Course Curriculum (in light of NEP 2020) for B. Tech.

In

Computer Science and Engineering

(For students admitted in 2022-23 onwards)

National Institute of Technology Arunachal Pradesh

P.O.: Jote, Dist.: Papumpare, Arunachal Pradesh, Pin–791113
www.nitap.ac.in

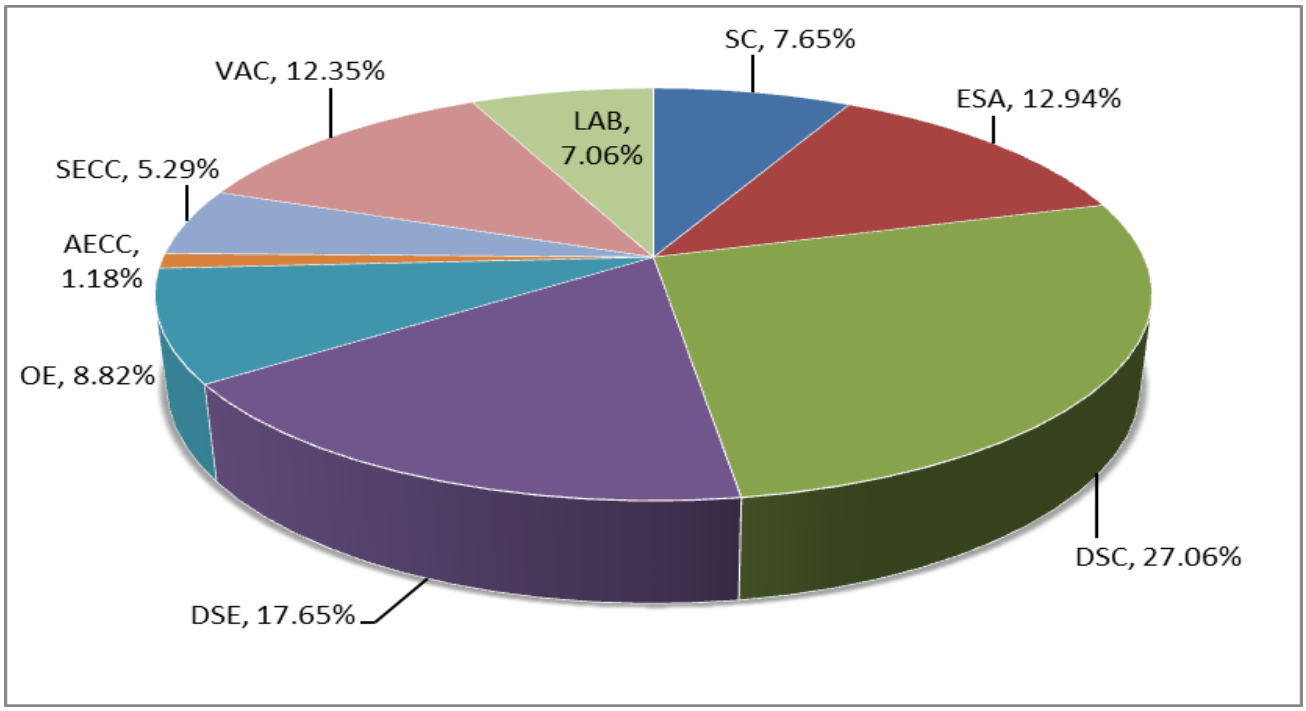
1.0 Semester wise Credit point distribution

Sl. No.	Year	Credit Point	
		ODD	EVEN
1	First	22	22
2	Second	21	21
3	Third	24	23
4	Fourth	20	17
Total Credit Point		**87**	**83**
		170	

1.1 Subject Category wise Credit point Distribution

Course Category	Sem-I	Sem-II	Sem-III	Sem-IV	Sem-V	Sem-VI	Sem-VII	Sem-VIII	Total Credit Point
Science Core (SC)	7	3	3	-	-	-	-	-	**13**
Engineering Science and Arts (ESA)	8	14	-	-	-	-	-	-	**22**
Departmental Specific Core (DSC)	4	3	9	9	9	9	3	-	**46**
Departmental Specific Elective (DSE)	-	-	3	3	3	6	9	6	**30**
Open Elective (OE)	-	-	3	3	3	3	3	-	**15**
Ability Enhancement Compulsory Course (AECC)	-	-	-	-	1	-	1	-	**2**
Skill Enhancement Compulsory Course (SECC)	3	-	-	3	3	-	-	-	**9**
Value Added Course (VAC)	-	2	-	-	2	2	4	11	**21**
Laboratory (LAB)	-	-	3	3	3	3	-	-	**12**
Total Credit Point	**22**	**22**	**21**	**21**	**24**	**23**	**20**	**17**	**170**

1.2 Subject Category wise Credit point Distribution (in percentage)



This graphical representation is as per NEP committee's recommendation

2.0 Course Structure

I[st] Semester							
Sl No	**Course Code**	**Subject Category**	**Course Title**	**L**	**T**	**P**	**C**
1	BS-1101	SC1	Engineering Mathematics-I	2	0	0	2
2	BS-1102	SC2	Engineering Chemistry	2	0	0	2
3	BS-1103	SC3	Engineering Physics	2	0	0	2
4	BT-1101	ESA1	Biology for Engineers	2	0	0	2
5	CS -1101	DSC1	Fundamentals of Computer Science and Engineering	3	0	0	3
6	MH-1101	SECC1	Communication Skill	2	0	0	2
7	EE-1102	ESA2	Basic of Electrical and Electronics Engineering	2	0	0	2
8	CS-1102	ESA3	Coding Laboratory	0	0	4	2
9	EE-1103	ESA4	Basic of Electrical and Electronics Engineering Laboratory	0	0	2	1
10	BS-1104	SC4	Engineering Physics Lab	0	0	2	1
11	ME-1102	ESA5	Engineering Drawing	0	0	2	1
12	CS-1103	DSC2	Fundamentals of Computer Science and Engineering Laboratory	0	0	2	1
13	MH-1102	SECC2	Language Laboratory	0	0	2	1
14	MH-1103	VAC1	NSS/NCC/Yoga (Audit Pass)	0	0	0	0
			Contact Hours	15	0	14	
			Total Credits				22

II[nd] Semester							
Sl No	**Course Code**	**Subject Category**	**Course Title**	**L**	**T**	**P**	**C**
1	BS-1201	SC5	Engineering Mathematics-II	2	0	0	2
2	CS-1201	ESA6	Programming and Data Structure	3	0	0	3
3	EC-1201	ESA7	Introduction to Digital engineering	2	0	0	2
4	MH-1201	ESA8	Introduction to Innovation and Creativity	2	0	0	2
5	ME-1201	ESA9	Engineering Mechanics	3	0	0	3
6	CS-1202	DSC3	Multimedia and Web Design	3	0	0	3
7	EC-1202	ESA10	System Design	2	0	0	2
8	ME-1204	ESA11	Workshop Practice-I	0	0	2	1
9	EC-1203	VAC2	Do It Yourself (DIY)/Industry Exposure	0	0	0	1
10	BS-1202	SC6	Basic Science Laboratory-II	0	0	2	1
11	CS-1204	ESA12	Programming and Data Structure Laboratory	0	0	2	1
13	MH-1202	VAC3	Gandhian Technology	0	0	2	1
			Contact Hours	17	0	8	
			Total Credits				22

III[rd] Semester							
Sl No	**Course Code**	**Subject Category**	**Course Title**	L	T	P	C
1	BS-2101	SC7	Engineering Mathematics-III	3	0	0	3
2	CS-2101	DSC4	Object Oriented Programming	3	0	0	3
3	CS-210A	DSE1	Design & Analysis of Algorithm	3	0	0	3
4	EC-2102	DSC5	Digital Logic Design	3	0	0	3
5	BS-2102	DSC6	Discrete Mathematics	3	0	0	3
6	YY-210X	**OE**	**OE1***	3	0	0	3
7	CS-2102	LAB1	Object Oriented Programming Laboratory	0	0	2	1
8	EC-2104	LAB2	Digital Logic Design Laboratory	0	0	2	1
9	CS-2103	LAB3	Design Analysis of Algorithm Laboratory	0	0	2	1
			Contact Hours	18	0	6	
			Total Credits				21

IV[th] Semester							
Sl No	**Course Code**	**Subject Category**	**Course Title**	**L**	**T**	**P**	**C**
1	CS-2201	DSC7	Software Engineering	3	0	0	3
2	BS-2201	DSC8	Optimization Techniques	3	0	0	3
3	CS-2202	DSC9	Formal Language and Automata Theory	3	0	0	3
4	CS-220A	DSE2	Computer Organization & Architecture	3	0	0	3
5	YY-220X	**OE**	**OE2***	3	0	0	3
6	MH-2201	SECC3	Entrepreneur Essential and Early Stage Start-up	3	0	0	3
7	CS-2203	LAB4	Computer Organization & Architecture Laboratory	0	0	2	1
8	CS-2204	LAB5	Software Engineering Laboratory	0	0	2	1

9	CS-2205	LAB6	Formal Language and Automata Theory Laboratory	0	0	2	1
			Contact Hours	18	0	6	
			Total Credits				21
Vth Semester							
Sl No	**Course Code**	**Subject Category**	**Course Title**	**L**	**T**	**P**	**C**
1	CS-3101	DSC10	System Software and administration	3	0	0	3
2	CS-3102	DSC11	Operating System	3	0	0	3
3	CS-3103	DSC12	Python for Data Science	3	0	0	3
4	CS-310A	DSE3	Compiler Design	3	0	0	3
5	YY-310X	**OE**	**OE3***	3	0	0	3
6	CS-3104	AECC1	Internship-I	0	0	0	1
7	MH-3101	SECC4	Engineering Economics	3	0	0	3
8	CS-3105	VAC4	Minor Project-I	0	0	4	2
9	CS-3106	LAB7	System Software and administration Laboratory	0	0	2	1
10	CS-3107	LAB8	Operating System Laboratory	0	0	2	1
11	CS-3108	LAB9	Compiler Design Laboratory	0	0	2	1
			Contact Hours	18	0	10	
			Total Credits				24
VIth Semester							
Sl No	**Course Code**	**Subject Category**	**Course Title**	**L**	**T**	**P**	**C**
1	CS-3201	DSC13	Computer Networking	3	0	0	3
2	CS-3202	DSC14	Introduction to IoT	3	0	0	3
3	CS-3203	DSC15	Computer Graphics	3	0	0	3
4	CS-320A	DSE4	Database Management System	3	0	0	3
5	CS-321A	DSE5	Machine Learning & Artificial Intelligence	3	0	0	3
6	YY-320X	**OE**	**OE4***	3	0	0	3
7	CS-3204	VAC5	Minor Project-II	0	0	4	2
8	CS-3205	LAB10	Computer Networking Laboratory	0	0	2	1
9	CS-3206	LAB11	Database Management Laboratory	0	0	2	1
10	CS-3207	LAB12	Machine Learning & Artificial Intelligence Laboratory	0	0	2	1
			Contact Hours	18	0	10	
			Total Credits				23
VIIth Semester							
Sl No	**Course Code**	**Subject Category**	**Course Title**	**L**	**T**	**P**	**C**
1	CS-4101	DSC16	Product Design and Development	1	0	4	3
2	CS-410A	DSE6	Cryptography and Network Security	3	0	0	3
3	CS-411A	DSE7	Data Mining & Warehousing	3	0	0	3
4	CS-412A	DSE8	Internet and Web Technology	3	0	0	3

5	YY-410X	**OE**	**OE5***	3	0	0	3
6	CS-4101	AECC2	Internship-II	0	0	0	1
7	CS-4102	VAC6	Major Project-I	0	0	8	4
			Contact Hours	13	0	12	
			Total Credits				20
VIIIth Semester							
Sl No	**Course Code**	**Subject Category**	**Course Title**	**L**	**T**	**P**	**C**
1	CS-420*	DSE9	Elective-I (Swayam/ NPTEL)	3	0	0	3
2	CS-421*	DSE10	Elective-II (Swayam/ NPTEL)	3	0	0	3
3	CS-4201	VAC7	Major Project-II	0	0	22	11
			Contact Hours	6	0	22	
			Total Credits				17

***The students of Department of CSE have to choose a subject offered by other department as open elective.**

List of Elective Subjects

Sl No	ELECTIVE	Subject Code (*)	Course Title
1	I	CS-420A CS-420B CS-420C CS-420D CS-420E CS-420F	Introduction to Speech Processing Introduction to Blockchain Technology Pattern Recognition and Image Processing Data Compression Software Project Management Real Time Operating System
2	II	CS-421A CS-421B CS-421C CS-421D CS-421E CS-421F	Natural Language Processing (NLP) Soft Computing Virtualization and Cloud Computing Distributed Operating System Advanced Java Programming Parallel Algorithm

CS-210X: Design & Analysis of Algorithm
CS-220X: Optimization Techniques
CS-310X: Python for Data Science
CS-320X: Machine Learning & Artificial Intelligence
CS-410X: Data Mining & Warehousing

} **Minor in Machine Learning**

CS-210X: Design & Analysis of Algorithm
CS-220X: Optimization Techniques
CS-311X: Operating System
CS-321X: Computer Networking
CS-411X: Cryptography and Network Security

} **Minor in Cryptography**

3.0 List of Department specific electives

DSE1	DSE2	DSE3	DSE4	DSE5	DSE6	DSE7	DSE8	DSE9	DSE10
CS-210A	CS-220A	CS-310A	CS-320A	CS-321A	CS-410A	CS-411A	CS-412A	CS-420A CS-420B CS-420C CS-420D CS-420E CS-420F	CS-421A CS-421B CS-421C CS-421D CS-421E CS-421F
Object Oriented Programming	Computer Organization & Architecture	Compiler Design	Database Management System	Machine Learning & Artificial Intelligence	Cryptography and Network Security	Data Mining & Warehousing	Internet and Web Technology	Elective-I (Swayam/ NPTEL)	Elective-II (Swayam/ NPTEL)

- **Students are urged to register for the electives given under DSE9 and DSE10 using the SWAYAM/NPTEL, etc. portal.**

4.0 Open elective (offered by other departments)

- Students are free to choose any subjects of their interest offered as open electives by other department of the Institute.
- The total course has to be of 15 credits.
- During the beginning of the 3rd semester onwards, HoD, CSE will notify the specific subject offered as an open elective for other departments.

Open Electives (Offered by CSE department for other departmental students)

Sl No	Course Code	Course Title	L	T	P	C
1	CS-210X	OE1 – Object Oriented Programming	3	0	0	3
2	CS-220X	OE2 – Software Engineering	3	0	0	3
3	CS-310X	OE3 – Python for Data Science - Operating System	3	0	0	3
4	CS-320X	OE4 – Computer Networking - Machine learning and Artificial Intelligence	3	0	0	3
5	CS-410X	OE5 – Data Mining & Warehousing - Cryptography and Network Security	3	0	0	3
Contact Hours			**15**	**0**	**0**	
Total Credits						**15**

5.0 Internship

- Internship - I: Student will go for internship during summer vacation (after 4th semester) for a period of 4 weeks. The assessment will be done on 5th semester
- Internship - II: Student will go for internship during summer vacation (after 6th semester) for a period of 4 weeks. The assessment will be done on 7th semester

6.0 Institute Vision

To transform into an acclaimed institution of higher learning with creation of an impact on the north eastern region in terms of innovation and entrepreneurship.

7.0 Institute Mission

1. To generate new knowledge through state of the art academic program and research in multidisciplinary field.
2. To identify regional, Indian and global need to serve the society better.
3. To create an ambience to flourish new ideas, research and academic excellence to produce new leaders and innovators.
4. To collaborate with other academic, research institutes and industries for holistic growth of the students.
5. Utilization of available big resources to encourage entrepreneurship through formation of start-ups.

8.0 Departmental Vision

To create the most conducive environment for quality academic and research oriented undergraduate and postgraduate education in computer science and engineering and prepare the students for a globalised technological society and orient them towards serving the society.

9.0 Departmental Mission

1. To impart high quality professional training at the PhD, postgraduate and undergraduate level with an emphasis on basic principles of computer science and engineering.
2. To impart moral and ethical values, and interpersonal skills to the students
3. To empower the students with the required skills to solve the complex technological problems of modern society and also provide them with a framework for promoting collaborative and multidisciplinary activities.

10.0 Programme Outcomes (POs)

PO1	An ability to apply knowledge of mathematics, probability, statistics, science, electronics and electrical engineering as applicable to computer science and engineering.
PO2	An ability to design hardware and software systems, components and processes to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability.
PO3	An ability to understand the impact of engineering solutions on the environment, economy and social issues both in the local and global perspective
PO4	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities.
PO5	Recognize the need and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PO6	Work cooperatively, responsibly, creatively, and respectfully in teams.
PO7	An Ability to acquire entrepreneurship and leadership qualities.

11.0 Program Educational Objectives (PEOs)

PEO1	High level attainment in professional career and higher education by accruing knowledge of computation, mathematics and basic principles of engineering.
PEO2	Analysis of real life problems to develop economically viable and socially acceptable solutions of engineering problem.
PEO3	Excellence in professionalism, moral and ethical conduct, interpersonal skills and adaptable communication to prevalent trends in technology and vis-à-vis changing technology.

12.0 Program Specific Outcomes (PSOs)

PSO1	Apply standard Software Engineering practices and strategies in real-time software project development using open-source programming environment or commercial environment to deliver quality product for the organization success
PSO2	Design and develop computer programs/computer-based systems in the areas related to algorithms, networking, web design, cloud computing, IoT and data analytics of varying complexity
PSO3	Acquaint with the contemporary trends in industrial/research settings and thereby innovate novel solutions to existing problems

1st Semester						
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	BS-1101	Engineering Mathematics-I	2	0	0	2
2	BS-1102	Engineering Chemistry	2	0	0	2
3	BS-1103	Engineering Physics	2	0	0	2
4	BT-1101	Biology for Engineers	2	0	0	2
5	CS-1101	Fundamentals of Computer Science and Engineering	3	0	0	3
6	MH-1101	Communication Skill	2	0	0	2
7	EE-1102	Basic of Electrical and Electronics Engineering	2	0	0	2
8	CS-1102	Coding Laboratory	0	0	4	2
9	EE-1103	Basic of Electrical and Electronics Engineering Laboratory	0	0	2	1
10	BS-1104	Engineering Physics Lab	0	0	2	1
11	ME-1102	Engineering Drawing	0	0	2	1
12	CS-1103	Fundamentals of Computer Science and Engineering Laboratory	0	0	2	1
13	MH-1102	Language Laboratory	0	0	2	1
14	MH-1103	NSS/NCC/Yoga (Audit Pass)	0	0	0	0
Contact Hours			15	0	14	
Total Credits						22

Subject Code: BS 1101
Subject Name: Engineering Mathematics- I
Credit Point: 2 [L=2, T=0, P=0]

A. Course Objectives:

The course is designed to meet with the objectives of:

1. providing high quality education in pure and applied mathematics in order to prepare students for graduate studies or professional careers in mathematical sciences and related fields,
2. imparting theoretical knowledge and to develop computing skill to the students in the area of Science and Technology,
3. providing teaching and learning to make the students competent to their calculating ability, logical ability and decision-making ability,
4. giving students theoretical knowledge of Calculus, Algebra and the practical applications in the various fields of Science and Engineering,

B. Course Content:

Matrix Algebra: Basic concept of matrices & Determinant, Jacobi's theorem. Rank of a matrix, rank nullity theorem, Introduction to Vector space, Linear dependent and independent, System of homogeneous and non-homogeneous linear equations, Eigen values and Eigen vectors of a square matrix, Cayley-Hamilton theorem and its applications.

Differential Calculus: Higher order derivatives, Leibnitz's theorem and its application, Rolle's theorem and its application, Mean Value theorems–Lagrange & Cauchy and their application, Taylor's theorem and its application, Expansions of functions by Taylor's and Maclaurin's theorem. Partial Derivatives, Differential calculus for two variables.

Integral Calculus: Double and triple integrals and evaluation of area and volume, change of variables.

C. Text Books:

1. Kreyszig E., Advanced Engineering Mathematics, John Wiley, 2010, 11th edition.
2. Grewal B. S., Higher Engineering Mathematics, Khanna Publishers, 2014, 43rd edition.
3. Marsden J., Tromba A. J. and Weinstein A., Basic Multivariable Calculus, Springer, India, Private Ltd, 2009.

D. Reference Books:

1. Finney R. L. and Thomas G. B., Calculus and Analytical Geometry (Linear Algebra), Narosa Publishing House, 2021, 9th edition.
2. Hofmann K. M. and Kunze R., Linear Algebra, Prenticehall, 2015, 2nd edition,.
3. Bartle and Sherbart, Introduction to Real Analysis, Wiley, 2014, 4th edition.
4. Apostol T. M., Calculus,Vol I and II, John Wiley and Sons Ltd;, 2007, 2nd edition.
5. Stewart J., Transcendental Calculus, Cengage; 2014, 2nd edition,.
6. Mappa S. K., Higher Algebra, Shrat book House, 2014.
7. Mappa S. K., Real Analysis, Shrat book House, 2013, 7th edition.
8. Wylie C. R. and Barrett L. C., Advanced Engineering Mathematics, McGraw Hill, 1995.

E. Course Outcomes:

The outcomes of course are following:

1. Students will be more confident about their computing skill, logical skill and decision making skill,
2. Students will find various applications of calculus and algebra in the practical fields of science and engineering,
3. Students will become more competent to analyze mathematical and statistical problems, precisely define the key terms, and draw clear and reasonable conclusions,
4. Student will be able to explain the importance of mathematics and its techniques to solve real life problems and provide the limitations of such techniques and the validity of the results,

Subject Code: BS 1102
Subject Name: Engineering Chemistry
Credit Point: 2 [L=2, T=0, P=0]

A. Course Objectives:

1. To enable the students to acquire knowledge about basic chemistry and its technology.
2. To understand applicability of chemistry for engineering purposes.
3. To make them apply the knowledge of chemistry for analysis, evaluation and design system components or processes related to chemistry.

B. Course Content:

Chemical thermo dynamics: first law, energy, enthalpy, Cp and Cv, second law, entropy, free energy, chemical kinetics: rate of elementary reactions, surface chemistry: surfactants and colloidal systems; electrochemistry: conductance, Kohlrausch's law, cell EMF.

Ligand, somerism, valence bond theory, valence shell electron pair repulsion theory, crystal field theory, molecular orbital theory, charge transfer transition, d-d transition, John-Teller effect, magnetic properties, bioinorganic chemistry.

Hybridization, inductive effect, resonance, hyper conjugation, carbocation, carbanion and free radicals, substitution and addition reactions, introduction to instrumental methods (IR, UV-vis, NMR and Mass-spectroscopy).

Polymers and materials: addition and condensation polymers, degree of polymerization, thermoplastic and thermosetting plastics, conducting polymers, nanomaterials and ceramics, nanocomposites, corrosion, explosive materials.

C. Text Books:

1. Morrison R. T., Boyd R. N. and Bhattacharjee S. K., Organic chemistry, Pearson education, New Delhi, 2010, 7th Ed.,.
2. Rakshit P.C., Physical chemistry, Sarat book distributors, Kolkata, 2004, 7th Ed.
3. Huheey J. E., Keiter E. A., Keiter R. L., Inorganic chemistry: principles of structure and reactivity, Pearson Education, New Delhi, 2009, 4th Ed..

D. Reference Books:

1. Ray B. C., Das S. N. and Biswas S., Engineering chemistry, New Central Book Agency, Kolkata, 2008.
2. Gowariker V. R, Viswanathan N. V and Sreedhar J., Polymer science, New Agency International, Kolkata, 2012.
3. Malik W. U., Tuli G. D. and Madan R. D., Selected topics in inorganic chemistry, S. Chand, New Delhi, 2012.
4. Ahluwalia V. K. and Parashar R. K., Organic reaction mechanisms,, Narosa publishing house, Kolkata, 2013, 4th Ed.

E. Course Outcomes:

After studying this course, students will be able to

1. acquire basic knowledge in engineering chemistry.
2. apply their knowledge for various technological and engineering issues.
3. select appropriate analysis, evaluation and methods for interpret the concern results.

Subject Code: BS 1103
Subject Name: Engineering Physics
Credit Point: 2[L=2, T=0, P=0]

A. Course Objectives:

The course is designed to meet with the objectives of:

1. imparting theoretical & practical knowledge to the students in the area of engineering physics.
2. providing teaching and learning to make students acquainting with modern state-of-art of Engineering.
3. injecting the future scope and the research direction in the field of Physics with specific specialization.
4. making students competent to design & development of Engineering Physics.

B. Course Content:

Electricity and Magnetism:

Coulombs law in vector form, Electric field, Gauss's law (differential and integral form), Electric potential and energy, multipole expansion of electric potential, Boundary value problem (Poisson's Eqn. and Laplace's Eqn.). Dielectric, Polarization and Bound charges, Biot-Savart's law, Ampere's law (differential and integral form), Faraday's law of electromagnetic induction, Lenz's Law, Self and mutual Inductance, Maxwell'sfield equation in vacuum and matter.Wave solution of Electromagnetic waves.

Modern Physics and Quantum Mechanics:

Photo electric effect, Compton effect, Blackbody radiation (no derivations), Wave particle duality, two slit experiments, de-Broglie's hypothesis, Heisenberg's uncertainty principle, concept of wave function and wave packet**,** phase velocity and group velocity, Formulation of quantum mechanics and basic postulates, physical interpretation of wave function, Schrodinger's wave equation, Steady state of Schrodinger's wave equation, One dimensional quantum problems:Free particle, particle in a box, particle in a step potential, harmonic oscillator.

C. **Text Books:**

1. Griffiths J. D, "Introduction to Electrodynamics," Pearson Education India Learning Private Limited, 2015, 4th edition.
2. Griffiths J. D, "Introduction to Quantum Mechanics," Pearson Education, 2015, 2nd edition,.
3. Beise, A., Mahajan, S. and Choudhury S. R., "Concepts of Modern Physics," McGraw-Hill Education, 2017, 7th edition.

D. Reference Books:

1. Krane K., "Modern Physics", Wiley, 2016.
2. Jackson, J. D. "Classical Electrodynamics", Wiley, 1998, 3rd edition.
3. Feynman R. P., Leighton R. B. and Matthew S., "The Feynman Lectures on Physics Vol. 1 to Vol. 3" The New Millennium Edition, 2012.

E. Course Outcomes:

Students successfully completing this module will be able to:

1. demonstrate competency and understanding of the basic concepts found in physics.
2. utilize the scientific method for formal investigation and to demonstrate competency with experimental methods that are used to discover and verify the concepts related to content knowledge.
3. engineering applications capability to understand advanced topics in engineering. apply quantum mechanics to engineering phenomena
4. identify formula and solve engineering problems.

Subject Code: BT-1101
Subject Name: ESA1-Biology for Engineers
Credit Point: 2 (L=2, T=0, P=0)

A. Course Objectives:

- imparting knowledge on the origin of Earth and life forms on Earth, appreciating importance of biological diversity and understanding biomolecules being the main component of life.
- understanding "Cell" – the basic UNIT in different life forms, and structure and function of different organelles in living organisms
- imparting knowledge on nutrient uptake and assimilation, and metabolism in living organisms, providing knowledge on Bioenergetics of living cells, different organelles involved in electron transport systems, nervous, digestive and immune systems in animals.
- imparting knowledge on immunity of the body and various advanced applications derived out of the natural systems
- imparting knowledge on DNA as a genetic material and various advanced technology derived out of it for variety of applications
- imparting knowledge on interference of biological systems in various machines, structures, process and instrumentation
- motivating young minds to utilise their interdisciplinary knowledge to become a thinker in innovation of effective ideas for solving problems related to biological systems

B. Course Content:

Origin of Life: theories of origin of life, Classification of various forms of life (virus, bacteria, fungi, plantae, Animalia)
Nutrients and Bioenergetics: Essential nutrients (carbohydrates proteins, lipids, nucleic acids, minerals, vitamins), Bioenergetics; basics of aerobic and anaerobic glycolysis and citric acid cycle.
Cell: Cell concept, prokaryotic and eukaryotic cell, cell organelles and their functions, Cell division: Mitosis and meiosis, Cancer biology
Immunology: Immune systems and cell types, applications of immunology: biosensors, nanoparticles.
Genes and Chromosomes: Principles of inheritance, Mendelian Genetics, Discovery of DNA as genetic material, DNA mutation and effects, Genetic engineering/Cloning and its applications

C. Text Books:

1. Harvey Lodish; Arnold Berk; Chris A. Kaiser; Monty Krieger; Anthony Bretscher; HiddePloegh; Kelsey C. Martin; Michael Yaffe; Angelika Amon. Molecular Cell Biology (Ninth Edition). W. H. Freeman, 2020
2. J. L. Tymoczko, J. M. Berg and L. Stryer, Biochemistry, 8th Ed, W. H. Freeman & Co, 2015.
3. D. L. Nelson and M. M. Cox, Lehninger Principles of Biochemistry, 7th Ed, Macmillan Worth, 2017.
4. N.A. Campbell, J.B. Reece, "Biology" Person Education, Inc& Dorling Kinderley Publishing, Inc, 2015
5. wen, Judith A., Jenni Punt, and Sharon A. Stranford. Kuby immunology. New York, NY, USA:: WH Freeman, 2013.
6. Niemeyer, Christof M., and Chad A. Mirkin, eds. Nanobiotechnology: concepts, applications and perspectives. Vol. 1. John Wiley & Sons, 2004.

D. Reference Books:

1. Nruno Antonny, Catherine Rabouille. Cell Organlles, Current Opinion in Cell Biology, Elsevier, 2017

2. Joel B. Hagen. Five Kingdoms, More or Less: Robert Whittaker and the Broad Classification of Organisms, BioScience, Oxford Academic, 2012
3. Pascal Maguin, Luciano A. Marraffini, From the discovery of DNA to current tools for DNA editing, JEM, 2021

E. Course Outcomes:

1. Students will understand the characteristics of living organisms; appreciate the importance of diversity of life and their interaction with the environment.
2. Students will be able to explain the interrelationship between biomolecules and the living system, and influences of biomolecules upon the structure and function of intracellular components.
3. Students will have a broad knowledge on Bioenergetics of living cells; and a brief on important biological systems of animal.
4. Students will learn different functions of cell organelles, cell types and various positive and negative functional implications, development of new tools and kits from the knowledge of natural system.
5. Students will learn the basis of inheritance and introduction to technological aspects and varied applications and advanced tools to tackle medical complications
6. Students will learn the interference of biological systems in various machines, structures, process and instrumentation
7. Students will develop keen interest in applying basic engineering skills to solving problems related to biological systems through their concepts in biology

Subject Code: CS-1101
Subject Name: Fundamentals of Computer Science and Engineering
Credit Point: 3 **(**L=3, T=0, P=0)

A. Course Objectives:

1. To understanding of basic concepts of computer science and engineering.
2. To learn the basic components of Computer and their requirements.
3. To understand basics of computer and working with OS.
4. To develop working skills with productivity tools and graphics designing.
5. To acquire basics about the digital systems.
6. To introduce the basic Networking Concept and Internet.

B. Course Content:

Introduction to Computer: Generations of Computer (I-V); Block Diagram of a Computer; Functions of the Different Units- Input unit, Output unit, Memory unit, CPU (ALU+CU).

Input & Output Devices: Keyboard, Point and draw devices, mouse, joystick, track ball, light pen; Data Scanning devices - image scanner, OCR, OMR, MICR, Bar code reader, card reader; Voice Recognition Device, Digitizers; Output Devices- Monitor, Printer, laser printer, dotmatrix printer, ink jet printer, Projector.

Memories: **(Brief Introduction)** [Memory hierarchy]: Registers [Types of Registers]; Cache Memory; Primary Memory- RAM, SRAM, DRAM, ROM, Firmware; Secondary

Memories: Hard disk- tracks, sectors, clusters, cylinders; Floopy [data storage mechanism]; **System Software:** Operating System- function and types; Program Language Translators- Assembler, Compiler, Interpreter; Utility Programs; Communication Software; Performance Monitoring Software.

Application Software: Software hierarchy and dependence between the different layers.

Computer Languages: Machine language, Assembly language, High level language

Digital Number System: Number System Conversion; Arithmetic Operations-Boolean, Octal, Hexadecimal, etc.

Networking& web Designing: The need and use of Computer Networks. Concepts of Networking-LAN, WAN, MAN. ISP's in India and their responsibilities. Video Conference, downloading and uploading files. Introduction to HTML, Basic tags, Formatting tags, Stylesheets, Table handling, Lists, Hyperlinks in HTML

Cloud Computing: Introduction, Advantages & Disadvantages, Cloud Computing Technologies, Types of Clouds, Cloud Computing Models (Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS)), Virtualization.

C. Text Books:

1. Sinha K P, Sinha P., Computer Fundamentals, BPB Publication, 2017.
2. Rajaraman V., Adabala N., Fundamentals of Computers, PHI, 2014.
3. Bartee Thomas C., Digital Computer Fundamentals, McGraw Hill Education India, 2001.
4. Goel A., Computer Fundamentals, Pearson, 2010
5. Rajaraman V., Adabala N., Fundamentals of Computers, Sixth Edition, PHI, 2015

D. Reference Books:

1. Bartee Thomas C., Digital Computer Fundamentals, McGraw Hill Education India, 2001.
2. Goel A., Computer Fundamentals, Pearson, 2010
3. Rajaraman V., Adabala N., Fundamentals of Computers, Sixth Edition, PHI, 2015.
4. Jain Satish, Iyer G M, Web Designing and Publishing, BPB Publications, 2020.
5. Kundu Sudakshina, Fundamentals of Computer Networks, Second Edition, PHI, 2008

E. Course Outcomes:

After successfully completing this course, a student will be able to:

1. Converse in basic computer terminology
2. Formulate opinions about the impact of computers on society
3. Possess the knowledge of basic hardware peripherals
4. Know the requirement and useful ness of System software and Application software
5. Gain the basic principle of computer networking and web-designing

Subject Code: MH-1101
Subject Name: Communication skills Credit Point: 2 (L=2, T=0, P=0)

A. Course Objectives:

The course is designed to meet the following objectives:

- To increase the student's ability to improve and utilize the skills necessary to be competent communicator.
- To enhance the students' linguistic understanding of his or her own communication behaviour.
- To improve the students' communication skills in both social and professional contexts.
- To enhance language proficiency and thereby the employability of budding engineers and technologists.

B. Course Content:

Fundamentals of Communication-Concept and Meaning, Process of Communication, Communication Channels, Importance of Communication, Role of Cross-cultural Communication, Communication Cycle, Objectives and Barriers of Communication(linguistic and semantic, psychological, physical, mechanical, cultural), Importance of Audience and Purpose, Types of Communication, Styles of Communication, Verbal and Nonverbal Communication, Comparing General Communication and Technical Communication, Role of Communication in Technology, Persuasive Skills, Negotiation Skills, Language Skills (listening, speaking, reading, writing),Listening-Types of Listening, Writing- Writing Formal Letters, Résumés, Reports, User Manuals, Emails and Blogs, Essentials of Grammar- Sentence Formation, Common Errors and Misappropriations, Note Making, Oral and Poster Presentation Skills, Interview Skills and Etiquette, Language Usage in Social Media.

C. Text Books:

1. Salaria, R.S. and Kul Bhushun Kumar, Effective Communication Skills, Khanna Publishing, 2022.
2. Edwards, Vanessa Van. Cues: Master the Secret Language of Charismatic Communication, Penguin, 2022.
3. Kumar, Sanjay and Pushp Lata, Communication Skills: Workbook, Oxford University Press (OUP), 2018.
4. Mitra, Barun K. Personality Development and Soft Skills, Oxford University Press(OUP), 2016.

D. Reference Books:

1. Kumar, Sanjay and Pushpa Lata, English Language and Communication Skills for Engineers (as per AICTE Syllabus), Oxford University Press (OUP), 2018.
2. Raman, Meenakshi and Sangeeta Sharma, Technical Communication: Principles and Practice, Oxford University Press (OUP), 2017.
3. Quirk, Randolph, Sidney Greenbaum, Geoffrey Leech, Jan Svartvik. A Comprehensive Grammar of the English Language, Pearson Education India, 2010.

E. Course Outcomes:

By the end of this course, you will be able to:

1. Display competence in oral, written, and visual communication.
2. Apply communication theories in various speech acts.
3. Practice the effective way of communication with good personality traits and etiquette.
4. Understand the process of communication and its effect on giving and receiving information.

Subject Code: EE-1102
Subject Name: Basic of Electrical and Electronics Engineering Credit Point: 3 (L=3, T=0, P=0)

A. Course Objectives:

- To understand the structure and properties of different type of electrical circuits, networks and sources.
- To apply different mathematical tools & techniques for analysing electrical networks.
- To apply circuit analysis techniques to simplify electrical networks.
- To solve problems of electrical circuits.

B. Course Content:

Network Theorems: Formulation of network equations, Source transformation, Loop variable analysis, Node variable analysis. Superposition, Thevenin's, Norton's & Maximum power transfer theorem and its application in three phase unbalanced circuit analysis. Solution of Problems with DC & AC sources.

Coupled circuits: Magnetic coupling, Polarity of coils, Polarity of induced voltage, Concept of Self and Mutual inductance, Coefficient of coupling, Modelling of coupled circuits, Solution of problems. ***AC Fundamentals:*** RMS Values, Average Values, Peak Factor, Crest Factor, Resonance. Power in purely resistive, inductive, capacitive, RL, RC and RLC Circuits.

Number Systems: Decimal, Binary, Octal, Hexadecimal systems, conversion of a number from one base to another, complements of number systems and its addition and subtraction, Introduction to logic gates.

Boolean Algebra: Theorems and operations, Boolean expressions and truth tables, Duality and inversion, multiplying out and factoring expressions, Exclusive-OR and equivalence operations, Positive and negative logic.

C. Text Books:

1. Theraja B. L., Theraja A.K., A Textbook of Electrical Technology Vol 1, Shree Hari Publications, 2021.
2. Morris Mano M., Digital Logic and Computer Design, Pearson Education India, First Edition, 2016.

D. Reference Books:

1. Kumar Anand, Fundamentals of Digital Circuits, Prentice Hall, 3rd Edition, 2014.
2. Salivahanan.S., Pravin Kumar.S., Digital Electronics, Vikas Publishing House, 2011.

E. Course Outcomes:

After completion of this course, the learners will be able to

1. describe different type of networks, sources and signals with examples.
2. explain different network theorems, coupled circuit and tools for solution of networks.
3. apply network theorems and different tools to solve network problems.
4. select suitable techniques of network analysis for efficient solution.
5. estimate parameters of two-port networks.
6. design filter circuits.

Subject Code: CS1102
Subject Name: Coding Laboratory
Credit Point: 2 **(**L=0, T=0, P=4)

A. Course Objectives:

1. The student will gain a thorough understanding of the fundamentals of C programming.
2. A student can code, compile and test C programs.
3. Could take Systems programming or Advanced C programming course.
4. Although this course does not deal with object-oriented programming methodology, it will assist the student build the required foundations to undertake a course in OOP.

B. Course Content:

Introduction: The von Neumann architecture, machine language, assembly language, high level programming languages, compiler, interpreter, loader, linker, text editors, operating systems, flowchart.

C Fundamentals: Introduction to C, Data types, Constants and variable declaration, Scope, Storage classes, Data input and output functions, Sample programs.

Operators & Expressions: Arithmetic, Relational, Logical, Bitwise operators, Conditional, Assignment, Library functions.

Decision making: Simple If statement, if-else statement, nested if else statement, Switch statement, nested switch, the operator, goto statement.

Decision making & branching: while statement, do-while statement, for statement.

Array: Declaration, Initialization and processing One-dimension array, Two-dimension array and multi dimension array and their operations.

String & pointer: String: Operation on String without using library function and using library function. Pointer: Declaration of pointer variables, accessing the variable by using pointer, pointer increment and decrement operator, pointer and array

Functions: Basic functions, function type, function with no argument & no return value, function with no argument but return value, function with argument & return value, Storage class identifier, Call by reference, Recursive function. Pointer to function.

Structure & Union: Defining a structure, accessing of structure variable, structure and array, array within structure. Nested structure, structure & functions, Pointer & structure,

Unions, Enum.

File management system: Advantage of using file, Open, close, read, write in the files, Operation on files.

Dynamic memory Allocation: use of malloc, calloc, realloc, free. Library functions, Implementation of Linked list and their various operations.

The pre-processor: macro statements.

C. Text Books:

1. Kerninghan and Ritchie, The 'C' programming language, 2nd Edition, Pearson, 2008.
2. Yashavant P. Kanetkar, Let Us C: Authentic guide to C programming language, 15th edition, BPB, 2021.
3. Balaguruswamy, Programming In ANSI C, 8th Edition, Tata McGraw-Hill Education, 2019

D. Reference Books:

1. Zed A. Shaw, Learn C the Hard Way: Pratical Exercises on Computational Subjects You Keep Avoiding (Like C), 2015.
2. Deepali Srivastava and S.K Srivastava, C in Depth, BPB Publication, 2017.
3. Griffiths David and Dawn Griffiths, Head First C, A Brain Friendly Guide, 2012.
4. Grey Perry and Dean Miller, C Programming Absolute Beginner's Guide, 3rd Edition, 2013.

E. Course Outcomes:

1. Understand the basic terminology used in computer programming.
2. Write, compile and debug programs in C language in different operating systems.
3. Design programs involving decision structures, loops and functions.
4. Use and apply the dynamics of memory by the use of pointers in engineering applications.
5. Use and apply the differences between structure oriented and function oriented programming in programming applications.

Subject Code: EE-1103
Subject Name: Basic of Electrical and Electronics Engineering Laboratory Credit Point: 1 (L=0, T=0, P=2)

A. Course Objectives:

- To understand the structure and properties of different type of electrical circuits, networks and sources.
- To apply different mathematical tools & techniques for analysing electrical networks.
- To apply circuit analysis techniques to simplify electrical networks.
- To solve problems of electrical circuits.

B. List of Practical:

1. V-I Characteristics of Carbon and Tungsten filament lamp.

2. V-I Characteristics of Fluorescence Lamp.
3. V-I Characteristics of RLC Series Circuit.
4. V-I Characteristics of RLC Parallel Circuit.
5. Verification of truth tables of different logic and universal gates.
6. Implementation of logic gates with the help of universal gates.

C. Course Outcomes:

After completion of this course, the learners will be able to

1. describe different type of networks, sources and signals with examples.
2. explain different network theorems, coupled circuit and tools for solution of networks.
3. apply network theorems and different tools to solve network problems.
4. select suitable techniques of network analysis for efficient solution.
5. estimate parameters of two-port networks.
6. design of filter circuits.

Subject Code: BS 1104
Subject Name: Engineering Physics Laboratory
Credit Point: 1 [L=0, T=0, P=2]

A. Course Objectives:

The course is designed to meet with the objectives of:

1. imparting practical knowledge to the students in the area of engineering physics.
2. student will have exposure to various experimental skills which is very essential for an engineering student.
3. to gain practical knowledge by applying the experimental methods to correlate with the physics theory.
4. to learn the usage of various areas of physics like electricity and magnetism systems for various measurements.

B. List of Experiments:

1. Determination of Planck's constant using photocell.
2. Verification of Stefan's radiation law.
3. Verification of Bohr's atomic orbital theory through Frank-Hertz experiment.
4. Verification of Biot-Savart's law.
5. Charging and discharging of capacitor using RC circuit
6. Hall Effect.
7. To determine e/m ratio

C. Reference Books:

1. Arora C. L., "Practical Physics", S. Chand Publications, 2010.
2. Squires G. L., "Practical Physics", Cambridge University Press, 2014.

D. Course Outcomes:

Students successfully completing this module will be able to:

1. apply the various procedures and techniques for the experiments.
2. develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results.
3. understand principle, concept, working and application of new technology and comparison of results with theoretical calculations.

Subject Code: ME-1102
Subject Name: Engineering Drawing
Credit Value: 1 [L = 0, T = 0, P = 2]

A. Course Objectives:

The course is design to meet with the following objectives:

- Increase ability to understand Engineering Drawing.
- Learn to sketch and take field dimensions.
- Learn to take data and transform it into graphic drawings.
- Learn basic Auto Cad skills.
- Learn basic engineering drawing formats.
- Prepare the student for future Engineering positions.

B. Course Content:

Indian standards: Sheet layout, type of lines and their representations,

scales. ***Principles of orthographic projection (multi view drawing):***

1st and 3rd angle projection. ***Projections:*** Points, lines, surfaces and

solids.

Projection of sections and intersections of solids: Isometric projection.
Use of drafting software

C. Reference Books:

1. Dhananjay, A. J., "Engineering Drawing", 1st Ed., 2017, TMH.
2. Bhatt, N.D. and Panchal, V.M., "Engineering Drawing", 43rd ed., 2014, Charotar Publishing House Pvt.Ltd.
3. Venugopal, K. and Prabhu,V. R., "Engineering Graphics", 15th Ed., 2018, New Age International Pvt. Ltd.

D. Course Outcomes:

Upon completion of the subject student's ability to:

1. Understand orthographic projections and sections.
2. Basic understanding of Indian standards of Engineering drawing.
3. Develop engineering drawings by projection techniques.

4. Utilise AutoCAD towards developments of drawings.

Subject Code: CS-1103
Subject Name: Fundamentals of Computer Science and Engineering Laboratory
Credit Point:1 **(**L=0, T=0, P=2)

A. Course Objectives:

1. To understanding of basic concepts of Computer system.
2. To learn the basic components of Computer system and their requirements.
3. To learn the basics DOS commands to work with computer System.
4. To develop the working skills with Microsoft Office.
5. To understand the basic knowledge of Linux.
6. To learn the basics Linux commands to work with CUI computer System.

B. Course Content:

Experiments on dismantling of PC: Dismantling the system unit, recognize all major components inside a PC, describe function of each component and define the relationship of internal components.

Experiments on Microsoft word and Presentation: Ms-Word, Ms-Excel, Ms-PowerPoint.

Experiments on linux: Install rpm and deb packages, Perfom these commands in linux-chmod, su, chown, chgrp, ls, kdir, pwd, date, who, find, uname, wc, ifconfig; Create, open , edit, view file in linux; Create user and group through CLI.

OpenStack: Installation and deployment of multimode cluster, Automating Cloud resources using Linux shell script, creating instances and injecting SSH keypairs, simulating production scenarios involving SDN.

C. Text Books:

1. Sinha K P, Sinha P., Computer Fundamentals, BPB Publication, 2017.
2. Gookin Dan, DOS For Dummies, John Wiley & Sons Inc, 1998
3. Siechert Carl, Bott Ed, Microsoft Office Inside Out: 2013 Edition, Microsoft, 2013
4. Blum Richard, Bresnahan Christine, Linux Command Line and Shell Scripting Bible, 3rd Edition, John Wiley & Sons Inc, 2015
5. Richard Petersen, Linux: The Complete Reference, McGraw Hill Education, 2017

D. Reference Books:

1. McLoughlin V. Ian, Computer Systems: An Embedded Approach, McGraw-Hill Education, 2018.
2. Balagurusamy E, Fundamentals of Computers, McGraw Hill Education, 2009.
3. Phillips Harry, Skagerberg Eric, Microsoft Windows 2000 MS-DOS Command Line, Second Edition, Course Technology Inc, 2002.
4. Lambert Joan, Frye Curtis, Microsoft Office Step by Step (Office 2021 and Microsoft 365), Microsoft, April 2022.
5. Barrett J Daniel, Efficient Linux at the Command Line, O'Reilly Media, Inc, February 2022.

E. Course Outcomes:

After successfully completing this course, a student will be able to:

1. Understand all the components of a Computer System and their requirements.
2. Understand how the different components of a Computer System are connected to each other.
3. Perform different Functions of a Computer System using DOS commands.
4. Manipulate, Prepare and Present the different data in an organized form using MS Office.
6. Use the different LINUX Commands and the basics of LINUX programming.

Subject Code: MH-1102
Subject Name: Language Laboratory
Credit Point:1 (L=0, T=0, P=2)

A. Course Objectives:

The course is designed to meet the following objectives:

- To facilitate computer-assisted multi-media instruction enabling individualized and independent language learning
- To sensitize students to the nuances of English speech sounds, word accent, intonation and rhythm
- To bring about a consistent accent and intelligibility in students' pronunciation of English by providing an opportunity for practice in speaking
- To improve the fluency of students in spoken English and neutralize their mother tongue influence
- To train students to use language appropriately for public speaking and interviews

B. Course Content:

Basics of Phonetics, Speech Sounds – Vowels and Consonants, Word Stress and Rhythm, Accent, Intonation, Phonetics Drills, Developing Effective Listening Skills-Listening Comprehension Drills, Speaking - Conversations, Dialogues, and Debates, Role Play, Situational Dialogues, Expressions in Various Situations, Making Requests and Seeking Permissions, Formal Presentations. Telephone Etiquette, Building Advanced Vocabulary and English Grammar Exercises.

C. Text Books:

1. Words Worth English Language Software
2. Kumar, Rajesh, English Language Communication Skills: Lab Manual Cum Workbook with CD, Cengage Learning India, 2014

D. Reference Books:

1. Jones, Daniel. English Pronouncing Dictionary, Cambridge University Press, 2011.
2. Bansal, R. K. & J. B. Harrison. Spoken English with CD, Orient Blackswan, 2013.

E. Course Outcomes:

By the end of this course, you will be able to:

1. Understand of nuances of English language through audio - visual experience and group activities.
2. Reach the neutral intelligibility.
3. Attain the clarity and confidence to enhance their employability skills.
4. Express themselves fluently and appropriately in social and professional contexts.

2nd Semester						
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	BS-1201	Engineering Mathematics-II	2	0	0	2
2	CS-1201	Programming and Data Structure	3	0	0	3
3	EC-1201	Introduction to Digital engineering	2	0	0	2
4	MH-1201	Introduction to Innovation and Creativity	2	0	0	2
5	ME-1201	Engineering Mechanics	3	0	0	3
6	CS-1202	Multimedia and Web Design	3	0	0	3
7	EC-1202	System Design	2	0	0	2
8	ME-1204	Workshop Practice-I	0	0	2	1
9	EC-1203	Do It Yourself (DIY)/Industry Exposure	0	0	0	1
10	BS-1202	Basic Science Laboratory-II	0	0	2	1
11	CS-1204	Programming and Data Structure Laboratory	0	0	2	1
12	MH-1202	Gandhian philosophy Technology	0	0	2	1
Contact Hours			17	0	8	
Total Credits						22

Subject Code: BS 1201
Subject Name: Engineering Mathematics- II
Credit Point: 2 [L=2, T=0, P=0]

A. Course objectives:

The course is designed to meet the following objectives:

1. imparting theoretical knowledge to the students about three and more dimensional objects in space and to improve their capability of visualizing of objects in space.
2. Making student competent enough to construct a differential equation/mathematical modeling for every real life situation with its solution.
3. Giving students theoretical knowledge of vectors with the flavor of Calculus.
4. Introduce the concepts of Laplace and Fourier transforms and its application to the solution of differential equations (ODE &PDE) to the students.

B. Course Content:

Vector Calculus: Basics of vector calculus, Line integral, Surface integral and Volume integral, Path independence, Fundamental theorem of Calculus, Green's, Gauss' and Stokes' theorems (without proofs) and their simple applications.

Ordinary Differential Equations: First order ODEs, Higher order linear differential equation with constant coefficients, Euler's homogeneous equation, Series solutions of linear differential equations with variable coefficients (Ordinary point).

Partial Differential Equations: Basic of PDEs (order, degree, Linear, Non-Linear, homogeneous, non-homogeneous), Classification of 2^{nd} Order PDEs; boundary and initial value problems (Dirichlet and Neumann type) involving wave equation, D'Alembert method, heat conduction equation, Laplace's equations and solutions by method of separation of variables (Cartesian coordinates).

C. Text Books:

1. Kreyszig E., Advanced Engineering Mathematics, John Wiley, 2010, 11^{th}edition.
2. Ross S. L., Ordinary Differential Equation, Wiley and Sons Ltd., 2010, 3rd edition.
3. Farlow S. J., Partial Differential Equation for Scientists and Engineers, Dover Publications, 1993, 1^{st} edition.

D. Reference Books:

1. Boyce and Diprima R. C., Elementary Differential Equations and Boundary value Problems, Wiley publications, 2009, 9th edition.
2. Sneddon I. N., Elements of Partial Differential Equations, Dover Publications Inc., 2013, 2^{nd}edition.
3. Jeffrey A., Advanced Engineering Mathematics, Academic Press, 2001, 1^{st}edition.
4. Coddington E., and Levinson N., Introduction to Ordinary Differential Equations McGraw Hill Education, 2017, 1st edition.

E. Course Outcomes:

Upon completion of the subject:

1. Students will have strong visualizing capability in their mind about any object.
2. Students are so trained that they will recognize various real life situation/problem and able to solve them by constructing a differential equation/ mathematical model.
3. Students will be able to find the Laplace representation as transforms of functions of one/two variable.

Subject Code: CS - 1201
Subject Name: Programming and Data Structure
Credit Point: 3 **(**L=3, T=0, P=0)

A. Course Objectives:

1. Designing principles of algorithms and data structures
2. Learning efficiency and scaling of algorithms
3. Learning essential algorithms in computing
4. Understanding generic data structures for common problems

B. Course Content:

Performance of algorithms: Basic concepts, Mathematical Background, Complexity Analysis, space and time complexity, asymptotic notations, Types of Date Structure.

Linear Data Structures: Arrays: one dimensional, multi-dimensional, Sparse Matrix, Elementary Operations

Stacks: Representation, elementary operations and applications such as infix to postfix, postfix evaluation, parenthesis matching

Queues: Simple queue, circular queue, de-queue, elementary operations and applications.

Linked lists: Linear, circular and doubly linked lists, elementary operations and applications such as polynomial manipulation

Non-Linear Data Structures: Trees: Binary tree representation, tree traversal, complete binary tree, heap, binary search tree, height balanced trees like AVL tree and 2-3 tree, tries, red-black tree, B-tree, B+ tree, m-way Search tree, other operations and applications of trees

Graphs: representation, Adjacency list, graph traversal, path matrix, connected components, topological sort, Spanning tree, BFS, DFS.

Sorting and Searching:

Sorting: Selection sort, bubble sort, quick sort, merge sort, heap sort, insertion sort, selection sort, radix sort.
Searching: linear and binary search,
Hashing: hash tables, hash functions, and open addressing.

File structures: Introduction, data file types, file organization, file access methods.

C. Text Books:

1. Lipschutz S., Data Structure, McGraw Hill Education, 2014.
2. Deshpande P.S., Kakde O.G., C & Data Structures, Charles River Media, 2004.
3. Balagurusamy E., Data Structures Using C, McGraw Hill Education, 2017.
4. Srivastava S.K., Srivastava D., Data Structures Through C In Depth, BPB Publications, 2004.

D. Reference Books:

1. Drozdek A., Data Structures and Algorithms in C++, Cengage Learning, 2012.
2. Radhakrishnan M., Srinivasan V., Data Structures Using C, BPB Publications, 2008.
3. Gupta P., Aggarwal V., Varshney M., Data Structure Using C, Laxmi Publications, 2011.
4. Aho A.V., Hopperoft J.E., UIlman J.D., Data Structures and Algorithms, Pearson, 1998.
5. Tanenbaum A.M., Data Structures using C, Pearson Education, 2009.
6. Agarwal A., Data structure Through C, Cyber Tech Publications, 2005.
7. Bandyopadhyay S.K., Data Structures Using C, Pearson Education India, 2009.
8. Thareja R., Data Structures Using C, Oxford University Press, 2011.

E. Course Outcomes:

After successfully completion of this module students will be able to:

1. Assess performance efficiency of sequential algorithms.
2. Design data structures to enable algorithms and design sequential algorithms for performance.
3. Implement designing algorithms and corresponding data structures using object oriented programming languages.
4. Demonstrate deployment of essential data structures such as lists, stacks, queues, and trees.

Subject Code: EC-1201
Subject Name: Introduction to Digital Engineering
Credit Value: 2 (L = 2, T = 0, P = 0)

A. Course Objectives

The objective of the course is:

- Understand different digital technology used in everyday life.
- Work with electrical circuits in cascaded form and implementation in real world.

B. Course Content

Introduction- What is *digital* (analog vs. digital)? What is *technology*? History of Computing/Internet Hardware – from electricity to hardware to software
Binary Arithmetic- Boolean Logic
Computer Architecture- Quantum computing
IoT - Introduction to principles and uses- BIG DATA - Introduction to principles and uses
VR/AR - Introduction to principles and uses
AI - Introduction to principles and uses Blockchain - Introduction to principles and uses
Databases and mySQL queries
Networking Protocols
Introduction to Data Analytics, Machine Learning, Security, Quantum Technology and Cyber Physical System (CPS)
Careers in Digital Technologies Ethics and the Future of Computing
Model based analysis; Data driven analysis

C. Text Books

1. B. Marr, "Tech Trends in Practice: The 25 Technologies that are Driving the 4th Industrial Revolution", Wiley, 2020.

D. Reference Books

1. A. Goel, "Computer Fundamentals", Pearson, 2010.

E. Course Outcomes

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

1. Understand basic fundamentals of different digital techniques
2. Understand the fundamentals of AI, Blockchain and its use
3. Understand different network protocols.

Subject Code: MH-1201
Subject Name: Introduction to Innovation and Creativity (3-0-0-3) Credit Point:3 (L=3, T=0, P=0)

A. Course Objectives:

The course is designed to meet the objectives of:

- To involve themselves in the innovation and creative activities
- Starting innovative practices in their entrepreneurial activities.
- Developing their skills on the traits that they want to carry forward.

- Starting activities based on the search of new ideas.

B. Course Content:

Introduction to innovation and creativity, opportunity identification: the search for new idea, entrepreneurial imagination and creativity, The role of creative thinking, Components of creativity, Indication of creativity, Developing your creativity, the creative thinking process, Two approaches to creative problem-solving, the most common idea killers, Arenas in which people are creative, the creative climate, Innovation and entrepreneur, the innovation process, types of innovation, Proof of Concept(PoC), product development, the major misconceptions of innovation, principles of innovation, Methods to initiate ventures, creating new ventures: new-new approach & new-old approach, ways to develop personal creativity: recognise relationships, develop a functional perspective, use your brains, and eliminate muddling mind –sets, design thinking, design innovation, technological innovation and designing entrepreneurship, creative design. Case study on startup/unicon

C. Text Books:

1. Donald F. Kuratko, Entrepreneurship: Theory, Process, Practice Cengage Learning 2017
2. Cynthia, L. Greene, Entrepreneurship Ideas in Action. Thomson Asia Pvt. Ltd., Singapore. 2004

D. Reference Books:

1. Barringer Entrepreneurship: Successfully Launching New Ventures, Pearson Education Publishing 2015
2. Timmons, Jerry A., and Spinelli, Stephen, 2009. New Venture Creation: Entrepreneurship for the 21st Century, 8th Edition, Boston, MA: IrwinMcGraw-Hill
3. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi, 2001

E. Programme Outcomes:

1. Start their venture more scientifically.
2. Start their venture by linking with the all the stakeholders.
3. Enable to identify various opportunity mapping
4. Explore many possibilities of generating new idea leading to enterprise.

Subject Code: ME-1201
Subject Name:
Engineering Mechanics
Credit Point:3 (L=3,
T=0, P=0)

A. Course Objectives:

The course is designed to meet with the following objectives:

- Ability to utilise scalar and vector analytical techniques for analysing forces in statically determinate structures.
- Ability to apply fundamental concepts of kinematics and kinetics of particles to

the analysis of simple, practical problems.

- Student gets a basic idea of Centre of gravity, moment of inertia, mass moment of inertia, friction.

B. B. Course Content:

Forces and Moments: Force, moment and couple, wrench, equivalent force and moment, forces in space equilibrium, FBD, general equations of equilibrium-Lami's theorem, analysis of forces in truss and frames, brief introduction to vector approach.

Friction: Introduction to dry friction, laws of friction, friction of simple machines, inclined planes, screw jacks, clutch, and collar pivot bearing (uniform wear and uniform pressure assumptions).

Centre of gravity and moment of inertia: Centre of gravity, volume and composite bodies, area moment of inertia and mass moment of inertia for plane figures and bodies.

Virtual work and energy method: Virtual displacement; principle of virtual work; applications of virtual work principle to machines.

Kinematics of particle: Introduction, rectilinear motion, plane curvilinear motion, rectangular coordinates (x-y), normal and tangential coordinates (r-θ).

Kinetics of particle: Review of force, mass, acceleration, work and energy, impulse, momentum, linear impulse and linear momentum, angular impulse and angular momentum, impact, central-force and motion, and relative motion,

Kinetics of system of particles: Introduction, generalized Newton's second law, work-energy, impulse-momentum, conservation of energy and momentum, steady mass flow, variable mass.

Plane kinematics of rigid bodies: Introduction, rotation, absolute motion, relative velocity, instantaneous center of zero velocity, relative acceleration, motion relative to rotating axes.

Plane kinetics of rigid bodies: Introduction, general equation of motion, translation, fixed axis rotation, general plane motion, work energy relations, acceleration from work-energy, virtual work, impulse-momentum equation.

C. C. Text Books:

1. Timoshenko S. and Young D.H., "Engineering Mechanics", 5th Ed., 2017, MGH.
2. Beer and Johnston, "Vector Mechanics for Engineers: Statics and Dynamics", 10th Ed., 2012, TMGH.

D. D. Reference Books:

1. Meriam, J. L. and Kraige, L. G., "Engineering Mechanics, Volume 1: Statics", 8th Ed., 2017, Wiley.
2. Meriam, J. L. and Kraige, L. G., "Engineering Mechanics, Volume 2: Dynamics", 5th Ed., 2006, Wiley.
3. Shames, I. H. and Rao,G. K., "Engineering Mechanics: Statics and Dynamics'",

4thEd., 2006, Pearson.

4. Nelson A., "Engineering Mechanics: Statics and Dynamics", 1st Ed., 2017, TMGH.

E. Course Outcomes:

Upon completion of the subject, students should have the knowledge of:

1. Basic understanding of different type of forces, moments and resolving them.
2. Evaluation of centre of gravity, moment of inertia and mass moment of inertia for various figures & bodies.

Apply principles of kinematics, kinetics and effects of friction for solving problems.

Subject Code: CS-1202
Subject Name: Multimedia and Web Design
Credit Point: 3 **(**L=3, T=0, P=0)

A. Course Objectives:

1. Students will understand multimedia in respect to many application including business, schools, home, education, and virtual reality.
2. Students will understand the hardware and software needed to create projects using creativity and organization to create them.
3. Student will develop multimedia skills understanding the principal players of individual players in multimedia teams in developing projects.
4. Students will learn the cost involved in multimedia planning, designing, and producing.

B. Course Content:

Coding Basics: Intro to HTML Syntax: The HTML, head, title, & body tags, Headings, paragraphs, & lists, The strong & em tags, The doctype, The lang attribute, The meta tag & the unicode character set, Coding Links: Absolute & Relative URLs, Anchor tags & hrefs, Linking to other websites, Linking to pages within a website, Opening a link in a new browser window/tab, Adding Images, The break tag, The image tag & source attribute, Using the width, height, & alt attributes, Using horizontal rules

Intro to Cascading Style Sheets (CSS): CSS Class Selectors The class attribute CSS class selectors The span tag CSS opacity Div Tags, ID Selectors, & Basic Page Formatting Dividing up content with the div tag Assigning IDs to divs Setting width & max-width CSS background-color Adding padding inside a div Centering content CSS borders CSS shorthand & the DRY principle Using Browser Developer Tools Opening the DevTools in Chrome Editing HTML in the DevTools Elements panel Enabling, disabling, & editing CSS in the DevTools Using DevTools to fine-tune your CSS Hexadecimal shorthand HTML5 Semantic Elements & Validating HTML The outline algorithm The header, nav, aside, & footer elements Understanding articles & sections The main element The figure & figcaption elements Checking for errors: validating your code

Basics of web-programming Programming: Client-side scripting: JAVASCRIPT, Overview of Java, JAVA Applet

PHP: Concept of PHP, features of PHP, other equivalent tools – JSP, PHP Including PHP in web page, **Data types, Variables,** Operator precedence Built In Functions., **String Manipulation Functions, Time & Date Functions, Arrays, Conditional statements, Loops, User Defined Functions,** Global Variables, Elements of $_SERVER, PHP Forms, Text Files, Other Features: PHP File Upload, Cookies, Sessions (start, modify and destroy), Error Handling

C. Text Books:

1. Richardson T., and Thies C., Multimedia Web Design and Development, Mercury Learning and Information, 2013.
2. Steinmetz R., Multimedia: Computing Communications & Applications, Pearson Education India, 2002.

D. Reference Books:

1. Xavier C, "Web Technology & Design New Age Publication.

2. Andleigh K. Prabhat., Thakrar K., Multimedia Systems Design 1st Edition, Pearson, 2015.

3. Maidasani Dinesh., Multimedia Applications and Web Designing, Laxmi Publications, 2008.

E. Course Outcomes:

1. Ability to develop proficiency in Webpage Development and website management
2. Ability to develop proficiency in creating dynamic Web Interface
3. Ability to write server and client sides scripts and manage websites
4. Ability to design a web page using Image, Audio and Video editing tools
5. Ability to understand the basic concepts of Open Source Standards and Open Source software.

Subject Code: EC-1202

Subject Name: System Design
Credit Point: 3 [L = 3, T = 0, P = 0]

A. Course Objectives:

- Understand the basic concept of system engineering.

- Describe the various system engineering stages.
- Understand the system development process.
- Knowing the system management concept.

B. Course Content:

Introduction: Basic concept of system level input & output with qualities, properties, characteristics, functions, behaviours & performances

System Engineering Major Process flow: Concepts of Interdisciplinary design, integration, complex systems and life cycles

System Engineering Stages

a. Analysis of base level Requirement and appropriate Management.
b. Functional Analytics, Interpretation and Allocation of inference.
c. Design Synthesis.
d. Systems Analysis and Control.
e. Verification.
f. Conclusion

System Engineering Types **(concept of product system, service system, enterprise system and system of systems)**

Systems Engineering responsibilities

a. Management and monitoring of all installed systems and infrastructure.
b. Installation, configuration, testing and maintaining operating systems, application software and system management tools.
c. Ensure the highest levels of quality standards on systems and infrastructure.

System Engineering Skill (for analysis, problem solving, and conflict resolution)

a. Communication skill
b. Interpersonal skill
c. Project management skill
d. Governance skills

System Development Process

a. Life cycle Planning and Life Cycle integration
b. System Development Life Cycle Phasing (planning, analysis, design, development, testing, implementation, and maintenance)
c. Industrial System Engineering (Quality Function Deployment, Product Planning, Design Planning, Production & Operational Planning, Planning for Quality Control & Assurance, Whole Value chain concept)

System Engineering Management

a. Management of complex systems over their life cycles

C. Text Books:

1. Systems engineering principles and practice book by Alexander Kossiakoff

D. Reference Books:

1. Systems Engineering Handbook: A Guide for System Life Cycle Processes and Activities by INCOSE
2. Handbook of Systems Engineering and Management Book by Andrew P. Sage and William B. Rouse
3. A Practical Guide to SysML: The Systems Modeling Language Book by Alan Moore, Rick Steiner, and Sanford Friedenthal

E. Course Outcomes:

1. Understand the various stages and types of system engineering.
2. Know the system development process.
3. Understand the system management concept

Subject Code: ME-1204
Subject Name: Workshop Practice-I Credit Point:1 (L=0, T=0, P=2)

A. Course Objectives:

- Students able to understand different tool &equipment for work shop practice.
- Students acquire skills for the preparation of different Carpentry/fitting/welding models.
- Students able to understand the safety precaution in the workshop
- Student acquires skills of Application orientated tasks.

B. Course Content:

Introduction and demonstration: Introduction to various shops/ sections and workshop layouts, safety norms to be followed in a workshop should be conveyed to students.

Carpentry shop*:* Introduction of tools and operations, types of woods & their applications, types of carpentry hardware and their uses, carpentry joints, carpentry operations such as marking, sawing, planning, chiseling, grooving, boring, joining, types of woods and carpentry hardware.

Fitting shop: Introduction of tools and operations, types of marking tools and their uses, types of fitting cutting tool and their uses, fitting operations such as chipping, filing, scraping, grinding, sawing, marking, drilling, tapping.

Metal joining shop: Introduction of tools, types of welding joint, arc welding, gas welding, gas cutting.

Machine shop: Introduction of machine tools and operations, demonstrations of basic machine tools like lathe, shaper, drilling, milling machine and CNC with basic operations and uses.

List of workshop practices:

1. Hands on practice and job making in carpentry.
2. Hands on practice and job making in fitting.
3. Hands on practice and job making in welding.
4. Demonstrate the operations of machine shop.

C. Text Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Media promoters and publishers private limited,

Mumbai, Vol. I 2008 and Vol. II 2010.
2. Raghuvanshi B.S., Workshop Technology Vol. I & II, Dhanpath Rai & Sons. 2017.
3. Bawa H S., Workshop Practices, Tata McGraw-Hill, 2009.

D. Reference Books:

1. John K.C., Mechanical Workshop Practice. 2nd Edition, PHI, 2010.
2. Kannaiah P. and Narayana K.L., Workshop Manual, 2nd Edition, Scitech publishers**,** 2009.

E. Course Outcomes:

1. Study and practice on machine tools and their operation
2. Select the appropriate tools required for specific operation.
3. Practice on manufacturing of components using workshop trades including fitting, carpentry, foundry and welding.
4. Identify and apply suitable tools for machining processes including turning, facing, thread cutting and tapping

Subject Code: EC-1203
Subject Name: Do It Yourself (DIY)/ Industry Exposure
Credit Point: 1 (L=0, T=0, P=0)

A. Course Objectives:

The course is designed to meet with the objectives of:

- To inculcate in the mind of students the real meaning of electronics,
- To learn various electronics components along with their pin configuration,
- To give practical knowledge, on building circuits.

B. Course Content:

Improving soldering skill, Practicing soldering
Learning electronics concepts, Getting to know various electronics components and learning how they are working in the complete circuit, Learning how to properly use various electronics components
Learning about the right pin configuration, and a lot of other
beneficial reasons. Learning about circuit schematic diagrams

C. Text Books:

1. Alan R Winstanley, The Basic Soldering Guide Handbook: Learn to solder electronics successfully, CreateSpace Independent Publishing Platform, 2014
2. Manoj Yadav, Electronic Components: A must read for all beginners, students and those interested in electronics, Notion Press, 1st edition, 2021

D. Reference Books:

1. Oyvind Nydal Dahl, A Beginner's Guide To Circuits: Nine Simple Projects with Lights, Sounds, and More, No Starch Press, 2018
2. Stan Gibilisco, Beginner's Guide to Reading Schematics, McGraw Hill TAB; 4th Edition, 2018

E. Course Outcomes:

Students successfully completing this module will be able to:

1. Acquainted with soldering mechanism.
2. Acquainted with the methods of designing of innovative circuit using electronic components.
3. Substantially prepared to learn about techniques of schematic diagrams.

Subject Code: BS 1202
Subject Name: Engineering Chemistry Lab
Credit Point: 1 [L=0, T=0, P=2]

A. Course Objectives:

1. To enable the students to acquire knowledge about chemistry practical and its technological importance towards research works.
2. To understand applicability of chemistry for engineering and research purposes.
3. To make them apply the knowledge of fundamental chemistry for design system components or processes and researches considering the public health and safety, and the cultural, societal, and environmental considerations.

B. <u>List of Experiments:</u>

1. Determination of the concentration of NaOH solution.
2. Standardization of $KMnO_4$ solution by Mohr's salt.
3. Estimation of hardness of water using EDTA titration.
4. Conductometric titration for
   - Determination of the strength of a given HCl solution by titration against a standard NaOH solution.
   - Analysis of a mixture of strong and weak acid by strong base.
5. Estimation of available chlorine in bleaching powder.
6. Determination of pH value of the solution by digital pH meter and pH paper.

C. Reference Books:

1. Rao M. V. B., Laboratory Mannual for Engineering and Physical Chemistry, Studium Press (India) PVT. Ltd. 2013.
2. Israel V. A., Vogel's Qualitative Inorganic Analysis, Publisher: Pearson Education Limited, ISBN: 9780582218666, 0582218667

D. Course Outcomes:

After studying this course, students will be able to

1. an ability to function on research areas in multidisciplinary subjects.

2. design economically, environmental friendly and new methods of synthesisfor various needful products.
3. a knowledge of titration for various kinds of acid-base for new experimental aspects.

Subject Code: CS1204
Subject Name: Programming and Data Structure Laboratory
Credit Point: 1 **(**L=0, T=0, P=2)

A. Course Objectives:

The course is designed to meet the objectives of:

1. To implement linear and non-linear data structures
2. To understand the different operations of search tree
3. To implement graph traversal algorithms
4. To get familiarized to sorting and searching algorithms

B. Course Content:

Laboratory assignments will be based on the implementation of the basic operations and application algorithms (as mentioned below) using various data structures. Programs are to be implemented using any preferable language such as C, C++, Java.
Array implementation of Stack and Queue ADTs.
Array implementation of List ADT.
Linked list implementation of List, Stack and Queue ADTs.
Applications of List, Stack and Queue ADTs.
Implementation of Binary Trees and operations of Binary Trees.
Implementation of Binary Search Trees.
Implementation of AVL Trees.
Implementation of Heaps using Priority Queues.
Graph representation and Traversal algorithms.
Applications of Graphs.
Implementation of searching and sorting algorithms.
Hashing – any two collision techniques.

C. Text Books/ Reference Books:

1. Mehta D.P., Sahni S., Handbook of Data Structures and Applications, Chapman and Hall, 2020.

2. Goodrich M.T., Tamassia R., Mount D. M., Data Structures and Algorithms in C++, Wiley, 2011.
3. Langsam Y., Augenstein M.J., Tenenbaum A.M., Data Structures Using C and C++, Pearson Education, 2011.

D. Course Outcomes:

After successfully completion of this module students will be able to:

1. Write functions to implement linear and non-linear data structure operations.
2. Suggest appropriate linear / non-linear data structure operations for solving a given problem.
3. Appropriately use the linear / non-linear data structure operations for a given problem
4. Apply appropriate hash functions that result in a collision free scenario for data storage and retrieval

Subject Code: MH-1202
Subject Name: Gandhian Technology
Credit Point:1 (L=0, T=0, P=2)

A. Course Objectives:

The course is designed to meet the following objectives:

- To understand the life style and significance of M. K. Gandhi in modern world
- To introduce Gandhian Thought as an academic discipline to students
- To convey the importance of Gandhian Values in different walks of life
- To create awareness about the significance of Gandhian Thought for Academics and life in general, in students and common stakeholder through workshop and related activities done by Gandhi Study Center.

B. Course Content:

Ethics in Gandhian Thought: Socio- Political and Economic Thoughts of Gandhiji, Gandhian methods for Global Peace, Gandhian Development, Mahatma Gandhi's Perspectives on Technology. Participating practical oriented activities done by GSC/ Technology-attributes/innovation/activities of Gandhian way of life styles/Gandhian economics, Indian cottage industry and its improvement, Inclusive growth and through sustainable development

C. Text Books:

1. Gandhi, Gopal krishna, Mohandas Karamchand Gandhi: Restless as Mercury, My Life as a Young Man, Aleph Book Company, 2021.
2. Beitzel, Terry and et al. Reflections on Mahatma Gandhi: The Global Perspectives, Rawat Publications, India, 2021.
3. Gandhi, M.K. The story of my experiments with truth (an autobiography), Navajivan Publishing House, 1927.

D. Reference Books:

1. Awasthi, R.K. Technological Transformation and Relevance of Gandhi in Modern India, IJSW online, Retrieved May 2022.
2. Talwar, Sushant. Mahatma and machines: Understanding Gandhi's thoughts on modern technology, https://www.timesnownews.com/, 2019.
3. Kothari,L. S. Science and Technology in India: What Can We Learn From Gandhi?, Source: International Seminar on Gandhi And The Twenty First Century, (January 30-February 4, 1998) New Delhi- Wardha.
4. Ram K.Vepa, New Technology: A Gandhian Concept, Gandhi Book House New Delhi, 1975

E. Course Outcomes:

By the end of this course, you will be able to:

1. Understand how a simple thought changes the world
2. Identify the various barriers and challenges faced in India and try to solve from Gandhian perspectives
3. Dedicate your ideas to poor people and transform technology among people
4. Aware of the economic and social equality and relationship with peace

3rd Semester						
Sl No	**Course Code**	**Course Title**	L	T	P	C
1	BS-2101	Engineering Mathematics-III	3	0	0	3
2	CS-2101	Object Oriented Programming	3	0	0	3
3	CS-210A	Design & Analysis of Algorithm	3	0	0	3
4	EC-2102	Digital Logic Design	3	0	0	3
5	BS-2102	Discrete Mathematics	3	0	0	3
6	YY-210X	**OE1***	3	0	0	3
7	CS-2102	Object Oriented Programming Laboratory	0	0	2	1
8	EC-2104	Digital Logic Design Laboratory	0	0	2	1
9	CS-2103	Design Analysis of Algorithm Laboratory	0	0	2	1
Contact Hours			18	0	6	
Total Credits						21

Subject Code: BS 2101

Subject Name: Engineering Mathematics- III

Credit Point: 3 [L=3, T=0, P=0]

A. Course objectives:

The course is designed to meet the objectives of:

1. imparting theoretical knowledge and practical application to the students in the area of Stochastic Process,
2. introducing the basic notions of probability theory and develops them to the stage where one can begin to use probabilistic ideas in statistical inference and modeling, and the study of stochastic processes,
3. providing confidence to students in manipulating and drawing conclusions from data and provide them with a critical frame work for evaluating study designs and results,
4. injecting future scope and the research directions in the field of stochastic process.

B. Course Content:

Probability: Random Experiment, Sample space; Events; Probability of events, Frequency Definition of probability; Axiomatic definition of probability; Finite sample spaces, Probability of Non-disjoint events (Theorems). Conditional probability; General Multiplication Theorem; Independent events; Bayes'theorem and related problems.

Random variables: Probability mass function; Probability density function and distribution function. Distributions: Binomial, Poisson, Uniform, Exponential, Normal, t and $\chi 2$. Expectation and Variance (t and $\chi 2$ excluded); Moment generating function; Transformation of random variables (One variable); Central limit theorem (Statement only).

Basic Statistics: Measures of Central tendency: Moments, skew-ness and Kurtosis – Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression– Rank correlation.

Statistics: Population; Sample; Statistic; Estimation of parameters (consistent and unbiased); Sampling distribution of sample mean and sample variance (proof notrequired).

Estimation: Maximum likelihood estimate of statistical parameters (Binomial,Poissonand Normal distribution). Interval estimation (Normal distribution). Testing of hypothesis and $\chi 2$ goodness of fit.

Curve fitting: Linear and Nonlinear

C. Text Books:

1. Rohatgi V. K. and Saleh A. K. Md E., An Introduction to Probability and Statistics, Willy, 2008, 2nd edition.
2. Gupta S. C., & Kapoor V. K., Fundamental of Mathematical Statistics, Sultan Chand &Sons, 2014.

D. Reference Books:

1. Ross S. M., Introduction to Probability Models, Academic Press, 2014, 14th edition.

2. Cramer H., Random Variables and Probability Distributions, Cambridge University Press, 2014, Revised ed.
3. Spiegel M. R., Probability and Statistics, McGraw-Hill, 2017, 3rdedition.
4. Mayer P. L., Introductory Probability and Statistical Applications, Oxford & IBH, 1970, 2nd ed.
5. Feller W., An Introduction to ProbabilityTheory and Its applications, Vol I, Jon Willy and Sons, 2008, 3rd edition.
6. Chung K. L., A course of Probability Theory, Academic Press, 2000, 3rd edition.

E. Course Outcomes:

Upon Completion of the subjects:

1. Students will add new interactive activities to fill gaps that we have identified by analyzing student log data and by gathering input from other college professors on where students typically have difficulties,
2. Students will add new simulation-style activities to the course in Inference and Probability, Student s will be able to take up prospective research assignments.

Subject Code: CS – 2101
Subject Name: Object Oriented Programming
Credit Point: 3 **(**L=3, T=0, P=0)

A. Course Objectives:

The course is designed to meet with the objectives of:

1. Learning to program in an object-oriented programming language, focusing those who already have some experience with another programming language, and who now wish to move on to an object-oriented one.
2. Learning object-oriented programming language namely, Java.

B. Course Content:

Introduction: Basic features & concepts of Object-Oriented Programming, (OOP), Benefits, Languages and Applications of OOPs.

Java Basics: History of Java, Java buzzwords, data types, variables, scope and lifetime of variables, arrays, operators, expressions, control statements, type conversion and costing, simple java program, classes and objects – concepts of classes, objects, constructors, methods, access control, this keyword, garbage collection, overloading methods and constructors, parameter passing, recursion, string handling

Inheritance: Definition, single, multilevel, multiple, hierarchical and hybrid inheritances, virtual base classes, abstract classes

Packages and Interfaces: Defining, Creating and Accessing a Package, Understanding CLASSPATH, importing packages, differences between classes and interfaces, defining

an interface, implementing an interface, applying interfaces, variables in an interface and extending interfaces. Exploring packages – Java.io,java.util.

Exception handling and multithreading: Concepts of exception handling, benefits of exception handling, Termination or resumptive models, exception hierarchy, usage of try, catch, throw, throws and finally, built in exceptions, creating own exception subclasses. Differences between multithreading and multitasking, thread life cycle, creating threads, synchronizing threads, daemon threads, thread groups.

Templates: Class templates, function templates, overloading of function templates, member function templates

Strings: Creating and manipulating string objects, accessing characters in strings.

Applets: Concepts of Applets, differences between applets and applications, the life cycle of an applet, types of applets, creating applets, passing parameters to applets.

Event Handling: Events, Event sources, Event classes, Event Listeners, Delegation event model, handling mouse and keyboard events, Adapter classes, inner classes. The AWT class hierarchy, user interface components- labels, button, canvas, scrollbars, text components, checkbox, checkbox groups, choices, lists panels – scrollpane, dialogues, menubar, graphics, layout manager – layout manager types – border, grid, flow, card and grib bag.

C. Text Books:

1. Balagurusamy Elappa., Programming with JAVA: A primer, Tata McGraw Hill, 4th Edition, 2010.
2. Schildt Herbert., Java 2: The complete reference, Tata McGraw Hill, 5th Ediition, 2009.

D. Reference Books:

1. Bhaskar V. Vijaya & Reddy P. Venkata Subba., Object-oriented programming through JAVA, Mumbai Scitech Publication, 2007.

E. Course Outcomes:

Students completing this module will be able to:

1. Explain the principles of the object-oriented programming paradigm specifically including abstraction, encapsulation, inheritance and polymorphism using Java, use an object-oriented programming language, and associated class libraries, to develop object-oriented programs using Java.
2. Design, develop, test, and debug programs using object-oriented principles in conjuncture with an integrated development environment using Java.
3. Use java standard API library to write complex programs

4. Develop interactive programs using applets.

Subject Code: CS-210A
Subject Name: Design & Analysis of Algorithm
Credit Point: 3 **(**L=3, T=0, P=0)

A. Course Objectives:

1. Learning specification of the concept of algorithm and analysis of its computational complexity,
2. Learning design principles of algorithms and their application to computing problems,
3. Making analysis accessible to all levels of readers.

B. Course Content:

Models of computation: RAM, TM etc. time and space complexity
Asymptotic Notation: Big-O, omega, theta etc.; finding time complexity of well known algorithms like- heap sort, search algorithm etc.
Algorithm Design techniques: Recursion- Definition, Use, Limitations, and Examples: Hanoi problem. Tail Recursion, etc.
Divide and Conquer: Basic method, use, Examples: Merge sort, Quick Sort, Binary Search, etc.
Dynamic Programming: Basic method, use, Examples: matrix-chain multiplication, all pair shortest paths, single-source shortest path, travelling Salesman problem, etc.
Branch and Bound: Basic method, use, Examples: The 15-puzzle problem, etc.
Backtracking: Basic method, use, Examples: Eight queens problem, Graph coloring problem, and Hamiltonian problem, etc.
Greedy Method: Basic method, use, Examples: Knapsack problem, Job sequencing with deadlines, minimum spanning tree (Prim's and Kruskal's algorithms), etc.
Lower Bound Theory: Bounds on sorting and sorting techniques using partial and total orders.
Disjoint Set Manipulation: Set manipulation algorithm like UNION-FIND, union by rank, Path compression.
Matrix manipulation algorithms: Different types of algorithms and solution of simultaneous equations, DFT & FFT algorithm; integer multiplication schemes
Notion of NP-completeness: Non deterministic algorithm, COOK‘s theorem, P class, NP-hard class, NP-complete class, CNF Satisfiability problem, proof a problem to be NP hard, Clique Decision Problem.
Approximation algorithms: Necessity of approximation scheme, performance guarantee, Polynomial time approximation schemes: 0/1 knapsack problem
String Matching Algorithm

C. Text Books:

1. Cormen T H., Leiserson C E., Rivest R L., and Stein C., Introduction to Algorithms,

Fourth Edition, MIT Press, 2022.
2. Knuth D E., The Art of Computer Programming: Fundamental Algorithms, Second Edition, Addison- Wesley Publishing Company, 1973.
3. Horowitz E., Sahni S., Rajasekaran S., Computer Algorithms, Second Edition, Silicon Press, 2008.
4. Goodman S E., Hedetniemi S T., Introduction to Design and Analysis Of Algorithms, McGraw-Hill, 1977.
5. Mehlhorn K., Data Structures and Algorithms 1: Sorting and Searching‖, Springer Science & Business Media, 2012.

D. Reference Books:

1. Mehlhorn K., Data Structures and Algorithms 2: Graph Algorithms and NP-Completeness, Springer Science & Business Media, 2012.
2. Baase S., Computer algorithms: introduction to design and analysis, Pearson Education India, 2009.
3. Horowitz E. and Shani S., Fundamentals of Computer algorithms, Galgotia Publications, 1984.
4. Reingold E M., Nievergelt J., Deo N. Combinational algorithms: Theory and Practice, Pearson Education Canada, 1977.
5. Borodin A., Munro I., The computational complexity of Algebraic and Numeric problems, American Elsevier Pub.Co., 1975.
6. Skiena S S., The Algorithm Design Manual‖, Springer Science & Business Media, 2009, 2, illustrated, reprint.
7. Aho A V., Hopcroft J E., Design and Analysis of Computer Algorithms‖, Pearson Education India, 1974.

E. Course Outcomes:

1. Design algorithms for difficult problems.
2. Analyse and understand their complexity.
3. Implement the algorithms in practice.

Subject Code: EC - 2102
Subject Name: Digital Logic Design
Credit Value: 3 (L = 3, T = 0, P = 0)

A. Course Objectives:

1. To build a solid foundation about Boolean algebra
2. To study Digital Logic Gates and Circuits
3. To provide a clear foundation of Modern Digital Systems

B. Course Content:

Minimization techniques: Minterms and maxterms expressions. Algebraic method, Karnaugh maps (including 5 and 6 variables), Quine-McCluskey method, Multi-output circuits, Multi-level circuits, Design of circuits with universal gates.
Codes: BCD, Excess- 3, Gray, ASCII, EBCDIC.
***Combinational circuits*:** Arithmetic circuits: adders and subtractor-ripple carry adders, Carry look ahead adders, Adder cum subtractor, BCD Adder and Subtractor, Comparator, Decoder, Encoder, Priority encoder, MUX/DEMUX and their structures, logic using ROM array, Applications of MSI designs.
Sequential circuits: Latches and Flip-Flops: SR latch, SR Flip-Flop, JK Flip-Flop, D Flip-Flop, T Flip-Flop, Flip-Flops with preset and clear inputs, Triggering methods and their circuits, Conversion of one type of flip flop to another, Excitation table, Applications of Flip Flops. Difference between synchronous and asynchronous circuits.

Shift Registers: Right shift, Left shift, Bidirectional, SISO, SIPO, PISO, PIPO, Universal shift registers.
Counters: Operation; up counter, Down counter, up/down counter, mod *n* counters, other types of Counters: Ring counter, Johnson counter, BCD counter.
Finite State Machines: Mealy & Moore types, Basic design steps, Design of counters using sequential circuit approach.
Asynchronous sequential circuits: Analysis and synthesis, State reduction and state assignment, Hazards.
Introduction to digital logic families: Characteristics, Basic working of TTL NAND gate, ECL gate and CMOS logic gate, Memory Devices: types of memories, RAM BJT cell and MOS RAM cells, Organization of a RAM
ADC & DAC: Analog and digital data conversions, D/A converter: Specifications, Weighted resistor type, R-2R ladder type, Voltage mode and current mode R-2R Ladder types, Switches for D/A converters, High speed sample-and-hold circuits, A/D Converters: Specifications, Flash type, Successive approximation type, Single slope type, Dual slope type, A/D converter using voltage-to-time conversion, Over-sampling A/D converters.

C. Text Books:

1. Malvino & Leach, “Digital Principles and Applications”, Tata McGraw Hill, 2010.
2. M. Morris Mano, “Digital Logic Design”, Prentice Hall, 2018.

D. Reference Books

1. H. Roth (Jr.), “Fundamentals of Logic Design”, Cengage Engineering, 2013.
2. R L Morris & J R Miller, “Designing with TTL Integrated Circuits”, McGraw Hill, 1971.
3. R. P. Jain, “Modern Digital Electronics”, Tata McGraw Hill, 2009.
4. Anand Kumar, “Fundamentals of Digital Circuits”, Prentice Hall, 2014.
5. J Crowe & B. Hayes-Gill, “Introduction to Digital Electronics”, Butterworth-Heinemann, 1998.

E. Course Outcomes

1. Design and analyse combinational and sequential logic circuits.
2. Optimize combinational and sequential logic circuits
3. Analyse a memory cell and apply for organizing larger memories

Subject Code: BS 2102; BS 210X (Open Elective)
Subject Name: Discrete Mathematics
Credit Point: 3 [L=3, T=0, P=0]

A. Course Objectives:

The course is designed to meet the objectives of:

a) To extend student's Logical and Mathematical maturity and ability to deal with abstraction and to introduce most of the basic terminologies used in computer science courses and application of ideas to solve practical problems.
b) Apply logical reasoning to solve a variety of problems.

B. Course Content:

Sets and Properties: Finite and Infinite Sets, Combinations of Sets, Countable and uncountable Sets, Mathematical Induction, Principle of Inclusion and Exclusion, Pigeon hole Principles, Proposition a logic.

Relations and Functions: Properties of Binary Relations, Equivalence Relations and Partitions, Partial Ordering, Partial order relation, Relations and Lattices.

Group and Rings: Groups, Subgroups, Permutation Groups, Cyclic group, Cosets and Lagrange's Theorem, Rings, Integral Domains and Fields.

Discrete Numeric Functions and Generating Functions: Manipulation of Numeric Functions, Asymptotic Behavior of Numeric Functions, Generating Functions.

Recurrence Relations and Recursive Algorithms: Recurrence Relations, Linear Recurrence Relations with Constant Coefficients.

Boolean Algebra: Lattices and Algebraic Systems, Principle of Duality, Basic Properties of Algebraic System, Distributive and Complemented Lattices, Karnaugh Mapping and Quine Mccluskey Tabular Method.

Graph Theory: Basic concepts, Graph isomorphism, Bipartite graph, Subgraph, Degree, Walk, Path, Cycle, Connectivity. Cut vertices and cut edges, Trees, Binary tree, Spanning trees, Euler graph, Euler tours and Hamiltonian cycles.

C. Text Books:

1. Liu C. L., "Elements of Discrete Mathematics", Mc Graw Hill Education; 2017, 4th edition.
2. Malik D.S. and Sen M. K., Discrete Mathematical Structures: Theory and Applications, Cengage, 2012, 1st edition.

D. Reference Books:

1. Rosen K. H., Discrete Mathematics and its Applications, McGraw Hill Education; 2017, 7th edition.
2. Lipschutz S., Lipson M. L., "Discrete Mathematics", Schaum's soutlines, Print, 2013, 3rd edition.
3. Biggs N. L., "Discrete Mathematics", Oxford, 2009, 2nd Edition.
4. Garnier R. & Taylor J., "Discrete Mathematics", C R C Press; 2009, 3rd edition.
5. Johnsonbaugh R. , "Discrete Mathematics", Pearson; 201, 8th edition.
6. Deo N., Graph theory with Applications to Engineering and Computer Science, Prentice Hall India Learning Private Limited, 1979, 9th edition.
7. J. P. Tremblay and R. P. Manohar, Discrete Mathematics with Applications to Computer Science, McGraw-Hill Education, 2017, 1st edition.

E. Course Outcomes:

Upon completion of the subject:

a) Students will have acquired greater precision in logical argument and have gained a core mathematical understanding of discrete mathematics.
b) Students will have learned and practiced basic concepts of mathematical proof (direct proof, proof by contradiction, mathematical induction).
c) Students will be able to simplify complex mathematical expressions and apply general formulae to specific contexts.

1. Students will have a basic understanding of information technology and its use in mathematical contexts.

Subject Code: CS - 2102
Subject Name: Object Oriented Programming Laboratory
Credit Point: 3 **(**L=0, T=0, P=2)

A. Course Objectives:

The course is designed to meet with the objectives of:

1. Learning to program in an object-oriented programming language, focusing those who already have some experience with another programming language, and who now wish to move on to an object-oriented one.
2. Learning object-oriented programming language namely, Java.

B. Course Content:

1. Write a program in Java to demonstrate class, constructor, overloading, inheritance, overriding
2. Write a program in Java to demonstrate wrapper class, vectors, arrays
3. Write a program in Java to demonstrate interfaces- multiple inheritances, extending interfaces
4. Write a program in Java to demonstrate packages
5. Write a program in Java to demonstrate multithreaded programming, handling errors and exceptions, applet programming and graphics programming
6. Write a program in Java to demonstrate Java SWING application.
7. Write a program in Java to demonstrate Client-Server Programming.

C. Text Books:

1. Balagurusamy Elappa., Programming with JAVA: A primer, Tata McGraw Hill, 4th Edition, 2010.
2. Schildt Herbert., Java 2: The complete reference, Tata McGraw Hill, 5th Ediition, 2009.

D. Reference Books:

1. Bhaskar V. Vijaya & Reddy P. Venkata Subba., Object-oriented programming through JAVA, Mumbai Scitech Publication, 2007.

E. Course Outcomes:

Students completing this module will be able to:-

1. Explain the principles of the object-oriented programming paradigm specifically including abstraction, encapsulation, inheritance and polymorphism using Java, use an object-oriented programming language, and associated class libraries, to develop object-oriented programs using Java.
2. Design, develop, test, and debug programs using object-oriented principles in conjuncture with an integrated development environment using Java.
3. Use java standard API library to write complex programs
4. Develop interactive programs using applets.

Subject Code: EC - 2104
Subject Name: Digital Logic Design Laboratory
Credit Value: 1 (L = 0, T = 0, P = 2)

A. Course Objectives

1. To build a solid foundation about Boolean algebra
2. To study the applications of Digital Logic Gates and Circuits

B. List of Experiments

Expt. No. 1. Verification of truth tables of different logic and universal gates.

Expt. No. 2. Design and verification of adder subtractor circuits using universal gates.

Expt. No. 3.

Minimize the following logic system with SOP/POS by tabular technique & implement the circuit.

i. SOP: $f(A,B,C,D) = m_0 + m_1 + m_2 + m_3 + m_5 + m_6 + m_{10} + m_{13} + m_{15}$

ii. POS: $f(X,Y,Z) = M_0.M_1.M_3.M_7$

Expt. No. 4. Design Gray to Binary and Binary to Gray code Converter & test the circuit.

Expt. No. 5. Verification of the truth table of the Multiplexer / Demultiplexer.

Expt. No. 6. Design and test of flip-flops using NOR/NAND gates.

Expt. No. 7. Verification of 3-bit synchronous / asynchronous up / down counter.

Expt. No. 8. Basic GATEs implementation in HDL

Expt. No. 9. Design and implementation of 3-bit synchronous up/down counter in HDL.

Expt. No. 10. Construction and verification of 4-bit ripple counter and Mod-10 / Mod-12 Ripple counters using JK flip-flop in HDL.

C. Text Books

1. Malvino & Leach, "Digital Principles and Applications", Tata McGraw Hill, 2010.

2. M. Morris Mano, "Digital Logic Design", Prentice Hall, 2018.

D. Reference Books

1. H. Roth (Jr.), "Fundamentals of Logic design", Cengage Engineering, 2013.

2. R L Morris & J R Miller, "Designing with TTL Integrated Circuits", McGraw Hill, 1971.

3. R. P. Jain, "Modern Digital Electronics", Tata McGraw Hill, 2009.

4. Anand Kumar, "Fundamentals of Digital Circuits", Prentice Hall, 2014.

5. J Crowe & B. Hayes-Gill, "Introduction to Digital Electronics", Butterworth-Heinemann, 1998.

E. Course Outcomes

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

CO1. Design and analyse combinational and sequential logic circuits.

CO2. Optimize combinational and sequential logic circuits

Subject Code: CS - 2103
Subject Name: Design & Analysis of Algorithm Laboratory
Credit Point: 0 **(**L=0, T=0, P=2)

A. Course Objectives:

1. Learning specification of the concept of algorithm and analysis of its computational complexity,
2. Learning design principles of algorithms and their application to computing problems.

B. Course Content:

Divide and Conquer:

Implement Binary Search using Divide and Conquer approach Implement Merge Sort using Divide and Conquer approach Implement Quick Sort using Divide and Conquer approach, Find Maximum and Minimum element from an array of integer using Divide and Conquer approach

Greedy method:

Knapsack Problem, Job sequencing with deadlines, Minimum Cost Spanning Tree by Prim's Algorithm, Minimum Cost Spanning Tree by Kruskal's Algorithm

Dynamic Programming:

Find the minimum number of scalar multiplication needed for chain of matrix Implement all pair of Shortest path for a graph (Floyed Warshall Algorithm) Implement Traveling Salesman Problem, Implement Single Source shortest Path for a graph (Dijkstra, Bellman Ford)

Brunch and Bound:

Implement 15 Puzzle Problems

Backtracking:

Implement 8 Queen Problem Graph Coloring Problem Hamiltonian Problem

Graph Traversal Algorithm:

Implement Breadth First Search (BFS) Implement Depth First Search (DFS)

C. Text Books:

1. Cormen T H., Leiserson C E., Rivest R L., and Stein C., Introduction to Algorithms, Fourth Edition, MIT Press, 2022.
2. Knuth D E., The Art of Computer Programming: Fundamental Algorithms, Second Edition, Addison- Wesley Publishing Company, 1973.
3. Horowitz E., Sahni S., Rajasekaran S., Computer Algorithms, Second Edition, Silicon Press, 2008.
4. Goodman S E., Hedetniemi S T., Introduction to Design and Analysis Of Algorithms, McGraw-Hill, 1977.
5. Mehlhorn K., Data Structures and Algorithms 1: Sorting and Searching‖, Springer Science & Business Media, 2012.

D. Reference Books:

1. Mehlhorn K., Data Structures and Algorithms 2: Graph Algorithms and NP-Completeness, Springer Science & Business Media, 2012.
2. Baase S., Computer algorithms: introduction to design and analysis, Pearson Education India, 2009.
3. Horowitz E. and Shani S., Fundamentals of Computer algorithms, Galgotia Publications, 1984.

4. Reingold E M., Nievergelt J., Deo N. Combinational algorithms: Theory and Practice, Pearson Education Canada, 1977.
5. Borodin A., Munro I., The computational complexity of Algebraic and Numeric problems, American Elsevier Pub.Co., 1975.
6. Skiena S S., The Algorithm Design Manual‖, Springer Science & Business Media, 2009, 2, illustrated, reprint.
7. Aho A V., Hopcroft J E., Design and Analysis of Computer Algorithms‖, Pearson Education India, 1974.

E. Course Outcomes:

1. Develop programs for sorting a given set of elements and analyse its time complexity.
2. Solve and analyse the problems using greedy methods.
3. Solve and analyse the problems using dynamic programming.
4. Apply backtracking method to solve various problems.
5. Apply branch and bound method to solve 0/1 knapsack problem.

4th Semester						
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	CS-2201	Software Engineering	3	0	0	3
2	BS-2201	Optimization Techniques	3	0	0	3
3	CS-2202	Formal Language and Automata Theory	3	0	0	3
4	CS-220A	Computer Organization & Architecture	3	0	0	3
5	YY-220X	**OE2**	3	0	0	3
6	MH-2201	Entrepreneur Essential and Early Stage Start-up	3	0	0	3
7	CS-2203	Computer Organization & Architecture Laboratory	0	0	2	1
8	CS-2204	Software Engineering Laboratory	0	0	2	1
9	CS-2205	Formal Language and Automata Theory Laboratory	0	0	2	1
Contact Hours			18	0	6	
Total Credits						21

Subject Code: CS - 2201
Subject Name: Software Engineering
Credit Point: 3 **(**L=3, T=0, P=0)

A. Course Objectives:

1. The need of software engineering, its different life cycles and different phases,
2. To measure cost, efforts, time and team management etc,
3. Testing and maintenance techniques of big projects and different risks and its management systems.

B. Course Content:

Overview of System Analysis & Design: Business System Concept, System Development Life Cycle, Waterfall Model, Spiral Model, Feasibility Analysis, Technical Feasibility, Cost- Benefit Analysis, COCOMO model.
System Requirement Specification: DFD, Data Dictionary, ER diagram, Process Organization & Interactions. System Design: Problem Partitioning, Top-Down And Bottop-Up design; Decision tree, decision table and structured English; Functional vs. Object- Oriented approach.
Coding & Documentation: Structured programming, OO programming, information hiding, Reuse, system documentation. Testing: Levels of Testing, Integration Testing, Test case Specification, Reliability Assessment, Validation & Verification Metrics, Monitoring & Control.
Software Project Management: Project Scheduling, Staffing, Software Configuration Management, Quality Assurance, Project Monitoring. Software modelling: with Unified Modelling Language. Case Tools: Concepts, use and application.

C. Text Books:

1. Mall Rajib, Fundamentals of Software Engineering, PHI, 2014

2. Jalote Pankaj, Software Engineering: A Precise Approach, Wiley India, 2010
3. Waman S Jawadekar, Software Engineering: A Primer, Tata McGraw-Hill, 2008
4. Vliet V Hans, Software Engineering: Principles and Practice, John Wiley &Sons Ltd.2008

D. Reference Books:

1. Sommerville Ian, Software Engineering, Pearson, 2017.
2. Pressman, Software Engineering Practitioner's Approach, McGraw Hill Education, 2012.
3. Rao R Ramisetty, TinnaluriNarayana, Murali Dabbu, Software Engineering New Approach, BSP, 2018.

E. Course Outcomes:

1. Students will be able to decompose the given project in various phases of a lifecycle.
2. Students will be able to choose appropriate process model depending on the user requirements.
3. Students will be able perform various life cycle activities like Analysis, Design, Implementation, Testing and Maintenance.
4. Students will be able to know various processes used in all the phases of the product.
5. Students can apply the knowledge, techniques, and skills in the development of a software product.

Subject Code: BS – 2201
Subject Name: Optimization Techniques
Credit Point: 3 **(**L=3, T=0, P=0)

A. Course Objectives:

The course is designed to meet the objectives of:

1. To make the students introduction of the methods of Operations Research,
2. Emphasize the mathematical procedures of nonlinear programming search techniques,
3. A scientific approach to decision making, which seeks to determine how best to design and operate a system, usually under conditions requiring the allocation of scarce resources.

B. Course Content:

LPP: Linear programming problems and applications, various components of LP problem formulation, Solving Linear Programming problem using simultaneous equations and Graphical Method, Simplex Method, Duality theory, Transportation and Travelling-Salesman problem, Assignment problems.

Game Theory: Two person Zero-sum game, saddle point, Graphical method, Dominance properties, solution of game by simplex method.

Network Analysis: Shortest Path Algorithms: Dijkstra and Floyd Algorithm, Maximal

Flow, Maxflow Mincut theorem, PERT and CPM.
Non-Linear programming Problem: Nonlinear programming, Karush-Kuhn-Tucker necessary and sufficient conditions of optimality, Quadratic programming, Wolfe's method, Beale's method.

C. Text Books:

1. Hamdy A.Taha, "Operations Research", Ninth edn., Pearson, Pearson Education India; 9 edition, 2014.
2. Hillier & Lieberman— Introduction to Operations Research, McGraw Hill Education;3 edition, 2017.

D. References Books:

1. S.D.Sharma, Operations Research, KEDARNATH RAMNATH,2003.
2. Kanti Swaroop, P.K.Gupta & ManMohan,"Operations Research", Sulthan Chand, 2010.
3. Hadley G.,"Linear Programming", Narosa, 2002.
4. Operations Research–Schaum outline series, McGraw Hill Education;2 edition,2017.
5. J. G. Chakraborty & P. R. Ghosh,"Linear Programming & Game Theory", Moulik Library, 2013.

E. Course Outcomes:

Students successfully completing this module will be able to:

1. Identify and develop operational research models from the verbal description of the real system & use mathematical software to solve the proposed models,
2. Understand the mathematical tools that are needed to solve optimization problems,
3. Develop a report that describes the model and the solving technique, analyse the results and propose recommendations in language understandable to the decision-making processes in Management Engineering.

Subject Code: CS-2202
Subject Name: Formal Language and Automata Theory
Credit Point: 4 **(**L=3, T=1, P=0)

A. Course Objectives:

The course is designed to meet with the objectives of:

1. providing a deeper understanding of programming languages design motivations and semantics, facilitating students to select and use the most appropriate language for a given task and write correct programs,
2. Illustrating language processing techniques: compilation and interpretation.

B. Course Content:

Introduction: Introduction to the theory of formal languages, Chomsky Hierarchy of languages, definition, recognition of a language by an automata, grammar, DFA, NFA, equivalence of DFA and NFA, regular sets & regular expressions, equivalence of Moore & Mealy machines, applications of finite automata.

Closure Properties of Regular Sets: Pumping lemma & its application, closure properties minimization of finite automata: minimisation by distinguishable pair, Myhill-Nerode theorem.

Context Free Grammars: Introduction, definition, derivation trees, simplification, CNF & GNF

Pushdown Automata: Definition, moves, Instantaneous Descriptions, language recognized by PDA, acceptance by final state & empty stack, the equivalence of PDA and CFG, deterministic PDA.

Closure Properties of CFLs: Pumping lemma & its applications, closure properties, decision algorithms.

Turing machine: Informal proofs that some computational problems cannot be solved, Turing machines (TMs), their instantaneous descriptions. Language acceptance by TMs. Hennie convention for TM transition diagrams, halting problem of TM, Recursively enumerable (r.e.) and recursive languages, notion of undecidable problems. Universal language and universal, some undecidable problems of TMs. Rice's theorem.

C. Text Books:

1. Mishra K.L. P., & Chandrasekharan N., Theory of Computer Science: Automata, Languages and Computation, 3rd Edition, Prentice HallIndia, 2006.
2. Lewis R. H., & Papadimitrou H. C., Elements of the theory of Computation, Pearson Education, 2005.
3. Hopcroft E. John., & Ullman D. Jeffrey., Introduction to Automata Theory, Languages & Computation ,2nd Edition, Pearson education, 2001.

D. Reference Books:

1. Kain Y. Richard., Theory of Automata& Formal Language, McGrawHill,
2. Kohavi Zvi., Switching and Finite Automata Theory, 2nd edition, TataMcGraw-Hill, 2017.
3. Linz Peter., An Introduction to Formal Languages and Automata, Jones & Bartlett Publishers, 2012
4. Straubing Howard., Finite Automata, Formal Logic, and Circuit Complexity, Springer, 1994.
5. Carroll John., & Darrell Long., Theory of Finite Automata: With an Introduction to Formal Languages, Prentice Hall, 1989.

E. Course Outcomes:

1. Understand and apply formal notations via regular expressions and grammars, as well as their recognisers (finite automata, push-down automata).
2. Provide relevant formal definitions for given languages, discuss virtual machines and intermediate languages trade-offs,
3. Understand and apply basic language processing techniques: compilation and interpretation.

Subject Code: CS-220A
Subject Name: Computer Organization & Architecture
Credit Point: 3 **(**L=3, T=0, P=0)

A. Course Objectives:

1. To understand the structure, function and characteristics of computer systems.
2. To understand the design of the various functional units and components of computers.
3. To identify the elements of modern instructions sets and their impact on processor design.
4. To explain the function of each element of a memory hierarchy,
5. To identify and compare different methods for computer I/O.

B. Course Content:

Fundamentals of Computers: Digital computers, layers in computer system, types of computers, history of computers
Data representation and computer arithmetic: Data types, complement, fixed point representation, floating point representation, multiplication and division of sign and unsigned integers.
Micro operation and design of arithmetic logic unit: Register transfer micro operation, bus transfer, memory transfer, arithmetic micro operation, logic micro operation, logic unit, shift unit, design of arithmetic and logic unit.
Instruction set: Instruction code, register, computer instruction, timing and control, instruction cycle, instruction formats, CPU organization, instruction length, addressing standard, addressing mode, instruction set, RISC, CISC.
Design of control unit: hardware control design, micro programmed control.
Memory organization: memory hierarchy, main memory, cache memory, virtual memory.
Input-output organization: peripheral device, I/O interface and I/O driver, synchronous and asynchronous data transfer, modes of data transfer, priority interrupt, DMA, input-output processor.
Parallel processing: performance measurement of computer, parallel computer structure, general classification of computer architecture, pipelining, vector processing, multiprocessor system, flow computers.
Introduction to Microprocessor: Microcomputer structure and operation, 8086 microprocessor family, Overview, Architecture of processor 8085 and 8086.

C. Text Books:

1. W. Stallings, Computer Organization and Architecture: Designing for Performance,

Pearson Education India, 2019.
2. A. Patterson and J. L. Hennessy, Computer Organization and Design, Morgan Kaufmann, 2013.
3. S. Tanenbaum, Structured Computer Organization, 5th Ed., Prentice Hall of India, 2013.

D. Reference Books:

1. C. Hamacher, Z. Vranesic, Computer Organisation‖, Tata Mcgraw Hill, 2011.
2. M. Jain, S.Jain, V. Pillai, Computer Organization and System Software, BPB Publications, 2003.
3. P. Pal Chaudhuri, Computer Organisation & Design, PHI Learning Private Ltd., 2009.

E. Course Outcomes:

1. Identify various components of computer and their interconnection
2. Identify basic components and design of the CPU: the ALU and control unit.
3. Compare and select various Memory devices as per requirement.
4. Compare various types of IO mapping techniques
5. Critique the performance issues of cache memory and virtual memory

Subject Code: MH-2201
Subject Name: Entrepreneur Essential and Early-stage Start-up
Credit Point: 3 (L=3, T=0, P=0)

A. Course Objectives:

The course is designed to meet the objectives of:

1. To involve themselves in the business activities
2. Starting innovative practices in their entrepreneurial activities.
3. Developing theirs kills on the traits that they want to carry forward.

B. Course Content:

Introduction to Entrepreneurship Meaning, Role of Entrepreneur, Entrepreneur Process: different approaches, Qualities of successful Entrepreneur, Functions of an Entrepreneur, Types of Entrepreneur, Issues & Problems Entrepreneurial Practices, Motivation for becoming an Entrepreneur. SME Concept, its role, status, prospects and policies for promotion of SMEs. Importance of Entrepreneurship: innovations, Qualities of successful Entrepreneur, Functions of an Entrepreneur, Types of Entrepreneurs, Issues &Problems Entrepreneurial Practices. Identifying and Assessing the Idea, Identifying Target Segment & Market Sizing, Analysing Environment & Competitive Advantage, Choosing the right legal structure, Permits, Registrations & Compliances, Components of a Business Plan, Creating an Effective B-Plan Part, Valuation, Investor pitch. Importance of

Entrepreneurship: Entrepreneurship and Innovations, Converting Innovation to Economic Value which includes, Growth Strategies, value position, Market Segments, Value Chain Structure, Revenue Model, Contribution of Entrepreneurs: Towards R&D, creates Wealth of Nation & Self prospect with Challenge. Characteristics of Entrepreneurship idea generation techniques, Business plan, Strategic Plan etc.

C. Text Books:

1. Donald F. Kuratko, Entrepreneurship: Theory, Process, Practice Cengage Learning 2017
2. Desai, Vasant, Small Scale Industries and Entrepreneurship. Himalaya Publishing House, Delhi.2008
3. Kaulgud, Aruna Entrepreneurship Management. Vikas Publishing House, Delhi.2003
4. Cynthia, L. Greene. Entrepreneurship Ideas in Action. Thomson Asia Pvt. Ltd., Singapore. 2004

D. Reference Books:

1. Barringer Entrepreneurship: Successfully Launching New Ventures, Pearson Education Publishing 2015
2. Timmons, Jerry A., and Spinelli, Stephen, New Venture Creation: Entrepreneurship for the 21st Century, 8th Edition, Boston, MA: Irwin McGraw-Hill 2009.
3. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi, 2001

E. Programme Outcomes:

1. Start the venture more scientifically.
2. Start the venture by linking with the financial institutions.
3. Seeking for a start-up idea
4. To be an entrepreneurs

Subject Code: CS-2203
Subject Name: Computer Organization & Architecture Laboratory
Credit Point: 1 **(**L=0, T=0, P=2)

A. Course Objectives:

1. Learn and understand the basics of Hardware description language and its use in designing electronic circuits.
2. This course deals with programming using Verilog for advanced digital design techniques.
3. Introduces students to gate, dataflow (RTL), behavioural, and switch level modelling.

B. Lab Content:

1. Write a Verilog code to implement S-R flipflop and also implement the testbench to verify the outputs.
2. Write a Verilog code to implement D- latch and also implement the testbench to verify the outputs.
3. Write a Verilog code to implement D- latch with reset asynchronous and also implement the testbench to verify the outputs.
4. Write a Verilog code to implement D- latch with reset synchronous and also implement the testbench to verify the outputs.
5. Write a Verilog code to T- flipflop with asynchronous reset and also implement the testbench to verify the outputs.
6. Write a Verilog code to T- flipflop with synchronous reset and also implement the testbench to verify the outputs.
7. Write a Verilog code to implement JK flipflop and also implement the testbench to verify the outputs.
8. Write a Verilog code to implement Counter also implement the testbench to verify the outputs.
9. Write a Verilog code to implement 8-bit Ripple carry adder and also implement the testbench to verify the outputs.
10. Write a Verilog code to design an ALU and also implement the testbench to verify the outputs.

C. Reference Books:

1. Michael D Ciletti, Advanced Digital Design with the VERILOG HDL, PHI, 2010.
2. Palnitkar Samir, Verilog HDL, Pearson Education, 2003.
3. Brown Stephen and Vranesic Zvonko - Fundamentals of Digital Logic with Verilog, TMH, 2013.
4. Z Navabi, Verilog Digital System Design, McGraw Hill, 2005.

D. Course Outcomes:

1. Understand the basics of Hardware Description Languages, Program structure and basic language elements of Verilog.
2. Understand types of modelling, modules, functions of Verilog and simulate and synthesize related Programs.
3. Design, Simulate and synthesize various Verilog descriptions for Combinational circuits.
4. Design, Simulate and synthesize various Verilog descriptions for Sequential circuits.

Subject Code: CS- 2204
Subject Name: Software Engineering Laboratory
Credit Point: 1 **(**L=0, T=0, P=2)

A. Course Objectives:

1. To have hands on experience in developing a software project by using various software engineering principles and methods in each of the phases of software development.
2. To impart state-of-the-art knowledge on Software Engineering and UML in anointer active manner
3. Present case studies to demonstrate practical applications of different concepts.
4. Provide a scope to students where they can solve small, real-life problems.

B. Lab Content:

Practicing and Modeling UML use case diagram & capturing use case scenarios: Use case diagrams, Use Case, Graphical Representation, Association between Actors and Use Cases, Use Case Relationships, Relationship, Extend Relationship,| Generalization Relationship,| Identifying Actors, Identifying Use cases, E-R modelling

Practicing and Modeling DFD: Data Flow Diagram, Graphical notations for Data Flow Diagram, Explanation of Symbols used in DFD, Context diagram and levelling DFD.

Estimation of test coverage metrics & structural complexity: Control Flow Graph, Terminologies, McCabe's Cyclomatic Complexity, Computing Cyclomatic Complexity, Optimum Value of Cyclomatic Complexity, Merits, Demerits

Practicing and Designing test suite: Software Testing, Standards for Software Test Documentation, Testing Frameworks, Test Cases and Test Suite, Unit Testing, Integration Testing, System Testing, Some Remarks.

C. Reference Books:

1. Booch Grady, Rambaugh James, Jacobson Ivar,The unified modeling language user guide, Pearson Education, 2012.
2. Stephen R. Schach, Object-oriented and Classical Software Engineering, McGraw-Hill, 2010.
3. Dennis Alan ,Wixom Barbara, Tegarden David, Systems Analysis and Design: An Object-Oriented Approach with UML, Wiley,2015.

D. Course Outcomes:

1. Can produce the requirements and use cases the client wants for the software being produced.
2. Participate in drawing up the project plan. The plan will include at least extent and work assessments of the project, the schedule, available resources, and risk management can model and specify the requirements of mid-range software and their architecture.
3. Create and specify such a software design based on the requirement specification that the software can be implemented based on the design.
4. Can assess the extent and costs of a project with the help of several different assessment methods.

Subject Code: CS- 2205
Subject Name: Formal System and Automata Laboratory
Credit Point: 1 **(**L=0, T=0, P=2)

A. Course Objectives:

The course is designed to meet with the objectives of:

1. providing a deeper understanding of programming languages design motivations and semantics, facilitating students to select and use the most appropriate language for a given task and write correct programs,
2. Illustrating language processing techniques: compilation and interpretation.

B. Laboratory Content:

1. Deterministic Finite Automata (DFA)
2. Nondeterministic Finite Automata (NFA)
3. Conversion of NFA to DFA
4. DFA Minimization
5. DFA to regular grammar conversion
6. DFA to regular expression conversion
7. Combining automata
8. Regular expression to DFA conversion
9. Mealy and Moore machine
10. Pushdown automata
11. Single tape Turing machine
12. Multi-tape Turing machine
13. Context free grammars (CFG) with single symbols
14. CFG with multiple symbols
15. LL Parsing
16. LR Parsing
17. Regular expressions
18. Regular pumping lemma
19. Context free pumping lemma
20. CFG to Chomsky Normal form transformation

C. Text Books:

1. Mishra K.L. P., & Chandrasekharan N., Theory of Computer Science: Automata, Languages and Computation, 3rd Edition, Prentice HallIndia, 2006.
2. Lewis R. H., & Papadimitrou H. C., Elements of the theory of Computation, Pearson Education, 2005.
3. Hopcroft E. John., & Ullman D. Jeffrey., Introduction to Automata Theory, Languages & Computation ,2nd Edition, Pearson education, 2001.

D. Reference Books:

1. Kain Y. Richard., Theory of Automata& Formal Language, McGrawHill,
2. Kohavi Zvi., Switching and Finite Automata Theory, 2nd edition, TataMcGraw-Hill, 2017.
3. Linz Peter., An Introduction to Formal Languages and Automata, Jones & Bartlett Publishers, 2012
4. Straubing Howard., Finite Automata, Formal Logic, and Circuit Complexity, Springer, 1994.
5. Carroll John., & Darrell Long., Theory of Finite Automata: With an Introduction to Formal Languages, Prentice Hall, 1989.

E. Course Outcomes:

1. Understand and apply formal notations via regular expressions and grammars, as well as their recognisers (finite automata, push-down automata).
2. Provide relevant formal definitions for given languages, discuss virtual machines and intermediate languages trade-offs,
3. Understand and apply basic language processing techniques: compilation and interpretation.

5th Semester						
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	CS-3101	System Software and administration	3	0	0	3
2	CS-3102	Operating System	3	0	0	3
3	CS-3103	Python for Data Science	3	0	0	3
4	CS-310A	Compiler Design	3	0	0	3
5	YY-310X	**OE3**	3	0	0	3
6	CS-3104	Internship-I	0	0	0	1
7	MH-3101	Engineering Economics	3	0	0	3
8	CS-3105	Minor Project-I	0	0	4	2
9	CS-3106	System Software and administration Laboratory	0	0	2	1
10	CS-3107	Operating System Laboratory	0	0	2	1
11	CS-3108	Compiler Design Laboratory	0	0	2	1
Contact Hours			18	0	10	
Total Credits						24

Subject Code: CS-3101
Subject Name: System Software and administration
Credit Point: 3 **(**L=3, T=0, P=0)

A. Course Objectives:

The course is designed to meet the objectives of:

1. working principle of Assemblers, Macro Processors, Loaders etc, different loaders

and loading schemes,
2. Working principle and different configurations in unix based operating systems.
3. Process programming in unix based operating system.
4. Structure of file Systems in unix operating systems and Network File Systems, and process of system backup and recovery.

B. Course Content:

Assemblers: General design procedures, instructions and data representations, Design of two pass assemblers, Linux assembly language, assembly language programming and simulation using X86, Cross Assemblers

Macro Processors: Features of a macro facility, macro instruction arguments, conditional macro expansion, macro calls within macros, Macro Assemblers.

Loader schemes: Compile and go loaders, absolute loaders, relocating loader, Linking, Reallocation- static & dynamic linking, Direct linking loaders.

Binders, Overlays, dynamic binders; working principle of Editors, Debuggers.

Overview of Unix system, commands and utilities; Basic Linux administration and installation: grub, rpm, yum, disk partitioning; Basic Linux utilities, logging, backup, authentication; Internet mail system: send mail, elm, mail administration; Program Maintenance: make, sccs, debugging with gdb and ddd (Data Display Debugger)Archiving: shar, tar; Shell use: redirection, .cshrc, environment variables; Regular Expression parsing: grep, egrep, sed, awk; Shell programming: bash; Scripting Languages like Perl, Python, Java Script; Database Driven Web Site: PHP and MySQL; Study of unix file systems and functionalities of different directories, directory layout.

Different Editors and their operation techniques: vi, nano, vim, emacs

Documentation and Presentation: Document writing and Slides using LaTex; Windows Administration: Managing the server operating system, file, and directory services, Software distribution and updates, Profiling and monitoring assigned servers, Security and Troubleshooting;

Services and Daemons: Configuring the Default Runlevel, Configuring the Services, Running Services, Additional Resources, list of services and their names, Case study of services: NFS, FTP, DNS etc. Case study on Bit bucket, GitHub

C. Text Books:

1. Tanenbaum S. Andrew., & Austin Todd., Structured Computer Organization, Pearson, 2013.
2. Britton L. Robert., MIPS Assembly Language Programming, Pearson/Prentice Hall, 2004.
3. Beck L. L., System Software, (3rd Ed.), Pearson Education India, 1997.
4. Lamport L., LaTeX: A Document Preparation System, 2nd Ed, Addison-Wesley Series, 1994.

D. Reference Books:

1. Nithyashri J., System Software, Tata McGraw-Hill Education, 2010.
2. Chattopadhyay Shantanu., System Software, PHI Learning Pvt. Ltd., 2007.
3. Das S., Unix System V.4 Concepts and Applications, 3rd Ed., Tata Mcgraw-Hill, 2003.
4. Maxwell Steve., UNIX System Administration: A Beginner's Guide, McGraw Hill Professional, 2002.
5. Kauler B., Windows assembly language & Systems Programming: 16- and 32-Bit Low- Level Programming for the PC and Windows, 2nd Ed., CMP Books, 1997.

E. Course Outcomes:

1. Know assembler, linker, loader, macro and their working principles.
2. Practice different general commands and pipelining used in unix commands.
3. Learn different types of loaders using programming languages.
4. Learn shell programming in unix based operating systems.
5. Configuration of different services in unix operating systems.

Subject Code: CS3102/ CS-311X (Open Elective)
Subject Name: Operating System
Credit Point: 3 **(**L=3, T=0, P=0)

A. Course Objectives:

The course is designed to meet the objectives of:

1. Appreciating the role of an operating system.
2. Making aware of the issues in management of resources like processor, memory and input- output.
3. Selecting appropriate productivity enhancing tools or utilities for specific needs like filters or version control.
4. Obtaining some insight into the design of an operating system.

B. Course Content:

Introduction: Introduction to Operating System: Operating system functions, evaluation of Operating System, Different types of Operating System: batch, multi-programmed, time-sharing, real-time, distributed, parallel.

System Structure: Computer system operation, I/O structure, storage structure, storage hierarchy, different types of protections, operating system structure (simple, layered, virtual machine), Operating System services, system calls.

Process Management: Processes: Concept of processes, process scheduling, operations on processes, co-operating processes, inter- process communication. Threads: overview, benefits of threads, user and kernel threads.

CPU Scheduling: Scheduling criteria: pre-emptive & non-pre-emptive scheduling, scheduling algorithms (FCFS, SJF, RR, priority), algorithm evaluation, multi-processor scheduling.

Process Synchronization: background, critical section problem, critical region,

synchronization hardware, classical problems of synchronization, semaphores.

Deadlocks: system model, deadlock characterization, methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock.

Storage Management: Memory Management: background, logical vs. physical addresses space, TLB, swapping, contiguous memory allocation, paging, segmentation, segmentation with paging. Virtual Memory: background, demand paging, performance, page replacement, page replacement algorithms (FCFS, LRU), allocation of frames, thrashing.

File Systems: file concept, access methods, directory structure, file system structure, allocation methods (contiguous, linked, and indexed), free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency & performance.

I/O Management: I/O hardware, polling, interrupts, DMA, application I/O interface (block and character devices, network devices, clocks and timers, blocking and non-blocking I/O), kernel I/O subsystem (scheduling, buffering, caching, spooling and device reservation, error handling), performance.

Disk Management: disk structure, disk scheduling (FCFS, SSTF, SCAN, C-SCAN), disk reliability, disk formatting, boot block, bad blocks.

Protection & Security: Goals of protection, domain of protection, security problem, authentication, one time password, program threats, system threats, threat monitoring, encryption.

Case Studies: Dos & Unix.

C. Text Books:

1. Silberschatz A., Galvin P.B., Gagne G., Operating System Concepts, Wiley, 2014.
2. Tanenbaum A.S., Woodhull A.S., Operating System Design & Implementation, Pearson Education, 2011.
3. Anderson T., Dahlin M., Operating Systems: Principles and Practice, Recursive Books, 2015.
4. Dhamdhere D.M., Operating Systems: A Concept Based Approach, McGraw-Hill, 2011.

D. Reference Books:

1. Stallings W., Operating Systems: Internals and Design Principles, Pearson Education, 2018.
2. Tanenbaum A.S., Bos H., Modern Operating Systems, Pearson Education, 2016.
3. Deitel H.M., Deitel P. J., Choffnes D. R., Operating Systems, Pearson Education, 2003.
4. Milenkovie M., Operating System: Concept & Design, McGraw-Hill Education, 2001.
5. Nutt G., Operating Systems: A Modern Perspective, Pearson Education, 1997.

E. Course Outcomes:

After successfully completion of this module students will be able to:

1. Understands what are an operating system and the role it plays.
2. Get high level understanding of the structure of operating systems, applications, and the relationship between them.
3. Gather knowledge of the services provided by operating systems,
4. Get exposure to some details of major OS concepts.

Subject Code: CS – 3103/ CS-310X (Open Elective)
Subject Name: Python for data science
Credit Point: 3 **(**L=3, T=0, P=0)

A. Course Objectives:

1. Building robust applications using Python programming language's features.
2. Understanding the usage of Python libraries.
3. Basic process of data science
4. An applied understanding of how to manipulate and analyze uncurated datasets
5. How to effectively visualize results

B. Course Content:

The concept of data types; variables, assignments; immutable variables; numerical types; arithmetic operators and expressions; comments in the program; understanding error messages; Conditions, boolean logic, logical operators; ranges; Control statements: if-else, loops (for, while); short-circuit (lazy) evaluation; Strings and text files; manipulating files and directories, os and sys modules; text files: reading/writing text and numbers from/to a file; creating and reading a formatted file (csv or tabseparated); String manipulations: subscript operator, indexing, slicing a string.

Lists, tuples, and dictionaries; basic list operators, replacing, inserting, removing an element; searching and sorting lists; dictionary literals, adding and removing keys, accessing and replacing values; traversing dictionaries; Design with functions: hiding redundancy, complexity; arguments and return values; formal vs actual arguments, named arguments.

Data visualization and cleaning; Numpy, pandas Series data structure, Querying series, Dataframe data structure, missing value, merging dataframe, scale, Pivot Table, filter cleaning and Manipulating data and Visualization, Data Visualization with Seaborn, Matplotlib package

C. Text Books:

1. T.R. Padmanabhan, Programming with Python, Springer, 1st Ed., 2016.
2. Kenneth Lambert, Fundamentals of Python: First Programs, Cengage Learning,, 1st Ed., 2012.

D. Reference Books:

1. J V, Python Data Science Handbook Essential tools for working with data, O'Reilly Media, 2016
2. Madhavan S, Mastering Python for Data Science, Packt Publishing, 2015

E. Course Outcomes:

1. Write python programs that solve simple business problems.
2. Create python applications that are robust and multithreaded.
3. Write simple GUI interfaces for a program to interact with users, and to understand the event-based GUI handling principles in python.
4. Data manipulation and visualization using python

Subject Code: CS-310A
Subject Name: Compiler Design
Credit Point: 3 **(**L=3, T=0, P=0)

A. Course Objectives:

The course is designed to meet with the objectives of:

1. Providing a thorough introduction to the theory and practice of programming language translation.
2. Introducing to the design and implementation of programming language translators.

B. Course Content:

Compilers, Analysis of the source program: The phases of the compiler.

The role of the lexical analyzer: Tokens, Patterns, Lexemes, Input buffering, Specifications of token, Recognition of a tokens, Finite automata, Regular expression to Finite Automata, Design of a lexical analyzer generator (LEX).

The role of a parser: Context free grammars, Writing a grammar, Top down Parsing, Non- recursive Predictive parsing (LL), Bottom up parsing, Handles, Viable prefixes, Operator precedence parsing, LR parsers (SLR, LALR), Parser generators (YACC). Error recovery strategies for different parsing techniques.

Syntax director definitions: Construction of syntax trees, Bottom-up evaluation of S attributed definitions, L attributed definitions, Bottom-up evaluation of inherited attributes. Type systems, Specification of a simple type checker, Equivalence of type expressions, Type conversions.

Source language issues (Activationtrees, Controlstack, scope of declaration, Binding of names), Storage organization (Subdivision of run-time memory, Activation records), Storage allocation strategies, Parameter passing (call by value, call by reference, copy restore, call by name), Symbol tables, dynamic storage allocation techniques.

Intermediate languages: Graphical representation, Three-address code, Implementation of three address statements (Quadruples, Triples, Indirect triples).

Code optimization: Introduction, Basic blocks & flow graphs, Transformation of basic blocks, DAG representation of basic blocks, the principle sources of optimization, Loops in flow graph, Peephole optimization.

Issues in the design of code generator: A simple code generator, Register allocation & assignment.

C. Text Books:

1. Aho V. Alfred., Lam S. Monica., Sethi Ravi., Ullman D. Jeffrey., Compiler: Principles, Techniques and Tools, Pearson Education. 2007.
2. Holub I. Allen., Compiler Design in C, Prentice-Hall of India Pvt. Limited, 2006.

D. Reference Books:

1. Cooper Keith., Torczon Linda., Engineering a compiler, Elsevier, 2011.
2. Raghavan V., Principles of Compiler Design, McGraw Hill, 2010.

E. Course Outcomes:

Students successfully completing this module will be able to

1. Design lexical and syntax analyzer phases of complier.
2. Demonstrate the basic notions and techniques for programming language translation
3. Demonstrate the basic notions and techniques for intermediate code generation.
4. Generate and program a small compiler or interpreter.

Subject Code: MH-3101
Subject Name: Engineering Economics
Credit Point: 3 (L=3, T=0, P=0)

A. Course Objectives:

The course is design to meet the following objectives:

1. Learn the fundamentals of Engineering Economics
2. Understand and use of Economic concepts in making business decision
3. Use economic information to manage the organization
4. Use economic tools with respect to acceptance or rejection of investment proposals
5. Know the current issues relating to economic environment

B. Course content:

Basics of Economics: Basic Concepts, Scope, Importance and definitions, Relevant to Managerial Economics-Factors Influencing Managerial Decision — Managerial economics and other disciplines, Relation between Science, Engineering, Technology and Economics Demand Analysis : Managerial Decisions-Meaning-Types—Determinants, Demand Functions, Demand Elasticity, Demand Forecasting Methods, Accuracy of Forecasting Cost concept :Costs Concepts-Accounting Cost and Economic Cost determinants of Cost, Cost —Output Relationship, Break Even Analysis- Meaning, Assumption, Uses and Limitation, Break Even Point (BEP)- Meaning, Determinants of Break Even Point- Break Even Charts, linear approach (Simple numerical problems to be solved). Market Structure and Product Pricing :Perfect and Imperfect Market Structures. Conditions of Perfect Competition. Price of a Product under demand and supply forces. Equilibrium Price. Pricing under Monopoly and Monopolistic Competition. Pricing under

Oligopoly. Kinked Demand Curve. Discriminating Prices. Inflation, Business cycle, Nation alI income: Inflation- meaning, feature, Types, causes, Effects of Inflation, Measures to Control Inflation. Business Cycle - Features of Business Cycle, Causes of Business Cycle, Types of Business Cycle, Theories of Business Cycle, Impacts/ Effects of Business Cycle, Measures to Control Business cycle, National Income & Current Issues- Concepts of National Income, Factors Determining Level (Size)of National Income, Methods of Measurement of National Income, Choice of Methods of National Income, Importance of Measurement of National Income, Difficulties in Measuring National Income.

C. Text Books:

1. Park, S. Chan, Fundamentals of Engineering Economics, Fourth Edition, Pearson New York, 2019
2. Yates, J.K. Engineering Economics, 1st Edition, CRC Press, Boca Raton, 2016.
3. Brajesh Kumar, Zahid A.Khan, Arshad N. Siddiquee, Mustufa H. Abidi , Principles of Engineering Economics with Applications, Cambridge University Press; 2nd edition 2018
4. Singh, Seema, Economics for Engineering Students, Second Edition. I.K. International Publishing House, Delhi, 2014.

D. Reference Books:

1. Panneer Selvam, Engineering Economics, Second Edition, New Delhi, PHI Learning Private Limited,2013.
2. Pravin Kumar, Fundamentals of Engineering Economics, New Delhi, John, and Wile y ,2012.
3. *Gupta , G.S. Managerial Economics, Joel Dean, Englewood Cliffs, N.J.*: *Prentice-*. Hall, 2011
4. Diwedi, D.N., Managerial Economics ,New Delhi, Pearson Education India,2012. 5. Varshney, S.C., Managerial Economics, New Delhi Sultan Chand & Sons, 2010

E. Course outcomes:

1. Learn the fundamentals of Engineering Economics.
2. Understand and use of Economic concepts in making business decision.
3. Use economic information to manage the organization.
4. Use economic tools with respect to acceptance or rejection of investment proposals.
5. Know the recent trends relating to economic environment.

Subject Code: CS-3106
Subject Name: System Software and administration Laboratory
Credit Point:3 **(**L=0, T=0, P=2)

A. Course Objectives:

The course is designed to meet the objectives of:

1. Working principle of Assemblers, Macro Processors, Loaders etc, different loaders and loading schemes,
2. Working principle and different configurations in unix based operating systems.
3. Process programming in unix based operating system.
4. Structure of file Systems in unix operating systems and Network File Systems, and process of system backup and recovery.

B. Course Content:

1. Study and installation of unix based operating system.
2. Study and practices of basic unix commands, shortcuts and pipelining, managing accounts, privileges given to different users, create groups, changes passwords etc
3. Introduction of Shell Programming with examples.
4. Study and practice of Linux assembly language programming using x86 assembly language programming.
5. Study and practice of NASM assembly language programming.
6. Implementation of Pass 1 and Pass 2 of aassembler.
7. Implementation of Macroprocessor
8. Implementation a Symbol Table With different functions.
9. Implementation of a Single Pass and two pass Macro Processor.
10. Study and configuration of NFS Configuration.
11. Study and practice of Process Identification, Creation and Kill using system call fork() & exec() function and Zombie processes.

C. Text Books:

1. Tanenbaum S. Andrew., & Austin Todd., Structured Computer Organization, Pearson, 2013.
2. Britton L. Robert., MIPS Assembly Language Programming, Pearson/Prentice Hall, 2004.
3. Beck L. L., System Software, (3rd Ed.), Pearson Education India, 1997.
4. Lamport L., LaTeX: A Document Preparation System, 2nd Ed, Addison-Wesley Series, 1994.

D. Reference Books:

1. Nithyashri J., System Software, Tata McGraw-Hill Education, 2010.
2. Chattopadhyay Shantanu., System Software, PHI Learning Pvt. Ltd., 2007.
3. Das S., Unix System V.4 Concepts and Applications, 3rd Ed., Tata Mcgraw-Hill, 2003.
4. Maxwell Steve., UNIX System Administration: A Beginner's Guide, McGraw Hill Professional, 2002.
5. Kauler B., Windows assembly language & Systems Programming: 16- and 32-Bit

Low- Level Programming for the PC and Windows, 2nd Ed., CMP Books, 1997.

E. Course Outcomes:

1. Know assembler, linker, loader, macro and their working principles.
2. Practice different general commands and pipelining used in unix commands.
3. Learn different types of loaders using programming languages.
4. Learn shell programming in unix based operating systems.
5. Configuration of different services in unix operating systems.

Subject Code: CS3107
Subject Name: Operating System Laboratory
Credit Point: 1 **(**L=0, T=0, P=2)

A. Course Objectives:

The course is designed to meet the objectives of:

1. Appreciating the role of an operating system.
2. Making aware of the issues in management of resources like processor, memory and input- output.
3. Selecting appropriate productivity enhancing tools or utilities for specific needs like filters or version control.
4. Obtaining some insight into the design of an operating system.

B. Course Content:

Basics of UNIX commands.
Shell programming.
Implementation of CPU scheduling. a) Round Robin b) SJF c) FCFS d) Priority.
Implement all file allocation strategies.
Implement Semaphores.
Implement File Organization Techniques.
Implement Bankers algorithm for Dead Lock Avoidance.
Implement an Algorithm for Dead Lock Detection.
Implement the all page replacement algorithms a) FIFO b) LRU c) LFU.
Implement Shared memory and IPC.
Implement Paging Technique f memory management.

C. Text Books:

1. Silberschatz A., Galvin P.B., Gagne G., Operating System Concepts, Wiley, 2014.

D. Reference Books:

1. Stallings W., Operating Systems: Internals and Design Principles, Pearson Education, 2018.

2. Anderson T., Dahlin M., Operating Systems: Principles and Practice, Recursive Books, 2015.
3. Milenkovie M., Operating System: Concept & Design, McGraw-Hill Education, 2001.

E. Course Outcomes:

After successfully completion of this module students will be able to:

1. Understands what are an operating system and the role it plays.
2. Get high level understanding of the structure of operating systems, applications, and the relationship between them.
3. Gather knowledge of the services provided by operating systems,
4. Get exposure to some details of major OS concepts.

Subject Code: CS-3108
Subject Name: Compiler Design Laboratory
Credit Point: 3 **(**L=0, T=0, P=2)

A. Course Objectives:

The course is designed to meet with the objectives of:

1. Providing a thorough introduction to the theory and practice of programming language translation.
2. Introducing to the design and implementation of programming language translators.

B. Course Content:

1. Programming assignments related to divide the given input program into lexemes, to compute FIRST, FOLLOW function.
2. Implementation of operator precedence parsing, recursive descent parsing, implementation of lexical analyzer using LEX tool.
3. Using LEX program to identify a simple and a compound statement.
4. Count the number of key words and identifiers in a sentence.
5. Convert an octal number into decimal number.
6. YACC program to check the validity of an arithmetic expression.
7. An assignment to design a small compiler.

C. Text Books:

1. Aho V. Alfred., Lam S. Monica., Sethi Ravi., Ullman D. Jeffrey., Compiler: Principles, Techniques and Tools, Pearson Education. 2007.
2. Holub I. Allen., Compiler Design in C, Prentice-Hall of India Pvt. Limited, 2006.

D. Reference Books:

1. Cooper Keith., Torczon Linda., Engineering a compiler, Elsevier, 2011.
2. Raghavan V., Principles of Compiler Design, McGraw Hill, 2010.

E. Course Outcomes:

Students successfully completing this module will be able to

1. Design lexical and syntax analyzer phases of complier.
2. Demonstrate the basic notions and techniques for programming language translation
3. Demonstrate the basic notions and techniques for intermediate code generation.
4. Generate and program a small compiler or interpreter.

6th Semester						
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	CS-3201	Computer Networking	3	0	0	3
2	CS-3202	Introduction to IoT	3	0	0	3
3	CS-3203	Computer Graphics	3	0	0	3
4	CS-320A	Database Management System	3	0	0	3
5	CS-321A	Machine Learning & Artificial Intelligence	3	0	0	3
6	YY-320X	**OE4**	3	0	0	3
7	CS-3204	Minor Project-II	0	0	4	2
8	CS-3205	Computer Networking Laboratory	0	0	2	1
9	CS-3206	Database Management Laboratory	0	0	2	1
10	CS-3207	Machine Learning & Artificial Intelligence Laboratory	0	0	2	1
Contact Hours			18	0	10	
Total Credits						23

Subject Code: CS - 3201
Subject Name: Computer Networking
Credit Point:3 **(**L=3, T=0, P=0)

A. Course Objectives:

1. Understanding the state-of-the-art in network protocols, architectures, and applications.
2. Examining and studying of different protocols in OSI and TCP/IP.
3. Understanding of network addressing, mapping etc.
4. Understanding error control flows control packet recovery etc.
5. Understanding the structure of LAN, WAN and MAN.
6. Understanding internetworking of devices.

B. Course Content:

Basic: Introduction to Networking and its origin, layered task, Protocol stack, OSI model, TCP/IP model and brief functionality.

Physical layer and media: Data, Signals, Transmission, Digital transmission- digital to digital conversion, Analog to digital conversion, bandwidth utilization and spread spectrum.

Circuit and Packet Switching:- Switched Networks, Circuit-Switching Networks, Switching Concepts, Routing in Circuit-Switched Networks, Control Signalling, Packet-Switching Principles, Routing, Congestion Control, X.25 282. , structure of a switch.

Data link layer: Error correction and Detection, Data link control- framing, flow and error control, Noise less channels- Simple Protocols, Stop and wait protocol, Noisy channel protocol- Stop and Wait ARQ, Go and Back N ARQ, Selective Repeat Automatic Repeat Request, HDLC-Configuration and Transfer mode, Multiple Access-Random Access, Control access, Channelization, Wired Network (IEEE 802.3), Wireless Network (IEEE 802.11), Virtual LAN, Virtual Circuit Networks-Frame relay and ATM LAN etc.

Network Layer: Logical Addressing, Internet Protocol (IP), Address mapping, Error reporting, and multicasting- ARP, RARP, BOOTP, DHCP, ICMP,IGMP , Network Address Translators (NAT) Network Delivery-Delivery, Forwarding and Routing, Unicast routing protocol- Intra & inter domain routing, RIP, OSPF, BGP

Transport layer: Process to Process delivery-Connection oriented and connectionless service, UDP, TCP, SCTP, error and flow controls, Congestion control and Quality of service- Open loop congestion control, Closed loop congestion control, Congestion control in TCP and in frame relay Quality of service-flow characteristics, flow cases, different techniques to improve QoS, RSVP.

Application layer: Name Space, Domain in Namespace, Distribution of name space, DNS- generic, country and inverse domain, Resolution: Resolver, Mapping name to Address, Mapping address to names, recursive resolution. Remote logging- telnet, Electronic mail-SMTP, POP, IMAP and file transfer- FTP architecture, commands of FTP. WWW and HTML-Architecture, web documents, HTTP, Web services. Uniform Resource Locators (URL) and Universal Resource Identifier (URI). Multimedia protocols- RTP,RTCP.

C. Text Books:

1. Stallings W. ― Data and Computer Communications, Tenth Edition, Pearson Prentice Hall, 2017.
2. Fourouzan B A., ―Data Communications and Networking, Fourth Edition, Tata McGraw-Hill Education, 2017.
3. Tanenbaum A S., ―Computer Networks, Sixth Edition, Pearson education, 2021.

D. Reference Books:

1. Kurose J F., Ross K W., Computer Networking – A Top-Down Approach Featuring the Internet, 3/e, Pearson Education India, 2005.

2. Keshav S., An Engineering Approach to Computer Networking: ATM Networks, The Internet, And The Telephone Network‖, Pearson education, 2002.
3. Halsall, Data Communication, ―Computer Networks and Open Systems, Pearson, 2003.
4. Stevens W R., Kevin R F., TCP/IP Illustrated, Volume 1, 2/e, Addison-Wesley.
5. Wright G R., Stevens W R., TCP/IP Illustrated, Volume 2, Addison-Wesley Professional, 1995.
6. Douglas C., Internetworking with TCP/IP: Principles, protocols, and architecture illustrated, Prentice Hall, 2006.
7. Halabi S., Internet Routing Architectures, Pearson Education India, 2008.
8. L. Peterson L L., and Davie B S., Computer Networks: A System Approach,5, revised, Elsevier, 2011.

E. Course Outcomes:

Students successfully completing this module will be able to:

1. Learn components and rules of communications.
2. Configuration and design of a small network.
3. Learn about research areas and future internets research fields.
4. Learn to configure NAT, DHCP, switch security, VLAN etc

Subject Code: CS - 3202
Subject Name: Introduction to Internet of Things (IoT)
Credit Point: 3 **(**L=3, T=0, P=0)

A. Course Objectives:

1. Introduce Internet of Things (IoT) and enabling technologies
2. Collecting sensor data and to perform further data analytics
3. Designing IoT devices to work with a Cloud Computing infrastructure
4. Define the infrastructure for supporting IoT deployments and transfer of IoT data to the cloud.

B. Course Content:

Introduction: Defining IoT, characteristics, physical and logical design, functional blocks, communication models, APIs, protocols, applications, IoT enabling technologies, IoT levels and deployment, domain specific IoTs in energy consumption monitoring, smart energy meters, home automation, smart grid and solar energy harvesting, intelligent parking, data lake services scenarios.

Sensors: Sensing components, sensor modules, nodes, wireless technologies for the IoT, edge connectivity.

Challenges in IoT: Design challenges, development challenges, security challenges, challenges of IoT data collection and management, other challenges.

IoT governance and future trends: IoT strategies, key components of IoT Governance, management strategies, implementing the IoT governance framework, IoT centre of excellence, IoT governance challenges related to future trends, industry 4.0, IIoT.

Connectivity: wireless sensor networks, M2M, difference between IoT and M2M, SDN and NFV for IoT, network function virtualization, need for IoT systems management, simple network management protocol, limitations of SNMP, network operator requirements, NETCONF, YANG, IOT Systems management with NETCONF-YANG

Analytics and applications: Descriptive, diagnostic, predictive and prescriptive analytics, real-time and local analytics, databases, cloud analytics and applications, Extract-Transform-Load (ETL), Combining IoT Data with Static Data.

C. Text Books:

1. Bahga A., Madisetti V., Internet of Things: A Hands-On Approach, Orient Blackswan Private Limited, 2015.
2. Kellmereit D., The Silent Intelligence: The Internet of Things. Lightning Source Inc., 2014.

D. Reference Books:

1. Misra S., Mukherjee A., Roy A., Introduction to IoT, Cambridge University Press, 2022.
2. Waher P., Learning Internet of Things, Packt Publishing, 2015.

E. Course Outcomes:

1. Understand the fundamental concepts and background of IoT and its applications.
2. Familiar with the basics of various sensors and actuators.
3. Understand where the IoT concept fits within the broader Information and Communication Technology industry and possible future trends.
4. Appreciate the role of big data, cloud computing and data analytics in a typical IoT system.
5. Apply the knowledge and skills acquired during the course to build and test a complete working IoT system involving prototyping, programming and data analysis.

Subject Code: CS-3203
Subject Name: Computer Graphics
Credit Point: 3 **(**L=3, T=0, P=0)

A. Course Objectives:

1. Introducing graphical techniques such as modelling, representation, illumination,

shadowing, rendering and texturing,

2. To learn two dimensional and three-dimensional computer graphics with comprehend advanced software tools of computer graphics.
3. To learn the basic graphics principles to use them in designing computer graphics programs.

B. Course Content:

Introduction to Computer Graphics & Graphics Systems: Overview of computer graphics, representing pictures; color models; storage tube graphics display, Raster scan display, printers etc.; Active & Passive graphics devices; Computer graphics software.

Scan conversion: Points & lines, Line drawing algorithms; DDA algorithm, Bresenham's line algorithm, Circle generation algorithm; Ellipse generating algorithm; scan line polygon, fill algorithm, boundary fill algorithm, flood fill algorithm.

2D Transformation & Viewing: Basic transformations: translation, rotation, scaling; Matrix representations & homogeneous coordinates, transformations between coordinate systems; reflection shear; Transformation of points, lines , parallel lines, intersecting lines; clipping operations, point clipping , line clipping, clipping circles , polygons & ellipse.

3DTransformation & Viewing: 3D transformations: translation, rotation, scaling & other transformations. Rotation about an arbitrary axis in space, reflection through an arbitrary plane; general parallel projection transformation; clipping, viewport clipping, 3Dviewing

Curves: Curve representation, surfaces, designs, Bezier curves, B-spline curves, end conditions for periodic B-spline curves, rational B-spline curves.

Hidden Surfaces: Depth comparison, Z-buffer algorithm, Back face detection, BSP tree method, the Printer's algorithm, scan-line algorithm; Hidden line elimination, wire frame methods, fractal - geometry.

C. Text Books:

1. Hearn, Baker ―Computer Graphics (C version 2nd Ed.) – Pearson education.
2. Foley, Vandam, Feiner, Hughes –―Computer Graphics principles (2nd Ed.) – Pearson Education.
3. Z. Xiang, R. Plastock ― Schaum's outlines Computer Graphics (2nd Ed.) – Tata McGraw Hill

D. Reference Books:

1. F. Rogers, J. A. Adams ― Mathematical Elements for Computer Graphics (2nd Ed.) – Tata McGraw Hill
2. Mukherjee Arup, Introduction to Computer Graphics, Vikas Hill, Computer Graphics using open GL, Pearson Education
3. W. M. Newman, R. F. Sproull ―Principles of Interactive computer Graphics‖ – Tata McGraw Hill.
4. Computer Graphics and Multimedia: Applications, Problems and solution by John DiMarco, Idea Group Publication.

5. Computer Graphics, Multimedia and Animation by Malay K. Pakhira, Prentice-Hall
6. Multimedia, Computer Graphics and Broadcasting, by Taihoonkim, HojjatAdeli

E. Course Outcomes:

1. Comprehend mathematical basics which are used in computer graphics and also learn how to use them in designing computer graphics programs.
2. Create graphics programming using OpenGL.
3. Describe basic graphics principles which are used in games, animations and film making.

Subject Code: CS-320A
Subject Name: Database Management Systems
Credit Point: 3 **(**L=3, T=0, P=0)

A. Course Objectives:

1. Introduction & Conceptual Modeling
2. Relational Model: Concepts, Constraints, Languages, Design and Programming
3. Database Design Theory and Methodology
4. Data Storage, Indexing, Query Processing and Physical Design
5. Transaction Processing Concepts
6. Database Security and Authorization

B. Course Content:

Introduction & Conceptual Modelling: Database and Database Users, Database System Concepts and Architecture, Data Modelling using ER Model, Enhanced ER Modelling.

Relational Model: Concepts, Constraints, Languages, Design and Programming: Relational Data Model and Relational Database Constraints, Relational Algebra and Relational Calculus, Relational Database Design by ER to & EER to Relational Mapping, SQL: Schema Definition, Basic Constraints, Queries, Assertions, Views and Programming Techniques.

Database Design Theory and Methodology: Functional Dependencies, Normalization, Relational Database Design Algorithms and Other Dependencies, Practical Database Design Methodology.

Data Storage, Indexing, Query Processing and Physical Design: Disk Storage, File Structures, Hashing, Indexing Structures for Files, Algorithms for Query Processing and Optimization, Practical Database Design and Tuning.

Transaction Processing Concepts: Transaction Processing Concepts and Theory, Concurrency Control Techniques, Database Recovery Techniques.

Database Security and Authorization: Database Security Issues, Discretionary Access Control, Mandatory and Role base Access Control, Statistical Database Security.

C. Text Books:

1. Avi Silberschatz, Henry F. Korth, S. Sudarshan, Database System Concepts, McGraw-Hill, 2020.
2. Ramez Elmasri, Shamkant B. Navathe, Fundamentals of DatabaseSystems, Pearson, 2020.
3. Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, McGraw-Hill, 2019.

D. Reference Books:

1. C.J.Date, An Introduction to Database Systems, Addison-Wesley ongman, 2014.
2. JeffreyD. Ullman, Principles of Database Systems, Galgotia Publication, 1994.
3. Wilfried Lemahieu, Seppe Vanden Broucke, Bart Baesens, Principles of Database Management, Cambridge University Press, 2020.

E. Course Outcomes:

1. Ability to understand user requirements and develop ER model
2. Ability to map ER model into Relational model
3. Ability to normalize Relational model
4. Ability to implement Relational model using DBMS software
5. Ability to understand Transactions, Recovery and Security of DBMS

Subject Code: CS-321A
Subject Name: Machine Learning & Artificial Intelligence
Credit Point: 3 **(**L=3, T=0, P=0)

A. Course Objectives:

1. This introductory course gives an overview of many concepts, techniques, and algorithms in machine learning.
2. The course will give the student the basic ideas and intuition behind modern machine learning methods.
3. Several software libraries and data sets publicly available will be used to illustrate the application of these algorithms.

B. Course Content:

Introduction to Machine Learning, linear classification, perceptron update rule, Perceptron convergence, generalization, Maximum margin classification, Classification errors, regularization. Features extraction techniques PCA, LDA etc.

Logistic regression, Linear regression, estimator bias and variance, active learning, Active learning, non-linear predictions, Kernel regression, kernel optimization, Model selection criteria, Description length, feature selection, expectation maximization.

Classification problems; decision boundaries; nearest neighbor methods, Probability and classification, Naive Bayes, Bayes' Rule and Naive Bayes Model, Hidden Markov models (HMMs), Bayesian networks, Learning Bayesian networks, Logistic regression, online gradient descent, neural network, support vector machine (SVM), kernel ridge regression.

Ensemble methods: Bagging, random forests, boosting, Unsupervised learning: clustering, k-means, hierarchical agglomeration.

C. Text Books:

1. Tom.M.Mitchell, "Machine Learning, McGraw Hill International Edition".
2. Rosasco. Introductory Machine Learning Notes.
3. Hastie, Tibshirani and Friedman. Elements of statistical learning.
4. Larry Wasserman. Clustering chapter

D. Reference Books:

1. Simon Haykin, Neural Networks and Learning Machines Third Edition, Pearson Publisher
2. Christopher M. Bishop, Pattern Recognition and Machine Learning (Information Science and Statistics), Springer, 2006
3. Pattern Classification. Richard Duda, Peter Hart and David Stock. Second Edition, Wiley-Interscience, 2000.
4. Machine Learning. Tom Mitchell. First Edition, McGraw-Hill, 1997.

E. Course Outcomes:

1. Develop an appreciation for what is involved in learning models from data.
2. Have an understanding of the strengths and weaknesses of many popular machine learning approaches.
3. Understand how to evaluate models generated from data.
4. Apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.

Subject Code: CS-3205
Subject Name: Computer Networking Laboratory
Credit Point:1 **(**L=0, T=0, P=2)

A. Course Objectives:

1. To understand the working principle of various communication protocols.

2. To understand the network simulator environment and visualize a network topology and observe its performance.
3. To analyze the traffic flow and the contents of protocol frames.

B. Course Content:

List of Experiments

1. Implement the data link layer framing methods such as character, character-stuffing and bit stuffing.
2. Write a program to compute CRC code for the polynomials CRC-12, CRC-16 and CRC CCIP
3. Develop a simple data link layer that performs the flow control using the sliding window
4. Study of different types of cross-wired cable and straight through cable.
5. Study of Basic network commands and network configuration commands.
6. Socket programming using Java or C programming language.
7. protocol, and loss recovery using the Go-Back-N mechanism.
8. Implement Dijsktra's algorithm to compute the shortest path through a network
9. Take an example subnet of hosts and obtain a broadcast tree for the subnet.
10. Implement distance vector routing algorithm for obtaining routing tables at each node.
11. Implement data encryption and data decryption
12. Write a program for congestion control using Leaky bucket algorithm.
13. Write a program for frame sorting technique used in buffers.
14. Wireshark
    i). Packet Capture Using Wire shark
    ii). Starting Wire shark
    iii). Viewing Captured Traffic
    iv). Analysis and Statistics & Filters.
16. How to run Nmap scan
17. Operating System Detection using Nmap
18. Do the following using NS2 Simulator
    i). NS2 Simulator-Introduction
    ii). Simulate to Find the Number of Packets Dropped
    iii). Simulate to Find the Number of Packets Dropped by TCP/UDP
    iv). Simulate to Find the Number of Packets Dropped due to Congestion
    v). Simulate to Compare Data Rate& Throughput.
    vi). Simulate to Plot Congestion for Different Source/Destination
    vii). Simulate to Determine the Performance with respect to Transmission of Packets

C. Text Books:

1. Stallings W. ― Data and Computer Communications, Tenth Edition, Pearson Prentice Hall, 2017.
2. Fourouzan B A., ―Data Communications and Networking, Fourth Edition, Tata McGraw-Hill Education, 2017.
3. Tanenbaum A S., ―Computer Networks, Sixth Edition, Pearson education, 2021.

D. Reference Books:

1. Gosling J., Joy B., Steele G L., Bracha G., The Java Language Specification, 2/e, Addison-Wesley, 2000.
2. Stroustrup B., The C++ Programming Language, 3/e, Addison-Wesley Longman ReadingMA,1997.
3. Lippman S B., C++ Primer, 2/e, Addison-Wesley,1991.
4. Budd T., C++ for Java Programmers, Addison Wesley,1999.
5. Daconta M C., Java for C/C++ programmers, John Wiley & Sons,1996.

E. Course Outcomes:

1. Implement data link layer farming methods.
2. Analyze error detection and error correction codes.
3. Implement and analyze routing and congestion issues in network design.
4. Implement Encoding and Decoding techniques used in presentation layer.
5. To be able to work with different network tools.

Subject Code: CS-3206
Subject Name: Database Management Systems Laboratory
Credit Point: 1 **(**L=0, T=0, P=2)

A. Course Objectives:

1. Create and use a database.
2. SQL: DDL, DML & DCL commands.
3. Advanced SQL queries.
4. Development of DBMS applications.

B. Course Content:

1. Data Definition Language (DDL) commands in RDBMS.
2. Data Manipulation Language (DML) and Data Control Language (DCL) commands in RDBMS.
3. High-level language extension with Cursors.
4. High level language extension with Triggers
5. Procedures and Functions.
6. Embedded SQL.
7. Database design using E-R model and Normalization.
8. Design and implementation of Payroll Processing System.
9. Design and implementation of Banking System.
10. Design and implementation of Library Information System.

C. Text Books:

1. Bob Bryla & Kevin Loney, Oracle Database 12C The Complete Reference, Oracle Press, 2020.
2. Steven Feuerstein &Bill Pribyl, ORACLE PL/SQL Programming, Shroff/O'Reilly, 2020.

D. Reference Books:

1. Oracle Database A Complete Guide, Oracle Press, 2021.

E. Course Outcomes:

1. Design database schema for a given application and apply normalization
2. Acquire skills in using SQL commands for data definition and data manipulation.
3. Develop solutions for database applications using procedures, cursors and triggers

Subject Code: CS-3207
Subject Name: Machine Learning & Artificial Intelligence Laboratory
Credit Point: 1 **(**L=0, T=0, P=2)

A. Course Objectives:

1. To develop skills of using recent machine learning software for solving practical problems.
2. To introduce students to the basic concepts and techniques of Machine Learning.
3. Make use of Data sets in implementing the machine learning algorithms

B. Course Content:

- Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
- Build an Artificial Neural Network by implementing the Back propagation Algorithm and test the same using appropriate data sets.
- Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
- Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Python ML library.
- Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two

algorithms and comment on the quality of clustering.

- Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions.
- Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.
- Implement Support Vector Machine to classify the breast cancer images.

C. Text Books:

- Tom.M.Mitchell, "Machine Learning, McGraw Hill International Edition".
- Rosasco. Introductory Machine Learning Notes.
- Hastie, Tibshirani and Friedman. Elements of statistical learning.
- Larry Wasserman. Clustering chapter

D. Reference Books:

1. Simon Haykin, Neural Networks and Learning Machines Third Edition, Pearson Publisher
2. Christopher M. Bishop, Pattern Recognition and Machine Learning (Information Science and Statistics), Springer, 2006
3. Pattern Classification. Richard Duda, Peter Hart and David Stock. Second Edition, Wiley-Interscience, 2000.
4. Machine Learning. Tom Mitchell. First Edition, McGraw-Hill, 1997.

E. Course Outcomes:

1. Understand the mathematical and statistical prospective of machine learning algorithms through python programming.
2. Design and evaluate the unsupervised models through python/Matlab in built functions.
3. Evaluate the machine learning models pre-processed through various feature engineering algorithms by python programming/Matlab.

7th Semester						
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	CS-4101	Product Design and Development	1	0	4	3
2	CS-410A	Cryptography and Network Security	3	0	0	3
3	CS-411A	Data Mining & Warehousing	3	0	0	3
4	CS-412A	Internet and Web Technology	3	0	0	3
5	YY-410X	**OE5**	3	0	0	3
6	CS-4101	Internship-II	0	0	0	1
7	CS-4102	Major Project-I	0	0	8	4
Contact Hours			13	0	12	
Total Credits						20

Subject Code: CS-4101
Subject Name: Product Design and Development
Credit Point: 3 **(**L=3, T=0, P=0)

A. Course Objectives:

1. To give students broad but comprehensive theoretical analysis, ideas & practical design & implementation of useful computer systems.
2. To impart the essential knowledge of computer system, microcontroller and web design with the fine arts & analysis to enhance hands on experience & to encourage innovations.

B. Course Content:

System analysis: Requirement analysis, Scope definition, Logical Design, Business Analysis, Accident Analysis, Problem analysis, Decision analysis, policy analysis. Different tools to represent in creative system design

Product Design: Physical design, Logical design, Alternative Design analysis: Rapid Application development (RAD), Joint application design (JAD), System Development Life cycle (SDLC).

Product Development: Embedded Product design with backend Android / Raspberry Pi and frontend Android based integrated App design & development, Hardware-software co-design.

C. Text Books:

1. Vahid, F., & Givargis, T. D. (2001). Embedded system design: a unified hardware/software introduction. John Wiley & Sons.
2. Krajewski, M. (2019). Hands-On High Performance Programming with Qt 5: Build cross-platform applications using concurrency, parallel programming, and memory management. Packt Publishing Ltd.

D. Reference Books:

NIL

E. Course Outcomes:

1. Take up innovative project for designing computer systems of varied nature.
2. Learn system analysis, system design etc.
3. Ability to perform independent research and analysis

Subject Code: CS-410A/ CS-411X (Open Elective)
Subject Name: Cryptography and Network Security
Credit Point: 3 **(**L=3, T=0, P=0)

A. Course Objectives:

1. Understanding the state-of-the-art of cryptography and their security goals.
2. Examining and studying of different cryptographic methods for achieving confidentiality of date.
3. Examining and studying of different cryptographic methods for achieving integrity of date.
4. Understanding message authentication and hash function
5. Understanding the various protocol in network security.

B. Course Content:

Introduction of Information Security: Cryptography, Conventional Encryption, Traditional technique: Substitution cipher, Transmission cipher, Stream Cipher, Block Cipher, Roaster Machine.

Modern Symmetric Techniques, Mathematics of symmetric key cryptography, Cryptanalysis of classical ciphers, General Attacks, Secret and Private Key Cryptography, DES, Modes of operation of DES, Automatic Variable Key, Proof of DES, Merits and Demerits of DES, Quantification of Performance, TDES, Advanced Encryption Standard/AES, Comparison of Secret Key Systems, Modes of operation of AES Limitations of AES, Limitation of Secret or Private Key Crypto systems. Asymmetric key cryptography: Mathematics of Asymmetric key cryptography, Public Key Cryptography RSA Algorithm, Limitations of RSA Algorithm, Comparison of RSA and TRAP DOOR Public Key Crypto systems, Rabin Cryptosystem, ElGamal Cryptosystem, Elliptic Curve Cryptosystems.

Key management: Key Transport Protocols, Needham Schroeder Protocol, Key Agreement Protocol, Diffie -Hellman Protocol, Station to Station Protocol, Merkless Puzzle Technique of key agreement, Public Key Distribution, Message integrity and message authentication, Cryptography hash function, Digital Signature, Entity Authentication.

Networks security: Application Layer: PGP and S/MIME, Transport Layer: SSL and TLS, Network Layer: IPSec.

C. Text Books:

1. Kahate A., Cryptography and Network Security, Third Edition, Tata McGraw-Hill Education, 2013.
2. Forouzan B A., Mukhopadhyay D., Cryptography and Network Security, Third Edition, Tata McGraw-Hill Education, 2015
3. Stallings W., Cryptography and Network Security, Fifth Edition, Principle and Practice, Pearson Education India, 2011

D. Reference Books:

1. Erschloe M., Information Warfare: How to Survive Cyber Attacks, Osborne/McGraw-Hill, 2001.
2. Hatch B., Lee J., Kurtz G., Hacking Exposed: Linux: Linux Security Secrets and Solutions, Osborne McGraw-Hill, 1983.
3. Kenneth R V W., Richard F., Incident Response‖, O'Reilly, 2001.
4. Mandia K., Prosise C, Incident Response: Investigating Computer Crime, Osborne/McGraw-Hill, 2001.
5. Schiffman M., Hacker's Challenge, McGraw Hill Professional, 2002.
6. Allen J., The CERT Guide to System and Network Security Practices Addison-Wesley, 2001.
7. Smith R E. Authentication: From Passwords to Public Keys, Addison-Wesley, 2002.
8. McClure S., Shah S., Shah S., Web Hacking: Attacks and Defence, Addison-Wesley Professional, 2003.
9. Shema M., Johnson B C., Jones K J., Anti Hacker Tool Kit: Key Security Tools and Configuration Techniques‖, San Val, Incorporated, 2002.

E. Course Outcomes:

1. Identify and classify particular examples of attacks.
2. Identify physical points of vulnerability in simple networks.
3. Compare and contrast symmetric and asymmetric encryption systems and their vulnerability to attack, and explain the characteristics of hybrid systems.
4. Describe the use of hash functions and explain the characteristics of one-way and collision- free functions.
5. Role of third-party agents in the provision of authentication services.

Subject Code: CS-411A/ CS-410X (Open Elective)
Subject Name: Data Mining & Warehousing
Credit Point: 3 **(**L=3, T=0, P=0)

A. Course Objectives:

1. Classical models and algorithms in data warehousing and data mining,
2. Analysis of data, problem identification and application of appropriate models and algorithms.
3. Analysis of strengths and weaknesses of various methods and algorithms.

B. Course Content:

Data Warehousing: Data warehousing Components –Building a Data warehouse –- Mapping the Data Warehouse to a Multiprocessor Architecture – DBMS Schemas for Decision Support –Data Extraction, Cleanup, and Transformation Tools –Metadata.
Business Analysis: Reporting and Query tools and Applications – Tool Categories – The Need for Applications – Cognos Impromptu – Online Analytical Processing (OLAP) – Need –Multidimensional DataModel–OLAPGuidelines– MultidimensionalversusMultirelationalOLAP–CategoriesofTools– OLAP Tools and the Internet.**DataMining:**Introduction–Data–TypesofData–DataMiningFunctionalities– Interestingness of Patterns – Classification of Data Mining Systems – Data Mining Task Primitives –Integration of a Data Mining System with a Data Warehouse – Issues –Data Pre-processing. **Association Rule Mining and Classification:** Mining Frequent Patterns, Associations and Correlations–MiningMethods– MiningVariousKindsofAssociationRules–CorrelationAnalysis–Constraint Based Association Mining – Classification and Prediction - Basic Concepts - Decision Tree Induction – Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods –Prediction **Clustering and Applications and Trends in Data Mining:** Cluster Analysis - Types of Data – Categorization of Major Clustering Methods – K-means – Partitioning Methods – Hierarchical Methods - Density-Based Methods –Grid Based Methods – Model-Based Clustering Methods – Clustering High Dimensional Data - Constraint – Based Cluster Analysis – Outlier Analysis – Data Mining Applications.

C. Text Books:

1. Matteo Golfarelli, Steffano Rizzi, Data Warehouse Design: Modern Principles and Methodologies, McGraw-Hill, 2009.
2. Paulraj Ponniah,Data Warehousing Fundamentals, John Wiley & Sons, 2006.
3. Ralph Kimball, Margy Ross, Warren Thornthwaite, Joy Mundy, Bob Becker,The Data Warehouse Lifecycle Toolkit, John Wiley & Sons, 2008.
4. Jiawei Han and Micheline Kamber, Data Mining Concepts and Techniques, Elsevier, 2007.

D. Reference Books:

1. Ralph Kimball & Margy Ross, The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling, 3rd Edition, John Wiley & Sons, 2013.

2. David Hand, Heikki Mannila, Padhraic Smyth, Principles of Data Mining, MIT Press, 2001.

E. Course Outcomes:

1. Learn implementation of classical algorithms in data mining and data warehousing,
2. Learn to identify the application area of algorithms, and apply them,
3. Learn clustering application and resent works in data mining.

Subject Code: CS-412A
Subject Name: Internet and Web Technology
Credit Point: 2 **(**L=0, T=0, P=4)

A. Course Objectives:

The course is designed to meet the objectives of:

1. To complete an in-depth knowledge of web technology.
2. To know and to have the idea for different web application that most web developers are likely to use.
3. To be aware of, and to have used, the enhancements of the web applications.
4. To know the different types of web application software.

B. Course Content:

- Experimental study of application protocols such as HTTP, FTP, SMTP, using network packet sniffers and an alyzers such as Ethereal. Small exercises in socket programming in C/C++/Java.
- Experiments with packet sniffers to study the TCP protocol. Using OS (net stat, etc) tools to understand TCP protocol FSM, retransmission timer behaviour congestion control behavior.
- Introduction to ns2 (network simulator) - small simulation exercises to study TCP behaviour under different scenarios.
- Setting up a small IP network - configure interfaces, IP addresses and routing protocols to set up a small IP network. Study dynamic behaviour using packet sniffers.
- Experiments with in 2 to study behaviour (especially performance of) link layer protocols such as Ethernet and 802.11 wireless LAN.
- Practical on Server Configuration Example, Web Server, Mail Server, FTP Server etc.
- Practice on Cisco Packet Tracer simulator.
- Basic use of HTML tag, linking image table, frame, form design.
- DHTML- inline styles, creating style sheets with the style element, linking external style sheet, positioning elements, user style sheet.
- Creating even than dlerthat responds to mouse and key board event:
- Onload, on mouseover, on mouse out, on focus, on blur, on submit, on result, onclick, on change.
- Structuring data with xml, xml parser, extensible style language (xsl); customising mark up language.

- Configuring apache-tomcat server. 6. Building simple jsp: Declaring variables and methods in jsp, inserting java expression in jsp, processing request from user, generating a dynamic response for the user. Accessing database from jsp, inserting applet into jsp

C. Text Books:

1. Xavier C., Web Technology and Design 1st Edition, New Age Publication, 2003.
2. Allamaraju S., Professional Java server programming: J2EE Edition, Wrox Press, 2000.
3. Bates C., Web Programming Building Internet Applications, 2nd Edition, WILEY Dreamtech.

D. Reference Books:

1. Dietel M. H., Internet and World Wide Web - How to program, PHI/Pearson Education Asia, 2007.
2. Bergsten H., Java Server Pages, SPD O 'Reilly, 2003.
3. Naughton P., and Schildt H., The complete Reference Java 2 Fifth Edition, McGraw-Hill Education, 2002.

E. Course Outcomes:

1. Develop client/server applications
2. Update and retrieve the data from the databases using SQL
3. Develop server side programs in the form of servlets

8th Semester						
Sl No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	CS-420*	Elective-I (Swayam/ NPTEL)	3	0	0	3
2	CS-421*	Elective-II (Swayam/ NPTEL)	3	0	0	3
3	CS-4201	Major Project-II	0	0	22	11
Contact Hours			6	0	22	
Total Credits						17

List of Elective Subjects

Sl No	ELECTIVE	Subject Code (*)	Course Title
1	I	CS-420A	Introduction to Speech Processing
		CS-420B	Introduction to Blockchain Technology
		CS-420C	Pattern Recognition and Image Processing
		CS-420D	Data Compression
		CS-420E	Software Project Management

		CS-420F	Real Time Operating System
2	II	CS-421A CS-421B CS-421C CS-421D CS-421E CS-421F	Natural Language Processing (NLP) Soft Computing Virtualization and Cloud Computing Distributed Operating System Advanced Java Programming Parallel Algorithm

Subject Code: Introduction to Speech Processing
Subject Name: CS-420A
Credit Point: 3 **(**L=3, T=0, P=0)

A. Course Objectives:

1. To understand the speech production mechanism and the various speech analysis techniques and speech models
2. To understand the speech compression techniques
3. To understand the speech recognition techniques
4. To know the speaker recognition and text to speech synthesis techniques

B. Course Content:

SPEECH SIGNAL CHARACTERISTICS & ANALYSIS: Speech production process, speech sounds and features, Phonetic Representation of Speech, representing speech in time and frequency domains, Short-Time Analysis of Speech, Short- Time Energy and Zero-Crossing Rate, Short-Time Autocorrelation Function, Short-Time Fourier Transform (STFT), Speech Spectrum, Cepstrum, Mel-Frequency Cepstrum Coefficients, Hearing and Auditory Perception, Perception of Loudness, Critical Bands, Pitch Perception. **SPEECH COMPRESSION:** Sampling and Quantization of Speech (PCM), Adaptive differential PCM, Delta Modulation, Vector Quantization, Linear predictive coding (LPC), Code excited Linear predictive Coding (CELP). **SPEECH RECOGNITION:** LPC for speech recognition- Hidden Markov Model (HMM)-training procedure for HMM, sub-word unit model based on HMM, language models for large vocabulary speech recognition, Overall recognition system based on sub-word units, Context dependent sub-word units, Semantic post processor for speech recognition. **SPEAKER RECOGNITION:** Acoustic parameters for speaker verification, Feature space for speaker recognition-similarity measures, Text dependent speaker verification-Text independent speaker verification techniques. **SPEAKER RECOGNITION AND TEXT TO SPEECH SYNTHESIS:** Text to speech synthesis (TTS), Concatenative and waveform synthesis methods, sub-word units for TTS, intelligibility and naturalness-role of prosody

C. Text Books:

1. Lawrence R. Rabiner and Ronald W. Schafer, Digital Processing of Speech Signals, Pearson, 2004.
2. Lawrence Rabiner, Biing-Hwang Juang, B. Yegnanarayana, Fundamentals of Speech Recognition, Pearson, 2009.
3. Xuedong Huang, Alex Acero, Hsiao-wuen Hon, Spoken Language Processing: A guide to Theory, Algorithm, and System Development, Prentice Hall PTR, 2001.

D. Reference Books:

1. John R. Deller, Jr., John H. L. Hansen, John G. Proakis, Discrete Time Processing of Speech Signals, Wiley-IEEE Press, 2000.
2. Lawrence R. Rabiner and Ronald W. Schafer, Theory and Applications of Digital Speech Processing, Pearson, 2010.

E. Program Outcomes:

1. Design speech compression techniques
2. Configure speech recognition techniques
3. Design speaker recognition systems
4. Design text to speech synthesis systems

Subject Code: CS 420B
Subject Name: Introduction to Blockchain Technology
Credit Point: 3 **(**L=3, T=0, P=0)

A. Course Objectives:

1. To assess blockchain applications in a structured manner.
2. To impart knowledge in block chain techniques and able to present the concepts clearly and structured.
3. To get familiarity with future currencies and to create own crypto token.

B. Course Content:

Basics: Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. Cryptography: Hash function, Digital Signature-ECDSA, Memory Hard Algorithm, Zero Knowledge Proof

Blockchain: Introduction, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public blockchain.

Distributed Consensus: Nakamoto consensus, Proof of Work, Proof of Stake, Proof of

Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate.

Cryptocurrency: History, Distributed Ledger, Bitcoin protocols-Mining strategy and rewards, Ethereum-Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin.

Cryptocurrency Regulation: Stakeholders, Roots of Bitcoin, Legal Aspects-Cryptocurrency Exchange, Black Market and Global Economy.

Applications: Internet of Things, Medical Record Management System, Domain Name Service and future of Blockchain.

C. Text Books:

1. Thompson J., Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming, Create Space Independent Publishing Platform, 2017.
2. Narayanan A., Bonneau J., Felten E., Miller A., Goldfeder S., Bit coin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press, 2016.

D. Reference Books:

1. Wood G., ETHEREUM: A Secure Decentralized Transaction Ledger, Yellow paper, 2014.

E. Course Outcomes:

1. Understand the various technologies and its business use.
2. Analyse the block chain applications in a structure manner.
3. Explain the modern concepts of block chain technology systematically.
4. Handle the cryptocurrency.
5. Understand the modern currencies and its market usage

Subject Code: CS – 420C
Subject Name: Pattern Recognition and Image Processing
Credit Point: 3 **(**L=3, T=0, P=0)

A. Course Objectives:

1. Understand different clustering techniques and general understanding of the fundamentals of digital image processing
2. Introduce the student to analytical tools which are currently used in digital image processing as applied to image information for human viewing
3. Develop the students ability to apply these tools in the laboratory in image restoration, enhancement and compression
4. Understand differences between computer vision and image processing,

5. Know the basic components of an image processing system.

B. Course Content:

Basic Concepts: Pattern Recognition Systems, Fundamental Problems in pattern recognition system design, Design concepts and Methodologies, Character recognition, Speech recognition, Finger print Recognition — Pattern Recognition Model.
Decision Functions: Linear Decision functions Distance functions. Minimum distance classification, clustering concepts, Cluster seeking algorithms, Maximum distance, K-means Algorithms.

Bayes classified: decision function For Bayes classifier Bayes Classifier for normal patterns. Trainable pattern classifiers deterministic approach, perception approach reward punishment concept. **Gradient approach**: Gradient Descent algorithms LMSE Algorithms Multi category classification.

Trainable pattern classifiers: statistical approach stochastic approximation methods, Robbin Minro algorithms increment correction algorithms, LMSE algorithms. Syntactic patter recognition formulation syntax directed recognition picture descript.
Digital Image fundamentals: Representation, elements image transforms Fast Fourier transform, DCT and DWT.

Image enhancement: Spatial domain - frequency domain methods Histogram, Modification techniques Image Smoothing, image sharpening.
Image encoding: Fidelity criteria, Encoding process, Mapping Quantizer coder Image Segmentation Masks Point detection Line Detection Edge Detection.

C. Text Books:

1. Gonzalez R C., Woods R E., Wesley A., Digital Image Processing, Third Edition, Pearson, 2008.
2. Tou J T., Gonzalez R C., Pattern Recognition Principles, Addison Wesley, 1976.
3. Jain A K., Fundamentals of Digital Image Processing, PHI Pearson Education

D. Reference Books:

1. Luo D., Pattern Recognition and Image Processing, Horwood, 1998
2. Leondes C T., Image Processing and Pattern Recognition, Elsevier
3. Shih F Y., Image Processing and Pattern Recognition: Fundamentals and Techniques, John Wiley & Sons
4. James C B., Keller J., Krisnapuram R., Pal N R., Fuzzy Models and Algorithms for Pattern Recognition and Image Processing, Springer
5. Ghosh A., Pal S K., Soft Computing Approach to Pattern Recognition and Image Processing, World Scientific Publishing Co. Pte. Ltd.
6. Shen J., Wang P S., Zhang T., Multispectral Image Processing and Patternn Recognition, World Scientific Publishing Co. Pte. Ltd.
7. Young T Y., Handbook of pattern recognition and image processing‖, Academic Press, 1994.

E. Course Outcomes:

1. Understand the basics of the human visual system as they relate to image processing; including spatial frequency resolution and brightness adaption
2. Understand how images are represented; including optical images, analog images, and digital images
3. Understand image types such as binary images, gray-scale images, color and multi-spectral images
4. Know the key concepts in image file formats and understand the model for an image analysis process
5. Understand why pre-processing is performed and know about image geometry, convolution masks, image algebra and basic spatial filters

Subject Code: CS – 420D
Subject Name: Data Compression
Credit Point: 3 (L=3, T=0, P=0)

A. Course Objectives:

1. Introduce the fundamentals concepts of Data Compression,
2. Equip students with the knowledge and skills of coding Theory,
3. Explore the different paradigms of image and data compression.

B. Course Content:

Introduction: Compression Techniques: Loss less compression, Lossy Compression, Measures of performance, Modeling and coding, Mathematical Preliminaries for Lossless compression: A brief introduction to information theory, Models: Physical models, Probability models, Markov models, composite source model, Coding: uniquely decodable codes, Prefix codes.

Huffman coding: The Huffman coding algorithm: Minimum variance Huffman codes, Adaptive Huffman coding: Update procedure, Encoding procedure, Decoding procedure. Golomb codes, Rice codes, Tunstall codes, Applications of Hoffman coding: Loss less image compression, Text compression, Audio Compression.

Arithmetic Coding: Coding a sequence, Generating a binary code, Comparison of Binary and Huffman coding, Applications: Bi-level image compression-The
JBIG standard, JBIG2, Image compression. Dictionary Techniques: Introduction, Static Dictionary: Diagram Coding, Adaptive Dictionary. The LZ77 Approach, The LZ78 Approach, Applications: File Compression-UNIX compress, Image Compression: The Graphics Interchange Format (GIF), Compression over Modems: V.42 bits, Predictive Coding: Prediction with Partial match (ppm): The basic algorithm, The ESCAPE SYMBOL, length of context, The Exclusion Principle, The Burrows-Wheeler Transform: Move-to-front coding, CALIC, JPEG-LS, Multi- resolution Approaches, Facsimile Encoding, Dynamic Markoy Compression.

Mathematical Preliminaries for Lossy: Coding Distortion criteria, Models, Scalar Quantization: The Quantization problem, Uniform Quantizer, Adaptive Quantization, Non uniform Quantization. **Vector Quantization:** Advantages of Vector Quantization over Scalar Quantization, The Linde-Buzo-Gray Algorithm, Tree Structured Vector Quantizers. Structured Vector Quantizers.

C. Text Books:

1. Sayood K., Introduction to Data Compression, Elsevier Science, 2012
2. Ida M. P. , Fundamental Data Compression, Butterworth-Heinemann, 2005
3. Adam D., Elements of Data Compression, Brooks/Cole-Thomson Learning, 2002

D. Reference Books:

1. David S., Variable-length Codes for Data Compression, Springer, 2007
2. Sayood K, Lossless Compression Handbook, Academic Press, 2002
3. Source Wikipedia, LLC Books, ―Compression Algorithms: Lossless Compression Algorithms, Lossy Compression Algorithms, Huffman Coding, Lossless Data Compression, Jpeg, General Books, 2010
4. Kamisetty R R, Pat Y, The Transform and Data Compression Handbook, CRC Press, 2010
5. Peter D. S, Video compression: fundamental compression techniques and an overview of the JPEG and MPEG compression systems‖, McGraw-Hill, 1998

E. Program Outcomes:

1. Learn Lossy, Lossless compression.
2. Learn Transformation for compression like DCT, DFT, vector transformation.
3. Learn JPEG compression techniques.
4. Learn Video, audio compression etc.

Subject Code: CS – 420E
Subject Name: Software Project Management
Credit Point: 3 **(**L=3, T=0, P=0)

A. Course Objectives:

1. Deliver successful software projects that support organization's strategic goals,
2. Match organizational needs to the most effective software development model,
3. Plan and manage projects at each stage of the software development life cycle (SDLC),
4. Create project plans that address real-world management challenges,
5. Develop the skills for tracking and controlling software deliverables.

B. Course Content:

Fundamentals: Conventional Software Management – Evolution of Software Economics

– Improving Software Economics – Conventional versus Modern Software Project Management.

Software Management Process Framework: Lifecycle Phases – Artifacts of the Process – Model Based Software Architectures – Workflows of the Process – Checkpoints of the Process.

Software Management Disciplines: Iterative Process Planning – Organization and Responsibilities – Process Automation – Process Control and Process Instrumentation – Tailoring the Process.

Managed And Optimized Process: Data Gathering and Analysis – Principles of Data Gathering – Data Gathering Process – Software Measures – Data Analysis – Managing Software Quality – Defect Prevention. Case Studies: COCOMO Cost Estimation Model – Change Metrics – CCPDS– R.

C. Text Books:

1. Walker R, Software Project Management A Unified Framework, Pearson Education,2004
2. Humphrey W, Managing the software process, Addison Wesley, 1989. (Unit IV)
3. Ramesh G, Managing Global Projects, Tata McGraw Hill, 2001.
4. Bob H, Mike C, Software Project Management, 3rd Edition, Tata McGraw Hill, 2004.

D. Reference Books:

1. Robert T. F, Donald F. S, Linda S, Quality Software Project Management, Prentice Hall Professional, 2002
2. Robert B K, Software Project Management: Measures for Improving Performance, Management Concepts, 2006
3. Kelkar S. A, Software project management: a concise study, PHI Learning Pvt. Ltd., 2012

E. Program Outcomes:

1. Understand various aspects of project management,
2. Work in software project management projects,
3. Understand requirements of a project plan,
4. Group of tasks performed in a definable time period in order to meet a specific set of objectives.

Subject Code: CS – 420F
Subject Name: Real Time Operating System
Credit Point: 3 **(**L=3, T=0, P=0)

A. Course Objectives:

The course is designed to meet the objectives of:

1. Participant with basics of real-time operating systems
2. Give the participant knowledge and skills necessary to develop software for embedded

computer systems using a real-time operating system.

B. Course Content:

Introduction to Operating System: Computer Hardware Organization, BIOS and Boot Process, Multi-threading concepts, Processes, Threads, Scheduling.

Basics of real-time concepts: Terminology: RTOS concepts and definitions, real-time design issues, examples, Hardware Considerations: logic states, CPU, memory, I/O, Architectures, RTOS building blocks, Real-Time Kernel

Process Management: Concepts, scheduling, IPC, RPC, CPU Scheduling, scheduling criteria, scheduling algorithms
Threads: Multi-threading models, threading issues, thread libraries

Mutex: creating, deleting, prioritizing mutex, mutex internals **Inter-process communication:** buffers, mailboxes, queues, semaphores, deadlock, priority inversion, Pipes

Memory Management: process stack management, run-time buffer size, swapping, overlays, block/page management, replacement algorithms, real-time garbage collection
Kernel Design Issues: structure, process states, data structures, inter-task communication mechanism, Linux Scheduling

C. Text Books:

1. Hermann K, Real-Time Systems: Design Principles for Distributed Embedded Applications, Springer Science & Business Media, 2011.
2. Philips A. L, Real-Time System Design and Analysis, John Wiley & Sons, 2004.
3. Doug A, Linux for Embedded and Real-Time Applications, Newnes, 2012.
4. Albert M. K, Cheng, Real-Time Systems: Scheduling, Analysis, and Verification, John Wiley & Sons, 2003.

D. Reference Books:

1. Francis C, Joëlle D, Claude K, Zoubir M, Scheduling in Real-Time Systems, John Wiley & Sons, 2002.
2. Joseph M, Real-Time Systems Specification, Verification and Analysis. Prentice Hall, 1996.
3. Krishna C. M., Shin K. G, Real-Time Systems, McGraw-Hill, 1997.
4. Labrosse J. J., Micro C O S The Real Time Kernel, Newnes, 2002.

E. Program Outcomes:

1. Evaluate the nature of real-time systems in appropriate terminology.
2. Critically evaluate the real-time characteristics of a system to assist in deciding which software or kernel is appropriate for a problem.
3. Interpret and compare the design of a real-time system in a range of formats.
4. Evaluate advanced real-time system areas, including scheduling and distributed.

5. Formulate judgements and synthesise conclusions following completion of research into a real- time system topic.

Subject Code: Natural Language Processing
Subject Name: CS-421A
Credit Point: 3 **(**L=3, T=0, P=0)

A. Course Objectives:

1. To learn the fundamentals of natural language processing
2. To understand the use of CFG and PCFG in NLP
3. To understand the role of semantics of sentences and pragmatics
4. To apply the NLP techniques to IR applications

B. Course Content:

INTRODUCTION: Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM - Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance **WORD LEVEL ANALYSIS:** Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models. **SYNTACTIC ANALYSIS:** Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing – Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs - Feature structures, Unification of feature structures. **SEMANTICS AND PRAGMATICS:** Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods. **DISCOURSE ANALYSIS AND LEXICAL RESOURCES:** Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC).

C. Text Books:

1. Daniel Jurafsky & James H. Martin, Speech and Language Processing, Pearson, 2014.
2. Jacob Eisenstein, Introduction to Natural Language Processing, MIT Press, 2019.

D. Reference Books:

1. Christopher D. Manning and Hinrich Schütze. Foundations of Statistical Natural Language Processing. MIT Press, 1999.
2. Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, Harshit Surana. Practical Natural Language Processing. O'Reilly. 2020.
3. Steven Bird, Ewan Klein and Edward Loper, Natural Language Processing with Python, O_Reilly Media, 2009.

E. Program Outcomes:

1. To tag a given text with basic Language features
2. To design an innovative application using NLP components
3. To implement a rule-based system to tackle morphology/syntax of a language
4. To design a tag set to be used for statistical processing for real-time applications
5. To compare and contrast the use of different statistical approaches for different types of NLP applications.

Subject Code: CS – 421B
Subject Name: Soft Computing
Credit Point: 3 **(**L=3, T=0, P=0)

A. Course Objectives:

1. Learn the various soft computing frameworks.
2. Be familiar with design of various neural networks.
3. Be exposed to fuzzy logic.
4. Learn genetic programming.

B. Course Content:

Introduction: Artificial neural network: Introduction, characteristics- learning methods – taxonomy – Evolution of neural networks- basic models – important technologies – applications. Fuzzy logic: Introduction – crisp sets- fuzzy sets – crisp relations and fuzzy relations: cartesian product of relation – classical relation, fuzzy relations, tolerance and equivalence relations, non-iterative fuzzy sets. Genetic algorithm- Introduction – biological background – traditional optimization and search techniques – Genetic basic concepts.

Neural Networks: McCulloch-Pitts neuron – linear separability – hebb network – supervised learning network: perceptron networks – adaptive linear neuron, multiple adaptive linear neuron, BPN, RBF, TDNN- associative memory network: auto-associative memory network, hetero-associative memory network, BAM, hop field networks, iterative auto associative memory network & iterative associative memory network– unsupervised learning networks: Kohonen self-organizing feature maps, LVQ – CP networks, ART network.

Fuzzy Logic: Membership functions: features, fuzzification, methods of membership value assignments- Defuzzification: lambda cuts – methods – fuzzy arithmetic and

fuzzy measures: fuzzy arithmetic – extension principle – fuzzy measures – measures of fuzziness -fuzzy integrals – fuzzy rule base and approximate reasoning : truth values and tables, fuzzy propositions, formation of rules-decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems-overview of fuzzy expert system-fuzzy decision making.

Genetic Algorithm: Genetic algorithm and search space – general genetic algorithm – operators – Generational cycle – stoppingcondition–constraints–classification–geneticprogramming–multileveloptimization–real life problem- advances in GA

Hybrid Soft Computing Techniques & Applications: Neuro-fuzzy hybrid systems – genetic neuro hybrid systems – genetic fuzzy hybrid and fuzzy genetic hybrid systems–simplified fuzzy ART MAP–Applications: A fusion approach of multispectral images with SAR, optimization of traveling salesman problem using genetic algorithm approach, soft computing-based hybrid fuzzy controllers.

C. Text Books:

1. Sivanandam N. S. and Deepa N. S, Principles of Soft Computing, Wiley India Pvt Ltd, 2018.
2. Jang S. J., Sun T. C. and Mizutani E., Neuro-Fuzzy and Soft Computing, PHI / Pearson Education, 2015.
3. Rajasekaran S. and Pai Vijayalakshmi, Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis & Applications, Prentice-Hall of India Pvt. Ltd., 2013.

D. Reference Books:

1. George J. Klir, Ute St. Clair, Bo Yuan, Fuzzy Set Theory: Foundations and Applications, Prentice Hall, 2009.
2. David E. Goldberg, Genetic Algorithm in Search Optimization and Machine Learning, Pearson Education India, 2013.
3. Kosko Bart, Neural Network & Fuzzy System, PHI Publication, 2009.

E. Course Outcomes:

1. Learn about soft computing techniques and their applications
2. Analyze various neural network architectures
3. Understand perceptrons and counter propagation networks.
4. Define the fuzzy systems
5. Analyze the genetic algorithms and their applications.

Subject Code: CS – 421C
Subject Name: Virtualization and Cloud Computing
Credit Point: 3 **(**L=3, T=0, P=0)

A. Course Objectives:

1. Introduction to Cloud Computing, cloud concepts

2. Cloud service models including Iaas, Paas, Saas, and developing cloud based software applications
3. Virtualization techniques
4. Cloud security

B. Course Content:

Introduction Definitions, Characteristics of cloud computing, Advantages and disadvantages of cloud computing, Cloud computing Vs Grid computing, Cloud computing Vs Distributed computing, Cloud computing Vs Cluster Computing.

Virtualization Basic concept– Hypervisor- Types of virtualization- hardware, operating system, server, storage- Features of virtualization- Advantages and disadvantages of different types of virtualization.

Cloud Architecture Types of deployment models-Private, Public , Hybrid, Community, Types of service models-Iaas, PaaS, SaaS.

Cloud storage architecture Evolution of storage technology, storage models, file systems and database, distributed file systems, general parallel file systems. Google file system, Apache Hadoop, BigTable, Megastore, Amazon Simple Storage Service(S3).

Cloud Security Cloud vulnerabilities-Threats to cloud confidentiality-VM cross attack, Malicious Sys Admin- Defense mechanism-Coresidency detection, NoHype-Threats to cloud integrity- data loss/manipulation, dishonest computation- Defense Mechanism-Provable Data Possession (PDP), Proof of Retrievability, Dynamic PDP.

C. Text Books:

1. Kai H, Geoffry C. F, Jack J. D, Distributed and Cloud Computing, Elsevier, 2013.
2. Dan C M., Cloud Computing, Theory and Practice, Elsevier, 2017.
3. Arshadeep B, Vijay M, Cloud Computing, A Hands on approach, University Press, 2014

D. Reference Books:

1. Anthony T V, Toby J V, Robert E, Cloud Computing, A Practical Approach, McGraw Hill, 2009
2. Buyya R K, Christen V, Tammarai S, Mastering Cloud Computing, Foundations and Application Programming, Elsevier, 2013

E. Program Outcomes:

1. To learn how to use Cloud Services.
2. To implement Virtualization
3. To implement Task Scheduling algorithms.
4. Apply Map-Reduce concept to applications.
5. To build Private Cloud.

Subject Code: CS – 421D

Subject Name: Distributed Operating System
Credit Point: 3 **(**L=3, T=0, P=0)

A. Course Objectives:

1. Study of basic structure of Operating System.
2. Difference between OS and Distributed Operating Systems.
3. Study of Memory Management, Synchronization, Fault Tolerance, Deadlock.
4. Study of Multiprocessor Operating System, its Architecture and Management.

B. Course Content:

Introduction: Function of an operating system, Design approaches, concepts of processes, threats, Critical Section problem, Other synchronization problem, Communicating sequential processes. **Process Deadlocks:** Introduction, Preliminaries, Models of Deadlocks, Models of resources, A graph theoretic models of System State, Necessary and sufficient conditions for a Deadlocks. Detection, Prevention and Avoidance.
Distributed Operating Systems: Introduction, System Architectures, issues in Distributed Operating Systems, Communication Networks, and Limitations of Distributed OS.

Distributed Mutual Exclusion: Classifications of Mutual Exclusion, Preliminaries, Solutions of Mutual Exclusions- Non token based algorithm, Lamport's Algorithm, Maekawa's Algorithm, Token Based Algorithm etc.

Distributed Deadlock Detection: Introduction, Preliminaries, Deadlock handing strategies in Distributed OS, Control organizations for Distributed Deadlock Detection, Central Deadlock Detection Algorithms, Distributed Deadlock Detection Algorithm.

Agreement Protocol: System model, Classification of agreement problems, Application of Agreement Protocol.

Distributed File Systems: Mechanisms for building Distributed File Systems, Design Issues, Case Studies- Sun Network File System, The Sprite File Systems, Apollo Domain Distributed File System, Coda, Log Structure File Systems, and Disk Space Management.
Distributed Shared Memory: Architecture and Motivation, Algorithm for Implementing of DMS,Memory Coherence, Coherence Protocol, Case Studies- IVY, Mirage, Clouds.

Distributed Scheduling: Issues in load Distributing, Components of Load Distributing Algorithm, Stability, Load Distributing Algorithm, Performance Comparison, Selecting a Suitable Load Sharing Algorithm, Load Sharing Policies.

Failure Recovery: Classification of Failures, Backward and Forward Error recovery, Recovery in concurrent systems, Check points.

Fault Tolerance: Atomic Action and Committing, Commit Protocols, Non-Blocking Commit Protocols, Voting Protocols, Dynamic Voting Protocols, Case studies-Fault Tolerance under UNIX. **Multiprocessor System Architecture:** Motivations, Basic Architecture, Caching, Hypercube Architecture,

Multiprocessor Operating Systems: Structure, Multiprocessor Design issues, Threats, Process, Synchronization, Processor Scheduling, Memory Management, Reliability/Fault Tolerance

C. Text Books:

1. Singhal, "Advanced Concepts In Operating Systems", Tata McGraw-Hill Education, 2001.
2. Stevens W R, Stephen A. R, "Advanced Programming in the UNIX Environment, Addison-Wesley Professional Computing Series", Addison-Wesley, 2013.
3. Andrew S. T, "Distributed Operating Systems", Pearson Education India, 1995.
4. Wiseman, Yair, "Advanced Operating Systems and Kernel Applications: Techniques and Technologies, IGI Global, 2009

D. Reference Books:

1. Pramod C P. B, "An Introduction to Operating Systems: Concepts and Practice", PHI Learning Pvt. Ltd., 2010.
2. Abraham S, Galvin P B, Greg G, "Operating System Concepts, 9th Edition", Addison-Wesley, 2013.
3. Sibsankar H, Alex A A, "Operating Systems", Pearson Education India, 2010.
4. Chow, "Distributed Operating Systems And Algorithm Analysis", Pearson Education India, 2009
5. Pradeep K. S, "Distributed Operating Systems: Concepts And Design", Phi Learning Pvt. Ltd., 1998.
6. Thomas W. D, "Operating Systems In Depth: Design And Programming", John Wiley & Sons, 2011.

E. Course Outcomes:

1. Students will be able to work in threats programming.
2. Student will able to understand and work in Distributed File System.
3. Student will able to work in UNIX base Operating Systems.
4. Student will understand Fault Tolerance under UNIX.

Subject Code: CS – 421E
Subject Name: Advanced Java Programming
Credit Point: 3 **(**L=3, T=0, P=0)

A. Course Objectives:

1. How to interact with a relational database using java programming language.
2. How to write generic java programs.

3. Writing server side programs using java technology.

B. Course Content:

JDBC Architecture, a Relational Database Overview, Processing SQL Statements with JDBC Establishing a Connection, Connecting with DataSource Objects, Handling SQLExceptions, Retrieving and Modifying Values from Result Sets, Using Prepared Statements, Using Transactions, Using RowSet Objects

Generics & Collection Framework APIs. Introduction to Design Patterns: the Factory Design Pattern, the Singleton Design Pattern.

Why use Servlets & JSPs: an introduction to web servers & clients, HTML, HTTP Protocol, HTTP GET and POST requests, HTTP responses. Web App Architecture: high-level overview. A ModelView-Controller (MVC) overview and example, life cycle of a servlet, request & response objects, Init Parameters and ServletConfig, JSP init parameters, Context init parameters, attributes and listeners, session management.

Create a simple JSP using "out" and a page directive, JSP expressions, variables, and declarations, implicit objects, The Lifecycle and initialization of a JSP, other directives. Scriptless JSP: Standard actions, Expression Language, The EL implicit objects & EL functions, using JSTL.

C. Text Books:

1. Dietel, Deitel, Java How to Program, Pearson Education, 10th Ed., 2015.

D. Reference Books:

1. Bryan B, Kathy S, Bert B, Head First Servlets & JSPs, O'REILLY, 2nd Ed., 2008.
2. Eric F, Elisabeth F, Kathy S, Bert B, Head First Design Patterns, O'REILLY, 1st Ed., 2004

E. Course Outcomes:

1. Able to interact with a database using java-programming language.
2. Able to write generic programs with the usage of collection framework APIs
3. Able to design a web application using various J2EE constructs such as servlets and JSPs.

Subject Code: CS – 421F
Subject Name: Parallel Algorithm
Credit Point: 3 **(**L=3, T=0, P=0)

A. Course Objectives:

1. To acquaint students with the basic concepts of parallel and distributed computing.

2. The course aims to the general principles of parallel and distributed algorithms and their time complexity.
3. To Study different aspects of Parallel Models
4. To Study different aspects of Interconnection Architecture
5. Analyse fundamental parallel algorithms from various application domains.

B. Course Content:

Sequential model, need of alternative model, parallel computational models such as PRAM, LMCC, Hypercube, Cube Connected Cycle, Butterfly, Perfect Shuffle Computers, Tree model, Pyramid model, Fully Connected model, PRAM-CREW, EREW models, simulation of one model from another one.

Performance Measures of Parallel Algorithms, speed-up and efficiency of PA, Costoptimality, An example of illustrate Cost-optimal algorithms- such as summation, Min/Max on various models.

Parallel Sorting Networks, Parallel Merging Algorithms on CREW/EREW/MCC/, Parallel Sorting Networks on CREW/EREW/MCC/, linear array

Parallel Searching Algorithm, Kth element, Kth element in X+Y on PRAM, Parallel Matrix Transportation and Multiplication Algorithm on PRAM, MCC, Vector-Matrix Multiplication, Solution of Linear Equation, Root finding. Graph Algorithms - Connected Graphs, search and traversal, Combinatorial Algorithms- Permutation, Combinations, Derangements.

C. Text Books:

1. Quinn M.J, Designing Efficient Algorithms for Parallel Computer, Mc GrawHill, 2007
2. Greenlaw R, Hoover H.J, Ruzzo W.L, Limits to Parallel Computation: P-Completeness Theory, Oxford University Press, New York, 1995.
3. Kumar V., Grama A, Gupta A, Karypis G, Introduction to Parallel Computing, The Benjamin/Cummings Publishing Company, Redwood City, California, 1994.

D. Reference Books:

1. Cormen T, Leiserson C, Rivest R, Introduction to Algorithms, The MIT Press, Cambridge, 1992.
2. Akl S. G, The Design and Analysis of Parallel Algorithms, Prentice Hall, 1989.
3. Quinn M. J, Parallel Computing, McGraw Hill, 1994.
4. Leighton F.T., Introduction to Parallel Algorithms and Architectures: Arrays, Trees, Hypercubes, Morgan Kaufmann Publishers, 1992.
5. Bovet D.P., Crescenzi P, Introduction to the Theory of Complexity, Prentice Hall, 1994.
6. Selim G. A, Parallel Sorting Algorithms, Academic Press, 2014.

E. Program Outcomes:

1. Design, Implementation and evaluate parallel algorithms and in the field of HPC (High Performance Computing) in general.
2. Understand the role of computation models in parallel computation,
3. Understand the circuit and comparison network models,
4. Understand the basics of merging and sorting networks.