Nagarjuna College of Engineering & Technology, Bengaluru

An Autonomous Institute, Affiliated to VTU Belagavi

Scheme & Syllabus
of
IV Sem ISE

As per the NEP 2020 Guidelines,
Choice-Based Credit System
&
Outcome-Based Education

Information Science & Engineering

w.e.f.

Academic Year 2022-2023

VISION

To disseminate the IT knowledge among the students for achieving excellence in education and to irradiate budding engineers as leaders in information technology.

MISSION

M1: To maintain leadership and excellence in Information Technology.

M2: Achieving excellence in IT through analysis, design, development of software products

M3: Developing communication skills, leadership qualities and team work among students' community by providing opportunities to work on various projects through internship with industrypartners

M4: To inculcate Ethics and Human values for solving societal problems and environmental protection.

M5: Promoting research, higher studies and entrepreneurship among the students through outside world interaction

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

The graduates of Information Science and Engineering are expected to fulfil the following PEOs after a few years of their graduation.

PEO1: Pursue a successful career in the field of Information Science & Engineering or a related field utilizing his/her education and contribute to the profession as an excellent employee, or as an entrepreneur.

PEO2: Be able to work effectively in multidisciplinary environments and be responsible members/leaders of their communities

PEO3: The graduates of Information Science and Engineering Program should be able to establish an understanding of professionalism, teamwork, ethics, public policy that allows them to become good professional Engineers

PEO4: The graduates of Information Science and Engineering Program should be able to provide novel engineering solutions and efficient software designs with legal and ethical responsibility.

PEO5: Continuously improve by pursuing advanced degrees in engineering, business, or other professional fields through formal means or through informal self-study.

PROGRAM OUTCOMES (POs)

Graduates of the Information Science and Engineering Programmee will be able to achieve the following POs:

PO1: Engineering Knowledge
Apply the knowledge of mathematics, science, engineering fundamentals, and Information Science and Engineering principles to the solution of complex problems in Information Science and Engineering.

PO2: Problem Analysis
Identify, formulate, research literature, and analyze complex Information Science and Engineering problems reaching substantiated conclusions using first principles of mathematics and engineering sciences.

PO3: Design/Development of Solutions
Design solutions for complex Information Science and Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the publichealth and safety, and the cultural, societal, and environmental considerations.

PO4: 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 related to Information Science and Engineering problems.

PO5: Modern Tool Usage
Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex Information Science and Engineering activities with an understanding of the limitations.

PO6: 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 Information Science and Engineering practice.

PO7: Environment and Sustainability
Understand the impact of the professional **Information Science and Engineering** solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics
Apply ethical principles and commit to professional ethics and responsibilities and norms of the Information Science and Engineering practice.

PO9: Individual and Team work
Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication
Communicate effectively on complex Information Science and 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.

PO11: 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 Information Science and Engineering projects and in multidisciplinary environments.

PO12: 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.

PROGRAM SPECIFIC OUTCOMES (PSOs)

Program Specific Outcomes (PSOs) are what the graduates of a specific undergraduate engineering program should be able to do at the time of graduation.

PSO1: Professional Skills
The ability to understand, analyze and develop algorithms and write Information application programs in the areas related to information technology

PSO2: Problem-Solving Skills
Ability to understand the ethics, human values for solving societal problems and environmental protection

PSO3: Foundation of mathematical concepts
Ability to understand the software development skills and practical knowledge for promoting research, higher studies and entrepreneurship.

NAGARJUNA COLLEGE OF ENGINEERING & TECHNOLOGY, BENGALURU

B.E. in Information Science & Engineering

Scheme of Teaching and Examination 2021-22

Outcome-Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the Academic Year 2021-22)

IV SEMESTER

Sl. No.	Course and Course Code		Course Title	Teaching Department	Teaching Hours / Week				Duration in Hours	Examination			
					Theory / Lecture	Tutorial	Practical / Drawing	Self-study Component		CIE Marks	SEE Marks	Total Marks	Credits
					L	T	P	S					
1	BSC	21CSM41	Mathematical Foundations for Computing	Maths	2	2	0	0	3	50	50	100	3
2	IPCC	21ISI42	Design and Analysis of Algorithms	CSEB	3	0	2	0	3	50	50	100	4
3	IPCC	21ISI43	Computer Networks	CSEB	3	0	2	0	3	50	50	100	4
4	PCC	21IST44	Operating System	CSEB	3	0	0	0	3	50	50	100	3
5	AEC	21BET45	Biology for Engineers	BT/BSC / CSEB	2	0	0	0	2	50	50	100	2
6	PCC	21ISL46	Python Programming Lab	CSEB	0	0	2	0	3	50	50	100	1
7	HSMC	21CIP47	Constitution of India and Professional Ethics	HSMC	1	0	0	0	1	50	50	100	1
8	AEC	21ISL48X	Ability Enhancement Course – IV	Any Dept	0	0	2	0	1	50	50	100	1
9	UHV	21UHV49	Universal Human Values	Any Dept.	1	0	0	0	1	50	50	100	1
10	INT	21INT49	Inter/Intra Institutional Internship	Completed during the intervening period of II and III semesters by students admitted to first year of BE./B.Tech. and during the intervening period of III and IV semesters by Lateral entry students admitted to III semester. Evaluation by the appropriate authorities					3	100	--	100	2
11	EDC	21EDC49	Entrepreneurship Development Course – 2	ISE / EDC	0	2	0	0	1	Audit Course			
				TOTAL	15	4	8	0	21	550	450	1000	22

Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs

1	NCMC	21MATDIP41	Additional Mathematics – II	Maths	2	2	--	--	--	100	--	100	0

Note: BSC: Basic Science Course, **PCC**: Professional Core Course, **HSMC**: Humanity and Social Science & Management Courses, AEC –Ability Enhancement Courses. **INT**–Internship, **UHV**- Universal Human Value Courses, **IPCC**: Integrated Professional Core Course, **CSEB** – Computer Science and Engg. Board (CS / IS / AI / AD/ IC / CD)
L–Lecture**, T–**Tutorial, **P-**Practical/Drawing, **S–**Self Study Component, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Examination

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with Practical's of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (BE/B.Tech.) 2021-22 may be referred.

Non–credit mandatory courses (NCMC):

(A) Additional Mathematics I and II:

(1) These courses are prescribed for III and IV semesters respectively to lateral entry Diploma holders admitted to III semester of B.E./B.Tech., programs. They shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks. These courses are slated for CIE only and has no SEE.

(2) Additional Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

(3) Successful completion of the courses Additional Mathematics I and II shall be indicated as satisfactory in the grade card. Non-completion of the courses Additional Mathematics I and II shall be indicated as Unsatisfactory.

(B) National Service Scheme/Physical Education (Sport and Athletics)/ Yoga:

(1) Securing 40 % or more in CIE,35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

(2) In case, students fail to secure 35 % marks in SEE, they have to appear for SEE during the subsequent examinations conducted by the University.

(3) In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequent semester/s to earn the qualifying CIE marks.

(4) Successful completion of the course shall be indicated as satisfactory in the grade card. Non-completion of the course shall be indicated as Unsatisfactory.

(5) These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

Ability Enhancement Course – III	
21ISL481	Web Programming
21ISL482	Unix Shell Programming
21ISL483	R Programming

Internship of 04 weeks during the intervening period of IV and V semesters; 21INT68 Innovation/ Entrepreneurship/ Societal based Internship.

(1) All the students shall have to undergo a mandatory internship of 04 weeks during the intervening period of IV and V semesters. The internship shall be slated for CIE only and will not have SEE. The letter grade earned through CIE shall be included in the VI semester grade card. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be considered under F (fail) grade and shall have to complete during subsequently after satisfying the internship requirements.

(2) Innovation/ Entrepreneurship Internship shall be carried out at industry, State and Central Government /Non-government organizations (NGOs), micro, small and medium enterprise (MSME), Innovation centres or Incubation centres. Innovation need not be a single major breakthrough; it can also be a series of small or incremental changes. Innovation of any kind can also happen outside of the business world. Entrepreneurship internships offers a chance to gain hands on experience in the world of entrepreneurship and helps to learn what it takes to run a small entrepreneurial

business by performing intern duties with an established company. This experience can then be applied to future business endeavours. Start-ups and small companies are a preferred place to learn the business tack ticks for future entrepreneurs as learning how a small business operates will serve the intern well when he/she manages his/her own company. Entrepreneurship acts as a catalyst to open the minds to creativity and innovation. Entrepreneurship internship can be from several sectors, including technology, small and medium-sized, and the service sector.

(3) Societal or social internship.

Urbanization is increasing on a global scale; and yet, half the world's population still resides in rural areas and is devoid of many things that urban population enjoy. Rural internship, is a work-based activity in which students will have a chance to solve/reduce the problems of the rural place for better living. As proposed under the AICTE rural internship programme, activities under Societal or social internship, particularly in rural areas, shall be considered for 40 points under AICTE activity point programme.

MATHEMATICAL FOUNDATIONS FOR COMPUTING			
Course Code	**21CSM41**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (2:2:0:0)	**Credits (2:2:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

The goal of the course Mathematical Foundations For Computing- 21CSM 41 is to

- Understand an intense foundational introduction to fundamental concepts in discrete mathematics.
- Interpret, identify, and solve the language associated with logical structure, sets, relations and functions, modular arithmetic.
- Have insight into Statistical methods, Correlation and regression analysis. Fitting of curves.
- To develop probability distribution of discrete and continuous random variables, Joint probability distribution occurs in digital signal processing, design engineering and microwave engineering.
- To understand the concept of sampling and inference.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods maybe adopted so that the delivered lessons shall develop students theoretical and applied mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students for group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution of some exercises (post-lecture activity).

Module-1

Fundamentals of Logic: Basic connectives and truth tables, Logical equivalence – The laws of Logic, Logical implication – Rules of Inference. Fundamentals of Logic contd.: The Use of Quantifiers- Quantifiers, Definitions, and the Proofs of Theorems.

8 Hours

Self-study: Problems on Logical equivalence.[Text 1: 2.1, 2.2, 2.3, 2.4, 2.5]
(RBT Levels: L1, L2 and L3)

Module-2

Relations and Functions: Cartesian Products and Relations, Functions – Plain and One-to-One, Onto Functions. Function Composition, and Inverse Functions.

Relations: Properties of Relations, Computer Recognition – Zero-One Matrices and DirectedGraphs,Partial Orders – Hasse Diagrams, Equivalence Relations and Partitions.

Introduction to Graph Theory: Definitions and Examples, Subgraphs, Complements, andGraph Isomorphism, Vertex Degree, Euler Trails and Circuits.

8 Hours

Self-study: The Pigeon-hole Principle, problems and its applications.

[Text 1: 5.1, 5.2, 5.3, 5.6, 7.1, 7.2, 7.3, 7.4, 11.1, 11.2, 11.3]

(RBT Levels: L1, L2 and L3)

Module-3

Curve Fitting: Curve fitting by the method of least squares- fitting the curves of the form- $y = ax + b$, $y = ax^b$, $= ax^2 + bx + c$.

Statistical Methods: Correlation and regression-Karl Pearson's coefficient of correlation and rank correlation-problems. Regression analysis- lines of regression –problems.

8 Hours

Self-study: Fitting of the curve $y = ax^b$. Angle between two regression lines, problems.

[Text 1: 24.1, 24.4, 24.5, 24.6, 25.12, 25.13, 25.14, 25.16]

(RBT Levels: L1, L2 and L3)

Module-4

Probability Distribution.

Review of basic probability theory. Random variables (discrete and continuous), probability mass and density functions. Mathematical expectation, mean and variance. Binomial, Poisson and normal distributions- problems (derivations for mean and standard deviation for Binomial and Poisson distributions only)-Illustrative examples.

8 Hours

Self-study: exponential distribution.

[Text 1: 26.1, 26.2, 26.7, 26.8, 26.9, 26.10, 26.13, 26.14, 26.15, 26.16]

(RBT Levels: L1, L2 and L3)

Module-5

Joint probability distribution: Joint Probability distribution for two discrete random variables, expectation, covariance and correlation.

Sampling Theory: Introduction to sampling distributions, standard error, Type-I and Type-II errors. Test of hypothesis for means, student's t-distribution, Chi-square distribution as a test of goodness of fit.

8 Hours

Self-Study: Point estimation and interval estimation

[Text 1: 27.1, 27.2, 27.3, 27.4 27.5, 27.6, 27.7, 27.9, 27.10, 27.11, 27.12, 27.13, 27.14, 27.15, 27.16, 27.17, 27.18. Text 3: 5.6, 5.7]

(RBT Levels: L1, L2 and L3)

Teaching-Learning Process for all modules	**Chalk and Talk/PowerPoint presentation/YouTube videos.**

Course Outcomes:

After successfully completing the course, the students will be able to :

1. Apply the concepts of logic for effective computation and relating problems in the Engineeringdomain.
2. Analyse the concepts of functions and relations to various fields of Engineering. Comprehend the concepts of Graph Theory for various applications of Computational sciences.
3. Make use of the correlation and regression analysis to fit a suitable mathematical model for thestatistical data.
4. Apply discrete and continuous probability distributions in analyzing the probability models arising in the engineering field.
5. Construct joint probability distributions and demonstrate the validity of testingthe hypothesis.

Assessment Details (both CIE and SEE)

Component		Weightage (%)	
CIE's	CIE 1- At the end of 5th week	20	60
	CIE 2 - At the end of 10th week	20	
	CIE 3 - At the end of 15th week	20	
AAT's	AAT-1- At the end of 4th week	10	40
	AAT-2- At the end of 9th week	10	
	AAT-3- At the end of 13th week	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Suggested Learning Resources:

Text Books:

1. **Ralph P. Grimaldi and B V Ramana**: Discrete and Combinatorial Mathematics- An Applied Introduction, Pearson Education, Asia, Fifth edition – 2007. ISBN 978-81-7758-424-0.
2. **B. S. Grewal:** Higher Engineering Mathematics B. S. Grewal Khanna Publishers 44th Edition, 2017.
3. **Seymour Lipschutz and Marc Lars Lipson:** "Probability", (Chapters: 5 and 8), McGraw Hill Education (India) Private Limited, Chennai, Special Indian Edition, 2010,

Reference Books:

1. **Kenneth H. Rosen**: Discrete Mathematics and its Applications, Tata – McGraw Hill, Sixth Edition, Sixth reprint 2008. ISBN-(13):978-0-07-064824-1.
2. **C. L. Liu and D P Mohapatra:** Elementary Discrete Mathematics, Tata- McGraw Hill, Sixth Edition, ISBN:10:0-07-066913-9.
3. **J.P. Tremblay and R. Manohar:** Discrete Mathematical Structures with Applications to Computer Science, Tata – McGraw Hill, 35TH reprint 2008. ISBN 13:978-0-07- 463113-3.

4. **C. Ray Wylie, Louis C. Barrett:** "Advanced Engineering Mathematics" McGraw – Hill 6th Edition 1995.
5. **B. V. Ramana**: Higher Engineering Mathematics, McGraw-Hill 11th Edition,2010
6. **N. P. Bali and Manish Goyal:** A Text-Book of Engineering Mathematics, Laxmi Publications 2014
7. **Chandrika Prasad and Reena Garg:** Advanced Engineering Mathematics, Khanna Publishing, 2018

E-Resources:

List of NPTEL videos for various topics of Discrete Mathematical Structures
https://www.youtube.com/watch?v=9AUCdsmBGmA&list=PL0862D1A947252D20&index=10
https://www.youtube.com/watch?v=oU60TuGHxe0&list=PL0862D1A947252D20&index=11
https://www.youtube.com/watch?v=_BIKq9Xo_5A&list=PL0862D1A947252D20&index=13
https://www.youtube.com/watch?v=RMLR2JHHeWo&list=PL0862D1A947252D20&index=14
https://www.youtube.com/watch?v=nf9e0_ylGdc&list=PL0862D1A947252D20&index=15
https://www.youtube.com/watch?v=7cTWea9YAJE&list=PL0862D1A947252D20&index=24
https://www.youtube.com/watch?v=695iAm935cY&list=PL0862D1A947252D20&index=25
https://www.youtube.com/watch?v=ZECJHfsf4Vs&list=PL0862D1A947252D20&index=26
https://www.youtube.com/watch?v=Dsi7x-A89Mw&list=PL0862D1A947252D20&index=28
https://www.youtube.com/watch?v=xlUFkMKSB3Y&list=PL0862D1A947252D20
https://www.youtube.com/watch?v=0uTE24o3q-o&list=PL0862D1A947252D20&index=2
https://www.youtube.com/watch?v=DmCltf8ypks&list=PL0862D1A947252D20&index=3
https://www.youtube.com/watch?v=jNeISigUCo0&list=PL0862D1A947252D20&index=4
http://nptel.ac.in/courses.php?disciplineID=111
http://www.class-central.com/subject/math(MOOCs) http://academicearth.org/
VTU EDUSAT PROGRAMME – 20

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes
- Assignments
- Seminars

CO- PO Mapping :

POs / COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1				1									
CO2	3	3													
CO3	3	2				2									
CO4	3	3				2									
CO5	2	2				2									
Avg.	**2.8**	**2.2**				**1.75**									

DESIGN AND ANALYSIS OF ALGORITHMS

Course Code	**21ISI42**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (3:0:2:0)	**3:0:2:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 T + 20 P**	**Total Marks**	**100**
Credits	**04**	**Exam Hours**	**03**

Prerequisites:

Data Structures, Algorithms, Algebra.

Course Learning Objectives:

CLO1. Explain the methods of analysing the algorithms and to analyze performance of algorithms.

CLO2. State algorithm's efficiencies using asymptotic notations.

CLO3. Solve problems using algorithm design methods such as the brute force method, greedy method, divide and conquer, decrease and conquer, transform and conquer, dynamic programming, backtracking and branch and bound.

CLO 4. Choose the appropriate data structure and algorithm design method for a specified application.

CLO 5. Introduce P and NP classes.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in a multiple representation.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction: What is an Algorithm? It's Properties. Algorithm Specification-using natural language, using Pseudo code convention, Fundamentals of Algorithmic Problem solving, Analysis Framework-Time efficiency and space efficiency, Worst-case, Best-case and Average case efficiency.

Performance Analysis: Estimating Space complexity and Time complexity of algorithms.

Asymptotic Notations: Big-Oh notation (O), Omega notation (Ω), Theta notation with examples, Basic efficiency classes, Mathematical analysis of Non-Recursive and Recursive Algorithms with Examples.

Brute force design technique: Selection sort, sequential search, string matching algorithm with complexity Analysis. **08 Hours**

Textbook 1: Chapter 1 (Sections 1.1,1.2), Chapter 2(Sections 2.1,2.2,2.3,2.4), Chapter 3(Section 3.1,3.2) Textbook 2: Chapter 1(section 1.1,1.2,1.3)

Module 2
Divide and Conquer: General method, Recurrence equation for divide and conquer, solving it using Master's theorem. , Divide and Conquer algorithms and complexity Analysis of Finding the maximum & minimum, Binary search, Merge sort, Quick sort. **Decrease and Conquer Approach**: Introduction, Insertion sort, Graph searching algorithms, Topological Sorting. It's efficiency analysis. **08 Hours** **Textbook 2: Chapter 3(Sections 3.1,3.3,3.4,3.5,3.6)** **Textbook 1: Chapter 4 (Sections 4.1,4.2,4.3), Chapter 5(Section 5.1,5.2,5.3)**
Module-3
Greedy Method: General method, Knapsack Problem, solving Job sequencingwith deadlines Problems. **Minimum cost spanning trees**: Prim's Algorithm, Kruskal's Algorithm with performance analysis. **Single source shortest paths**: Dijkstra's Algorithm. **Transform and Conquer Approach**: Introduction, Heaps and Heap Sort. **08 Hours** **Textbook 2: Chapter 4(Sections 4.1,4.3,4.5)** **Textbook 1: Chapter 9(Section 9.1,9.2,9.3,9.4), Chapter 6(section 6.4)**
Module-4
Dynamic Programming: General method with Examples, Multistage Graphs. **Transitive Closure**: Warshall's Algorithm. **All Pairs Shortest Paths**: Floyd's Algorithm, Travelling Sales man, Bellman-Ford Algorithm. **Space-Time Tradeoffs**: Introduction, Sorting by Counting, Input Enhancement in String Matching-Harspool's algorithm. **08 Hours** **Textbook 2: Chapter 5 (Sections 5.1,5.2,5.4,5.9)** **Textbook 1: Chapter 8(Sections 8.2,8.4), Chapter 7 (Sections 7.1,7.2)**
Module-5
Backtracking: General method, solution using back tracking to N-Queens problem, Sum of subsets problem. **Branch and Bound**: Assignment Problem, 0/1 Knapsack problem **NP-Complete and NP-Hard problems**: Basic concepts, non- deterministic algorithms, P, NP,NP-Complete, and NP-Hard classes. **08 Hours** **Textbook 1: Chapter 12 (Sections 12.1,12.2) Chapter 11(11.3)** **Textbook 2: Chapter 7 (Sections 7.1,7.2,7.3,7.4,7.5) Chapter 11 (Section 11.1)**

Teaching-Learning Process for all modules	1. Chalk & board, Active Learning, MOOC, Problem based Learning. 2. Laboratory Demonstration.

PRACTICAL COMPONENTS

Sl. No	Experiments
1	Sort a given set of n integer elements us complexity. Run the program for varied a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator. Demonstrate using C/Java how the brute force method works along with its time complexity analysis: worst case, average case and best case.

2	Sort a given set of n integer elements using Merge Sort method and compute its time complexity. Run the program for varied values of n> 5000, and record the time taken to sort. Plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator. Demonstrate using C/Java how the divide-and-conquer method works along with its time complexity analysis: worst case, average case and best case.
3	Write & Execute C/Java ProgramTo solve Knapsack problem using Greedy method.
4	Write & Execute C/Java ProgramTo find shortest paths to other vertices from a given vertex in a weighted connected graph, using Dijkstra's algorithm
5	Write & Execute C/Java ProgramTo find Minimum Cost Spanning Tree of a given connected undirected graph using Kruskal's algorithm. Use Union-Find algorithms in your program.
6	Write & Execute C/Java Program To find Minimum Cost Spanning Tree of a given connected undirected graph using Prim's algorithm.
7	Write C/ Java programs to Solve All-Pairs Shortest Paths problem using Floyd's algorithm.
8	Write C/ Java programs to Solve 0/1 Knapsack problem using Dynamic Programming method.
9	Design and implement C/Java Program to find a subset of a given set S = {Sl, S2,…, Sn} of n positive integers whose SUM is equal to a given positive integer d. For example, if S = {1, 2, 5, 6, 8} and d= 9, there are two solutions {1, 2, 6} and {1, 8}. Display a suitable message, if the given problem instance doesn't have a solution.
10	Design and implement C/Java Program to implement N queens using backtracking principle.

At the end of the course the student will be able to:

CO 1. Analyze the performance of the algorithms, state the efficiency using asymptotic notations and analyze mathematically the complexity of the algorithm.

CO 2. Apply divide and conquer approaches and decrease and conquer approaches in solving the problems analyze the same

CO 3. Apply the appropriate algorithmic design technique like greedy method, transform and conquer approaches and compare the efficiency of algorithms to solve the given problem.

CO 4. Apply and analyze dynamic programming approaches to solve some problems. and improve an algorithm time efficiency by sacrificing space.

CO 5. Apply and analyze backtracking, branch and bound methods and to describe P, NP and NP- Complete problems.

Assessment Details (both CIE and SEE)

Component		**Weightage (%)**		
CIE's	CIE 1 5th week	20	60	Average of 3 tests for 20 marks
	CIE 2 10th week	20		
	CIE 3 15th week	20		
AAT's	AAT-1 10th week			10
	Lab Test	30		Reduced to 10
	Lab Record	20		10
Continuous Internal Evaluation Total Marks :100. Reduced to 50 Marks				
Semester End Examination (SEE) Total Marks :100. Reduced to 50 Marks				

Suggested Learning Resources:

Textbooks

1. Introduction to the Design and Analysis of Algorithms, Anany Levitin: 2nd Edition, 2009. Pearson.
2. Computer Algorithms/C++, Ellis Horowitz, SatrajSahni and Rajasekaran, 2nd Edition, 2014, Universities Press.

Reference Books:

1. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein, 3rd Edition, PHI.
2. Design and Analysis of Algorithms, S. Sridhar, Oxford (Higher Education)

Weblinks and Video Lectures (e-Resources):

1. http://elearning.vtu.ac.in/econtent/courses/video/CSE/06CS 43.html
2. https://nptel.ac.in/courses/106/101/106101060/
3. http://elearning.vtu.ac.in/econtent/courses/video/FEP/ADA.html
4. http://cse01-iiith.vlabs.ac.in/
5. http://openclassroom.stanford.edu/MainFolder/CoursePage.php?course= Intro To Algorithms

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Real world problem solving and puzzles using group discussion. E.g., Fake coinidentification, Peasant, wolf, goat, cabbage puzzle, Konigsberg bridge puzzle etc.,
2. Demonstration of solution to a problem through programming.

CO-PO & PSO Mapping:

Pos COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	3			2				1			1	3		
CO2	3	2							1			2	3	2	
CO3	2	2	3		1				1				3		1
CO4	2	3	3		1				1				3		1
CO5	2	3	2										3		
Avg	2.2	2.6	2.6		1.33				1			1.5	3	2	1

3-Strong, 2-Medium, 1-low

COMPUTER NETWORKS			
Course Code	**21ISI43**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P: S) (3:0:2:0)	**Credits (3:0:1:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 T + 20 P**	**Total Marks**	**100**
Credits	**04**	**Exam Hours**	**03**

Course Learning Objectives:

1. Understand the basics principle and standards for data Communication, Network Types, Topologies andProtocols.
2. Recognize the data link design issues and various data link protocols used for data transmission.
3. Familiarize the design, working and implementation of Internet protocols as well as routing protocolsresponsible for network layer communication.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
- Show Video/animation films to explain functioning of various concepts.
- Encourage collaborative (Group Learning) Learning in the class.
- Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recallit.
- Topics will be introduced in a multiple representation.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction and Physical Layer: Network hardware, Network software, Reference models - OSI, TCP/IP; Example networks –Internet; Wireless LANs - 802.11.

Physical Layer - Guided transmission media, Wireless transmission, Switching – Circuit switches, Packet switching.

08 Hours

Module-2

Data Link Layer and Medium Access Control Sub Layer

Data Link Layer: Data link layer design issues, Error detection and correction - CRC, Hamming codes; Elementary data link protocols, Sliding window protocols.

Medium Access Control Sub layer: ALOHA, Carrier sense multiple access protocols, Collision free protocols, Ethernet.

Textbook 1: Ch 3.1 to 3.4 , Ch 4.1 to 4.3

08 Hours

Module-3
Network Layer: Network layer design issues, Routing algorithms - Shortest path algorithm, Flooding, Distance vector routing, Hierarchical routing, Broadcast routing, Multicast routing, Congestion control algorithms, Network layer in the internet - The IP version 4 protocol, IP addresses, IP version 6, Internet control protocols, OSPF, BGP. **Textbook 1: Ch 5.1 to 5.3 & 5.6** **08 Hours**
Module-4
Transport Layer: UDP–Segment header, Remote procedure call, Real-time transport protocols; **TCP** – service model, Protocol, Segment header, Connection establishment, Connection release, Sliding window, Timer management, Congestion control. **Textbook 1: Ch 6.4 & 6.5** **08 Hours**
Module-5
Application Layer: Domain Name System (DNS) - Name space, Domain resource records, Name servers; Electronic mail - Architecture and services, User agent, Message formats, Message transfer, The World Wide Web - Architectural overview, HTTP, FTP. **Textbook 1: Ch 7.1 to 7.3** **08 Hours**

Teaching-Learning Process	Chalk & board, Active Learning, MOOC, Problem based learning. Laboratory Demonstration.

Sl. No.	**Experiment**
1	Study and submission of Report on Network Hardware Components, Network cables and Servers.
2	Implement the following data link layer framing methods Using Java. i) Character count ii) Character stuffing iii) Bit stuffing
3	Design and develop a Java program to compute checksum for the given frame 1101011011 using CRC-12, CRC-16, and CRC-CCIP. Display the actual bit string transmitted. Suppose any bit is inverted during transmission. Show that this error is detected at the receiver's end.
4	Implement Dijkstra's algorithm to compute the shortest path from Source to Destination in the network using Java
5	Implementation of Basic Network Commands and Network Configuration Commands using Command Prompt.
6	Implement three nodes point – to – point network with duplex links between them. Set the queue size, vary the bandwidth and find the number of packets dropped using NS2.
7	Build a LAN with Hubs and Switches and perform Simulation of LAN using packet Tracer
8	Build a Multi-LAN with Router Configuration and perform Simulation of Multi-LAN using packet Tracer.

9	Implement transmission of ping messages/trace route over a network topology consisting of 6 nodes and find the number of packets dropped due to congestion using NS2.
10	Implementation of RIP using Packet Tracer
11	Simulation of OSPF Protocol using Packet Tracer
12	Configure and simulation of a VLAN using Packet Tracer

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Gain Knowledge on the principles and standards of Reference Models, types of network topologies, Functions of layers and protocols.
2. Analyze Sub netting and routing algorithms for finding optimal paths in networks.
3. Develop and Solve problems related to flow control, error control and congestion control in data transmission.
4. Simulate the Network Topologies using the Packet Tracer Tool to analyze packet Transmission.
5. Apply Ethical principles and standards for developing network-based solutions.

Assessment Details (both CIE and SEE)

Component		Weightage (%)		
CIE's	CIE 1 5th week	20	60	Average of 3 tests for 20 marks
	CIE 2 10th week	20		
	CIE 3 15th week	20		
AAT's	AAT-1 10th week		05	2.5
	AAT-2		05	2.5
	Lab Test	30		Reduced to 15
	Lab Record	20		10
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks				
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks				

Suggested Learning Resources:

Text Books

1. Andrew S. Tanenbaum and David J. Wetherall, Computer Networks, Pearson, 5th Edition,2015.

Reference:

1. Behrouz A. Forouzan, Data Communications and Networking, McGraw Hill, 5th Edition,2013. James F. Kurose and Keith W. Ross, Computer Networking: A Top-Down Approach,Pearson, 7th Edition, 2017.

E-Resources:

1. https://archive.org/details/Data.Communications.and.Networking.5th.Edition
2. https://www.cisco.com/c/en/us/solutions/smallbusiness/resourcecenter/networking/networ king-basics.html.
3. http://ptgmedia.pearsoncmg.com/images/9780133814743/samplepages/9780133814743.pdf

CO- PO Mapping :

POs / COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1		1							1	3	2	1
CO2	3	3	2	1								1	2	3	1
CO3	2	2	3		1							1	1	2	3
CO4	3	2	2	2	3							1	2	3	1
CO5	2	2	2	2	3							1	2		3
Avg.	**2.6**	**2.3**	**2**	**1.7**	**2**							**1**	**2**	**2.5**	**1.8**

OPERATING SYSTEMS			
Course Code	**21IST44**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (3:0:0:0)	**Credits (3:0:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours Theory**	**Total Marks**	**100**
Credits	**03**	**Exam Hours**	**03**

Course objectives:

This course will enable students to:

1. Understanding the role of operating system with its function and services. (Understanding)
2. Compare Various Algorithm used for CPU Scheduling, Memory management and Disk SchedulingAlgorithm.(Evaluate)
3. Apply various concepts related with Deadlock to solve Problems.(Apply)
4. Analyze Protection and Security Mechanism in Operating System.(Analyze)

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
- Show Video/animation films to explain functioning of various concepts.
- Encourage collaborative (Group Learning) Learning in the class.
- Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, developthinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in a multiple representation.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world

Module-1

Operating System: Operating Systems Overview- Overview and Functions of operating systems, protection and security, distributed systems, operating Systems structures, services, system calls and their working. History and generation of operating system.

Process and Threads: Process and Threads - Process concepts, threads, scheduling-criteria, Algorithms, and their evaluation. Process Scheduling, Scheduling, case studies UNIX. Linux. Windows **Textbook 1: Chapter - 1,2,3**

08 Hours

Module-2

Concurrency Control(IPC): Process synchronization, critical- section problem. classic problems of Synchronization, SoftwareSolutions for synchronization problem. Hardware Solutions for synchronization problem. Synchronization and Their applications.[Understanding of Semaphore – Mutex – Monitor – Event Counters]

Textbook 1: Chapter - 4,5

08 Hours

Module-3
Memory Management: **Memory:** Swapping, contiguous memory allocation, paging, page table, segmentation, virtual memory, demand paging, page- replacement, Allocation of frames, **Virtual Memory:** Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault, Working Set, Dirty page/Dirty bit – Demand paging (Concepts only) – Page **Replacement policies :** Least Recently used (LRU) Optimal (OPT) , Second Chance (SC), First in First Out (FIFO), Not recently used (NRU). **Textbook 1: Chapter – 8,9,10** **08 Hours**
Module-4
Principles of Deadlock: Deadlock - system model, deadlock and its characterization with example, deadlock prevention techniques with example, detection and avoidance of a deadlock, methods to get recovery form deadlock **File System Interface:** File system Interface- the concept of a file, Access Methods. Directory Structure. File system mounting, file protection and sharing mechanism. File System implementation- File system structure, file/directory implementation, efficiency and performance, file allocation methods, Free- space management. **Textbook 1: Chapter - 7,11** **08 Hours**
Module-5
Mass Storage Structure & I/O System: Mass-storage structure- RAID structure, Disk structure, disk Attachment, disk scheduling, swap- space management. Stable-storage Implementation. Overview of Mass-storage structure. Tertiary storage Structure. **I/O systems**- Hardware, application l/o interface, kernel I/O subsystem, Transforming I/O requests to Hardware operations. STREAMS, performance. **Protection & Security: Protection** - Protection. Goals of Protection, Principles of Protection. Domain of protection Access Matrix, Implementation of Access Matrix. Access control, Revocation of Access Rights. **Case Study**: The Linux Operating System: Linux history; Design principles; Kernel modules; Process management; Scheduling; Memory Management; File systems, Input and output; Inter-process communication. **Textbook 1: Chapter - 2,21** **08 Hours**

Teaching-Learning Process for all modules	Chalk and board, Problem based learning, Demonstration

Course Outcomes

At the end of the course the student will be able to :

1. Demonstrate functional architecture of an operating system.
2. Describe process scheduling and Multithreading Concepts.
3. Use suitable techniques for handling the deadlocks.
4. Apply various memory management techniques.
5. Realize the different concepts of OS in platform of usage through case studies.

Assessment Details (both CIE and SEE)

Component		Weightage (%)	
CIE's	CIE 1 5th week	20	60
	CIE 2 10th week	20	
	CIE 3 15th week	20	
AAT's	AAT-1 10th week	10	
	AAT-2	10	
	AAT-3	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Suggested Learning Resources:

Text Books

1. Operating System Concepts- Abraham Silberchatz, Peter B. Galvin, Greg Gagne, 9th ed.
2. Operating Systems - Internals and Design Principles. Stallings, 6th Edition- 2009. Pearson education.
3. Operating systems- A Concept based Approach-D.M.Dhamdhere. 3rd Edition.TMH

Reference:

1. Modern Operating Systems, Andrew S Tanenbaum 3rd edition PHI.
2. Principles of Operating Systems, B.L. Stuart. Cengage learning, India Edition. Operating Systems. A.S. Godboie.2nd Edition, TMH

E-Resources:

CO- PO Mapping :

POs / COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2										2	2		2
CO2	2	3	3	2								2	2		3
CO3	2	2	3	2								2	2		2
CO4	2	3	1									2	2		2
CO5	3	2	3	2								3	3		3
Avg.	**2.2**	**2.4**	**2**	**2**								**2.2**	**2.2**		**2.4**

BIOLOGY FOR ENGINEERS			
Course Code	**21BET45**	**CIE Marks**	**50**
Teaching Hours/Week (L: T: P: S) (1:2:0:0)	**Credits (1:1:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**40 hours Theory**	**Total Marks**	**100**
Credits	**02**	**Exam Hours**	**03**

Course objectives:

This course will enable students to:

1. To familiarize the students with the basic biological concepts and their engineering applications.
2. To enable the students with an understanding of biodesign principles to create novel devices and structures.
3. To provide the students an appreciation of how biological systems can be re-designed as substitute products fornatural systems.
4. To motivate the students develop the interdisciplinary vision of biological engineering.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- Explanation via real life problem, situation modelling, and deliberation of solutions, hands-on sessions, reflectiveand questioning /inquiry-based teaching.
- Instructions with interactions in classroom lectures (physical/hybrid).
- Use of ICT tools, including YouTube videos, related MOOCs, AR/VR/MR tools.
- Flipped classroom sessions (~10% of the classes).
- Industrial visits, Guests talks and competitions for learning beyond the syllabus.
- Students' participation through audio-video based content creation for the syllabus (as assignments).
- Use of gamification tools (in both physical/hybrid classes) for creative learning outcomes.
- Students' seminars (in solo or group) /oral presentations.

Module-1

BIOMOLECULES AND THEIR APPLICATIONS (QUALITATIVE):

Carbohydrates (cellulose-based water filters, PHA and PLA as bioplastics), Nucleic acids (DNA Vaccine for Rabies and RNA vaccines for Covid19, Forensics – DNA fingerprinting), Proteins (Proteins as food – whey protein and meat analogs, Plant based proteins), lipids (biodiesel, cleaning agents/detergents), Enzymes (glucose-oxidase in biosensors, lignolytic enzyme in bio-bleaching).

05 Hours

Module-2

HUMAN ORGAN SYSTEMS AND BIO DESIGNS - 1 (QUALITATIVE):

Brain as a CPU system (architecture, CNS and Peripheral Nervous System, signal transmission, EEG, Robotic arms for prosthetics. Engineering solutions for Parkinson's disease).Eye as a Camera system (architecture of rod and cone cells, optical corrections, cataract, lens materials, bionic eye).Heart as a pump system (architecture, electrical signaling - ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pace makers, defibrillators).

05 Hours

Module-3

HUMAN ORGAN SYSTEMS AND BIO-DESIGNS - 2 (QUALITATIVE):

Lungs as purification system (architecture, gas exchange mechanisms, spirometry, abnormal lung physiology - COPD, Ventilators, Heart-lung machine).Kidney as a filtration system (architecture, mechanism of filtration, CKD, dialysis systems). Muscular and Skeletal Systems as scaffolds (architecture, mechanisms, bioengineering solutions for muscular dystrophy and osteoporosis).

05 Hours

Module-4

NATURE-BIOINSPIRED MATERIALS AND MECHANISMS (QUALITATIVE):

Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces), Plant burrs (Velcro), Shark skin (Friction reducing swim suits), Kingfisher beak (Bullet train). Human Blood substitutes - hemoglobin-based oxygen carriers (HBOCs) and perflourocarbons (PFCs).

05 Hours

Module-5

TRENDS IN BIOENGINEERING (QUALITATIVE):

Bioprinting techniques and materials, 3D printing of ear, bone and skin. 3D printed foods. Electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bioimaging and Artificial Intelligence for disease diagnosis. Self- healing Bioconcrete (based on bacillus spores, calcium lactate nutrients and biomineralization processes) and Bioremediation and Biomining via microbial surface adsorption (removal of heavy metals like Lead, Cadmium, Mercury, Arsenic).

05 Hours

Teaching-Learning Process for all modules	Chalk and board, Problem based learning, Demonstration

Course Outcomes

At the end of the course the student will be able to :

1. Elucidate the basic biological concepts via relevant industrial applications and case studies.
2. Evaluate the principles of design and development, for exploring novel bioengineering projects.
3. Corroborate the concepts of biomimetics for specific requirements.
4. Think critically towards exploring innovative bio based solutions for socially relevant problems.

Assessment Details (both CIE and SEE)

Component		**Weightage (%)**	
CIE's	CIE 1 5th week	20	60
	CIE 2 10th week	20	
	CIE 3 15th week	20	
AAT's	AAT-1 10th week	10	
	AAT-2	10	
	AAT-3	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Suggested Learning Resources:

Text Books:

1. Human Physiology, Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edition, 2022
2. Biology for Engineers, Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., andJaganthan M.K., Tata McGraw-Hill, New Delhi, 2012.
3. Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
4. Biomedical Instrumentation, Leslie Cromwell, Prentice Hall 2011.
5. Biology for Engineers, Sohini Singh and Tanu Allen, Vayu Education of India, New Delhi, 2014.

Reference:

1. Biomimetics: Nature-Based Innovation, Yoseph Bar-Cohen, 1st edition, 2012, CRC Press.
2. Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, D. Floreano and C. Mattiussi, MIT Press,2008.
3. Bioremediation of heavy metals: bacterial participation, by C R Sunilkumar, N Geetha A C Udayashankar LambertAcademic Publishing, 2019.
4. 3D Bioprinting: Fundamentals, Principles and Applications by Ibrahim Ozbolat, Academic Press, 2016.
5. Electronic Noses and Tongues in Food Science, Maria Rodriguez Mende, Academic Press, 2016

E-Resources:

1. VTU EDUSAT / SWAYAM / NPTEL / MOOCS / Coursera / MIT-open learning resource
2. https://nptel.ac.in/courses/121106008
3. https://freevideolectures.com/course/4877/nptel-biology-engineers-other-non-biologists
4. https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring-2009
5. https://ocw.mit.edu/courses/20-010j-introduction-to-bioengineering-be-010j-spring-2006
6. https://www.coursera.org/courses?query=biology
7. https://onlinecourses.nptel.ac.in/noc19_ge31/preview
8. https://www.classcentral.com/subject/biology
9. https://www.futurelearn.com/courses/biology-basic-concepts

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Group Discussion of Case studies
2. Model Making and seminar/poster presentations Design of novel device/equipment like Cellulose-based water filters, Filtration system mimicking the kidney,Bioremediation unit for E-waste management, AI and ML based Bio imaging

CO- PO Mapping :

POs / COs	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	3				1						2	1		1
CO2	2	2	2			1						2	2		2
CO3	1	1				1						2	1		1
CO4	2	3	2			2						3	2		2
Avg.	**1.75**	**2.25**	**2**			**1.25**						**2.25**	**2.5**		**2.5**

PYTHON PROGRAMMING LABORATORY			
Course Code	**21ISL46**	**CIE Marks**	**50**
Teaching Hours/Weeks (L:T:P:S) (0:0:2:0)	**Credits (0:0:1:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**24 Hours**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course Objectives:

1. Demonstrate the use of IDLE, Jupiter note book or PyCharm IDE to create Python Applications
2. Using Python programming language to develop programs for solving real-world problems
3. Implement the Object-Oriented Programming concepts in Python.
4. Appraise the need for working with various documents like Excel, PDF, Word and Others
5. Demonstrate regular expression using python programming

Note: Two hours tutorial is suggested for each laboratory sessions.

Prerequisite

- Students should be familiarized about Python installation and setting Python environment
- Usage of IDLE, Jupiter note book or IDE like PyCharm should be introduced Python
- Installation: https://www.youtube.com/watch?v=Kn1HF3oD19c PyCharm
- Installation: https://www.youtube.com/watch?v=SZUNUB6nz3g

Sl. No.	PART A – List of problems for which student should develop program and execute in the Laboratory
1	**Aim:** Introduce the Python fundamentals, data types, operators, flow control and exceptionhandling in Python a) Students test marks for each course is considered as the best of two test average marks out of three test's marks, Implement a python program to find the test average marks, take input from the user. b) Implement a Python program to check whether a given number is palindrome or not and also count the number of occurrences of each digit in the input number. Data types: https://www.youtube.com/watch?v=gCCVsvgR2KU Operators: https://www.youtube.com/watch?v=v5MR5JnKcZI Flow Control: https://www.youtube.com/watch?v=PqFKRqpHrjwFor loop: https://www.youtube.com/watch?v=0ZvaDa8eT5s While loop: https://www.youtube.com/watch?v=HZARImviDxg Exceptions: https://www.youtube.com/watch?v=6SPDvPK38tw
2	**Aim:** Demonstrating creation of functions, passing parameters and return values a) Defined as a function F as Fn = Fn-1 + Fn-2. Write a Python program which accepts a value for N (where N >0) as input and pass this value to the function. Display suitable error message if the condition for input value is not followed. b) Demonstrate how to implement a python program to convert binary to decimal, octal to hexadecimal using functions. Functions: https://www.youtube.com/watch?v=BVfCWuca9nw Arguments: https://www.youtube.com/watch?v=ijXMGpoMkhQ Returnvalue: https://www.youtube.com/watch?v=nuNXiEDnM44

3	**Aim:** Demonstration of manipulation of strings using string methods a) When an interpreter reads a line/ sentence from user, find the number of words, digits, uppercase letters and lowercase letters in that sentence; demonstrate with the help of python programming. b) Let us take two strings compare and find the string similarity between two given strings withthe help of python programming. **Sample Output:** **Sample Output:** Original string: Original string: Python Exercises Python Exercises Python Exercises Python Exercise Similarity between two said strings: Similarity between two said strings:1.0 0.967741935483871 Strings: https://www.youtube.com/watch?v=lSItwlnF0eU String functions: https://www.youtube.com/watch?v=9a3CxJyTq00
4	**Aim:** Discuss different collections like list, tuple and dictionary a) User enters a list of random numbers, the programmer need to arrange these random numbersin ascending order with sorting techniques such as insertion sort and merge sort using lists in python. b) Demonstrate with a python program to convert roman numbers into integer values usingdictionaries, by taking inputs from user. Lists: https://www.youtube.com/watch?v=Eaz5e6M8tL4 List methods: https://www.youtube.com/watch?v=8-RDVWGktuI Tuples: https://www.youtube.com/watch?v=bdS4dHIJGBc Tuple operations: https://www.youtube.com/watch?v=TItKabcTTQ4 Dictionary: https://www.youtube.com/watch?v=4Q0pW8XBOkc Dictionary methods: https://www.youtube.com/watch?v=oLeNHuORpNY
5	**Aim:** Demonstration of pattern recognition with and without using regular expressions a) Implement a function called isphonenumber () to recognize a pattern 415-555-4242 without using regular expression and also write the code to recognize the same pattern using regular expression. b) Develop a python program that could search the text in a file for phone numbers (+919900889977) and email addresses (sample@gmail.com) Regular expressions: https://www.youtube.com/watch?v=LnzFnZfHLS4
6	**Aim:** Demonstration of reading, writing and organizing files. a) Demonstrate how files are read in python by considering **myfile.txt** as an example file namewhich is entered by the user to perform the following operations. 1. Display the first N line of the file 2. Find the frequency of occurrence of the word accepted from the user in the file b) Python is termed as secure language; demonstrate a simple method of securing data bycreating a ZIP file of a particular folder which contains several files inside it. Files: https://www.youtube.com/watch?v=vuyb7CxZgbU https://www.youtube.com/watch?v=FqcjKewJTQ0 File organization: https://www.youtube.com/watch?v=MRuq3SRXses

7	**Aim:** Demonstration of the concepts of classes, methods, objects and inheritance a) Inheritance is one of the main pillars of OOPs concept. By using inheritance, a child class acquires all properties and behaviors of parent class. Referring the above inheritance concept write a python program to find the area of triangle, circle and rectangle. b) Implement a python program by creating a class called Employee to store the details of Name, Employee_ID, Department and Salary, and implement a method to update salary of employees belonging to a given department. OOP's concepts: https://www.youtube.com/watch?v=qiSCMNBIP2g Inheritance: https://www.youtube.com/watch?v=Cn7AkDb4pIU
8	**Aim:** Demonstration of classes and methods with polymorphism and overriding a) Inheritance applies to classes, whereas polymorphism applies to methods, using these concepts implement a python program to find whether the given input is palindrome or not (forboth string and integer). Overriding: https://www.youtube.com/watch?v=CcTzTuIsoFk
9	**Aim:** Demonstration of working with excel spreadsheets and web scraping a) XKCD is a webcomic website consists of many curious comics and sometimes user wants to save that comic image on their local devices, a user has to visit every page of the comic website. instead implement a python program to download the all XKCD comics. b) In python programming how to read the data from the spreadsheet and write the data in to the spreadsheet , by using the load_workbook() method, demonstrate with code snippet. Web scraping: https://www.youtube.com/watch?v=ng2o98k983k Excel: https://www.youtube.com/watch?v=nsKNPHJ9iPc
10	**Aim:** Demonstration of working with PDF, word and JSON files a) Demonstrate with a python program the possible ways to combine select pages from manyPDFs. b) Accessing current weather data for any location on Earth, We collect and process weather data from different sources such as global and local weather models, satellites, radars and a vast network of weather stations and in different format. Implement a python program to fetch current weather data from the JSON file format. PDFs:https://www.youtube.com/watch?v=q70xzDG6nls https://www.youtube.com/watch?v=JhQVD7Y1bsA https://www.youtube.com/watch?v=FcrW-ESdY-A Word files: https://www.youtube.com/watch?v=ZU3cSl51jWE JSON files: https://www.youtube.com/watch?v=9N6a-VLBa2I

Python (Full Course): https://www.youtube.com/watch?v=_uQrJ0TkZlc	
Pedagogy	For the above experiments the following pedagogy can be considered. Problem based learning, Active learning, MOOC, Chalk &Talk

PART B – Practical Based Learning

A problem statement for each batch is to be generated in consultation with the co-examiner and student should develop an algorithm, program and execute the program for the given problem with appropriate outputs.

Course Outcomes:

1. Demonstrate proficiency in handling of loops and creation of functions.
2. Identify the methods to create and manipulate lists, tuples and dictionaries.
3. Discover the commonly used operations involving regular expressions and file system.
4. Interpret the concepts of Object-Oriented Programming as used in Python.
5. Determine the need for scraping websites and working with PDF, JSON and other file formats.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8^{th} week of the semester and the second test shall be conducted after the 14^{th} week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

- SEE marks for the practical course is 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners areappointed by the University
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer scriptto be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- *Students can pick one experiment from the questions lot of PART A with equal choice to all the students in a batch. For PART B examiners should frame a question for each batch, student should develop an algorithm, program, execute and demonstrate the results with appropriate output for the given problem.*
- *Weightage of marks for PART A is 80% and for PART B is 20%. General rubrics suggested to befollowed for part A and part B.*
- Change of experiment is allowed only once and Marks allotted to the procedure part to bemade zero(Not allowed for Part B).
- The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

Textbooks:

1. Al Sweigart, **"Automate the Boring Stuff with Python",**1stEdition, No Starch Press, 2015. (Available under CC-BY-NC-SA license at https://automatetheboringstuff.com/)
2. Reema Thareja "**Python Programming Using Problem Solving Approach**" Oxford UniversityPress.
3. Allen B. Downey, **"Think Python: How to Think Like a Computer Scientist",** 2nd Edition, Green Tea Press, 2015. (Available under CC-BY-NC license at http://greenteapress.com/thinkpython2/thinkpython2.pdf)

CO- PO Mapping :

POs / COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2											3	1	
CO2	2		3										1	3	
CO3	1	3											1		3
CO4	3	2											1		
CO5	1	2		2	3				2				3		1
Avg.	**2**	**2.25**	**3**	**2**	**3**				**2**				**1.8**	**2**	**2**

Constitution of India and Professional Ethics			
Course Code	**21CIP47**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P:S) (0:2:0:0)	**Credits (0:1:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**25 Hours**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**01 Hour**

Course objectives:

This course will enable the students

1. To know the fundamental political structure & codes, procedures, powers, and duties of Indiangovernment institutions, fundamental rights, directive principles, and the duties of citizens.
2. To understand engineering ethics and their responsibilities, identify their individual roles and ethicalresponsibilities towards society.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

- Teachers shall adopt suitable pedagogy for effective teaching - learning process. The pedagogy shall involve thecombination of different methodologies which suit modern technological tools and software's to meet the present requirements of the Global employment market.
  (i) Direct instructional method (Low /Old Technology),
  (ii) Flipped classrooms (High/advanced Technological tools),
  (iii) Blended learning (combination of both),
  (iv) Enquiry and evaluation based learning,
  (v) Personalized learning,
  (vi) Problems based learning through discussion,
  (vii) Following the method of expeditionary learning Tools and techniques

- Apart from conventional lecture methods, various types of innovative teaching techniques through videos, animation films may be adapted so that the delivered lesson can enhance the students in theoretical applied andpractical skills in teaching of 21CIP39/49 in general.

Module - 1

Introduction to Indian Constitution: Definition of Constitution, Necessity of the Constitution, Societies before and after the Constitution adoption. Introduction to the Indian constitution, Making of the Constitution, Role of the Constituent Assembly. Preamble of Indian Constitution & Key concepts of the Preamble. Salientfeatures of India Constitution.

04 Hours

Module - 2
Fundamental Rights (FR's), Directive Principles of State Policy (DPSP's) and Fundamental Duties (FD's) : Fundamental Rights and its Restriction and limitations in different Complex Situations. DPSP's and its present relevance in Indian society. Fundamental Duties and its Scope and significance inNation building. **04 Hours**
Module - 3
Union Executive : Parliamentary System, Union Executive – President, Prime Minister, Union Cabinet, Parliament - LS and RS, Parliamentary Committees, Important Parliamentary Terminologies. Supreme Courtof India, Judicial Reviews and Judicial Activism. **04 Hours**
Module - 4
State Executive & Elections: Election Commission, Elections & Electoral Process. Amendment to Constitution (Why and How) **04 Hours**
Module - 5
Professional Ethics: Definition of Ethics & Values. Professional & Engineering Ethics. Positive and Negative aspects of Engineering Ethics. Clash of Ethics, Conflicts of Interest. The impediments to Responsibility. Professional Risks, Professional Safety and liability in Engineering. Trust & Reliability inEngineering, Intellectual Property Rights (IPR's). **04 Hours**

Teaching Learning Process	Chalk and talk method, Videos, Power Point presentation to teach. Creating real time stations in classroom discussions, Giving activities and assignments (Connecting Campus & community with administration real time situations).

Assessment Details (both CIE and SEE)

Component		Weightage (%)	
CIE's	CIE 1 5th week	20	60
	CIE 2 10th week	20	
	CIE 3 15th week	20	
AAT's	AAT-1 10th week	10	
	AAT-2	10	
	AAT-3	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Course outcome (Course Skill Set)

At the end of the course the student should :

CO 1: Understand the meaning and importance of Constitution.

O 2: State executives, Electoral process, Amendments.

CO 3: Analyse Panchayat Raj institutions as a medium of decentralization

CO 4: Realize special provisions given for women, children and weaker section of the society.

CO 5: Exhibit engineering ethics and responsibilities of engineers.

Assessment Details (both CIE and SEE)

Component		Weightage (%)	
CIE's	CIE 1 5th week	20	60
	CIE 2 10th week	20	
	CIE 3 15th week	20	
AAT's	AAT-1 10th week	10	
	AAT-2	10	
	AAT-3	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Suggested Learning Resources:

Textbook:

1. **"Constitution of India & Professional Ethics"** Published by Prasaranga or published onVTU website with the consent of the university authorities VTU Belagavi.
2. "**Engineering Ethics**", M.Govindarajan, S.Natarajan, V.S.Senthilkumar, Prentice –Hall, 2004

CO- PO Mapping :

POs / COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1												1			
CO2										1		2			
CO3										1		2			
CO4										2		2			
CO5										2		2			
Avg.										**1.5**		**1.8**			

Ability Enhancement Course- II - WEB PROGRAMMING LABORATORY			
Course Code	**21ISL481**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P: S) (0:0:2:0)	**Credits 0:0:1:0**	**SEE Marks**	**50**
Total Hours of Pedagogy	**10 Practical**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**01**

Course Objectives:

CLO 1. Recollect the evolution of World Wide Web and its relevance to today's technological Revolution and also, to comprehend HTML, CSS scripts to design web layouts.

CLO 2. Acquire Java Script skills for developing client side web applications.

CLO 3. Interpret the use of j Query libraries to simplify complicated JavaScript applications and also, to Perform DOM manipulation using j Query constructs.

CLO 4. Cognize Bootstrap framework with a focus on creating interactive and responsive web pages Faster and easier.

CLO 5. Assimilate XML fundamentals for developing applications over web.

Note: Two hours tutorial is suggested for each laboratory sessions.

Prerequisite	
	Students Should have good knowledge in Java Programming. Students Should have knowledge on Database and SQL queries , connectivity of front end and back end
Sl. No.	**PART A – List of problems for which student should develop program and execute in the Laboratory**
1	Aim: Introduction to the use of HTML tags Write a HTML script to display employee details like name, address, mobile number, email id etc similar to a telephone directory
2	Aim:. To develop web layouts with lists Program: Write a HTML program to display a nested list to list down all the elements serviced by an event management company. The list should be a nested list with main events and sub events
3	Aim: To develop web layouts with style sheets and web screens in a presentable form Program: Write a HTML and CSS script to create a webpage with table structure containing alternative backgrounds using class selector functionalities
4	Aim: Develop web layouts with style sheets and web screens in a presentable form Write a HTML and CSS program to design the cover page which displays the events taking place in and around the state.
5	Aim:. use of jQuery libraries to simplify complicated JavaScript applications Program: Write a HTML and javascript program to implement a simple banking application using SQL database. The application should provide features like withdraw, deposit, balance enquiry etc.

6	Aim: :Use of jQuery libraries to simplify complicated JavaScript applications Program: Write a HTML and javascript program to create a registration page having fields name, username, email Id, password & re-enter password and apply validation using match & equal functions
7	Aim: Use of jQuery libraries to simplify complicated JavaScript applications Write a HTML and jQuery program to create a webpage to fetch the details of the event and display the invitation
8	Aim Use of jQuery libraries to simplify complicated JavaScript applications Program: Write a HTML and jQuery program to design a webpage to accept event organizer name from the user and display it on the webpage.
9	Aim :Use of jQuery libraries to simplify complicated JavaScript applications Program: Write a HTML and jQuery program to design a webpage to accept event organizer name from the user and display it on the webpage.
10	Aim: Use Bootstrap framework to create interactive and responsive web pages Program: Write a HTML and bootstrap program to display glyphicons like envelop, print, search etc.. Also create buttons having glyphicons as links to carry out specific tasks.
11	Aim: Introduction to XML Program: Design an XML document to store information about a student in an engineering college affiliated to VTU. The information must include USN, Name, and Name of the College, Branch, Year of Joining, and email id. Make up sample data for 3 students. Create a CSS style sheet and use it to display the document.
12	Mini project Develop a web application project using the languages and concepts learnt .You can use any web technologies and frameworks and databases.

Course outcomes:

1. Adapt HTML and CSS syntax and semantics to build web pages and construct and visuall format tables and forms using HTML and CSS.
2. Develop Client side web applications using java scripts
3. Use jQuery constructs for DOM manipulation
4. Create interactive and responsive web pages faster using Bootstrap framework
5. Develop applications over the web using XML fundamentals

CO- PO Mapping :

POs / COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	3	1	3				1			2	2	1	
CO 2	2	3	3	2	3				1			2	3	3	3
CO 3	2	3	3	2	3	1				1		2	3	3	3
CO 4	2	2	3	2	3	2				1		2	2	2	
CO 5	2	3	3	2	3	2				2		2	2	2	
Avg.	**2**	**2.6**	**3**	**1.8**	**3**	**1.66**			**1**	**1.33**		**2**	**2.4**	**2.2**	**3**

Ability Enhancement Course – UNIX & Shell Programming			
Course Code	**21ISL482**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P: S) (0:0:2:0)	**Credits (0:0:1:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**20 Practical**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**01**

Course Objectives:

CLO 1. Describe basic and advanced Unix commands.
CLO 2. Explain the role of filters and file compression techniques..
CLO 3. Apply knowledge of programming language development tools..
CLO 4. Utilize the knowledge of Unix/Linux system administration and networking.
CLO 5. Analyze and understand genesis and diversity of both Linux and Unix system utilities

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) needs not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Unix & Shell Programming Laboratory:

1) Use of Basic UNIX Shell Commands: ls, mkdir, rmdir, cd, cat, touch, file, wc, sort, cut,

2) Commands related to inode, I/O redirection and piping, process control commands, mails.

3) Shell Programming: Shell script exercises based on following:
   (i) Interactive shell scripts
   (ii) Positional parameters
   (iii) Arithmetic
   (iv) if-then-fi, if-then- else-fi, nested if-else
   (v) Logical operators
   (vi) else + if equals elif, case structure
   (vii) while, until, for loops, use of break

4) Write a shell script to create a file. Follow the instructions
   (i) Input a page profile to yourself, copy it into other existing file;
   (ii) Start printing file at certain line
   (iii) Print all the difference between two file, copy the two files.
   (iv) Print lines matching certain word pattern

5) Write shell script for-
   (i) Showing the count of users logged in,
   (ii) Printing Column list of files in your home directory
   (iii) Listing your job with below normal priority
   (iv) Continue running your job after logging out.

6) Write a shell script to change data format. Show the time taken in execution of this script.

7) Write a shell script to print files names in a directory showing date of creation & serial number of the file.

8) Write a shell script to count lines, words and characters in its input (do not use wc).

9) Write a shell script to print end of a Glossary file in reverse order using Array. (Use awk tail)

10) Write a shell script to check whether Ram logged in, Continue checking further after every 30 seconds till success.

11) Write a shell script to compute gcd lcm & of two numbers. Use the basic function to find gcd & LCM of N numbers.

12) Write a shell script to find whether a given number is prime. Take a large number such as 15 digits or higher and use a proper algorithm.

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5^{th} week of the semester
2. Second test at the end of the 10^{th} week of the semester
3. Third test at the end of the 15^{th} week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4^{th} week of the semester
5. Second assignment at the end of 9^{th} week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13^{th} week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 01 hours)**

SEE paper will be set for 50 questions of each of 01 marks. The pattern of the question paper is MCQ. The time allotted for SEE is 01 hours

Course outcomes:

1. To provide introduction to basic commands of UNIX and its file system.
2. Understand commands related to process control and apply them to manage processes.
3. Understand the concepts of control structure, loops, case and functions in shell programming and apply them to create shell scripts.
4. Associate the concepts of arrays with linux and apply them to create, compile and execute C programs in linux terminal.
5. Compare different editors and use them to create shell script for given problem.

Textbooks:

1. Sumitabha Das: "UNIX – Concepts and Applications", (Chapters 1, 2, 4, 6-9, 11-14, 17, 19) Tata McGraw Hill, Noida, 4th Edition, 15th Reprint, 2011, ISBN-13: 978-0-07-063546-3.

Reference Books:

1. Behrouz A. Forouzan and Richard F. Gilberg: "UNIX and Shell programming", Cengage Learning, India, 1st Edition, 2005, ISBN: 81-35-0325-9.
2. M G Venkatesh Murthy: "UNIX and Shell programming", Pearson Education, Delhi, 1st Edition, 2005, ISBN: 81-7758-745-5.

Web links and Video Lectures (e-Resources):

1. http://www.mhhe.com/das/uca
2. http://www.tutorialspoint.com/unix/unix_tutorials.pdf.
3. http://www.perldoc.perl.org

CO- PO & PSO Mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3			1								2	3	2
CO2	2	2		2									2	2	3
CO3	2	2	2	2	2								2	3	2
CO4	2	3	2		2								2	3	2
CO5			2		3								2	2	2
Avg.	**2**	**2.5**	**2**	**2**	**2**								**2**	**2.6**	**2.2**

Ability Enhancement Course II – R Programming			
Course Code	**21ISL483**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P: S) (0:0:2:0)	**Credits (0:0:1:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**20 Practical**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**01**

Course Objectives:

CLO1. Understanding and being able to use basic programming concepts
CLO2. Automate data analysis
CLO3. Working collaboratively and openly on code
CLO4. Knowing how to generate dynamic documents
CLO5. To use continuous approach.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- Lecturer method (L) needs not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
- Use of Video/Animation to explain functioning of various concepts.
- Encourage collaborative (Group Learning) Learning in the class.
- Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
- Introduce Topics in manifold representations.
- Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

R Programming Laboratory:

Module 1:

Introduction: Overview of R, R data types and objects, reading and writing data, sub setting R Objects, Essentials of the R Language, Installing R, Running R, Packages in R, Calculations, Complex numbers in R, Rounding, Arithmetic, Modulo and integer quotients, Variable names and assignment, Operators, Integers, Factors, Logical operations

Lab program:

1. Download and install R-Programming environment and install basic packages using install. Packages () command in R.
2. Learn all the basics of R-Programming (Data types, Variables, Operators etc,.).
3. Write a program to find list of even numbers from 1 to n using R-Loops.

Module 2:

Control structures, functions, scoping rules, dates and times, Introduction to Functions, preview of Some Important R Data Structures, Vectors, Character Strings, Matrices, Lists, Data Frames, Classes Vectors: Generating sequences, Vectors and subscripts, Extracting elements of a vector using subscripts, Working with logical subscripts, Scalars, Vectors, Arrays, and Matrices, Adding and Deleting Vector Elements, Obtaining the Length of a Vector, Matrices and Arrays as Vectors Vector Arithmetic and Logical Operations, Vector Indexing, Common Vector Operations

Lab program:

1. Create a function to print squares of numbers in sequence.
2. Write a program to join columns and rows in a data frame using cbind() and rbind() in R.

Module 3:

Lists: Creating Lists, General List Operations, List Indexing Adding and Deleting List Elements, Getting the Size of a List, Extended Example: Text Concordance Accessing List Components and Values Applying Functions to Lists, DATA FRAMES, Creating Data Frames, Accessing Data Frames, Other Matrix-Like Operations.

Lab program:

1. Implement different String Manipulation functions in R.
2. Implement different data structures in R (Vectors, Lists, Data Frames)

Module 4:

FACTORS AND TABLES, Factors and Levels, Common Functions Used with Factors, Working with Tables, Matrix/Array-Like Operations on Tables , Extracting a Subtable, Finding the Largest Cells in a Table, Math Functions, Calculating a Probability, Cumulative Sums and Products, Minima and Maxima, Calculus, Functions for Statistical Distributions

Lab Programs:

1. Write a program to read a csv file and analyze the data in the file in R.
2. Create pie chart and bar chart using R.
3. Create a data set and do statistical analysis on the data using R.

Module 5:

Data Visualization using R: Scatter Plots - Box Plots - Scatter Plots and Box-and-Whisker Plots Together -Customize plot axes, labels, add legends, and add colours.

Lab Programs:

1. Construct a 3D scatter plot for the data to include two additional columns: names and gender and a function to load the data in the active session and save it as a data frame.
2. Implement the fan plot for the dataset data = c(179718,41370,41914,44280) and assign a set of colors to a variable and call it colors.
3. Project the 3D histogram with the z variable as well by generating the data for the x and y values using the seq() function: x = y = seq(-4,4,by =0.5)

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 01 hours)**

SEE paper will be set for 50 questions of each of 01 marks. The pattern of the question paper is MCQ. The time allotted for SEE is 01 hours

Course Outcomes:

At the end of the course the student will be able to:

1. Understand basics and different data sets using R programming
2. Construct or plot graphs and charts
3. Analyse the data and know descriptive statistics by using R Programming
4. Develop programming logic using R – Packages.
5. Predict the data and take decisions through R programming.

Text Books:

1. Crawley, M. J. (2006), "Statistics - An introduction using R", John Wiley, London 32.
2. Purohit, S.G.; Gore, S.D. and Deshmukh, S.R. (2015), "Statistics using R", second edition. Narosa Publishing House, New Delhi.
3. Shahababa B. (2011) , "Biostatistics with R", Springer, New York.
4. Braun & Murdoch (2007), "A first course in statistical programming with R", Cambridge University Press, New Delhi.

e- Resources & other digital material:

1. https://cran.r-project.org/doc/contrib/Owen-TheRGuide.pdf
2. https://sphweb.bumc.bu.edu/otlt/MPH-Modules/BS/R/R-Manual/R-Manual2.html
3. https://smac-group.github.io/ds/
4. https://www.geeksforgeeks.org/predictive-analysis-in-rprogramming

CO-PO/PSO mapping:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3				3								3		
CO2	2	3		1	3								3		
CO3	3			3	3								3	2	
CO4		2	3		3								1	2	
CO5	2		1	2	3										
Avg.	**2.5**	**2.5**	**2**	**2**	**3**								**2.5**	**2**	

UNIVERSAL HUMAN VALUES-II: UNDERSTANDING HARMONY AND ETHICAL HUMAN CONDUCT			
Course Code	**21UHV49**	**CIE Marks**	**50**
Teaching Hours/Week (L:T:P:S) (0:2:0:0)	**Credits (0:1:0:0)**	**SEE Marks**	**50**
Total Hours of Pedagogy	**20**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**01**

Course objectives:

This introductory course input is intended:

1. To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.
4. This course is intended to provide a much-needed orientational input in value education to the youngenquiring minds.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

- The methodology of this course is exploration and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.
- The course is in the form of 20 lectures (discussions)
- It is free from any dogma or value prescriptions.
- It is a process of self-investigation and self-exploration, and not of giving sermons. Whatever is found as truth or reality is stated as a proposal and the students are facilitated to verify
- It is their own right, based on their Natural Acceptance and subsequent Experiential Validation the whole existence is the lab and every activity is a source of reflection.
- This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student in every activity, leading to continuous self-evolution.
- This self-exploration also enables them to critically evaluate their pre-conditionings and present beliefs.

Module-1	
Introduction to Value Education: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – CurrentScenario, Method to Fulfill the Basic Human Aspirations **04 Hours**	
Module-2	
Harmony in the Human Being Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health **04 Hours**	
Module-3	
Harmony in the Family and Society Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order **04 Hours**	
Module-4	
Harmony in the Nature/Existence Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence **04 Hours**	
Module-5	
Implications of the Holistic Understanding – a Look at Professional Ethics Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession **04 Hours**	
Teaching-Learning Process	Introduction to the concepts- Chalk and talk method, Discussion, Sharing of experiences, Live Examples and videos

Course outcome (Course Skill Set)

At the end of the course the student should :

1. By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
2. They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). It is hoped that they 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.

Therefore, the course and further follow up is expected to positively impact common graduate attributes like:

a) Holistic vision of life
b) Socially responsible behaviour
c) Environmentally responsible work
d) Ethical human conduct
e) Having Competence and Capabilities for Maintaining Health and Hygiene
f) Appreciation and aspiration for excellence (merit) and gratitude for all

Assessment Details (both CIE and SEE)

Component		**Weightage (%)**	
CIE's	CIE 1 5th week	20	60
	CIE 2 10th week	20	
	CIE 3 15th week	20	
AAT's	AAT-1 10th week	10	
	AAT-2	10	
	AAT-3	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Suggested Learning Resources:

Text Book and Teachers Manual

1. The Textbook *A Foundation Course in Human Values and Professional Ethics*, R R Gaur, R Asthana, G P Bagaria, 2**nd** Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
2. The Teacher"s Manual Teachers" Manual for *A Foundation Course in Human Values and Professional Ethics*, R R Gaur, RAsthana, G

Reference Books

1. Jeevan Vidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, 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)
14. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
15. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth –Club of Rome's report, Universe Books.
16. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.
17. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
18. A N Tripathy, 2003, Human Values, New Age International Publishers.
19. SubhasPalekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) KrishiTantraShodh, Amravati.
20. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers , Oxford University Press
21. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
22. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
23. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

Web links and Video Lectures (e-Resources):

1. Value Education websites, https://www.uhv.org.in/uhv-ii, http://uhv.ac.in, http://www.uptu.ac.in
2. **Story of Stuff, http://www.storyofstuff.com**
3. **Al Gore, An Inconvenient Truth, Paramount Classics, USA**
4. **Charlie Chaplin, Modern Times, United Artists, USA**
5. **IIT Delhi, Modern Technology – the Untold Story**
6. Gandhi A., Right Here Right Now, Cyclewala Productions
7. https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw
8. https://fdp-si.aicte-india.org/8dayUHV_download.php
9. https://www.youtube.com/watch?v=8ovkLRYXIjE
10. https://www.youtube.com/watch?v=OgdNx0X923I
11. https://www.youtube.com/watch?v=nGRcbRpvGoU
12. https://www.youtube.com/watch?v=sDxGXOgYEKM

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

CO- PO Mapping :

POs / **COs**	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	2					2	3	3	3	1		3		3	2
CO2						3	3	3	3	2	1	3		2	
CO3	2					3	2	2	3	2	1	3		3	
Avg.	**2**					**2.66**	**2.66**	**2.66**	**3**	**1.66**	**1**	**3**		**2.66**	**2**

Entrepreneurship Development Course – II: Launching your Start-Up			
Course Code	**21EDC49**	**CIE Marks**	**Audit Course**
Teaching Hours/Week (L:T:P:S) (0:2:0:0)	**Audit Course**	**SEE Marks**	**Audit Course**
Total Hours of Pedagogy	**20**	**Total Marks**	**Audit Course**
Credits	**Audit Course**	**Exam Hours**	**Audit Course**

Course Description

Once you have a prototype and a clearer vision of the opportunity, you'll need to create a small organization to discover how to create a repeatable and scalable business model. Designed to provide you with a comprehensive overview of the critical components of creating a start-up, Entrepreneurship 2: Launching the Start-up, provides practical, real-world knowledge about the lean approach, the minimum viable product, when to pivot, when to quit your day job, the art of the pitch, building and managing a team, allocating equity, and building your external team, advisory board members, professional services, and entrepreneurial strategy. At the end of this course, you'll be able to create a strategy for launch, including knowing who you need to hire, how to manage them to provide the greatest value, and what legal aspects are involved. You'll also be prepared for Entrepreneurship 3: Growth Strategies.

Module 1:

Preparing to Launch: Essential Components

Introduction, The Lean Approach, Minimum Viable Products (MVPs), Hypothesis and Preliminary Experiments, The Pivot, Making the Leap, The Art of the Pitch.

05 Hours

Module 2:

Building the Team

The Importance of the Founding Team, the Role of Early Hires, Goals and Motivations, Founder's Agreements, Hiring Key Management, Finding Technical Resources, Allocating Equity Among Team Members

05 Hours

Module 3:

Networks, Professional Services, and Intellectual Property

Networks, Innovation, and Entrepreneurship, Mentors, Advisors, and Advisory Boards, Professional Services: Lawyers and Accountants, Intellectual Property Overview, Summary - Legal Forms of the Enterprise

05 Hours

Module 4:

Branding, Strategy, and Summary

Branding and Naming, Launching Your Start-up – Branding, Bias and Meritocracy, Incubators and Accelerators, Entrepreneurial Strategy.

05 Hours

Assessment Details (both CIE and SEE)

Component		Weightage (%)	
CIE's	CIE 1 5th week	20	60
	CIE 2 10th week	20	
	CIE 3 15th week	20	
AAT's	AAT-1 10th week	10	
	AAT-2	10	
	AAT-3	20	
Continuous Internal Evaluation Total Marks: 100. Reduced to 50 Marks			
Semester End Examination (SEE) Total Marks: 100. Reduced to 50 Marks			

Course outcomes:

1. Design a strategy to validate your hypothesis, identify the key components of a successful pitch.
2. Prepare for position your start-up for success by making data-driven decisions.
3. Determine professional services will be most useful, and apply theories of social networks to make the most suitable choices for your set of advisors.
4. Take product or service to market with a name, a brand, a strategy that positions your venture for success.
5. Create a strategy & manage launching enterprises to provide the greatest value, and what legal aspects are involved.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

CO- PO Mapping :

POs / COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	3						3			2			
CO2	2								2			2			
CO3				2	2			2		3		3			
CO4				1		2	2	2				3			
CO5	1		3	3					3			3			
Avg.	**2.66**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2.66**	**3**		**2.6**			

Online Resources

1. https://www.lingq.com/en/learn-english-online/courses/559361/