other management areas such as finance, marketing, strategy etc.
- CO4: Understand the qualities of a leader in the managerial aspect in future terms.
- CO5: Understand the managerial ethics and CSR and its importance.

**TEXT BOOKS:**

1. Robert N Anthony, David Hawkins, Kenneth Marchant, "Accounting: Texts and Cases", Thirteenth Edition, McGraw-Hill, 2017.
2. M.Y.Khan & P.K.Jain, "Management Accounting", Tata McGraw Hill, 2011.

**REFERENCES:**

1. R.Narayanaswamy, Financial Accounting - A managerial perspective, Fifth Edition, PHI Learning, New Delhi, 2011.
2. Jan Williams, "Financial and Managerial Accounting - The basis for business Decisions", Fifteenth Edition, Tata McGraw Hill Publishers, 2010.

**21CB921 ORGANIZATIONAL BEHAVIOUR**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
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.

**UNIT I 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 self-projection; 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.

**UNIT V INTERTEMPORAL CHOICE 9**

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: 45 PERIODS**

**OUTCOMES:**

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

- CO1: Understand and apply various concepts in traditional and modern Microeconomics.
- 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.

**TEXT BOOKS:**

1. N. Wilkinson and M. Klaes , “An Introduction to Behavioral Economics”, 2022.
2. Paul A. Samuelson, William D. Nordhaus, Sudip Chaudhuri and Anindya Sen, “Economics”, 19<sup>th</sup> Edition, Tata McGraw Hill, 2010.

**REFERENCES:**

1. M.L.Trivedi, “Managerial Economics: Theory & Applications”, Tata McGraw-Hill Education, 4<sup>th</sup> Edition, 2022.
2. Robert H. Frank, “Microeconomics and Behaviour”, McGraw-Hill, 9<sup>th</sup> Edition, 2014.



## 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.

<b>21CB002</b>	<b>OBJECT ORIENTED PROGRAMMING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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.

### **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 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 SortedSet) Atomic data types

(AtomicInteger, AtomicLong, AtomicIntegerArray), CountdownLatch, BlockingQueue  
 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**

**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.

**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.

<b>21CB003</b>	<b>COMPILER DESIGN</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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

**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 SYNTAX 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.

**TOTAL: 45 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.

<b>21CB004 BUSINESS STRATEGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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 FIRM'S INTELLECTUAL ASSETS 9**

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 Portfolio 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.

<b>21CB005 DESIGN THINKING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	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.

**UNIT I INTRODUCTION 9**

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

**UNIT II EMPATHIZE PHASE 9**

Empathize phase - Steps involved - Immersion activity- Questionnaire - Empathy map for case study

**UNIT III DEFINE PHASE****9**

Creation of personas in define phase - steps in problem statement creation - problem statement definition - Examples - Key problem statements.

**UNIT IV IDEATION PHASE****9**

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

**UNIT V 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: 45 PERIODS****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.



# HONOURS DEGREE COURSES

21CB921	PYTHON FOR 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 analytics and Big Data - facets of data - data analytics process - 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.

## UNIT III MANIPULATION WITH PANDAS 9+8

Data manipulation with Pandas - Data Indexing and Selection - Handling missing data - Hierarchical indexing - Combining datasets - Aggregation and Grouping - String operations - 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 data

like None, Nan.

5.Manipulate on the operation of Null Vaues (is null(), not null(), dropna(), fillna())

#### **UNIT IV DATA ANALYTICS IN SPREADSHEET**

**9+6**

Importing Data into Excel from Different Data Source -Data Cleansing and Preliminary Data Analysis-Correlations and the importance of Variables Technical Requirements-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

#### **UNIT V DATA VISUALIZATION**

**9+8**

Importing Matplotlib - Simple line plots - Simple scatter plots - visualizing errors - density and contour 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:75 ERIODS**

#### **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 analytics using excel & Python
- CO5: Interpret data using visualization tools in Python

#### **TEXT BOOKS:**

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. Roger D. Peng, R Programming for Data Science, Lulu.com, 2016
2. Laura Igual, Santi Seguí, "Introduction to Data Science: A Python Approach to Concepts, Techniques and Applications", 1st Edition, Springer, 2017
3. Peter Bruce, Andrew Bruce, "Practical Statistics for Data Scientists: 50 Essential Concepts", 3rd Edition, O'Reilly, 2017
4. Hector Guerrero, “Excel Data Analysis: Modelling and Simulation”, Springer International Publishing, 2nd Edition, 2019

21CB922	<b>BUSINESS INTELLIGENCE AND ANALYTICS</b> (Lab Integrated)	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		3	0	2	3

**OBJECTIVES:**

**The Course will enable learners to:**

- To understand the business intelligence (BI) methodology and concepts.
- To learn about descriptive, inferential statistics and data warehousing operations.
- To analyze wide range of applications of data mining.
- To analyze the various prescriptive analytics methods.
- To develop and deploy Business Analytic Models.

**UNIT I 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.

**UNIT II 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 expectancy and GDP per capita by year for different countries and regions, Explore and visualize the data using appropriate plots, and develop meaningful insights.

**UNIT III 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. Perform Customer Review Sentiment Analysis with text data extracted from customer reviews of a certain company and explore it using specialized statistical and linguistic tools to 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.

#### **UNIT IV 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.

#### **UNIT V 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, Dursun Delen, Efraim Turban, "Business Intelligence, Analytics, and Data Science: A Managerial Perspective", Pearson, 4th Edition, 2018.
2. Jesper Thorlund & Gert H.N. Laursen, "Business Analytics for Managers: Taking Business 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", 2nd Edition, Wiley, 2016.

**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 the foundation of cognitive computing- understanding cognition.

**UNIT II DESIGN PRINCIPLES FOR COGNITIVE SYSTEMS AND NLP IN COGNITIVE SYSTEMS 12**

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 motion and 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 system 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- Apply 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, Venu Govindaraju, C.R. Rao, "Cognitive Computing: Theory and Applications", Elsevier publications, North Holland Publication, 1st Edition, 2016.

2. Mallick, Pradeep Kumar, Borah, Samarjeet, "Emerging Trends and Applications in Cognitive Computing", IGI Global Publishers, 2019.

### **MINOR DEGREE COURSES**

<b>22CB924</b>	<b>SOFTWARE DEVELOPMENT PRACTICES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>

#### **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 - Git Aliases - 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 - Client-Side Scripting versus Server-side Scripting – HTML5 – Headings – Linking – Images – Special Characters and Horizontal Rules - Lists - Tables - Forms - Internal Linking - meta Elements - 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 BOOKS:**

1. Roger S. Pressman, "Software Engineering: A Practitioner's Approach", McGraw Hill International Edition, Ninth 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](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013382690411003904735_shared/overview)
7. [https://infyspringboard.onwingspan.com/web/en/app/toc/lex\\_auth\\_0130944214274703362099\\_shared/overview](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0130944214274703362099_shared/overview)

**LIST OF EQUIPMENTS:**

Systems with either Netbeans or Eclipse

Java/JSP/ISP Webserver/Apache

Tomcat / MySQL / Dreamweaver or

Equivalent/ Eclipse, WAMP/XAMP



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
  - Perimeter of an Rectangle
  - Employ Arrow functions
  - Employ HOC

**UNIT III** **REACT COMPONENTS** **9+6**

Class vs Functional Components, React Class Based Components – component DidMount, WillUpdate, shouldupdate, didcatchetc - State - useState, useRef, useEffect, useHistory Usage and Props(difference, when to use what, mutable or immutability, 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+6**

Custom Hooks, HTTP - Fetch, Axios, Services, Behaviour Subjects - StateLess, StateFull and Container Components, Error Handling - Build, Env, CORS, Unit Testing w React Testing 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
- 1) Enable Exception Handling
- 2) Enable HOC and Aux Components
- 3) Implement React-Testing Library

**Business Use Case Implementations**

- 1) Student Management System
- 2) Retail Bank System
- 3) eCommerce System
- 4) Student LMS Management System

## **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 .

## **TEXTBOOKS:**

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 (β 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	<b>SERVER SIDE PROGRAMMING WITH RUBY ON RAILS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		3	0	2	4

## OBJECTIVES:

**The Course will enable learners to:**

- To build web applications using the Ruby on 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

- 1) 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.
- 2) 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

- 1) 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.
- 2) 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

- 1) 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.
- 2) 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 Pipeline - ActiveRecord Migration - ActiveRecord Association - Cookies - Session - ActionDispatch - ActiveRecord Validation

**List of Exercise/Experiments**

- 1) Create a to-do list web application using Ruby on Rails.
- 2) 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**

- 1) Create a web application using Ruby on Rails to manage comments for the post from the users.
- 2) Create an online ecommerce marketplace web application using Ruby on Rails.

**TOTAL:45+30=75 PERIODS**

**OUTCOMES:**

**At the end of the 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, Edd Dumbill, "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, Dániel Szabó, "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