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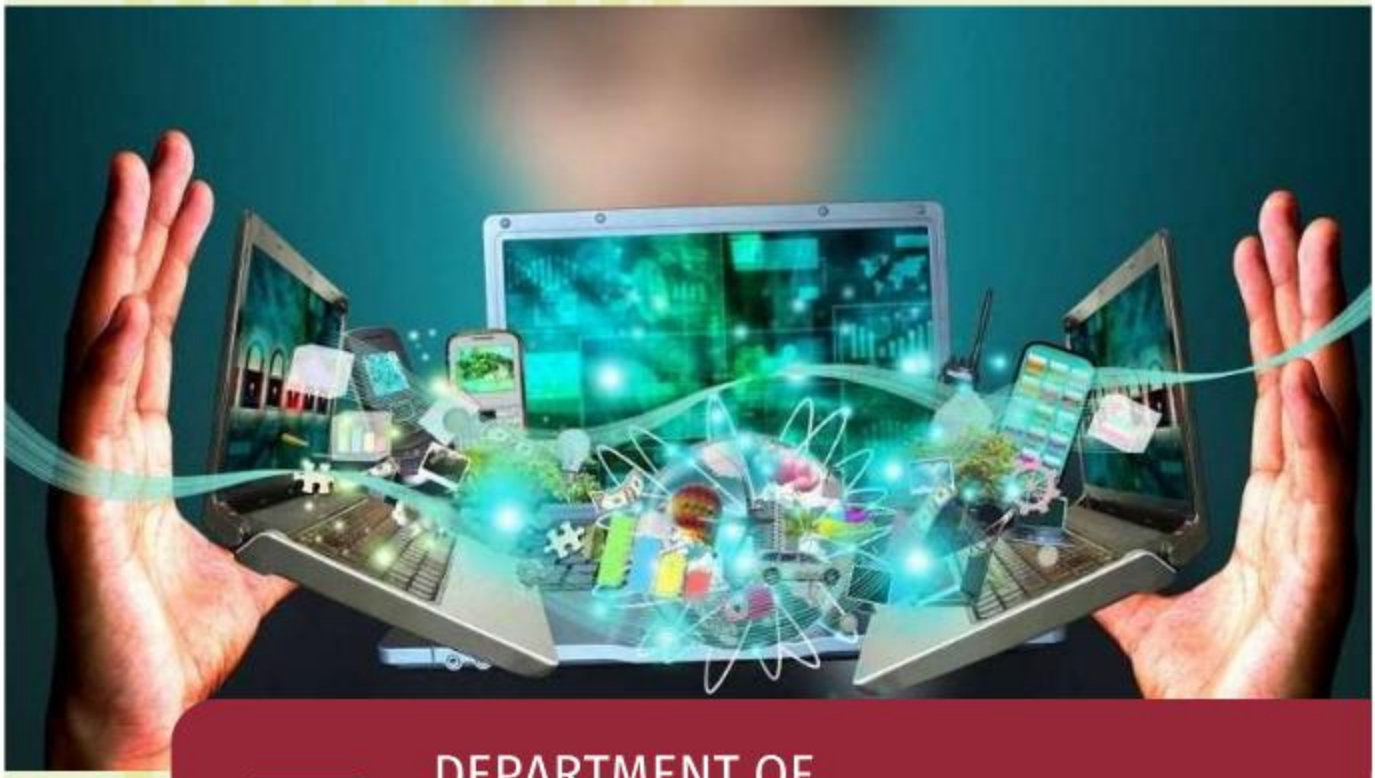
SAI RAM ENGINEERING COLLEGE

An Autonomous Institution

West Tambaram, Chennai - 44

www.sairam.edu.in

Approved by AICTE, New Delhi
Affiliated to Anna University



DEPARTMENT OF
COMPUTER SCIENCE & ENGINEERING
M.TECH. - 5 years Integrated Programme

AUTONOMOUS

CURRICULUM AND

SYLLABUS
I - V
SEMESTERS

REGULATIONS 2024

Academic Year 2024-25 onwards

SRI SAIRAM ENGINEERING COLLEGE

VISION

To emerge as a "Centre of excellence " offering Technical Education and Research opportunities of very high standards to students, develop the total personality of the individual and instil high levels of discipline and strive to set global standards, making our students technologically superior and ethically stronger, who in turn shall contribute to the advancement of society and humankind.

MISSION

We dedicate and commit ourselves to achieve, sustain and foster unmatched excellence in Technical Education. To this end, we will pursue continuous development of infra-structure and enhance state-of-the-art equipment to provide our students a technologically up-to date and intellectually inspiring environment of learning, research, creativity, innovation and professional activity and inculcate in them ethical and moral values.

Educational Organization Management System (EOMS) Policy

We at Sri Sai Ram Engineering College are committed to empower our students not only to excel academically but also imbibe essential values, enabling them to become exemplary global citizens. We build a better nation by fostering excellence and innovative practices in Engineering, Technology and Management Education. We are dedicated to consistently enhancing our systems, infrastructure and services to meet the needs and expectations of all our stakeholders for sustainable growth

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING - 5 YEARS INTEGRATED

VISION

To be a pioneer in providing industry and research focused integrated curriculum in computer science & engineering and to transform young minds to sustain technically and compete globally with enriched, ethical and moral values to serve the nation & beyond.

MISSION

Department of Computer Science & Engineering - 5 years Integrated Course, Sri Sairam Engineering College is committed to

- **M1** Accelerate the learning process by collaborating undergraduate fundamentals & postgraduate focused learning & research
- **M2** Tie-up with industries to facilitate advanced real time projects & internships to bridge gaps between industry & academics
- **M3** Impart research mindset to provoke innovative thoughts and be responsible for inventions benefitting society
- **M4** Inculcate moral and ethical values as a part of curriculum to enable interpersonal skills.

CHAIRMAN
BOARD OF STUDIES
M.TECH COMPUTER SCIENCE & ENGINEERING
(5 YEARS INTEGRATED)

AUTONOMOUS CURRICULA AND SYLLABI
Regulations 2024

SEMESTER I

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS L	T	P	CONTACT PERIODS	CREDITS
		THEORY					
1	24BSMA101	Matrices and Calculus	3	1	0	4	4
2	24HSEN101	Communicative English	3	0	0	3	3
3	24BSPH101	Engineering Physics	3	0	0	3	3
4	24BSCY101	Engineering Chemistry	3	0	0	3	3
5	24ESCS101	Problem Solving and Programming in C	3	0	0	3	3
6	24HSTA101	Heritage of Tamils	1	0	0	1	1
		PRACTICALS					
1	24ESGE102	Engineering Practices Laboratory	0	0	4	4	2
2	24ESPL101	Programming in C Laboratory	0	0	2	2	1
		VALUE ADDITIONS - I					
1	24ESID101	Idea Engineering Lab - I	0	0	2	2	1
2	24ENTP101	Functional Life Skills	1	0	1	2	1
		ONLINE SUPPLEMENTARY					
		As recommended by BoS					
				Total		27	22

SEMESTER II

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS L	T	P	CONTACT PERIODS	CREDITS
		THEORY					
1	24BSMA201	Discrete Structures	3	1	0	4	4
2	24HSEN201	Professional English	2	0	0	2	2
3	24BSPH203	Physics for Information Science	3	0	0	3	3
4	24BSCY201	Chemistry for Environment and Sustainability	3	0	0	3	3
5	24HSTA201	Tamils and Technology	1	0	0	1	1
6	24ESGE101	Engineering Graphics	1	2	0	3	3
7	24HSNC201	NCC Course Level 1*	2	0	0	2	0
		PRACTICALS					
1	24BSPL101	Physics and Chemistry Laboratory	0	0	4	4	2
2	24AIPT201	Python for Data Science Laboratory with Theory	1	0	4	5	3
		VALUE ADDITIONS - II					
1	24ESID201	Idea Engineering Lab - II	0	0	2	2	1
2	24ENTP201	Digital Dynamics	1	0	1	2	0
		ONLINE SUPPLEMENTARY					
1	24ESMC201	MS Office (Mandatory - NC)	0	0	0	0	0
				Total		31	22

*only for NCC cadets

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SEMESTER III

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			CONTACT PERIODS	CREDITS
			L	T	P		
		THEORY					
1	24BSMA301	Statistics and Linear Algebra	3	1	0	4	4
2	24CSPC301	Database Management Systems	3	0	0	3	3
3	24CSPC302	Data Structures	3	0	0	3	3
4	24ITPC302	Software Engineering	3	0	0	3	3
5	24CSPW301	Digital Design and Computer Organization with Laboratory	3	0	2	5	4
6	24HSMC301	Universal Human Values - II Understanding Harmony	2	1	0	3	3
7	24HSNC301	NCC course Level 2*	3	0	0	3	0
		PRACTICALS					
1	24CSPL301	Database Management Systems Laboratory	0	0	4	4	2
2	24CSPL302	Data Structures Laboratory	0	0	4	4	2
		VALUE ADDITIONS - III					
1	24CJTP301	Aptitude Skills - I	0	0	2	2	1
2	24CJID301	Innovative Design Lab – I	0	0	2	2	1
		ONLINE SUPPLEMENTARY					
1	24ESMC301	Joy of Computing using Python (Mandatory - NC)	2	0	0	2	0
		*only for NCC cadets		Total		36	26

SEMESTER IV

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			CONTACT PERIODS	CREDITS
			L	T	P		
		THEORY					
1	24BSMA402	Probability and Queueing Theory	3	1	0	4	4
2	24CJPC401	Core Java Programming	3	0	0	3	3
3	24CSPC401	Theoretical Computer Science	3	0	0	3	3
4	24CSPC402	Design and Analysis of Algorithms	3	0	0	3	3
5	24CJPW401	Object Oriented Analysis and Design with Laboratory	3	0	2	5	4
6	24MGOE9xx	Open Elective -I #	3	0	0	3	3
7	24HSNC401	NCC course Level 3*	3	0	0	3	0
		PRACTICALS					
1	24CJPL401	Java Programming Laboratory	0	0	4	4	2
2	24CJPT401	Operating System Laboratory With Theory	1	0	4	5	3
		VALUE ADDITIONS - IV					
1	24CJTP401	Aptitude Skills - II	0	0	2	2	0
2	24CJID401	Innovative Design Lab - II	0	0	2	2	1
		ONLINE SUPPLEMENTARY					
		As recommended by BOS					
				Total		37	26

*only for NCC cadets

Logistics Information System

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SEMESTER V

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			CONTACT PERIODS	CREDITS
			L	T	P		
THEORY							
1.	24ITPC501	Computer Networks	3	0	0	3	3
2.	24CJPW502	Web Technology Foundation with Laboratory	3	0	2	5	4
3.	24xxEL5xxx	Professional Elective - I	3	0	0	3	3
4.	24xxEL5yyy	Professional Elective - II	3	0	0	3	3
5.	24SCOE9XX	Open Elective -II*	3	0	0	3	3
6.	24MGMC501	Constitution of India	2	0	0	2	0
PRACTICALS							
1.	24ITPL501	Computer Networks Laboratory	0	0	4	4	2
VALUE ADDITIONS - V							
1.	24CJTP501	Skill Enhancement / Dept. Specific BIS Standards	0	0	2	2	1
2.	24CJID501	Prototype Development Lab - 1	0	0	2	2	1
ONLINE SUPPLEMENTARY							
		As Recommended by BOS					
				Total		27	20

SEMESTER VI

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			CONTACT PERIODS	CREDITS
			L	T	P		
THEORY							
1.	24CJPC601	Generative AI Tools & Techniques	3	0	0	3	3
2.	24xxEL6ww	Professional Elective-III	3	0	0	3	3
3.	24xxEL6xx	Professional Elective-IV	3	0	0	3	3
4.	24xxEL6yy	Professional Elective -V	3	0	0	3	3
5.	24XXOE9xx	Open Elective -III	3	0	0	3	3
6.	24HSMG601	Principles of Engineering Management	3	0	0	3	3
PRACTICALS							
1.	24CJPL601	Generative AI Tools & Techniques Laboratory	0	0	4	4	2
VALUE ADDITIONS - VI							
1.	24CJTP601	Technical Skill	0	0	2	2	0
2.	24CJID601	Prototype development Lab - II	0	0	2	2	1
ONLINE SUPPLEMENTARY							
		As Recommended by Bos					
				Total		26	21

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SEMESTER VII

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			CONTACT PERIODS	CREDITS
			L	T	P		
THEORY							
1.	24ITPC701	Cryptography and Network Security	3	0	0	3	3
2.	24MGEL703	Creative Innovation and Entrepreneurship	2	0	0	2	2
3	24CJPW701	Jee Framework With Laboratory	3	0	2	5	4
4.	24xxEL7xxx	Professional Elective-VI	3	0	0	3	3
5.	24XXEL7XX	Professional Elective -VII	3	0	0	3	3
PRACTICALS							
1.	24ITPL701	Network Security Laboratory	0	0	4	4	2
2.	20CJPJ701	Innovative Design Project - Phase I	0	0	8	8	4
VALUE ADDITIONS - VII							
1.	24CJTP701	Company Specific Skills	0	0	2	2	1
ONLINE SUPPLEMENTARY							
		As recommended by BoS					
				Total		30	22

SEMESTER VIII

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			CONTACT PERIODS	CREDITS
			L	T	P		
THEORY							
1.	24CJPW801	Front End Framework Engineering with Laboratory	3	0	2	5	4
2.	24CJPC801	Agile Methodologies	3	0	0	3	3
3.	24CJPW802	Mobile Application Development theory with Laboratory	3	0	2	5	4
4	24XXEL7YY	Professional Elective -VIII	3	0	0	3	3
5	24XXOE9xx	Open Elective (NPTEL Optional) OE4	3	0	0	3	3
PRACTICALS							
1.	24CJPJ801	Innovative Design Project- Phase II	0	0	6	6	3
VALUE ADDITIONS - VIII							
1.	24CJIN801	Internship	0	0	9	9	3
				Total		34	23

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SEMESTER IX

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			CONTACT PERIODS	CREDITS
			L	T	P		
PRACTICAL							
1	24CJPJ901	Project Phase – I	0	0	16	16	8
TOTAL						16	8

SEMESTER X

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			CONTACT PERIODS	CREDITS
			L	T	P		
PRACTICAL							
1	24CJPJ951	Project Phase – II	0	0	20	20	10
		TOTAL				20	10

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PROFESSIONAL ELECTIVES - I

S. NO	COURSE CODE	COURSE TITLE	CREDIT	DOMAIN	PREREQUISITE COURSES
1	24ITEL501	Computer Graphics and Multimedia	3	Computing Technologies	24ITPC301, 24BSMA301
2	24ITEL511	Graph Theory	3	Computing Technologies	24BSMA402, 24BSMA301
3	24ITEL503	Cloud Computing	3	Computing Technologies	24ITPC301, 24ITPW401
4	24AIEL501	Exploratory Data Analysis with R Software	3	Artificial Intelligence	24BSMA402, 24BSMA301
5	24AIEL502	Artificial Intelligence Fundamentals and Applications	3	Artificial Intelligence	24AIPT201
6	24AIEL503	Human Centered Computing	3	Artificial Intelligence	24ITPC302, 24ESCS101
7	24ITEL504	Foundation of Cryptography	3	Cyber Security	24BSMA201, 24ITPC301
8	24ITEL505	Intrusion Detection Systems	3	Cyber Security	24ITPW401, 24ITPC501
9	24ITEL506	Network Security and Protocol	3	Cyber Security	24ITPW401, 24ITPC501
10	24ITEL507	Data Warehousing and Data Mining	3	Data Science	24CSPC301, 24BSMA401, 24BSMA301, 24ESCS101
11	24ITEL508	Data Analytics with Python	3	Data Science	24BSMA301, 24ESCS101
12	24ITEL509	Big Data Essentials	3	Data Science	24CSPC301, 24CSPC302, 24ITPW401
13	24CSEL350	Machine Learning Algorithms	3	Machine Learning	24BSMA301, 24BSMA402,
14	24CSEL504	Machine Learning for Intelligent System	3	Machine Learning	24CSPC301, 24CSPC302
15	24CSEL505	Machine Learning Essential for Cyber security	3	Machine Learning	24BSMA301, 24BSMA402
16	24CIEL501	IoT Concepts And Applications	3	Industrial IoT	24ESCS101, 24AIPT201
17	24CIEL502	Data Science for Internet of Things	3	Industrial IoT	24AIPT201, 24BSMA301
18	24CIEL503	Dynamic Paradigm in IoT	3	Industrial IoT	24ESCS101, 24AIPT201

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PROFESSIONAL ELECTIVES - II

S. NO	COURSE CODE	COURSE TITLE	CREDIT	DOMAIN	PREREQUISITE COURSES
1	24ITEL510	Advanced Analysis of Algorithms	3	Computing Technologies	24CSPC302, 24CSPC402
2	24ITEL502	Distributed Systems	3	Computing Technologies	24CSPC302, 24CSPC402
3	24ITEL512	Parallel Algorithms	3	Computing Technologies	24ITPW401
4	24AIEL504	Business Intelligence	3	Artificial Intelligence	24CSPC301,24BSMA301
5	24AIEL505	Machine Learning Essentials	3	Artificial Intelligence	24CSPC301,24BSMA301
6	24AIEL506	Decision Support Systems	3	Artificial Intelligence	24BSMA301, 24CSPC301
7	24ITEL513	Secure Software Development	3	Cyber Security	24ITTP401, 24ITPW401
8	24ITEL514	Foundations of Cyber Physical Systems	3	Cyber Security	24ITPW401, 24ITPC501
9	24ITEL515	Mobile and Wireless security	3	Cyber Security	24ITPW401, 24ITPC501
10	24ITEL516	Learning Analytics Tools	3	Data Science	24CSPC301, 24BSMA401, 24BSMA301, 24ESCS101
11	24ITEL517	Data Science for Engineers	3	Data Science	24AIPT201, 24BSMA402
12	24ITEL518	Data Mining for Decision Making	3	Data Science	24CSPC301
13	24CSEL508	Machine Learning for Intrusion Detection	3	Machine Learning	24AIPT201, 24BSMA402
14	24CSEL509	Deep Learning Architectures and Applications	3	Machine Learning	24BSMA301
15	24CSEL510	Intelligent Decision Systems	3	Machine Learning	24AIPT201, 24BSMA301
16	24CIEL504	Web of Things	3	Industrial IoT	24ESCS101, 24CSPC301
17	24CIEL505	Wireless Technologies in Internet of Things	3	Industrial IoT	-
18	24CIEL506	Descriptive Analytics for IoT	3	Industrial IoT	24AIPT201

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SEMESTER - I

24BSMA101 SDG NO. 4 & 9	MATRICES AND CALCULUS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To understand and gain the knowledge of matrix algebra.
- To introduce the concepts of limits, continuity, derivatives, maxima and minima for functions of several variables.
- To acquaint the student with the concepts of vector calculus, needed for problems in all engineering disciplines.
- To provide understanding of double integration, triple integration and their applications.
- To impart the knowledge of Fourier series..

MODULE - I MATRICES 12

Eigenvalues and Eigenvectors of a real matrix – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem (without proof) – Symmetric and orthogonal matrices - Reduce the Quadratic to Canonical form using orthogonal transformation - Nature of Quadratic forms.

MODULE - II FUNCTIONS OF SEVERAL VARIABLES 12

Limits, Continuity - Definitions - Partial derivatives -Taylor's series - Jacobians, Maxima and Minima - Method of Lagrange multipliers.

MODULE - III VECTOR DIFFERENTIATION 4

Scalar and Vector valued functions- Gradient and Directional derivatives – Tangent plane - Divergence and Curl- Irrotational and Solenoidal vector fields - Scalar and Vector Potentials - Vector identities (without proof).

MODULE - IV VECTOR INTEGRATION 8

Line integral over a plane curve - Surface integral - Area of a curved surface - Volume integral - Greens, Gauss divergence and Stoke's theorems -Verification and Application in evaluating line, Surface and Volume integrals. Problems involving Cube and Cuboids.

MODULE - V MULTIPLE INTEGRALS 12

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Change of variables from cartesian to polar coordinates-Triple integrals – Volume of solids - Change of variables from cartesian to Spherical and Cylindrical polar coordinates.

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MODULE - VI FOURIER SERIES 12

Fourier series – Convergence of Fourier series -Half range Sine and Cosine series – Parseval's theorem.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Advanced Engineering Mathematics, Erwin Kreyszig, 9th Edition, John Wiley & Sons, 2006.
2. Calculus and Analytic geometry, G.B. Thomas and R.L. Finney, 9th Edition, Pearson, Reprint, 2002.

REFERENCES:

1. Higher Engineering Mathematics, B. V. Ramana, 11th reprint, Tata McGraw-Hill, New Delhi, 2010.
2. Engineering Mathematics for first year, T. Veerarajan, Tata McGraw-Hill, New Delhi, 2008.
3. A text-book of Engineering Mathematics, N.P. Bali and Manish Goyal, Laxmi Publications, Reprint, 2008.
4. Higher Engineering Mathematics, B. S. Grewal, 40th Edition, Khanna Publishers, New Delhi, 2007.

WEB REFERENCES:

1. https://math.mit.edu/~gs/linearalgebra/ila0601.pdf
2. http://ocw.mit.edu/ans7870/18/18.013a/textbook/HTML/chapter30/
3. https://ocw.mit.edu/courses/mathematics/18-02sc-multivariable-calculus-fall-2010/2.-partial derivatives/
4. http://ocw.mit.edu/ans7870/18/18.013a/textbook/HTML/chapter31/

ONLINE RESOURCES:

1. https://www.khanacademy.org/math/linear-algebra/alternate-bases/eigen-everything/v/linear algebra-introduction-to-eigenvalues-and-eigenvectors
2. https://www.khanacademy.org/math/differential-calculus

OUTCOMES:

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

1. Diagonalize the matrix using orthogonal transformation and apply Cayley Hamilton Theorem to find the inverse and integral powers of a square matrix. (K3)
2. Evaluate the limit, examine the continuity and use derivatives to find extreme values for functions of several variables. (K3)

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3. Compute the derivatives of scalar and vector point functions. (K3)
4. Use the vector point function to establish the relation between line, surface and volume integrals. (K3)
5. Apply double and triple integrals to find the area and the volume of a region. (K3)
6. Compute Fourier series expansion of a function. (K3)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	-	-	-	-	-	-	-	1
CO2	3	1	1	1	-	-	-	-	-	-	-	1
CO3	3	1	1	1	-	-	-	-	-	-	-	1
CO4	3	1	1	1	-	-	-	-	-	-	-	1
CO5	3	1	1	1	-	-	-	-	-	-	-	1
CO6	3	1	1	1	-	-	-	-	-	-	-	1

SEMESTER - I

24HSEN101 SDG NO. 4	COMMUNICATIVE ENGLISH	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Develop the basic LSRW skills
- Acquire enhanced knowledge of English grammar
- Improve modern and technical vocabulary
- Enhance the communicative and cognitive skills
- Interpret the texts and write reviews critically

MODULE - I COMMUNICATION PROCESS 8

Listening – informal conversations - Speaking – basics in speaking – speaking on given topics & situations – recording speeches and strategies to improve - Reading comprehension – skimming/ scanning/ predicting – question & answers – objective and descriptive answers - Writing – paragraph writing, personal notes - Language Development – parts of speech, prefix, suffix, word formation

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MODULE - II LANGUAGE BARRIERS, LEVELS AND CHANNELS 8

Listening –interviews - Speaking – describing a simple process – asking and answering questions - Reading – critical reading – finding key information in a given text – ideation, mind mapping - Writing - dialogue,, instructions – Language Development – regular, irregular verbs, tenses, framing questions,

MODULE - III NARRATION AND SUMMATION 8

Listening - long texts - TED talks - extensive speech on current affairs - Speaking – role plays – asking about routine actions and expressing opinions - Reading- longer texts & making a critical analysis of the given text - Writing – essay (comparative / analytical), jumbled sentences, recommendations - Language Development – writing single sentence definitions, sequence words

MODULE - IV WRITING MECHANICS 7

Listening -debates and discussions – practicing multiple tasks –Speaking - self introduction about friends/ places/ hobbies - Reading -Making inference from the reading passage – Predicting the content of the reading passage - Writing – informal letters, e-mails - accuracy, coherence, brevity – Language Development- single word substitutes, compound words- conditionals

MODULE - V INTERPRETATION SKILLS 7

Listening- popular speeches and presentations - Speaking - impromptu speeches -Reading - articles – magazines - Writing – review writing, channel conversion – bar diagram/ table, poster/ picture interpretation - Language Development – modal verbs, collocations, 21st century vocabulary

MODULE - VI COGENT EXPOSITIONS 7

Listening - Motivational speeches - Speaking - Debates and discussion - Reading - analytical reading - newspapers - Writing - process description - Language Development - voices, sentences expressing purpose, synonyms & antonyms

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Board of Editors. Using English: A Coursebook for Undergraduate Engineers and Technologists. Orient Blackswan Limited, Hyderabad: 2015.
2. A Course in Technical English, D. Praveen Sam and K.N. Shoba, Cambridge University Press, 2020

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REFERENCES:

1. Anderson, Paul V. Technical Communication: A Reader – Centered Approach. Cengage, New Delhi, 2008.
2. Smith-Worthington, Darlene & Sue Jefferson. Technical Writing for Success. Cengage, Mason, USA, 2007.
3. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford, 2007.
4. Chauhan, Gajendra Singh and et.al.Technical Communication (Latest Revised Edition). Cengage Learning India Pvt. Limited, 2018.

WEB REFERENCES:

1. https://onlinecourses.nptel.ac.in/noc19_hs31/preview
2. https://www.myenglishpages.com/speaking/#google_vignette

ONLINE RESOURCES:

1. https://wwPearson.com/english/catalogue/business-english/technical-english.html
2. https://ww.cambridgeenglish.org/learning-english/free-resources/

OUTCOMES:

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

1. Improve understanding and application of listening, speaking, reading, and writing skills (K2)
2. Demonstrate the ability to write personal notes, clear and coherent paragraphs (K2)
3. Apply analytical skills to write essays, rearrange jumbled sentences, and formulate recommendations (K3)
4. Apply skills to develop email etiquette and construct professional emails and informal letters (K3)
5. Analyze and interpret data to write comprehensive and effective reviews (K3)
6. Enhance vocabulary, improve grammatical accuracy, and confidently engage in debates (K2)

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CO-PO, PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	2	3	-	3	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO4	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO5	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO6	-	-	-	-	-	-	-	-	-	3	-	3	-	-

SEMESTER - I

24BSPH101 SDG NO. 4	ENGINEERING PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic concepts of mechanics and its use in engineering applications.
- To illustrate the various laws of electromagnetic waves and its applications.
- To understand the concept of waves and lasers and its applications.
- To apply the concepts of quantum mechanics to engineering studies.
- To identify the basic principles involved in thermal physics and its applications.
- To understand the basics of crystal for engineering applications.

MODULE - I PROPERTIES OF MATTER **8**

Elasticity – Hooke's law- Poisson's ratio - Stress - strain diagram and its uses - Twisting couple - shaft - Torsion pendulum: theory and experiment - bending of beams - bending moment - cantilever: theory and experiment - uniform and non-uniform bending: theory and experiment - I-shaped girders.

MODULE - II MECHANICAL WAVES AND LASERS **7**

Waves on a string – standing waves – traveling waves – Energy transfer of a wave – Reflection and refraction of light waves – interference –Theory of air wedge and experiment - Theory of laser – characteristics – Spontaneous and stimulated emission – Einstein's coefficients – population inversion – Nd-YAG laser, CO2 laser – Basic applications of lasers in industry.

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MODULE - III ELECTROMAGNETIC WAVES 8

The Maxwell's equations – wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field – properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter – polarization – Producing electromagnetic waves – Energy and momentum in EM - Reflection and transmission of electromagnetic waves from a non-conducting medium vacuum interface for normal incidence.

MODULE - IV BASIC AND APPLIED QUANTUM MECHANICS 7

Black body radiation – Planck's derivation – Electrons and matter waves –The Schrodinger equation (Time dependent and time independent forms) – significance of wave function – Normalization –Free particle – particle in a infinite potential well: 1D, 2D and 3D Boxes; - Barrier penetration and quantum tunneling (qualitative) – Scanning Tunneling Microscope.

MODULE - V CRYSTAL PHYSICS 8

Single crystalline, Polycrystalline and Amorphous materials - single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal - Miller indices - Interplanar distance - X-Ray diffraction - Calculation of number of atoms per unit cell - Atomic radius - Coordination number – packing. factor for SC, BCC, FCC and HCP structures - Polymorphism and allotropy. Crystal Growth: Chochralski technique - Molecular beam epitaxy.

MODULE - VI THERMAL PHYSICS 7

Transfer of heat energy - Conduction, Convection and Radiation - Thermal conductivity, Forbe's method and Lee's disc method - Conduction through compound media - series and parallel methods - Heat exchangers - Refrigerators and Solar water heaters.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. D.K. Bhattacharya & T.Poonam, "Engineering Physics". Oxford University Press, 2015.
2. R.K. Gaur & S.L. Gupta, "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. B.K. Pandey & S.Chaturvedi, "Engineering Physics", Cengage Learning India, 2017.
4. V. Rajendran, "Engineering Physics", Mc Graw Hill Publications Ltd. New Delhi, 2014.
5. M.N. Avadhanulu And P.G. Kshirsagar, "A textbook of Engineering Physics", S.Chand & Co Ltd 2016.

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REFERENCES:

1. D. Halliday, Resnick & J. Walker, "Principles of Physics", Wiley, 2015.
2. R.A. Serway, & J.W. Jewett, "Physics for Scientists and Engineers", Cengage Learning, 2010.
3. N.K. Verma," Physics for Engineers", PHI Learning Private Limited, 2014.
4. P.A. Tipler & G. Mosca "Physics for Scientists and Engineers", W.H.Freeman, 2020.
5. Brijlal and Subramanyam, "Properties of Matter", S. Chand Publishing, 2018.
6. Shatendra Sharma & Jyotsna Sharma, "Engineering Physics", Pearson, 2018.
7. Arthur Beiser. "Concepts of Modern Physics", McGraw-Hill, 6th Edition. 2003.
8. Charles Kittel, "Introduction to Solid State Physics". John Wiely & Sons. 8th Edition, 2005.

OUTCOMES:

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

1. Apply the concepts of stress, torsion, and bending to study the mechanical behavior of structural elements using theoretical and experimental methods. (K3)
2. Analyze wave phenomena and interference to study energy transfer, and evaluate laser principles with their industrial applications. (K4)
3. Examine Maxwell's equations and electromagnetic wave theory to analyze wave propagation, polarization and reflection-transmission phenomena in different media (K4)
4. Utilize the principles of quantum mechanics to explain black body radiation, matter waves, particle confinement in potential wells and tunneling phenomena. (K3)
5. Examine and compare the characteristics of various crystal structures, polymorphic forms, and crystal growth techniques. (K4)
6. Apply the principles of heat transfer to determine the thermal conductivity and explain the role of heat exchangers in refrigerators and solar water heaters. (K3)

Recommended by
Board of Studies of H&S dept.
Meeting No. 6 Dated: 31/08/2022

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CO-PO, PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-
CO5	-	3	-	-	-	-	-	-	-	-	-
CO6	3	-	-	-	-	-	-	-	-	-	-

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SEMESTER - I

24BSCY101 SDG NO. 4,7,8,9, 11,12 & 17	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To enumerate the importance, synthesis, and applications of polymers.
- To impart basic knowledge of chemistry and the principles involved in electrochemistry, energy storage devices, and their commercial applications.
- To familiarize the fundamental laws and concepts of important photophysical and photochemical processes, as well as spectroscopy.
- To explore the fundamental concepts, laws, and principles of thermodynamics, and apply its derivations to optimize and innovate engineering processes across various disciplines.
- To comprehend the chemistry of fuels and combustion, and their applications across various engineering and industrial processes.
- To gain an understanding of the emergence and challenges of nanomaterials and nanotechnology across various scientific and technological disciplines.

MODULE - I POLYMER CHEMISTRY 8

Polymers: Definition, Degree of polymerization, Functionality of monomer, Classification of polymer with examples, Types of polymerization, Mechanism of addition polymerization (Free radical mechanism).

Plastics: Definition and Characteristics - Thermoplastics & Thermosets. Preparation, properties and engineering applications of plastics -PVC, Teflon, Kevlar and Bakelite.

Fibers: Characteristics fibers - Preparation, properties and applications of Nylon and Dacron. Biodegradable polymers & Conducting Polymers: Characteristics, Classification and their applications.

MODULE - II ELECTROCHEMISTRY AND BATTERY TECHNOLOGY 7

Electrochemistry: Types of Cells (Electrochemical and Electrolytic cell) – Redox reaction – Single and Standard electrode potential, Reference electrodes - SHE, Calomel electrode, Measurement of Single Electrode Potential, Nerns't equation (Derivation & Problems), Electrochemical series and its significance.

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Batteries: Evolution of batteries – Primary and Secondary battery (Lead acid battery), Next Generation Battery Technology (NGBT) - Solid-state batteries (Lithium-ion), Sodium-ion batteries.

MODULE - III PHOTOCHEMISTRY & SPECTROSCOPY 7

Photochemistry: Laws of photochemistry - Grotthuss–Draper law, Stark–Einstein law and Lambert-Beer Law. Quantum efficiency – determination- Photo processes - Jablonski diagram (Internal Conversion, Intersystem crossing, Fluorescence, Phosphorescence), Chemiluminescence and Photo-sensitization.

Spectroscopy: Electromagnetic spectrum - Absorption of radiation – Electronic, Vibrational and Rotational transitions. UV-visible and IR spectroscopy – principles, instrumentation (Block diagram only).

MODULE - IV CHEMICAL THERMODYNAMICS 8

Terminology of Thermodynamics - Laws of Thermodynamics – I law – Significance – Mathematical formulation and its applications. II law – Need for the II law. Second law: Entropy - entropy change for an ideal gas, reversible and irreversible processes, entropy of phase transitions; Clausius inequality. Helmholtz and Gibbs free energy functions, Criteria of spontaneity, Maxwell relations, Gibbs-Helmholtz equation, Van't Hoff Isotherm and Isochore.

MODULE - V FUELS 8

Fuels: Introduction –Classification of fuels – Coal – Analysis of coal (proximate and ultimate). Carbonization – manufacture of metallurgical coke (Otto Hoffmann method) – Petroleum – manufacture of synthetic petrol (Bergius process). Knocking – Octane number and Cetane number – Gaseous fuels – Compressed natural gas (CNG), Liquefied petroleum gas (LPG). Biofuels – Gobar gas and Biodiesel.

Combustion of fuels: Introduction – Calorific value – Higher and Lower Calorific values- Theoretical calculation of Calorific value(Dulong formula) – Flue gas analysis (ORSAT Method).

MODULE - VI NANOCHEMISTRY 7

Introduction - Types of nanomaterials - Emergence and challenges in nanotechnology- Synthesis routes for nanomaterials: Bottom-up and top-down approaches - Sol-gel, precipitation, Thermolysis, Laser ablation, Chemical Vapour Deposition (CVD), Electro deposition - Properties of nanomaterials- Mechanical properties, Chemical, Optical, Electrical and Magnetic properties-applications of nanomaterials (Gold nanoparticles as an example). Quantum Dots - concept, properties and applications.

TOTAL: 45 PERIODS

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TEXT BOOKS:

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand &CompanyLTD, New Delhi, 2015.
2. P. C. Jain and Monika Jain, "Engineering Chemistry" Dhanpat Rai Publishing Company (P)LTD, New Delhi, 2015.
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India PVT, LTD, New Delhi, 2013.
4. Ravikrishnan A, 'Engineering Chemistry', Sri Krishna Hitech Publishing Company Pvt. Ltd, New Edition 2024.

REFERENCES:

1. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
2. Prasanta Rath, "Engineering Chemistry", Cengage Learning India PVT, LTD, Delhi, 2015.
3. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015.
4. Chemistry of Nanomaterials Vol.1 S.S.R Kumar Challa (Ed).
5. Advanced chemistry by Phillip Matthews Vol.1 and Vol.2.
6. Chemistry in Engineering and Technology Vol. 1 & 2, J.C. Kuriacose and J. Rajaram.
7. Applied chemistry - A textbook for Engineers and Technologists by H.D. Gesser.

OUTCOMES:

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

1. Explain the importance of polymers in science and technology, describe their roles in different applications and discuss their impacts on modern advancements. (K3)
2. Recognize the basic principles of electrochemistry and describe their application in battery technologies. (K3)
3. Apply the concepts of key photophysical and photochemical processes, as well as spectroscopy, to develop and optimize various applications. (K3)
4. Describe the principles of the second law of thermodynamics and its derivations to analyze engineering applications across all disciplines. (K3)
5. Categorize the chemistry of fuels and combustion and their applications at various levels. (K3)
6. Demonstrate the knowledge of nanomaterials, including their properties, behavior, interactions and applications across various disciplines of science and technology. (K3)

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CO-PO, Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	1	-	-	-	-	-	-	-	1
CO2	3	2	2	2	-	-	-	-	-	-	-	1
CO3	2	1	1	-	-	-	-	-	-	-	-	1
CO4	3	2	1	-	-	-	-	-	-	-	-	1
CO5	3	3	2	1	-	-	-	-	-	-	-	1
CO6	3	3	2	2	-	-	-	-	-	-	-	1

SEMESTER - I

24ESCS101 SDG NO. 4 & 9	PROBLEM SOLVING AND PROGRAMMING IN C	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Interpret Mathematical problems using algorithms, flowchart and pseudocode.
- To understand about the programming language
- To develop C Programs using basic Programming Constructs, Loops, Arrays and Strings
- To develop applications in C using Functions, Pointers and Structures
- To perform I/O operations and File Handling in C

MODULE-I INTRODUCTION TO PROGRAMMING AND ALGORITHMS FOR PROBLEM SOLVING 7

Introduction to Problem Solving through programs- Algorithm-Flowchart–Pseudocode-Memory, Variables, Values, Instructions, Programs-compilation process-Syntax and Semantic Errors- The language of C : Phases of developing a running computer program in C - Character set – Constants – Keywords – Primitive data types –Declaration, Type Conversion

MODULE-II BASICS OF C PROGRAMMING 7

Sequential- Arithmetic Operators, Relational Operators, Logical Operators, Increment Decrement Operators, Bitwise Operators, Assignment Operators and Expressions, Precedence and Order of Evaluation, selective – If Else-If, Switch- repetitive structures-for, while, do while, Nested loops, go to, break, continue –Finding maximum of 3 numbers, Unit converters, Interest calculators, multiplication tables, GCD and LCM, Prime number generation

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MODULE - III ARRAYS AND STRINGS 8

Introduction to Arrays: Declaration, Initialization – One Dimensional Array – Example Program: Computing Mean, Median and Mode - Two Dimensional Arrays – Example Program: Matrix Operations (Addition, Scaling, Determinant and Transpose) - String Operations: Length, Compare, Concatenate - Copy – Selection Sort - Linear and Binary Search.

MODULE - IV FUNCTIONS AND POINTERS 9

Introduction to Functions: Function Prototype, Function Definition, Function Call, Built-in Functions (String Functions, Math Functions) – Recursion – Example Program: Computation of Sine Series - Scientific Calculator using Built-in Functions - Binary Search using Recursive Functions - Factorial and Fibonacci Generation - Towers of Hanoi problem - – Pointers – Pointer Operators – Pointer Arithmetic – Arrays and Pointers –Array of Pointers – Example Program: Sorting of Names – Parameter Passing: Pass by Value - Pass by Reference – Example Program: Swapping of Two Numbers using Pass by Reference.

MODULE - V STRUCTURES 7

Structure - Nested Structures – Pointer and Structures – Array of Structures – Example Program using Structures and Pointers – Self Referential Structures – Dynamic Memory Allocation - Singly Linked List – Typedef.

MODULE - VI FILE PROCESSING 7

Files – Types of File Processing: Sequential Access, Random Access – Sequential Access File - Example Program: Finding Average of Numbers stored in Sequential Access File - Random Access File - Example Program: Transaction Processing Using Random Access Files – Command Line Arguments.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. R.G. Dromey, "How to solve it by Computers", Reprint, PHI Publishers, 2011.
2. Reema Thareja, "Programming in C", Oxford University Press, Second Edition, 2018.
3. Kernighan, B.W and Ritchie D.M, "The C Programming language", Second Edition, Pearson Education, 2015.

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REFERENCES:

1. Yashwant Kanetkar, "Let us C", 18th Edition, BPB Publications, 2021.
2. Byron Gottfried, "Programming with C", Fourth Edition, Tata McGraw Hill Education, 2018.
3. Paul Deitel and Harvey Deitel, "C How to Program", Seventh edition, Pearson Publication, 2015.
4. Jeri R. Hanly & Elliot B.Koffman, "Problem Solving and Program Design in C", Pearson Education, 2013.
5. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", First Edition, Oxford University Press, 2009.
6. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
7. Hanly J R & Koffman E.B, "Problem Solving and Programme design in C", Pearson Education, 2009.

WEB REFERENCES:

1. https://www.learn-c.org/
2. https://codeforwin.org/
3. https://www.cprogramming.com

ONLINE RESOURCES:

1. https://www.linuxtopia.org/online_books/programing_books/gnu_c_programming_tutorial
2. https://nptel.ac.in/courses/106105171
3. https://swayam.gov.in/nd1_noc19_cs42/preview

OUTCOMES:

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

1. Solve basic problems using algorithms, flowcharts, and pseudo code.(K3)
2. Analyze the various programming constructs for basic computational problems.(K4)
3. Implement simple C programs using arrays and strings. (K3)
4. Use functions, recursion, and pointers to perform calculations, searching, and sorting.(K3)
5. Apply structures and dynamic memory allocation in handling complex programming tasks. (K3)
6. Organize sequential and random file processing techniques to provide solutions for real-world computational problems. (K4)

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	2	2
CO2	-	3	-	-	-	-	-	-	-	-	-	2	2
CO3	3	-	-	-	-	-	-	-	-	-	-	1	2
CO4	-	3	-	-	-	-	-	-	-	-	-	2	2
CO5	-	3	-	-	-	-	-	-	-	-	-	2	3
CO6	-	-	3	-	-	-	-	-	-	-	-	3	3

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SEMESTER - I

24HSTA101 - SDG NO. 4	HERITAGE OF TAMILS	L	T	P	CP	C
		1	0	0	1	1

OBJECTIVES:

- Develop interest for classical language and literature to promote Tamil heritage
- Understand the ancient Tamil sculptures, folk and martial arts and contribution of Tamil to the freedom of India

அலகு ஐ மொழி மற்றும் இலக்கியம்

இந்திய மொழிக் குடும்பங்கள் — திராவிட மொழிகள் — தமிழ் ஒரு செம்மொழி — தமிழ் செவ்விலக்கியங்கள் — சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை — சங்க இலக்கியத்தில் பகிர்தல் அறம் — திருக்குறளில் மேலாண்மைக் கருத்துகள்

UNIT I LANGUAGE AND LITERATURE 5

Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural

அலகு II இடைகால மற்றும் நவீன இலக்கியங்கள்

தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம்- பக்தி இலக்கியம் — ஆழ்வார்கள் மற்றும் நாயன்மார்கள் — சிற்றிலக்கியங்கள் — தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி — தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு

Unit II MEDIEVAL AND MODERN LITERATURE 5

Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

அலகு III மரபு ஓ பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை

நடுகல் முதல் நவீன சிற்பங்கள் வரை — ஐம்பொன் சிலைகள் — பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் — தேர் செய்யும் கலை — சுடுமண் சிற்பங்கள் — நாட்டுப்புறத் தெய்வங்கள் — குமரிமுனையில் திருவள்ளுவர் சிலை — இசைக் கருவிகள் — மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் — தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

UNIT III HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE 5

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - Massive Terracotta sculptures> Village deities> Thiruvalluvar Statue at Kanyakumari> Making of musical instruments - Mridhangam> Parai> Veenai> Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

Recommended by
Board of Studies of HAS dept.
Meeting No. 6 Dated: 31/08/24

S. Namasivayam
Chairman
Board of Studies
Department of Humanities & Sciences

அலகு IV நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

UNIT IV FOLK AND MARTIAL ARTS 5

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

அலகு V தமிழர்களின் திணைக் கோட்பாடுகள்

தமிழகத்தின் தாவரங்களும், விலங்குகளும் — தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் — தமிழர்கள் போற்றிய அறக்கோட்பாடு — சங்க காலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் — சங்ககால நகரங்களும் துறைமுகங்களும் — சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி — கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

UNIT V THINAI CONCEPT OF TAMILS 5

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

அலகு VI இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு

இந்திய விடுதலைப் போரில் தமிழர்களின் பங்கு — இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் — சுயமரியாதை இயக்கம் — இந்தியமருத்துவத்தில் சித்த மருத்துவத்தின் பங்கு — கல்வெட்டுகள், கையெழுத்துப்படிகள் — தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

UNIT VI CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE 5

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

TOTAL: 30 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு — மக்களும் பண்பாடும் — கே.கே. பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியில் பணிகள் கழகம்)
2. கணினித் தமிழ் — முனைவர் இல.சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி — வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை — ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

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6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian> Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - „Sangam City Civilization on the banks of river Vaigai... (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation> Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation> Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

OUTCOMES:

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

1. மொழிக் குடும்பங்களின் வரலாறு மற்றும் தமிழ் இலக்கியங்களை மதிப்பிடுகிறார்கள் Students evaluate the history of language families and Tamil literatures (K3)
2. பக்தி மரபுகளின் தாக்கம் பெற்ற தமிழ் இலக்கியங்களைப் புரிந்துகொள்கிறார்கள் Students understand Tamil literatures influenced by Philosophical and religious traditions (K3)
3. தமிழகத்தின் பாறை, சிற்பம், ஓவியம்- கலை மரபுகளைப் பகுப்பாய்வு செய்கிறார்கள் Students analyze the artistic traditions of Tamil Nadu such as rock art, sculpture, and painting (K3)
4. தமிழக நாட்டுப்புறக் கலைகள் மற்றும் தற்காப்புக் கலைகளின் மாண்புகளை உணர்ந்து கொள்கிறார்கள் Students realize the significance of Tamil Nadu's folk arts and martial arts (K3)
5. பழந்தமிழரின் திணையியல் வாழ்வியலை மீளாய்வு செய்கிறார்கள் Students re-examine the ecological lifestyle (Thinai-based life) of the ancient Tamils (K3)
6. தேசிய இயக்கம் மற்றும் இந்தியப் பண்பாட்டில் தமிழர்களின் பங்களிப்பினை நினைவுகூர்கிறார்கள் Students recall the contribution of Tamils to the National Movement and Indian culture (K3)

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Meeting No. 6 Dated: 31/Oct/24

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CO-PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	3	3	-	-	-	-	-	-	-	2	2	2
CO2	2	3	3	-	-	-	-	-	-	-	2	2	2
CO3	2	3	3	-	-	-	-	-	-	-	2	2	2
CO4	2	3	3	-	-	-	-	-	-	-	2	2	2
CO5	2	3	3	-	-	-	-	-	-	-	2	2	2
CO6	2	3	3	-	-	-	-	-	-	-	2	2	2

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SEMESTER - I

24ESGE102 SDG NO. 4,9,12	ENGINEERING PRACTICES LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To provide exposure to the students with hands-on experience on various basic engineering practices in Electrical and Electronics Engineering, Civil and Mechanical Engineering.

ELECTRICAL ENGINEERING PRACTICE

1. Residential house wiring using switches, fuse, indicator, lamp, and energy meter.
2. Fluorescent lamp wiring.
3. Staircase wiring.
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of electrical equipment.

ELECTRONICS ENGINEERING PRACTICE

1. Study of Electronic components and equipment – Resistor- colour coding, measurement of AC signal parameter (peak-peak RMS, period, frequency) using CRO.
2. Study of logic gates AND, OR, EX-OR, and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components, Devices, and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of Half Wave Rectifier and Full Wave Rectifier.
6. Simulation of Half Wave Rectifier and Full Wave Rectifier using TinkerCAD.

CIVIL ENGINEERING PRACTICE

Buildings:

Study of plumbing and carpentry components of residential and industrial buildings, safety aspects.

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Plumbing Works:

1. Study of pipeline joints, its location and functions: valves, taps, couplings,unions, reducers, elbows in household fittings.
2. Study of pipe connections requirements for pumps and turbines.
3. Preparation of plumbing line sketches for water supply and sewage works.
4. Hands-on-exercise: Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
5. Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

1. Study of the joints in roofs, doors, windows and furniture.
2. Hands-on-exercise: Wood work, joints by sawing, planing and cutting.

MECHANICAL ENGINEERING PRACTICE

Welding:

1. Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
2. Gas welding demo practice.

Basic Machining:

1. Simple Turning and Taper turning.
2. Drilling Practice.

Sheet Metal Work:

1. Forming & Bending.
2. Model making – Trays and funnels.
3. Different type of joints.

Demonstration on:

1. Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.
2. Foundry operations like mould preparation for gear and step cone pulley.
3. Fitting – Exercises – Preparation of square fitting and V – fitting models.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Electrical

1. Assorted electrical components for house wiring	15 Sets
2. Electrical measuring instruments	10 Sets
3. Study purpose items:	
Iron box, fan and regulator, emergency lamp	1 Each

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4. Megger (250V/500V)	1 No
5. Power Tools:	
Range Finder	2 Nos
Digital Live-wire detector	2 Nos

Electronics

1. Soldering guns	10 Nos
2. Assorted electronic components for making circuits	50 Nos
3. Small PCBs	10 Nos
4. Multimeters	40 Nos

Civil

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	15 Sets
2. Carpentry vice (fitted to work bench).	15 Nos
3. Standard woodworking tools.	15 Sets
4. Models of industrial trusses, door joints, furniture joints	5 each
5. Power Tools:	
Rotary Hammer	2 Nos
Demolition Hammer	2 Nos
Circular Saw	2 Nos
Planner 2 Nos	
Hand Drilling Machine	2 Nos
Jigsaw 2 Nos	

Mechanical

1. Arc welding transformer with cables and holders	5 Nos
2. Arc welding transformer with cables and holders	5 Nos
3. Welding accessories like welding shield, chipping hammer, wire brush, etc.	5 Sets
4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2 Nos
5. Centre lathe.	2 Nos
6. Hearth furnace, anvil and smithy tools.	2 Sets
7. Moulding table, foundry tools.	2 Sets
8. Power Tool: Angle Grinder.	2 Nos
9. Study-purpose items: centrifugal pump, air-conditioner.	1 each

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OUTCOMES:

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

1. Infer the values of resistance, peak to peak RMS values, time period, frequency. [K2]
2. Outline the logic gates, rectifier, timer circuits and soldering practices. [K2]
3. Demonstrate the measurement of electrical parameters such as voltage, current, resistance, power and energy. (K2)
4. Illustrate the residential wiring, staircase wiring and fluorescent lamp wiring.[K2]
5. Prepare the carpentry and plumbing joints. (K2)
6. Perform the basic operations of welding, sheet metal work and basic machining operations in Lathe and Drilling (K2)

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	1	-	3	2
CO2	3	2	1	-	-	-	-	-	-	-	1	-	3	2
CO3	3	2	1	-	-	-	-	-	-	-	1	-	3	2
CO4	3	1	1	-	-	-	-	-	-	-	1	-	3	2
CO5	2	-	-	-	-	-	-	2	-	-	-	-	2	2
CO6	2	-	-	-	-	-	-	2	-	-	-	-	2	2

SEMESTER - I

24BSPL101 SDG NO. 4,6,11, 12 & 17	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
		0	0	4	2

PHYSICS LABORATORY (Any Five Experiments to be conducted)

OBJECTIVES:

- Demonstrate the wave nature of light using diffraction and interference properties.
- Study the thermal conductivity of a bad conductor.

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- Verify experimentally the elastic properties of materials.

Sl.No.	Name of the Experiment
1	(a) Determination of wavelength of Laser (b) Determination of numerical aperture and acceptance angle in an optical fiber. (c) Determination of particle size using laser source.
2	Determination of thermal conductivity of a bad conductor – Lee's Disc method.
3	Determination of Young's modulus by non-uniform bending method.
4	Determination of the period of oscillation of a given torsional pendulum for a fixed length and find the rigidity modulus of the wire.
5	Find out the thickness of the given wire by air wedge method.
6	Calculation of lattice cell parameter – X-ray diffraction method.
7	Determination of Planck's constant.
8	Determination of wavelength of mercury spectrum – spectrometer grating.
9	Determination of velocity of sound and compressibility of liquid – Ultrasonic Interferometer.
10	Determination of band gap of a semiconductor.
11	Determination of Hall coefficient by Hall Effect experiment.
12	Determination of solar cell characteristics.

CHEMISTRY LABORATORY (Any Five Experiments to be conducted)

OBJECTIVES:

- To acquaint students with practical knowledge of the basic concepts of chemistry that they will encounter during their studies and in the industry and engineering fields.
- To acquaint students with the determination of the molecular weight of a polymer by viscometry.
- To develop and understand the basic concepts of acidic and basic nature using pH.

Sl.No.	Name of the Experiment
1	Conductometric titration of strong acid vs strong base.
2	Determination of chloride content of water sample by Argentometric method.
3	Determination of strength of acids in a mixture of acids using conductivity meter.

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4	Determination of total, temporary & permanent hardness of water by EDTA method.
5	Estimation of iron content of the given solution using potentiometer.
6	Determination of DO content of water sample by Winkler's method.
7	Determination of strength of given hydrochloric acid using pH meter.
8	Estimation of iron content of the water sample using spectrophotometer (1,10- Phenanthroline / thiocyanate method).
9	Estimation of Sodium and Potassium in the given sample of water using Flame Photometer.
10	Determination of molecular weights of polymer samples using Ostwald's Viscometer.
11	Synthesis of nano-CdS by precipitation. (Demonstration only)
12	Corrosion experiment-weight loss method.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Engineering Physics Lab, Dr. G. SenthilKumar, VRB publishers. (2019)
2. Engineering Physics Practical, Dr. P. Mani, Dhanam Publications. (2020)

TEXTBOOK:

1. Vogel's Textbook of Quantitative Chemical Analysis (8th edition,2014).
2. Practical Physical chemistry by B. Viswanathan, P. S. Raghavan (Vivabooks), 2009.
3. Foundation of Experimental Chemistry by Jubaraj B. Baruah, ParikshitGogoi, 2010.

OUTCOMES:

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

1. Demonstrate the wave nature of light using diffraction and interference properties. (K3)
2. Study the thermal conductivity of a bad conductor. (K3)
3. Verify experimentally the elastic properties of materials. (K3)
4. Describe multiple measurement techniques, including volumetric titrations, conductivity, pH, redox potential and optical density measurements, used to estimate the amount of substance present in a solution. (K3)

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5. Apply spectroscopic techniques to determine the concentration of metal ions in solutions and use viscometry to determine the molecular weight of a polymer. (K3)
6. Demonstrate the ability to synthesize nanoparticles using simple chemical or physical methods and apply the weight loss method to study and analyze the corrosion behavior of materials in different environments.(K3)

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	-	-	-	-	-	-	3
CO2	3	3	2	2	-	-	-	-	-	-	-	2
CO3	3	3	2	2	-	-	-	-	-	-	-	3
CO4	2	2	2	1	-	-	-	-	-	-	-	1
CO5	2	2	2	1	-	-	-	-	-	-	-	1
CO6	2	2	2	1	-	-	-	-	-	-	-	1

SEMESTER - I

24ESPL101 SDG NO. 4 & 9	PROGRAMMING IN C LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To develop programs in C using basic Programming Constructs
- To develop applications in C using Arrays and Strings
- To design and implement applications in C using Functions, Structures
- To develop applications in C using Files

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LIST OF EXPERIMENTS

1. Write a program using I/O statements and expressions.
2. Write programs using decision-making constructs.
3. Write a program to find whether the given year is a leap year or not? (Hint: not every century is a leap. For example 1700, 1800 and 1900 is not a leap year)
4. Write a program to perform the Calculator operations, namely, addition, subtraction, multiplication, division and square of a number.
5. Write a program to check whether a given number is an Armstrong number or not?
6. Write a program to check whether a given number is odd or even?
7. Write a program to find the factorial of a given number.
8. Write a program to find out the average of 4 integers.
9. Write a program to print half pyramid of *.
10. Write a program to display array elements using two dimensional arrays.
11. Write a program to perform swapping using a function.
12. Write a program to display all prime numbers between two intervals using functions.
13. Write a program to solve towers of Hanoi using recursion.
14. Write a program to get the largest element of an array using the function.
15. Write a program to concatenate two strings.
16. Write a program to find the length of String.
17. Write a program to find the frequency of a character in a string.
18. Write a program to store Student Information in Structure and Display it.
19. The annual examination is conducted for 10 students for five subjects. Write a program to read the data and determine the following:

(a) Total marks obtained by each student.

(b) The highest marks in each subject and the marks of the student who secured it.

(c) The student who obtained the highest total marks.

20. Write a program to demonstrate file operations (e.g. count the number of characters, words and lines in a file, replace a specific word with the given word in the same file).

TOTAL: 30 PERIODS

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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Stand alone desktops with C compiler 30 Nos. (Or)
   Server with C compiler supporting 30 terminals or more.

OUTCOMES:

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

1. Illustrate C programs for simple applications making use of basic constructs, arrays, strings, functions and recursion.(K2)
2. Demonstrate C programs involving pointers, and structures. (K3)
3. Interpret applications using sequential and random access files. (K3)

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	-	-	-	-	-	-	3	1	2
CO2	3	3	3	3	2	-	-	-	-	-	-	3	2	1
Co3	3	3	3	3	2	-	-	-	-	-	-	3	3	2

SEMESTER - I

24ESID101 SDG NO. 1-17	IDEA ENGINEERING LAB - I	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To understand the significance of Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs) of the United Nations
- To familiarize with SDG targets and indicators
- To identify the Constitutional implementation pertaining to SDGs in Panchayat Raj
- To acquire knowledge of the State and the Central government welfare schemes
- To recognise the role of educational institutions' in community development
- To develop critical thinking skills to address complex societal challenges through an immersion program

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MODULE - I United Nations Sustainability and the Sustainable Development Agenda 3

- Introduction to Sustainability
- Indian Rural Environment: Necessity and Sustainability
- Millennium Development Goals (MDGs)
- United Nations Sustainable Development Goals (SDGs) & the Agenda
- Overview of the Sustainable Development Goals (SDGs)

MODULE - II Universal SDG Targets 4

- SDG Framework
- Key Components
- Pillars of the SDGs
- Targets of the Goals
- Indicators of the Targets

MODULE - III SDG and Indian Gram Panchayat 3

- Gram Panchayat
- Salient Features of Constitutional Amendments
- Transition from SDGs to LSDGs (Localizing Sustainable Development Goals)

MODULE - IV Government Schemes 4

- Introduction to State and Central Government Schemes
- Overview of Government Schemes
- Localization and Implementation at the Regional Level
- Impact on Local Communities

MODULE - V Community Engagement 4

- Key Recommendations of the National Education Policy
- Guidelines for Fostering Social Responsibility
- Awareness
- Participation
- Collaboration

MODULE - VI Idea Generation 12

- Immersion Program
- Focus Areas
- Channelizing Ideas
- Forming Working Teams for SDGs (Sustainable Development Goals)

TOTAL: 30 PERIODS

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REFERENCES:

1. Joy Elamon and Ms. Mariamma Sanu George,"The Handbook on Sustainable Development Goals and Gram Panchayats" , State Institute for Rural Development (SIRD).
2. Dr.C.R.Rene Robin, Dr.PA.Shanthi , Dr.B.Thanuja & Dr.V.Yuvaraj ,"Sairam SDG Idea Engineering Lab I", Sri Sairam Engineering College.

WEB REFERENCES

1. UN Sustainable Development Goals
2. https://srmuniv.digimat.in/nptel/courses/video/109106200/L30.html
3. https://avcce.digimat.in/nptel/courses/video/109106200/L26.html

OUTCOMES:

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

1. Understand the United Nations Agenda of MDGs and SDGs (K1)
2. Summarize the targets and indicators of SDGs (K2)
3. Interpret the constitutional amendments of LSDG in Gram Panchayat (K2)
4. Classify various localized and regional government schemes (K2)
5. Understand social responsibility in community development (K1)
6. Implement viable projects in SDGs through the immersion program (K3)

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	2	2	-	2	-	2	2
CO2	-	-	-	-	-	2	2	-	2	-	2	2
CO3	-	-	-	-	-	2	2	-	2	-	2	2
CO4	-	-	-	-	-	2	2	-	2	-	2	2
CO5	-	-	-	-	-	2	2	-	2	-	2	2
CO6	2	2	-	-	-	2	2	-	2	-	2	2

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SEMESTER - I

24ENTP101 SDG NO. 4	FUNCTIONAL LIFE SKILLS	L	T	P	C
		0	0	2	1

OBJECTIVES:

- Resolve common communication problems
- Observe the effectiveness of nonverbal messages
- Communicate precisely through the digital media
- Understand the importance of empathetic listening
- Explore reading and speaking processes

MODULE - I LISTENING 5

Techniques of effective listening
Listening and comprehending
Probing questions
Barriers to listening
Reflection from listening

MODULE - II SPEECH MECHANICS 5

Pronunciation
Enunciation
Vocabulary
Fluency
Common errors

MODULE - III READING SKILLS 5

Techniques of effective reading
Kinds of reading
Gathering ideas and information from the text
Evaluating the ideas and information
Interpreting the text from multiple angles

MODULE - IV WRITING ASPECTS 5

Writing process
Effective writing strategies
Different modes of writing
Optimizing the use of resources
Editing

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MODULE - V PRESENTATION SKILLS 5

Types of presentations
Nonverbal communication
Understanding the purpose and the audience
Beginning and closure of presentations
Presentation tools and strategies

MODULE - VI ARTICULATION ASPECTS 5

Perform exercises
Slow speeches
Long speeches
Monologues, Dialogues and Conversation
Feedback necessity

TOTAL : 30 PERIODS

REFERENCES:

1. Sen, Madhuchanda.2010, An Introduction to Critical Thinking, Delhi, Pearson.
2. Effective Communication Skills Strategies for Success. Edited by Nitin Bhatnager and Mamta Bhatnager. 2023, Pearson
3. Technical Communication: Principles and Practice, Meenakshi Raman and Sangeeta Sharma. Oxford University Press, 2015

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc19_hs31/preview
2. https://www.myenglishpages.com/speaking/#google_vignette

OUTCOMES:

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

1. Utilize various listening techniques effectively (K1)
2. Demonstrate the ability to speak spontaneously in different contexts (K1)
3. Comprehend and interpret written texts accurately (K2)
4. Exhibit the ability to write freely with sufficient and relevant content (K1)
5. Articulate explanations clearly and concisely (K1)
6. Understand and present convincing speeches/ arguments effectively (K2)

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CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	2	-	2	-	-
CO2	-	-	-	-	-	-	-	-	-	2	-	2	-	-
CO3	-	-	-	-	-	-	-	-	-	2	-	2	-	-
CO4	-	-	-	-	-	-	-	-	-	2	-	2	-	-
CO5	-	-	-	-	-	-	-	-	-	2	-	2	-	-
CO6	-	-	-	-	-	-	-	-	-	2	-	2	-	-

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SEMESTER - II

24BSMA201 SDG NO. 4	DISCRETE STRUCTURES	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To understand the concepts of Logic, Rules of inference and Quantifiers.
- To learn the concepts of Mathematical induction, Permutation and Combination.
- To impart the knowledge on Groups and Normal subgroups.
- To develop Graph Algorithms by using the concepts of Graphs.
- To learn the concepts of Lattices and Boolean algebra.

MODULE - I LOGICS 9

Basic Connectives – Truth Tables – Logical Equivalence - The Laws of Logic- Logical Implications - Normal Forms – Rules of Inference – The use of Quantifiers.

MODULE - II COMBINATORICS 9

The Principles of Mathematical Induction – Basic counting techniques – Inclusion and exclusion - Pigeonhole principle – Permutation – Combination.

MODULE - III ALGEBRAIC STRUCTURES WITH ONE BINARY OPERATION 12

Semi Groups– Monoids– Groups - Subgroups – Cosets- Normal subgroups – Lagrange's theorem.

MODUL - IV GRAPHS 12

Graphs - Definition -Special types of Graphs- Matrix representation of Graphs - Graph isomorphism- Path, Cycle, Connectivity - Eulerian and Hamiltonian Graphs.

MODULE - V LATTICES 9

Partial ordering - Posets - Lattices as Posets - Properties of lattices - Lattices as algebraic systems - Sub lattices - Direct product and homomorphism - Some special lattices.

MODULE - VI BOOLEAN ALGEBRA 9

Boolean Algebra – Definition – Identities of Boolean Algebra -Demorgan's laws.

TOTAL: 60 PERIODS

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TEXT BOOKS:

1. Discrete Mathematics and its Applications: with Combinatorics and Graph Theory, Kenneth H. Rosen, 7th Edition, Tata McGraw –Hill Education Pvt. Ltd., 2015.
2. Discrete Mathematical Structure with Applications to Computer Science", J.P. Tremblay and R. Manohar, McGraw-Hill Education (India) Edition 1997.

REFERENCES:

1. Discrete Mathematics with Applications, Susanna S. Epp, 4th edition, Brooks/Cole, Cengage Learning, 2010.
2. Discrete Mathematics, Norman L. Biggs, 2nd Edition, Oxford University Press, 2002.
3. Discrete Mathematics, Seymour Lipschutz, Marc Lipson, Schaum's Outlines Series, 3rd edition, McGraw-Hill Education, 2009.
4. Elements of Discrete Mathematics: A Computer Oriented Approach, C. L. Liu and D. P. Mohapatra, 4th Edition, Tata McGraw –Hill Education Pvt. Ltd., 2012.

WEB REFERENCES:

1. https://web.stanford.edu/class/cs103x/cs103x-notes.pdf
2. https://www.cs.cornell.edu/~rafael/discmath.pdf
3. http://home.iitk.ac.in/~arlal/book/mth202.pdf
4. https://drive.google.com/file/d/1-PqMUlqDim1-AHQK5_zL34I97zHV3W15/view

ONLINE RESOURSES:

1. https://nptel.ac.in/courses/106106183
2. https://www.youtube.com/watch?v=xlUFkMKSB3Y&list=PL0862D1A947252D20
3. https://www.youtube.com/watch?v=4LlTmsfDS4Y&list=PLEAYkSg4uSQ2Wfc_l4QEZUSRdx2ZcFziO&index=13
4. https://www.youtube.com/watch?v=jBsEKyx6Rj0&list=PLwdnzlV3ogoVxVxCTlI45pDVM1aoYoMHf
5. https://www.youtube.com/watch?v=rdXw7Ps9vxc&list=PLHXZ9OQGMqxersk8fUxiUMSIx0DBqsKZS

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OUTCOMES:

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

1. Construct mathematical arguments using logical connectives, quantifiers and verify the correctness of an argument using symbolic logic, truth tables. (K3)
2. Apply counting principle and mathematical induction to solve combinatorial problems. (K3)
3. Explain the fundamental concepts of algebraic structures such as groups and Boolean algebra. (K3)
4. Illustrate the concepts of graphs. (K3)
5. Apply the concepts of Lattices in the field of computer science. (K3)
6. Apply the concepts of Boolean algebra in logical circuits. (K3)
6. Solve difference equations using Z-transforms. (K3)

CO-PO, MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	2
CO2	3	-	-	-	-	-	-	-	-	-	-	2
CO3	3	-	-	-	-	-	-	-	-	-	-	2
CO4	3	-	-	-	-	-	-	-	-	-	-	3
CO5	3	-	-	-	-	-	-	-	-	-	-	2
CO6	3	-	-	-	-	-	-	-	-	-	-	3

SEMESTER - II

24HSEN201 SDG NO. 4	PROFESSIONAL ENGLISH	L	T	P	C
		2	0	0	2

OBJECTIVES:

- Acquire techniques for comprehending and critically analyzing passages
- Improve the communicative competence
- Enhance learners' ability to read and write complex texts, summaries, definitions and reports
- Write effective formal letters and reports
- Develop skills for preparing effective job application

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MODULE - I EFFECTIVE COMMUNICATION 6

Listening – Listening to conversations – Speaking – making conversations in real life occurrences – Reading - short stories, happenings - Writing – autobiographical writing, preparation of checklist – communication and types of communication – Language Development –- subject - verb agreement, commonly confused words – spellings

MODULE - II BASICS OF TECHNICAL WRITING 5

Listening – listening to advertisements and products – Speaking - creating greetings/wishes/excuses and thanks – Reading – articles/novels - Writing - summary of articles, writing modes, formats, compositions - Language Development - reported speech, numerical adjectives

MODULE - III REPORT WRITING 4

Listening – listening to podcasts – Speaking - practicing telephonic conversations – observing and responding. Reading – regular columns of newspapers/magazines - Writing – reports – feasibility, accident, preparation of agenda and minutes – Language Development - cause & effect expressions, discourse markers

MODULE - IV DIVERSE WRITING SKILLS 5

Listening – documentaries, anecdotes and short stories - Speaking – expressing opinions using verbal and non-verbal communication – Reading biographies/autobiographies, travelog, – Writing – formal letters – inviting guests – acceptance/declining letters - Language Development- degrees of comparison – embedded sentences - acronyms and abbreviations

MODULE - V CAREER COMPETENCIES 6

Listening – expert talks – recommending suggestions & solutions – Speaking – Debate- participating in a group discussion – learning GD strategies – Reading – innovations, ideations - Writing – Job application, resume, – proposals – Language Development – verbal analogies – phrasal verbs

MODULE - VI LEXICAL ENHANCEMENT 4

Listening - technical and general talks - Speaking - oral presentation with visual aids - Reading - successful stories/autobiographies - Writing - writing blogs - Language Development - common errors in English, idiomatic expressions

TOTAL: 30 PERIODS

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TEXT BOOKS:

1. Board of editors. Fluency in English: A Course book for Engineering and Technology. Orient Blackswan, Hyderabad 2016.
2. Raman, Meenakshi, Sharma. Sangeeta (2019). Professional English. Oxford University Press.

REFERENCES:

1. Bailey, Stephen. Academic Writing: A Practical Guide for Students. Routledge, New York,2011.
2. Raman, Meenakshi, Sharma, Sangeeta. Technical Communication. Principles and Practice. Oxford University Press, New Delhi, 2014.
3. Muralikrishnan & Mishra Sunitha, Communication skills for Engineers 2nd ed. Pearson, Tamil Nadu, India 2011. P. Kiranmai and Rajeevan, Geetha. Basic Communication Skills, Foundation Books, New Delhi, 2013.
4. Vesilind Aarne P., Public Speaking and Writing Skills for Engineering Students (2nd Ed), Lakeshore press, 2007
5. Richards, Jack C. Interchange Students' Book – 2. Cambridge University Press, New Delhi, 2015.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc20_hs21/preview
2. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/109106122/lec1.pdf
3. https://takelessons.com/en-in/search?service=English&sort=1&utm_

ONLINE RESOURCES:

1. https://www.coursera.org/specializations/improve-english?
2. https://www.fluentu.com/blog/educator-english/business-english-conversation-topics/

OUTCOMES:

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

1. Demonstrate an understanding of various types of communication and prepare effective checklists.(K2)
2. Summarize articles/ write ups (K2)
3. Construct feasibility reports, accident reports, survey reports and meeting minutes (K3)
4. Apply skills to compose official letters with emphasis and clarity (K3)

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5. Compose job applications and technical proposals (K3)
6. Demonstrate the ability to express opinions in both oral and written forms of communication (K2)

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO4	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO5	-	-	-	-	-	-	-	-	-	3	-	3	-	-
CO6	-	-	-	-	-	-	-	-	-	3	-	3	-	-

SEMESTER - II

24BSPH203 SDG NO. 4	PHYSICS FOR INFORMATION SCIENCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the essential principles of physics of conducting materials, superconducting and optical properties of materials
- To educate the basic principles of semiconductor device and electron transport properties
- To become proficient in magnetic materials
- To acquaint the basics of superconducting and optical materials
- To acquire the basic working of nanoelectronic devices
- To understand the basics of quantum computing

MODULE - I CONDUCTING MATERIALS 8

Classical free electron theory - Expression for electrical conductivity - Thermal conductivity expression - Wiedemann-Franz law - Success and failures - Fermi- Dirac statistics - Density of energy states - Electron in periodic potential - Energy bands in solids – Electron effective mass - Concept of hole.

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MODULE - II SEMICONDUCTOR MATERIALS **7**

Direct and indirect band gap semiconductors - Intrinsic Semiconductors - Carrier concentration in intrinsic semiconductors - Extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors - Variation of carrier concentration with temperature - Variation of Fermi level with temperature and impurity concentration - Carrier transport in Semiconductor: random motion, drift, mobility and diffusion - Hall effect and devices.

MODULE - III MAGNETIC PROPERTIES OF MATERIALS **8**

Magnetic dipole moment - atomic magnetic moments - magnetic permeability and susceptibility - Magnetic material classification: diamagnetism - paramagnetism - ferromagnetism - antiferromagnetism - ferrimagnetism - Ferromagnetism: Domain Theory - M versus H behaviour - Hard and soft magnetic materials - applications – Magnetic principle in computer data storage - Magnetic hard disc - GMR sensor.

MODULE - IV SUPERCONDUCTING & OPTICAL PROPERTIES OF MATERIALS **7**

Superconductivity - Type-I and Type-II superconductors - Properties and applications - Classification of optical materials - Absorption and emission of light in metals, semiconductors and insulators - Carrier generation and recombination processes - Photo current in a P-N diode - Solar cell - LED - Organic LED - Optical data storage techniques and devices.

MODULE - V NANO DEVICES **8**

Introduction - Size dependence of Fermi energy - Quantum confinement - Quantum structures - Density of states in quantum well, quantum wire and quantum dot structure - Band gap of nanomaterials - Tunneling: single electron phenomena and single electron transistor - Quantum dot laser - Carbon nanotubes: Properties and applications.

MODULE - VI QUANTUM COMPUTING **7**

Quantum system for information processing - quantum states – classical bits – quantum bits or qubits – multiple qubits – Bloch sphere - Superposition - Entanglement - quantum gates - CNOT gate - Types of Quantum Computer: Quantum Annealer- Analog Quantum- Universal Quantum.

TOTAL: 45 PERIODS

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TEXT BOOKS:

1. Jasprit Singh, "Semiconductor Devices: Basic Principles", Wiley 2012.
2. Kasap, S.O., "Principles of Electronic Materials and Devices", McGraw- Hill Education, 2017.
3. Kittel, C., "Introduction to Solid State Physics", Wiley, 2018.
4. S.O.Pillai, "Solid State Physics, New Academic Science", 2017.
5. D.K.Bhattacharya & Poonam Tandon., "Physics for Information Science and Electronics Engineering", Oxford Higher Education", 2017.

REFERENCES:

1. Garcia, N. & Damask, A., "Physics for Computer Science Students", Springer-Verlag, 2012.
2. Hanson, G.W., "Fundamentals of Nanoelectronics", Pearson Education, 2009.
3. Rogers, B., Adams, J. & Pennathur, S., "Nanotechnology: Understanding Small Systems", CRC Press, 2014.

OUTCOMES:

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

1. Explore the basic concepts of free electron theory of solids and apply it to determine the conducting properties, carrier concentration and effective mass of an electron in conductors (K3)
2. Analyze the band structures and carrier concentrations of semiconductors, study their variations with temperature, and examine carrier transport mechanisms (K4)
3. Have an insight into the different types of magnetic materials and magnetic data storage device (K3)
4. Analyze the properties of superconductors and optical interactions in materials and explain the working of optoelectronic and optical storage devices (K4)
5. Examine quantum confinement and quantum structures, analyze the working principles of quantum devices, and explore the applications of carbon nanotubes (K4)
6. Apply the basic concepts of quantum computing to demonstrate the operation of quantum gates and the formation of entangled states (K3)

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CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	-	3	-	-	-	-	-	-	-	-	-	-
CO5	-	3	-	-	-	-	-	-	-	-	-	-
CO6	3	-	-	-	-	-	-	-	-	-	-	-

SEMESTER - II

24BSCY201 SDG NO. 4	CHEMISTRY FOR ENVIRONMENT AND SUSTAINABILITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To gain a comprehensive understanding of environmental science, the intricate relationships within ecosystems, and the crucial role of biodiversity conservation..
- To introduce the structure and components of the atmosphere, and provide an overview of the photochemical reactions involved.
- To foster a sound understanding of water quality parameters and water treatment techniques.
- To explore the various components of soil and understand the steps involved in Solid Waste Management (SWM).
- To advocate the benefits of renewable energy and promote awareness of sustainable energy practices. .
- To implement the principles of Green Chemistry in alignment with the Sustainable Development Goals (SDGs).

MODULE - I INTRODUCTION TO ENVIRONMENTAL SCIENCE 8

Environment: Definition, concept of environment and its components - scope and importance of environment – need for public awareness.

Ecosystem: Structure and functions: Structures - Biotic and Abiotic components. Functions - Energy flow in ecosystems, food chains and food webs. Biogeochemical cycles(C,N&P), Ecological succession.

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Biodiversity and its conservation: Definition, types, importance of biodiversity, values and threats to biodiversity. Endangered and endemic species - concept and basis of identification of 'Hotspots'; hotspots in India. Strategies for biodiversity conservation: in situ, ex situ and in vitro conservation.

MODULE - II ATMOSPHERIC CHEMISTRY 7

Atmospheric Chemistry - Composition and structure of atmosphere. Climate change - greenhouse effect - role of greenhouse gases (CO2, CH4, N2O, CFCs) on global warming. Chemical and photochemical reactions in the atmosphere - Formation of smog, PAN, acid rain (causes, effect and control measures). Oxygen and ozone chemistry - Ozone layer depletion (causes, effect and control measures).

MODULE - III WATER CHEMISTRY 8

Importance and scope of water chemistry - Sources and impurities in water - Water Quality Parameters - Specifications as per WHO/BIS standards. Hardness of water, types, numerical problems on hardness of water. Softening of water - Internal treatment (Lime-soda, Phosphate, Calgon, Sodium Aluminate and Colloidal conditioning). External treatments: Ion exchange and Zeolite processes. Municipal water treatment: primary treatment and disinfection (UV, Ozonation, break-point chlorination). Desalination of brackish water by Reverse osmosis. Sustainable water management practices (water recycling and rainwater harvesting)

MODULE - IV SOIL CHEMISTRY AND SOLID WASTE MANAGEMENT 7

Soil Chemistry: Chemical composition of soil, Acid-Base and Ion-Exchange Reactions in Soil, Soil acidity and salinity. Importance of NPK in Soil Fertility. Modern agriculture - Impacts of both excessive and insufficient fertilizer use, alongside the effects of pesticides on soil chemistry and the environment. Sustainable agriculture - Approaches to improve soil salinity (leaching, soil amendments, crop rotation), Design and use of green pesticides for sustainable farming.

Solid Waste Management System: Sources and types of solid waste, Elements of solid waste management, Methods of residential and commercial waste collection, Treatment / processing - Incineration, Composting, Landfill - Dumpsite rehabilitation.

MODULE - V ENERGY AND ENVIRONMENT 8

Energy sources – Renewable and non-renewable energy sources. Principle and generation of solar energy (solar collectors, photo-voltaic modules, solar ponds), wind energy, geothermal energy; tidal energy, OTEC energy from

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biomass, biofuels, Nuclear energy - fission and fusion, Nuclear fuels, Nuclear reactor – principles and types. Need for energy efficiency, Energy conservation and sustainability - action strategies for sustainable energy management from a future perspective.

MODULE - VI GREEN CHEMISTRY AND SUSTAINABILITY 7

Green Chemistry: Introduction to green chemistry, Principles of Green Chemistry (12-principles), the concept of atom economy and chemical synthesis, Important techniques used in green chemistry. Application of green chemistry, viz. replacement of ozone depleting substances including CFCs, manufacture of biodegradable polymers, use of H2O2 as benign bleaching agents in the paper industry.

Sustainable Development: Definition and concepts of sustainable development, Need for sustainable development; Sustainable development goals – 17 SDG goals.

Sustainable practices: Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment and Environmental Impact Assessment.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
3. Ravikrishnan A, 'Environmental Science and Engineering', Sri Krishna Hitech Publishing Company Pvt. Ltd, Revised Edition 2020.
4. Vogel's Textbook of Quantitative Chemical Analysis (8th edition,2014).

REFERENCES:

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) PVT, LTD, Hyderabad, 2015.
3. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India PVT, LTD, Delhi, 2014.
4. Chemistry for Environmental Engineering, Clair N. Sawyer, Perry L. Mc Carty, Gene F. Parkin, 4th Edition, McGraw-Hill.

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OUTCOMES:

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

1. Develop a foundational understanding of environmental science, the interactions within ecosystems, the significance of biodiversity, and the importance of conservation strategies for maintaining ecological balance. (K3)
2. Identify the primary components of the atmosphere, explain the causes of atmospheric pollution, and propose basic strategies to promote a sustainable and clean atmosphere. (K3)
3. Demonstrate complex water quality parameters, and develop innovative methods for producing cost-effective soft water suitable for both industrial use and potable consumption. (K3)
4. Describe the composition and functions of soil components, analyze the sources and characteristics of solid wastes, and evaluate the methods and strategies employed in solid waste management (SWM). (K3)
5. Explain renewable and non-renewable resources, describe various methods for harnessing energy from different sources and explain their applications in various contexts. (K3)
6. Illustrate a comprehensive understanding of green chemistry principles and their alignment with sustainable development goals, preparing them to contribute to environmentally friendly and sustainable practices in their future careers.(K3)

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	-	-	-	-	-	-	-	-	2
CO2	3	2	2	-	-	-	-	-	-	-	-	3
CO3	3	2	1	-	-	-	-	-	-	-	-	3
CO4	2	2	1	-	-	-	-	-	-	-	-	2
CO5	3	2	2	-	-	-	-	-	-	-	-	3
CO6	3	3	-	2	1	-	-	-	-	-	-	3

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SEMESTER - II

24HSTA201 SDG NO. 4	TAMILS AND TECHNOLOGY	L	T	P	C
		1	0	0	1

OBJECTIVES:

- Understand the techniques that help for a better livelihood
- Identify the methods used for scientific Tamil computing

UNIT - I WEAVING AND CERAMIC TECHNOLOGY 3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT - II DESIGN AND CONSTRUCTION TECHNOLOGY 3

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

UNIT - III MANUFACTURING TECHNOLOGY 3

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads - Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

UNIT - IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT - V SCIENTIFIC TAMIL & TAMIL COMPUTING 3

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2 கணினித் தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3 கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)

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4. பொருநை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

தமிழர் மரபு

அலகு - I நெசவு மற்றும் பானைத் தொழில்நுட்பம்: 3

சங்க காலத்தில் நெசவுத் தொழில் - பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு - II வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்: 3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க கொலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு- சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் ___ சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் - சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் - நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாட்டு வீடுகள் - பிரிட்டிஷ் கொலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக் கலை.

அலகு - III உற்பத்தித் தொழில் நுட்பம்: 3

கப்பல் கட்டும் கலை -உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருக்குதல், எஃகு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணொடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத்துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு - IV வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்: 3

அணை, ஏரி, குளங்கள், மதகு -சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் -

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வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் ___ பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.

அலகு - V அறிவியல் தமிழ் மற்றும் கணித்தமிழ்: 3

அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக்கழகம் - தமிழ் மின் நூ லகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai" (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

OUTCOMES:

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

1. Understand Weaving and Ceramic Technology during Sangam Age (K2)
2. Explore about Design & Construction of House and Temples during Sangam Age (K2)

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3. Appreciate Manufacturing Technology of Tamils (K2)
4. Perceive Agriculture and Agro-processing during Sangam Age (K2)
5. Comprehend Ancient Knowledge of Ocean & Fisheries(K2)
6. Understand the Scientific Tamil & Tamil Computing (K2)

CO-PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	3	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	3	-	-	-	-	-	3	-	-
CO3	3	-	-	-	-	3	-	-	-	-	-	3	-	-
CO4	3	-	-	-	-	3	-	-	-	-	-	3	-	-
CO5	3	-	-	-	-	3	-	-	-	-	-	3	-	-
CO6	3	-	-	-	-	3	-	-	-	-	-	3	-	-

SEMESTER - II

24ESGE101 SDG NO. 4,6,7,9, 12,14 & 15	ENGINEERING GRAPHICS	L	T	P	C
		1	2	0	3

OBJECTIVES:

- To develop in students, graphic skills for communication of concepts, ideas and design of engineering products.
- To visualize the job in three dimensions.
- To have a clear conception and appreciation of the shape, size, proportion and design.
- To expose the student community to existing national standards related to technical drawings.

MODULE - I PLANE CURVES 6+4

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid on Horizontal Surfaces – Drawing of tangents and normal to the above curves.

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MODULE - II PROJECTION OF POINTS, LINES AND PLANES 6+4

Projection of Points (Concept only). Projection (Elevation and Plan) of straight lines, inclined to both reference planes by rotating line method. Projection of plane surfaces, inclined to one of the reference planes by rotating object method.

MODULE - III PROJECTION OF SOLIDS 6+4

Projection of regular solids (Prisms, Pyramids, Cylinder and cone) in first quadrant, by rotating object method when the axis is inclined to one of the reference planes.

MODULE - IV ORTHOGRAPHIC PROJECTION 6+4

Orthographic Projection - Principles of orthographic projections, Orthographic projection of objects from pictorial view.

MODULE - V SECTION AND DEVELOPMENT OF LATERAL SURFACE 6+4

Projection of sectioned solids (Prisms, Pyramids, Cylinder and cone) and true shape of the sections, when the axis of the solid is perpendicular to HP alone and cutting plane inclined to HP only. Development of lateral surfaces of sectioned regular vertical solids (Prisms, Pyramids, Cylinder and Cone) with cutting plane inclined to HP only.

MODULE - VI ISOMETRIC PROJECTIONS 6+4

Isometric projection – Principle, isometric scale, Isometric views and Isometric projections of truncated solids - Prisms, Pyramids, Cylinder and Cone in simple vertical positions only.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2011.
2. T. Jeyapoovan, "Engineering Graphics using AUTOCAD", Vikas Publishing House Pvt Ltd, 7th Edition.

REFERENCES:

1. N S Parthasarathy and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
2. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.
3. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.

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WEB REFERENCES:

1. https://archive.nptel.ac.in/courses/112/102/112102304/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/105/104/105104148/
2. https://nptel.ac.in/courses/112/103/112103019/

OUTCOMES:

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

1. Perform free hand drawing of conical sections and cycloids. (K3)
2. Sketch the orthographic projection of lines and plane surfaces of rectangle, square, pentagon and Hexagon. (K3)
3. Draw the orthographic projection of regular solids like prism, pyramids, cylinder and cone using change of position method. (K3)
4. Draw plan, elevation and side views for the 3dimensional isometric drawing by using the concepts of orthographic projection. (K3)
5. Draw the section and development of lateral surfaces for the regular solids like Prism, Pyramid, Cylinder and Cone for the axis perpendicular to HP. (K3)
6. Draw the isometric view, projection for regular and truncated solids like Prism, Pyramid, Cylinder and Cone. (K3)

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	2	-	-	-	-	3
CO2	3	-	-	-	-	-	-	-	2	-	-	-	-	3
CO3	3	-	-	-	-	-	-	-	2	-	-	-	-	3
CO4	3	-	-	-	-	-	-	-	3	-	-	-	-	3
CO5	3	-	-	-	-	-	-	-	2	-	-	-	-	3
CO6	3	-	-	-	-	-	-	-	3	-	-	-	-	3

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SEMESTER - II

24HSNC201 SDG NO. 4	NCC COURSE LEVEL 1	L	T	P	C
		2	0	0	0

ARMY WING

NCC GENERAL		**6**
NCC 1	Aims, Objectives & Organization of NCC	1
NCC 2	Incentives	2
NCC 3	Duties of NCC Cadet	1
NCC 4	NCC Camps: Types & Conduct	2
NATIONAL INTEGRATION AND AWARENESS		**4**
NI 1	National Integration: Importance & Necessity	1
NI 2	Factors Affecting National Integration	1
NI 3	Unity in Diversity & Role of NCC in Nation Building	1
NI 4	Threats to National Security	1
PERSONALITY DEVELOPMENT		**7**
PD 1	Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving	2
PD 2	Communication Skills	3
PD 3	Group Discussion: Stress & Emotions	2
LEADERSHIP		**5**
L 1	Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code	3
L 2	Case Studies: Shivaji, Jhasi Ki Rani	2
SOCIAL SERVICE AND COMMUNITY DEVELOPMENT		**8**
SS 1	Basics, Rural Development Programmes, NGOs, Contribution of Youth	3
SS 4	Protection of Children and Women Safety	1
SS 5	Road / Rail Travel Safety	1
SS 6	New Initiatives	2
SS 7	Cyber and Mobile Security Awareness	1

TOTAL: 30 PERIODS

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NAVAL WING		
NCC GENERAL		6
NCC 1	Aims, Objectives & Organization of NCC	1
NCC 2	Incentives	2
NCC 3	Duties of NCC Cadet	1
NCC 4	NCC Camps: Types & Conduct	2
NATIONAL INTEGRATION AND AWARENESS		4
NI 1	National Integration: Importance & Necessity	1
NI 2	Factors Affecting National Integration	1
NI 3	Unity in Diversity & Role of NCC in Nation Building	1
NI 4	Threats to National Security	1
PERSONALITY DEVELOPMENT		7
PD 1	Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving	2
PD 2	Communication Skills	3
PD 3	Group Discussion: Stress & Emotions	2
LEADERSHIP		5
L 1	Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code	3
L 2	Case Studies: Shivaji, Jhasi Ki Rani	2
SOCIAL SERVICE AND COMMUNITY DEVELOPMENT		8
SS 1	Basics, Rural Development Programmes, NGOs, Contribution of Youth	3
SS 4	Protection of Children and Women Safety	1
SS 5	Road / Rail Travel Safety	1
SS 6	New Initiatives	2
SS 7	Cyber and Mobile Security Awareness	1
	TOTAL: 30 PERIODS	

ARMY WING		
NCC GENERAL		6
NCC 1	Aims, Objectives & Organization of NCC	1
NCC 2	Incentives	2
NCC 3	Duties of NCC Cadet	1
NCC 4	NCC Camps: Types & Conduct	2

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NATIONAL INTEGRATION AND AWARENESS		**4**
NI 1	National Integration: Importance & Necessity	1
NI 2	Factors Affecting National Integration	1
NI 3	Unity in Diversity & Role of NCC in Nation Building	1
NI 4	Threats to National Security	1
PERSONALITY DEVELOPMENT		**7**
PD 1	Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving	2
PD 2	Communication Skills	3
PD 3	Group Discussion: Stress & Emotions	2
LEADERSHIP		**5**
L 1	Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code	3
L 2	Case Studies: Shivaji, Jhasi Ki Rani	2
SOCIAL SERVICE AND COMMUNITY DEVELOPMENT		**8**
SS 1	Basics, Rural Development Programmes, NGOs, Contribution of Youth	3
SS 4	Protection of Children and Women Safety	1
SS 5	Road / Rail Travel Safety	1
SS 6	New Initiatives	2
SS 7	Cyber and Mobile Security Awareness	1
	TOTAL: 30 PERIODS	

SEMESTER - II

24AIPT201 SDG NO. 4,9	PYTHON FOR DATA SCIENCE LABORATORY WITH THEORY	L	T	P	C
		1	0	4	3

OBJECTIVES:

- To learn the core programming basics required for Data Science using Python language.
- To develop simple Python programs with conditionals and loops
- To gain knowledge on Data Science modules NumPy, SciPy and Matplotlib
- To acquire skills in data preparatory and preprocessing steps.

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MODULE - I BASICS OF PYTHON PROGRAMMING 8

Introduction to Python- Features, Identifiers, Reserved words, Indentation, Comments, Built-in Data types and their Methods: Strings, List, Tuples, Dictionary, Set - Type Conversion- Operators. Decision Making- Looping- Loop Control statement- Math and Random number functions. User defined functions - function arguments & its types.

List of Experiments

1. Implement basic Python programs for reading input from console.
2. Perform Creation, indexing, slicing, concatenation and repetition operations on Python built-in data types: Strings, List, Tuples, Dictionary, Set

Module - II FILES, EXCEPTIONS,OOPS CONCEPTS 8

User defined Modules and Packages in Python- Files: File manipulations, File and Directory related methods - Python Exception Handling. OOPs Concepts - Class and Objects, Constructors – Data hiding- Data Abstraction- Inheritance

List of Experiments

1. Create packages and import modules from packages.
2. Write a program to implement OOP concepts like Data hiding and Data Abstraction..

Module - III DATA SCIENCE AND DESCRIPTIVE STATISTICS 8

Need for data science-Benefits and uses- Facets of Data - Data science process- Setting the Research goal-Retrieving Data –Cleansing, integrating and transforming data-Exploratory Data analysis- Data measurement scale- Data descriptive statistics (Measures of central tendency, dispersion/variation, measure of location, Shape and symmetry)-Understanding Python's role in data science.

List of Experiments

1. Write a program to handle numerical operations using math and random number functions
2. Create user-defined functions with different types of function arguments.

Module - IV INTRODUCTION TO NUMPY 7

NumPy Basics: Arrays and Vectorized Computation - The NumPy ndarray- Creating ndarrays - Data Types for ndarrays - Arithmetic with NumPy Arrays - Basic Indexing and Slicing - Boolean Indexing-Transposing Arrays and Swapping Axes.

Universal Functions: Fast Element -Wise Array Functions - Mathematical and Statistical Methods-Sorting- Unique and Other Set Logic

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List of Experiments

1. Create NumPy arrays from Python Data Structures, Intrinsic NumPy objects and Random Functions.
2. Manipulation of NumPy arrays- Indexing, Slicing, Reshaping, Joining and Splitting.

Module - V DATA MANIPULATION WITH PANDAS 7

Introduction to pandas Data Structures: Series, Data Frame, Essential Functionality: Dropping Entries Indexing, Selection, and Filtering- Function Application and Mapping-Sorting and Ranking. Summarizing and Computing Descriptive Statistics- Unique Values, Value Counts, and Membership. Reading and Writing Data in Text Format.

List of Experiments

1. Create Pandas Series and DataFrame from various inputs.
2. Import any CSV file to Pandas DataFrame and perform the following:

a. Visualize the first and last 10 records
b. Get the shape, index and column details
c. Select/Delete the records (rows)/columns based on conditions.
d. Perform ranking and sorting operations.
e. Do required statistical operations on the given columns.
f. Find the count and uniqueness of the given categorical values.
g. Rename single/multiple columns

Module - VI DATA CLEANING, PREPARATION AND VISUALIZATION 7

Data Cleaning and Preparation: Handling Missing Data - Data Transformation: Removing Duplicates, Transforming Data Using a Function or Mapping, Replacing Values, Detecting and Filtering Outliers- String Manipulation: Vectorized String Functions in pandas. Plotting with pandas: Line Plots, Bar Plots, Histograms and Density Plots, Scatter or Point Plots.

List of Experiments

1. Import any CSV file to Pandas Data Frame and perform the following:

a. Handle missing data by detecting and dropping/ filling missing values.
b. Transform data using apply () and map() method
c. Detect and filter outliers.
d. Perform Vectorized String operations on Pandas Series.
e. Visualize data using Line Plots, Bar Plots, Histograms, Density Plots and Scatter Plots.

TOTAL: 45 PERIODS

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TEXT BOOKS:

1. Y. Daniel Liang, "Introduction to Programming using Python", Pearson, 2nd Edition, 2021.
2. Wes McKinney, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", O'Reilly, 2nd Edition,2018.
3. Jake VanderPlas, "Python Data Science Handbook: Essential Tools for Working with Data", O'Reilly, 2017.
4. Davy Cielen,Arno D.B.Meysman and Mohamed Ali,"Introducing Data Science",Manning Publications,2016.

REFERENCES:

1. W esley J. Chun, "Core Python Programming", Prentice Hall, 2006.
2. Mark Lutz, "Learning Python", O'Reilly, 4th Edition, 2009.

WEB REFERENCES:

1. https://www.edx.org/course/python -basics-for-data-science
2. https://www.edx.org/course/analyzing -data-with-python
3. https://www.coursera.org/learn/python -plotting?specialization=data - science- python
4. https://www.programmer-books.com/introducing -data-science-pdf/

OUTCOMES:

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

1. Use Python built-in data types and their methods to solve basic data science problems and demonstrate the need for data-driven approaches. (K3)
2. Develop an application with user-defined modules and packages using OOP concept (K3)
3. Apply knowledge of data acquisition, cleaning, and transformation in practical tasks. (K3)
4. Use NumPy arrays to perform data manipulation tasks such as slicing, indexing, and reshaping.(K3)
5. Apply powerful data manipulations using Pandas. (K3)
6. Implement data preprocessing and visualization using Pandas.(K3)

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CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PO1
CO1	3	2	-	-	-	-	-	-	-	-	-	3	2	3
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	3
CO3	2	2	-	-	-	-	-	-	-	-	2	2	2	2
CO4	3	2	-	-	3	-	-	-	-	-	-	2	2	3
CO5	3	2	-	2	3	-	-	-	-	-	-	-	-	3
CO6	3	3	2	2	3	-	-	-	-	-	2	-	-	3

SEMESTER - II

24ESID201 SDG NO. 1-17	IDEA ENGINEERING LAB – II	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To Provide awareness on Printed Circuit Board (PCB) design using ORCAD software.
- To Upskill learners through practical experience with 3D printing and scanning technologies.
- To Raise awareness of at least three Internet of Things (IoT) projects and their applications.
- To prepare the learners to correctly align the ideas to SDGs
- To comprehensive knowledge on entrepreneurship and effective idea presentation techniques.
- To evaluate the effectiveness of SDGs and implementation strategy

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MODULE - 1 Basics of Design Thinking in Electrical and Electronic Components 4

- Awareness Session on Basics of Design Thinking
- Study of Active & Passive Electronic Components
- Study of Basic AC & DC Electrical Circuits
- Study of Microprocessors & Microcontrollers
- Demonstration of Arduino Board, ESP 32 Board ,Raspberry Pi Board & PCB design software-Eagle

MODULE - 2 Embedded systems, IOT and Robotics 4

- Study of Sensors and Transducers
- Study of Embedded Protocols ,IOT Protocols & Embedded C
- Demonstration of Robotics & Drones model

MODULE - 3 Basics of Mechanical Engineering 4

- Study of Mechanical Modeling using Fusion 360
- Demonstration of 3D Scanner,3D Printer, Laser Cutter &RD Works Software
- Study of Slicer Software & Master Cam Software

Module - 4 Alignment and Mapping of Ideas 4

- Project Title: Justification of SDG and SAP - Problem Statement & Solution

MODULE - 5 Entrepreneurship skills 4

- Startup Awareness
- Entrepreneurship Opportunities
- Mock Presentations
  - Innovation
  - Novelty
  - Feasibility
  - Presentation Skills

MODULE - 6 Sairam SDG Ideathon 10

Evaluation Stages:

- First Round
- Second Round
- Idea Pitching

TOTAL: 30 PERIODS

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Sri Sairam Engineering College

REFERENCES:

1. D P Kothari and I.J Nagarath, "Basic Electrical and Electronics Engineering", McGraw Hill Education (India) Private Limited, Second Edition, 2020
2. S.K. Bhattacharya, Basic Electrical Engineering, Pearson Education, 2019
3. Elements of Mechanical Engineering by N M Bhatt and J R Mehta, Mahajan Publishing House
4. Basic Mechanical Engineering by Pravin Kumar, Pearson Education
5. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017.
6. R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2017.
7. JohnJ.Craig ,Introduction to Robotics Mechanics and Control, Third edition, Pearson Education, 2009.

WEB REFERENCES

1. https://onlinecourses.nptel.ac.in/noc24_ee112/preview
2. https://onlinecourses.nptel.ac.in/noc24_cs115/preview
3. https://onlinecourses.nptel.ac.in/noc24_me104/preview
4. https://onlinecourses.nptel.ac.in/noc24_me88/preview

OUTCOMES:

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

1. Gain the knowledge on Basic Electronics & Electrical Circuits (K2)
2. Understand the Basics of Embedded systems,IOT & Robotics (K1)
3. Explore the the Basics of Mechanical Modeling (K2)
4. Interpret the mapping of SDGs to ideas. (K4)
5. Illustrate the ideas in the Ideathon event emphatically .(K4)

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO1
CO1	1	-	-	-	1	-	-	-	-	-	-	1
CO2	1	-	-	-	1	-	-	-	-		-	1
CO3	1	-	-	-	1	-	-	-	-		-	1
CO4	-	-	-	-	-	2	-	3	3		2	-
CO5	-	-	-	-	-	3	-	3	3		2	-

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SEMESTER - II

24ENTP201 SDG NO. 4	DIGITAL DYNAMICS	L	T	P	C
		0	0	2	0

OBJECTIVES:

- Explore online communication
- Master computer skills
- Use virtual platforms
- Understand digital ethics and cyber security
- Observe and follow do's and don'ts

MODULE - I DIGITAL CULTURE AND SOCIETY 6

Adapting to changes
Importance in today's digital landscape
Digital identity and self- presentation
Online communities and forums
Digital divide and consequences
Online collaboration and collective action

MODULE - II DIGITAL LITERACY AND ACCESS TO TECHNOLOGY 5

Computer skills
Social and cultural understanding
Social media campaign and Activism
Netiquettes
Trending Technologies
Digital tools and softwares

MODULE - III DIGITAL ETHICS 3

Digital ethics and moral panics
The art of protecting secrets
Overview of digital tools

MODULE - IV CYBER SECURITY 3

Threats, vulnerability and consequences
Data making and usage practice
Importance of security

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MODULE - V DIGITAL NETWORKING

Remote work and virtual teams
Authenticity in digital interactions
Engaging content creation
Tools and and techniques for insightful usage
Balancing online and offline interactions
Collaboration for research and innovation

MODULE - VI BUREAU OF INDIAN STANDARDS (BIS): BASIC CONCEPTS, STANDARDS FORMATION PROCESS AND CHALLENGES 6

Standardization –Basic Concepts:

Basic concepts of standardization
Purpose of standardization, marking and certification of articles and processes
Importance of standards to industry, policy makers, trade, sustainability and innovation

Standards Formulation Process and Challenges:

Objectives, roles and functions of BIS, Bureau of Indian Standards Act, ISO/ IEC Directives
WTO Good Practices for Standardization

World of Standards:

Important Indian and International Standards

TOTAL: 30 PERIODS

REFERENCES:

1. Communication Skills and Soft Skills – an Integrated Approach. Edited by E. Sureshkumar, P. Sreehari and J. Savithri, Pearson.
2. Silvia. P.J.2007. How to Read a Lot. Washington DC, American Psychological Association.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc19_hs31/preview
2. https://www.sscnasscom.com/ssc-projects/capacity-building-and-development/training/gbfs/

OUTCOMES:

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

1. Apply online communication techniques and collaboration skills (K3)
2. Enumerate the principles of digital ethics in online interactions (K2)

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3. Understand the importance of Bureau of Indian Standards (BIS). (K2)

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	3	-	2	-	-	-
CO2	-	-	-	-	-	-	-	-	3	-	2	-	-	-
CO3	-	-	-	-	-	-	-	3	2	-	2	-	-	-

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SEMESTER - III

24BSMA301 - SDG NO. 4	STATISTICS AND LINEAR ALGEBRA	L	T	P	CP	C
		3	1	0	5	4

OBJECTIVES:

- The main objective of this course is to provide students with the foundations of statistics and linear algebra mostly used in varied applications in engineering.

MODULE - I BASIC STATISTICS 9

Measures of Central tendency – Dispersion - Moments, Skewness and Kurtosis - Correlation and regression – Rank correlation

MODULE - II TESTS OF SIGNIFICANCE FOR LARGE SAMPLES 9

Sampling distributions - Statistical hypothesis - large sample test for single proportion, difference of proportions, single mean, difference of means.

MODULE - III TESTS OF SIGNIFICANCE FOR SMALL SAMPLES 9

Tests based on t-distribution - single mean, Difference of means -paired t test, F test -Chi-square test for independence of attributes and Goodness of fit.

MODULE - IV VECTOR SPACES 9

Vectors and Linear combinations – Vector spaces (Definitions and examples)– Subspaces (Definitions and examples) – Linear independence and linear dependence – Bases and dimensions.

MODULE - V LINEAR TRANSFORMATION AND DIAGONALIZATION 12

Linear transformation - Null spaces and ranges - Dimension theorem (Statement only) - Matrix of a linear transformation - Eigenvalues and eigenvectors - Diagonalizability- Test for Diagonalization.

MODULE - VI INNER PRODUCT SPACES 12

Inner product- norms - Gram Schmidt orthogonalization process - Adjoint of linear operator - Least square approximation.

TOTAL : 60 PERIODS

TEXT BOOKS:

1. Basic Statistics, Agarwal B. L., 5th Edition, New Age International (P) Ltd., 2022.

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Department of Humanities & Sciences

2. Linear Algebra, Stephen Friedberg, Arnold Insel and Lawrence Spence, 5th Edition, Pearson, 2018..
3. Elementary Linear Algebra, Howard Anton and Chris Rorres, 11th Edition, Wiley Publications, 2014 (Units - IV, V & VI).
4. Linear Algebra and Learning from Data, Gilbert Strang, 1st Edition, Wellesley-Cambridge Press, 2019

REFERENCES:

1. Schaum's Outline on Probability and Statistics, Spiegel M. R., Schiller J. and Srinivasan R. A., 2nd Edition, McGraw-Hill Education, 2000.
2. Probability and Statistics for Engineers and Scientists, Walpole R. E., Myers R. H., Myers S. L. and Ye K., 8th Edition, Pearson Education, Asia, 2007.
3. Linear Algebra - A Geometric Approach, Kumaresan S., Reprint, Prentice Hall of India, New Delhi, 2010.
4. Advanced Engineering Mathematics, Kreyszig E. , 8th Edition, John Wiley, 1999.

WEB REFERENCES:

1. https://nptel.ac.in/courses/111105041/
2. https://www.imsc.res.in/~svis/Algebra/Sunder-LinearAlg-notes.pdf

ONLINE RESOURCES:

1. https://ocw.mit.edu/courses/mathematics/18-06-linear-algebra-spring-2010/video-lectures/
2. https://www.khanacademy.org/math/statistics-probability/significance-tests-one-sample/more-significance-testing-videos/v/hypothesis-testing-and-p-values

COURSE OUTCOMES

Upon completion of the course, the student should be able to:

1. Compute measures of central tendency, dispersion, moments, skewness, kurtosis, correlation, regression, and rank correlation for given data sets using appropriate statistical methods. (K3)
2. Formulate and analyze the null and alternative hypothesis for large samples using proportions and means of samples. (K4)
3. Analyze the null and alternative hypothesis for small samples using t-tests, F-test, and Chi-square tests. (K4)
4. Determine the bases and dimension of vector spaces and subspaces. (K3)

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5. Analyze the matrix of a linear transformation for its rank, nullity and diagonalizability. (K4)
6. Apply the Gram-Schmidt orthogonalization process to construct an orthonormal basis from a given set of vectors and solve least squares approximation problems. (K3)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	3	-
CO2	-	3	-	-	-	-	-	-	-	-	-	3	-
CO3	-	3	-	-	-	-	-	-	-	-	-	3	-
CO4	3	-	-	-	-	-	-	-	-	-	-	3	-
CO5	-	3	-	-	-	-	-	-	-	-	-	3	2
CO6	3	-	-	-	-	-	-	-	-	-	-	3	2

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SEMESTER - III

		L	T	P	CP	C
24CSPC301 106104135 SDG NO. 4	DATABASE MANAGEMENT SYSTEMS	3	0	0	3	3

OBJECTIVES:

- To learn the fundamentals of data models and to represent a database system using ER diagrams.
- To study SQL and relational database design.
- To understand the internal storage structures using different file and indexing techniques which will help in physical DB design.
- To understand the fundamental concepts of transaction processing- concurrency control techniques and recovery procedures.
- To have an introductory knowledge about the Storage and Query processing Techniques

MODULE - I CONCEPTUAL DATA MODELLING 6

Database environment – Purpose of Database System – Views of data – Data Models –Database System Architecture - Database design – Entity-Relationship model – Enhanced-ER model.

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MODULE - II DATABASE DESIGN 8

ER and EER-to-Relational Mapping – Functional Dependencies – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multivalued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form.

MODULE - III RELATIONAL DATABASES 8

Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features – Embedded SQL– Dynamic SQL.

MODULE - IV TRANSACTIONS 8

Transaction Concepts – ACID Properties – Schedules – Serializability – Concurrency Control – Need for Concurrency – Locking Protocols – Two Phase Locking – Deadlock – Transaction Recovery - Save Points – Isolation Levels – SQL Facilities for Concurrency and Recovery.

MODULE - V IMPLEMENTATION TECHNIQUES 7

File Organization – Organization of Records in Files – Indexing and Hashing – Static Hashing – Dynamic Hashing – Query Processing Overview – Algorithms for SELECT operations – Query optimization.

MODULE - VI ADVANCED TOPICS 8

Distributed Databases: Architecture, Data Storage, Transaction Processing – Object-based Databases: Object Database Concepts, Object-Relational features, ODMG Object Model, ODL, OQL - XML Databases: XML Hierarchical Model, DTD, XML Schema.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Sixth Edition, Pearson Education, 2011.

REFERENCES:

1. C.J.Date, A.Kannan, S.Swamynathan, —An Introduction to Database Systems, Eighth Edition, Pearson Education, 2006.
2. Raghu Ramakrishnan, —Database Management Systems, Fourth Edition, McGraw-Hill College Publications, 2015.
3. G.K.Gupta,"Database Management Systems, Tata McGraw Hill, 2011

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OUTCOMES

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

1. Apply different data models and database architectures to design efficient database systems. (K3)
2. Build relational databases by applying normalization techniques to ensure data integrity and reduce redundancy. (K3)
3. Construct SQL queries to perform data definition, manipulation, and retrieval operations on relational databases. (K3)
4. Analyze transaction schedules and concurrency control mechanisms to assess their impact on database correctness and performance. (K4)
5. Identify file organization methods, hashing techniques, and query processing strategies to optimize database access. (K3)
6. Distinguish various database models, comparing their characteristics and applicability in different scenarios. (K4)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	3	-	-	-	-	-	-	2	1	2	2
CO2	3	-	3	-	-	-	-	-	-	-	1	2	2
CO3	-	-	3	-	-	-	-	-	-	-	-	2	2
CO4	-	3	-	-	-	-	-	-	-	-	-	2	2
CO5	3	-	3	-	-	-	-	-	-	2	-	2	2
CO6	-	3	-	-	-	-	-	-	-	2	-	2	2

SEMESTER - III

24CSPC302 106106130 SDG NO. 4	DATA STRUCTURES	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To understand the concepts of List ADT's
- To learn Linear Data Structures – Stacks, and Queues
- To apply the Concept of Tree data Structures
- To learn and apply Dynamic Data Structures - Graph
- To understand and Analyze Sorting, Searching and Hashing Algorithms

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MODULE - I LINEAR DATA STRUCTURES – I 9

Linked List: Introduction - Abstract Data Types (ADT) - Basic concept of Data Structures - Performance measures for Data Structures - List ADT – Array-Based Implementation – Linked List Implementation –- Singly Linked Lists- Circularly Linked Lists- Doubly-Linked Lists – Applications of Lists –Polynomial Manipulation – All Operations (Insertion, Deletion, Merge, Traversal).

MODULE - II LINEAR DATA STRUCTURES – II 9

Stacks and Queues: Stack ADT – Implementations: Array and Linked list - Applications - Balancing symbols - Evaluating arithmetic expressions - Conversion of Infix to postfix expression - Queue ADT - Implementations: Array and Linked list – Double ended queue(DeQUEUE) – Circular Queue - Applications of queues.

MODULE - iii NON LINEAR DATA STRUCTURES – I 8

Trees : Tree ADT – Tree Traversals - Binary Tree ADT – Expression Trees –Applications of Trees – Binary Search Tree ADT - AVL Trees – B-Tree - B+ Tree - Priority Queue (Heaps) – Binary Heap – Leftist Heap – Applications of Heap.

MODULE - IV NON LINEAR DATA STRUCTURES – II 9

Graphs : Definition – Representation of Graph – Types of Graph – Breadth First Traversal - Depth First Traversal - Topological Sort – Dijkstra's algorithm – Floyd's Algorithm - Minimum spanning tree – Prim's and Kruskal's algorithms – Applications of Graphs.

MODULE - V SEARCHING, SORTING 5

Searching: Definition - Linear Search - Binary Search - Sorting - Bubble Sort - Selection Sort - Insertion Sort - Shell Sort – Radix Sort – Bucket Sort - Merge Sort – Quick Sort - Counting Sort - Amortized Sorting.

MODULE - VI HASHING TECHNIQUES 5

Hashing – Hash Table - Hash functions – Properties of good hash function - Division Method, Multiplication Method, Mid-Square Method, Folding Method - Universal hashing - Collision resolution and overflow handling techniques - Open Hashing (Separate Chaining) - Open Addressing / Closed Hashing - Linear Probing, Quadratic Probing, Double Hashing, Rehashing - Extendible Hashing.

TOTAL : 45 PERIODS

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TEXT BOOKS:

1. Alfred V. Aho, "Data Structures and Algorithms", Bell Laboratories, Murray Hill, New Jersey,2013.
2. Reema Thareja, "Data Structures Using C", Second Edition, Oxford University Press, 2011.

REFERENCES:

1. M. A. Weiss, "Data Structures and Algorithm Analysis in C", Pearson Education Asia, 2002.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, "Introduction to Algorithms", Second Edition, Mcgraw Hill, 2002.
3. Stephen G. Kochan, "Programming in C", 3rd edition, Pearson Education.
4. Aho, Hopcroft and Ullman, "Data Structures and Algorithms", Pearson Education, 1983.
5. Ellis Horowitz, SartajSahni, Susan Anderson-Freed, "Fundamentals of Data Structures in C", Second Edition, University Press, 2008.

WEB REFERENCES:

1. https://www.programiz.com/dsa
2. http://masterraghu.com/subjects/Datastructures/ebooks/rematharej a.pdf

OUTCOMES

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

1. Implement programs using arrays and linked lists for various applications(K3).
2. Build programs using stacks and queues (K3).
3. Use operations on both unbalanced and balanced trees to devise solutions for various problems (K3).
4. Solve problems using graph (K3)
5. Apply sorting and searching in algorithmic problem-solving and competitive programming. (K3)
6. Compare hash functions and collision methods to obtain the best approach for efficient data storage and retrieval. (K4).

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CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	3	2
CO2	-	3	-	-	-	-	-	-	-	-	-	3	2
CO3	-	3	-	-	-	-	-	-	-	-	-	3	3
CO4	-	-	-	-	-	-	3	-	-	-	-	3	2
CO5	-	-	-	-	-	-	-	-	3	-	-	3	2
CO6	3	-	-	-	-	-	-	-	-	-	-	2	3

SEMESTER - III

24ITPC302 106105182 SDG NO. 4 & 9	SOFTWARE ENGINEERING	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To address the real time complex engineering problems using innovative approaches with strong core computing skills
- To apply core-analytical knowledge and appropriate techniques and provide solutions to real time challenges of national and global society
- Apply ethical knowledge for professional excellence & leadership for the betterment of the society
- Use software design principles and tools to create modular, maintainable and scalable software architectures
- Develop life-long learning skills needed for better employment and entrepreneurship

MODULE - I SOFTWARE PROCESS AND AGILE DEVELOPMENT 7

Introduction to Software Engineering - Software Process Model - Agile Model- Waterfall Model- V-Model- Incremental Model- RAD Model- Iterative Model- Spiral Model- Prototype Model- Perspective and Specialized Process Models – Introduction to Agility - Agile process - Extreme Programming -XPProcess

MODULE - II REQUIREMENTS ANALYSIS AND SPECIFICATION 8

Software Requirements: Functional and Non-Functional -User requirements - System requirements - Software Requirements Document – Requirement Engineering Process, Feasibility Studies, Requirements elicitation and

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analysis, requirements validation, requirements management-Classical analysis: Structured system Analysis,PetriNets-DataDictionary

MODULE - III SOFTWARE DESIGN **8**

Design process – Design Concepts - Design Model – Design Heuristic – Architectural Design - Architectural styles - Architectural Design - Architectural Mapping using Data Flow - User Interface Design: Interface analysis, Interface Design – Component level Design: Designing Class based components,traditionalComponents

MODULE - IV TESTING AND MAINTENANCE **8**

Software testing fundamentals-Internal and external views of Testing-white box testing – basis path testing-control structure testing-black box testing-Regression Testing – Unit Testing – Integration Testing – Validation Testing –System Testing And Debugging –Software Implementation Techniques: Coding practices-Refactoring-Maintenance and Reengineering-BPR model-Reengineering process model-Reverse and Forward Engineering

MODULE - V PROJECT MANAGEMENT **7**

Software Project Management: Estimation – LOC, FP Based Estimation, Make/Buy Decision, Uncertainties in Effort Estimation, Building Effort Estimation Models, A Bottom-Up Estimation Approach, COCOMO I & II Model – Project Scheduling – Scheduling, Earned Value Analysis Planning – Project Plan, Planning Process, RFP

MODULE - VI RISK MANAGEMENT **7**

Risk Management – Identification, Projection – Risk Management-Risk Identification - RMMM Plan (Risk Mitigation, Monitoring, and Management Plan) - CASE TOOLS: CASE Tools, Scope, Benefits of CASE Tool, support in Software Life Cycle, Architecture of CASE Environment, Types of CASE Tools

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Software Engineering A Practitioner's Approach, Roger S Pressman, 6th edition. McGraw Hill International Edition.
2. Software Engineering, Ian Sommerville, 7th edition, Pearson education.
3. Gene Kim, Jez Humble, Patrick Debois, and John Willis, The DevOps Handbook- How to Create World-Class Agility, Reliability, & Security in Technology Organizations, IT Revolution Press,2nd Edition,2016

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REFERENCES:

1. Rajib Mall, —Fundamentals of Software Engineering, Third Edition, PHI Learning Private Limited,2009
2. Pankaj Jalote, —Software Engineering, A Precise Approach, Wiley India, 2010.
3. Kelkar S.A., —Software Engineering, Prentice Hall of India Pvt Ltd, 2007.
4. Stephen R.Schach, —Software Engineering, Tata McGraw-Hill Publishing Company Limited,2007

ONLINE RESOURCES:

1. http://www.vssut.ac.in/lecture_notes/lecture1428551142.pdf
2. https://freevideolectures.com/course/2318/software-engineering
3. https://courses.cs.washington.edu/courses/cse403/01au/lectures/
4. https://www.ece.rutgers.edu/~marsic/books/SE/instructor/slides/
5. https://swayam.gov.in/nd1_noc19_cs69/preview
6. https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-cs69
7. https://nptel.ac.in/courses/106/105/106105182/

OUTCOMES

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

1. Apply Agile Practices and Software Process Models (K3)
2. Identify the various Requirement Analysis and Documentation Techniques (K3)
3. Apply Software Design Principles and Models (K3)
4. Analyze Software Testing Strategies and Debugging Techniques (K4)
5. Make use of the Project Management Techniques for Effort Estimation and Scheduling (K3)
6. Examine the ways of mitigating Risks in Software Development (K4)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	-	-	-	2	-	2	-	-	2
CO2	-	3	-	-	-	-	-	-	2	-	-	-	1
CO3	3	-	-	-	-	-	-	2	-	-	-	-	2
CO4	-	3	-	-	-	-	-	-	-	-	-	2	2
CO5	-	-	-	-	3	-	-	2		2	-	2	3
CO6	-	-	-	-	-	-	-	-	-	2	-	-	3

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SEMESTER - III

24CSPW301 117105078 SDG NO. 4	DIGITAL DESIGN AND COMPUTER ORGANIZATION WITH LABORATORY	L	T	P	CP	C
		3	0	2	5	4

OBJECTIVES:

- To acquire the knowledge in digital fundamentals and its simplification methods.
- To familiarize the design of various combinational digital circuits using logic gates.
- To realize various sequential circuits using flip flops.
- To understand the basic structure, operations along with implementation of fixed point and floating-point arithmetic operations.
- To study the design of data path unit and control unit for processors and introduce the parallel processing techniques.
- To understand the concept of various memories and interfacing.

MODULE - I BOOLEAN ALGEBRA AND LOGIC GATES **8**

Digital Systems – Number-base conversions – Complements of Numbers - Binary Codes- Boolean Algebra and Logic Gates – Theorems and Properties of Boolean Algebra – Boolean Functions – Canonical and Standard Forms – Digital Logic Gates – Gate-Level Minimization – The Map Method – Four-Variable K-Map - NAND and NOR Implementations.

MODULE - II COMBINATIONAL LOGIC **7**

Combinational Circuits – Analysis and Design Procedures – Binary Adder Subtractor – Decimal Adder – Binary Multiplier – Magnitude Comparator – Decoders – Encoders – Multiplexers.

MODULE - III SYNCHRONOUS SEQUENTIAL LOGIC **8**

Sequential Circuits – Storage Elements: Latches, Flip-Flops – Analysis of Clocked Sequential Circuits – State Reduction and Assignment – Design Procedure – Registers and Counters

MODULE - IV BASIC STRUCTURE AND ARITHMETIC OPERATIONS **7**

Functional Units – Basic Operational Concepts – Performance- MIPS Addressing-Addition and Subtraction – Multiplication – Division – Floating Point Representation – Floating Point Operations

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Meeting No. 7 Dated: 30.5.24

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MODULE - V PROCESSOR, CONTROL UNIT AND PARALLELISM **8**

Building a Datapath- Pipelining-Pipelined datapath and control – Handling Data Hazards & Control Hazards-Parallel processing challenges – Flynn's classification – SISD, MIMD, SIMD, SPMD, and Vector Architectures - Hardware multithreading- Multi-core processors-Introduction to Graphics Processing Units, Clusters, Warehouse Scale Computers and other Message-Passing Multiprocessors.

MODULE - VI MEMORY & I/O SYSTEMS **7**

Memory Hierarchy - memory technologies – cache memory – Measuring and Improving Cache Performance – Virtual memory, TLB's – Accessing I/O Devices – Interrupts – Direct Memory Access – Bus structure – Bus operation – Arbitration – Interface circuits – USB

List of Experiments: **15**

1. Implementation of Boolean expression using logic gates.
2. Design of Adders
3. Design of Subtractors.
4. Design of Multiplexers & Demultiplexers.
5. Design of Encoders and Decoders.
6. Implementation of a boolean function using a multiplexer.
7. Verification of truth-tables of different types of flip-flops
8. Design and implementation of shift registers
9. Design and implementation of counters

TOTAL: 60 PERIODS

LAB REQUIREMENTS:

HARDWARE:

DIGITAL TRAINER KITS

DIGITAL IC's required for the experiments in sufficient numbers

SOFTWARE:

HDL, Verilog simulator

TEXT BOOKS:

1. M. Morris R. Mano, Michael D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL, VHDL, and SystemVerilog", 6th Edition, Pearson Education, 2017.
2. David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, Fifth Edition, Morgan Kaufmann/Elsevier, 2014.

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3. Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraig Manjikian, Computer Organization and Embedded Systems, Sixth Edition, Tata McGraw Hill, 2012.

REFERENCES:

1. G. K. Kharate, "Digital Electronics", Oxford University Press, 2010.
2. John F. Wakerly, "Digital Design Principles and Practices", Fifth Edition, Pearson Education, 2017.
3. William Stallings, "Computer Organization and Architecture – Designing for Performance", Eighth Edition, Pearson Education, 2010.
4. John L. Hennessey and David A. Patterson, "Computer Architecture – A Quantitative Approach", Morgan Kaufmann, Elsevier Publishers, Fifth Edition, 2012.

OUTCOMES

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

1. Make use of Boolean algebra and number systems to simplify Boolean expressions through Karnaugh Maps (K-Map).(K3)
2. Construct various combinational logic circuits based on given functional requirements. (K3)
3. Analyze the operation and behavior of synchronous sequential logic circuits under differentinput conditions. (K4)
4. Implement arithmetic operations and floating-point computations using the basic structural units and operational concepts of a computer system. (K3)
5. Demonstrate the roles of hardware components and memory units in a computer system. (K3)
6. Utilize knowledge of computer hardware and memory organization to relate components to their specific functions. (K3)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	3	3
CO2	-	-	-	-	3	-	-	-	-	-	-	3	3
CO3	-	2	-	-	-	-	-	-	-	-	-	3	2
CO4	-	-	2	-	-	-	-	-	-	-	-	3	3
CO5	-	-	-	3	-	-	-	-	-	-	-	3	2
CO6	-	-	-	-	-	2	-	-	-	-	-	3	2

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SEMESTER - III

24HSMC301 - SDG NO. 4 & 9	UNIVERSAL HUMAN VALUES – II UNDERSTANDING HARMONY	L	T	P	CP	C
		2	1	0	3	3

OBJECTIVES:

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- Developing clarity with harmony in the human being, family, society and nature/existence
- Strengthening of self-reflection.
- Development of commitment and courage to act.
- Recognizing the potential of excellence than competition

SYLLABUS:

The course has 28 lectures and 14 practice sessions in 6 modules:

MODULE - I COURSE INTRODUCTION - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION (5+2)

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I
2. Self-Exploration-what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self- exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly-A critical appraisal of the current scenario

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

MODULE - II UNDERSTANDING HARMONY IN THE HUMAN BEING - HARMONY IN MYSELF (5+2)

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

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7. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
8. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
9. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
10. Understanding the characteristics and activities of 'I' and harmony in 'I'
11. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail

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

MODULE - III UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY HARMONY IN HUMAN-HUMAN RELATIONSHIP (6+2)

12. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values ofrelationship
13. Understanding the meaning of Trust; Difference between intention and competence
14. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
15. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals

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

MODULE - IV UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE - WHOLE EXISTENCE AS COEXISTENCE (6+2)

16. Understanding the harmony in the Nature
17. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self- regulation in nature
18. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space
19. Holistic perception of harmony at all levels of existence.

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

MODULE - V IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS (4+4)

20. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family
21. Natural acceptance of human values
22. Definitiveness of Ethical Human Conduct
23. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
24. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people- friendly and eco friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.

MODULE - VI UNIVERSAL HUMAN ORDER (4+3)

25. Programs to ensure Sanyam and Health
26. Case studies of typical holistic technologies, management models and production systems
27. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations
28. Sum up.

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

TOTAL : 45 PERIODS

TEXT BOOKS:

1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 3rd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1.

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REFERENCES:

1. AICTE Model Curriculum in Humanities, Social Science and Management Courses (UG Engineering & Technology)Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values,A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence-JC Kumarappa
8. Bharat Mein Angreji Raj- Pandit Sunderlal
9. Rediscovering India- by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda- Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

OUTCOMES

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

1. Express the harmony of relationship among human being, family, society, nature and existence with right understanding and right feeling. (K2)
2. Develop the responsibility of handling problems by finding holistic and sustainable solutions based on the natural acceptance for maintaining mutual human relationships. (K2)
3. Develop a holistic perspective of life based on self-exploration about self, family, society and nature/existence. (K2)
4. Elucidate a critical ability for dedicative commitment towards human values, relationships and society. (K2)
5. Implement the process of verification and validation of learning in daily life. (K2)
6. Develop self reflection, commitment and courage to act in life challenging situations. (K2)

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CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	-	-	3	3	2	-	-	3
CO2	-	1	-	-	-	3	3	2	-	-	-
CO3	-	-	3	-	-	3	3	2	-	-	-
CO4	-	-	-	-	-	3	3	2	-	2	3
CO5	-	-	-	-	-	3	3	-	-	-	3
CO6	-	-	-	-	-	3	3	-	-	3	2

SEMESTER - III

24HSNC301 - SDG NO. 4	NCC COURSE LEVEL 2	L	T	P	CP	C
		3	0	0	3	0

ARMY WING

PERSONALITY DEVELOPMENT **9**

PD 3 Group Discussion: Change your mindset, Time Management, Social Skills 6

PD 5 Public Speaking 3

LEADERSHIP **7**

L 2 Case Studies: APJ Abdul Kalam, Deepa Malik, Maharana Pratap, N Narayan Murty, Ratan Tata, Rabindra Nath Tagore, Role of NCC cadets in 1965 7

DISASTER MANAGEMENT **13**

DM 1 Disaster Management Capsule: Organisation, Types of Disasters, Essential Services, Assistance, Civil Defence Organisation 3

DM 2 Initiative Training, Organising Skills, Do's & Don't's, Natural Disasters, Man Made Disasters 9

DM 3 Fire Service & Fire Fighting 1

ENVIRONMENTAL AWARENESS & CONSERVATION **3**

EA 1 Environmental Awareness and Conservation 3

GENERAL AWARENESS **4**

GA 1 General Knowledge 4

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ARMED FORCES 6

AF 1	Armed Forces, Army, CAPF, Police	6

ADVENTURE 1

AD 1	Introduction to Adventure Activities	1

BORDER & COASTAL AREAS **2**

BCA 1	History, Geography & Topography of Border/Coastal areas	2

TOTAL: 45 PERIODS

NAVAL WING

PERSONALITY DEVELOPMENT **9**

PD 3	Group Discussion: Change your mindset, Time Management, Social Skills	6
PD 5	Public Speaking	3

LEADERSHIP 7

L 2	Case Studies: APJ Abdul Kalam, Deepa Malik, Maharana Pratap, N Narayan Murty, Ratan Tata, Rabindra Nath Tagore, Role of NCC cadets in 1965	7

DISASTER MANAGEMENT **13**

DM 1	Disaster Management Capsule: Organisation, Types of Disasters, Essential Services, Assistance, Civil Defence Organisation	3
DM 2	Initiative Training, Organising Skills, Do's & Don't's, Natural Disasters, Man Made Disasters	9
DM 3	Fire Service & Fire Fighting	1

ENVIRONMENTAL AWARENESS & CONSERVATION **3**

EA 1	Environmental Awareness and Conservation	3

GENERAL AWARENESS **4**

GA 1	General Knowledge	4

NAVAL ORIENTATION 6

AF 1	Armed Forces and Navy Capsule	3
EEZ 1	EEZ Maritime Security and ICG	3

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Meeting No. 6 Dated: 31/10/2019

S. Ramakrishnan
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ADVENTURE 1

AD 1	Introduction to Adventure Activities	1

BORDER & COASTAL AREAS **2**

BCA 1	History, Geography & Topography of Border/Coastal areas	2

TOTAL: 45 PERIODS

AIR FORCE WING

PERSONALITY DEVELOPMENT 9

PD 3	Group Discussion: Change your mindset, Time Management, Social Skills	6
PD 5	Public Speaking	3

LEADERSHIP 7

L 2	Case Studies: APJ Abdul Kalam, Deepa Malik, Maharana Pratap, N Narayan Murty, Ratan Tata, Rabindra Nath Tagore, Role of NCC cadets in 1965	7

DISASTER MANAGEMENT **13**

DM 1	Disaster Management Capsule: Organisation, Types of Disasters, Essential Services, Assistance, Civil Defence Organisation	3
DM 2	Initiative Training, Organising Skills, Do's & Don't's, Natural Disasters, Man Made Disasters	9
DM 3	Fire Service & Fire Fighting	1

ENVIRONMENTAL AWARENESS & CONSERVATION **3**

EA 1	Environmental Awareness and Conservation	3

GENERAL AWARENESS **4**

GA 1	General Knowledge	4

GENERAL SERVICE KNOWLEDGE **6**

GSK 1	Armed Forces & IAF Capsule	2
GSK 2	Modes of Entry in IAF, Civil Aviation	2
GSK 3	Aircrafts - Types, Capabilities & Role	2

ADVENTURE 1

AD 1	Introduction to Adventure Actitivities	1

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BORDER & COASTAL AREAS 2

BCA 1 History, Geography & Topography of Border/Coastal areas 2

TOTAL :45 PERIODS

SEMESTER - III

24CSPL301 - SDG NO. 4	DATABASE MANAGEMENT SYSTEMS LABORATORY	L	T	P	CP	C
		0	0	4	4	2

OBJECTIVES:

- To learn the use of Data Definition, Data Manipulation Commands, Nested and Join queries.
- To learn PL/SQL Programming
- To understand Functions, Procedures and Procedural extensions of databases.
- To be familiar with the use of a Front End Tool
- To understand the design and implementation of typical Database applications.

LIST OF EXPERIMENTS:

1. Create an Employee Database management system and perform Data Manipulation commands.
2. Create a Student Database management system and perform Transactional Control Statements on the database.
3. Use Student Database and perform Simple queries, nested queries and subqueries to display relevant information.
4. Use Employee Database and perform Joins using relational databases.
5. Create a view for the student id, first name, last name and phone number using the student database.
6. Write a PL/SQL program to find the sum & average marks of all the students using procedures.
7. Write a function and pass a department number to it. If the DEPT table does not contain that department number, return a FALSE value, otherwise return a TRUE value. Print the appropriate message in the calling program based on the result.
8. Write a PL/SQL function to display the details of the employee when Employee number is given as input. Handle Exceptions.
9. Create the following tables with given attributes having appropriate data type and specify the necessary primary and foreign key constraints:

   Customer (Custid, Custname, phone number, pan, DOB)

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HomeLoan (HLoanid, Amount, Custid)
VehicleLoan (VLoanid, Amount, Custid)

- Create a view with customerid, Customer name and total loan amount (HomeLoan and VehicleLoan)
- Write a trigger which displays the Home Loan details whenever the values are inserted in the respective table.

10. Database Design using ER Modeling, Normalization Implementation for any application.
11. Develop an application for Employee payroll processing System to add, delete, update employee particulars and generate payslip with the employee table created.

TOTAL : 45 PERIODS

LAB REQUIREMENTS:

Front end: VB/VC ++/JAVA or Equivalent
Back end: Oracle 11 / SQL / MySQL/Postgres / DB2 or Equivalent
Oracle Server

OUTCOMES

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

1. Apply SQL commands to create relational databases, perform data manipulation and implement transaction control for real-world scenarios.(K3)
2. Analyze and implement advanced SQL operations such as joins, subqueries, views, triggers and PL/SQL programming to retrieve, manipulate and maintain data efficiently.(K4)
3. Evaluate database design principles through ER modeling, normalization, exception handling and develop applications to solve real-world problems. (K5)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	2	3	-	-	-	-	-	-	2	2
CO2	-	3	-	3	3	-	-	-	-	-	-	2	2
Co3	-	-	3	3	2	-	-	-	-	-	-	2	2

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Department of Computer Science and Engineering
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SEMESTER - III

24CSPL302 - SDG NO. 4	DATA STRUCTURES LABORATORY	L	T	P	CP	C
		0	0	4	4	2

OBJECTIVES:

- To design and Implement the operations in linked list data structure
- To Implement the stack and queue functionality for suitable applications
- To solve problems using tree and graph structures
- To Understand and performing the searching operations
- To Analyze various Internal and External sorting techniques

LIST OF EXPERIMENTS:

1. Create a linked list with nodes having information about a student and perform I. Insert a new node at specified position. II. Delete of a node with the roll number of student specified. III. Reversal of that linked list.
2. Implement a Student Record System using a Linked List, supporting Insertion, Deletion, and Search operations.
3. Create a doubly linked list with nodes having information about an employee and perform Insertion at front of doubly linked list and perform deletion at end of that doubly linked list.
4. Create a circular linked list having information about a college and perform Insertion at front perform Deletion at end.
5. Create a stack and perform Pop, Push, and Traverse operations on the stack using array.
6. Design and implement a stack using linked list, and demonstrate Insertion (Push), Deletion (Pop), and Display (Traversal) operations with proper memory management.
7. Implement a Queue ADT using a linked list and Support Enqueue (Insertion), Dequeue (Deletion), and Traverse (Display) operations. Ensure proper memory management. Handle underflow and overflow conditions effectively.
8. Design a Queue ADT using an array and Implement Enqueue, Dequeue, and Traverse operations. Handle overflow and underflow conditions effectively. Maintain efficient front and rear pointers for optimal performance.
9. Design a Stack-based Infix to Postfix Converter in C. Implement operator precedence, associativity, and parenthesis handling. Convert valid infix expressions into postfix notation. Ensure proper input validation and error handling.

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10. Develop an Expression Evaluator using a Stack, handling Postfix Expression Conversion and Evaluation.
11. Write a program to implement Quick Sort. Discuss how the choice of pivot affects the performance of the algorithm.
12. Create a program for Selection Sort. Implement it recursively and explain how the merging process works.
13. Implement Insertion Sort and compare its efficiency with Bubble Sort for small-sized arrays.
14. Implement the Insertion Sort algorithm and analyze its performance for different input sizes.
15. Implement a Binary Search Tree (BST) with insert, search, and delete operations and Write traversal methods (in-order, pre-order, post-order) and functions to find the minimum and maximum values.
16. Implement Dijkstra's algorithm to find the shortest path from a source node to all other nodes in a graph with non-negative edge weights.

TOTAL: 45 PERIODS

LAB REQUIREMENTS:

Systems with Linux Operating System with GNU compiler / PC with Windows, Turbo C/Dev C++, Borland C, 30 Nos.

OUTCOMES

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

1. Implement various linear and non-linear data structures with fundamental operations.(K3)
2. Solve the real-world computational problems.using suitable data structures(K3)
3. Analyze the performance of different data structures in terms of time and space complexity (K4)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	-	-	-	-	3	-	-	-	-	-	-	1	2
CO2	-	-	-	3	-	-	-	-	-	-	-	1	2
CO3	-	-	3	-	-	-	-	-	-	-	-	1	2

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SEMESTER - III

24CJTP301 - SDG NO. 4	APTITUDE SKILLS - I	L	T	P	CP	C
		0	0	2	2	1

APTITUDE & COGNITIVE SKILLS – PHASE 1

OBJECTIVES:

- Enrich students on quantitative ability, reasoning ability, and verbal ability
- Build a strong foundation for solving recruitment-based problems with speed and accuracy.
- Enhance creative thinking skills and Strengthen problem-solving skills.

MODULE - I QUANTITATIVE ABILITY **22**

Number Properties, Speed Math, HCF and LCM, Percentages, Time and Work, Time Speed and Distance, Ratio Proportion and Variations, Averages Mixtures and Alligation

MODULE - II QUANTITATIVE ABILITY AND REASONING ABILITY **16**

Profit and Loss, Simple Interest and Compound Interest, Blood Relation, Directions, Coding and Decoding, Series, Ranking and Arrangements

MODULE - III VERBAL ABILITY **7**

Verbal Analogy – Vocabulary building – Sentence Structures - Comprehension – correct usage of words – Error deduction

TOTAL: 45 PERIODS

REFERENCES:

1. Quantitative Aptitude for Competitive Examinations – R.S. Aggarwal
2. A Modern Approach to Logical Reasoning – R.S. Aggarwal
3. High School English Grammar & Composition – Wren & Martin
4. Word Power Made Easy – Norman Lewis.
5. Fast Track Objective Arithmetic – Rajesh Verma

LIFE SKILLS, RANGER AND ROVER & BIS STANDARDS – PHASE 2

OBJECTIVES:

- Familiarize the team and leadership skills.
- Understand the standards relevant to ECE.

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M TECH COMPUTER SCIENCE & ENGINEERING
(5 YEARS INTEGRATED)

MODULE - I JEEVAN KAUSHAL 2.0 – TEAM SKILLS AND LIFE SKILLS 12

Trust and Collaboration: Importance of Trust in Creating a Collaborative Team- Agree to Disagree and Disagree to Agree – Spirit of Teamwork - Understanding Fear of Being Judged and Strategies to Overcome.

Brainstorming: Basics and the process – Effective technique for ideation – Types – Importance and Benefits

Internal Communication: Internal Communication – Meaning and the Need, Use of Various Channels for Transmitting Information to Team Members including Digital and Physical.

Leadership Skills: Leadership concept - Leadership skills – Leadership moralities – Leadership models

MODULE - II RANGER AND ROVER 10

Four Bonds of BSG: Sign, Salute, Left Handshake, Moto and Good Turn.

Discipline and Uniform: Uniform of Rovers and Rangers, 14 Programme ideals.

Knowledge of Merit: Know about Knowledge of Merit Badges (Proficiency Badge).

Sustainability E-learning: (Online Course Available in WOSM Learning Zone).

Activating the Earth Tribe Initiative in your Community.

MODULE - III ELECTROMAGNETIC COMPATIBILITY (EMC) AND ELECTROMAGNETIC INTERFERENCE 8

Introduction to the concept of Electromagnetic compatibility of electrical and/or electronic equipment, between themselves and with electrical power networks including electromagnetic interference and measurement and calculation methods to assess human exposure to electric, magnetic and electromagnetic fields. Discussion on IS 14700/ IEC 61000 series of Standards.

TOTAL: 45 PERIODS

REFERENCES:

1. Curriculum and Guidelines for Life Skills (Jeevan Kaushal) 2.0, UGC, New Delhi.
2. A World Built on Standards: A Textbook for Higher Education, Published by: Danish Standards Foundation, 2015.
3. SO / IEC Guide 59, BIS Standards Formulation Manual, 2nd Revision, 2022.

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M TECH COMPUTER SCIENCE & ENGINEERING
(5 YEARS INTEGRATED)

ONLINE RESOURCES

1. https://www.cambridgeenglish.org/learning-english
2. https://lms.scout.org/course_items/show/1172182?course_id=214307#course-item-id=1172182
3. https://lms.scout.org/courses/show/214123?force_course_hub=true

OUTCOMES

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

1. Apply quantitative aptitude for solving numerical problems [K3]
2. Describe logical reasoning to tackle emotional challenges. [K2]
3. Use verbal communication and comprehension skills through grammar and language exercises. [K3]
4. Apply critical thinking and problem-solving skills in various cognitive scenarios. [K3]
5. Interpret language nuances in diversified situations and exhibit scouting spirits amidst communities. [K2]
6. Explain the basic principle of BIS Standards relevant to EMC and EMI. [K2]

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	1	-	-
CO2	-	-	-	-	-	2	-	-	-	-	1	-	-
CO3	-	-	-	-	-	-	-	-	2	-	1	-	-
CO4	-	2	-	-	-	-	-	-		-	1	-	-
CO5	-	-	-	-	-		-	2	3	-	1	-	-
CO6	-	-	-	-	-	3	-	-	-	-	1	-	-

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M TECH COMPUTER SCIENCE & ENGINEERING
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SEMESTER - III

24CJID301 - SDG NO. 4,11,15	INNOVATIVE DESIGN LAB - I	L	T	P	CP	C
		0	0	2	2	1

OBJECTIVES:

- To provide opportunities for students to develop an entrepreneurial mindset and explore real-world problem-solving through a startup-centric approach.
- To enable hands-on experience in identifying market needs
- To enable development of skill sets for designing, validating, and realizing a Minimum Viable Product (MVP) for an entrepreneurial venture.
- To guide students in validating market opportunity, and formulating a solution with realistic constraints.
- To inculcate ethical research practices, foster a commitment to lifelong learning, and promote the development of socially responsible and sustainable innovations aligned with relevant Sustainable Development Goals (SDGs).
- To prepare students to design sustainable business models and present entrepreneurial ideas through structured, outcome-driven business pitches using core startup frameworks.

COURSE METHODOLOGY:

1. This initiative is designed to inculcate ethical principles of research and to get involved in a life-long learning process for the students, specifically through the lens of entrepreneurship and innovation.
2. The project work must involve identifying a problem, validating market opportunity, and developing a solution with realistic constraints, culminating in a business plan and prototype/MVP. It must also include appropriate elements of the following: market research, competitive analysis, value proposition design, business model development, financial feasibility, go-to-market strategy, and potentially software/hardware development for the MVP.
3. Project can be individual work or a group project, with a maximum of 3 students. In case of a group project, the individual project report of each student should specify the individual's contribution to the group project. The roles and responsibilities of all team members must be well-defined and documented.
4. On completion of the project, the student shall submit a detailed project report outlining their entrepreneurial journey, solution development, and business plan. The project should be reviewed and the report shall

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be evaluated, and the students shall appear for a viva-voce oral examination on the project approved by the Coordinator and the project guide.

EVALUATION:

1. First evaluation (Milestone 1 - Week 4): 20 marks (Focus on Problem Identification, Opportunity Discovery, Customer & Markets, Value Proposition)
2. Second evaluation (Milestone 2 - Week 8): 30 marks (Focus on Competitive Advantage, Business Model, and MVP Development)
3. Final evaluation (Milestone 3 & 4 - Last week of the semester): 50 marks (Focus on Financial Feasibility, Go-to-Market Strategy, Growth and Scale, Funding Strategy, and Overall Project Report & Viva-Voce)

Note: All three evaluations are mandatory for course completion and for awarding the final grade.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

1. Apply entrepreneurial thinking to identify and articulate real-world problems and explore market needs using structured approaches. (K3)
2. Develop skill sets to design potential solutions and validate market opportunities within realistic constraints. (K4)
3. Evaluate sustainable, ethical, and responsible innovation strategies, and communicate business models effectively. (K5)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	-	-	-	-	2	-	-	-	2	2
CO2	3	3	2	-	-	-	-	2	-	-	-	2	2
CO3	3	3	3	-	-	-	-	2	-	-	-	2	2

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24BSMA402 SDG NO. 4	PROBABILITY AND QUEUEING THEORY (CSE, IT, M.Tech. (CSE), IoT)	L T P CP C 3 1 0 5 4

OBJECTIVES:

- To impart necessary basic knowledge in Probability theory, Random Processes and Queueing models which are invariably used in Computer science courses

MODULE I PROBABILITY AND RANDOM VARIABLES 9

Probability – Axioms of probability – Conditional probability – Baye's theorem- Discrete and Continuous random variables – Moments – Moment generating functions.

MODULE II DISCRETE AND CONTINUOUS DISTRIBUTIONS 9

Binomial, Poisson, Geometric, Uniform, Exponential, Erlang and Normal distributions.

MODULE III TWO-DIMENSIONAL RANDOM VARIABLES 12

Joint distributions – Marginal and Conditional distributions – Covariance – Correlation and Linear Regression – Transformation of Random Variables – Central Limit Theorem (for independent and identically distributed random variables).

MODULE IV RANDOM PROCESSES 12

Classification – Stationary process – Markov process - Poisson process – Discrete parameter Markov chain – Chapman Kolmogorov equations – Limiting distributions.

MODULE V QUEUEING MODELS 9

Markovian queues – Birth and Death processes – Single and multiple server Queueing models – Little's formula - Queues with finite waiting rooms.

MODULE VI ADVANCED QUEUEING MODELS 9

Finite source models - M/G/1 queue – Pollaczek-Khinchin formula - M/D/1 and M/E_K/1 as special cases – Series queues – Open Jackson networks.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Fundamentals of Applied Probability and Random Processes, Ibe, O. C., 2nd Edition, Elsevier, 2019. (1.1-1.3, 1.6, 1.7 (1.7.1), 1.8, 1.13 - exercise problems in these sections ; 2.1 – 2.8, 3.1 – 3.5, 3.9 , 4.1 - 4.3, 4.4 - 4.4.2, 4.7 – 4.11, 5.1 - 5.7, 6.1 – 6.3, 6.8, 6.10, 8.1 - 8.5, 10.5 (10.5.1 - 10.5.6), 10.6, 10.7 (10.7.1-10.7.5)) (Modules I, II & III, IV).
2. Fundamentals of Queueing Theory, Gross, D., Shortle, J. F., Thompson, J. M. and Harris. C. M., 4th Edition, Wiley Student, 2014. (1.1 – 1.5, 1.7, 2.1 - 2.7, 4.1 - 4.2, 5.1 (5.1.1)) (Modules V and VI).

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REFERENCES:

1. Schaum's Outline Theory and Problems of Probability, Random variables and Random Processes, Hwei Hsu, 1st Edition, Tata Mcgraw Hill, New Delhi, 2004.
2. Operations Research, Taha, H. A., 10th Edition, Pearson India Education Services, Delhi, 2019.
3. Probability and Statistics with Reliability, Queueing and Computer Science Applications, Trivedi, K. S., 2nd Edition, John Wiley and Sons, 2002.
4. Probability and Stochastic Processes, Yates, R. D. and Goodman. D. J., 2nd Edition, Wiley India Pvt. Ltd., Bangalore, 2012.
5. Probability and Statistics, Random Processes and Queueing Theory, Veerarajan T., 4th Edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2015.

WEB REFERENCES:

1. https://nptel.ac.in/courses/117103017/
2. https://archive.nptel.ac.in/courses/111/102/111102111/
3. Lecture Notes | Probability and Random Variables | Mathematics | MIT OpenCourseWare
4. https://diposit.ub.edu/dspace/bitstream/2445/127366/3/memoria.pdf

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/111105041/
2. https://archive.nptel.ac.in/courses/111/102/111102111/
3. https://archive.nptel.ac.in/courses/111/104/111104079/
4. https://archive.nptel.ac.in/courses/111/102/111102160/

Course Outcomes:

Upon completion of the course, the student should be able to

- Apply probability concepts, random variables, and moment-generating functions to solve engineering problems involving uncertainty. (CO1) (K3)
- Apply discrete and continuous probability distributions to model and solve engineering problems involving random phenomena. (CO2) (K3)
- Apply joint, marginal, and conditional distributions along with correlation and regression concepts to analyze relationships between two random variables in engineering problems. (CO3) (K4)
- Apply concepts of random processes, including Markov and Poisson processes, to model and analyze stochastic systems evolving over time. (CO4) (K4)
- Apply Markovian queueing models and related concepts to analyze and solve problems involving service systems with waiting lines. (CO5) (K4)
- Apply advanced queueing models and network theories to analyze complex service systems and their performance. (CO6) (K4)

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CO- PO, PSO MAPPING: M. Tech. (CSE)

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CO1	3	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	-	-	-	-	-	-	-	-	-	-	3	-
CO3	-	3	-	-	-	-	-	-	-	-	-	3	-
CO4	-	3	-	-	-	-	-	-	-	-	-	3	2
CO5	-	3	-	-	-	-	-	-	-	-	-	3	2
CO6	-	3	-	-	-	-	-	-	-	-	-	3	2

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SEMESTER - IV

24CJPC401 106105191 SDG NO. 4,9	CORE JAVA PROGRAMMING	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To explain the features of java programming, Inheritance and Interfaces
- To illustrate the use of the file system, JDBC.
- To define Exceptions and use I/O streams
- To develop a Java application with threads and generic classes, GUI

MODULE I INTRODUCTION TO OOP AND JAVA FUNDAMENTALS 8

JVM-Internals, JVM Architecture, JDK, JRE, JVM Memory. Class fundamentals: Declaring objects, Assigning object reference variable, Methods & Method Signatures, Method returning Values, Method with parameters, Variable argument, Input / Output Basics – Streams – Byte Streams and Character Streams – Reading and Writing Console – Reading and Writing Files.

MODULE II INHERITANCE 7

Inheritance – Superclasses– Subclasses –Protected Members – Constructors in SubClasses– The Object Class – Abstract Classes and Methods – Final Methods and Classes.

MODULE III INTERFACES 7

Interfaces – Defining an Interface - Implementing Interface - Differences between Classes and Interfaces and Extending Interfaces – Object Cloning-Inner Classes -Array Lists -Strings.

MODULE IV EXCEPTION, CONCURRENCY, MULTI-THREADING 8

Exceptions – Exception Hierarchy– Throwing and Catching Exceptions – Built-in Exceptions-Creating own Exceptions - Thread Life Cycle - Creating Threads, Inter Thread Communication, Synchronization of threads using Synchronized keyword and lock method. Thread pool and Executors framework, Futures and callable, Fork-Join in Java. Deadlock conditions. Enumeration - usage

MODULE V GENERIC PROGRAMMING 7

Basics, Generic Programming – Generic Classes – Generic Methods, Generics and type safety Collections Interfaces –Collection, Set, List, Queue, Collections Classes – Array List, Hash Set, Tree Set. Accessing a Collection via Iterators. MapInterfaces. MapClasses– AbstractMap, HashMap, TreeMap - Generic

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Programming.

MODULE VI EVENT-DRIVEN PROGRAMMING 8

Graphics programming – Frame – Components – working with 2D shapes – Using color, fonts, and images – Basics of event handling – event handlers – adapter classes–actions– mouse events –AWT event hierarchy– buttons – layout management

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Herbert Schildt, "Java - The Complete Reference", 8th Edition, McGrawHill Education, 2011.
2. Cay S. Horstmann and Gary Cornell, "Core Java: Volume I – Fundamentals", Eighth Edition, Sun Microsystems Press, 2008.

REFERENCES:

1. Paul Deitel, Harvey Deitel, "Java SE 8 for Programmers", 3rd Edition, Pearson, 2015.
2. Steven Holzner, "Java 2 Blackbook", Dream Tech Press, 2011.
3. Timothy Budd, "Understanding Object-Oriented Programming with Java", Updated Edition, Pearson Education, 2000.
4. E.Balagurusamy- "Programming with Java", 6th Edition, McGrawHill Education, 2019.

WEB REFERENCES:

1. https://www.geeksforgeeks.org/java/
2. https://www.tutorialspoint.com/java/
3. https://www.javatpoint.com/java-tutorial
4. https://www.w3schools.com/java/
5. http://www.javaworld.com

ONLINE RESOURCES:

1. https://www.coursera.org/specializations/object-oriented-programming
2. https://www.udemy.com/topic/java-certification/
3. https://www.edx.org/learn/java

OUTCOMES:

Upon completion of the course, students should be able to

1. Construct basic Java programs by applying OOP fundamental concepts. (K3)
2. Apply Inheritance, Object Class, Abstract and Final Classes to build a Real world Java application. (K3)

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3. Develop a java program using interfaces, inner classes, object cloning, array lists, and string operations to solve the real world problems (K3)
4. Construct the java programms using Java Exceptions, Multithreading. (K3)
5. Apply Generic Programming Concept to solve the real-world problem (K3)
6.Develop GUI program using graphics programming concepts, including the use of frames, components, 2D shapes, event handling, and layout management

CO - PO, PSO MAPPING :

1. Construct basic Java programs by applying OOP fundamental concepts. (K3)
2. Apply Inheritance, Object Class, Abstract and Final Classes to build a Real world Java application. (K3)
3. Develop a java program using interfaces, inner classes, object cloning, array lists, and string operations to solve the real world problems (K3)
4. Construct the java programms using Java Exceptions, Multithreading. (K3)
5. Apply Generic Programming Concept to solve the real-world problem (K3)
6.Develop GUI program using graphics programming concepts, including the use of frames, components, 2D shapes, event handling, and layout management

	PO1	PO 2	PO3	PO 4	PO5	PO6	PO 7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	3	1
CO2	3	3	3	-	2	-	-	-	-	-	-	3	2
CO3	3	3	3	-	2	-	-	-	-	-	-	3	2
CO4	3	3	3	-	2	-	-	-	-	-	-	3	3
CO5	3	2	-	-	3	-	-	-	-	-	-	2	1
CO6	3	3	3	-	3	2	-	-	2	2	-	3	2

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24CSPC401 - Theoretical Computer Science

Prerequisite for Courses :

Discrete Mathematics , Computer Organization & Architecture

Objectives:

To construct Automata for any given pattern and its equivalent regular expressions
To design a context free grammar for any given language and push down automata for the language
To understand Turing machines and undecidable problems
To learn about the various phases of the Compiler
To learn various Parsing techniques
To understand Intermediate code generation, code optimization & code generation.

MODULE I AUTOMATA FUNDAMENTALS & FINITE AUTOMATA 7

Introduction to formal proof - Inductive Proofs–Finite Automata–Deterministic Finite Automata – Non-deterministic Finite Automata –Finite Automata with Epsilon Transitions-Equivalence and Minimization of Automata

MODULE 2 REGULAR EXPRESSIONS & CONTEXT FREE GRAMMAR 8

Regular Expressions–FA and Regular Expressions-State Elimination Method-CFG –Parse Trees – Ambiguity in Grammars and Languages – Normal Forms for CFG (Chomsky Normal form)

MODULE 3 PUSHDOWN AUTOMATA 8

Definition of the Pushdown Automata –Equivalence of Pushdown Automata and CFG - Deterministic Pushdown Automata

MODULE 4 TURING MACHINE 8

Introduction to Turing Machines - Types – Programming Techniques for Turing Machine (Addition, Subtraction , Multiplication)

MODULE 5 INTRODUCTION TO COMPILERS & LEXICAL ANALYSIS 7

Compilation and Interpretation-Phases of a compiler -Lexical Analysis – Role of Lexical Analyzer-Recognition of Tokens

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MODULE 6 SYNTAX ANALYSIS, CODE GENERATION & CODE OPTIMIZATION 7

Role of the parser- Top Down parsing – Predictive LL(1) Parsing – Bottom-up parsing – SLR Parser - Issues in the design of code generator -Basic Blocks and Flow Graphs-Principal Sources of Optimization-Peep-hole optimization

TEXT BOOK:

1. J.E.Hopcroft, R.Motwani and J.D Ullman, "Introduction to Automata Theory, Languages and Computations", Second Edition, Pearson Education, 2011.
2. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, "Compilers: Principles, Techniques and Tools", Second Edition, Pearson Education, 2009.

REFERENCES:

1. H.R.Lewis and C.H.Papadimitriou, "Elements of the theory of Computation", Second Edition, PHI, 2010.
2. J.Martin, "Introduction to Languages and the Theory of Computation", 4th Edition, TMH, 2019.
3. Micheal Sipser,"Introduction of the Theory and Computation", 4th Edition, Thomson Brokecole, 2014.
4. V. Raghavan, "Principles of Compiler Design", Tata McGraw Hill Education Publishers, 2010.
5. Randy Allen, Ken Kennedy, "Optimizing Compilers for Modern Architectures: A Dependence based Approach", Morgan Kaufmann Publishers, 2002.

WEB REFERENCES:

1. https://nptel.ac.in/courses/106/104/106104148
2. https://swayam.gov.in/nd1_noc19_cs79/
3. http://www.holub.com/software/compiler.design.in.c.docs.pdf
4. http://www.cs.usfca.edu/~galles/compilerdesign/x86.pdf

ONLINE RESOURCES:

1. http://www.youtube.com/watch?v=eqCkkC9A0Q4
2. https://online.standford.edu/courses/soe-ycsautomata- automata- theory
3. https://www.javatpoint.com/compiler-tutorial

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OUTCOMES:

Upon completion of the course, the student should be able to

CO1	Apply models of computation to construct automata. (K3)
CO2	Build the Regular Expression and Context Free Grammar for any given language (K3)
CO3	Construct the PushDown Automata for the regular language (K3)
CO4	Develop the Turing machine for the regular language (K3)
CO5	Identify the role of each phase of a compiler and Lexical Analyzer (K3)
CO6	Develop parser, code generation and code optimization to generate the optimized code (K3)

CO-PO, PSO Mapping

	PO1	PO2	PO 3	PO 4	PO5	PO6	PO 7	PO 8	PO 9	PO10	PO11	PSO1	PSO2
CO1	3							2				2	2
CO2			3						2			2	2
CO3	3							2				2	2
CO4		3										2	2
CO5		3						2				2	2
CO6			3						2			2	2

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SEMESTER 4

24CSPC402 -DESIGN AND ANALYSIS OF ALGORITHM

MODULE - I INTRODUCTION 8

Notion of an Algorithm – Fundamentals of Algorithmic Problem Solving – Important Problem Types – Fundamentals of the Analysis of Algorithmic Efficiency –Asymptotic Notations and their properties - Analysis Framework – Empirical analysis - Mathematical analysis for Recursive and Non-recursive algorithms .

MODULE - II BRUTE FORCE AND DIVIDE-AND-CONQUER 8

Brute Force – Computing an- String Matching - Closest-Pair and Convex-Hull Problems - Exhaustive Search - Travelling Salesman Problem - Knapsack Problem - Assignment Problem. Divide and Conquer Methodology – Binary Search – Merge sort – Quick sort – Heap Sort - Multiplication of Large Integers – Closest-Pair and Convex - Hull Problems.

MODULE - III DYNAMIC PROGRAMMING AND GREEDY TECHNIQUES 7

Dynamic programming – Principle of optimality - Coin Changing Problem - Computing a Binomial Coefficient – Floyd's Algorithm – Multi Stage Graph - Optimal Binary Search Trees – Knapsack Problem and Memory functions.

MODULE - IV GREEDY TECHNIQUES 7

Greedy Technique – Container Loading Problem - Prim's Algorithm and Kruskal's Algorithm – 0/1 Knapsack Problem - Optimal Merge pattern - Huffman Trees.

MODULE - V ITERATIVE IMPROVEMENT 7

The Simplex Method - The Maximum-Flow Problem – Maximum Matching in Bipartite Graphs - Stable Marriage problem.

MODULE - VI COPING WITH THE LIMITATIONS OF ALGORITHM POWER 8

Lower - Bound Arguments - P, NP, NP - Complete and NP-Hard Problems Backtracking – n-Queen Problem - Hamiltonian Circuit Problem – Subset Sum Problem. Branch and Bound -Assignment Problem – Knapsack Problem – Travelling Salesman Problem - Approximation Algorithms for NP-Hard Problems – Travelling Salesman Problem – Knapsack Problem.

TOTAL : 45 PERIODS

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Course Outcome:

CO1: Analyze the efficiency of algorithms using various frameworks. — K4

CO2: Make use of algorithm design techniques like brute force and divide and conquer techniques to solve problems. — K3

CO3: Use dynamic programming techniques for solving problems. — K3

CO4: Implement greedy technique concept to solve various problems. — K3

CO5: Apply iterative improvement techniques to formulate and solve complex optimization and matching problems. — K3

CO6: Analyze the constraints and use approximation and randomized method to obtain efficient solution. — K4

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2
CO 1	-	3										1	3
CO 2	3	-										2	3
CO 3	3	-										2	3
CO 4	-	3										2	3
CO 5	3	-										2	3
CO 6	-	3										2	3

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SEMESTER-IV

24CJPW401 106105153 SDGNO.4,9	OBJECT ORIENTED ANALYSIS AND DESIGN WITH LABORATORY	L	T	P	CP	C
		3	0	2	5	4

OBJECTIVES:

- To employ the UML notation and symbols to create effective and efficient system designs.
- To understand Object Oriented Process with classes and responsibilities.
- To design with static,dynamic and implementation diagrams.
- To improve the software design with design patterns
- To test the software against its requirement specification.

MODULE-IINTRODUCTIONTOOBJECTMODELINGANDUML **12**

Understanding the real world using the Objects Model - Classes, Inheritance and multiple configurations - Introduction to the UML Language. Analysis of system requirements - Actor definitions - Writing a case goal. Use Case Diagram - Use Case Relationships - Requirements Analysis Using Case ModelingAnalysisofsystemrequirements

LISTOFEXPERIMENTS:

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

MODULE-IIOBJECTORIENTEDDESIGNPRINCIPLESANDPROCESS **10**

The object and class Concepts, Identifying classes, Identifying responsibilities, Relationships between Classes, Use Cases, CRC cards, UML class diagrams, Sequence diagrams, State diagrams, Classes: Terms and concepts, Common modelling techniques; Relationships Modelling simple dependencies, Common mechanisms and diagrams.

LISTOFEXPERIMENTS:

1. Write a java program to find the largest among three numbers
2. Sort the strings in ascending order using constructors.
3. Design a package to perform bank accounting transactions.
4. Pay roll processing using Inheritance for employees.

MODULE-IIISTATICUMLDIAGRAMS 10

Class Diagram-Elaboration-Domain Model-Finding conceptual classes and description classes - Associations - Attributes - Domain model refinement - Finding conceptual class Hierarchies - Aggregation and Composition - Relationship between sequence diagrams and use cases - When to use Class Diagrams.

LISTOFEXPERIMENTS:

1. Identify the conceptual classes and develop a Domain Model and also derive a Class Diagram from that.

MODULE-IVDYNAMICUMLDIAGRAMS 10

Dynamic Diagrams-UML interaction diagrams-System sequence diagram-Collaboration diagram - When to use Communication Diagrams - State machine diagram and Modeling - When to use State Diagrams - Activity diagram - When to use activity diagrams Implementation Diagrams - UML package diagram - When to use package diagrams - Component and Deployment Diagrams-When to use Component and Deployment diagrams

LISTOFEXPERIMENTS:

1. The interaction between objects and represent them using UML Sequence and Collaboration Diagrams
2. Draw relevant Statechart and Activity Diagrams for the same system.
3. Implement the system as per the detailed design

MODULE-VDESIGNPATTERNS 10

Design Pattern - Describing Design Patterns - Creational Design Patterns - StructuralDesignPatterns-BehavioralDesignPatterns-SingletonPattern-Factory Method Pattern - Abstract Factory Pattern - Builder Pattern - Prototype Pattern - Adapter Pattern - Decorator Pattern - Facade Pattern - Composite Pattern - Flyweight Pattern - Proxy Pattern - Strategy Pattern - Observer Pattern - Command Pattern - State Pattern - Iterator Pattern - Template Method Pattern.

CASESTUDYDISCUSSIONS:

1. Implement Design patterns using Java

MODULE-VITESTING 8

Software Quality Assurance – Impact of object orientation on Testing – Develop Test Cases and Test Plans.

LISTOFEXPERIMENTS:

1. Develop test cases and test plans for the designed system.
2. Perform basic unit testing usingJ unit.

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Suggested domains for Experiments:

1. Attendance Monitoring System
2. Book bank
3. Exam Registration
4. Online Food Ordering System
5. Online courser servation system
6. E-ticketing
7. Smart Home Automation
8. Credit card processing
9. Job Portal System
10. Weather Forecasting System

Suggested Software Tools: Rational Rose,Visualparadigm,Eclipsewithjdk17,junit.

TOTAL:60PERIODS

TEXTBOOKS:

1. Craig Larman, "Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development", Pearson Education,3rdEdition,2005.
2. Grady Booch, James Rumbaugh, Ivar Jacobson (2009), The Unified Modeling Language User Guide, 2nd edition, Pearson Education, New Delhi,India.

REFERENCES:

1. Erich Gamma, Richard Helm, Ralph Johnson, and John M. Vlissides, "Design Patterns: Elements of Reusable Object-Oriented Software" Addison-WesleyProfessional,1994.
2. Ali Bahrami, "Object Oriented Systems Development", McGraw Hill Edition,2017.

WEBREFERENCES:

1. http://www.uml.org.
2. http://modeling-languages.com/uml-tutorial-online.
3. http://www.nptel.ac.in.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/106105153.
2. https://www.tutorialspoint.com/object_oriented_analysis_design/index.htm.

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Suggested domains for Experiments:

1. Attendance Monitoring System
2. Book bank
3. Exam Registration
4. Online Food Ordering System
5. Online courser servation system
6. E-ticketing
7. Smart Home Automation
8. Credit card processing
9. Job Portal System
10. Weather Forecasting System

Suggested Software Tools: Rational Rose,Visualparadigm,Eclipsewithjdk17,junit.

TOTAL:60PERIODS

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2. Grady Booch, James Rumbaugh, Ivar Jacobson (2009), The Unified Modeling Language User Guide, 2nd edition, Pearson Education, New Delhi,India.

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1. Erich Gamma, Richard Helm, Ralph Johnson, and John M. Vlissides, "Design Patterns: Elements of Reusable Object-Oriented Software" Addison-WesleyProfessional,1994.
2. Ali Bahrami, "Object Oriented Systems Development", McGraw Hill Edition,2017.

WEBREFERENCES:

1. http://www.uml.org.
2. http://modeling-languages.com/uml-tutorial-online.
3. http://www.nptel.ac.in.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/106105153.
2. https://www.tutorialspoint.com/object_oriented_analysis_design/index.htm.

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3. https://www.geeksforgeeks.org/software-engineering-object-oriented-design.

OUTCOMES

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

1. Apply the fundamental concepts of object-oriented modeling and system requirements using UML use case modelling techniques.(K3)
2. Identify classes, responsibilities, and relationships to design object oriented systems using appropriate UML diagrams and basic Java implementations.(K3)
3. Analyze static structural models such as class and domain models by identifying conceptual classes, relationships, attributes, and hierarchies.(K4)
4. Examine dynamic behavioral models including sequence, collaboration, state machine, and activity diagrams to represent system behavior and interactions. (K4)
5. Analyze,apply and Understand various object-oriented design patterns to develop flexible and reusable software components.(K4)
6. Discover test cases and test plans, incorporating quality assurance practices in the context of object-oriented software development.(K4)

CO-PO,PSOMAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	-	-	-	3	1
CO2	3	2	2	2	-	-	-	-	1	-	-	3	2
CO3	3	2	3	3	-	-	-	-	-	-	-	3	2
CO4	2	3	3	3	2	-	-	-	-	-	-	3	3
CO5	2	2	2	3	3	2	-	-	-	-	-	2	1
CO6	2	1	2	2	2	-	3	-	2	1	-	3	2

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OPEN ELECTIVES

24MGOE904 – SDG NO. 4,12	LOGISTICS INFORMATION SYSTEM	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- Understand the principles, architecture, and functional components of Logistics Information Systems (LIS) and their role in logistics management.
- Analyze the use of forecasting tools, ERP, CRM, and project management systems in integrated logistics and supply chain operations.
- Apply emerging technologies such as RFID, IoT, and mobile intelligence to optimize logistics operations and enhance decision-making.

MODULE - I INTRODUCTION TO IT IN LOGISTICS, LIS PRINCIPLES, AND VIRTUALIZATION. 7

Introduction IT and management in Logistics and challenges-Strategic planning and models - LIS-Definition-Information functionality - Principles of designing or evaluating LIS applications., Virtualization and Virtual Machines.

MODULE - II SYSTEM ARCHITECTURE, PLANNING AND OPERATING FLOWS 7

LIS Architecture: Components: Two forms of activities; Planning and co-ordination flows and operating flows - Flow and use of integrated logistics information. Case Studies

MODULE - III FORECASTING METHODS, AND ERROR MANAGEMENT IN LOGISTICS INFORMATION. 8

Information forecasting: Definition-Process- components-characteristics. Information Approaches forecast techniques - Forecast error. Case Studies

MODULE - IV ENTERPRISE-LEVEL SYSTEMS — ERP, SCM, AND CPFR INTEGRATION 8

Functional Area and Compliance systems: Management levels and functional systems Enterprise Systems and applications: Enterprise systems, Enterprise Resource Planning (ERP), Supply Chain Management (SCM), Collaborative Planning, Forecasting, and Replenishment system (CPFR). Case Studies

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MODULE - V **CRM, PERFORMANCE ANALYTICS, AND FLEET MANAGEMENT INFORMATION SYSTEMS.** **8**

Customer Relationship Management (CRM). Performance Management: Data visualization, Mashups, and Mobile intelligence, Fleet Management Information System. Case Studies

MODULE - VI **IT-BASED PROCESS INTEGRATION** **7**

Business Process and Project Management: Architecture and IT design, System development, Software and Applications for management ERP Modules, Barcoding, RFID, Mobile Solution for Distribution, IoT in Logistics. Case Studies

TOTAL : 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES

- Use Excel to simulate demand forecasting using moving average and exponential smoothing techniques.
- Design an LIS architecture diagram showcasing flows and integration points.
- Create logistics dashboards using Power BI or Tableau with KPIs like delivery performance and fleet utilization.
- Build a prototype using RFID/barcode scanning, or simulate IoT sensor applications in fleet/warehouse operations.

TEXTBOOKS:

1. Bowersox, D. J., Closs, D. J., and Cooper, M. B. (2019). Supply Chain Logistics Management (5th ed.). McGraw-Hill Education.
2. Ross, D. F. (2015). Introduction to Supply Chain Management Technologies (2nd ed.). CRC Press.

REFERENCE BOOKS:

1. Monk, E., and Wagner, B. (2012). Concepts in Enterprise Resource Planning (4th ed.). Cengage Learning.
2. Turban, E., Volonino, L., and Wood, G. (2018). Information Technology for Management (11th ed.). Wiley.
3. Hugos, M. H. (2018). Essentials of Supply Chain Management (4th ed.). Wiley.

WEB REFERENCES

1. https://www.ascm.org
2. https://www.scmglobe.com
3. https://searcherp.techtarget.com

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4. https://sloanreview.mit.edu
5. https://www.rfidjournal.com

MOOC COURSES

1. https://www.coursera.org/learn/digital-supply-chain
2. https://open.sap.com
3. https://www.coursera.org/learn/forecasting-models
4. https://www.udemy.com/course/rfid-in-logistics-and-supply-chain/

OUTCOMES:

Upon completion of the course, the student should be able to:

1. Apply the fundamentals of LIS and IT's role in strategic logistics planning, virtualization, and architecture design. (K3)
2. Identify the architecture and flows of LIS and describe how planning and coordination are enabled by information integration. (K3)
3. Apply forecasting techniques and evaluate forecast accuracy using quantitative tools and methods. (K3)
4. Analyze enterprise-wide systems including ERP, SCM, and CPFR, and understand compliance and functional applications. (K4)
5. Design CRM and performance dashboards integrating mobile intelligence, data visualization, and fleet management. (K6)
6. Implement modern digital solutions like RFID, IoT, and mobile systems for process optimization and logistics system integration. (K3)

CO - PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	-	1	-	-	-	-	-
CO2	-	3	-	-	-	1	-	-	2	-	-
CO3	3	-	-	-	-	-	1	1	-	-	-
CO4	-	3	-	-	-	2	1	1	1	2	1
CO5	-	-	3	-	-	1	1	1	1	-	1
CO6	-	2	-	-	-	1	1	1	1	1	1

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... Kalaivani Engineering College

AIRMANSHIP		**1**
A 1	Airmanship	1
BASIC FLIGHT INSTRUMENTS		**3**
FI 1	Basic Flight Instruments	3
AERO MODELLING		**3**
AM 1	Aero Modelling Capsule	3
GENERAL SERVICE KNOWLEDGE		**2**
GSK 4	Latest Trends & Acquisitions	2
AIR CAMPAIGNS		**6**
AC 1	Air Campaigns	6
PRINCIPLES OF FLIGHT		**6**
PF 1	Principles of Flight	3
PF 2	Forces acting on Aircraft	3
NAVIGATION		**5**
NM 1	Navigation	2
NM 2	Introduction to Met and Atmosphere	3

TOTAL :45 PERIODS

SEMESTER - IV

24CJPL401 - SDG NO. 4, 9, 11	JAVA PROGRAMMING LABORATORY	L	T	P	CP	C
		0	0	4	4	2

OBJECTIVES:

- To understand Object Oriented Programming concepts and basic characteristics of Java.
- To know the principles of Packages, Inheritance and Interfaces.
- To develop a Java application with Threads and Generic classes.
- To make the students understand the life cycle of the Applets and its functionality.

LIST OF EXPERIMENTS:

1. Basic JAVA Programs.

a). Write a program to find the sum of individual digits of a positive integer.

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b). Write a program to generate the first n terms of the sequence.

c). Write a program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.

d). Write a program to find both the largest and smallest number in a list of integers.

e). Write a program to find the factorial of the list of number reading input as a command.

2. Write a program to calculate bonuses for different departments using method overriding.

3. Write a Java program to perform the following operations.

a). Find the string index.

b). Compare two strings & Concatenation of 2 strings

c). Retrieve the single character from string,conversion of Lower to Upper and vice versa.

d). Find the substring of the given string.

e). Split the string.

4. Write a program to implement the concept of importing classes from user defined packages and creating packages.

5. Write a Java program that reads the contents of a text file named input.txt and creates a new file named output.txt that contains the same contents in uppercase letters.

6. Implementation of inheritance in Java

a). Write a Java program where a Person class contains personal details and a Student class inherits from it to include academic details like roll number and course.

b). Write a Java program where a Person class is extended by Employee, and Employee is extended by Manager, showing personal, work, and leadership details.

c). Write a Java program where a base class Vehicle is extended by Car and Bike classes, each defining their own characteristics along with shared properties.

7. Implement a Java program to Create an interface Controllable with a method start() and stop().Implement this interface in two classes: Car and Bike.Each class should provide its own implementation of starting and stopping the vehicle.

8. Write a Java program with a class Outer that contains an inner class Inner. The Outer class should have a method that prints a message, and the Inner class should have its own method that prints a different message. In the main method, create objects to call both methods and display the messages.

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9. Create a Custom Exception for Invalid Age Input in a Voting System.
10. Write a Java Program that opens a file using FileReader and handles FileNotFoundException and IOException.
11. Write a Java Program to calculate the sum of the array using Multithreading.
12. Write a Java program to create two threads with different priorities and observe the order of execution by printing thread names and their priorities.
13. Write a Java program to create a producer-consumer scenario using the wait() and notify() methods for thread synchronization.
14. Write a Java Program to implement to create multiple threads which prints the message alternatively.
15. Write a Java Program to create a generic method that takes a list of any type and returns it as a new list with the elements in reverse order.
16. Write a Java Program using Generic Classes to count the number of occurrences of the element in a List.
17. Write a program to implement thread, applets and graphics to animate ball movement.
18. Write a program to create different shapes and fill colors using Applet.
19. Create a Java AWT application with two buttons and a label. Implement action listeners to update the label text when each button is clicked. Also, use a mouse adapter to detect mouse clicks on the window and display the click coordinates on the label. Arrange components using a layout manager.

TOTAL : 45 PERIODS

LAB REQUIREMENTS:

Hardware :

Desktop Systems - Intel Core i5-12th Gen Processor, 8GB RAM, Monitor 1024 x 768 color

Software :

Systems with either Netbeans or Eclipse / Windows operating system / JDK 1.8

OUTCOMES :

On completion of this laboratory course, the student should be able to

1. Implement Java Programming using Inheritance,Polymorphism and Packages.(K4)
2. Implement the real world application program using multithreading and Generic concepts.(K4)

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3. Create applications using applets,event-driven programming and AWT graphics to design dynamic and interactive applications. (K6)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	0	2	0	0	0	0	0	1	3	1
CO2	3	1	3	0	2	0	0	0	0	0	1	3	2
CO3	1	2	3	2	0	0	0	0	0	0	1	2	2

SEMESTER - IV

24CJPT401 - SDG NO. 4 & 9	OPERATING SYSTEM LABORATORY WITH THEORY	L	T	P	CP	C
		1	0	4	5	3

OBJECTIVES:

- To understand the basic concepts, functions of Operating Systems, Processes and Threads
- To analyze Scheduling algorithm and understand the concept of Deadlock
- To analyze various Memory Management schemes and understand I/O management and File Systems
- To be familiar with the basics of Linux system and Mobile OS like iOS and Android

MODULE - I OPERATING SYSTEM OVERVIEW **10**

Operating system overview: Objectives – functions - Computer System Organization Operating System Structure - Operating System Operations- System Calls, System Programs.

LIST OF EXPERIMENTS

1. Basics of UNIX commands.
2. Write programs using the following system calls of UNIX operating system fork, exec, getpid, exit, wait, close, stat, opendir, readdir
3. Write C programs to simulate UNIX commands like cp, ls, grep, etc.
4. Shell Programming
5. Write C programs to invoke system calls like read(), write(), and fork() in Linux.

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MODULE - II PROCESS MANAGEMENT **10**

Processes: Process Concept - Process Scheduling - Operations on Processes – Inter process Communication. Process Synchronization: The Critical-Section Problem - Semaphores - Classic Problems of Synchronization – Monitors.

LIST OF EXPERIMENTS

1. Develop a program to provide synchronization among the 5 philosophers in Dining Philosophers problem using semaphore.
2. Develop a program to provide synchronization among the producer and consumer processes in producer – consumer problem using a monitor.

MODULE - III SCHEDULING AND DEADLOCK MANAGEMENT **10**

CPU Scheduling: Scheduling Criteria - Scheduling Algorithms. Deadlocks: Deadlock Characterization - Methods for Handling Deadlocks - Deadlock Prevention - Deadlock Avoidance - Deadlock Detection - Recovery from Deadlock.

LIST OF EXPERIMENTS

1. A washing machine which requires the process to be executed sequentially. Consider the processes P1, P2, P3, P4 whose arrival times are 1, 5, 9, 10 and burst times are 4, 3, 5, 2 respectively. Implement an appropriate algorithm. Find the CPU idle time, so that the water can be supplied during that period of time.

Process	BurstTime	Arrival Time
P1	3	0
P2	6	2
P3	4	4
P4	5	6
P5	2	8

2. Implement shortest job first for the following data: Consider the following set of processes, CPU burst time, Arrival time. Calculate the average waiting time, average response time and average turnaround time.

Process	BurstTime	Arrival Time
P1	3	0
P2	6	2
P3	4	4
P4	5	6
P5	2	8

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3. Implement Round Robin for the following data Consider the following set of processes and length of the CPU burst time given in milliseconds.

Process	Burst Time
P1	10
P2	1
P3	2
P4	1
P5	5

4. Write C program to implement Threading & Synchronization Applications Implementation of Bankers Algorithm for Deadlock Avoidance Consider the following data:

Process	Allocation A B C D	Max A B C D	Available A B C D
P1	0 0 1 2	0 0 1 2	2 1 0 0
P2	2 0 0 0	2 7 5 0	
P3	0 0 3 4	6 6 5 6	
P4	2 3 5 4	4 3 5 6	
P5	0 3 3 2	0 6 5 2	

i) Calculate the need matrix

ii) Is this system currently in a safe or unsafe state?

iii) Is the system currently deadlock or not.

iv) Which process,if any, or may become deadlock?

MODULE - IV STORAGE MANAGEMENT **10**

Main Memory: Swapping - Contiguous Memory Allocation, Segmentation, Paging. Virtual Memory: Demand Paging - Page Replacement - Allocation of Frames - Thrashing.

LIST OF EXPERIMENTS

1. Implementation of the following Memory Allocation Methods for fixed partition

i. a) First Fit b) Worst Fit c) Best Fit

2. Implementation of Paging Technique of Memory Management

3. Consider the following scenario: A process has been allocated 3 page frames. Assume that none of the pages of the process are available in the memory initially. The process makes the following sequence of page references (reference string): 1, 2, 1, 3, 7, 4, 5, 6, 3, 1, 2, 4, 6, 3, 1. Find out a page replacement policy which gives the least number of page faults. Implementation of the following Page Replacement Algorithms

a) FIFO b) LRU c) LFU

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MODULE - V FILE SYSTEMS AND I/O SYSTEMS **10**

Mass Storage System – Overview of Mass Storage Structure - Disk Structure - Disk Scheduling and Management - Swap Space Management - File-System Interface - File Concept - Access Methods - Directory Structure - Directory Organization - File System Mounting - File Sharing and Protection - File System Implementation- File System Structure - Directory Implementation - Allocation Methods.

LIST OF EXPERIMENTS

1. Implementation of the various File Organization Techniques
2. Implementation of the following File Allocation Strategies
   a) Sequential b) Indexed c) Linked

MODULE – VI CASE STUDY **10**

Linux System - Design Principles - Kernel Modules - Process Management - Scheduling - Memory Management - Input-Output Management - File System - Inter-Process Communication - Mobile OS - iOS and Android - Architecture and SDK Framework - Media Layer- Services Layer- Core OS Layer- File System.

LIST OF EXPERIMENTS

1. Write and load a simple Linux kernel module (e.g., Hello World).
2. Use malloc(), free(), brk(), sbrk() to manage heap memory.
3. Simulate basic I/O drivers or interact with I/O devices using system calls.

TOTAL : 60 PERIODS

TEXT BOOKS:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", 9th Edition, John Wiley and Sons Inc., 2012.
2. Harvey M. Deitel, "Operating Systems", Third Edition, Pearson Education, 2004.

REFERENCES:

1. Ramez Elmasri, A. Gil Carrick, David Levine, "Operating Systems – A Spiral Approach", Tata McGraw Hill Edition, 2010.
2. Achyut.Godbole, Atul Kahate, "Operating Systems", McGraw Hill Education, 2016.
3. Andrew S. Tanenbaum, "Modern Operating Systems", Second Edition, Pearson Education, 2004.
4. Gary Nutt, "Operating Systems", Third Edition, Pearson Education, 2004.
5. Daniel P Bovet and Marco Cesati, "Understanding the Linux kernel", Third Edition, O'Reilly, 2005.
6. Neil Smyth, "iPhone iOS 4 Development Essentials – Xcode", Fourth Edition, Payload media, 2011.

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WEB REFERENCES:

1. https://nptel.ac.in/courses/106/106/106106144/
2. https://www.coursera.org/courses?query=operating%20system
3. https://www.computerhope.com/jargon/o/os.html
4. https://www.os-book.com/OS9/slide-dir/
5. http://web.iitd.ac.in/~minati/MTL458.html

ONLINE RESOURCES:

1. https://www.udacity.com/course/introduction-to-operating-systems--ud923
2. https://freevideolectures.com/course/3670/introduction -to-operating-systems

OUTCOMES

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

1. Apply operating system concepts and UNIX system calls to develop and execute basic system-level programs and shell scripts.(K3)
2. Implement process synchronization techniques using semaphores and monitors to solve classical inter-process communication problems.(K3)
3. Apply CPU scheduling and deadlock handling techniques by implementing scheduling algorithms, synchronization mechanisms, and deadlock avoidance strategies.(K3)
4. Examine memory management problems and segmentation. (K4)
5. Develop file system structures and allocation strategies by implementing file organization and storage management techniques.(K3)
6. Implement Linux system concepts by developing kernel modules, managing memory, and performing I/O operations through system-level programming.(K3)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	3	1	2	–	–	2	–	2	–	3	2
CO2	3	3	3	1	2	–	2	2	2	2	–	3	3
CO3	3	3	3	1	2	–	2	2	2	2	–	3	3
CO4	3	3	3	1	2	–	–	–	–	–	–	3	2
CO5	3	3	3	1	2	–	–	–	–	–	–	3	2
CO6	3	3	3	1	2	–	–	–	–	–	–	3	3

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Meeting No. 7 Dated: 15.4.25

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SEMESTER V

COURSE CODE: 24ITPC501	COMPUTER NETWORKS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24ITPC301					

OBJECTIVES:

- To understand the fundamentals of data communication, network types and protocol models.
- To learn physical and data link layer concepts including transmission, error control and LAN technologies.
- To analyze network and transport layer protocols such as IP addressing, routing, TCP and UDP.
- To explore application layer protocols and basic network security mechanisms

MODULE - I FUNDAMENTALS OF DATA COMMUNICATION 6

Data Communications- Data Representation and Data Flow-Network Criteria and Physical Structures-Types of Networks: LAN, WAN, Internet-Network Topologies-Protocol Layering and Design Issues-TCP/IP Protocol Suite- OSI model

MODULE - II PHYSICAL LAYER 7

Data and Signals (Analog & Digital)-Performance-Transmission Media (Guided & Unguided)-Switching- Circuit-Switched Networks -Packet Switching

MODULE - III DATA LINK LAYER 9

Data Link Layer Services-Data Link Layer - Addressing-Error Detection And Correction -Block Coding -Cyclic Codes -Checksum -DLC Services -Data-Link Layer Protocols -HDLC- Wired LAN's: Ethernet - Wireless LAN's – Introduction – IEEE 802.11, Bluetooth – Connecting Devices.

Recommended in Board of Studies (BoS) Meeting No. 08 held on 12/05/2026

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MODULE - IV NETWORK LAYER 9

Network Layer Services – Packet switching – Performance – IPV4 Addresses – Forwarding of IP Packets - Network Layer Protocols: IP, ICMP v4 – Unicast Routing Algorithms – Protocols – Multicasting Basics – IPV6 Addressing – IPV6 Protocol.

MODULE - V TRANSPORT LAYER 8

Introduction -Transport-Layer Protocols -User Datagram Protocol - Transmission Control Protocol -SCTP

MODULE - VI APPLICATION LAYER & NETWORK SECURITY 6

Socket Interface and Socket programming- Standard Client-Server protocols such as WWW, HTTP, FTP, E-Mail ,SSH , DNS & SNMP.

TOTAL : 45 PERIODS

TEXT BOOK:

1. Behrouz A.Foruzan, "Data Communication and Networking", McGraw Hill Education,Sixth Edition, 2022
2. Larry L. Peterson and Bruce S. Davie,Computer Networks: A Systems Approach, Sixth Edition, Morgan Kaufmann / Elsevier, 2021

REFERENCES:

1. James F. Kurose and Keith W. Ross, Computer Networking: A Top-Down Approach, Ninth Edition, Pearson Education, 2025.
2. Andrew S. Tanenbaum and David J. Wetherall, Computer Networks, Sixth Edition, Pearson Education, 2021

ONLINE RESOURCES:

1. https://www.geeksforgeeks.org/computer-network-tutorials/
2. https://www.tutorialspoint.com/data_communication_computer_network/index.htm
3. https://nptel.ac.in/courses/106105183

OUTCOMES

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

1. Illustrate the fundamental concepts of data communication, network types, and protocol models (OSI & TCP/IP) for basic networking and communication applications (K3)

Recommended in Board of Studies (BoS) Meeting No. 08 **held on** 12/05/2026

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2. Demonstrate physical layer concepts including signals, transmission media, and switching techniques in data communication systems. (K3)
3. Analyze data link layer protocols, error detection and correction methods, and LAN technologies in network communication systems (K4)
4. Examine the operation of network layer services, routing, and IP protocols in data communication networks. (K4)
5. Illustrate transport layer protocols such as UDP, TCP, and SCTP in network communication.(K3)
6. Interpret socket programming and standard application layer protocols in networking. (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	-	2	-	-	-	-	-	-	2	2
CO2	2	2	2	-	2	-	-	-	-	-	-	2	2
CO3	2	2	2	-	2	-	-	-	-	-	-	2	2
CO4	2	2	2	-	2	-	-	-	-	-	-	2	2
CO5	2	2	2	-	2	-	-	-	-	-	-	2	2
CO6	2	2	2	-	2	-	-	-	-	-	2	2	2

SEMESTER V

COURSE CODE: 24CJPW502	WEB TECHNOLOGY FOUNDATION WITH LABORATORY	L	T	P	CP	C
		3	0	2	5	4
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24CSPC301, 24CJPW401					

OBJECTIVES:

- To Learn the basic concepts in HTML, CSS, Javascript
- To understand the responsive design and development
- To understand the fundamentals of Javascript
- To explore advanced ES6 features

Recommended in Board of Studies (BoS) Meeting No. ३ **held on** 15.4.25

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MODULE - I FOUNDATIONS OF WEB DESIGN WITH HTML AND BASIC NODE.JS **10**

Working of Web -HTML Markup for Structure - Creating simple page - Text formatting - Links - Images - Tables - Forms - HTML5 basics- Introduction to NodeJs.

List of Experiments:

1. To Design a student profile page with links and images.
2. To Create a time table using tables.
3. To Build a registration form with input fields.
4. To Create a simple HTML5 webpage using semantic tags.
5. To Write a basic Node.js program to display "Hello World".

MODULE - II CSS FOR STYLING AND LAYOUT DESIGN **10**

Introduction to CSS -Inline, Internal and External CSS - Formatting Text using CSS - Colors, Backgrounds and Gradients - Padding, Borders and Margins - Box Model - Basic Positioning Techniques.

List of Experiments:

1. Apply Inline, Internal and External CSS in a webpage.
2. Design a Styled Webpage using colors, fonts, backgrounds and text formatting.
3. Demonstrate CSS Box Model using padding, borders and margins.

MODULE - III CSS FRAMEWORKS AND ADAPTIVE WEB DESIGN **10**

Floating and positioning - Page Layout with CSS - Transition, Transforms and Animation - Mobile-First or Desktop-First - CSS Grids, CSS Frameworks, UI Kits, and Flexbox for Responsive Web Design.

List of Experiments:

1. Create a Responsive Webpage using media queries.
2. Develop a Layout using CSS Grid and Flexbox.
3. Design Animated Buttons/Cards using transitions and transforms.

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MODULE - IV JAVASCRIPT FUNDAMENTALS AND DOM MANIPULATION **10**

Introduction to JavaScript - Variables and Data Types - Operators and Expressions - Control flow and Conditional Statements - Functions and Scope - Arrays and Loops - Objects and Properties - Events and Event Handling - Document Object Model - Basic manipulation of HTML and CSS using Javascript - Handling Errors and Exceptions.

List of Experiments:

1. Develop a Student Grade Calculator using JavaScript conditions.
2. Create Interactive Events using button click and mouse events.
3. Manipulate Webpage Content Dynamically using DOM methods.

MODULE - V MODERN JAVASCRIPT WITH ES6 AND ASYNC PROGRAMMING **10**

Introduction to ES6 - Block scoped variables with let and const - Arrow functions and default parameters - Template literals and string interpolation - Destructuring and Spreading - Map,Filter and Reduce - Callbacks - Async/Await and Asynchronous programming..

List of Experiments:

1. Implement Arrow Functions and let/const in JavaScript programs.
2. Perform Array Operations using map(), filter() and reduce().
3. Develop Async Programs using promises and async/await.

MODULE - VI CLIENT-SIDE SCRIPTING WITH JQUERY, AJAX AND BOOTSTRAP **10**

Link/code JS with html - Introduction to jQuery - Library usage - DOM - Manipulation and Traversal using JQuery- Elements using JQuery- HTML using JQuery- FORMS using JQuery - CSS using JQuery- Events using JQuery- AJAX Calls.-Introduction to bootstrap.

List of Experiments:

1. Validate a Registration Form using jQuery.
2. Fetch Data Dynamically using AJAX calls.
3. Design a Responsive Webpage using Bootstrap components.

TOTAL : 60 PERIODS

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TEXT BOOK:

1. Jennifer Niederst Robbins, "Learning Web Design", O'REILLY 4th Edition, 2012
2. Ricardo Zea, "Mastering Responsive Web Design", PACKT Publishing, 2015
3. David Flanagan, "JavaScript: The Definitive Guide", O'Reilly Media, 2020

REFERENCES:

1. Jon Duckett, "HTML and CSS: Design and Build Websites", John Wiley and Sons, edition 2014
2. Jon Duckett, Jack Moore, "JavaScript & JQuery: Interactive Front-End Web Development", John Wiley and Sons, edition 2014
3. Ethan Brown, "JavaScript and ES6: A Comprehensive Guide" O'Reilly Media 2021

WEB REFERENCES:

1. https://www.tutorialspoint.com/javascript
2. https://www.w3schools.com/css/
3. https://www.w3schools.com/jquery/

ONLINE RESOURCES:

1. https://www.edx.org/course/html5-and-css-fundamentals
2. https://www.udemy.com/course/html-css-javascript-course/

OUTCOMES:

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

1. Develop structured web pages using HTML5 elements, forms, tables, images and basic Node.js concepts. [K3]
2. Apply CSS properties to design and organize visually appealing web page layouts. [K3]
3. Construct responsive web interfaces using advanced CSS techniques, Flexbox, Grid and frameworks. [K3]
4. Build interactive web pages using JavaScript concepts and DOM manipulation techniques. [K3]
5. Utilize ES6 features and asynchronous programming methods for modern web applications. [K3]
6. Develop dynamic and responsive user interfaces using JavaScript, jQuery, AJAX and Bootstrap. [K3]

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CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1	1	-	2	-	-	-	1	1	-	2	1
CO2	2	1	2	-	2	-	-	-	1	1	-	2	1
CO3	2	2	2	1	2	-	-	-	1	1	-	2	2
CO4	2	2	2	1	2	-	-	-	1	1	-	2	2
CO5	2	2	1	1	2	-	-	-	1	1	-	2	2
CO6	2	2	2	1	2	-	-	-	1	1	1	2	2

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SEMESTER V

COURSE CODE: 24MGMC501	CONSTITUTION OF INDIA	L	T	P	CP	C
		2	0	0	2	0
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	-					

OBJECTIVES:

- To know about Indian constitution.
- To know about central government functionalities in India.
- To know about state government functionalities in India.
- To know about Constitution function.
- To Know about Constitutional remedies

MODULE - I INTRODUCTION 5

Historical Background – Constituent Assembly of India – Philosophical foundations of the Indian Constitution – Preamble – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties.

MODULE - II STRUCTURE AND FUNCTION OF CENTRAL GOVERNMENT 5

Union Government – Structures of the Union Government and Functions – President – Vice President – Prime Minister – Cabinet – Parliament – Supreme Court of India.

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MODULE - III STRUCTURE AND FUNCTION OF STATE GOVERNMENT 5

State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts.

MODULE - IV CONSTITUTION FUNCTIONS 5

Indian Federal System – Centre – State Relations – President's Rule – Constitutional Amendments – Constitutional Functionaries.

MODULE - V CONSTITUTIONAL REMEDIES 5

Enforcement of fundamental rights - Power of parliament to modify the rights the conferred by this part in their application to forces.

MODULE - VI CONSTITUTIONAL GOVERNANCE IN THE DIGITAL ERA AND CONTEMPORARY ISSUES 5

Constitutional Values and Good Governance – Right to Information (RTI) and Citizen Participation – Digital Governance and e-Governance Initiatives in India – Constitutional Perspectives on Artificial Intelligence (AI) and Emerging Technologies.

TOTAL : 30 PERIODS

TEXT BOOKS:

1. Durga Das Basu, Introduction to the Constitution of India, 27th Edition (2024), LexisNexis Butterworths Wadhwa.
2. M. V. Pylee, An Introduction to the Constitution of India, Latest Revised Edition (2024), Vikas Publishing House.
3. P. M. Bakshi, The Constitution of India, 18th Edition (2025), Universal LexisNexis
4. Brij Kishore Sharma, Introduction to the Constitution of India, 15th Edition (2024), PHI Learning

REFERENCE BOOKS:

1. D. D. Basu, Shorter Constitution of India, Latest Revised Edition, LexisNexis
2. Subhash C. Kashyap, Our Constitution: An Introduction to India's Constitution and Constitutional Law, Latest Edition, National Book Trust
3. M. Laxmikanth, Indian Polity, 7th Edition (2025), McGraw Hill Education
4. J. N. Pandey, Constitutional Law of India, Latest Edition (2024), Central Law Agency.
5. V. N. Shukla, Constitution of India, Revised by Mahendra Pal Singh, 14th Edition / Latest Available Edition, Eastern Book Company

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ONLINE REFERENCES

1. https://iasexamportal.com/ebook/the-constitution-of-india
2. https://eclass.cc/courses/udemy_basics_of_indian_constitution_a_refresher_course
3. https://ox.libguides.com/c.php?g=422964&p=2888489
4. https://mylaw.net/litigation/constitutional-law-course
5. www.tutorialspoint.com/indian_polity/indian_polity_sources_consitution.htm
6. www.drishtiias.com/gs-special/gs-special-polity/important-sources-of-the-indian-constitution
7. www.india.gov.in/my-government/constitution-india/constitution-india-full-text
8. http://legislative.gov.in/constitution-of-india

MOOC REFERENCES

1. https://www.mooc-list.com/tags/law
2. https://www.udemy.com/course/polity-and-constitution/
3. https://swayam.gov.in/nd2_cec19_hs13/preview
4. https://www.udemy.com/course/basics-of-indian-constitution-a-refresher-course/

OUTCOMES:

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

1. Explain the historical evolution, philosophy and fundamental principles of the Constitution of India. (K2)
2. Describe the structure, powers and functions of the Union Government under the Constitution. (K2)
3. Interpret the structure and functioning of State Governments and the judicial system in India. (K2)
4. Analyze federal relations, constitutional amendments and constitutional functionaries. (K4)
5. Examine constitutional remedies and mechanisms for protection of fundamental rights. (K4)
6. Apply constitutional values and principles to contemporary governance, digital rights, AI ethics and emerging societal challenges. (K3)

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CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	-	1	-	-	-	2	1	2	-	-	-	2	2
CO2	-	2	-	-	-	2	2	2	-	-	-	2	2
CO3	-	2	-	-	-	2	2	2	-	-	-	2	2
CO4	-	2	1	-	-	2	2	2	-	-	-	2	2
CO5	-	2	1	-	-	2	2	2	-	-	-	2	2
CO6	-	2	1	-	-	2	2	2	-	-	-	2	2

SEMESTER V

COURSE CODE: 24ITPL501	COMPUTER NETWORKS LABORATORY	L	T	P	CP	C
		0	0	4	4	2
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4				
PRE-REQUISITE COURSES	24ITPC301					

OBJECTIVES:

- To provide hands-on experience in designing and configuring basic computer networks using Cisco Packet Tracer.
- To develop practical skills in IP addressing, network topology creation, and connectivity testing.
- To understand and implement core networking concepts such as ARP, VLAN, DHCP, DNS, and routing protocols.
- To simulate and analyze client-server communication using application layer protocols like HTTP and FTP, and transport layer concepts using TCP/UDP

LIST OF EXPERIMENTS

1. Basic LAN setup and IP addressing between Pcs
2. Network topology creation (Star, Bus, Ring)
3. Ping command for connectivity testing
4. ARP protocol simulation in LAN
5. Ethernet LAN setup using switch

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6. Wireless LAN (Wi-Fi) configuration
7. Static routing between two networks
8. RIP routing configuration (basic dynamic routing)
9. VLAN creation and simple switch configuration
10. Inter-VLAN communication setup
11. DHCP configuration for automatic IP allocation
12. DNS configuration and name resolution
13. HTTP web server and client communication
14. FTP file transfer between client and server
15. TCP vs UDP basic communication simulation

TOTAL: 30 PERIODS

LAB REQUIREMENTS:

Cisco Packet Tracer,Windows/Linux operating system, Basic text editor (Notepad or equivalent, if required for notes)

OUTCOMES:

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

1. Configure and test LAN setup, IP addressing, network topologies, Ethernet/Wi-Fi configuration, and connectivity using networking tools and commands. (K3)
2. 2. Implement routing and switching techniques including static routing, RIP routing, VLANs, Inter-VLAN communication, DHCP, and DNS configuration in computer networks. (K3)
3. Analyze network communication and protocol behavior through ARP simulation, HTTP, FTP, and TCP/UDP communication experiments. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	2	-	3	-	-	-	-	-	-	3	-
CO2	3	2	3	-	3	-	-	-	-	-	-	3	2
CO3	2	3	-	3	2	-	-	-	-	-	-	3	-

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SEMESTER V

COURSE CODE: 24CJTP501	SKILL ENHANCEMENT	L	T	P	CP	C
		0	0	2	2	1
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4				
PRE-REQUISITE COURSES	-					

APTITUDE & COGNITIVE SKILLS – PHASE 1

OBJECTIVES:

- Educate and enrich students on quantitative ability, reasoning ability, and verbal ability.
- Build a strong foundation for solving recruitment-based problems with speed and accuracy.
- Enhance creative thinking skills.
- Enhance logical problem-solving skills.

MODULE - I QUANTITATIVE ABILITY **22**

Number Properties, Speed Math, HCF and LCM, Percentages, Time and Work, Time Speed and Distance, Ratio Proportion and Variations, Averages Mixtures and Alligation

MODULE - II QUANTITATIVE ABILITY REASONING ABILITY **16**

Profit and Loss, Simple Interest and Compound Interest, Blood Relation, Directions, Coding and Decoding, Series, Ranking and Arrangements

MODULE - III VERBAL ABILITY **7**

Subject-Verb Agreement, Tenses, Prepositions - Concepts, Error Spotting, Sentence Correction, Fill in the Blanks

TOTAL : 45 PERIODS

REFERENCES

1. Quantitative Aptitude for Competitive Examinations – R.S. Aggarwal
2. A Modern Approach to Logical Reasoning – R.S. Aggarwal
3. High School English Grammar & Composition – Wren & Martin
4. Word Power Made Easy – Norman Lewis.
5. Fast Track Objective Arithmetic – Rajesh Verma

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BIS STANDARDS, RANGER AND ROVER, LIFE SKILLS – PHASE 2

OBJECTIVES

To enable students to,

- Familiarize the team and leadership skills.
- Understand the standards relevant to ECE.

MODULE - I **JEEVAN KAUSHAL 2.0 - COGNITIVE SKILLS, INNOVATIVE LEADERSHIP AND DESIGN THINKING, ETHICS AND INTEGRITY** **14**

Cognitive and Non-cognitive Skills - Cognitive Skills: Meaning, Types of Cognitive Skills, Strategies to Develop Cognitive Skills- Critical Thinking Skills- Problem-solving skills - Ability to Learn, Non-cognitive Skills: Meaning and Types of Non-cognitive Skills, Strategies to Develop Non-cognitive Skills- Empathy- Creativity- Teamwork- Collaboration- Resilience - Interpersonal Skills- Perseverance- Social Control- Social Skill, Peer Pressure – Stress and Stress Management.

Innovative Leadership and Design Thinking- Concept of emotional and social intelligence, Concept of emotional and social intelligence, Innovative Leadership- Synthesis of human and artificial intelligence, Why does culture matter for today's global leaders? Design Thinking- What is design thinking?, Key elements of design thinking, How to transform challenges into opportunities?, How to develop human-centric solutions for creating social good?

Ethics and Integrity - Learning through Biographies - What makes an individual great?, Understanding the persona of a leader for deriving holistic inspiration, Drawing insights for leadership, How leaders sail through difficult situations? Ethics and Conduct - Importance of ethics, Ethical decision making, Personal and professional moral codes of conduct, creating a harmonious life

MODULE - II **RANGER AND ROVER** **10**

Scouting for Boys: Camp Life, Trekking Wood Craft.

Community Service: Meaning, Types of Community Service & duration, difference between Community Service and Community Development.

WOSM / WAGGGS / Govt. of India Initiatives (One Event At least) - Surf Smart, Free Being Me, Messengers of Peace, Scouts of the World Award

Messengers of Peace and Scouts

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MODULE - III INTERNET OF THINGS AND ENVIRONMENTAL TESTING OF ELECTRONIC EQUIPMENT PROCEDURES 6

Internet of Things: Brainstorming about the standards pertaining to IoT & Digital Twins, including maritime and underwater IoT i.e; IS/ISO/IEC TR 22417:2017, IS/ISO/IEC 21823 series.

Environmental Testing of Electronics Equipment: Introduction to Standards pertaining to Environmental Test Procedures i.e. IS/IEC 60068 series, IS 9000, IS 9001 and IS 9002 series that are used extensively in the testing of all electronics products.

TOTAL :30 PERIODS

REFERENCES:

1. Curriculum and Guidelines for Life Skills (Jeevan Kaushal) 2.0, UGC, New Delhi.
2. A World Built on Standards: A Textbook for Higher Education, Published by: Danish Standards Foundation, 2015.
3. SO / IEC Guide 59, BIS Standards Formulation Manual, 2nd Revision, 2022.

ONLINE RESOURCES

1. https://lms.scout.org/courses/show/214209?force_course_hub=true
2. https://free-being-me.com/wp-content/media/ABC_OLDER-2.pdf
3. https://www.wagggs.org/en/what-we-do/surf-smart-20/surf-smart-get-involved/

OUTCOMES

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

1. Demonstrate improved quantitative aptitude for solving numerical problems. [K2]
2. Apply logical reasoning to tackle reasoning-based challenges. [K2]
3. Enhance verbal communication and comprehension skills through grammar and language exercises. [K2]
4. Use ethical principles, emotional intelligence, and leadership insights from biographies to practice responsible decision-making and professional conduct. (K3)
5. Illustrate the objectives and practices of WOSM/WAGGGS and Government of India initiatives such as Messengers of Peace, Surf Smart, and Scouts of the World Award. (K3)
6. Apply the concepts of IoT, Digital Twins, and related standards in identifying applications of connected systems in modern technologies. (K3)

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CO - PO - PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	2	-	-	-	-	-	-	2	-	-
CO2	2	2	2	2	1	-	-	-	1	-	2	-	-
CO3	2	2	2	2	-	-	-	-	1	-	2	-	-
CO4	-	-	-	-	-	2	-	3	3	3	-	2	2
CO5	-	-	-	-	-	3	2	2	2	2	1	2	2
CO6	3	2	2	-	3	1	-	-	-	-	-	2	2

SEMESTER V

COURSE CODE: 24CJID501	PROTOTYPE DEVELOPMENT LABORATORY – I	L	T	P	CP	C
		0	0	0	4	1
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24ESID101, 24ESID201, 24ITID301, 24ITID401					

OBJECTIVES:

- To enable students to transform innovative ideas into feasible prototype solutions through structured problem identification, design thinking, and concept development.
- To provide experiential learning in prototype design and development by focusing on user-centric requirements, iterative design, and technical validation.
- To develop proficiency in problem analysis, feasibility assessment, requirement engineering, and prototype implementation.
- To instill a foundation of innovation and entrepreneurship by integrating ethical design principles, sustainability values, and responsible technology development.
- To enable data-driven solution development through literature survey, user feedback analysis, and technology exploration.
- To facilitate multidisciplinary problem-solving through engineering design, prototype realization, testing, validation, and technical communication.

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COURSE METHODOLOGY

- This course is designed to develop innovation-oriented thinking and practical problem-solving abilities through prototype development activities focusing on real-world challenges.
- The project work shall involve the identification of a problem, requirement analysis, feasibility study, solution design, prototype development, testing, validation, and documentation. Students shall apply design thinking principles throughout the development cycle.
- Projects may be carried out individually or in groups with a maximum of three students. In the case of group projects, each student shall submit an individual project contribution report clearly specifying their role and responsibilities.
- Students shall maintain a detailed project portfolio containing problem statements, literature survey findings, design documents, prototype iterations, testing results, and validation reports.
- Periodic reviews shall be conducted to assess progress in prototype development, implementation, testing, and refinement. Students shall demonstrate prototype functionality during review evaluations.
- At the end of the semester, students shall submit a comprehensive project report and present a working prototype for evaluation by the course coordinator and project review committee.

EVALUATION

1. First Evaluation (Immediately after first internal examination): 20 Marks
   (Problem Identification and Validation, Literature Survey, Requirement Analysis, Initial Design Proposal)
2. Second Evaluation (Immediately after second internal examination): 30 Marks
   (Prototype Design Completion, Prototype Development Progress, Initial Testing and Validation Results)
3. Final Evaluation (Last week of the semester): 50 Marks
   (Functional Prototype Demonstration, Innovation and Creativity, Technical Implementation, Project Report, Viva-Voce)

Note: All three evaluations are mandatory for course completion and for awarding the final grade.

TOTAL : 30 PERIODS

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OUTCOMES:

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

1. Analyze real-world problems, user requirements, and design constraints to formulate innovative prototype solutions using design thinking methodologies. (K4)
2. Evaluate alternative technologies, development approaches, and feasibility aspects for prototype design and implementation. (K5)
3. Create functional prototypes by integrating appropriate tools, technologies, and engineering principles to address identified problems. (K6)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	-	2	-	-	-	-	-	-	2	3
CO2	3	3	3	-	3	-	-	-	-	-	-	2	3
CO3	3	3	3	-	3	-	-	-	-	-	-	3	3

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PROFESSIONAL ELECTIVES - I

COURSE CODE: 24ITEL501	COMPUTER GRAPHICS AND MULTIMEDIA	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106103224	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24ITPC301, 24BSMA301					

OBJECTIVES:

- To understand the fundamental concepts of graphics and multimedia.
- To understand the Two/Three Dimensional Graphics and their Transformations
- To get knowledge about various Object representation methods and Visible Surface Detection methods
- To study the Multimedia concepts and various I/O technologies

MODULE - I OUTPUT PRIMITIVES 7

Output Primitives: Points and Lines – Line-Drawing algorithms: DDA and Bresenham's Algorithm – Loading frame Buffer – Line function – Circle-Generating algorithms: Midpoint Circle Generating Algorithm – Ellipse-generating algorithms. Attributes of Output Primitives: Line Attributes – Curve attributes – Color and Grayscale Levels – Area-fill attributes – Character Attributes.

MODULE - II 2D GRAPHICS 7

Basic Transformations – Matrix Representations – Composite Transformations – Other Transformations. 2D Viewing: The Viewing Pipeline – Viewing Co-ordinate Reference Frame – Window-to-Viewport Co-ordinate Transformation - 2D Viewing Functions – Clipping Operations.

MODULE - III 3D GRAPHICS 7

3D Geometric and Modeling Transformations – Translation - Rotation - Scaling- Composite Transformations - 3D Viewing – Viewing Pipeline - Viewing Coordinates - Projections - Clipping - Visible Surface Detection Methods.

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MODULE - IV ILLUMINATION, COLOR MODELS AND ANIMATION 8

Light Sources - Basic Illumination Models – Halftone Patterns and Dithering Techniques- Properties of Light - Standard Primaries and Chromaticity Diagram; Intuitive Colour Concepts - RGB Colour Model - YIQ Colour Model - CMY Colour Model - HSV Colour Model - HLS Colour Model - Colour Selection- Virtual Reality - Animation.

MODULE - V MULTIMEDIA SYSTEMS DESIGN AND FILE HANDLING 8

Multimedia Basics – Multimedia Applications – Multimedia System Architecture - Defining Objects for Multimedia Systems – Multimedia Data Interface Standards – Multimedia Databases - Compression and Decompression – Data and File Format Standards – Digital Voice and Audio – Video Image and Animation – Full Motion Video – Storage and Retrieval Technologies.

MODULE - VI HYPERMEDIA 6

Multimedia Authoring and User Interface - Hypermedia Messaging -Mobile Messaging – Hypermedia Message Component – Creating Hypermedia Message – Integrated Multimedia Message Standards – Integrated Document Management – Distributed Multimedia Systems - Case Study: Blender Graphics -Blender Fundamentals–Drawing Basic Shapes – Modelling-Shading & Textures

TOTAL : 45 PERIODS

BOOKS AND REFERENCES:

1. Donald Hearn and Pauline Baker M, "Computer Graphics", Prentice Hall, New Delhi,2007
2. Andleigh, P. K and KiranThakrar, "Multimedia Systems and Design", PHI, 2003

REFERENCES:

1. Judith Jeffcoate, "Multimedia in practice: Technology and Applications", PHI, 1998.
2. Foley, Vandam, Feiner and Hughes, "Computer Graphics: Principles and Practice", 2nd Edition, Pearson Education, 2003.
3. Jeffrey McConnell, "Computer Graphics: Theory into Practice", Jones and Bartlett Publishers,2006.
4. Hill F S Jr., "Computer Graphics", Maxwell Macmillan, 1990.

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5. Peter Shirley, Michael Ashikhmin, Michael Gleicher, Stephen R Marschner, Erik Reinhard, KelvinSung, and AK Peters, "Fundamentals of Computer Graphics", CRC Press, 2010.
6. William M. Newman and Robert F.Sproull, "Principles of Interactive Computer Graphics", McGraw Hill 1978.

ONLINE RESOURCES:

1. https://www.blender.org/support/tutorials
2. http://www.doc.ic.ac.uk/~dfg/graphics/graphics.html
3. http://www.nptelvideos.in/2012/11/computer-graphics.html
4. http://cs.wellesley.edu/~cs110/lectures/M01-color/graphics.pdf
5. www.scratchapixel.com
6. http://dl.finebook.ir/book/9e/11032.pdf
7. https://www.blender.org/support/tutorials
8. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-837-computer-graphics-fall-2012/download-course-materials

OUTCOMES:

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

1. Implement output primitives and drawing algorithms to create basic graphical objects with attributes. (K3)
2. Perform 2D transformations, viewing and clipping techniques using matrix representations. (K3)
3. Illustrate 3D transformations, projections and visible surface detection methods for object representation. (K3)
4. Utilize illumination models, color models and animation techniques for realistic graphics. (K3)
5. Apply multimedia system design concepts including architecture, databases and file handling techniques. (K3)
6. Construct hypermedia applications and create basic 3D scenes using Blender. (K3)

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CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	3	-	-	-	-	-	-	2	2
CO2	3	2	-	-	-	-	-	-	-	-	-	2	2
CO3	3	2	-	-	-	-	-	-	-	-	-	2	2
CO4	3	2	-	-	2	-	-	-	-	-	2	2	2
CO5	3	2	-	-	2	-	-	-	-	-	2	2	2
CO6	3	2	2	-	3	-	-	-	-	-	-	2	2

PROFESSIONAL ELECTIVES - I

COURSE CODE: 24ITEL511	GRAPH THEORY	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106105847	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24BSMA402, 24BSMA301					

OBJECTIVES:

- Enable learners to apply graph theory concepts to solve real-world and computational problems.
- To introduce fundamental concepts of graph theory, including vertices, edges, paths, and connectivity.
- To utilize graph theory to model and solve practical problems in logistics, biology, and computer science.
- To apply algorithms for finding shortest paths, spanning trees, and network flow.

MODULE - I FUNDAMENTALS OF GRAPHS 8

Introduction to graphs - Basic properties of graphs - Definition and types of graphs (simple, multigraph, directed, weighted) - Graph representation (adjacency matrix, adjacency list) - Degree of vertices, Handshaking Lemma -Sub graphs and induced graphs - Complete and bi-partite graphs - Isomorphism of graphs.

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MODULE - II PATHS AND CONNECTIVITY 7

Paths and circuits - Walks, paths, trails, circuits - Connected and disconnected graphs - Open and closed walks - Simple paths and cycles - Length of a path - Components of a graph - Cut vertices and bridges - Circuits and cycles in graphs - Directed and undirected cycles - Detection of cycles in graphs.

MODULE - III EULER AND HAMILTONIAN GRAPHS 7

Euler paths and circuits (Fleury's Algorithm) - Hamiltonian paths and cycles - Necessary and sufficient conditions - Eulerian Graphs - Hamiltonian cycles - Matrix representation of graphs - Chordal graphs - Weighted graphs.

MODULE - IV TREES AND SPANNING TREES 9

Definition and properties of trees - Spanning trees and minimal spanning trees - Algorithms: Prim's and Kruskal's - Independence sets and covering in graphs - Minimum Spanning Trees (MST) - Concept of weighted graphs - Definition and significance of MST Applications (network design, cost minimization)- Algorithms for MST - Prim's Algorithm- Greedy approach - Step-by-step construction - Implementation logic..

MODULE - V GRAPH COLORING AND PLANARITY 7

Vertex coloring and chromatic number - Applications of graph coloring (scheduling, map coloring) - Planar graphs and Euler's formula – Cut Vertices and Cut edges - Edge connectivity - Vertex Colouring of graphs - Edge Colouring of graphs - The four-colour and five-colour theorems..

MODULE - VI APPLICATIONS OF GRAPH THEORY 7

Perfect graphs – applications of graph in switching theory –Directed graphs or (Digraphs) - Shortest path algorithms (Dijkstra's Algorithm) Network flows (basic idea) - Applications in computer science, transportation, and social networks.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. R. Balakrishnan & K. Ranganathan, "A Textbook of Graph Theory", 2012, (Springer edition).
2. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice-Hall, 2017.
3. Douglas B. West, "Introduction to Graph Theory",2nd Edition, 2001.

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REFERENCES:

1. R. Balakrishnan, K. Ranganathan, "A Textbook of Graph Theory", 1st Edition, Volume 1, 2012.
2. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall, 2017
3. Douglas B. West, "Introduction to Graph Theory", 2nd Edition, Prentice Hall,2001.
4. Frank Harary, "Graph Theory", 1st Edition, Addison-Wesley,1969.
5. Jonathan L. Gross, Jay Yellen, Ping Zhang , "Handbook of Graph Theory", 2nd Edition, Volume 1, CRC Press, 2014.
6. J.A. Bondy, U.S.R. Murty, "Graph Theory–Graduate Texts in Mathematics", Springer, 2008.
7. Alan Gibbons, "Algorithmic Graph Theory", 1st Edition,Cambridge University Press, 1985.

ONLINE RESOURCES:

1. https://www.geeksforgeeks.org/dsa/graph-data-structure-and-algorithms/
2. https://www.geeksforgeeks.org/dsa/eulerian-path-and-circuit/
3. https://www.geeksforgeeks.org/quizzes/minimum-spanning-tree/
4. https://www.geeksforgeeks.org/dsa/graph-coloring-applications/
5. ONLINE REFERENCES:
6. https://www.getyoureducation.net/course/advanced-graph-theory
7. https://www.coursera.org/learn/graphs?utm_source=chatgpt.com
8. https://www.mygreatlearning.com/academy/learn-for-free/courses/introduction-to-graph-theory
9. https://nptel.ac.in/courses/111106050
10. https://nptel.ac.in/courses/111107058
11. https://ocw.mit.edu/courses/18-225-graph-theory-and-additive-combinatorics-fall-2023/

OUTCOMES:

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

1. Apply graph representations and basic properties to model problems (K3)
2. Analyze connectivity and solve problems involving paths and circuits (K3)

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3. Apply Euler and Hamiltonian concepts to real-world problems (K3)
4. Construct and optimize spanning trees using standard algorithms (K3)
5. Apply graph coloring and planarity concepts in practical scenarios (K3)
6. Use graph algorithms to solve real-world applications (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	1	-	-	-	-	-	-	3	1
CO2	3	3	-	1	1	-	-	-	-	-	-	3	2
CO3	3	3	1	1	1	-	-	-	-	-	-	3	2
CO4	3	3	2	1	2	-	1	-	-	-	1	3	3
CO5	3	2	2	1	1	-	1	-	-	-		2	2
CO6	3	3	2	2	2	1	1		1	1	1	3	3

PROFESSIONAL ELECTIVES - I

COURSE CODE: 24ITEL503	CLOUD COMPUTING	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106105167	SYLLABUS VERSION 1.0	SDG NO. 9, 11, 13				
PRE-REQUISITE COURSES	24ITPW401					

OBJECTIVES:

- To interpret the basics of cloud computing.
- To learn about concepts of virtualization and virtualization infrastructure.
- To understand the principles of Cloud Architecture, Design challenges and Infrastructure.
- To explore and experiment various Cloud deployment environments.
- To learn about the security issues in the cloud environment.

MODULE - I CLOUD ARCHITECTURE AND MODELS 7

Cloud Architecture: System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture – Cloud Characteristics – Cloud deployment models – Cloud service models – Pros and Cons of Cloud.

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MODULE - II INTRODUCTION TO VIRTUALIZATION 8

Basics of Virtualization – Virtualization Types – Implementation Levels of Virtualization – Virtualization Structures / Tools and Mechanisms – Virtualization of CPU, Memory, I/O Devices – Virtual Clusters and Resource management – Virtualization for Data-Center Automation – Virtualization Support and Disaster Recovery – Taxonomy of Virtual Machines – Create VM Cluster using VMWare or Virtual Box and deploy an application.

MODULE - III CLOUD INFRASTRUCTURE 8

Cloud Infrastructure: Architectural design of compute and storage clouds – Layered cloud architecture Development – Design Challenges – Inter Cloud Resource Management – Resource Provisioning and Platform Deployment – Global Exchange of Cloud Resources.

MODULE - IV CLOUD DEPLOYMENT ENVIRONMENT 7

Parallel Programming Framework: Hadoop Map Reduce – Google App Engine – Amazon AWS – Microsoft Azure; Cloud Software Environments – Eucalyptus – OpenStack – OpenNebula – Aneka.

MODULE - V CLOUD SECURITY 7

Data Security and Storage; Identity and Access Management (IAM) – IAM Challenges – IAM Architecture and Practice; Security Management in the Cloud – Security Management Standards – SaaS, Paas and IaaS Availability Management – Access Control; Security-As-A-Service.

MODULE - VI CLOUD SIMULATOR & CLOUD APPLICATIONS 8

CloudSim – Architecture - Cloudlets – VM creation – Broker – VM allocation – Hosts – Data Center. Web Service Architecture – Web service APIs – Web service authentication - Web service authentication methods - Technologies and the processes required when deploying web services; Deploying a web service from inside and outside a cloud architecture, advantages and disadvantages.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Kai Hwang, Geoffery C Fox, Jack J Dongarra, "Distributed and Cloud Computing: Clus- ters, Grids, Clouds and the Future of Internet", 1st Edition, Morgan Kaufman Publisher, Oxford, an Imprint of Elsevier, 2012.
2. Srinivasan A, Suresh J, "Cloud Computing: A practical Approach for Learning and Implementation", Pearson Education India, 2014.

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REFERENCES:

1. Tim Mather, Subra Kumaraswamy, Shahed Latif , "Cloud Security and Privacy: an enterprise perspective on risks and compliance", O'Reilly Media, 2009.
2. Danielle Ruest, Nelson Ruest, "Virtualization: A Beginner's Guide", McGraw-Hill Osborne Media, 2009.
3. James E Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
4. William von Hagen, "Professional Xen Virtualization", Wrox Publications, January, 2008.
5. David Marshall, Wade A Reynolds, "Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center", Auerbach Publications, 2006.
6. Ronald L. Krutz, Russell Dean Vines, "Cloud Security – A comprehensive Guide to Secure Cloud Computing", Wiley, 2010. 3. Rajkumar Buyya, Christian Vecchiola, S.TamaraiSelvi, "Mastering Cloud Computing", Tata McGraw Hill,2013.
7. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", first edition, McGrawHill Osborne Media, 2009.

ONLINE RESOURCES:

1. National Institute of Standards and Technology - https://www.nist.gov /itl/cloud
2. Amazon Web Services Documentation - https://docs.aws.amazon.com
3. Microsoft Azure Learn - https://learn.microsoft.com/azure
4. Google Cloud Docs - https://cloud.google.com/docs
5. OpenStack Foundation - https://www.openstack.org
6. https://onlinecourses.nptel.ac.in/noc24_cs118/announcements
7. https://www.coursera.org/browse/information-technology/cloud-computing
8. https://www.edx.org/learn/cloud-computing
9. https://aws.amazon.com/training/learn-about/cloud-practitioner/
10. https://learn.microsoft.com/en-us/training/paths/azure-fundamentals/
11. https://www.cloudskillsboost.google/paths/11

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OUTCOMES:

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

1. Apply cloud computing architecture concepts, including distributed system models and NIST reference architecture, to solve real-world cloud scenarios. (K3)
2. Implement virtualization techniques to create virtual machines, manage virtual clusters, and utilize tools like VMware or VirtualBox. (K3)
3. Use cloud infrastructure design principles to develop scalable compute and storage solutions with efficient resource provisioning. (K3)
4. Build applications using parallel programming frameworks and cloud platforms such as Hadoop, AWS, Azure, and Google App Engine. (K3)
5. Apply cloud security mechanisms, including identity and access management (IAM), access control, and data protection strategies. (K3)
6. Model cloud simulation tools like CloudSim and web service technologies to model, deploy, and evaluate cloud-based applications. (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	-	2	-	-	-	-	-	-	2	2
CO2	2	2	3	-	3	-	-	-	-	-	-	2	2
CO3	2	2	3	-	3	-	-	-	-	-	2	2	2
CO4	2	2	3	-	3	-	-	-	-	-	2	2	2
CO5	2	2	3	-	2	-	-	-	-	-	-	2	2
CO6	2	2	3	-	3	-	-	-	-	-	2	2	2

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PROFESSIONAL ELECTIVES - I

COURSE CODE: 24AIEL501	EXPLORATORY DATA ANALYSIS WITH R SOFTWARE	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 8, 9				
PRE-REQUISITE COURSES	24ITPW401					

OBJECTIVES:

- To understand the fundamental concepts, applications, and workflow of Data Science.
- To apply R programming concepts and commands for performing data manipulation and statistical computations.
- To prepare and preprocess datasets for analysis using appropriate data cleaning and transformation techniques.
- To perform Exploratory Data Analysis (EDA) using graphical and statistical methods to discover patterns and insights from data.
- To analyze data using measures of central tendency, dispersion, moments, and scaling techniques.

MODULE - I: INTRODUCTION TO DATA SCIENCE AND R SOFTWARE 7

Introduction to Data Science - Introduction to R software with R commands - Calculations with R software - Data Preparation and Introduction to Exploratory Data Analysis

MODULE - II EXPLORATORY DATA ANALYSIS AND UNIVARIATE VISUALIZATION 8

Introduction to Exploratory Data Analysis - Frequency Distribution - Univariate Graphics -Univariate Plots

MODULE - III UNIVARIATE ANALYSIS AND MEASURES OF DATA DISTRIBUTION 7

Univariate Graphics - Plots - Central Tendency of Data - Central Tendency of Data and Variation in Data

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MODULE - IV STATISTICAL MEASURES OF DISPERSION AND DATA TRANSFORMATION 8

Variation in Data :Variation in Data - Variation in Data - Moments- Scaling of Data

MODULE - V ASSOCIATION ANALYSIS AND CORRELATION OF VARIABLES 7

Association of Variables with Graphic - Association of Variables and Correlation Coefficient

MODULE - VI MULTIVARIATE DATA ANALYSIS AND REGRESSION TECHNIQUES 8

Association of Variables for rank data - discrete data - Least Squares Method - Least Squares Method - EDA with Multivariate Data

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Hadley Wickham and Garrett Grolemund, "R for Data Science", O'Reilly Media, 2nd Edition, 2023.
2. Roger D. Peng, "R Programming for Data Science", Leanpub, 2016.

REFERENCES

1. Jared P. Lander, "R for Everyone: Advanced Analytics and Graphics", Addison-Wesley Professional, 2nd Edition, 2017.
2. Peter Bruce, Andrew Bruce, and Peter Gedeck, "Practical Statistics for Data Scientists: 50+ Essential Concepts Using R and Python", O'Reilly Media, 2nd Edition, 2020.
3. John M. Chambers, "Software for Data Analysis: Programming with R", Springer, 2nd Edition, 2017.

WEB REFERENCES

1. https://r4ds.hadley.nz/
2. https://posit.co/resources/
3. https://r-graph-gallery.com/

ONLINE REFERENCES

1. https://r4ds.hadley.nz/
2. https://r-graphics.org/
3. https://dplyr.tidyverse.org/

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OUTCOMES:

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

1. Apply the fundamental concepts of Data Science and R programming to perform data manipulation, computations, and preliminary data preparation tasks.(K3)
2. Utilize exploratory data analysis techniques, frequency distributions, and univariate visualizations to summarize and explore datasets..(K3)
3. Analyze data distributions using graphical methods and measures of central tendency to interpret the characteristics of datasets..(K4)
4. Examine data variability through measures of dispersion, moments, and data scaling techniques for effective data transformation..(K4)
5. Analyze the association between variables using graphical methods and correlation coefficients to identify relationships and dependencies..(K4)
6. Evaluate relationships among rank, discrete, and multivariate data using association measures and least squares regression techniques for data-driven insights.(K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	2	-	-	-	-	-	-	-	2	3
CO2	3	1	-	2	-	-	-	-	-	-	-	2	2
CO3	2	2	1	2	-	-	-	-	-	-	-	2	2
CO4	3	2	-	2	-	-	-	-	-	-	-	-	2
CO5	2	2	3	2	2	-	-	-	-	-	-	2	-
CO6	2	2	-	2	2	-	-	-	-	-	-	3	2

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PROFESSIONAL ELECTIVES - I

COURSE CODE: 24AIEL502	ARTIFICIAL INTELLIGENCE FUNDAMENTALS AND APPLICATIONS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106108705	SYLLABUS VERSION 1.0	SDG NO. 9, 11				
PRE-REQUISITE COURSES	24AIPT201, 24AMPC302					

OBJECTIVES:

- To introduce the fundamental concepts, techniques, and applications of Artificial Intelligence.
- To equip learners with problem-solving methods, knowledge representation, machine learning, and deep learning techniques, and to provide an understanding of the ethical implications of AI in society.
- Apply uninformed and informed search algorithms (BFS, DFS, A*, etc.).
- Analyze real-world applications such as: Natural Language Processing (NLP) Expert Systems, Robotics and Computer Vision.
- To understand the machine learning concept.
- To explore real-world AI applications.

MODULE - I INTRODUCTION TO ARTIFICIAL INTELLIGENCE 7

Foundations and history of AI, definitions and goals of AI, the Turing Test and intelligent behaviour, intelligent agents and rationality, agent architectures (reactive, deliberative, hybrid), PEAS framework (Performance measure, Environment, Actuators, Sensors), types of environments — deterministic vs stochastic, static vs dynamic, fully vs partially observable, discrete vs continuous. Applications of AI in healthcare, finance, transportation, and entertainment. Current trends, opportunities, and limitations of AI.

MODULE - II PROBLEM SOLVING AND SEARCH TECHNIQUES 8

Problem formulation and state space representation. Uninformed search strategies — Breadth-First Search (BFS), Depth-First Search (DFS), Uniform Cost Search, Depth-Limited Search, Iterative Deepening Search. Informed/heuristic search techniques — Greedy Best-First Search, A* algorithm, IDA*. Properties of heuristics: admissibility and consistency. Local search algorithms — Hill Climbing, Simulated Annealing, Genetic Algorithms. Adversarial search — Minimax algorithm, Alpha-Beta pruning. Constraint Satisfaction Problems (CSPs) and backtracking search.

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MODULE - III KNOWLEDGE REPRESENTATION AND REASONING 8

Propositional logic — syntax, semantics, inference rules. First-order logic (predicate logic) — quantifiers, variables, functions. Resolution and unification. Forward chaining and backward chaining. Semantic networks, frames, and ontologies. Rule-based expert systems. Reasoning under uncertainty: probability basics, Bayes' theorem, Bayesian networks, Dempster-Shafer theory. Introduction to fuzzy logic — fuzzy sets, membership functions, fuzzy inference systems.

MODULE - IV MACHINE LEARNING FOUNDATIONS 8

Introduction to machine learning and its relationship with AI. Supervised, unsupervised, and reinforcement learning paradigms. Regression techniques — linear and logistic regression. Classification algorithms — Decision Trees, k-Nearest Neighbours (k-NN), Naive Bayes classifier, Support Vector Machines (SVM). Unsupervised learning — k-Means clustering, hierarchical clustering-Performance metric evaluation

MODULE - V NEURAL NETWORKS AND DEEP LEARNING 7

Biological inspiration and the artificial neuron. Perceptron and Multilayer Perceptron (MLP). Activation functions — sigmoid, tanh, ReLU, softmax. Forward propagation and the backpropagation algorithm. Gradient descent and its variants — SGD, Momentum, Adam. Convolutional Neural Networks (CNNs) — convolution, pooling, architectures like LeNet, AlexNet, ResNet. Recurrent Neural Networks (RNNs), Long Short-Term Memory (LSTM), and Gated Recurrent Units (GRU).

MODULE - VI ETHICS AND AI APPLICATIONS 7

AI ethics — bias and fairness, accountability, explainable AI (XAI), privacy and security concerns. Societal impact and the future of AI.Natural Language Processing (NLP) — tokenization, stemming, lemmatization, word embeddings (Word2Vec, GloVe), sentiment analysis, chatbots. Computer Vision — image classification, object detection, face recognition. Expert Systems — architecture and case studies (MYCIN, DENDRAL). Robotics and autonomous systems — perception, planning, control. Generative AI and Large Language Models (LLMs) — GPT, BERT, diffusion models.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", 4th Edition, Pearson, 2021.

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2. Elaine Rich, Kevin Knight, Shivashankar B. Nair, "Artificial Intelligence", 3rd Edition, McGraw Hill, 2017.
3. Tom M. Mitchell, "Machine Learning", McGraw Hill, 2017.
4. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016.
5. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", 3rd Edition, O'Reilly, 2022.

REFERENCES:

1. Deepak Khemani, "Search Methods in Artificial Intelligence", Cambridge University Press in 2024.
2. George F. Luger, "Artificial Intelligence: Structures and Strategies for Complex Problem Solving", Addison Wesley, 1998.

WEB REFERENCES:

1. NPTEL – Artificial Intelligence: Search Methods for Problem Solving
2. NPTEL – Introduction to Machine Learning
3. IBM Artificial Intelligence Resources

ONLINE RESOURCES:

1. NPTEL Course – Artificial Intelligence
2. NPTEL Course – Introduction to Machine Learning
3. Coursera – Artificial Intelligence Courses
4. edX – Artificial Intelligence Programs
5. Kaggle Learn – Machine Learning and AI Tutorials

OUTCOMES:

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

1. Apply the fundamental concepts, history, definitions, and goals of Artificial Intelligence to analyze intelligent systems. (K3)
2. Apply problem formulation and state space representation techniques to model Artificial Intelligence search problems. (K3)
3. Utilize propositional logic concepts including syntax, semantics, and inference rules for logical problem solving in Artificial Intelligence. (K3)
4. Examine the fundamentals of machine learning and its relationship with Artificial Intelligence, including supervised, unsupervised, and reinforcement learning paradigms. (K4)

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5. Implement artificial neuron models, Perceptron, and Multilayer Perceptron (MLP) networks for basic neural network applications. (K3)
6. Construct expert system models based on architectures and case studies such as MYCIN and DENDRAL for knowledge-based problem solving. (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	2	3
CO2	3	-	-	-	-	-	-	-	-	-	-	3	3
CO3	2	3	-	-	-	-	-	-	-	-	-	2	3
CO4	3	3	-	-	-	-	-	-	-	-	-	2	2
CO5	2	3	-	-	-	-	-	-	-	-	-	2	2
CO6	2	3	-	-	-	-	-	-	-	-	-	3	2

PROFESSIONAL ELECTIVES - I

COURSE CODE: 24AIEL503	HUMAN CENTERED COMPUTING	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106106701	SYLLABUS VERSION 1.0	SDG NO. 9, 11, 13				
PRE-REQUISITE COURSES	24ITPC302, 24ESCS101					

OBJECTIVES:

- To understand the principles, concepts, and foundations of Human–Computer Interaction (HCI).
- To learn user-centered design methodologies and interaction design processes.
- To apply design principles, usability guidelines, and accessibility standards in interface design.
- To develop prototypes and user interfaces using modern design tools and frameworks.
- To evaluate interactive systems using qualitative and quantitative usability assessment techniques.
- To explore emerging interaction paradigms, AI-driven interfaces, and ethical considerations in HCI.

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MODULE - I FOUNDATIONS OF HCI 8

Introduction to Human-Computer Interaction (HCI), history and evolution of HCI, importance of human-centered design. The human — sensory perception (vision, hearing, touch), memory (sensory, short-term, long-term), cognition, attention, and motor skills. The computer — input devices (keyboard, mouse, touchscreen, voice, gesture), output devices (display, audio, haptic). Interaction styles — command line interfaces, menu-based, form fill-in, direct manipulation, GUI/WIMP, web-based, mobile, voice, and immersive interfaces. Norman's seven stages of action and the gulfs of execution and evaluation.

MODULE - II INTERACTION DESIGN PROCESS 8

User-Centered Design (UCD) principles and philosophy. Design thinking framework — empathize, define, ideate, prototype, test. Requirements gathering techniques — interviews, surveys, questionnaires, ethnographic studies, contextual inquiry, focus groups. Personas, user profiles, and scenarios. User stories and use cases. Task analysis — Hierarchical Task Analysis (HTA), GOMS model. Participatory and co-design approaches. Iterative design cycle and the role of stakeholders.

MODULE - III DESIGN PRINCIPLES AND GUIDELINES 8

Shneiderman's Eight Golden Rules of interface design. Nielsen's Ten Usability Heuristics. Don Norman's design principles — visibility, feedback, affordance, signifiers, mapping, constraints, consistency. Gestalt principles of visual perception — proximity, similarity, closure, continuity, figure-ground. Visual design fundamentals — color theory, typography, layout, white space, hierarchy. Accessibility — Web Content Accessibility Guidelines (WCAG), assistive technologies, universal design principles. Designing for diverse users including users with disabilities, elderly users, and children.

MODULE - IV PROTOTYPING AND IMPLEMENTATION 7

Importance and role of prototyping in design. Low-fidelity prototyping — sketches, paper prototypes, storyboards, wireframes. High-fidelity prototyping — interactive mockups, clickable prototypes. Industry-standard prototyping tools — Figma, Adobe XD, Sketch, Balsamiq, InVision, Axure. Design systems and style guides (Material Design, Apple Human Interface Guidelines). Responsive and adaptive design. Mobile-first design approach. Cross-platform design considerations — web, iOS, Android. Handoff from designer to developer.

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MODULE - V EVALUATION TECHNIQUES 7

Goals and types of evaluation — formative vs summative. Expert-based evaluation methods — heuristic evaluation, cognitive walkthrough, pluralistic walkthrough. User-based evaluation methods — usability testing, think-aloud protocol, A/B testing, eye-tracking studies. Quantitative metrics — task completion time, error rate, success rate, System Usability Scale (SUS), Net Promoter Score (NPS). Qualitative analysis — affinity diagrams, thematic analysis. Remote vs lab-based testing. Use of analytics and heatmaps. Ethics in user research and informed consent.

MODULE - VI ADVANCED TOPICS AND EMERGING INTERFACES 7

Mobile and touch interfaces — gestures, multi-touch, haptics. Voice User Interfaces (VUI) and conversational design — Alexa, Siri, Google Assistant. Augmented Reality (AR) and Virtual Reality (VR) interfaces — design challenges and opportunities. Wearable computing and smart devices. Tangible and embedded interaction. Brain-Computer Interfaces (BCI). Designing for AI systems and chatbots — trust, transparency, explainability. Ethics in design — dark patterns, persuasive design, addictive design, privacy. Case studies of successful and failed interface designs.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human-Computer Interaction", Pearson/Prentice-Hall, 2004.
2. Ben Shneiderman, Catherine Plaisant, "Designing the User Interface: Strategies for Effective Human-Computer Interaction", 6th Edition,Pearson Education, 2016.

REFERENCES

1. Donald A. Norman, "The Design of Everyday Things", Revised and Expanded Edition, Basic Books, 2013.
2. Helen Sharp, Jennifer Preece, Yvonne Rogers, "Interaction Design: Beyond Human-Computer Interaction", 5th Edition, Wiley, 2019.
3. Steve Krug, "Don't Make Me Think, Revisited: A Common-Sense Approach to Web Usability", 3rd Edition, New Riders, 2014.

WEB REFERENCES:

1. https://www.interaction-design.org
2. https://www.nngroup.com

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3. World Wide Web Consortium (W3C) Web Accessibility Initiative https://www.w3.org/WAI

ONLINE RESOURCES:

1. NPTEL Course – Human Computer Interaction
2. Coursera – User Experience (UX) Design Courses
3. edX – Human Computer Interaction Courses

OUTCOMES:

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

1. Apply human cognitive and perceptual principles in interaction design. (K3)
2. Apply user-centered design methods to identify user requirements and problems. (K3)
3. Analyse usability principles and design guidelines to create user interfaces. (K4)
4. Develop low- and high-fidelity prototypes using design tools. (K3)
5. Analyse usability issues using expert reviews and user testing methods. (K4)
6. Analyse emerging interaction technologies and ethical aspects of interface design. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	2	-
CO2	2	3	-	-	-	-	-	-	-	-	-	3	-
CO3	2	3	-	-	-	-	-	-	-	-	-	2	3
CO4	2	2	-	-	-	-	-	-	-	-	-	2	2
CO5	2	3	-	-	-	-	-	-	-	-	-	2	2
CO6	2	3	-	-	-	-	-	-	-	-	-	3	2

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PROFESSIONAL ELECTIVES - I

COURSE CODE: 24ITEL504	FOUNDATIONS OF CRYPTOGRAPHY	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 10610221	SYLLABUS VERSION 1.0	SDG NO. 4, 9, 16				
PRE-REQUISITE COURSES	24BSMA201, 24ITPC301					

OBJECTIVES:

- To understand the objectives of confidentiality, integrity, authentication, and non-repudiation, and how cryptographic systems achieve these goals.
- To understand cryptographic theories, algorithms, and systems.
- To analyze cryptographic techniques, protection mechanisms, public key signature schemes, and cryptographic protocols along with their strengths and weaknesses.
- To apply cryptographic methods to solve real-world security problems.

MODULE - I INTRODUCTION TO CRYPTOGRAPHY 7

Introduction to Cryptography: Basics of Symmetric Key Cryptography, Basics of Asymmetric Key Cryptography.- Classical encryption techniques: substitution techniques, transposition techniques, steganography.- Foundations of modern cryptography: perfect security – information theory – product cryptosystem – cryptanalysis.

MODULE - II SYMMETRIC CRYPTOGRAPHY 8

MATHEMATICS OF SYMMETRIC KEY CRYPTOGRAPHY: Algebraic structures - Modular arithmetic-Euclid"s algorithm- Congruence and matrices - Groups, Rings, Fields- Finite fields

SYMMETRIC KEY CIPHERS: SDES – Block cipher Principles of DES – Strength of DES – Differential and linear cryptanalysis - Block cipher design principles – Block cipher mode of operation – Evaluation criteria for AES – Advanced Encryption Standard - RC4 –Key distribution.

MODULE - III PUBLIC KEY CRYPTOGRAPHY 9

MATHEMATICS OF ASYMMETRIC KEY CRYPTOGRAPHY:

Primes – Primality Testing –Factorization – Euler's totient function, Fermat's and Euler's Theorem - Chinese Remainder Theorem – Exponentiation and logarithm. ASYMMETRIC KEY CIPHERS: RSA cryptosystem – Key distribution

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– Key management – Diffie Hellman key exchange -ElGamal cryptosystem – Elliptic curve arithmetic-Elliptic curve cryptography.

MODULE - IV MESSAGE AUTHENTICATION AND INTEGRITY 7

Left or Right Security (LOR) - Message Authentication Codes (MACs): Formal Definition of Weak and Strong MACs, Using a PRF as a MAC, Variable length MAC - Auhentication function – Hash function – Security of hash function and MAC – SHA 256/512..

MODULE - V PUBLIC KEY SIGNATURE SCHEMES 7

Public Key Signature Schemes: Formal Definitions, Signing and Verification, Formal Proofs of Security of Full Domain Hashing - Assumptions for Public Key Signature Schemes: One way functions Imply Secure One-time Signatures - Shamir's Secret Sharing Scheme - Formally Analyzing Cryptographic Protocols - Zero Knowledge Proofs and Protocols.

MODULE - VI FORMAL NOTIONS OF ATTACKS 7

Formal Notions of Attacks: Different types of Attacks and its purposes - Brute Force Attack - Man-in-the- Middle Attack (MITM) - Replay Attack - Side-Channel Attack - Dictionary Attack and Birthday Attack.

Attacks under Message Indistinguishability: – Chosen Plaintext Attack(IND-CPA), – Chosen Ciphertext Attacks (IND-CCA1 and IND-CCA2), – Attacks under Message Non-malleability: NMCPA and NM-CCA2, – Inter-relations among the attack modelS - Differential Cryptanalysis - Linear Cryptanalysis

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Jonathan Katz and Yehuda Lindell, Introduction to Modern Cryptography, CRC Press. 2020, 3rd Editon (Low Priced Edition Available in India)
2. O. Goldreich, Foundations of Cryptography, CRC Press. 2004 (Low Priced Edition Available).

REFERENCE BOOKS:

1. Hans Delfs, Helmut Knebl, "Introduction to Cryptography, Principles and Applications", Springer, 2015
2. Wenbo Mao, "Modern Cryptography, Theory and Practice", Pearson Education, 2004 (Low Priced Edition)

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ONLINE RESOURCES

1. NPTEL Course on Foundation of cryptography
2. NPTEL Course on cryptography and network security
3. Shaffi Goldwasser and Mihir Bellare, Lecture Notes on Cryptography, 2006 http://citeseerx.ist.psu.edu

OUTCOMES:

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

1. Apply classical (substitution, transposition) and modern cryptographic techniques (symmetric and asymmetric encryption) to ensure secure communication (K3)
2. Analyze and evaluate cryptographic algorithms such as DES, AES, and RC4 in terms of strengths and weaknesses (K4)
3. Analyze asymmetric key cryptographic systems and evaluate key generation, distribution, and protection mechanisms (K4)
4. Apply message authentication techniques and cryptographic methods to address security problems (K3)
5. Analyze public key signature schemes and cryptographic protocols (K4)
6. Apply and analyze cryptographic methods for encryption, decryption, and attack scenarios (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	-	-	-	-	2	-	-	-	2	2
CO2	2	2	2	-	-	-	-	-	-	-	-	2	2
CO3	2	2	2	-	-	-	-	-	-	-	-	2	2
CO4	2	2	2	-	-	-	-	-	-	-	-	2	2
CO5	2	2	2	-	-	-	-	-	-	-	-	2	2
CO6	2	2	2	-	-	2	-	3	-	-	-	2	2

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PROFESSIONAL ELECTIVES - I

COURSE CODE: 24ITEL505	INTRUSION DETECTION SYSTEM	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4				
PRE-REQUISITE COURSES	24ITPW401, 24ITPC501					

OBJECTIVES:

- To understand the evolution of Intrusion Detection Systems (IDS), fundamental auditing concepts, and analyze internal and external threats affecting enterprise networks.
- To identify and differentiate IDS types (Host-based, Network-based, Hybrid), evaluate intrusion data sources, and analyze intrusion models with appropriate detection techniques.
- To assess system vulnerabilities using credential and non-credential methods, evaluate risks in networked environments, and design suitable intrusion response strategies aligned with organizational security policies.
- To implement and manage IDS solutions using Snort, including installation, configuration, rule creation, preprocessors, and output modules; analyze alerts using tools like ACID and SnortSnarf, and evaluate IDS/IPS architectures (centralized and distributed).

MODULE - I FOUNDATIONS OF INTRUSION DETECTION 7

History of Intrusion Detection — evolution from early audit systems to modern IDS-Audit concepts: definition, purpose, and role in security frameworks-Internal threats: insider attacks, privilege misuse, data leakage-External threats: unauthorized access, network-based attacks, social engineering-Types of attacks: DoS/DDoS, Man-in-the-Middle, Replay, Spoofing, Buffer Overflow-Need for Intrusion Detection Systems in modern enterprise environments

MODULE - II TYPES AND COMPONENTS OF IDS 7

Types of IDS: Anomaly-based, Signature-based, and Specification-based detection-Host-Based IDS (HIDS): log monitoring, system call analysis, file integrity checking-Network-Based IDS (NIDS): packet sniffing, traffic pattern analysis-Network-based information sources: flow records, packet captures,

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firewall logs-Host-based information sources: OS audit logs, application logs, registry changes-Hybrid IDS: combining host and network data for comprehensive detection

MODULE - III INTRUSION PREVENTION & ANALYSIS TECHNIQUES **8**

Intrusion Prevention Systems (IPS): inline detection, active blocking mechanisms-Protocol-based IDS: deep packet inspection, application-layer analysis-Model for intrusion analysis: phases of attack, attacker profiling-Analysis schemes: statistical analysis, pattern matching, machine learning approaches-Response requirements: timeliness, accuracy, completeness-Types of responses: active vs passive, automated vs manual-Mapping responses to security policies and organizational requirements

MODULE - IV VULNERABILITY & CREDENTIAL ANALYSIS **7**

Vulnerability analysis: identifying weaknesses in systems and networks-Credential analysis: authentication weaknesses, password attacks, privilege escalation-Non-credential analysis: exploiting software flaws, misconfigured services-Introduction to Snort: architecture, components and design philosophy-Snort installation scenarios: inline, passive, and hybrid deployment modes-Installing Snort on Linux/Windows, location of Snort files and directories-Running Snort on multiple network interfaces-Snort command line options and operational modes (Sniffer, Packet Logger, NIDS)

MODULE - V SNORT RULES, CONFIGURATION & DATABASE INTEGRATION **8**

Snort rule syntax: rule headers — action, protocol, IP addresses, ports, direction-Rule options: content, flags, threshold, priority, classtype, sid, rev-Snort alert modes: fast, full, console, syslog, unified-Snort configuration file (snort.conf): variables, include directives, output plugins-Preprocessors: Frag3, Stream5, HTTP Inspect, SMTP, FTP, portScan-Output modules: logging to files, databases, unified format-Using Snort with MySQL: schema setup, barnyard2, database logging configuration

MODULE - VI ALERT ANALYSIS, AGENT DEVELOPMENT & IDS/IPS ARCHITECTURE **8**

ACID (Analysis Console for Intrusion Databases): installation, interface, alert queries-SnortSnarf: report generation, alert summarization, trend analysis-Agent development for intrusion detection: autonomous detection agents, agent communication-Multi-agent IDS frameworks: cooperative detection and distributed architectures-Architecture models of IDS: centralized vs

distributed, agent-based models-Architecture models of IPS: inline IPS, out-of-band IPS, host-based IPS-Evaluation criteria for IDS/IPS: detection rate, false positive rate, performance impact

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Rafeeq Rehman — Intrusion Detection with SNORT, Apache, MySQL, PHP and ACID, 1st Ed., Prentice Hall, 2003.

REFERENCE BOOKS

1. Christopher Kruegel, Fredrik Valeur, Giovanni Vigna — Intrusion Detection and Correlation: Challenges and Solutions, 1st Ed., Springer, 2005.
2. Carl Endorf, Eugene Schultz and Jim Mellander — Intrusion Detection & Prevention, 1st Ed., Tata McGraw-Hill, 2004.
3. Stephen Northcutt, Judy Novak — Network Intrusion Detection, 3rd Ed., New Riders Publishing, 2002.

WEB REFERENCES :

1. https://www.ibm.com/think/topics/intrusion-detection-system
2. https://www.geeksforgeeks.org/ethical-hacking/intrusion-detection-system-ids
3. https://www.snort.org
4. https://suricata.io
5. https://scholarworks.uark.edu/csceuht/105/
6. https://medium.com/@redfanatic7/suricata-vs-snort-detailed-guide-to-the-programs-c331cff452a1
7. https://people.clarkson.edu/~jmatthew/publications/SPIE_Snort Suricata_2013.pdf

ONLINE RESOURCES:

1. Coursera – Introduction to IDS
2. Coursera – Intrusion Detection Specialization
3. SANS SEC503 – Network Monitoring and Threat Detection In-Depth
4. Johns Hopkins – Certificate Program in Intrusion Detection

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OUTCOMES:

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

1. Recall the history of IDS, define fundamental concepts, and identify internal/external threats and attack types. (K3)
2. Explain host-based and network-based information sources and differentiate types of IDS (K3)
3. Describe IPS, protocol-based and hybrid IDS, analyze intrusion models and apply analysis techniques. (K3)
4. Install , configure and operate Snort in various modes on single and multiple network interfaces (K3)
5. Create and manage Snort rules, configure preprocessors, output modules and integrate with MySQL (K3)
6. Use ACID and SnortSnarf for alert analysis, develop IDS agents and evaluate IDS/IPS architecture models (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	2	3
CO2	3	2	2	-	-	-	-	-	-	-	-	2	3
CO3	3	3	2	-	-	-	-	-	-	-	-	3	3
CO4	2	3	3	2	-	-	-	-	-	-	-	2	3
CO5	2	3	3	2	-	-	-	-	-	-	-	2	3
CO6	2	3	3	2	2	-	-	-	-	-	-	3	3

PROFESSIONAL ELECTIVES - I

COURSE CODE: 24ITEL506	NETWORK SECURITY AND PROTOCOL	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 9				
PRE-REQUISITE COURSES	24ITPW401, 24ITPC501, 24ITPC701					

OBJECTIVES:

- To understand network protocols, communication models, and their security requirements from a cyber security perspective.

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- To analyze protocol vulnerabilities, attack surfaces, and real-world exploits affecting secure communication systems.
- To apply protocol-level security mechanisms and secure communication practices for protecting network services.
- To evaluate security threats, countermeasures, and defensive techniques in modern network protocol environments.

MODULE - I NETWORK PROTOCOL FUNDAMENTALS 7

Protocol Basics: Definition, role of protocols in communication, layered architecture – OSI & TCP/IP Models: Layer functions, protocol mapping, communication flow – Core Protocols Overview: IP, TCP, UDP, ICMP – Packet Structure: Headers, payloads, encapsulation – Protocol Weaknesses: Design limitations and security gaps.

MODULE - II IP AND ROUTING PROTOCOL SECURITY 8

IP Protocol: IPv4 structure, fragmentation, addressing – Routing Protocols: ARP, ICMP, routing basics – Vulnerabilities: IP spoofing, ARP poisoning, ICMP misuse – Attack Techniques: Man-in-the-Middle (MITM), packet injection – Mitigation: Secure routing practices, filtering techniques.

MODULE - III TRANSPORT LAYER PROTOCOLS & ATTACKS 7

TCP Protocol: Handshake, session management, flags – UDP Protocol: Characteristics and risks – Attacks: TCP SYN flood, session hijacking, port scanning – Analysis: Packet-level inspection of transport protocols – Defenses: Rate limiting, secure configurations.

MODULE - IV APPLICATION LAYER PROTOCOL SECURITY 7

HTTP/HTTPS: Structure, vulnerabilities, secure communication – DNS Protocol: Resolution process, DNS spoofing/cache poisoning – Email Protocols: SMTP, POP3, IMAP security issues – Web Attacks: Injection, session attacks – Mitigation: Secure protocol usage, encryption (TLS).

MODULE - V PROTOCOL ANALYSIS AND MONITORING 8

Packet Analysis: Capturing and analyzing traffic – Tools: Wireshark for protocol inspection – Deep Packet Inspection (DPI): Concepts and use cases – Network Monitoring: Logs, alerts, anomaly detection – Intrusion Detection: Signature vs anomaly-based detection.

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MODULE - VI ADVANCED PROTOCOL SECURITY AND CASE STUDIES 8

Secure Protocols: SSL/TLS, IPsec basics – Protocol Hardening: Best practices and configurations – Zero Trust Communication: Continuous validation concepts – Case Studies: Real-world protocol exploits and breaches – Emerging Threats: Protocol abuse in modern networks.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. James F. Kurose, Keith W. Ross, Computer Networking: A Top-Down Approach, Pearson India Low Priced Edition Available 2021 (8th Edition)

REFERENCE BOOKS :

1. William Stallings, Cryptography and Network Security, 7th Edition, 2017
2. Behrouz A. Forouzan, Cryptography and Network Security, 3rd Edition, 2015
3. Yoram Orzach, Deepanshu Khanna, Network Protocols for Security Professionals, 1st Edition, 2023

ONLINE COURSES

1. https://nptel.ac.in/courses/106105162
2. https://nptel.ac.in/courses/106105183
3. https://nptel.ac.in/courses/106105217

OUTCOMES:

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

1. Apply knowledge of network protocols to identify security issues (K3).
2. Implement protocol analysis techniques using tools (K3)
3. Analyze vulnerabilities in core network protocols (K4)
4. Amine protocol-based attacks and exploitation methods (K4)
5. Apply secure protocol configurations and defenses (K3)
6. Analyze real-world protocol breaches and mitigation strategies (K4)

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CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	-	-	-	-	-	2	-	-	-	2	2
CO2	2	-	-	-	-	-	-	-	-	-	-	3	2
CO3	2	3	-	-	-	-	-	-	-	-	-	3	3
CO4	2	2	-	-	-	-	-	-	-	-	-	3	2
CO5	2	3	-	-	-	-	-	-	-	-	-	3	2
CO6	-	-	-	-	-	2	-	3	-	-	-	3	3

PROFESSIONAL ELECTIVES - I

COURSE CODE: 24ITEL507	DATA WAREHOUSING AND DATA MINING	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24BSMA301, 24BSMA402					

OBJECTIVES:

- To examine the concepts, architecture, and design of data warehousing systems to support efficient data management and business decision-making.
- To analyze multidimensional data models, OLAP operations, and data pre-processing techniques for transforming raw data into meaningful insights.
- To implement data mining algorithms for discovering patterns, associations, and knowledge from large datasets.
- To apply classification, clustering, and data analysis tools for building and evaluating data-driven models.

MODULE - I DATA WAREHOUSING FUNDAMENTALS 7

Basic Concepts – Data Warehousing Components – Building a Data Warehouse – Database Architectures for Parallel Processing – Parallel DBMS Vendors – Multidimensional Data Model – Data Warehouse Schemas for Decision Support - Concept Hierarchies

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MODULE - II OLAP AND BUSINESS ANALYSIS 8

Multidimensional Data Model – OLAP Operations (Roll-up, Drill-down, Slice, Dice, Pivot) – OLAP vs OLTP – Characteristics of OLAP Systems – Database Architectures for Parallel Processing – Parallel DBMS

MODULE - III DATA PRE-PROCESSING AND VISUALIZATION 8

Data Mining Overview and KDD Process – Data Objects and Attribute Types – Statistical Description of Data – Data Cleaning, Integration, Reduction – Data Transformation and Discretization – Data Similarity and Dissimilarity Measures – Data Visualization Techniques

MODULE - IV FREQUENT PATTERN MINING 7

Mining Frequent Patterns – Association Rule Mining – Correlation Analysis – Pattern Evaluation Methods – Multilevel and Multidimensional Pattern Mining – Constraint-Based Pattern Mining – Classification using Frequent Patterns

MODULE - V CLASSIFICATION TECHNIQUES 7

Decision Tree Induction – Bayesian Classification – Rule-Based Classification – Support Vector Machines – Lazy Learners – Model Evaluation and Accuracy Improvement Techniques

MODULE - VI CLUSTERING AND DATA ANALYSIS TOOLS 8

Clustering Techniques and Cluster Analysis – Partitioning Methods – Hierarchical Methods – Density-Based and Grid-Based Methods – Outlier Detection Techniques – Introduction to WEKA Tool – Classification, Clustering and Association using WEKA

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Jiawei Han, Jian Pei, Hanghang Tong, "Data Mining: Concepts and Techniques," Fourth Edition, Elsevier, 2022.
2. Pang-Ning Tan, Michael Steinbach, Anuj Karpatne, Vipin Kumar, "Introduction to Data Mining," Second Edition, Pearson, 2019.

REFERENCE BOOKS

1. Alex Berson, Stephen J. Smith, "Data Warehousing, Data Mining & OLAP," Tata McGraw-Hill, Reprint 2016.
2. Ian H. Witten, Eibe Frank, Mark A. Hall, Christopher J. Pal, "Data Mining: Practical Machine Learning Tools and Techniques," Fourth Edition, Elsevier, 2016.

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3. Martin Kleppmann, "Designing Data-Intensive Applications," O'Reilly Media, 2017.
4. Parteek Bhatia, "Data Mining and Data Warehousing: Principles and Practical Techniques," Cambridge University Press, 2019.

WEB REFERENCES:

1. https://nptel.ac.in/courses/106105174
2. https://swayam.gov.in/nd1_noc20_cs12/preview
3. https://www.cs.waikato.ac.nz/ml/weka/
4. https://www.tutorialspoint.com/data_mining/index.htm

OUTCOMES:

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

1. Apply data warehousing concepts, architectures, and multidimensional models for decision support systems. (K3)
2. Utilize OLAP operations and business analysis techniques to analyze multidimensional data. (K3)
3. Perform data pre-processing and visualization techniques to transform raw data into suitable formats for analysis. (K3)
4. Execute frequent pattern mining and association rule techniques to discover meaningful patterns in datasets. (K3)
5. Implement classification algorithms to develop predictive models and improve their performance. (K3)
6. Apply clustering techniques and data mining tools to analyze data and extract useful knowledge. (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3
CO2	3	3	-	2	-	-	-	-	-	-	-	-	2
CO3	3	3	-	2	-	-	-	-	-	-	-	-	2
CO4	2	3	-	-	-	-	-	-	-	-	-	-	2
CO5	3	3	2	-	-	-	-	-	-	-	-	2	3
CO6	2	-	-	-	3	-	-	-	-	-	-	3	3

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PROFESSIONAL ELECTIVES - I

COURSE CODE: 24ITEL508	DATA ANALYTICS WITH PYTHON	L	T	P	CP	C
		3	0	0	4	3
NPTEL CODE: 106107220	SYLLABUS VERSION 1.0	SDG NO. 4, 8, 11				
PRE-REQUISITE COURSES	24ESCS101 , 24BSMA301					

OBJECTIVES:

- To introduce the fundamental concepts, lifecycle, and applications of Data Analytics in various domains.
- To develop proficiency in Python programming and essential libraries such as NumPy and Pandas for data manipulation and analysis.
- To enable students to perform data preprocessing, exploratory data analysis, and data visualization for extracting meaningful insights from datasets.
- To provide knowledge of statistical analysis and basic machine learning techniques for solving real-world data-driven problems and supporting decision-making.

MODULE - I INTRODUCTION TO DATA ANALYTICS 7

Data Analytics – Definition – Data Analytics Lifecycle – Types of Analytics: Descriptive, Diagnostic, Predictive, Prescriptive – Applications of Data Analytics – Data Types and Sources.

MODULE - II PYTHON PROGRAMMING BASICS 7

Python Fundamentals – Variables and Data Types – Operators – Control Structures – Functions and Modules – Introduction to NumPy, Arrays and Operations.

MODULE - III DATA HANDLING USING PANDAS 8

Data Collection – Data Formats (CSV, Excel, JSON) – Pandas Data Structures – Data Cleaning – Handling Missing Values – Data Transformation – Data Integration.

MODULE - IV EXPLORATORY DATA ANALYSIS 7

Descriptive Statistics – Data Summarization – Correlation and Covariance – Identifying Patterns and Trends – Basic Statistical Measures.

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MODULE - V DATA VISUALIZATION 8

Principles of Visualization – Matplotlib – Seaborn – Types of Plots: Line, Bar, Histogram, Scatter – Visualization for Decision Making.

MODULE - VI STATISTICAL ANALYSIS AND APPLICATIONS 8

Probability Basics – Hypothesis Testing – Regression Analysis – Classification and Clustering Basics – Case Studies and Mini Project.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Wes McKinney, Python for Data Analysis: Data Wrangling with pandas, NumPy, and Jupyter, 3rd Edition, O'Reilly Media, 2022.
2. Fabio Nelli, Python Data Analytics: Data Analysis and Data Science Using Pandas, Matplotlib and the Python Programming Language, 3rd Edition, Apress, 2023.
3. Jake Vander Plas,Python Data Science Handbook,O'Reilly Media, 1st Edition, 2016.

REFERENCES

1. Fabio Nelli, Python Data Analytics: Data Analysis and Science Using Pandas, Matplotlib and the Python Programming Language, 3rd Edition, Apress, 2023.
2. Yuli Vasiliev, Python for Data Science: A Hands-On Introduction, 2nd Edition, No Starch Press, 2024.
3. Gareth James,Daniela Witten, Trevor Hastie, Robert Tibshirani, An Introduction to Statistical Learning, Springer, 2nd Edition, 2021.
4. Trevor Hastie,Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer, 2nd Edition, 2009.

WEB REFERENCES

1. https://onlinecourses.nptel.ac.in/noc23_cs116
2. https://www.python.org/doc/
3. https://pandas.pydata.org/docs/
4. https://numpy.org/doc/

ONLINE RESOURCES

1. https://www.youtube.com/playlist?list=PLZoTAELRMXVNUL99R4bDlVtR5Xl4cY1M

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2. https://www.youtube.com/playlist?list=PL-osiE80TeTsqhIuOqKhwlXsIBIdSeYtc
3. https://www.youtube.com/playlist?list=PL9ooVrP1hQOEDSc5QEbIhJWl2PyaO8R1n

OUTCOMES:

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

1. Apply fundamental concepts of data analytics and analytical approaches. (K3)
2. Apply Python programming constructs, functions, and NumPy operations to solve data analytics problems. (K3)
3. Apply Pandas-based techniques for data collection, cleaning, transformation, integration, and management of datasets. (K3)
4. Analyze datasets using exploratory data analysis techniques and statistical measures to discover patterns, trends, and relationships. (K4)
5. Analyze and interpret data using visualization techniques. (K4)
6. Analyze real-world datasets using statistical and machine learning techniques. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	2	2
CO2	3	3	2	-	-	-	-	-	-	-	-	3	3
CO3	3	3	2	-	-	-	-	-	-	-	-	3	3
CO4	3	3	2	-	-	-	-	-	-	-	-	3	3
CO5	3	2	3	-	-	-	-	-	-	-	-	3	3
CO6	3	3	3	-	-	-	-	-	-	-	-	3	3

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PROFESSIONAL ELECTIVES - I

COURSE CODE: 24ITEL509	BIG DATA ESSENTIALS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106104189	SYLLABUS VERSION 1.0	SDG NO. 4, 8				
PRE-REQUISITE COURSES	24ITPC301 , 24ITPW301					

OBJECTIVES:

- To provide the knowledge in the basic and advanced methods of big data technology and tools, including Hadoop and its ecosystem.
- To understand the concepts of Hadoop and HDFS.
- To perform Map Reduce analytics using Hadoop Related tools.
- To illustrate and implement the SPARK programming.

MODULE - I UNDERSTANDING BIG DATA AND ITS APPLICATIONS 8

Evolution of Big Data – Characteristics of Big Data – Value of Big Data – Structured and Unstructured Data – Big Data Applications and Use Cases – Web Analytics – Big Data in Marketing, Healthcare, Finance, and Risk Management – Big Data Technologies – Big Data Storage and Analytics.

MODULE – II FUNDAMENTALS OF HADOOP 8

Introduction to Hadoop – Hadoop Ecosystem – Hadoop Distributed File System (HDFS) – HDFS Architecture and Components – HDFS Commands and Interfaces – Data Flow in HDFS – Data Ingestion using Flume and Sqoop – Hadoop I/O – Compression and Serialization – Avro and Hadoop File Formats.

MODULE - III MAP REDUCE FRAMEWORK 8

Developing a Map Reduce Application - How Map Reduce Works - Anatomy of a Map Reduce Job Run-Failures- Job Scheduling-Shuffle and Sort – Task execution – Map Reduce Types and Formats- Map Reduce Features- Hadoop Environment. YARN – Failures in Classic Map Reduce and YARN – job scheduling – Shuffle and sort – Task execution – Map Reduce types – Input formats–Output formats.

MODULE - IV HADOOP ECOSYSTEM AND TOOLS 7

Introduction to PIG-Execution Modes of Pig-Comparison of Pig with Databases- Grunt- Pig Latin- User Defined Functions- Data Processing

Operators- Hive-Hive Shell-Hive Services- Hive Metastore- Comparison with Traditional Databases- HiveQL- Tables- Querying Data and User Defined Functions- Hbase-HBasics- Concepts- Clients-Hbase Versus RDBMS.

MODULE - V INTRODUCTION TO SPARK PROGRAMMING 7

Introduction to Spark – Spark Architecture – RDDs – Transformations and Actions – DataFrames and Datasets – Spark SQL – Writing Spark Applications using Scala, Python, R and Java – Spark Shell – Spark Streaming (Basic Concepts) – Introduction to Mllib.

MODULE - VI GPU COMPUTING AND CUDA FOR BIG DATA 7

Introduction to GPU Computing-CUDA Programming Model- CUDAAPI-Simple Matrix-Multiplication in CUDA- CUDA Memory Model- Shared Memory Matrix Multiplication- Additional CUDA API Features- Data Analysis with CUDA and Spark

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Tom White, Hadoop: The Definitive Guide, 5th Edition, O'Reilly Media, 2023.
2. Seema Acharya and Subhashini Chellappan, Big Data Analytics, 3rd Edition, Wiley India, 2024.
3. Bill Chambers and Matei Zaharia, Spark: The Definitive Guide – Big Data Processing Made Simple, O'Reilly Media, Reprint Edition, 2023.
4. Jason Sanders and Edward Kandrot, CUDA by Example: An Introduction to General-Purpose GPU Programming, Updated Reprint, Addison-Wesley, 2023.
5. Raj Kamal and Preeti Saxena, Big Data Analytics, 3rd Edition, McGraw Hill Education, 2024.

REFERENCES

1. Vignesh Prajapati, Big Data Analytics with Hadoop 3, Packt Publishing, 2022.
2. Holden Karau, Andy Konwinski, Patrick Wendell, and Matei Zaharia, Learning Spark: Lightning-Fast Data Analytics, 3rd Edition, O'Reilly Media, 2024.
3. Eric Sammer, Hadoop Operations, 3rd Edition, O'Reilly Media, 2023.
4. John Cheng, Max Grossman, and Ty McKercher, Professional CUDA C Programming, Wiley, Reprint Edition, 2023.

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5. Anand Rajaraman and Jeffrey Ullman, Mining of Massive Datasets, 3rd Edition, Cambridge University Press, 2024.

WEB REFERENCES

1. https://www.analyticsvidhya.com/resources-big-data/
2. https://www.tutorialspoint.com/big_data_analytics/index.html
3. https://nptel.ac.in/courses/106104189

ONLINE RESOURCES

1. https://www.analyticsvidhya.com/resources-big-data/
2. https://www.edureka.co/blog/big-data-tutorial

OUTCOMES:

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

1. Utilize Big Data concepts, characteristics, and technologies to address data-intensive applications across various domains. (K3)
2. Implement Hadoop architecture, HDFS, and data ingestion tools for efficient storage and management of large-scale data. (K3)
3. Execute MapReduce applications using Hadoop and YARN for distributed data processing. (K3)
4. Analyze the use of Pig, Hive, and HBase in managing and processing Big Data workloads. (K4)
5. Analyze Spark components and develop scalable data processing applications using Spark frameworks. (K4)
6. Analyze CUDA-based GPU computing techniques and evaluate their integration with Spark for high-performance Big Data analytics. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	3	-	-	-	-	-	-	-	-	3	3
CO2	3	2	3	-	-	-	-	-	-	-	-	3	3
CO3	3	3	2	-	-	-	-	-	-	-	-	3	3
CO4	3	3	2	-	-	-	-	-	-	-	-	3	3
CO5	3	3	2	-	-	-	-	-	-	-	-	3	3
CO6	3	3	2	-	-	-	-	-	-	-	-	3	3

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PROFESSIONAL ELECTIVES - I

COURSE CODE: 24CSEL503	MACHINE LEARNING ALGORITHMS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106106139	SYLLABUS VERSION 1.0	SDG NO. 9, 11				
PRE-REQUISITE COURSES	24BSMA301, 24BSMA402, 24CSPC301, 24CSPC302					

OBJECTIVES:

- To understand the basic concepts of Machine Learning
- To learn different types of Machine Learning approaches
- To explore data preprocessing and feature engineering techniques
- To understand fundamental algorithms in Machine Learning
- To analyze model performance and evaluation techniques

MODULE - I INTRODUCTION TO MACHINE LEARNING 9

Introduction to Machine Learning – Definition – Importance – Applications of Machine Learning – Types of Data – Supervised, Unsupervised and Reinforcement Learning – Machine Learning workflow – Role of Data in ML – Real-world examples

MODULE - II DATA PREPROCESSING 9

Data Collection – Data Cleaning – Handling missing values – Data transformation – Feature scaling – Encoding categorical data – Feature selection – Train-test split – Data normalization and standardization

MODULE - III SUPERVISED LEARNING 8

Regression - Linear Regression – Multiple Regression – Evaluation metrics (MSE, RMSE)- Classification: Logistic Regression – K-Nearest Neighbors (KNN) – Decision Trees – Applications

MODULE - IV UNSUPERVISED LEARNING 9

Clustering- K-Means Clustering – Hierarchical Clustering – Dimensionality Reduction – Principal Component Analysis (PCA) – Applications of clustering

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MODULE - V MODEL EVALUATION 5

Confusion Matrix – Accuracy, Precision, Recall, F1 Score – Cross-validation – Bias-Variance tradeoff – Overfitting and Underfitting

MODULE - VI INTRODUCTION TO TOOLS & APPLICATIONS 5

Python for Machine Learning – Libraries: NumPy, Pandas, Matplotlib, Scikit-learn – Basic implementation workflow – Case studies in ML (recommendation systems, prediction models)

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Tom M. Mitchell, "Machine Learning", McGraw Hill, 2017.
2. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn", O'Reilly, 2019.

REFERENCES:

1. Ethem Alpaydin, "Introduction to Machine Learning", 2nd Edition, MIT Press, 2010.
2. Bishop C.M., "Pattern Recognition and Machine Learning", Springer, 2006.
3. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.
4. Andreas Müller, "Introduction to Machine Learning with Python", O'REILLY, 2017.

WEB REFERENCES:

1. https://scikit-learn.org
2. https://www.kaggle.com
3. https://machinelearningmastery.com

OUTCOMES:

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

1. Explain the fundamental concepts and types of Machine Learning. (K2)
2. Describe data preprocessing techniques including data cleaning, transformation, and feature selection. (K2)
3. Apply data preprocessing methods on datasets using appropriate tools. (K3)
4. Apply supervised learning algorithms such as regression and classification for problem-solving. (K3)

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5. Apply unsupervised learning techniques like clustering for data analysis. (K3)
6. Use Machine Learning tools and libraries to implement basic ML models. (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	-	-	-	2	2
CO2	3	3	2	2	-	-	-	-	-	-	-	2	2
CO3	3	3	3	2	2	-	-	-	-	-	-	3	2
CO4	3	3	3	2	2	-	-	-	-	-	-	3	2
CO5	3	3	2	2	2	-	-	-	-	-	-	2	3
CO6	3	3	3	2	3	-	-	-	-	-	-	-	3

PROFESSIONAL ELECTIVES - I

COURSE CODE: 24CSEL504	MACHINE LEARNING FOR INTELLIGENT SYSTEMS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 108104049	SYLLABUS VERSION 1.0	SDG NO. 9, 11				
PRE-REQUISITE COURSES	24BSMA301, 24BSMA402, 24CSPC301, 24CSPC302					

OBJECTIVES:

- To introduce basic machine learning techniques such as regression, classification
- To learn about introduction of clustering, types and segmentation methods
- To learn about fuzzy logic, fuzzification and defuzzification
- To learn about the basics of neural networks and neuro fuzzy networks.
- To learn about Recurrent neural networks and Reinforcement learning.

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MODULE - I INTRODUCTION TO MACHINE LEARNING **8**

Philosophy of learning in computers- Overview of different forms of learning- Classifications vs. Regression- Evaluation metrics and loss functions in Classification- Evaluation metrics and loss functions in Regression- Applications of AI in Robotics.

MODULE - II CLUSTERING AND SEGMENTATION METHODS **8**

Introduction to clustering- Types of Clustering- Agglomerative clustering- K-means clustering- Mean Shift clustering- K-means clustering application study- Pattern recognition- K-nearest neighbor algorithm- Principal component analysis (PCA)- Feature Selection using PCA - Case studies

MODULE - III FUZZY LOGIC **8**

Introduction to Fuzzy Sets- Classical and Fuzzy Sets- Membership Function- Fuzzy rule generation- Operations on Fuzzy Sets- Numerical examples- Fuzzy Arithmetic-Numerical examples- Fuzzy Logic- Fuzzification- Defuzzification- Applications

MODULE - IV NEURAL NETWORKS **8**

Mathematical Models of Neurons- ANN architecture- Learning rules- Multi-layer Perceptrons- Back propagation- Introduction of Neuro-Fuzzy Systems- Architecture of Neuro Fuzzy Networks- Applications

MODULE - V RNN AND REINFORCEMENT LEARNING **7**

Recurrent neural networks- Unfolding Computational Graphs- Application of RNN- Reinforcement learning- Examples for reinforcement learning- Markov decision process- components of RL- Q-learning- Case Studies

MODULE - VI TOOLS AND APPLICATIONS **6**

Python for Machine Learning – Libraries: NumPy, Pandas, Matplotlib, Scikit-learn – Implementation workflow – Case studies: robotics, prediction systems.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Micheal Negnevitsky, "Artificial Intelligence: A Guide to Intelligent Systems", 3rd Edition, Addision Wesley, England, 2011.

REFERENCES:

1. Bruno Siciliano, Oussama Khatib, "Handbook of Robotics", 2nd Edition, Springer, 2016.

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2. Simon Haykin, "Neural Networks and Learning Machines: A Comprehensive Foundation", Third Edition, Pearson, Delhi 2016.
3. Timothy J Ross, "Fuzzy Logic with Engineering Applications", 4th Edition, John Wiley & sons, 2011.

WEB REFERENCES:

1. Google AI – Machine Learning Crash Course
2. PyTorch Official Tutorials
3. Towards Data Science
4. Analytics Vidhya
5. KDnuggets – Machine Learning Resources
6. Microsoft Learn – AI and Machine Learning

OUTCOMES:

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

1. Explain fundamental machine learning techniques such as regression and classification. (K2)
2. Describe clustering and segmentation methods for data analysis. (K2)
3. Apply fuzzy logic concepts including fuzzification and defuzzification in real-world problems. (K3)
4. Explain the architecture and learning mechanisms of neural networks and neuro-fuzzy systems. (K2)
5. Apply recurrent neural networks and reinforcement learning techniques for sequential decision-making problems. (K3)
6. Use machine learning tools and libraries to implement intelligent system applications. (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	1	-	-	-	-	-	-	-	2	2
CO2	3	2	-	2	-	-	-	-	-	-	-	2	2
CO3	3	3	2	2	-	-	-	-	-	-	-	3	2
CO4	3	2	1	2	-	-	-	-	-	-	-	3	2
CO5	2	3	3	2	-	-	-	-	-	-	-	2	3
CO6	2	2	3	3	-	-	-	-	-	-	-	-	3

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PROFESSIONAL ELECTIVES - I

COURSE CODE: 24CSEL505	MACHINE LEARNING ESSENTIALS FOR CYBERSECURITY	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106105217	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24BSMA301, 24BSMA402, 24CSPC301, 24CSPC302					

OBJECTIVES:

- To understand the role of machine learning in cybersecurity applications.
- To learn data preprocessing and feature engineering techniques for security datasets.
- To explore supervised and unsupervised learning algorithms for cyber threat detection.
- To analyse deep learning techniques for advanced cybersecurity applications.
- To evaluate adversarial machine learning threats and defense mechanisms.
- To apply ML tools and frameworks for developing cybersecurity solutions.

MODULE - I INTRODUCTION TO MACHINE LEARNING IN CYBERSECURITY **8**

Basics of Cybersecurity – Threats, Vulnerabilities and Risks – CIA Triad – Need for Intelligent Security Systems – Role of Machine Learning in Cybersecurity – Types of Machine Learning: Supervised, Unsupervised and Semi-supervised – Applications in Malware Detection, Phishing and Intrusion Detection – ML-driven Security Strategies.

MODULE - II DATA PREPROCESSING FOR CYBERSECURITY **8**

Security Data Collection (Logs, Network Traffic, Alerts) – Data Cleaning and Handling Missing Values – Feature Engineering for Security Datasets – Feature Scaling and Encoding – Indicators of Compromise (IOCs) – Train-Test Split, Normalization and Standardization – Case Study: Preprocessing Security Datasets.

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MODULE - III SUPERVISED LEARNING FOR CYBERSECURITY 8

Classification Models: Logistic Regression, Decision Trees, Random Forest, Support Vector Machines – K-Nearest Neighbors (KNN) – Applications in Malware Detection and Phishing Classification – Evaluation Metrics: Accuracy, Precision, Recall, F1 Score, ROC-AUC – Detection of Known Attacks using Supervised Learning.

MODULE - IV UNSUPERVISED AND DEEP LEARNING APPROACHES 8

Clustering Techniques: K-Means, Hierarchical Clustering – Dimensionality Reduction: PCA – Anomaly Detection Techniques – Introduction to Deep Learning – CNNs for Malware Detection – RNNs for Sequential Data – Applications in Zero-day Attack Detection and Behavioral Analysis.

MODULE - V ADVERSARIAL MACHINE LEARNING AND SECURITY 7

Adversarial Attacks: Evasion and Poisoning Attacks – Model Stealing and Membership Inference – Security Risks in ML Models – Defensive Techniques: Adversarial Training, Gradient Masking – Robustness Testing – Secure ML Model Design Principles.

MODULE - VI TOOLS, IMPLEMENTATION & CASE STUDIES 6

Python for Cybersecurity ML – Libraries: NumPy, Pandas, Scikit-learn, TensorFlow, Keras – Implementation Workflow for ML-based Security Systems – Case Studies: Phishing Detection, Network Anomaly Detection, Malware Classification – Emerging Trends: AI-driven Security, Automated Threat Intelligence.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn & TensorFlow", O'Reilly, 2019.
2. William Stallings, "Cryptography and Network Security", 5th edition, Prentice Hall, 2011.
3. Ali A. Ghorbani, "Network Intrusion Detection and Prevention", Springer, 2010.

REFERENCES

1. Ian Goodfellow, "Deep Learning", MIT Press, 2016.
2. Bishop C.M., "Pattern Recognition and Machine Learning", Springer, 2006.

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3. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.
4. Chris Sanders, Applied Network Security Monitoring, Syngress, 2013.

WEB REFERENCES

1. https://scikit-learn.org
2. https://www.kaggle.com
3. https://machinelearningmastery.com
4. https://www.tensorflow.org
5. https://pytorch.org
6. https://www.cisecurity.org

OUTCOMES:

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

1. Explain machine learning concepts in cybersecurity applications. (K2)
2. Apply preprocessing and feature engineering techniques to security datasets. (K3)
3. Implement supervised learning algorithms for cyber threat detection. (K3)
4. Analyse unsupervised and deep learning techniques for anomaly detection. (K3)
5. Explain adversarial attacks and defense mechanisms in ML. (K2)
6. Use ML tools and frameworks to develop cybersecurity solutions. (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	-	-	-	2	2
CO2	3	3	2	2	-	-	-	-	-	-	-	2	2
CO3	3	3	3	2	2	-	-	-	-	-	-	3	2
CO4	3	3	3	2	2	-	-	-	-	-	-	3	2
CO5	3	3	2	2	2	-	-	-	-	-	-	2	3
CO6	3	3	3	2	3	-	-	-	-	-	-	-	3

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PROFESSIONAL ELECTIVE - I

COURSE CODE: 24CIEL501	IOT CONCEPTS AND APPLICATIONS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106105166	SYLLABUS VERSION 1.0	SDG NO. 9, 11, 12				
PRE-REQUISITE COURSES	24CIPC301					

OBJECTIVES:

- To provide fundamental knowledge of IoT architecture and design
- To understand communication models and protocols in IoT
- To explore technologies and platforms like Arduino and Raspberry Pi
- To develop IoT-based applications using real-time data

MODULE - I INTRODUCTION TO INTERNET OF THINGS 8

Introduction to IoT: Sensing-Actuation- Basics of Networking-Wireless Sensor Networks-Machine-to-Machine Communications

MODULE - II FUNCTIONAL COMPONENTS AND DEVICE INTEGRATION 7

Sensors and Actuators – Smart Objects and Embedded Platforms – Control Units and Microcontrollers – Wireless Connectivity Technologies (BLE, ZigBee, Wi-Fi) – Positioning Systems (GPS/GNSS) – Cellular IoT Communication (GSM/4G/5G) – Device Interoperability and Resource Management.

MODULE - III PROTOCOLS AND TECHNOLOGIES BEHIND IOT 7

Communication Protocols -IoT Protocols: IPv6, 6LoWPAN – RFID – – Big Data Analytics – Cloud Computing – Cloud Connectivity-Sensor-Cloud -Fog Computing- Embedded Systems.

MODULE - IV OPEN PLATFORMS AND PROGRAMMING 8

Implementation of IoT with Raspberry Pi (contd), Introduction to SDN, SDN for IoT -Data Handling and Analytics -Architecture – Programming – Interfacing – GPIO Access – Signal Transmission

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MODULE - V IOT APPLICATIONS 8

Business Models for IoT – Smart Mobility – Industrial IoT – Healthcare-Activity Monitoring-Environmental Monitoring – Home Automation

MODULE - VI IOT ANALYTICS, SECURITY AND EMERGING TRENDS 7

Data acquisition –Data Collection and Preprocessing Techniques- Stream analytics – Edge analytics – ML for IoT – Predictive analytics – Security challenges – Encryption – Authentication – API integration – AIoT – Digital Twin – 5G – Blockchain.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017
2. Samuel Greengard, The Internet of Things, The MIT Press, 2nd Edition in 2021

REFERENCES:

1. Perry Lea, "IoT and Edge Computing for Architects: Implementing edge and IoT systems from sensors to clouds with communication systems, analytics, and security", Packt Publication, 2nd Edition (2020)
2. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012
3. IOT (Internet of Things) Programming: A Simple and Fast Way of Learning, Kindle Edition (2016).
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.
5. ArshdeepBahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015

WEB REFERENCES:

1. https://nptel.ac.in/courses/106105166
2. https://www.arduino.cc/ttps://www.ibm.com/smarterplanet/us/en/?ca=v_smarterplanet
3. https://link.springer.com/chapter/10.1007/978-3-030-41110-7_1

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OUTCOMES:

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

1. Build IoT Devices using IoT concepts and architecture (K3).
2. Develop communication models and IoT protocols (K3).
3. Apply IoT systems using Arduino/Raspberry Pi (K3).
4. Analyze the application of cloud computing and data analytics in IoT. (K4)
5. Examine different IoT business models and their role in delivering smart services and solutions. (K4).
6. Investigate IoT security mechanisms and emerging technologies. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	-	-	1	1	-	-	1	2	2
CO2	3	-	-	-	-	-	1	1	-	-	1	2	2
CO3	3	-	-	-	-	-	1	1	-	-	2	2	2
CO4	3	2	-	-	-	-	1	1	-	-	2	2	2
CO5	3	2	-	-	-	-	1	1	-	-	2	2	2
CO6	3	2	-	-	-	-	1	1	-	-	2	2	2

PROFESSIONAL ELECTIVE - I

COURSE CODE: 24CIEL502	DATA SCIENCE FOR INTERNET OF THINGS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 117103488	SYLLABUS VERSION 1.0	SDG NO. 4, 7				
PRE-REQUISITE COURSES	24EEPC201, 24EEPC303, 24EEPC304					

OBJECTIVES:

- Understand the fundamental concepts of Data Science, IoT architecture, and data acquisition techniques for IoT applications.
- Apply machine learning algorithms, Python programming, and data visualization techniques to analyze IoT datasets.

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- Analyze IoT security, privacy challenges, and real-time data processing frameworks for efficient data management.
- Develop analytical solutions using modern data science tools and stream analytics techniques for IoT-based applications.

MODULE - I INTRODUCTION TO DATA SCIENCE **8**

Introduction to Data Science, Data Science Life Cycle, IoT Architecture and Ecosystem, IoT Data Characteristics and Challenges, Data Acquisition from IoT Devices

MODULE - II MACHINE LEARNING IN DATASCIENCE **7**

Introduction to Machine Learning, Main Challenges of Machine Learning, Training and Testing Datasets, Support Vector Machines - SVM Classification, Decision Trees, Dimensionality Reduction Techniques

MODULE - III INTERACTIVE DATA VISUALIZATION FOR IOT **8**

Principles of Interactive Data Visualization, Web Technologies for Visualization, Interactive Visualization Techniques, IoT Data Preparation and Visualization, D3 Techniques

MODULE - IV PYTHON FUNDAMENTALS FOR DATA ANALYSIS **7**

Introduction to Python for Data Analysis – Python Programming Basics – Python Data Structures – Functions and Modules – NumPy Arrays and Vectorized Operations – Pandas Series and DataFrames – Data Import and Export – Basic Data Inspection and Manipulation.

MODULE - V SECURITY, PRIVACY & CHALLENGES **7**

Security Principles (Confidentiality, Integrity, Availability) – Authentication, Authorization, and Access Control – IoT Threats and Vulnerabilities – Privacy Issues in IoT – Security Challenges in IoT Environments, Future trends in IoT with Data Science.

MODULE - VI INTRODUCTION TO REAL-TIME DATA PROCESSING AND STREAM ANALYTICS FOR IOT **8**

Introduction to Real-time Data Processing in IoT - Overview, Characteristics, Stream Processing Frameworks for IoT-Apache Kafka - Apache Flink, and Apache Storm, Techniques for Real-time Stream Analytics - Windowing techniques for processing streaming data - Aggregation and summarization.

TOTAL : 45 PERIODS

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TEXT BOOKS:

1. P. G. Madhavan, Ph.D., "Data Science for IoT Engineers A Systems Analytics Approach", MERCURY LEARNING AND INFORMATION 2nd Edition 2021.
2. Aurélien Géron, Hands-on Machine Learning with Scikit-Learn, Keras, and Tensor Flow-O'Reilly Media, 3rd Edition 2023
3. Arshdeep Bahga and Vijay Madisetti, Internet of Things A Hand-on Approach, Universities press, 2015
4. Shilpi Saxena, Saurabh Gupta, Practical Real-Time Data Processing and Analytics-2017
5. Murray, Scott, Interactive data visualization for the Web : an introduction to designing with D3 - 2017
6. Wes McKinney, Python for Data Analysis O'Reilly Media 2022

REFERENCES:

1. S.Smys, Tomonobu Senjyu, Pavel Lafata Editors, Sixth International Conference volumes, Springer, 2024
2. Data Science and Internet of Things: Research and Applications at the Intersection of DS and IoT, Springer, 2021.

WEB REFERENCES:

1. https://people.smp.uq.edu.au/DirkKroese/DSML/DSML.pdf
2. https://www.mdpi.com/2073-431X/12/2/34

OUTCOMES:

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

1. Apply the data science life cycle and IoT data acquisition techniques to collect and prepare data for analysis. (K3)
2. Utilize machine learning algorithms and dimensionality reduction techniques to determine their suitability for IoT data analytics. (K3)
3. Demonstrate the use of interactive visualization techniques and D3.js for representing IoT data..(K3)
4. Apply Python programming, NumPy, and Pandas libraries to preprocess, inspect, and manipulate IoT data. (K4)
5. Implement security mechanisms, including authentication, authorization, and access control, to enhance the security and privacy of IoT systems. (K3)

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6. Examine real-time data processing frameworks and stream analytics techniques to determine their effectiveness in processing IoT data streams. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	1	1	-	2	2
CO2	3	-	-	-	-	-	-	-	2	1	-	2	2
CO3	2		-	-	-	-	-	-	1	2	-	2	2
CO4	3	2	-	2	-	-	-	-	1	1	-	2	2
CO5	3	-	-	-	-	-	-	-	1	1	-	2	2
CO6	3	2	-	-	-	-	-	-	1	1	-	2	2

PROFESSIONAL ELECTIVE - I

COURSE CODE: 24CIEL503	DYNAMIC PARADIGM IN IOT	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 117103488	SYLLABUS VERSION 1.0	SDG NO. 4				
PRE-REQUISITE COURSES	24CIPC301, 24CIPT401, 24AIPT201					

OBJECTIVES:

- To understand the role of cloud computing and cloud platforms in enabling Internet of Things (IoT) applications.
- To apply machine learning algorithms for intelligent analysis and decision-making using IoT data.
- To explore IoT data analytics and visualization techniques for extracting actionable insights from sensor data.
- To develop the ability to integrate DevOps practices with IoT for efficient application development, deployment, and management.

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MODULE - I IOT AND CLOUD 8

Cloud Computing Concept–Grid – SOA and Cloud Computing – Cloud Middleware NIST's SPI Architecture and Cloud Standards – Cloud of Things – Architecture – Four Deployment Models–Foundational Technological Enabler Cloud Providers and Systems – Microsoft Azure IoT–Amazon Web Services–Google's cloud IoTs.

MODULE - II IOT AND MACHINE LEARNING 7

IoT and Machine Learning Integration – Feature Engineering for IoT - Implementation of Supervised Algorithm (Regression and classification applied to sensor - Implementation of Unsupervised Algorithm (anomaly detection and clustering for fault identification and predictive maintenance) Edge Machine Learning and Model Deployment - IoT security threats

MODULE - III IOT AND DATA ANALYTICS 7

Defining IoT Analytics–IoT Analytics challenges– IoT analytics for the cloud–Microsoft Azure overview– Strategies to organize Data for IoT Analytics– Linked Analytics Data Sets–Managing Data lakes– Dash boarding–Designing visual analysis for IoT data–creating a dashboard –creating and visualizing alerts–Study real time –case study on IoT Analytics.

MODULE - IV IOT AND IT'S SECURITY 8

Cyber security vernacular Attack and threat terms– Defense terms, Anatomy of IoT cyber attacks – Mirai, Stuxnet–Chain Reaction, Physical and hardware security– Root of Trust–Network stack – Transport Layer Security– Software defined perimeter– Software-Defined Perimeter architecture – OWASP – Existing Security attacks and its prevention methods.

MODULE - V IOT AND DEVOPS 7

Introduction to DevOps– DevOps application – business scenarios– DevOps process – Source Code Management (SCM)– Code review–Configuration Management– Build management–DevOps frameworks–DevOps maturity life cycle–DevOps maturity map– DevOps progression.

MODULE - VI IOT APPLICATIONS AND FUTURE PARADIGMS 8

Smart Cities and Smart Infrastructure – Industrial IoT (IIoT) – Healthcare IoT Systems – Smart Agriculture and Environmental Monitoring – Edge and Fog Computing in IoT – Digital Twin Concepts in IoT – AIoT (Artificial Intelligence Things) – Blockchain for IoT Security – Sustainable IoT aligned with SDG Goals.

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TEXT BOOKS:

1. IoT and Edge Computing for Architects, Perry Lea Packt Publication,2nd Edition(2020).
2. The Internet of Things in the Cloud A Middleware Perspective, Honbo Zhou – CRC Publication, 1st Edition (2012)
3. Analytics for the Internet of Things (IoT), Andrew Minteer, Packt Publication 1st Edition 2017
4. Hands-on DevOps, Sricharan Vadapalli, Packt Publication, 1st Edition 2017

REFERENCES:

1. Enterprise Cloud Computing, Gautam Shroff, Cambridge,2010
2. Mastering Cloud Computing -Foundations and Applications Programming, Raj Kumar Buyya, Christian Vecchiola, S. Thamarai Selvi, MK Publication, 2013.
3. Machine Learning in Action||, Peter Harrington, DreamTech Press,1st Edition (2012).
4. Introduction to Machine Learning||, Ethem Alpaydın, MIT Press, 4th Edition (2020)
5. Learning AWS IoT- Effectively Manage Connected Devices on the AWS Cloud Using Services Such as AWS Greengrass, AWS Button, Predictive Analytics and Machine Learning, Agus Kurniawan, Packt Publication,1st Edition (2018)
6. Practical Dev-Ops, Joakim Verona, Packt Publication, 2nd Edition (2018)

WEB REFERENCES:

1. https://hub.packtpub.com/25-datasets-deep-learning-iot/
2. https://data.world/datasets/iot
3. https://dashboard.healthit.gov/datadashboard/data.php
4. https://www.data.gov/
5. https://dev.socrata.com/data/
6. https://www.kaggle.com/

OUTCOMES:

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

1. Apply cloud computing concepts, deployment models, cloud service architectures, and cloud platforms to develop IoT-enabled cloud applications.(K3)

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2. Analyze machine learning algorithms, feature engineering techniques, and edge machine learning models to support intelligent IoT data processing and predictive decision-making. (K4)
3. Build IoT analytics solutions by utilizing cloud-based data management, visualization techniques, dashboards, and real-time analytics tools.(K3).
4. Examine IoT cybersecurity threats, attack models, security architectures, transport layer security, and defense mechanisms to enhance the security of IoT systems.(K4)
5. Utilize DevOps practices, source code management, configuration management, build management, and DevOps frameworks to streamline IoT application development and deployment. (K3)
6. Evaluate emerging IoT paradigms, including Industrial IoT (IIoT), AIoT, Digital Twins, Blockchain, Edge/Fog Computing, and sustainable IoT solutions for real-world applications. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	1	-	-	2	2
CO2	2	2	-	-	-	-	-	-	2	1	-	2	2
CO3	2	-	-	-	-	-	-	-	1	-	-	2	2
CO4	2	2	-	-	-	-	-	-	1	2	-	2	2
CO5	2	-	-	-	-	-	-	-	1	-	-	2	2
CO6	2	2	-	-	-	-	-	-	2	1	-	2	2

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PROFESSIONAL ELECTIVES - II

COURSE CODE: 24ITEL510	ADVANCED ANALYSIS OF ALGORITHMS	L	T	P	CP	C
		3	0	0	4	3
NPTEL CODE: 106105704	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24ITPC301					

OBJECTIVES:

- To understand advanced algorithmic analysis techniques including amortized analysis.
- To study advanced data structures and network flow algorithms.
- To analyze matching problems and stable matching algorithms.
- To explore randomized algorithms and order statistics techniques.
- To understand computational complexity, NP-completeness and reductions.
- To examine approximation algorithms for NP-hard optimization problems

MODULE - I AMORTIZED ANALYSIS & ADVANCED DATA STRUCTURES 8

Introduction to Amortized Complexity – Aggregate Method – Accounting Method – Potential Function Method – Applications of Amortized Analysis – Fibonacci Heaps: Structure, Operations, Amortized Cost Analysis and Applications.

MODULE - II NETWORK FLOW ALGORITHMS 8

Maximum Flow Problem – Flow Networks – Ford-Fulkerson Method – Edmond-Karp Algorithm– Dinic's Algorithm – Push-Relabel Method – Correctness and Complexity Analysis.

MODULE - III MATCHING AND FLOW APPLICATIONS 8

Applications of Maximum Flow – Hall's Marriage Theorem – Maximum Bipartite Matching –König's Theorem – Edmonds' Blossom Algorithm for Maximum Matching in General Graphs – Stable Matching Problem – Gale-Shapley Algorithm.

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MODULE - IV ORDER STATISTICS, STRING MATCHING AND RANDOMIZED ALGORITHMS 7

Order Statistics – Selection Algorithms – String Matching Techniques – Introduction to Randomized Algorithms – Karger's Minimum Cut Algorithm – Karger-Stein Algorithm – Analysis of Randomized Algorithms..

MODULE - V COMPUTATIONAL COMPLEXITY & NP - COMPLETENESS 7

Lower Bounds on Sorting – Decision and Optimization Problems – Complexity Classes P and NP – Introduction to NP-Completeness – Polynomial-Time Reductions – NP-Completeness Proof Techniques and Examples.

MODULE - VI APPROXIMATION ALGORITHMS 8

Approximation Algorithms – Approximation Ratio – Approximation Algorithm for 3SAT – Metric Traveling Salesman Problem (Metric TSP) – Performance Guarantees – Limitations of Approximation Algorithms.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, " Introduction to Algorithms", Fourth Edition, MIT Press, 2022.
2. Jon Kleinberg and Éva Tardos, "Algorithm Design", First Edition, Pearson Education, 2006.

REFERENCES:

1. Vijay V. Vazirani, "Approximation Algorithms", Springer, First Edition, 2003.
2. Sanjoy Dasgupta, Christos Papadimitriou and Umesh Vazirani, "Algorithms", McGraw-Hill Education, First Edition, 2008.
3. Michael T. Goodrich, Roberto Tamassia and Michael H. Goldwasser, "Data Structures and Algorithms in Python", Wiley, Second Edition, 2013.
4. Dexter C. Kozen, "The Design and Analysis of Algorithms", Springer, First Edition, 1992.
5. Christos H. Papadimitriou, "Computational Complexity", Addison-Wesley, First Edition, 1994.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/106105704
2. https://nptel.ac.in/courses/106106131
3. https://ocw.mit.edu

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4. https://online.stanford.edu
5. https://visualgo.net

OUTCOMES:

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

1. Apply amortized analysis techniques and advanced data structures to evaluate algorithmic efficiency. (K3)
2. Analyze and implement maximum flow algorithms for network optimization problems. (K4)
3. Solve matching problems using graph-theoretic algorithms and stable matching techniques. (K4)
4. Apply order statistics, string matching and randomized algorithms to computational problems. (K3)
5. Examine computational complexity classes and prove NP-completeness using polynomial-time reductions. (K4)
6. Design and analyze approximation algorithms for NP-hard optimization problems. (K5)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	1	-	2	-	-	-	-	-	-	2	2
CO2	2	2	2	-	2	-	-	-	-	-	-	2	2
CO3	2	2	2	2	2	-	-	-	-	-	-	2	2
CO4	2	2	2	-	2	-	-	-	-	-	-	2	2
CO5	2	3	1	-	1	-	-	-	-	-	-	2	2
CO6	2	3	3	-	2	-	-	-	-	-	-	2	2

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PROFESSIONAL ELECTIVES - II

COURSE CODE: 24ITEL511	DISTRIBUTED SYSTEMS	L	T	P	CP	C
		3	0	0	4	3
NPTEL CODE: 106106168	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24CSPC302, 24CSPC402, 23ITPW401					

OBJECTIVES:

- To understand foundations of Distributed Systems
- To introduce the idea of peer to peer services and file system
- To understand in detail the system level and support required for distributed system
- To understand the issues involved in studying process and resource management

MODULE - I INTRODUCTION 5

Introduction – Examples of Distributed Systems–Trends in Distributed Systems – Focus on resource sharing – Challenges. Case study: World Wide Web.

MODULE - II COMMUNICATION IN DISTRIBUTED SYSTEM 9

System Model – Inter process Communication - the API for internet protocols – External data representation and Multicast communication. Network virtualization: Overlay networks. Case study: MPI Remote Method Invocation and Objects: Remote Invocation – Introduction - Request-reply protocols - Remote procedure call - Remote method invocation. Case study: Java RMI - Group communication - Publish-subscribe systems - Message queues - Shared memory approaches -Distributed objects - Case study: Enterprise Java Beans - from objects to components

MODULE - III PEER TO PEER SERVICES AND FILE SYSTEM 9

Peer-to-peer Systems – Introduction - Napster and its legacy - Peer-to-peer – Middleware - Routing overlays. Overlay case studies: Pastry, Tapestry- Distributed File Systems –Introduction - File service architecture – Andrew File system. File System: Features-File model -File accessing models - File sharing semantics. Naming: Identifiers, Addresses, Name Resolution – Name Space Implementation – Name Caches – LDAP.

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MODULE - IV SYNCHRONIZATION AND REPLICATION 9

Introduction - Clocks, events and process states - Synchronizing physical clocks- Logical time and logical clocks - Global states – Coordination and Agreement – Introduction - Distributed mutual exclusion – Elections – Transactions and Concurrency Control– Transactions -Nested transactions – Locks – Optimistic concurrency control - Timestamp ordering – Atomic Commit protocols -Distributed deadlocks – Replication – Case study – Coda

MODULE - V PROCESS & RESOURCE MANAGEMENT 6

Process Management: Process Migration: Features, Mechanism - Threads: Models, Issues, Implementation. Resource Management: Introduction- Features of Scheduling Algorithms –Task Assignment Approach – Load Balancing Approach – Load Sharing Approach.

MODULE - VI DISTRIBUTED ALGORITHMS 7

Synchronous network model - Algorithms: leader election, maximal independent set -Asynchronous system model: I/O automata, operations on automata, fairness - Asynchronous shared memory model - Mutual exclusion: model, the problem, stronger conditions, lockout-free mutual exclusion algorithms, lower bound on the number of registers - Asynchronous network model - Asynchronous network algorithms: leader election in a ring and an arbitrary network.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. George Coulouris, Jean Dollimore and Tim Kindberg, "Distributed Systems Concepts and Design", Fifth Edition, Pearson Education, 2012.
2. Nancy A. Lynch, "Distributed Algorithms", Hardcourt Asia Pvt. Ltd., Morgan Kaufmann, 2000.

REFERENCES:

1. Pradeep K Sinha, "Distributed Operating Systems: Concepts and Design", Prentice Hall of India, 2007.
2. Tanenbaum A.S., Van Steen M., "Distributed Systems: Principles and Paradigms", Pearson Education, 2007.
3. Liu M.L., "Distributed Computing, Principles and Applications", Pearson Education, 2004.
4. Nancy A Lynch, "Distributed Algorithms", Morgan Kaufman Publishers, USA, 2003.

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ONLINE RESOURCES:

1. https://www.cs.helsinki.fi/u/jakangas/Teaching/DistSys/DistSys-08f-1.pdf
2. https://www.vidyarthiplus.com/vp/attachment.php?aid=43022

OUTCOMES:

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

1. Apply the use of distributed system with architecture, trends, and resource sharing in World Wide Web. (K3)
2. Articulate various communication mechanisms in distributed systems, like RPC, RMI, multicast, message-oriented middleware, and network virtualization (K3)
3. Sketch the design and operation of peer-to-peer systems and distributed file systems. (K3)
4. Examine synchronization, coordination, and replication techniques with logical clocks, mutual exclusion, elections, transactions, and concurrency control mechanisms (K3)
5. Determine the key process and resource management strategies. (K3)
6. Re-enact the use of distributed algorithms for synchronous and asynchronous systems (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	-	-	-	-	-	-	-	-	2	2
CO2	2	2	2	2	-	-	-	-	-	-	-	2	2
CO3	2	2	2	-	-	-	-	-	-	-	-	2	2
CO4	2	2	2	2	-	-	-	-	-	-	-	2	2
CO5	2	2	2	2	-	-	-	-	-	-	-	2	2
CO6	2	2	2	2	-	-	-	-	-	-	-	2	2

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PROFESSIONAL ELECTIVES - II

COURSE CODE: 24ITEL512	PARALLEL ALGORITHMS	L	T	P	CP	C
		3	0	0	4	3
NPTEL CODE: 106103359	SYLLABUS VERSION 1.0	SDG NO. 9				
PRE-REQUISITE COURSES	24CSPC302, 24CSPC402, 24ITPW401					

OBJECTIVES:

- To introduce the design principles of parallel algorithms
- To understand various models of parallel computation (PRAM, EREW, CREW, CRCW and DCM) and Performance analysis metrics such as cost, speedup and efficiency.
- To learn fundamental parallel algorithms for sorting and Searching
- To apply parallel algorithms to solve matrix operations, algebraic and Geometry problems.
- To apply parallel algorithm techniques in solving real-world computational problems

MODULE - I INTRODUCTION TO PARALLEL ALGORITHMS 7

Introduction to Parallel Algorithms-Parallel Programming Paradigms-Parallel Architecture-Need for Parallel Algorithms-Serial vs Parallel Computation-Concepts of Concurrency and Parallelism-Overview of Models of Computation-Applications of Parallel Algorithms

MODULE - II MODELS & COMPLEXITY ANALYSIS 8

Introduction to PRAM Model-PRAM Model (EREW, CREW, CRCW)-Distributed Computing Model (DCM – basics)-Work, Time Complexity, Cost Optimality-Brent's Theorem (basic idea)-Analysis of Parallel Algorithms

MODULE - III PERFORMANCE AND BASIC PARALLEL TECHNIQUES 7

Performance Measures: cost, speedup, efficiency-Work-time analysis-Basic Parallel Techniques-Parallel Prefix (Scan) Computation-Pointer Jumping Technique-Divide and Conquer Approach-Parallel Reduction Operations-Synchronization and Communication overheads

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MODULE - IV PARALLEL SORTING & SEARCHING 8

Sorting Networks and Bitonic Sort & odd-Even Transposition Sort-Cole's Merge sort-Sorting on Linear Array-Sorting in EREW, CREW, CRCW-Parallel Searching: Linear and Binary Search-Performance Comparison

MODULE - V ALGEBRAIC, GRAPH & GEOMETRY ALGORITHMS 7

Matrix Transposition-Matrix Multiplication (Matrix–Matrix, Matrix–Vector)-Connected Components-Minimum Spanning Tree-All-Pairs Shortest Paths-Computational Geometry Problems

MODULE - VI ADVANCED PREFIX ALGORITHMS AND APPLICATIONS 8

Prefix Sums (Advanced)-Job Sequencing Problem-Knapsack Problem-Integer Addition and Multiplication-Speedup, Efficiency, Scalability-Amdahl's Law and Gustafson's Law-Applications in AI, Big Data, Scientific Computing

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar , "Introduction to Parallel Computing" , Edition: 2nd Edition, 2003.
2. Joseph JáJá , "Introduction to Parallel Algorithms", Addison-Wesley ,1992

REFERENCES:

1. Xavier & Iyengar, "Introduction to Parallel Algorithms", Wiley, 1998.
2. Sanders et al., "Sequential and Parallel Algorithms and Data Structures", Springer, 2019.
3. Barry Wilkinson & Michael Allen, "Parallel Programming: Techniques and Applications Using Networked Workstations and Parallel Computers", Pearson, 2005.
4. Selim G. Akl , "Design and Analysis of Parallel Algorithms", Prentice Hall, 1989.

ONLINE RESOURCES:

1. https://www.mindluster.com/lesson/221422-video?
2. https://slidetodoc.com/pram-model-lecture-3-efficient-parallel-algorithms-comp/
3. https://www.geeksforgeeks.org/dsa/bitonic-sort/
4. https://onlinecourses-archive.nptel.ac.in/noc19_cs17/preview1
5. https://www.nptelprep.in/courses/106104120/materials
6. https://ocw.mit.edu/search/?q=parallel%20algorithms&t=Algorithms%20and%20Data%20Structures

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OUTCOMES:

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

1. Apply parallel algorithm design principles to solve computational problems using appropriate models.(K3)
2. Apply PRAM models (EREW, CREW, CRCW) and distributed computing concepts to implement parallel solutions.(K3)
3. Apply performance analysis metrics such as cost, speedup, efficiency and work-time analysis to evaluate parallel algorithms(K3)
4. Implement parallel sorting and searching algorithms.(K3)
5. Apply parallel algorithms to solve matrix operations, graph problems and computational geometry problems.(K3)
6. Apply parallel algorithms to solve real-world problems(K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	-	-	-	-	-	-	-	2	2	2
CO2	2	2	2	2	2	-	-	-	-	-	2	2	2
CO3	2	2	2	-	-	-	-	-	-	-	2	2	2
CO4	2	2	2	2	-	-	-	-	-	-	2	2	2
CO5	2	2	2	2	-	-	-	-	-	-	2	2	2
CO6	2	2	2	2	-	-	-	-	-	-	2	2	2

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PROFESSIONAL ELECTIVES - II

COURSE CODE: 24AIEL504	BUSINESS INTELLIGENCE	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106101224	SYLLABUS VERSION 1.0	SDG NO. 9, 11				
PRE-REQUISITE COURSES	24CSPC301,24BSMA301					

OBJECTIVES:

- Understand the fundamentals, concepts, and architecture of Business Intelligence systems.
- Apply data analysis, visualization, and reporting techniques for business decision-making.
- Analyze business data using statistical and analytical tools.
- Develop dashboards, KPIs, and performance monitoring systems for organizations.
- Explore predictive analytics and intelligent business applications using BI tools.
- Apply Business Intelligence techniques to solve real-world business and industrial problems.

MODULE - I INTRODUCTION TO BUSINESS INTELLIGENCE 7

Introduction to Business Intelligence – Evolution and Importance of BI – BI Architecture and Components – Data, Information, and Knowledge – Business Analytics and Decision Support Systems – BI Process and Framework – Applications of BI in Finance, Marketing, Healthcare, Retail, Manufacturing, and Education – BI Tools and Technologies – Ethics, Privacy, and Security Issues in Business Intelligence.

MODULE - II DATA WAREHOUSING AND DATA MANAGEMENT 7

Data Warehousing Concepts – Data Sources and Data Integration – ETL (Extract, Transform, Load) Process – Data Cleaning and Data Preprocessing – Data Marts and Metadata – OLTP and OLAP Systems – Multidimensional Data Models – Star Schema and Snowflake Schema – Big Data Concepts in BI – Data Governance and Quality Management.

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MODULE - III DATA ANALYTICS AND STATISTICAL TECHNIQUES 8

Introduction to Data Analytics – Descriptive, Predictive, and Prescriptive Analytics – Statistical Analysis for BI – Correlation and Regression Analysis – Classification and Clustering Techniques – Forecasting and Trend Analysis – Association Rule Mining – Text Analytics and Sentiment Analysis – Business Metrics and KPI Analysis – Data-driven Decision Making.

MODULE - IV DATA VISUALIZATION AND DASHBOARD DESIGN 8

Importance of Data Visualization – Principles of Effective Visualization – Types of Charts and Graphs – Interactive Dashboards – Dashboard Design Process – KPI Dashboards and Executive Dashboards – Storytelling with Data – Visualization Tools: Power BI, Tableau, Google Data Studio – Designing Reports and Infographics – Common Visualization and Dashboard Design Pitfalls.

MODULE - V BUSINESS INTELLIGENCE TOOLS AND APPLICATIONS 8

Business Intelligence Tools Overview – Microsoft Power BI – Tableau – Excel for Business Analytics – Creating Reports and Dashboards – Data Modeling using BI Tools – Real-time Business Monitoring – Cloud-based BI Systems – Mobile BI Applications – BI for Customer Relationship Management (CRM) and Supply Chain Management (SCM) – Case Studies in Business Intelligence Applications.

MODULE - VI EMERGING TRENDS IN BUSINESS INTELLIGENCE 7

Artificial Intelligence and Machine Learning in BI – Predictive Analytics and Forecasting – Self-service BI – IoT and Real-time Analytics – Data Mining Techniques – Natural Language Processing in BI – Intelligent Decision Support Systems – Blockchain and BI – Cybersecurity Analytics – Future Trends and Challenges in Business Intelligence Systems.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Efraim Turban, Ramesh Sharda, and Dursun Delen, "Decision Support and Business Intelligence Systems", Pearson Education, 10th Edition, 2017.
2. David Loshin, "Business Intelligence: The Savvy Manager's Guide", Morgan Kaufmann Publishers, 2nd Edition, 2012.
3. Cindi Howson, "Successful Business Intelligence: Unlock the Value of BI and Big Data", McGraw Hill Education.

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REFERENCES:

1. Ralph Kimball and Margy Ross, "The Data Warehouse Toolkit", Wiley Publications.
2. Larissa T. Moss and Shaku Atre, "Business Intelligence Roadmap", Addison Wesley.
3. Carlo Vercellis, "Business Intelligence: Data Mining and Optimization for Decision Making", Wiley Publications.
4. Jiawei Han, Micheline Kamber, and Jian Pei, "Data Mining: Concepts and Techniques", Morgan Kaufmann.
5. Wayne Winston, "Microsoft Excel Data Analysis and Business Modeling", Microsoft Press.

WEB REFERENCES:

1. Microsoft Power BI Documentation: https://learn.microsoft.com/power-bi/
2. Tableau Learning Resources: https://www.tableau.com/learn
3. IBM Business Analytics Resources: https://www.ibm.com/analytics

ONLINE RESOURCES:

1. Coursera – Business Intelligence Courses: https://www.coursera.org/
2. Google Looker Studio Documentation: https://support.google.com/looker-studio
3. NPTEL–Business Intelligence and Analytics Courses: https://nptel.ac.in/courses/110105089

OUTCOMES:

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

1. Apply Business Intelligence concepts, architectures, frameworks, and decision support systems to address business problems in diverse domains. (K3)
2. Analyze data warehousing architectures, ETL processes, multidimensional data models, and data management techniques for effective business intelligence solutions (K4)
3. Apply statistical and analytical techniques such as regression, classification, clustering, forecasting, and KPI analysis for data-driven decision making. (K3)
4. Analyze and design effective visualizations, dashboards, and reports using BI principles and modern visualization tools. (K4)

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5. Develop business intelligence solutions using contemporary BI tools such as Power BI, Tableau, and Excel for real-time monitoring and business analytics. (K3)
6. Analyze the impact of emerging technologies such as AI, Machine Learning, IoT, NLP, Blockchain, and cybersecurity analytics in next-generation business intelligence systems. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	2	3
CO2	2	3	-	-	-	-	-	-	-	–	-	3	3
CO3	3	-	-	-	-	-	-	-	-	-	-	2	3
CO4	2	3	-	-	-	-	-	-	-	-	-	2	2
CO5	3	-	-	-	-	-	-	-	-	-	-	2	2
CO6	2	3		-	-	-	-	-	-	-	-	3	2

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24AIEL505	MACHINE LEARNING ESSENTIALS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106106139	SYLLABUS VERSION 1.0	SDG NO. 9, 11				
PRE-REQUISITE COURSES	24BSMA301, 24CSPC302					

OBJECTIVES:

- Understand the fundamental concepts, techniques, and applications of Machine Learning.
- Apply data preprocessing and feature engineering techniques for machine learning models.
- Analyze supervised and unsupervised learning algorithms for predictive analytics.
- Implement machine learning models using appropriate tools and frameworks.
- Evaluate and optimize machine learning models using performance metrics.

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- Apply machine learning techniques to solve real-world intelligent system problems.

MODULE - I INTRODUCTION TO MACHINE LEARNING 7

Introduction to Artificial Intelligence and Machine Learning – Types of Machine Learning: Supervised, Unsupervised, and Reinforcement Learning – Applications of Machine Learning – Machine Learning Workflow – Data Collection and Preparation – Training, Validation, and Testing Datasets – Introduction to Python Libraries for Machine Learning – Introduction to Scikit-learn – Challenges and Limitations of Machine Learning – Ethical Issues in Machine Learning.

MODULE - II `DATA PREPROCESSING AND FEATURE ENGINEERING 8

Data Cleaning and Data Integration – Handling Missing Values and Outliers – Data Transformation Techniques – Feature Scaling: Normalization and Standardization – Feature Selection Methods – Dimensionality Reduction Techniques – Principal Component Analysis (PCA) – Encoding Categorical Variables – Data Visualization for Machine Learning – Introduction to Exploratory Data Analysis (EDA).

MODULE - III SUPERVISED LEARNING ALGORITHMS 7

Introduction to Supervised Learning – Regression and Classification Concepts – Linear Regression – Logistic Regression – Decision Trees – Random Forest – Support Vector Machines – K-Nearest Neighbor Algorithm – Naive Bayes Classification – Model Training and Testing – Bias and Variance – Overfitting and Underfitting – Cross Validation Techniques – Performance Metrics: Accuracy, Precision, Recall, F1-Score, ROC Curve.

MODULE - IV UNSUPERVISED LEARNING AND CLUSTERING TECHNIQUES 8

Introduction to Unsupervised Learning – Clustering Concepts and Applications – K-Means Clustering – Hierarchical Clustering – Density-based Clustering – Association Rule Mining – Market Basket Analysis – Dimensionality Reduction for Visualization – Anomaly Detection – Recommendation Systems – Applications of Unsupervised Learning in Business and Industry.

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MODULE - V NEURAL NETWORKS AND DEEP LEARNING FUNDAMENTALS **8**

Introduction to Artificial Neural Networks – Biological Inspiration of Neural Networks – Structure of Neurons and Layers – Activation Functions – Feed forward Neural Networks – Back propagation Algorithm – Deep Learning Concepts – Convolutional Neural Networks (CNN) – Recurrent Neural Networks (RNN) – Introduction to Tensor Flow and Keras – Applications of Deep Learning in Image Processing, Speech Recognition, and Natural Language Processing.

MODULE - VI MACHINE LEARNING APPLICATIONS AND EMERGING TRENDS **7**

Machine Learning for Predictive Analytics – Natural Language Processing Basics – Computer Vision Applications – Time Series Forecasting – Reinforcement Learning Fundamentals – Explainable AI and Responsible AI – Edge AI and IoT Applications – Machine Learning in Healthcare, Finance, Smart Manufacturing, and Cyber security – Model Deployment Concepts – Future Trends in Machine Learning and Intelligent Systems.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Tom M. Mitchell, "Machine Learning", McGraw Hill Education, International Edition.
2. Andreas C. Müller and Sarah Guido, "Introduction to Machine Learning with Python: A Guide for Data Scientists", O'Reilly Media, 1st Edition, 2016.
3. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", O'Reilly Media, 3rd Edition, 2022.

REFERENCES:

1. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press.
2. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer.
3. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, "Deep Learning", MIT Press.
4. Trevor Hastie, Robert Tibshirani, and Jerome Friedman, "The Elements of Statistical Learning", Springer.
5. Sebastian Raschka and Vahid Mirjalili, "Python Machine Learning", Packt Publishing.

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WEB REFERENCES:

1. Scikit-learn Official Documentation: https://scikit-learn.org/stable/
2. TensorFlow Official Documentation: https://www.tensorflow.org/
3. Keras Documentation: https://keras.io/

ONLINE RESOURCES:

1. Google Machine Learning Crash Course: https://developers.google.com/machine-learning/crash-course
2. Coursera – Machine Learning by Andrew Ng: https://www.coursera.org/learn/machine-learning
3. Kaggle Learn – Machine Learning Courses: https://www.kaggle.com/learn

OUTCOMES:

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

1. Apply machine learning concepts, workflows, data preparation techniques, and Python-based tools to develop basic machine learning solutions for real-world problems. (K3)
2. Analyze and preprocess datasets using data cleaning, feature engineering, dimensionality reduction, and exploratory data analysis techniques to improve model performance. (K4)
3. Apply supervised learning algorithms such as regression, classification, decision trees, random forests, and support vector machines for predictive modeling tasks. (K3)
4. Analyze unsupervised learning techniques including clustering, association rule mining, anomaly detection, and recommendation systems for pattern discovery and knowledge extraction. (K4)
5. Apply neural network architectures and deep learning frameworks to develop solutions for image, speech, and natural language processing applications. (K3)
6. Analyze emerging machine learning technologies, responsible AI practices, and domain-specific applications to address complex challenges in intelligent systems. (K4)

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CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	2	2
CO2	2	3	-	-	-	-	-	-	-	-	-	3	2
CO3	3	-	-	-	-	-	-	-	-	-	-	2	2
CO4	2	3	-	-	-	-	-	-	-	-	-	2	3
CO5	3	-	-	-	-	-	-	-	-	-	-	2	3
CO6	2	3	-	-	-	-	-	-	-	-	-	3	3

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24AIEL506	DECISION SUPPORT SYSTEMS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 110105147	SYLLABUS VERSION 1.0	SDG NO. 9, 11, 13				
PRE-REQUISITE COURSES	24CSPC301, 24BSMA301					

OBJECTIVES:

- Understand the fundamentals, concepts, and applications of Decision Support Systems (DSS).
- Analyze organizational decision-making processes and the role of DSS in improving business performance.
- Apply data management, model management, and knowledge-based techniques in DSS design.
- Develop skills in data analysis, visualization, and reporting for managerial decision-making.
- Explore intelligent and group decision support systems using modern analytical tools.
- Apply DSS concepts to real-world business, healthcare, industrial, and strategic decision-making scenarios.

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MODULE - I CLOUD ARCHITECTURE AND MODELS **7**

Cloud Architecture: System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture – Cloud Characteristics – Cloud deployment models – Cloud service models – Pros and Cons of Cloud.

MODULE - II INTRODUCTION TO VIRTUALIZATION **8**

Basics of Virtualization – Virtualization Types – Implementation Levels of Virtualization – Virtualization Structures / Tools and Mechanisms – Virtualization of CPU, Memory, I/O Devices – Virtual Clusters and Resource management – Virtualization for Data-Center Automation – Virtualization Support and Disaster Recovery – Taxonomy of Virtual Machines – Create VM Cluster using VMWare or Virtual Box and deploy an application.

MODULE - III CLOUD INFRASTRUCTURE **8**

Cloud Infrastructure: Architectural design of compute and storage clouds – Layered cloud architecture Development – Design Challenges – Inter Cloud Resource Management – Resource Provisioning and Platform Deployment – Global Exchange of Cloud Resources.

MODULE - IV CLOUD DEPLOYMENT ENVIRONMENT **7**

Parallel Programming Framework: Hadoop Map Reduce – Google App Engine – Amazon AWS – Microsoft Azure; Cloud Software Environments – Eucalyptus – OpenStack – OpenNebula – Aneka.

MODULE - V CLOUD SECURITY **7**

Data Security and Storage; Identity and Access Management (IAM) – IAM Challenges – IAM Architecture and Practice; Security Management in the Cloud – Security Management Standards – SaaS, Paas and IaaS Availability Management – Access Control; Security-As-A-Service.

MODULE - VI CLOUD SIMULATOR & CLOUD APPLICATIONS **8**

CloudSim – Architecture - Cloudlets – VM creation – Broker – VM allocation – Hosts – Data Center. Web Service Architecture – Web service APIs – Web service authentication - Web service authentication methods - Technologies and the processes required when deploying web services; Deploying a web service from inside and outside a cloud architecture, advantages and disadvantages.

TOTAL : 45 PERIODS

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TEXT BOOKS:

1. Efraim Turban, Ramesh Sharda, and Dursun Delen, "Decision Support and Business Intelligence Systems", Pearson Education, 10th Edition, 2017.
2. Marakas George M., "Decision Support Systems in the Twenty-First Century", Prentice Hall, 2nd Edition, 2003.
3. Power D.J., "Decision Support, Analytics, and Business Intelligence", Business Expert Press, 2019.

REFERENCES:

1. Daniel J. Power, "Decision Support Systems: Concepts and Resources for Managers", Greenwood Publishing.
2. Ralph H. Sprague and Hugh J. Watson, "Decision Support Systems: Putting Theory into Practice", Prentice Hall.
3. Sauter Vicki L., "Decision Support Systems for Business Intelligence", Wiley Publications.
4. James O'Brien and George Marakas, "Management Information Systems", McGraw Hill Education.
5. Jiawei Han, Micheline Kamber, and Jian Pei, "Data Mining: Concepts and Techniques", Morgan Kaufmann.

WEB REFERENCES:

1. Decision Support Systems Journal – Elsevier: https://www.journals.elsevier.com/decision-support-systems
2. IBM Business Analytics Resources: https://www.ibm.com/analytics
3. Microsoft Power BI Documentation: https://learn.microsoft.com/power-bi/

ONLINE RESOURCES:

1. Tableau Learning Resources: https://www.tableau.com/learn
2. Coursera – Business Intelligence and Decision Support Courses: https://www.coursera.org/
3. Google Cloud Decision Intelligence Resources: https://cloud.google.com/solutions

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OUTCOMES:

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

1. Apply the concepts, architecture, frameworks, and decision-making models of Decision Support Systems to solve organizational decision problems. (K3)
2. Analyze data management techniques, data warehousing, OLTP/OLAP systems, and business intelligence tools for effective decision support. (K4)
3. Apply analytical, statistical, optimization, forecasting, and simulation models to support business decision-making processes. (K3)
4. Analyze the role of knowledge-based systems, artificial intelligence, machine learning, and intelligent agents in enhancing decision support capabilities. (K4)
5. Apply Group Decision Support Systems (GDSS), enterprise decision support applications, and cloud-based DSS solutions for collaborative decision making. (K3)
6. Analyze emerging trends such as Big Data Analytics, IoT, GIS, Blockchain, Cybersecurity, and Sustainable DSS for intelligent and strategic decision support. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	2	2
CO2	2	3	-	-	-	-	-	-	-	–	-	3	2
CO3	3	-	-	-	-	-	-	-	-	-	-	2	2
CO4	2	3	-	-	-	-	-	-	-	-	-	2	3
CO5	3	-	-	-	-	-	-	-	-	-	-	2	3
CO6	2	3		-	-	-	-	-	-	-	-	3	3

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PROFESSIONAL ELECTIVES - II

COURSE CODE: 24ITEL513	SECURE SOFTWARE DEVELOPMENT	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 9, 16				
PRE-REQUISITE COURSES	24ITTP401, 24ITPW401					

OBJECTIVES:

- To understand the principles of secure software system development and the integration of security throughout the Software Development Life Cycle (SDLC).
- To analyze risks, threats, and vulnerabilities associated with software design, development, and deployment processes.
- To apply secure coding practices, security testing techniques, and defensive programming methods for developing reliable software systems.
- To evaluate real-world software security failures, attack scenarios, and mitigation strategies for improving application security.

MODULE - I INTRODUCTION TO SECURE SOFTWARE DEVELOPMENT 8

Fundamentals of software security – Security goals: Confidentiality, Integrity, Availability – Security principles: Least privilege, defense in depth, fail-safe defaults – Overview of Secure Software Development Life Cycle (SSDLC) – Common software vulnerabilities – Introduction to risk, threats, and attacks – Case studies of security breaches and lessons learned.

MODULE - II THREAT MODELINGAND RISK ANALYSIS 8

Concepts of threat modeling – Identifying assets, threats, and vulnerabilities – STRIDE and DREAD models – Risk assessment techniques – Attack surface analysis – Misuse/abuse cases – Security requirements engineering – Risk mitigation strategies – Integrating security into requirements phase.

MODULE - III SECURE DESIGN PRINCIPLES 7

Secure design methodologies – Design patterns for security – Principles of secure architecture – Trust boundaries and attack vectors – Input validation and data protection design – Authentication and authorization mechanisms –

Cryptographic fundamentals in design – Secure API design – Minimizing attack surface.

MODULE - IV SECURE CODING PRACTICES 7

Common coding vulnerabilities: Buffer overflow, injection attacks, cross-site scripting – Secure coding standards – Input validation and output encoding – Error handling and logging – Memory management issues – Secure use of libraries and frameworks – Language-specific security practices – Static code analysis tools.

MODULE - V SECURITY TESTING AND VALIDATION 8

Security testing fundamentals – Static and dynamic analysis – Penetration testing concepts – Fuzz testing – Vulnerability scanning tools – Test case design for security – Code review techniques – Security validation in SDLC – Compliance and standards (OWASP, ISO).

MODULE - VI DEPLOYMENT, MAINTENANCE AND INCIDENT RESPONSE 7

Secure deployment practices – Configuration management – Patch management – Monitoring and logging – Incident detection and response – Handling security breaches – Secure updates and maintenance – DevSecOps concepts – Continuous security integration.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Aspen Olmsted, Security-Driven Software Development, Wiley, 2019.
2. Gary McGraw, Software Security: Building Security In, Addison-Wesley

REFERENCE BOOKS:

1. . Mark Graff and Kenneth van Wyk, Secure Coding: Principles and Practices, O'Reilly.
2. Michael Howard and David LeBlanc, Writing Secure Code, Microsoft Press.
3. OWASP Foundation, OWASP Top 10 Documentation.

WEB REFERENCES:

1. https://owasp.org
2. https://cwe.mitre.org

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3. https://nvd.nist.gov
4. https://www.sans.org

OUTCOMES:

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

1. Apply fundamental concepts of secure software development and security principles in software system design. (K3)
2. Analyze threats, vulnerabilities, and risk factors affecting secure software systems. (K4)
3. Apply secure design principles and threat modeling techniques to develop secure applications. (K3)
4. Implement secure coding practices and mitigation techniques to prevent common software vulnerabilities. (K3)
5. Evaluate security testing, verification, and validation methods for ensuring software security and reliability. (K5)
6. Evaluate secure deployment, maintenance, and update practices for protecting software systems throughout their lifecycle. (K5)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	–	–	–	–	–	–	–	–	–	2	–
CO2	2	3	–	-	–	–	–	–	–	–	–	2	2
CO3	2	2	3	–	–	–	–	–	–	–	–	3	2
CO4	2	3	2	-	–	–	–	–	–	–	–	2	3
CO5	3	2	3	-	–	–	–	–	–	–	–	3	3
CO6	2	2	–	-	–	–	–	–	–	–	–	–	3

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PROFESSIONAL ELECTIVES - II

COURSE CODE: 24ITEL514	FOUNDATIONS OF CYBER PHYSICAL SYSTEMS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106105241	SYLLABUS VERSION 1.0	SDG NO. 9, 16				
PRE-REQUISITE COURSES	24ITPW401, 24ITPC501					

OBJECTIVES:

- To understand the fundamental concepts, architecture, and components of Cyber Physical Systems (CPS).
- To analyze communication models, real-time computing, and security challenges in CPS environments.
- To apply sensing, control, networking, and embedded computing techniques for CPS design and implementation.
- To evaluate CPS applications, reliability, safety, and emerging technologies in smart and interconnected systems.

MODULE - I INTRODUCTION TO CYBER PHYSICAL SYSTEMS 7

Fundamentals of CPS - Definition and characteristics of CPS - Evolution of Cyber Physical Systems - CPS architecture and design principles - Components of CPS: sensing, communication, computation, and control - CPS and Embedded Systems - Embedded systems overview - Difference between CPS and IoT - Smart devices and intelligent systems - Applications of CPS in real-world environments - CPS Design Challenges - Scalability and interoperability - Reliability and fault tolerance - Timing and synchronization issues - Safety and security concerns.

MODULE - II SENSORS, ACTUATORS, AND EMBEDDED COMPUTING 8

Sensors and Actuators - Types of sensors and actuators - Sensor data acquisition and processing - Signal conditioning techniques - Smart sensing systems - Embedded Computing Platforms - Microcontrollers and embedded processors - Real-time embedded systems - Resource constraints in embedded devices - Power management techniques - CPS Hardware Integration - Interfacing techniques - Device communication protocols - Edge devices and gateways - Hardware-software co-design,

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MODULE - III COMMUNICATION AND NETWORKING IN CPS **8**

Communication Models - Wired and wireless communication - Machine-to-machine (M2M) communication - Internet of Things (IoT) integration - Middleware for CPS - Networking Protocols - TCP/IP for CPS - MQTT, CoAP, and ZigBee protocols - Industrial communication protocols - Time-sensitive networking - Real-Time Communication - Synchronization and scheduling - Real-time operating systems (RTOS) - Latency and QoS requirements - Distributed CPS communication models,

MODULE - IV CONTROL SYSTEMS AND SECURITY IN CPS **7**

Control Systems - Feedback and control mechanisms - Modeling and simulation of CPS - Real-time control systems - Adaptive and autonomous control - CPS Security- Threats and vulnerabilities in CPS - Cyber attacks on industrial systems - Authentication and access control - Secure communication mechanisms - Safety and Reliability- Fault detection and recovery - Resilience in CPS - Safety-critical systems - Risk assessment techniques.

MODULE - V DATA ANALYTICS AND INTELLIGENT CPS **7**

Data Management in CPS - Data acquisition and storage - Big data analytics in CPS - Cloud-assisted CPS - Edge and fog computing - Intelligent CPS - Artificial Intelligence and Machine Learning in CPS - Predictive maintenance systems - Smart decision-making systems - Autonomous cyber physical environments - CPS Optimization - Resource optimization - Energy-efficient CPS - Performance monitoring and evaluation - Scalability management.

MODULE - VI APPLICATIONS, CASE STUDIES, AND EMERGING TRENDS **8**

CPS Applications - Smart grid systems - Smart transportation and autonomous vehicles - Healthcare and medical CPS - Smart manufacturing and Industry 4.0 - Emerging Trends - Digital twins - Blockchain-enabled CPS - 5G-enabled CPS communication - Human-CPS interaction systems - Case Studies - Industrial automation systems - Smart city implementations - CPS security incidents and analysis - Future research directions in CPS.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Rajeev Alur, Principles of Cyber-Physical Systems, MIT Press, 2015.
2. Edward A. Lee and Sanjit A. Seshia, Introduction to Embedded Systems: A Cyber-Physical Systems Approach, MIT Press, 2nd Edition, 2017.

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REFERENCE BOOKS

1. Houbing Song, Danda B. Rawat, Sabina Jeschke, Christian Brecher, Cyber-Physical Systems: Foundations, Principles and Applications, Elsevier Publications, 2017.
2. Kim Fowler, Cybersecurity for Industrial Control Systems: SCADA, DCS, PLC, HMI, and SIS, Institution of Engineering and Technology (IET), 2020.
3. Luca Foschini, Antonio Corradi, and Emanuele Borea, Practical Cyber-Physical Systems: A Hands-on Approach, Springer Publications, 2020.
4. Hermann Kopetz, Real-Time Systems: Design Principles for Distributed Embedded Applications, Springer Publications, 2nd Edition, 2011.

WEB RESOURCES

1. MIT Cyber Physical Systems Research Center
2. National Institute of Standards and Technology (NIST) – CPS Program
3. IEEE Cyber Physical Systems Initiative
4. Open Source IoT and CPS Resources – Eclipse Foundation
5. MIT OpenCourseWare
6. IEEE Xplore Digital Library

OUTCOMES:

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

1. Apply the concepts, architecture, and design principles of Cyber Physical Systems for developing intelligent interconnected systems. (K3)
2. Analyze sensing, embedded computing, and communication mechanisms used in CPS environments. (K4)
3. Apply networking protocols, real-time communication, and middleware technologies in Cyber Physical Systems. (K3)
4. Examine control mechanisms, security challenges, and safety requirements in CPS applications. (K4)
5. Evaluate data analytics, intelligent decision-making, and optimization techniques in Cyber Physical Systems. (K5)
6. Evaluate emerging CPS technologies, real-world applications, and security solutions for smart interconnected environments. (K5)

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Information Tec[illegible]ology

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	-	2	-	-	-	-	1	-	2	3
CO2	3	3	-	2	3	-	-	-	-	-	-	2	3
CO3	2	3	3	-	3	-	-	1	-	-	-	3	3
CO4	2	3	2	2	3	1	-	1	-	-	-	2	3
CO5	2	3	3	2	3	1	1	-	-	1	-	3	3
CO6	2	3	3	3	3	1	1	2	1	1	1	3	3

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24ITEL515	MOBILE AND WIRELESS SECURITY	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 108101585	SYLLABUS VERSION 1.0	SDG NO. 4, 9, 10, 16				
PRE-REQUISITE COURSES	24ITPC301, 24BSMA301					

OBJECTIVES:

- To understand the architecture, protocols, and security requirements of mobile and wireless networks.
- To analyze vulnerabilities, threats, and attacks in wireless communication technologies and mobile platforms.
- To explore authentication, encryption, access control, and secure communication mechanisms used in wireless environments.
- To apply security techniques and countermeasures for securing mobile devices, wireless networks, and emerging mobile applications.

MODULE - I INTRODUCTION TO MOBILE AND WIRELESS SECURITY 7

Introduction to Wireless Networks-Evolution of wireless communication - Cellular networks and mobile computing concepts - WLAN, PAN, MANET, VANET and IoT networks - Security requirements in wireless systems - Wireless communication standards - Security Challenges - Open medium vulnerabilities - Threats in wireless communication - Security goals - Wireless attack surfaces and risk assessment - Wireless Security Fundamentals - Cryptography for wireless networks - Authentication mechanisms - Key management techniques - Security protocols overview.

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MODULE - II WIRELESS NETWORK SECURITY **8**

IEEE 802.11 Wireless LAN Security - Wi-Fi architecture -WEP security mechanism - WPA and WPA2 protocols - WPA3 security enhancements - Wireless Attacks - Rogue access points - Packet sniffing and eavesdropping - MAC spoofing - Replay attacks - Denial of Service attacks - Secure Wireless Communication - VPN in wireless networks - Firewalls and IDS for LANs - Wireless intrusion detection systems - Secure wireless configuration and monitoring

MODULE - III MOBILE DEVICE AND PLATFORM SECURITY **8**

Mobile Operating Systems - Android architecture and security model - iOS security architecture - Mobile application lifecycle - Mobile Device Threats - Malware, spyware, ransomware - Rooting and jail breaking - Data leakage and privacy threats - SMS and Bluetooth attacks - Mobile Security Mechanisms - Sandboxing - Secure boot process - Mobile device management (MDM) - Mobile endpoint security solutions

MODULE - IV CELLULAR NETWORK AND AUTHENTICATION SECURITY **7**

Cellular Network Architecture - GSM, GPRS, 3G, 4G and 5G overview - SIM architecture and subscriber identity management - Cellular Security - GSM authentication and encryption - LTE security architecture - 5G security framework - Authentication and key agreement protocols - Cellular Network Threats - IMSI catcher attacks - Base station attacks - SIM cloning - Signaling attacks and mitigation techniques

MODULE - V MOBILE APPLICATION AND DATA SECURITY **7**

Mobile Application Security - Secure mobile application design - Secure coding practices - OWASP Mobile Security risks - API security in mobile applications - Data Protection - Data encryption techniques - Secure storage mechanisms - Cloud synchronization security - Backup and recovery security - Mobile Payment Security - NFC security - Mobile wallet security - Biometric authentication - Secure transaction mechanisms

MODULE - VI EMERGING TRENDS AND CASE STUDIES IN MOBILE SECURITY **8**

Emerging Technologies - IoT and mobile security integration - Security in wearable devices - Edge and cloud-assisted mobile security - AI-based mobile threat detection - Advanced Security Solutions - Blockchain in mobile security - Zero trust architecture - Behavioral authentication - Threat intelligence

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systems - Case Studies - Real-world wireless attacks - Android malware analysis - Security breach investigations - Industrial best practices and future trends

TOTAL : 45 PERIODS

TEXT BOOKS:

1. William Stallings, Wireless Communications and Networks, Pearson Education, 2nd Edition, 2017.
2. Jochen Schiller, Mobile Communications, Pearson Education, 2nd Edition, 2015.

REFERENCE BOOKS

1. Charlie Kaufman, Radia Perlman, Mike Speciner, Network Security: Private Communication in a Public World, Pearson Education, 3rd Edition, 2016.
2. Nikos Komninos, Wireless and Mobile Network Security, Auerbach Publications, CRC Press, 2018.
3. Nadav Levanon, Mobile and Wireless Network Security and Privacy, Springer Publications, 2019.
4. Joshua J. Drake, Zach Lanier, Collin Mulliner, Pau Oliva Fora, Stephen A. Ridley, Georg Wicherski, Android Hacker's Handbook, Wiley Publications, 2014.

WEB RESOURCES

1. OWASP Mobile Security Project
2. NIST Wireless and Mobile Security Guidelines
3. Android Security Documentation
4. Cisco Wireless Security Resources
5. IEEE Xplore Digital Library
6. OWASP Mobile Top 10 Risks

OUTCOMES:

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

1. Apply the concepts, architecture, and security requirements of mobile and wireless networks to establish secure communication environments. (K3)
2. Analyze vulnerabilities, attacks, and threats in wireless LANs and mobile communication systems. (K4)
3. Apply authentication, encryption, and access control mechanisms in wireless environments. (K3)

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4. Examine security models and protection mechanisms in mobile operating systems and applications. (K4)
5. Evaluate security solutions for mobile applications, mobile payments, and cloud-assisted mobile systems. (K5)
6. Develop secure strategies and recommend countermeasures for emerging mobile and wireless security challenges. (K5)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	2	-	-	-	-	-	-	2	2
CO2	3	3	-	2	2	-	-	-	-	-	-	2	3
CO3	2	3	3	-	3	-	-	-	-	-	-	3	3
CO4	2	3	2	2	3	-	-	-	-	-	-	2	3
CO5	2	3	3	2	3	-	-	-	-	-	-	3	3
CO6	2	3	3	3	3	-	-	2	-	-	-	3	3

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PROFESSIONAL ELECTIVES - II

COURSE CODE: 24ITEL516	LEARNING ANALYTICS TOOLS	L	T	P	CP	C
		3	0	0	4	3
NPTEL CODE: 106101224	SYLLABUS VERSION 1.0	SDG NO. 4, 9, 16				
PRE-REQUISITE COURSES	24ESCS101, 24BSMA301, 24BSMA402					

OBJECTIVES:

- Understand the fundamentals, significance, and key terminologies of learning analytics in educational environments.
- Learn methods of educational data collection, preprocessing, summarization, and pattern identification techniques.
- Apply statistical and predictive modeling techniques to analyze educational data and support decision-making.
- Explore text analysis and advanced analytics techniques for extracting meaningful insights from educational data.

MODULE - I INTRODUCTION TO LEARNING ANALYTICS 7

Role of Data Analytics in Education - Learning Analytics: Definition, Scope & Importance - Educational Data Mining (EDM) & Applications - Academic vs. Learning Analytics - Data, Information & Knowledge in Education - Four Levels of Analytics: Descriptive, Diagnostic, Predictive, Prescriptive - Ethical Issues: Data Privacy & Security - Learning Analytics Tools & Platforms

MODULE - II DATA COLLECTION AND PREPROCESSING 7

Types of Educational Data (Behavior, Performance, Interaction) - Data Collection Methods: Surveys, LMS, MOOCs, OER - Data Cleaning: Handling Missing Values & Outliers - Data Transformation: Normalization, Aggregation, Standardization - Data Integration & Handling Multiple Formats - Feature Engineering for Learning Analytics - Tools: Weka, R, Python

MODULE - III DESCRIPTIVE AND DIAGNOSTIC ANALYTICS 7

Overview of Descriptive Analytics - Key Statistics: Mean, Median, Mode, Standard Deviation - Data Visualization: Histograms, Bar Charts, Box Plots - Diagnostic Analytics & Pattern Recognition - Correlation Analysis & Causal Relationships - Visualization: Scatter Plots, Heatmaps, Correlation Matrices - Advanced Analytics: Principal Component Analysis (PCA) - Case Studies

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MODULE - IV PREDICTIVE ANALYTICS **8**

Introduction to Predictive Analytics - Supervised vs. Unsupervised Learning - Key ML Models: Linear & Logistic Regression, Decision Trees - Naïve Bayes for Classification - Model Evaluation: Accuracy, Precision, Recall, F1-Score - Tools: Weka, Orange, Scikit-learn

MODULE - V TEXT ANALYTICS AND ADVANCED TECHNIQUES **8**

Introduction to Text Analytics - Text Mining: Tokenization, Lemmatization, Stopword Removal -Sentiment Analysis & Topic Modeling (LDA) - NLP for Educational Data - Process & Sequence Mining in Learning Paths - Advanced Models: Random Forest, SVM

MODULE - VI APPLICATIONS AND ETHICS **8**

Real-World Learning Analytics Applications - Designing Data-Driven Interventions - Ethics & Legal Considerations in Education Data - Communicating & Visualizing Analytics Results - Case Studies on Effective Implementation

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Siemens, G., & Gasevic, D. (Eds.). (2017). Handbook of Learning Analytics (1st ed.). Society for Learning Analytics Research (SoLAR). ISBN: 978-0-9952408-0-3.
2. Romero, C., Ventura, S., Pechenizkiy, M., & Baker, R. S. J. (Eds.). (2010). Handbook of Educational Data Mining. CRC Press / Taylor & Francis Group. ISBN: 978-1-4398-0457-5.

REFERENCES:

1. Witten, I. H., Frank, E., Hall, M. A., & Pal, C. J. (2016). Data Mining: Practical Machine Learning Tools and Techniques (4th ed.). Morgan Kaufmann / Elsevier. ISBN: 978-0-12-804291-5.
2. Manning, C. D., Raghavan, P., & Schütze, H. (2008). Introduction to Information Retrieval. Cambridge University Press. ISBN: 978-0-521-86571-5.

WEB RESOURCES :

1. NPTEL Course Page – Learning Analytics Tools (106101224), IIT Bombay, Prof. Ramkumar Rajendran. https://nptel.ac.in/courses/106101224
2. Handbook of Learning Analytics (Free PDF) – SoLAR Community (2017). https://solaresearch.org/hla-17/
3. Weka Machine Learning Workbench – University of Waikato. https://www.cs.waikato.ac.nz/ml/weka/

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4. Orange Data Mining Tool – University of Ljubljana. https://orange datamining.com/
5. ProM Process Mining Tool – Eindhoven University of Technology. https://promtools.org/
6. Open University Learning Analytics Dataset (OULAD) – anonymized student data for EDM practice. https://analyse.kmi.open.ac.uk/open_dataset
7. LAK Conference Proceedings Archive – ACM Digital Library. https://dl.acm.org/conference/lak
8. EDM Conference Proceedings Archive – Educational Data Mining Society. https://educationaldatamining.org/EDM2024/proceedings/
9. Moodle Learning Analytics Documentation (data collection, dashboards). https://docs.moodle.org/en/Learning_analytics
10. Stanford NLP Group – Introduction to Information Retrieval. https://nlp.stanford.edu/IR-book/
11. Google Colab Tutorials for Data Analytics in Education – practical Python notebooks. https://colab.research.google.com/
12. Kaggle – Educational Data Mining & Student Performance Datasets (practice data). https://www.kaggle.com/datasets?search=student+performance

OUTCOMES:

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

1. Apply foundational concepts and techniques of learning analytics in educational contexts. (K3)
2. Use appropriate tools to collect and process educational data. (K3)
3. Execute statistical and machine learning techniques to extract insights from learning data. (K3)
4. Implement data-driven learning interventions based on analytical insights. (K3)
5. Practice ethical, privacy, and legal principles in learning analytics. (K3)
6. Illustrate learning analytics results effectively using visualizations and reports. (K3)

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CO - PO, PSO MAPPING:

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CO1	3	2	1	1	-	-	-	-	-	-	-	2	1
CO2	2	2	–	2	-	-	-	-	-	-	-	3	2
CO3	3	3	2	3	-	-	-	-	-	-	-	3	2
CO4	2	3	3	2	-	-	-	-	-	-	-	2	3
CO5	1	2	–	–	-	-	-	-	-	-	-	1	1
CO6	–	–	–	1	-	-	-	-	-	-	-	2	2

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24ITEL517	DATA SCIENCE FOR ENGINEERS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106106179	SYLLABUS VERSION 1.0	SDG NO. 4, 8, 9				
PRE-REQUISITE COURSES	24AIPT201, 24BSMA301, 24CSPC301					

OBJECTIVES:

- To understand the fundamental concepts of data science and apply mathematical foundations such as linear algebra, probability, and statistics for data analysis.
- To develop skills in data preprocessing, feature engineering, and model selection for effective data-driven problem-solving.
- To implement and evaluate supervised and unsupervised machine learning techniques for extracting insights and making predictions from data.
- To apply Python-based data science tools and libraries, including time series analysis, to solve real-world engineering problems.

MODULE - I FOUNDATIONS OF DATA SCIENCE AND PYTHON ANALYTICS 7

Data Science overview and lifecycle – Applications in Engineering – Types of data – Python for Data Science (NumPy, Pandas, Matplotlib) – Data import/export – Exploratory Data Analysis (EDA) – Data cleaning and preprocessing – Data visualization techniques.

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MODULE - II MATHEMATICAL FOUNDATIONS FOR DATA SCIENCE 7

Vectors and matrices – Matrix operations – Eigenvalues and Singular Value Decomposition (SVD) – Optimization fundamentals – Gradient and partial derivatives – Gradient Descent and variants – Convex functions – Applications in machine learning.

MODULE - III STATISTICAL METHODS AND DECISION THEORY 7

Vectors and matrices – Matrix operations – Eigenvalues and Singular Value Decomposition (SVD) – Optimization fundamentals – Gradient and partial derivatives – Gradient Descent and variants – Convex functions – Applications in machine learning.

MODULE - IV SUPERVISED MACHINE LEARNING TECHNIQUES 8

Linear and Logistic Regression – k-Nearest Neighbours (kNN) – Support Vector Machines (SVM) – Decision Trees – Model evaluation metrics – Cross-validation – Model selection and regularization techniques.

MODULE - V UNSUPERVISED LEARNING AND FEATURE ENGINEERING 8

Clustering techniques (k-Means, Hierarchical Clustering, DBSCAN) – Cluster validation – Dimensionality Reduction (PCA, LDA, t-SNE) – Feature engineering and selection – Ensemble learning methods (Random Forest, Boosting) – Bootstrapping and Cross-validation.

MODULE - VI ADVANCED ANALYTICS, DEEP LEARNING AND BIG DATA 8

Time Series Analysis and Forecasting – Artificial Neural Networks (ANN) – Convolutional and Recurrent Neural Networks (CNN, RNN) – Big Data fundamentals – Hadoop and Spark ecosystem – Data pipelines and cloud platforms – Engineering case studies.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Wes McKinney, "Python for Data Analysis", 3rd Edition, O'Reilly Media, 2022.
2. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", 3rd Edition, O'Reilly Media, 2022.
3. Joel Grus, "Data Science from Scratch", 2nd Edition, O'Reilly Media, 2019.

REFERENCES

1. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, "An Introduction to Statistical Learning with Applications in Python", Springer, 2023.

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2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016.
3. Douglas Montgomery, George Runger, "Applied Statistics and Probability for Engineers", 7th Edition, Wiley, 2018.
4. Gilbert Strang, "Introduction to Linear Algebra", 5th Edition, Wellesley-Cambridge Press, 2016.

WEB RESOURCES

1. https://nptel.ac.in/courses/106106179 – NPTEL Data Science for Engineers (IIT Madras)
2. https://scikit-learn.org/stable/user_guide.html – Scikit-Learn User Guide
3. https://pandas.pydata.org/docs/ – Pandas Documentation
4. https://www.kaggle.com/learn – Kaggle Learn (Practical Data Science)
5. https://archive.ics.uci.edu/ml/ – UCI Machine Learning Repository

OUTCOMES:

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

1. Apply Python and data science libraries for data preprocessing, analysis, and visualization. (K3)
2. Apply mathematical and optimization techniques in data science and machine learning. (K3)
3. Apply statistical methods and hypothesis testing for data-driven decision-making. (K3)
4. Analyze and evaluate supervised machine learning models using performance metrics. (K4)
5. Analyze data using clustering, dimensionality reduction, and feature engineering techniques. (K4)
6. Analyze advanced techniques such as ensemble learning, deep learning, time series analysis, and big data frameworks. (K4)

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CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	3	2
CO2	3	3	1	-	-	-	-	-	-	-	-	3	1
CO3	3	3	1	-	-	-	-	-	-	-	-	2	2
CO4	3	3	2	-	-	-	-	-	-	-	-	3	3
CO5	3	3	2	-	-	-	-	-	-	-	-	3	3
CO6	3	3	3	-	-	-	-	-	-	-	-	3	3

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24ITEL518	DATA MINING FOR DECISION MAKING	L	T	P	CP	C
		3	0	0	4	3
NPTEL CODE: 110104118	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24ESCS101, 24BSMA301, 24ITPW301, 24BSMA402					

OBJECTIVES:

- To apply data-driven approaches and decision support systems for organizational decision-making.
- To analyze datasets using exploratory and predictive analytics techniques for decision modeling.
- To utilize multi-criteria decision-making methods for evaluating and selecting alternatives.
- To evaluate decision problems using hierarchical, ranking, and outranking techniques.

MODULE - I DECISION SUPPORT SYSTEMS AND DATA-DRIVEN DECISION MAKING **8**

Introduction to Decision Making – Types of Decisions and Decision-Making Process – Business Intelligence and Decision Support Systems – Role of Data Mining in Decision Making – Knowledge Discovery in Databases (KDD) Process – Data Mining Methodology for Decision Support – Data Warehousing

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Concepts for Analytical Decision Making – Exploratory Data Analysis (EDA) for Decision Support – Statistical Description of Data – Data Visualization Techniques for Decision Making – Correlation and Covariance Analysis – Ethical Issues and Challenges in Data-Driven Decision Making.

MODULE - II PREDICTIVE ANALYTICS AND DECISION MODELLING 8

Classification and Prediction for Decision Making—Decision Tree Induction—Bayesian Classification—Regression Analysis—Model Evaluation Techniques: Accuracy, Precision, Recall, F-Measure, and ROC Curve—Predictive Analytics and Decision Modelling—Principal Component Analysis (PCA) and Factor Analysis for Decision Support—Recommendation Systems—Business and Marketing Analytics—Time Series Forecasting for Strategic Decisions—Case Studies in Business Decision Making—Ethical and Privacy Issues in Predictive Modelling.

MODULE - III FOUNDATIONS OF DECISION MAKING AND DECISION ANALYSIS 8

Multi-Criteria Decision Making (MCDM): Concepts, Characteristics, and Applications – Multi-Attribute Utility Theory (MAUT) – Utility Functions and Preference Structures – Utility Theory and Risk Analysis – Pareto Optimality and Pareto Efficiency – Dominance Relationships – Decision Trees: Structure, Construction, Evaluation, and Applications in Decision Analysis.

MODULE - IV PERFORMANCE EVALUATION AND HIERARCHICAL DECISION MODELS 8

Data Envelopment Analysis (DEA): Concepts, Efficiency Measurement, CCR and BCC Models, Applications of DEA—Analytical Hierarchy Process (AHP): Pairwise Comparisons, Consistency Analysis, Priority Vector Estimation, Applications—Analytical Network Process (ANP): Network Structures, Dependency and Feedback Relationships, Supermatrix Concept—Comparative Analysis of AHP and ANP—Case Studies on Resource Allocation and Decision Prioritization.

MODULE - V RANKING AND OUTRANKING METHODS IN MCDM 8

Technique for Order Preference by Similarity to Ideal Solution (TOPSIS): Concepts, Computational Procedure, Applications—ELECTRE Family of Methods: Concordance and Discordance Analysis, Outranking Relations—PROMETHEE Methods: Preference Functions, Positive and Negative Flows, Ranking Alternatives—MACBETH: Measuring Attractiveness by a Categorical-Based Evaluation Technique—Comparative Study of Ranking and Outranking Approaches—Decision Support Applications.

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MODULE - VI ADVANCED DECISION SUPPORT TECHNIQUES **8**

SWOT Analysis: Internal and External Environmental Assessment—System Analysis and Systems Thinking in Decision Making—Other Decision-Making Tools: Weighted Scoring Models, Goal Programming, Decision Support Systems—Fundamentals of Fuzzy Sets and Fuzzy Logic—Fuzzy Membership Functions—Fuzzy MCDM Approaches—Applications of Fuzzy Logic in Engineering, Business, and Management Decisions—Integrated Decision-Making Frameworks and Case Studies.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Jiawei Han, Jian Pei, and Hanghang Tong, "Data Mining: Concepts and Techniques," Fourth Edition, Elsevier, 2022.
2. Belton, V. and Stewart, T.J., "Multiple Criteria Decision Analysis: An Integrated Approach", Springer Science & Business Media, 2017.
3. Tzeng, G.H. and Huang, J.J., "Multiple Attribute Decision Making: Methods and Applications", CRC Press, 2011.
4. Figueira, J., Greco, S., and Ehrgott, M., "Multiple Criteria Decision Analysis: State of the Art Surveys", Springer, Second Edition, 2016.

REFERENCES

1. Saaty, T.L., "Decision Making with the Analytic Hierarchy Process", RWS Publications, 2008.
2. Saaty, T.L., "Theory and Applications of the Analytic Network Process", RWS Publications, 2013.
3. Zimmermann, H.J., "Fuzzy Set Theory and Its Applications", Fourth Edition, Springer, 2011.
4. Cooper, W.W., Seiford, L.M., and Tone, K., "Data Envelopment Analysis: A Comprehensive Text with Models, Applications, References, and DEA-Solver Software", Second Edition, Springer, 2007.
5. Goodwin, P. and Wright, G., "Decision Analysis for Management Judgment", Sixth Edition, Wiley, 2020.

WEB REFERENCES:

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_mg121
2. Scikit-Learn Documentation
3. WEKA Data Mining Software
4. IBM Decision Support Systems Resources
5. Oracle Business Intelligence Resources
6. INFORMS Decision Analysis Society
7. International Society on Multiple Criteria Decision Making

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OUTCOMES:

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

1. Apply business intelligence, decision support systems, and data mining methodologies to solve decision-making problems. (K3)
2. Analyze datasets using exploratory data analysis and predictive analytics techniques for informed decision-making. (K4)
3. Utilize MCDM methodologies, including MAUT, utility theory, and decision trees for evaluating alternatives. (K3)
4. Analyze complex decision problems using DEA, AHP, and ANP models. (K4)
5. Apply ranking and outranking techniques such as TOPSIS, ELECTRE, PROMETHEE, and MACBETH for decision support. (K3)
6. Develop decision support solutions using fuzzy logic and advanced decision-making frameworks. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3
CO2	3	3	-	2	-	-	-	-	-	-	-	-	2
CO3	3	3	2	-	-	-	-	-	-	-	-	-	2
CO4	2	3	2	-	-	-	-	-	-	-	-	-	2
CO5	3	2	-	3	-	-	-	-	-	-	-	2	3
CO6	2	-	3	2	3	-	-	-	-	-	-	3	3

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PROFESSIONAL ELECTIVES - II

COURSE CODE: 24CSEL508	MACHINE LEARNING FOR INTRUSION DETECTION	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106105152	SYLLABUS VERSION 1.0	SDG NO. 9, 11				
PRE-REQUISITE COURSES	24AIPT201, 24BSMA301, 24BSMA402					

OBJECTIVES:

- To understand the role of machine learning in enhancing intrusion detection systems.
- To learn data preprocessing and feature engineering techniques specific to security datasets.
- To explore supervised and unsupervised learning algorithms for intrusion detection.
- To analyse IDS/IPS architectures integrated with ML approaches.
- To evaluate model performance using security-specific metrics and alert correlation techniques.
- To apply ML tools and libraries for building practical intrusion detection solutions.

MODULE - I INTRODUCTION TO MACHINE LEARNING IN SECURITY 8

Basics of Security and Intrusions – Need for Intrusion Detection Systems (IDS) – Role of Machine Learning in Security – Classification of IDS: Host-based, Network-based – Sources of Vulnerabilities and Attacks against Security Objectives – Countermeasures and ML-driven defense strategies.

MODULE - II DATA PREPROCESSING FOR INTRUSION DETECTION 8

Security Data Collection (logs, traffic, alerts) – Data Cleaning and Handling Missing Values – Feature Engineering for IDS datasets – Feature Scaling and Encoding Categorical Data – Train-test split, Normalization, and Standardization – Case study: Preprocessing KDD Cup / NSL-KDD dataset.

MODULE - III SUPERVISED LEARNING FOR IDS 8

Regression models for anomaly scoring – Classification models: Logistic Regression, Decision Trees, Random Forests – K-Nearest Neighbors (KNN) for intrusion detection – Evaluation metrics: Accuracy, Precision, Recall, F1 Score, ROC-AUC – Applications of supervised ML in detecting known attacks.

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MODULE - IV UNSUPERVISED AND DEEP LEARNING APPROACHES 8

Clustering: K-Means, Hierarchical Clustering for anomaly detection – Dimensionality Reduction: PCA, Autoencoders – Anomaly Detection using statistical and ML-based methods – Introduction to Deep Learning for IDS: CNNs, RNNs, LSTMs – Applications in detecting zero-day and unknown attacks.

MODULE - V IDS/IPS ARCHITECTURE AND ALERT MANAGEMENT 7

IDS/IPS Architectures: Single-tiered, Multi-tiered, Peer-to-Peer – Sensor, Agent, and Manager components with ML integration – Information flow in IDS/IPS with ML models – Alert Management and Correlation: preprocessing, correlation techniques, post-processing – Cooperative Intrusion Detection and ML-based fusion techniques.

MODULE - VI TOOLS, IMPLEMENTATION & CASE STUDIES 6

Python for Security-focused ML – Libraries: NumPy, Pandas, Scikit-learn, TensorFlow, PyTorch – Implementation workflow for IDS using ML – Case studies: ML-based IDS (Snort + ML, Suricata + ML) – Emerging trends: Hybrid IDS, Federated Learning for IDS.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. C. Endorf, E. Schultz and J. Mellander, "Intrusion Detection & Prevention", McGraw-Hill/Osborne, 2004.
2. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow", O'Reilly, 2019.
3. Ali A. Ghorbani, "Network Intrusion Detection and Prevention: Concepts and Techniques", Springer, 2010.

REFERENCES:

1. J. M. Kizza, "Computer Network Security", Springer, 2005.
2. Chris Sanders and Jason Smith, "Applied Network Security Monitoring: Collection, Detection, and Analysis", Syngress, 2013.
3. Bishop C.M., "Pattern Recognition and Machine Learning", Springer, 2006.
4. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.

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WEB REFERENCES:

1. https://scikit-learn.org
2. https://www.kaggle.com
3. https://machinelearningmastery.com
4. https://www.tensorflow.org
5. https://pytorch.org
6. https://www.sans.org/white-papers/intrusion-detection (sans.org in Bing)
7. https://www.cisecurity.org

OUTCOMES:

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

1. Explain the integration of machine learning concepts into intrusion detection systems. (K2)
2. Apply preprocessing and feature engineering techniques to security datasets. (K2)
3. Implement supervised and unsupervised ML algorithms for intrusion detection. (K3)
4. Analyse IDS/IPS architectures enhanced with ML components. (K3)
5. Evaluate IDS performance using security-specific metrics and alert correlation. (K3)
6. Use ML tools and libraries to build and test intrusion detection models. (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	1	-	-	-	-	-	-	-	2	2
CO2	3	3	2	2	-	-	-	-	-	-	-	2	2
CO3	3	3	3	2	2	-	-	-	-	-	-	3	2
CO4	3	3	3	2	2	-	-	-	-	-	-	3	2
CO5	3	3	2	2	2	-	-	-	-	-	-	2	3
CO6	3	3	3	2	3	-	-	-	-	-	-	-	3

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PROFESSIONAL ELECTIVES - II

COURSE CODE: 24CSEL509	DEEP LEARNING ARCHITECTURES AND APPLICATIONS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106106184	SYLLABUS VERSION 1.0	SDG NO. 9, 11				
PRE-REQUISITE COURSES	24AIPT201, 24BSMA301, 24BSMA402, 24CSPC302, 24CSPC402					

OBJECTIVES:

- Understand the fundamental techniques and principles of Neural Networks.
- Identify and apply appropriate Deep Learning architectures for analyzing data across various problem domains.
- Analyze Deep Learning concepts through Convolutional Neural Network case studies.
- Implement different Deep Learning algorithms for real-world problems.
- Study advanced Deep Learning techniques and emerging applications.

MODULE - I FOUNDATIONS OF DEEP LEARNING & NEURAL NETWORKS 7

Historical context and motivation for Deep Learning-Machine Learning vs Deep Learning.-Fundamentals of Neural Networks. Comparison of Biological and Artificial Neurons-Perception model and its limitations-Model of Artificial Neuron-Feed forward Neural Networks. Shallow vs Deep Networks. Vanishing and exploding gradient problem Role of data, computation, and algorithms in the success of Deep Learning.

MODULE - II DEEP NEURAL NETWORK TRAINING & OPTIMIZATION APPLICATION 8

Deep Network architectures-Loss functions and optimization overview. Backpropagation algorithm (intuition and workflow)-Regularization techniques: L1, L2, Dropout, Early stopping-Model exploration and hyperparameter tuning-Bias–Variance tradeoff. Batch Normalization.

Weight initialization techniques (Xavier, He initialization)-Learning rate scheduling and optimization strategies.

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MODULE - III REPRESENTATION LEARNING & UNSUPERVISED DEEP LEARNING **7**

Representation Learning-Width and Depth of Neural Networks. Activation Functions: ReLU, Leaky ReLU, ELU / EReLU-Unsupervised training of Neural Networks-Autoencoders: basic, sparse, and denoising autoencoders-Restricted Boltzmann Machines (RBMs). Variational Autoencoders (conceptual)-Dimensionality reduction using deep models.

MODULE - IV CONVOLUTIONAL NEURAL NETWORKS (CNNS) **8**

Introduction to Convolutional Neural Networks-Convolution operation, filters, feature maps-Stride, padding, pooling techniques-Parameter sharing and regularization in CNNs-Architectural overview of CNNs. Popular CNN architectures: AlexNet, ResNet-Applications in image and text classification. Transfer Learning-Fine-tuning pre-trained CNN models

MODULE - V SEQUENCE MODELING & RECURRENT NEURAL NETWORKS **7**

Sequential data modeling concepts-Unfolding computational graphs. Recurrent Neural Networks (RNNs)-Deep RNNs-Bidirectional RNNs. Encoder–Decoder architecture-Sequence-to-sequence learning models-Long Short-Term Memory (LSTM) and Gated Recurrent Units (GRU).Introduction to Attention mechanisms-Applications in speech, text, and time-series analysis.

MODULE - VI ADVANCED DEEP LEARNING TECHNIQUES **8**

Deep Belief Networks (DBN)-Deep Boltzmann Machines (DBM)-Deep Associative Memory Networks-Generative Adversarial Networks (GANs). Deepfake Technology – concepts and challenges-Ethical issues and societal impact of Deep Learning-Introduction to Explainable AI (XAI)-Generative Neural Networks. Case Studies: Designing Deep Learning solutions for identifying fake fingerprints. Detection of fake images and deepfake videos.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Simon Haykin, "Neural Networks, A Comprehensive Foundation", 2nd Edition, Addison Wesley Longman, 2001.
2. Ian Good fellow, Yoshua Bengio, Aaron Courville, "Deep Learning",MIT Press,2016.

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3. Jeff Heaton, Deep Learning and Neural Networks, Heaton Research Inc, 2015.
4. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017
5. David – Foster "Generative Deep Learning"- O'Reilly Media, Inc- 2nd Edition (latest): Published April 2023

REFERENCES:

1. Cosma Rohilla Shalizi," Advanced Data Analysis from anElementary Point of View", 2015.
2. Deng &Yu, "Deep Learning: Methods and Applications", Now Publishers, 2013.
3. Michael Nielsen," Neural Networks and Deep Learning", Determination Press, 2015.

WEB REFERENCES:

1. www.nptel.ac.in/courses/106/106/106106184/
2. www.nptel.ac.in/courses/106/106/106106201/
3. www.nptel.ac.in/courses/106/105/106105215/
4. www.ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-s191-introductionto-deep-learning-january-iap-2020/5.
5. www.kaggle.com/learn/intro-to-deep-learning

OUTCOMES:

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

1. Analyze the fundamental concepts, learning paradigms, and architectures of Neural Networks and Deep Learning models.(K3)
2. Analyze Deep Learning training, optimization, and regularization techniques to improve model performance and generalization.(K3)
3. Design and implement Convolutional Neural Networks for image-based applications such as handwriting and object recognition.(K4)
4. Design and implement Recurrent Neural Network–based models for sequential and time-series data analysis.(K4)
5. Evaluate and compare Deep Learning architectures and generative models for real-world datasets with respect to accuracy, efficiency, robustness, and ethical implications.(K5)
6. Critically assess advanced Deep Learning techniques including GANs, deep fake technologies, and Explainable AI methods to ensure responsible and interpretable AI solutions.(K5)

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CO - PO, PSO MAPPING:

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CO1	3	3	1	2	-	-	-	-	-	-	3	1	2
CO2	3	3	2	2	-	-	-	-	-	-	3	2	2
CO3	3	3	3	3	-	-	-	-	-	-	3	3	3
CO4	3	3	2	3	-	-	-	-	-	-	3	2	3
CO5	3	3	2	3	-	-	-	-	-	-	3	2	3
CO6	3	3	2	3	-	-	-	-	-	-	3	2	3

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24CSEL510	INTELLIGENT DECISION SYSTEMS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106105221	SYLLABUS VERSION 1.0	SDG NO. 9, 11				
PRE-REQUISITE COURSES	24AIPT201, 24BSMA301, 24BSMA402, 24CSPC302, 24CSPC402					

OBJECTIVES:

- To understand the fundamentals of Reinforcement Learning (RL)
- To learn Markov Decision Processes (MDP) and Bellman equations
- To apply value-based and policy-based learning techniques
- To explore model-free and model-based RL algorithms
- To implement RL in real-world applications
- To evaluate performance of RL models

MODULE - I INTRODUCTION TO REINFORCEMENT LEARNING 8

Introduction to Reinforcement Learning – Agent and Environment – Reward Signal – Policy – Value Function – Exploration vs Exploitation – Multi-armed Bandit Problem – Action-value methods – ε-greedy method – Upper Confidence Bound (UCB).

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MODULE - II MARKOV DECISION PROCESSES (MDP) **8**

Markov Property – MDP Framework – State, Action, Reward – Transition Probabilities – Return – Discount Factor – Value Functions – Bellman Equations – Optimal Value Function – Policy Evaluation and Policy Improvement.

MODULE - III DYNAMIC PROGRAMMING METHODS **7**

Policy Iteration – Value Iteration – Generalized Policy Iteration (GPI) – Convergence of DP algorithms – Applications and limitations of Dynamic Programming.

MODULE - IV MONTE CARLO METHODS **7**

Monte Carlo Prediction – Monte Carlo Control – Exploring Starts – On-policy and Off-policy Learning – Importance Sampling – Incremental Implementation – Applications.

MODULE - V TEMPORAL DIFFERENCE LEARNING **8**

TD Learning – TD(0) Prediction – SARSA – Q-Learning – Expected SARSA – Comparison between MC and TD methods – Bias and Variance tradeoff.

MODULE - VI ADVANCED TOPICS IN RL **7**

Function Approximation – Deep Reinforcement Learning (Introduction) – Policy Gradient Methods – Actor-Critic Methods – Applications of RL (Gaming, Robotics, Recommendation Systems).

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction", 2nd Edition, MIT Press, 2018.
2. Csaba Szepesvári, "Algorithms for Reinforcement Learning", Morgan & Claypool, 2010.

REFERENCES:

1. David Silver,"Reinforcement Learning Course Notes", University College London.
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016
3. Marco Wiering, Martijn van Otterlo, "Reinforcement Learning: State-of-the-Art", Springer.

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WEB REFERENCES:

1. https://www.geeksforgeeks.org/machine-learning/reinforcement-learning/
2. https://spinningup.openai.com
3. https://www.coursera.org/learn/reinforcement-learning

OUTCOMES:

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

1. Explain the fundamentals of reinforcement learning and decision-making models (K2)
2. Apply MDP and Bellman equations to solve sequential decision problems (K3)
3. Implement Dynamic Programming methods for optimal policy finding (K3)
4. Apply Monte Carlo methods for prediction and control (K3)
5. Develop Temporal Difference learning algorithms such as Q-learning and SARSA (K3)
6. Analyze advanced RL methods including deep RL and policy gradients (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	1	-	-	-	-	-	-	-	2	2
CO2	3	3	2	2	-	-	-	-	-	-	-	2	2
CO3	3	3	3	2	-	-	-	-	-	-	1	2	2
CO4	2	3	3	2	-	-	-	-	-	-	1	2	2
CO5	3	3	3	3	-	-	-	-	-	-	1	2	2
CO6	3	3	3	3	-	-	-	-	-	-	1	2	2

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PROFESSIONAL ELECTIVE - II

COURSE CODE: 24CIEL504	WEB OF THINGS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 117103488	SYLLABUS VERSION 1.0	SDG NO. 7, 9, 11				
PRE-REQUISITE COURSES	24ESCS101, 24AIPT201, 24CIPT401					

OBJECTIVES:

- To understand the fundamentals and architecture of the Web of Things (WoT).
- To learn the reference models, design principles, and architectures of the Web of Things.
- To develop knowledge of programming frameworks, protocols, and technologies for implementing Web of Things applications.
- To acquire an understanding of Web of Things applications and their role in developing interoperable smart systems.

MODULE - I INTRODUCTION TO WoT AND TOOLS 7

Fundamentals of Internet of Things(IoT) and Web of Things (WoT) - Connected objects - Ontology of WoT - Context Modelling - Embedded devices - Introduction to Raspberry Pi - Node.js on RaspberryPi - Connecting sensors and actuators on Pi - Modeling REST full services

MODULE - II MASHUP TOOLS AND MODEL DRIVEN ENGINEERING 8

Mashup tools - Model driven engineering for WoT - Comparing mashup and Model driven tools - Modeling of RESTful services - Modeling WoT system with generic RESTful operations - Building network of things: Topologies - Classification models - Network protocols for things: spatial considerations, Internet protocols and IoT - IoT Personal Area Networks, IoT Wide Area Networks.

MODULE - III NETWORKING IN IOT 8

Application protocols: Zigbee, Bluetooth application stack - Application protocol for things: Apple home kit, Google weave - Message Queuing Telemetry Transport (MQTT) - Constraint application protocol - WoT architecture - Compose-Building IoT with Avatars: Avatar based IoT platform - Disruption tolerant communication-Context modeling and management -

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Social vision of WoT - Challenges of WoT - Testbed of WoT and IoT - Hardware of a WoT testbed - Software of WoT testbed.

MODULE - IV INTEGRATION IN WOT **7**

Web API's for things: Devices & resources – Principles for web API's - Publish subscribe model – Web hooks, Comes and web sockets – Implementing web things - Connecting devices to the web - Direct integration pattern - REST on devices - Gateway integration pattern - CoAP - Cloud integration pattern - MQTT communication- - Discovering things - Describing web things - Implementing web thing model on Pi-Semantic WoT - Schema and JSON-LD.

MODULE - V REPRESENTATION AND STORAGE **8**

Automatic integration and querying of semantic rich heterogeneous data: introduction - Semantic WoT(SWoT) - Semantic web assembler of SWoT-Case study: smart application-Building entity graphs for WoT - Background and methodology - Interoperability and cross domain applications – Trends and evolution - Challenges in interoperability - Contributions- M3 framework - Datastorage in WoT framework - Methods and challenges - Data storage in cloud platform - Tendency for data storage technology-Future directions.

MODULE - VI SECURITY IN WOT **7**

Securing things – Open issues and challenges – Web of Topics (WoX) model–Design and implementation – Security from IoT to WoT – Existing models – Security in WoT: Encryption 101, TLS - Enabling HTTPS and WSS with TLS on Pi - Authentication and access control with REST and API tokens – Open Authorization – Social WoT authentication proxy – Implementing a social WoT authentication proxy - Social impact and vulnerable populations - WoT and health - Potential positive implications for health - Challenges from health perspective - Unintended consequences for social health - Implications.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Dominique Guinard & Vlad Trifa, "Building the Web of Things", MIT Press, 2016.
2. Arshdeep Bahga & Vijay Madisetti, "Internet of Things: A Hands-on Approach", Universities Press, 2015.
3. Adrian McEwen & Hakim Cassimally, "Designing the Internet of Things", Wiley, 2013.
4. Maneesh Rao, "Internet of Things with Raspberry Pi 3", Packt Publishing, 2018.

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REFERENCES:

1. Andy King, "Programming the Internet of Things", O'Reilly Media, 2021.
2. Dean Allemang & James Hendler, "Semantic Web for the Working Ontologist", 2nd Edition, Morgan Kaufmann, 2011.
3. David Hanes, Gonzalo Salgueiro, Patrick Grossetete et al., "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases", Cisco Press, 2017.
4. Mario Casciaro & Luciano Mammino, "Node.js Design Patterns", 3rd Edition, Packt Publishing, 2020.
5. Leonard Richardson, Mike Amundsen & Sam Ruby, "RESTful Web APIs", O'Reilly Media, 2013.
6. Ali Ismail Awad & Jemal Abawajy (Eds.), "Security and Privacy in the Internet of Things", CRC Press, 2021.
7. Brian Russell & Drew Van Duren, "IoT Security: Fundamentals", Wiley, 2018.
8. Tom Heath & Christian Bizer, "Linked Data: Evolving the Web into a Global Data Space", Morgan & Claypool, 2011.

WEBREFERENCES:

1. http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html
2. https://nptel.ac.in/courses/108102045
3. https://archive.nptel.ac.in/courses/106/105/106105193/
4. https://onlinecourses.nptel.ac.in/noc22_cs53/preview

OUTCOMES:

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

1. Apply the principles of the Web of Things (WoT), context modelling, embedded platforms, and RESTful services to design and implement connected IoT applications using Raspberry Pi. (K3).
2. Analyze mashup tools, model-driven engineering techniques, network topologies, and IoT communication protocols to design scalable Web of Things systems.(K4)
3. Examine application-layer protocols, Web of Things (WoT) architectures, context management techniques, and avatar-based IoT platforms to determine suitable networking solutions for Web of Things applications. (K4)
4. Identify appropriate Web APIs, REST, CoAP, MQTT, semantic web technologies, and integration patterns to build interoperable Web of Things (WoT) solutions.(K3).

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5. Implement semantic data representation, interoperability frameworks, and cloud-based storage techniques to support heterogeneous Web of Things (WoT) data management. (K3)
6. Assess security mechanisms, authentication methods, encryption techniques, TLS, and access control models to ensure secure Web of Things (WoT) applications and evaluate their social and healthcare implications. (K4).

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	-	-	-	1	-	-	-	2	2
CO2	3	2	-	-	-	-	-	1	-	-	-	2	2
CO3	3	2	-	-	-	-	-	1	1	-	-	2	2
CO4	3	-	-	-	-	-	-	1	1	-	-	2	2
CO5	3	-	-	-	-	-	-	1	-	-	-	2	2
CO6	3	1	-	-	-	-	-	1	-	-	-	2	2

PROFESSIONAL ELECTIVE - II

COURSE CODE: 24CIEL505	WIRELESS TECHNOLOGIES IN INTERNET OF THINGS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106105160	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24CIPC301,24CIPT401					

OBJECTIVES:

- To understand the fundamentals of wireless communication, IoT architecture, standards, and communication requirements for IoT systems.
- To study short-range, long-range, and cellular wireless technologies, protocols, and networking mechanisms used in IoT applications.
- To analyze mobility management, Quality of Service (QoS), advanced wireless communication techniques, and performance optimization in IoT networks.

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- To examine security, energy-efficient communication strategies, deployment aspects, and emerging wireless technologies for real-world IoT applications.

MODULE - I INTRODUCTION TO WIRELESS IoT COMMUNICATIONS 8

Introduction to Internet of Things (IoT) – IoT Architecture and Communication Models – Wireless Communication Fundamentals – IoT Network Requirements – Wireless Spectrum and Frequency Bands – Evolution of Wireless Technologies: WiFi, Bluetooth, ZigBee, Cellular IoT, 5G – Wireless Standards and Design Challenges for IoT Applications.

MODULE - II SHORT RANGE AND LONG RANGE WIRELESS TECHNOLOGIES 8

Short-Range Wireless Technologies: Bluetooth/BLE, ZigBee, IEEE 802.15.4, RFID, NFC, Wi-Fi and Wi-Fi HaLow – Wireless Personal Area Networks (WPAN) – Long-Range Wireless Technologies: LPWAN, LoRa, LoRaWAN, Sigfox – Cellular IoT Technologies: LTE-M, NB-IoT, 4G/5G IoT Communication – Comparative Analysis of Wireless Technologies for IoT.

MODULE - III WIRELESS CHANNELS, NETWORKING AND PROTOCOLS 7

Wireless Channel Characteristics – Propagation Models – Small Scale and Multipath Fading – IoT Communication Protocols: MQTT, CoAP, AMQP, DDS – IPv6 and 6LoWPAN for IoT – Routing Protocols for Wireless Sensor Networks – Adaptive Link and Network Layer Protocols – Edge, Fog and Cloud Connectivity in IoT.

MODULE - IV MOBILITY MANAGEMENT AND QUALITY OF SERVICE IN IOT NETWORKS 7

Mobility in Wireless IoT Networks – Cellular and Heterogeneous Network Architectures – Handoff Management – Roaming and Connectivity Management – Mobility Prediction in Smart Networks – QoS Challenges in IoT Systems – QoS Architecture, QoS Attributes and End-to-End QoS Management – Resource Allocation and Traffic Management in LTE/5G IoT Networks.

MODULE - V ADVANCED WIRELESS TECHNOLOGIES FOR IoT 7

MIMO Communication Systems – Diversity Techniques – Beamforming and Spatial Multiplexing – Massive MIMO for 5G IoT – Multi-User Communication Systems – Adaptive Wireless Communication Techniques – Channel Capacity

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and Performance Enhancement – Application of Optimization Techniques in Wireless Network Design.

MODULE - VI SECURITY, DEPLOYMENT AND IoT APPLICATIONS 8

Security Challenges in Wireless IoT Networks – Authentication, Access Control and Encryption Techniques – Secure Wireless Communication Protocols – Energy Efficient Wireless Communication and Power Management – IoT Device Deployment and Network Monitoring – Case Studies: Smart Homes, Smart Healthcare, Smart Agriculture, Smart Cities and Industrial

TOTAL : 45 PERIODS

TEXT BOOKS:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things, Cisco Press, 2017.
2. Vijay Madisetti and Arshdeep Bahga, Internet of Things – A Hands-On Approach, Universities Press, 2015.
3. Andreas F. Molisch, Wireless Communications: From Fundamentals to Beyond 5G", Wiley-IEEE Press., John Wiley & Sons, 3rd Edition (2022).
4. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos and David Boyle, From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, Academic Press, 2014.

REFERENCES:

1. Olivier Hersent, David Boswarthick and Omar Elloumi, The Internet of Things: Key Applications and Protocols, Wiley, 2nd Edition, 2012.
2. Behrouz A. Forouzan, Wireless Communication and Networking, McGraw-Hill Education, 1st Edition (2015).
3. Raj Kamal, Internet of Things: Architecture and Design Principles, McGraw-Hill Education, 5th Edition, 2024.
4. Adrian McEwen and Hakim Cassimally, Designing the Internet of Things, Wiley, 1st Edition (2014)
5. Aldo Morabito, The Internet of Things: Architectures, Protocols and Standards, Springer, 2018.

WEB REFERENCES:

1. https://onlinelibrary.wiley.com/doi/10.1155/2016/8206548
2. https://arxiv.org/abs/1611.00861

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3. https://www.sciencedirect.com/topics/engineering/wireless-technologies

OUTCOMES:

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

1. Apply IoT architectures, wireless communication principles, standards, and design requirements for IoT systems. (K3)
2. Utilize suitable short-range, long-range, and cellular wireless technologies for different IoT application scenarios. (K3)
3. Identify the wireless channels, communication protocols, networking approaches, and mobility management techniques in IoT environments. (K3)
4. Examine QoS requirements, advanced wireless communication methods, and optimization techniques for improving IoT network performance. (K4)
5. Analyze the security mechanisms, energy-efficient communication strategies, and deployment considerations in wireless IoT systems. (K4)
6. Dissect the wireless IoT solutions for real-world applications using appropriate technologies, protocols, and emerging communication paradigms. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	2	2	-	1	1
CO2	2	-	-	-	-	-	-	-	1	1	-	1	1
CO3	2	-	-	-	-	-	-	-	1	1	-	1	2
CO4	2	2	-	-	2	-	-	2	2	2	-	1	1
CO5	2	2	-	-	1	-	-	-	1	1	-	2	2
CO6	3	3	-	-	-	-	-	-	1	1	-	1	2

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PROFESSIONAL ELECTIVE - II

COURSE CODE: 24CIEL506	DESCRIPTIVE ANALYTICS FOR IOT	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 117103488	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24ITPW302, 24CIPC301					

OBJECTIVES:

- To learn the basics of Data analytics
- To learn about big data analytics platforms.
- To understand about handling the data with machine learning.
- To acquire knowledge about MongoDB.

MODULE - I INTRODUCTION DATA ANALYTICS FOR IOT **8**

Data Analytics - Structured data - Semi structured data - Unstructured data - Data in Motion vs Data at rest - Characteristics of Data - Evolution of Big data - Why Big Data - Importance of Big data - Big data applications - IoT Data Analytics Overview - IoT Data Analytics Challenges

MODULE - II BIGDATA PLATFORMS FOR IOT **8**

Massively Parallel processing databases - NoSQL - Definition - Types of NoSQL - Advantages of NoSQL - Use Of NoSQL in Industry - SQL vs NoSQL – New SQL- Comparison of NoSQL vs SQL vs New SQL - Hadoop - Features of Hadoop - Key advantages of Hadoop - Versions of Hadoop - Overview of Hadoop ecosystem - Hadoop distributions - Hadoop vs SQL - cloud based Hadoop solutions- Processing data with Hadoop-Map reduce Daemons-HDFS (Hadoop Distributed File Systems) - Hadoop to YARN-Interacting with Hadoop ecosystem-Pig-Hive-Sqoop-Hbase

MODULE - III HANDLING THE DATA WITH MACHINE LEARNING **8**

Definition of Machine Learning - NumPy - Pandas - Matplot - SciPy - Data serialization - Regression Model - Clustering - Collaborative Filtering- Association Rule Mining - Decision tree - random forest - Supervised learning- Unsupervised learning - reinforcement learning - Support vector machine - KNN algorithm

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MODULE - IV INTRODUCTION TO MONGODB 7

Definition - Need – Using JSON - Creating or generating a unique key - support for dynamic queries - Storing Binary data - Replication - Sharding -Updating information In place - Create database - Drop database - Insert method - Save() method - Update method - Remove method - Find method - Dealing with NULL values - Count, Limit, Sort and Skip-Arrays - Aggregate Function – Map Reduce Function - Java Script programming - Cursors in MongoDB - Indexes - Mongo Import - Mongo Export - Automatic generation of unique numbers for"_id field

MODULE - V BIGDATA TRENDS 7

Edge streaming analytics - Comparing Big Data and Edge Analytics - Distributed Analytics System - Network Analytics - Flexible Net Flow Architecture - FNF components

MODULE - VI CLOUD COMPUTING 7

Cloud computing - Massive Data challenges - Cloud Service Interactive Mode - Cloud Service Configuration Mode - Features, Scope, Role and modes of Industrial Cloud - Resource management in Cloud Computing - Data management in Cloud - Cloud Security - Open Source and commercial Cloud

TOTAL : 45 PERIODS

TEXT BOOKS:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry, "IoT Fundamentals Networking Technologies, Protocols and Use Cases for the Internet of Things "published by CISCO, 1st Edition (2017)
2. Kris MYLaw, Andrew WHIp,BrijBGupta, ShuangGeng,"Managing IoT and Mobile Technologies with Innovation, Trust and Sustainable Computing", CRC press, 1st Edition (2021)
3. Seema Acharya, Subashini Chellapan,"BigDataandAnalytics",2ndEdition by Wiley, 2nd Edition (2018 / 2019 Reprint).

REFERENCES:

1. Minteer ,Andrew, Analytics for the Internet of Things(IoT),Packt Publishing Ltd. July 2017, ISBN 9781787120730, 1st Edition (2017)
2. Kai Hwang, MinChen,Big-Data Analytics for Cloud, IoT and Cognitive Computing, Wiley, 1st Edition (2017)
3. Hwaiyu Geng, Internet of Things and Data Analytics Handbook, Wiley, 1st Edition (2017)

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4. Kristina Chodorow, "MongoDB: The Definitive Guide", 3rd Edition, O'Reilly Media, 3rd Edition (2020)
5. John Soldatos,Building Blocks for IoT Analytics Internet-of-Things Analytics,RivePublishers Gerardus Blokdyk, 1st Edition (2016)
6. Blokdyk, G. IoT Analytics A Complete Guide, (2021). 5StarCooks

WEBREFERENCES:

1. https://www.udemy.com/course/iot-data-analytics/?couponCode= KEEP LEARNING
2. https://onlinecourses.nptel.ac.in/noc21_cs14/preview
3. https://onlinecourses.nptel.ac.in/noc22_cs18/preview
4. https://www.udemy.com/course/iot-data-analytics/?coupon Code=KEEP LEARNING

OUTCOMES:

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

1. Identify the key concepts and techniques used in data analytics processes.(K3)
2. Make use of Hadoop and Spark tools for distributed storage and data processing.(K3)
3. Apply the process of data handling, preprocessing and preparation for machine learning models.(K3)
4. Utilize the fundamental concepts and operations of MongoDB (CRUD, aggregation, indexing).(K3)
5. Analyze and discuss the current trends and future directions in Big Data Analytics.(K4)
6. Examine Big Data solutions using cloud computing platforms and technologies.(K4)

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CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	1	-	-	3	2
CO2	3	-	-	-	-	-	-	1	2	-	-	3	3
CO3	3	-	-	-	-	-	-	1	2	-	-	3	3
CO4	3	-	-	-	-	-	-	-	2	-	-	3	3
CO5	2	2	-	-	-	-	-	1	2	-	-	2	2
CO6	3	2	-	-	-	-	-	1	2	-	-	3	2

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by investments in **INDUSTRY, INNOVATION AND INFRASTRUCTURE** that will help us to

REDUCE INEQUALITIES by all means. We will live in **SUSTAINABLE CITIES AND COMMUNITIES.**

RESPONSIBLE CONSUMPTION AND PRODUCTION will help in healing our planet.

CLIMATE ACTION will reduce global warming and we will have abundant,

flourishing **LIFE BELOW WATER**, rich and diverse **LIFE ON LAND.**

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