Sri

SAI RAM ENGINEERING COLLEGE

An Autonomous Institution

West Tambaram, Chennai - 44

www.sairam.edu.in

Approved by AICTE, New Delhi
Affiliated to Anna University



B.E. COMPUTER SCIENCE & ENGINEERING
INTERNET OF THINGS (IoT)

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 INTERNET OF THINGS (IoT)

VISION

To develop technical professionals into entrepreneurs and IoT experts and to provide students with the skill sets and subject knowledge that they need to succeed in the Internet of Things world.

MISSION

Computer Science and Engineering (Internet of Things), Sri Sai Ram Engineering College is committed to:

M1: To provide good infrastructure and teaching learning ambience

M2: Connect geographically dispersed devices with a variety of capabilities.

M3: Utilize Computers and peripherals to build IoT hardware.

M4: Facilitate Industry Academia interface to update the recent trends in IoT.

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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	24ESGE101	Engineering Graphics	1	2	0	3	3
7	24HSTA101	Heritage of Tamils	1	0	0	1	1
		PRACTICALS					
1	24BSPL101	Physics and Chemistry 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	1	0	1	2	1
2	24ENTP101	Functional Life Skills	0	0	2	2	1
		ONLINE SUPPLEMENTARY					
		As recommended by BOS					
					Total	30	25

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	24HSNC201	NCC Course Level 1*	2	0	0	2	0
		PRACTICALS					
1	24AIPT201	Python for Data Science Laboratory with Theory	1	0	4	5	3
2	24ESGE102	Engineering Practices Laboratory	0	0	4	4	2
		VALUE ADDITIONS - II					
1	24ESID201	Idea Engineering Lab - II	0	0	2	2	1
2	24ENTP201	Digital Dynamics	0	0	2	2	1
		ONLINE SUPPLEMENTARY					
1	24ESMC201	MS Office (Mandatory - NC)	0	0	2	2	0
					Total	28	19

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Academic Council Meeting
No. 8 Dated: 3/9/24

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Date: AC-19

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S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS L	T	P	CONTACT PERIODS	CREDITS
		THEORY					
1	24BSMA301	Statistics and Linear Algebra	3	1	0	4	4
2	24ITPC301	Data Structures and Algorithms	3	0	0	4	3
3	24ESCI301	Basic Electronics and Communication Engineering	3	0	0	3	3
4	24CIPC301	Introduction to Internet of Things	3	0	0	3	3
5	24HSMC301	Universal Human Values - II Understanding Harmony	2	1	0	3	3
6	24HSNC301	NCC course Level 2*	3	0	0	3*	0
		PRACTICALS					
7	24ITPL301	Data Structures and Algorithms Laboratory	0	0	4	4	2
8	24CIPL301	IoT and Embedded Systems laboratory	0	0	4	4	2
5	24CIPT301	Digital Design and Computer Organisation System Laboratory with Theory	1	0	4	5	3
		VALUE ADDITIONS - III					
9	24CITP301	Aptitude Skills - I	0	0	2	2	1
10	24CIID301	Innovative design Lab - I	0	0	2	2	1
		ONLINE SUPPLEMENTARY					
11	24ESMC301	Joy of Computing using Python (Mandatory - NC)	0	2	0	2	0
				Total		34	25

SEMESTER IV

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS L	T	P	CONTACT PERIODS	CREDITS
		THEORY					
1	24BSMA402	Probability and Queuing Theory	3	1	0	5	4
2	24SCPT401	Operating system in kali linux lab with theory	1	0	4	5	3
3	24CSPC401	Theoretical Computer Science	3	0	0	3	3
4	24ITPW301	Database Management System with Laboratory	3	0	2	5	4
5	24XXOEXXX	Open Elective - I#	3	0	0	3	3
6	24HSNC401	NCC course Level 3*	3	0	0	3*	0
		PRACTICALS					
7	24CSPT401	Object Oriented Programming Laboratory with theory	1	0	4	5	3
8	24CIPT401	Communication and Networking Technologies laboratory with theory	1	0	4	5	3
		VALUE ADDITIONS - IV					
9	24CITP401	Aptitude Skills - II	0	0	2	2	0
10	24CIID401	Innovative Design Lab - II	0	0	2	2	1
		ONLINE SUPPLEMENTARY					
		As recommended by BoS					
				Total			24

*only for NCC cadets to be conducted beyond working hours

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SEMESTER V

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS L	T	P	CP	C	PREREQUISITE COURSES
		THEORY						
1	24CIPW501	Virtualization and Coud Computing with Laboratory	3	0	2	5	4	24CIPT401, 24ITPW401
2	24XXEL5XX	Professional Elective - I	3	0	0	3	3	-
3	24XXEL5YY	Professional Elective - II	3	0	0	3	3	-
4	24HSMG501	Principles of Engineering Management	3	0	0	3	3	-
5	24XXOEXXX	Open elective - II #	3	0	0	3	3	-
6	24MGMC501	Constitution of India	2	0	0	2	0	-
		PRACTICALS						
7	24CIPT501	Architecture and Programming in IoT Laboratory with Theory	1	0	4	5	3	24CIPC301
		VALUE ADDITIONS						
8	24CITP501	Skill Enhancement	0	0	2	2	1	-
9	24CIID501	Prototype Development Laboratory - I	0	0	2	2	1	-
		ONLINE SUPPLEMENTARY						
		As recommended by BoS						
		Total				**27**	**20**	

Cyber Security Department Specific

SEMESTER VI

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS L	T	P	CONTACT PERIODS	CREDITS
		THEORY					
1	24AMPW403	Machine learning Techniques with laboratory	3	0	2	5	4
2	24XXEL6XX	Professional Elective - III	3	0	0	3	3
3	24XXEL6YY	Professional Elective - IV	3	0	0	3	3
4	24XXEL6ZZ	Professional Elective - V	3	0	0	3	3
5	24XXOE9XX	Open Elective - III	3	0	0	3	3
		PRACTICALS					
6	24CIPT601	Artificial Intelligence for IoT Laboratory with theory	1	0	4	5	3
7	24CIPT602	Sensors and Actuators Laboratory with theory	1	0	4	5	3
		VALUE ADDITIONS - VI					
8	24CITP601	Technical Skill	0	0	2	2	0
9	24CIID601	Prototype development Lab - II	0	0	2	2	1
		ONLINE SUPPLEMENTARY					
		As recommended by BOS					
		Total				**31**	**23**

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SEMESTER VII

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			CONTACT PERIODS	CREDITS
			L	T	P		
THEORY							
1	20CIPW701	Data Management in IoT with laboratory	3	0	2	5	4
2	24XXEL7YY	Professional Elective - VI	3	0	0	3	3
4	24XXOEXXX	Open Elective - IV	3	0	0	3	3
5	24MGEL703	Creative Innovation and Entrepreneurship	2	0	0	2	2
PRACTICALS							
7	24CIPJ701	Project work - Phase- I	0	0	8	8	4
8	24CIPL701	IoT Cloud Computing Laboratory	0	0	4	4	2
VALUE ADDITIONS - VII							
9	24CITP701	Company Specific Skills	0	0	2	2	1
ONLINE SUPPLEMENTARY							
		As recommended by BOS					
				Total		27	19

SEMESTER VIII

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			CONTACT PERIODS	CREDITS
			L	T	P		
THEORY							
1	24CIEL8xx	Professional Elective - VII	3	0	0	3	3
PRACTICALS							
1	24CIPJ801	Project Work - Phase II	0	0	12	12	6
VALUE ADDITIONS - VIII							
1	24CIIN801	Internship	0	0	9	9	3
				Total		24	12

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PROFESSIONAL ELECTIVES - I

S. NO	COURSE CODE	COURSE TITLE	CREDIT	DOMAIN	PREREQUISITE COURSES
1	24CIEL501	IoT Concepts and Applications	3	Industrial IOT	24CIPC301
2	24CIEL502	Data Science for Internet of Things	3	Industrial IOT	24AIPT201, 24BSMA301
3	24CIEL503	Dynamic Paradigm in IoT	3	Industrial IOT	24CIPC301, 24CIPT401, 24AIPT201
1	24ITEL501	Computer Graphics and Multimedia	3	Computing Technologies	24ITPC301, 24BSMA301
2	24ITEL511	Graph Theory	3	Computing Technologies	24ITPC402, 24BSMA301
3	24ITEL503	Cloud Computing	3	Computing Technologies	24ITPW401
1	24ECEL501	Simulation Techniques for Wireless Communication	3	Wireless Communication	24BSMA401
2	24ECEL502	Digital Theory of Communication	3	Wireless Communication	24ECPC402
3	24ECEL503	Statistical Theory of Communication	3	Wireless Communication	24BSMA301, 24ECPC301
1	24AIEL501	Exploratory Data Analysis with R Software	3	Artificial Intelligence	24BSMA406
2	24AIEL502	Artificial Intelligence Fundamentals and Applications	3	Artificial Intelligence	24AIPT201, 24AIPC302
3	24AIEL503	Human Centered Computing	3	Artificial Intelligence	24ITPC302, 24ESCS101
1	24MGEL5xx	Intellectual Property Rights	3	Management	

PROFESSIONAL ELECTIVES - II

S. NO	COURSE CODE	COURSE TITLE	CREDIT	DOMAIN	PREREQUISITE COURSES
1	24CIEL504	Web of Things	3	Industrial IOT	24ESCS101, 24AIPT201, 24CIPT401
2	24CIEL505	Wireless Technologies in Internet of Things	3	Industrial IOT	24CIPC301, 24CIPT401
3	24CIEL506	Descriptive Analytics for IoT	3	Industrial IOT	24ITPW302, 24CIPC301
1	24ITEL510	Advanced Analysis of Algorithms	3	Computing Technologies	24ITPC301
2	24ITEL502	Distributed Systems	3	Computing Technologies	24ITPC301, 24ITPW401
3	24ITEL512	Parallel Algorithms	3	Computing Technologies	24ITPC301, 24ITPW401
1	24ECEL513	Information Theory	3	Wireless Communication	24BSMA401, 24ECPC302
2	24ECEL514	Machine Learning for Communication and Signal Processing	3	Wireless Communication	24BSMA401
3	24ECEL515	Communication Technologies for Industry 4.0	3	Wireless Communication	24ECPC304, 24ECPT401
1	24AIEL504	Business Intelligence	3	Artificial Intelligence	24CIPC301, 24BSMA301
2	24AIEL505	Machine Learning Essentials	3	Artificial Intelligence	24BSMA301, 24CSPC302
3	24AIEL506	Decision Support Systems	3	Artificial Intelligence	24CSPC301, 24BSMA301
1	24MGEL5xx	Quality Management	3	Management	

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PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1 Graduates will have a sound understanding of fundamental concepts of IoT.

PEO 2 Graduates will be trained to gain domain expertise by applying the theory basics into practical situation through simulation and modeling techniques.

PEO 3 Graduates will enhance the capability through skill development and make them Industry ready by inculcating leadership and multitasking abilities.

PEO 4 Graduates will apply their expertise of the Internet of Things to research and Development and create novel products that benefit society.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1 The graduates will be able to develop and test integrated solutions for Internet of Things project development

PSO 2 The graduates will be empowered with the skills and expertise required delivering industry and societal solutions in the area of Internet of Things.

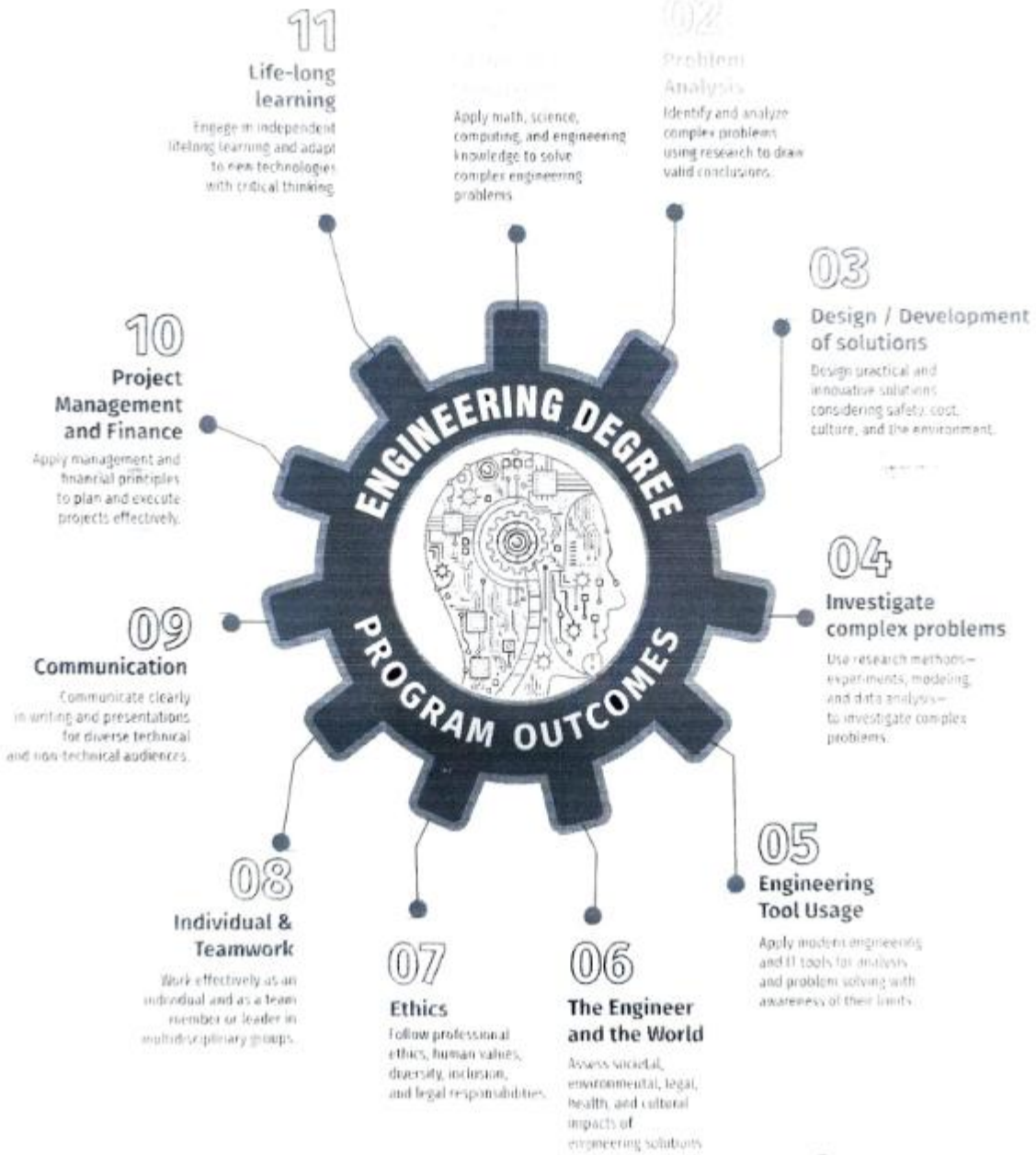
COMPONENTS OF THE CURRICULUM (COC)

Course Component	Curriculum Content (% of total number of credits of the program)	Total number of contact hours	Total Number of credits
Basic Sciences (BS)	18	32	30
Engineering Sciences (ES)	7	17	12
Humanities and Social Sciences (HS)	8	13	13
Professional Electives (EL)	14	23	23
Program Core + Program Lab (PC+PL)	6	14	10
Program theory with Lab (PW) / Program Lab With Theory (PT)	14	30	24
Open Elective (OE)	13	35	21
Training & Placement (TP)	7	12	12
Innovation & Development (ID) / Project (PJ)	2	14	4
Internships (IN)	9	32	16
Mandatory Courses (MC)	2	9	8
Total	100	231	168

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PROGRAMME OUTCOMES(POs)

PROGRAM OUTCOME REPRESENTS THE KNOWLEDGE, SKILLS AND ATTITUDES THAT THE STUDENTS WOULD BE EXPECTED TO HAVE AT THE END OF THE 4 YEAR ENGINEERING DEGREE PROGRAM



11 Life-long learning
Engage in independent lifelong learning and adapt to new technologies with critical thinking.

02 Problem Analysis
Identify and analyze complex problems using research to draw valid conclusions.

Apply math, science, computing, and engineering knowledge to solve complex engineering problems.

03 Design / Development of solutions
Design practical and innovative solutions considering safety, cost, culture, and the environment.

10 Project Management and Finance
Apply management and financial principles to plan and execute projects effectively.

04 Investigate complex problems
Use research methods—experiments, modeling, and data analysis—to investigate complex problems.

09 Communication
Communicate clearly in writing and presentations for diverse technical and non-technical audiences.

05 Engineering Tool Usage
Apply modern engineering and IT tools for analysis and problem solving with awareness of their limits.

08 Individual & Teamwork
Work effectively as an individual and as a team member or leader in multidisciplinary groups.

07 Ethics
Follow professional ethics, human values, diversity, inclusion, and legal responsibilities.

06 The Engineer and the World
Assess societal, environmental, legal, health, and cultural impacts of engineering solutions.

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SEMESTER - I

24BSMA101 - SDG NO. 4	MATRICES AND CALCULUS	L	T	P	CP	C
		3	1	0	4	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, 9th Edition, 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

COURSE OUTCOMES:

Upon completion of the course, the student should 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
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-
CO4	3	3	2	-	-	-	-	-	-	-	-
CO5	3	3	2	-	-	-	-	-	-	-	-
CO6	3	2	2	-	-	-	-	-	-	-	-

SEMESTER - I

24HSEN101 - SDG NO. 4	COMMUNICATIVE ENGLISH	L	T	P	CP	C
		3	0	0	3	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 skilis 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	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	3	-	2	-	-
CO2	-	-	-	-	-	-	-	-	3	-	2	-	-
CO3	-	-	-	-	-	-	-	-	3	-	2	-	-
CO4	-	-	-	-	-	-	-	-	3	-	2	-	-
CO5	-	-	-	-	-	-	-	-	3	-	2	-	-
CO6	-	-	-	-	-	-	-	-	3	-	2	-	-

SEMESTER - I

24BSPH101 - SDG NO. 4,7,9,11	ENGINEERING PHYSICS	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

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

Recommended by
Board of Studies of H&S dept.
Meeting No. 6 Dated: 30/5/2024

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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.

Recommended by
Board of Studies of H&S dept.
Meeting No. 6 Dated: 30/05/2019

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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)

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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	-	-	-	-	-	-	-	-	-	-

SEMESTER - I

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

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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.

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).

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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

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.
8. Chemical and Electrochemical Energy Systems, R. Narayanan, B. Viswanathan, University Press India Limited.

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)

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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)

CO-PO, Mapping:

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

SEMESTER - I

24ESCS101 106105171 SDG NO. 4 & 9	PROBLEM SOLVING AND PROGRAMMING IN C	L	T	P	CP	C
		3	0	0	4	0

OBJECTIVES:

- Interpret Mathematical problems using algorithms, flowchart and pseudocode.
- To understand 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.

Recommended by
Board of Studies of CSE dept.
Meeting No. 8 Dated: 09/04/25

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Department of Computer Science and Engineering
Sri Sairam Engineering College

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.

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:

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Board of Studies of CSE dept.
Meeting No. 8 Dated: 09/04/25

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Sri Sairam Engineering College

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.

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

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Meeting No. 8 Dated: 09/04/25

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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

SEMESTER - I

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

Recommended by Board of Studies of MECH dept. Meeting No. 8 Dated: 03/09/24

CHAIRMAN Board of Studies Mechanical Engineering

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.

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.

Recommended by
Board of Studies of MECH dept.
Meeting No. 8 Dated: 03/9/2

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Mechanical Engineering

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.

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	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

Recommended by
Board of Studies of MECH dept.
Meeting No. 8 Dated: 3/9/2024

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Board of Studies
Mechanical Engineering

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.

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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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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

SEMESTER - I

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

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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.
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.

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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. Apply the principles of elasticity and thermal physics to evaluate the various modulus of elasticity and conductivity of a bad conductor. (K3)
2. Explicate the properties of semi conductors by evaluating the band gap, I-V characteristics of solar cell and Hall effect of the materials. (K3)
3. 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)
4. Apply spectroscopic techniques, viscometry, synthesize nano particles, analyze the corrosion behaviour of materials in different environments. (K3)

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CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	-	-	2	-	-	-	-	-	2
CO2	3	3	-	-	2	-	-	-	-	-	2
CO3	3	3	-	-	2	-	-	-	-	-	2
Co4	3	3	-	-	2	-	-	-	-	-	2

SEMESTER - I

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

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.

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Meeting No. 8 Dated: 09/4/24

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Sri Sairam Engineering College

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: 45 PERIODS

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. Apply basic constructs, arrays, strings,functions and recursion for executing C programming applications.(K3)
2. Analyze C programs involving pointers and structures.(K4)
3. Evaluate applications using sequential and random access files.(K5)

CO-PO, PSO MAPPING:

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

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Meeting No. 8 Dated: 9/4/24

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SEMESTER - I

24ESID101 - SDG NO. 1-17	IDEA ENGINEERING LAB - I	L	T	P	CP	C
		0	0	2	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 recognize the role of educational Institutions in community development
- To develop critical thinking skills to address complex societal challenges through an immersion program

MODULE - 1 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 - 2 Universal SDG Targets 4

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

MODULE-3 SDG and Indian Gram Panchayat 3

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

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MODULE-4 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-5 Community Engagement **4**

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

MODULE-6 Idea Generation **12**

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

TOTAL: 30 PERIODS

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. Analyse and apply the concepts of sustainability,Rural environment,Gram panchayat and various government schemes to design innovative practical solutions that address real life rural challenges. (K2)
2. Compare MDG's,SDG's and LSDG's to analyse village topology and identify specific development targets to propose innovative rural solutions. (K4)

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3. Analyse the attainment levels of SDG's and write a reflective report on local community.(K4)
4. Formulate problem statement based on local community needs and propose innovative ideas for community development. (K4)
5. Perform an individual presentation of field observation by mapping them with relevant SDG's and justify their significance for rural development. (K4)

CO-PO, PSO MAPPING:

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

SEMESTER - I

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

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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

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.

Recommended by
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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. Employ reading, writing, and listening skills to communicate clearly in academic and professional contexts.
2. Demonstrate confident oral communication and presentation skills using appropriate tools and techniques.
3. Interpret ethical, inclusive, and culturally aware communication in team and societal settings

CO-PO, PSO MAPPING:

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

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SEMESTER - II

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

OBJECTIVES:

- To understand the fundamental concepts of logic, rules of inference, and quantifiers.
- To learn the principles of mathematical induction, permutations, and combinations.
- To gain knowledge of groups and normal subgroups in abstract algebra.
- To develop graph algorithms using the foundational concepts of graph theory.
- To understand the concepts of lattices and Boolean algebra and their applications.

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.

MODULE - 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.

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MODULE - VI BOOLEAN ALGEBRA **9**

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

TOTAL: 60 PERIODS

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, Reprint, 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 RESOURCES:

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=PLwdnzlV3ogoVxVxCTll45pDVM1aoYoMHf
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)

CO-PO, MAPPING:

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

SEMESTER - II

24HSEN201 - SDG NO.4	PROFESSIONAL ENGLISH	L	T	P	CP	C
		2	0	0	2	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	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	3	-	3	-	-
CO2	-	-	-	-	-	-	-	-	3	-	3	-	-
CO3	-	-	-	-	-	-	-	-	3	-	3	-	-
CO4	-	-	-	-	-	-	-	-	3	-	3	-	-
CO5	-	-	-	-	-	-	-	1	3	-	3	-	-
CO6	-	-	-	-	-	-	-	1	3	-	3	-	-

SEMESTER - II

24BSPH203 - SDG NO. 4,7,9	PHYSICS FOR INFORMATION SCIENCE	L	T	P	CP	C
		3	0	0	3	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.

MODULE - II SEMICONDUCTOR MATERIALS 7

Direct and indirect band gap semiconductors - Intrinsic Semiconductors - Carrier concentration in intrinsic semiconductors - Extrinsic semiconductors

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- 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

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.

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Meeting No. 6 Dated: 30/08/2024

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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)

CO-PO 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 - II

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

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 (CO_2, CH_4, N_2O, 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).

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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 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 H_2O_2 as benign bleaching agents in the paper industry.

Sustainable Development: Definition and concepts of sustainable development, Need for sustainable development; Sustainable development

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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.

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)

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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
CO1	2	2	1	-	-	-	-	-	-	-	-
CO2	3	2	2	-	-	-	-	-	-	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-
CO4	2	2	1	-	-	-	-	-	-	-	-
CO5	3	2	2	-	-	-	-	-	-	-	-
CO6	3	3	-	2	1	-	-	-	-	-	-

SEMESTER - II

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

OBJECTIVES:

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

அலகு-I நெசவு மற்றும் பானைத் தொழில்நுட்பம்

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

UNIT-I WEAVING AND POTTERY (CERAMIC) TECHNOLOGY 5

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

அலகு -II சங்ககாலவடிவமைப்புகள்

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள்ரூசங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு -சங்க காலத்தில் கட்டுமான பொருட்களும்நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள்.

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UNIT-II SANGAM AGE DESIGNS 5

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

அலகு -III பழங்காலகட்டிடத் தொழில்நுட்பம்

மாமல்லபுரச்சிற்பங்களும், கோவில்களும் - சோழர்காலத்துப்பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத்தலங்கள் - நாயக்கர்காலக்கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாட்டுவீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக்கட்டிடக் கலை.

UNIT-III ANCIENT CONSTRUCTION TECHNOLOGY 5

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.

அலகு- IV உற்பத்தித் தொழில்நுட்பம்

கப்பல் கட்டும் கலை -உலோகவியல் -இரும்புத் தொழிற்சாலை இரும்பை உருக்குதல், எஃகு - வரலாற்றுச்சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் சங்கு மணிகள் -எலும்புத்துண்டுகள் - தொல்லியல்சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

UNIT-IV MANUFACTURING TECHNOLOGY 5

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 beads - Archaeological evidences - Gem stone types described in Silappathikaram.

அலகு - V வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம்

அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக்குமுழித்தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காகவடிவமைக்கப்பட்டகிணறுகள்- வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள்- கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.

UNIT-V AGRICULTURE AND IRRIGATION TECHNOLOGY 5

Dam, Tank, Ponds, Sluice, Significance of KumizhiThoompu of Chola Period> Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries - Pearl - Conch diving -Ancient Knowledge of Ocean - Knowledge Specific Society.

அலகு-VI அறிவியல்தமிழ்மற்றும்கணித்தமிழ்

அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ்

Recommended for approval
Board of Studies of H&S dept.
Meeting No. 6 Dated: 30/05/2019

Chairman
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இணையக்கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.

UNIT-VI SCIENTIFIC TAMIL & TAMIL COMPUTING **5**

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: 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)
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. சங்ககால நெசவு மற்றும் பானைத்தொழில்நுட்பங்களைப் பற்றி அறிந்து கொள்ளுதல்
   To learn about the weaving and pottery (ceramic) technologies during the Sangam Age.(K2)
2. சங்ககாலவடிவமைப்புகள் மற்றும் கட்டுமானக்கலையைப் புரிந்து கொள்ளுதல்
   To understand the designs and structural constructions during the Sangam period.(K2)
3. பண்டைய கால கட்டிடக்கலையின்நுட்பங்கள் மற்றும் கட்டிடவடிவமைப்புகளை ஆராய்தல்.

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To explore the techniques and architectural patterns of ancient Tamil structures.(K2)

4. உற்பத்தி மற்றும் உலோகவியல்தொழில்நுட்பங்களைப் பற்றி அறிதல்.
   To gain knowledge on manufacturing and metallurgical technologies of ancient Tamils.(K3)
5. வேளாண்மை, நீர்ப்பாசனம் மற்றும் கடல்சார்தொழில்நுட்பங்களைப் பற்றி அறிந்து கொள்ளுதல்.
   To understand agricultural> irrigation> and marine technologies of ancient Tamil society.(K3)
6. அறிவியல்தமிழ் மற்றும் கணித்தமிழின்வளர்ச்சியையும் அதன் கணினி பயன்பாடுகளையும் புரிந்து கொள்ளுதல்.
   To understand the development of Scientific Tamil and its applications in Tamil computing.(K3)

CO- PO, PSO MAPPING

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

SEMESTER - II

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

Recommended by
Board of Studies of H&S dept.
Meeting No. 6 Dated: 30/08/2024

Chairman
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Department of Humanities & Sciences

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

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

Recommended by
Board of Studies of IT&S dept.
Meeting No. 6 Dated: 30/05/2019

Chairman
Board of Studies
Department of Humanities & Sciences

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

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

Recommended by
Board of Studies of H&S dept.
Meeting No. 6 Dated: 30 October

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Board of Studies
Department of Humanities & Sciences

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

Recommended by
Board of Studies of H&S dept.
Meeting No. 6 Dated: 30/8/2024

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SEMESTER - II

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

Recommended by
Board of Studies of AI&DS dept.
Meeting No. 8 Dated: 3/9/24

CHAIRMAN
Board of Studies
Artificial Intelligence and Data Science

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

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Meeting No. 8 Dated: 3/9/24

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Artificial Intelligence and Data Science

Statistical Methods-Sorting- Unique and Other Set Logic

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

Recommended by
Board of Studies of AI&DS dept.
Meeting No. 8 Dated: 3/9/24

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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. Identify the need for data science and solve basic problems using Python built-in data types and their methods. (K3)
2. Develop an application with user-defined modules and packages using OOP concept (K3)
3. Gain Knowledge on data science fundamentals and process.(K2)
4. Understand data operations using NumPy arrays.(K2)
5. Apply powerful data manipulations using Pandas. (K3)
6. Do data pre-processing and visualization using Pandas. (K3)

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Meeting No. 8 Dated: 3/9/24

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CO-PO, PSO MAPPING:

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

SEMESTER - II

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

Recommended by
Board of Studies of MECH dept.
Meeting No. 8 Dated: 3/9/24

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Board of Studies
Mechanical Engineering

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.

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.

Recommended by
Board of Studies of MECH dept.
Meeting No. 8 Dated: 3/9/24

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Board of Studies
Mechanical Engineering

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
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

Recommended by
Board of Studies of INECH dept.
Meeting No. 8 Dated: 3/9/24

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Mechanical Engineering

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

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)

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Meeting No. 8 Dated: 3/9/24

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Mechanical Engineering

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	-	-	-	-	-	-	-	-	-	-	2	2
CO4	3	-		-	-	-	-	-	-	-	-	2	2
CO5	2	-	-	-	-	-	-	-	-	-	-	2	2
CO6	2	-	-	-	-	-	-	-	-	-	-	2	2

SEMESTER - II

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

OBJECTIVES:

To impart the basics of technologies that are used to identify sustainable solutions to societal problems

- To Provide awareness on Printed Circuit Board (PCB) design using ORCAD software.
- To Raise awareness of at least three Internet of Things (IoT) projects and their applications.
- To Upskill learners through practical experience with 3D printing and scanning technologies.
- 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

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
- Demonstration of PCB design using the software's Orcad, Eagle etc.

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Board of Studies of H&S dept.
Meeting No. 6 Dated: 30/05/2024

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Department of Humanities & Sciences

MODULE-2 EMBEDDED SYSTEMS, IOT AND ROBOTICS **4**

- Study of sensors and transducers
- Study of embedded protocols, IOT Protocols & Embedded C
- Demonstration of Robotics & Drone models

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 SCOUT for SDG IDEATHON **12**

Evaluation Stages:

- First Round
- Second Round
- Idea Pitching

TOTAL: 30 PERIODS

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

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Meeting No. 6 Dated: 30/08/2024

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Department of Humanities & Sciences

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
CO1	1	-	-	-	1	-	-	-	-	-	-
CO2	1	-	-	-	1	-	-	-	-	-	-
CO3	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	CP	C
		1	0	1	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 7

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

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Meeting No. 6 Dated: 30/08/2024

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Department of Humanities & Sciences

CO-PO, PSO Mapping:

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

Recommended by
Board of Studies of H&S dept.
Meeting No. 6 Dated: 30/04/2019

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SEMESTER - III

24BSMA301 - SDG NO. 4	STATISTICS AND LINEAR ALGEBRA	L	T	P	CP	C
		3	1	0	4	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 : 45 PERIODS

TEXT BOOKS:

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

Recommended by Board of Studies of HAS dept. Meeting No. 6 Dated: 30/08/2024

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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. Compute and interpret large sample tests for proportions and means using sampling distributions and hypothesis testing. (K3)
3. Apply t-tests, F-test, and Chi-square tests to analyze small sample data for means, variance, independence of attributes, and goodness of fit. (K3)
4. Determine the bases and dimension of vector spaces and subspaces. (K3)

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5. Calculate matrix representations, null spaces, ranges, eigenvalues, eigenvectors, and determine diagonalizability of linear transformations (K3)
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	2	-	-	-	-	-	-	-	-	-	2	2
CO2	3	2	-	-	-	-	-	-	-	-	-	2	2
CO3	3	2	-	-	-	-	-	-	-	-	-	2	2
CO4	3	2	-	-	-	-	-	-	-	-	-	2	-
CO5	3	2	-	-	-	-	-	-	-	-	-	3	2
CO6	3	2	-	-	-	-	-	-	-	-	-	3	2

SEMESTER - III

24ITPC301 106105225 SDG NO. 4	DATA STRUCTURES AND ALGORITHMS	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To introduce the concepts of Abstract Data Types (ADTs) and provide a thorough understanding of Stacks and Queues
- To develop proficiency in implementing linked list structures
- To impart knowledge on tree data structures
- To familiarize with the fundamentals of graph theory
- To provide foundational skills in algorithm design and analysis

MODULE - I STACKS AND QUEUES 8

Stacks-and-Queues: Abstract-Data-Types-(ADTs): Stack ADT: Operations - Applications - Evaluating arithmetic expressions - Infix, Prefix and Postfix expression - Operations - Queue ADT: Operations - Circular Queue - Priority Queue - Dequeue

MODULE - II LINKED LIST 7

Linked List: List ADT – Array-Based Implementation – Linked List

Recommended by
Board of Studies of IT dept.
Meeting No. 8 Dated: 3/9/24

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Implementation -- Singly Linked Lists- Circularly Linked Lists- Doubly-Linked Lists – Applications of Lists – All Operations (Insertion, Deletion, Merge, Traversal).

MODULE - III TREES **7**

Trees – Tree Traversals - Binary Tree ADT – Expression Trees – Binary Search Tree ADT –Threaded Binary Trees- AVL Trees – B-Tree -Heap

MODULE - IV GRAPHS **8**

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

MODULE - V SORTING AND SEARCHING ALGORITHMS **8**

Bubble sort – Selection sort – Insertion sort - Divide and Conquer – Merge sort – Quick sort – Analysis of sorting algorithm – Linear search - Binary search.

MODULE - VI ALGORITHM ANALYSIS TECHNIQUES **7**

Fundamentals of Algorithmic Problem Solving – Fundamentals of the Analysis of Algorithmic Efficiency –Asymptotic Notations and their properties - –Empirical analysis - Mathematical analysis for Recursive and Non-recursive algorithms–Greedy Technique - 0/1 Knapsack problem

TOTAL : 45 PERIODS

TEXT BOOKS:

1. M. A. Weiss, "Data Structures and Algorithm Analysis in C", Pearson Education Asia, 2002.
2. AnanyLevitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education, 2012.
3. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, "Computer Algorithms/ C++", Second Edition, Universities Press, 2007.

REFERENCES:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, "Introduction to Algorithms", Second Edition, Mcgraw Hill, 2002.
2. Stephen G. Kochan, "Programming in C", 3rd edition, Pearson Education.
3. Aho, Hopcroft and Ullman, "Data Structures and Algorithms", Pearson Education,1983
4. Yashavant Kanetkar," Data Structures Through C", BPB, ISBN-13:978-9388511391,2019.

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Information Technology

WEB REFERENCES :

1. https://www.programiz.com/dsa
2. http://masterraghu.com/subjects/Datastructures/ebooks/remathareja.pdf
3. https://archive.nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs25/
4. https://nptel.ac.in/courses/106102064

OUTCOMES

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

1. Illustrate the ADT for stack and Queue Data Structures (K3)
2. Demonstrate the ADT for Linked List Data Structures (K3).
3. Interpret the ADT for Tree Data Structures in Real World Problem (K3).
4. Construct Non-Linear for Graph Data Structures (K3).
5. Compare sorting and searching algorithms in terms of time and space complexity.(K4)
6. Analyze greedy algorithms to develop efficient solutions for optimization problems.(K4)

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	2	3	-	2	-	-	-	-	-	-	2	2
CO3	3	2	3	2	-	-	-	-	-	-	-	2	3
CO4	3	2	3	2	-	-	-	-	-	-	-	3	3
CO5	3	3	3	2	-	-	-	-	-	-	-	2	2
CO6	3	3	3	2	-	-	-	-	-	-	-	3	2

Recommended by
Board of Studies of IT dept.
Meeting No. 8 Dated: 03/9/24

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Information Technology

SEMESTER - III

24ESCI301 - SDG NO. 4, 9	BASIC ELECTRONICS AND COMMUNICATION ENGINEERING	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To explore the key ideas and rules of electric circuit laws.
- To understand the working principle of various electronic devices.
- To learn about the key features, internal structure, and typical applications of operational amplifiers.
- To deal with Information theory and channel capacity.
- To acquire knowledge about analog communication.
- To gain knowledge about digital communication techniques.

MODULE - I ELECTRICAL CIRCUIT ANALYSIS 9

Ohm's Law, Kirchhoff's Law-Instantaneous Power- Series and Parallel circuit analysis with Resistive, Capacitive and Inductive network - Nodal analysis, Mesh analysis- Network theorems – Thevenin's theorem, Norton theorem, Maximum power transfer theorem and Superposition theorem.

MODULE - II ELECTRONIC CIRCUITS 7

PN Junction-VI Characteristics of Diode, Zener diode-Breakdown Mechanisms, Zener Diode Applications, Operation of a NPN Transistor, Operation of PNP Transistor, Transistors configurations , Transistor as an amplifier.

MODULE - III OPERATIONAL AMPLIFIER 7

Basic information about Op-amps-Ideal characteristics of Operational Amplifier-General operational amplifier stages-internal circuit diagrams of IC 741- OP-Amp as rectifiers-Basic Op-Amp Applications-Instrumentation Amplifier- V to I Converter, I to V Converter, Differentiator, Integrator, Log and Antilog Amplifier, Comparator.

MODULE - IV INFORMATION THEORY 7

Concept of amount of information, information units- Entropy: marginal, conditional, joint and relative entropies, relation among entropies, Mutual information, information rate, channel capacity.

MODULE - V ANALOG COMMUNICATION 8

Analog Communication–Types of modulation–AM–FM–Phase Modulation – Pulse Modulation – QAM – PAM – PWM–PPM–PCM.

Recommended by Board of Studies for CSE(IoT) dept. Meeting No. 6 Dated: 9/4/26

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Computer Science and Engineering
(Internet of Things)

MODULE - VI DIGITAL COMMUNICATION

Concepts of Sampling theorem.- Nyquist rate–Digital Modulation Schemes–ASK–FSK– PSK-Concept of Radio wave propagation- Radio signal transmission – Multiple access technique Cellular Wireless Networks.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. DP Kothari and I.J Nagarath,"Basic Electrical Engineering", McGraw-Hill Education (India) Private Limited, 4th Edition, April 12, 2019.
2. S Salivahanan, N. Suresh Kumar, "Electronic Devices and Circuits", McGraw-Hill Education, 3rd Edition, June 23, 2012.
3. D. Roy Choudhury, Shail B.Jain," Linear Integrated Circuits", New Age International Pvt.Ltd, 6th Edition, July 2021.
4. Wayne Tomasi, "Advanced Electronic Communication Systems", 6th Edition, Pearson Education, 2009.

REFERENCE BOOKS:

1. Chakrabarti A, "Circuits Theory Analysis and Synthesis", Dhanpath Rai & Sons, New Delhi, Seventh edition, 2023.
2. A Nagoor kani, "Circuit Analysis," McGraw Hill, First edition, 2018
3. Blake, "Electronic Communication Systems", Thomson Delmar Publications, Second edition 2002.
4. Simon Haykin, Communications Systems, 4th Edition Wiley Publications,2006..
5. Sergio Franco,Design with Operational Amplifiers and Analog Integrated Circuits||, 4th Edition, Tata Mc Graw-Hill, 2016.

WEB RESOURCES:

1. https://www.circuit-magic.com/
2. https://www.khanacademy.org/science/electrical-engineering/ee-circuit-analysis-topic
3. https://freevideolectures.com/course/2590/introduction-to-communication-theory
4. https://www.electronics-tutorials.ws/
5. https://www.khanacademy.org/science/electrical-engineering/eeamplifiers
6. https:// www. tutorialspoint. com/ linear_integrated_circuits_ applications/linear_integrated_circuits_applications_comparators.htm

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ONLINE RESOURCES:

1. https://nptel.ac.in/courses/117106108
2. https://nptel.ac.in/courses/108106181
3. https://nptel.ac.in/courses/117105143
4. https://nptel.ac.in/courses/108101113

OUTCOMES

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

1. Analyze the fundamental principles of electric circuit laws and their applications (K4).
2. Utilize the working concepts of various electronic devices (K3).
3. Examine the use of operational amplifiers in basic analog circuit applications (K4).
4. Identify information measures, such as entropy and mutual information, used in coding theory (K3).
5. Apply the principles of AM, FM, and PCM modulation schemes to interpret their operation and characteristics (K3).
6. Make use of digital modulation principles and characteristics to evaluate communication system performance (K3).

CO – PO, PSO MAPPING:

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

SEMESTER - III

24CIPC301 - SDG NO. 4, 9	INTRODUCTION TO INTERNET OF THINGS	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To understand the fundamentals of microprocessors and microcontrollers.
- To learn about the ARM Cortex M4 microcontroller.
- To gain foundational knowledge of the Internet of Things and its core concepts.

Recommended by Board of Studies of CSE(IoT) Meeting No. 6 Dated: 9/4/26

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(Internet of Things)

- To explore M2M communication and system management protocols .
- To study IoT system levels and apply Python programming for IoT development.
- To examine IoT implementations in various fields and gain hands-on experience.

MODULE - I MICROPROCESSORS AND MICROCONTROLLERS **9**

Introduction to Microprocessors, Study of 8 bit Microprocessor, Block diagram and architecture of 8086 family, pin configuration of 8086. Introduction to 8051 Microcontrollers, pin diagram explanation, internal diagram of 8051- Comparing Microprocessors and Microcontrollers.

MODULE - II EMBEDDED PROCESSOR **8**

Introduction to ARM Cortex M4 Microcontroller – Architecture – Registers –Memory Structure

MODULE - III INTRODUCTION TO INTERNET OF THINGS **7**

Introduction to IoT–Definition, Characteristics, functional requirements, motivation, Physical design-things in IoT, IoT protocols, Logical Design-functional blocks, communication models, Communication APIs, IoT Enabling Technologies

MODULE - IV M2M AND SYSTEM MANAGEMENT **7**

Introduction-M2M, Difference between M2M and IoT, SDN and NFV for IoT, System Management–need, SNMP, NETCONF, YANG.

MODULE - V DEVELOPING INTERNET OF THINGS AND USAGE OF PYTHON **7**

IoT levels and deployment -IoT Methodology-Purpose & Requirements specification, process specification, domain model specification, information model specification, service specification, IoT level specifications. IoT systems logical design using python-python data types & data structures, control flow, functions, remote access enablement using cloud, modules & package of python, python packages of interest for IoT.

MODULE - VI IoT APPLICATIONS and CASE STUDY **7**

IoT Applications in Home Automation, Cities, Agriculture, Industry. Case study for weather monitoring system-Exemplary device-Raspberry pi, Linux on Raspberry pi, Programming Raspberry Pi

TOTAL : 45 PERIODS

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Computer Science and Engineering
(Internet of Things)

TEXT BOOKS:

1. Arshdeep Bahga and Vijay Madisetti, Internet of Things A Hand-on Approach, Universities press, 2015
2. Dr. Ovidiu Vermesan and Dr. Peter Friess, Internet of Things: From research and innovation to market deployment, River Publishers, 2014.
3. Honbo Zhou, The Internet of Things in the Cloud: A Middleware Perspective - CRC Press, 2012.
4. Muhammad Ali Mazidi,The 8051 Microcontrollers & Embedded Systems, Second Edition,January 2007

REFERENCE BOOKS:

1. Dieter Uckelmann et.al, Architecting the Internet of Things, Springer, 2011
2. Pethuru Raj and Anupama C.Raman, "The Internet of Things: Enabling Technologies and Use Cases, CRC Press, 2022 by Auerbach Publications
3. Jonathan W. Valvano."Embedded Systems: Introduction to ARM Cortex-M Microcontrollers". CreateSpace Independent Publishing Platform , 2016.
4. Marilyn Wolf,Computers As Components Principles Of Embedded Computing System Design ,Elsevier PublicationsThird Edition,2013.
5. Yu-Cheng Liu (Author), Glenn A. Gibson,Microcomputer Systems: The 8086/8088 Family Architecture Programming and Design Hardcover ,Import, 2nd edition (13 January 1986)

WEB RESOURCES:

1. https://nevonprojects.com/iot-projects/
2. https://www.i-scoop.eu/industry-4-0/
3. https://www.coursera.org/courses?query=embedded%20systems
4. https://www.tutorialspoint.com/embedded_systems/index.htm
5. https://www.circuitstoday.com/embedded-systems-an-introduction
6. https://www.electronicsforu.com/resources/embedded-systems-overview

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/106105166
2. https://nptel.ac.in/courses/106105195
3. https://nptel.ac.in/courses/108108179
4. https://nptel.ac.in/courses/108102045
5. https://nptel.ac.in/courses/106105193
6. https://onlinecourses.swayam2.ac.in/aic20_sp04/preview

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OUTCOMES

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

1. Utilize the architecture and pin configurations of 8086 and 8051 for analyzing and designing microprocessor/microcontroller-based systems (K3).
2. Apply the key components of the ARM Cortex-M4 microcontroller to develop and analyze embedded applications(K3).
3. Develop and assess the functional requirements, architecture, and communication methods used in IoT systems (K3).
4. Utilize the concepts of M2M, IoT, SDN, NFV, and associated system management protocols in practical scenarios (K3).
5. Apply IoT methodology, design specifications, and the use of Python and its packages in IoT development (K3)
6. Develop IoT-based solutions for home automation, smart cities, agriculture, and industry (K3).

CO – PO, PSO MAPPING:

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

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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.

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

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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.

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)

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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)

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

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NAVAL ORIENTATION 6

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

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

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ADVENTURE 1

AD 1 Introduction to Adventure Actitivities 1

BORDER & COASTAL AREAS 2

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

TOTAL :45 PERIODS

SEMESTER - III

24ITPL301 - SDG NO. 4	DATA STRUCTURES AND ALGORITHMS LABORATORY	L	T	P	CP	C
		0	0	4	4	2

OBJECTIVES:

- To implement and demonstrate basic data structures
- To understand and apply algorithmic paradigms
- To apply graph algorithms and optimization techniques
- To develop and analyze efficient searching and sorting techniques
- To implement advanced data structures and algorithms

List of Experiments:

1. Implement the basic operations of a stack using arrays (push, pop, peek, and isEmpty).
2. Implement the basic operations of a queue using arrays (enqueue, dequeue, front,rear, and isEmpty).
3. Implement the conversion of an infix expression to a postfix expression using a stack.
4. Implement a singly linked list with basic operations such as insertion, deletion, and traversal.
5. Implement a doubly linked list with basic operations such as insertion, deletion, and traversal.
6. Implement a binary tree and perform basic operations like insertion, deletion, and traversal (inorder, preorder, postorder).
7. Implementation of AVL tree(all operation).
8. Implementation of Priority queue using Heap.
9. Graph representation and Traversal algorithms a) Depth first Search b) Breadth First Search.
10. Implement Dijkstra's algorithm to find the shortest path from a source vertex to all other vertices in a graph.
11. Implement linear search and Binary search.
12. Implement merge sort and quick sort for Divide and Conquer.

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13. Implement the 0/1 Knapsack Problem using the Greedy technique
14. Analyze and implement a recursive algorithm (like factorial or Fibonacci)

TOTAL: 45 PERIODS

LAB REQUIREMENTS: Turbo C/Dev C++, Borland C or GCC equivalent

OUTCOMES

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

1. Apply basic linear and non linear data structures. (K3)
2. Analyze and compare various trees, searching and sorting algorithms. (K4)
3. Apply algorithmic strategies such as greedy and graph-based techniques. (K3)

CO – PO, PSO MAPPING:

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

SEMESTER - III

24CIPL301 - SDG NO. 4 & 9	IOT AND EMBEDDED SYSTEMS LABORATORY	L	T	P	CP	C
		0	0	4	4	2

OBJECTIVES:

- To learn the fundamentals of Arduino programming and interfacing.
- To understand the Raspberry Pi platform and perform basic hardware interfacing.

LIST OF EXPERIMENTS:

Introduction to Arduino platform and programming

a) Toggling of LED
b) Blinking of LED Pattern
c) LCD Display
d) Digital I/O configuration.
e) Timer based LED Toggle.

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f) On-chip Temperature measurement through ADC.
g) Echo each character typed on serial terminal
h) Transmitting a string through UART
i) IR Sensor
j) Ultrasonic sensor

Raspberry Pi

k) Introduction to Raspberry PI platform
l) Creation of Tables using MSQL
m) Blink of LED

TOTAL : 45 PERIODS

OUTCOMES

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

1. Apply Arduino programming to interface LEDs, LCDs, sensors, ADC, and UART. (K3)
2. Implement digital I/O and timer programming for embedded applications. (K3)
3. Analyze Raspberry Pi programming and MySQL for basic IoT applications. (K4)

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	-	-	-	-	-	-	2	2	-	-	2	2
CO3	3	3	-	-	2	-	-	2	2	-	-	2	2

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SEMESTER - III

24CIPT301 - SDG NO. 4 & 9	DIGITAL DESIGN AND COMPUTER ORGANIZATION SYSTEM LABORATORY WITH THEORY	L	T	P	CP	C
		1	0	4	5	3

OBJECTIVES:

- To introduce basic postulates of Boolean algebra and show the correlation between Boolean expressions.
- To introduce the methods for simplifying Boolean expressions.
- To outline the formal procedures for the analysis and design of combinational circuits and sequential circuits.
- To illustrate the concept of synchronous and asynchronous sequential circuits.
- To introduce the concept of memories and programmable logic devices

MODULE - I LOGIC SIMPLIFICATION 7

Review of number systems and number representation – Binary codes – Code Conversion; Logic Simplification: Review of Boolean Algebra and De Morgan's Theorem – SOP and POS forms – Canonical forms – Karnaugh maps up to 4 variables- Implementation using logic gates.

List of Experiments

1. Verification of Boolean Theorems using basic gates
2. Converting Boolean functions to Standard SOP/POS Form using K map realization and Implementation.
3. Implementation of boolean functions using NAND and NOR gate.

MODULE - II COMBINATIONAL LOGIC DESIGN 7

Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Multiplexer, Demultiplexer, Magnitude Comparator, Decoder, Encoder.

List of Experiments

1. Design and implement Half/Full Adder and Subtractor
2. Design and implement combinational circuits using MSI devices:
   a. 4 bit binary adder/subtractor b. Magnitude comparator

MODULE - III SYNCHRONOUS SEQUENTIAL CIRCUITS 7

Flip - Flops: Bistable elements, Latches, Flip flops – SR, JK, T, D– operation and excitation tables, Triggering of Flip Flop- Master/Slave Flip flop. Registers and Counters: Shift registers - SISO, SIPO, PISO and PIPO; up/down Counters; Design of Synchronous counters - Shift Register Counters.

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List of Experiments

1. To design 4 bit synchronous Counter using JK Flip flops - Ic7476
2. To design and Implement- T and D flip flops

MODULE - IV ASYNCHRONOUS SEQUENTIAL CIRCUITS 7

Introduction to asynchronous sequential circuits - fundamental mode and pulse mode circuits - State Diagram and Excitation Table - Ripple Counters cycles and races, state reduction, race free assignments

List of Experiments

1. To design 4-bit Ripple counter using JK Flip flops - Ic7476
2. To design an asynchronous 4-bit up and down counter.

MODULE - V ARITHMETIC OPERATIONS IN PROCESSORS 5

Addition and Subtraction – Multiplication – Division – Floating Point Representation – Floating Point Operations – Subword Parallelism – one's and two's complement – Booth algorithm

List of Experiments

1. Binary number multiplication using Booth's algorithm
2. Addition and Subtraction Operations in Processors

MODULE - VI MEMORY DEVICES AND PROGRAMMABLE LOGIC DEVICES5

Memory Devices: Basic memory structure – ROM - PROM – EPROM – EEPROM –EAPROM, RAM – Static and dynamic RAM PLDs: PLA, PAL, PROM, Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using PLA, PAL. – CPLD.

List of Experiments

1. Implementation of adder using PAL and PLA
2. Implementation of Multiplier using PLA and PAL

TOTAL : 45 PERIODS

TEXT BOOKS:

1. M. Morris Mano and Michael D. Ciletti, "Digital Design", Fifth Edition, Pearson, 2014.
2. S. Salivahanan, S. Arivazhagan, "Digital Circuits and Design", Oxford Press India, Fifth Edition, 2018.
3. William Stallings, "Computer Organization and Architecture – Designing for Performance", Eighth Edition, Pearson Education, 2010.

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REFERENCE BOOKS

1. CharlesH.Roth. "Fundamentals of Logic Design", 6 Edition, Thomson Learning, 2013.
2. Thomas L. Floyd, "Digital Fundamentals", 10 Edition, Pearson Education Inc, 2011.
3. S.Salivahanan and S.Arivazhagan, "Digital Electronics", I Edition, Vikas Publishing House pvt Ltd, 2012
4. A.Anand Kumar, "Fundamentals of Digital Circuits", 4 Edition, PHI Learning Private Limited, 2016.

WEB RESOURCES:

1. http://nptel.ac.in/courses/117106086/1
2. http://nptel.ac.in/courses/117103064/

ONLINE RESOURCES:

1. https://www.allaboutcircuits.com/textbook/digital/
2. http://web.iitd.ac.in/~shouri/eel201/lectures.php

OUTCOMES

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

1. Apply logical reasoning techniques to simplify and implement digital functions for basic circuit realization.(K3)
2. Demonstrate the working of combinational circuits through hardware implementation and verification of outputs. (K3)
3. Apply the behavior of sequential digital circuits to determine suitable flip-flop and counter configurations for reliable system operation.(K3)
4. Utilize asynchronous sequential circuit behavior and evaluate counter design considering race conditions and state reductions . (K3)
5. Implement arithmetic algorithms used in processors to perform binary arithmetic and data manipulation operations. (K3)
6. Implement the digital logic circuits using programmable hardware resources for computing applications (K3)

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

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SEMESTER - III

24CITP301 - 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 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

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

OBJECTIVES:

- Understand team building and acquire leadership skills.
- Gain Scouting spirit.
- Familiarize with the standards relevant to IOT.

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MODULE - I JEEVAN KAUSHAL 2.0 – TEAM SKILLS AND LIFE SKILLS 14

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 6

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: 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.

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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	-	-

Recommended by
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Meeting No. 5 Dated: 17/04/25

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SEMESTER - III

24CIID301 - 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 be evaluated, and the students shall appear for a viva-voce oral examination on the project approved by the Coordinator and the project guide.

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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	2	-	-	-	-	2	-	-	-	2	2

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Meeting No. 5 Dated: 17/04/25

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(Internet of Things)

SEMESTER - IV

24BSMA402 - SDG NO. 4	PROBABILITY AND QUEUEING THEORY	L	T	P	CP	C
		3	1	0	4	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/EK/1 as special cases – Series queues – Open Jackson networks.

TOTAL: 60 PERIODS

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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 the 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)) (Module 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) (Module V & VI).

REFERENCES:

1. Schaum's Outline Theory and Problems of Probability, Random variables and Random Processes, Hwei Hsu, 1st Edition, Tata Mcgraw Hill Edition, 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/

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Meeting No. 6 Dated: 30/08/2019

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COURSE OUTCOMES

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

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

CO – PO, PSO MAPPING:

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

SEMESTER - IV

24SCPT401 noc21_cs88 SDG NO. 4, 9, 16	OPERATING SYSTEM IN KALI LINUX LAB WITH THEORY	L	T	P	CP	C
		1	0	4	5	3

OBJECTIVES:

- Understand the foundational knowledge of operating system concepts with a focus on security.
- Develop hands-on expertise in using Kali Linux for OS-level operations and security testing.

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Meeting No. 1 Dated: 21/4/25

21/1/26

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- Equip students to apply process, memory, and file management techniques in practical scenarios.
- Enable students to conduct network monitoring and security assessments using Kali tools.
- Prepare students for advanced use cases like penetration testing and incident response.
- To Understand the Penetration Testing workflow tools like Metasploit, Wireshark, and Burp Suite

MODULE - I INTRODUCTION TO OPERATING SYSTEMS AND KALI LINUX **6**

Operating System Overview: Functions and Types -Key OS Concepts: Processes, Threads, Scheduling, and Memory Management- Introduction to Kali Linux: History, Installation, and Key Features-Use Cases of Kali Linux for Penetration Testing

Lab Exercises:

1. Install and configure Kali Linux on VirtualBox or Bare Metal
2. Basic Command-Line Operations in Kali Linux

MODULE - II PROCESS MANAGEMENT AND SCHEDULING IN KALI LINUX **8**

Process Lifecycle: Creation, Execution, Termination- Scheduling Algorithms: First Come First Serve (FCFS), Shortest Job Next (SJN), Round Robin (RR)- Managing Processes in Kali Linux using Commands - Multi-tasking and Multi-threading in Kali Linux

Lab Exercises:

1. Using ps, top, kill, nice, and renice commands
2. Create and Manage Background Processes in Kali Linux

MODULE - III MEMORY MANAGEMENT AND FILE SYSTEMS IN KALI LINUX **8**

Memory Allocation Techniques: Paging and Segmentation- Virtual Memory and Swapping in Kali Linux- File Systems: EXT, NTFS, FAT32 Overview - File Permissions and Management in Kali Linux

Lab Exercises:

1. Configure and Monitor Memory Usage
2. Use Commands like chmod, chown, and lsattr to Manage File Permissions
3. Mount and Unmount Drives and File Systems

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MODULE - IV NETWORKING AND SECURITY FEATURES IN KALI LINUX 8

Basic Networking Concepts: TCP/IP Stack, Ports, and Protocols- Networking Tools in Kali Linux: nmap, netstat, ping- Security Essentials: Firewalls, SELinux, and IP Tables -Managing Network Interfaces in Kali Linux

Lab Exercises:

1. Perform Network Scanning with nmap
2. Monitor Network Traffic using tcpdump and wireshark
3. Configure and Test Firewall Rules with iptables

MODULE - V USER MANAGEMENT AND SCRIPTING IN KALI LINUX 7

Managing Users and Groups in Kali Linux- User Authentication and Password Management- Shell Scripting for Automation in Kali Linux- Automating Security Tasks using Scripts

Lab Exercises:

1. Create and Manage Users and Groups using useradd, usermod, and passwd
2. Write Shell Scripts for Automated Backup or Network Monitoring

MODULE - VI ADVANCED TOPICS AND USE CASES 8

Penetration Testing Workflow in Kali Linux- Advanced Tools in Kali Linux: Metasploit, Wireshark, and Burp Suite- Best Practices for Security and Incident Response-Future Trends in Operating Systems and Cyber Security

Lab Exercises:

1. Conduct a Penetration Testing Simulation with Metasploit
2. Capture and Analyze Packets with Wireshark
3. Perform Vulnerability Scanning using Kali Tools

TOTAL : 45 PERIODS

TEXT BOOKS:

1. "Operating System Concepts" by Abraham Silberschatz, Peter B. Galvin, Greg Gagne (10th Edition, 2018).
2. "Kali Linux Revealed" by Raphael Hertzog, Jim O'Gorman, and Mati Aharoni (2017).

REFERENCE BOOKS:

1. "Modern Operating Systems" by Andrew S. Tanenbaum and Herbert Bos (4th Edition, 2015).
2. "The Linux Command Line: A Complete Introduction" by William E. Shotts (2nd Edition, 2019).

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NPTEL Courses:

1. Operating System
2. Cyber Security

OUTCOMES

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

1. Apply the core operating system concepts and their applications in Kali Linux. (K3)
2. Implement process management and scheduling algorithms. (K3)
3. Explain the process, memory, and file management mechanisms in Kali Linux.(K3)

CO – PO, PSO MAPPING:

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

SEMESTER - IV

24CSPC401 106104028 SDG NO. 4	THEORETICAL COMPUTER SCIENCE	L	T	P	CP	C
		3	0	0	3	3

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 -Table Filling Algorithm.

MODULE - II 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.

MODULE - III PUSHDOWN AUTOMATA & TURNING MACHINE 8

Definition of the Pushdown Automata –Equivalence of Pushdown Automata and CFG - Deterministic Pushdown Automata - Turing Machines – Programming Techniques for Turing Machine - Non Recursive Enumerable (RE) Language – Undecidable Problem with RE.

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MODULE - IV INTRODUCTION TO COMPILERS & LEXICAL ANALYSIS 7

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

MODULE - V SYNTAX ANALYSIS 7

Role of the parser- Top Down parsing – Recursive Descent Parsing – Predictive LL(1) Parsing – Bottom-up parsing – Shift Reduce Parsing – LR Parsers – SLR Parser – LALR -Error Handling and Recovery in Syntax Analyzer-YACC.

MODULE - VI CODE GENERATION & CODE OPTIMIZATION 8

Intermediate languages – Declarations – Assignment Statements – Boolean Expressions – Case Statements –BackPatching – Procedure calls.-Issues in the design of code generator – The target machine - Basic Blocks and Flow Graphs - DAG Representation of Basic Blocks.- Principal Sources of Optimization – Peep-hole optimization - DAG Optimization of Basic Blocks

TOTAL : 45 PERIODS

TEXT BOOKS:

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

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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

OUTCOMES

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

1. Determine the models of computation and construct automata (K3)
2. Construct Regular Expression for any pattern and develop Context Free Grammar for any given language (K6)
3. Develop and understand the language of PushDown Automata and Turing machine (K6)
4. Interpret the role of each phase of a compiler and Lexical Analyzer (K5)
5. Construct parsers like top-down, bottom-up for a given grammar (K6)
6. Develop semantic analyzer, code generation and code optimization to get the optimized code (K6)

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	3	2	-	-	-	-	-	-	-	2	2
CO3	3	3	3	3	-	-	-	-	-	-	-	2	2
CO4	3	3	3	3	-	-	-	-	-	-	-	2	2
CO5	3	3	3	3	-	-	-	-	-	-	-	2	2
CO6	3	3	3	3	-	-	-	-	-	-	-	2	2

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Meeting No. 8 Dated: 9/04/25

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SEMESTER - IV

24ITPW301 106106220 SDG NO. 4 & 9	DATABASE MANAGEMENT SYSTEMS WITH LABORATORY	L	T	P	CP	C
		3	0	2	5	4

OBJECTIVES:

- To design database and database queries using ER diagrams and SQL respectively
- To understand Dependencies and various types of normalization in database application
- To understand the concepts of concurrent Transaction Processing and recovery procedures
- To understand the cursor, procedure and control structure in PL/SQL
- To obtain knowledge about the Distributed, Object Databases ,XML and NOSQL databases

MODULE - I DATABASE DESIGN AND RELATIONAL DATABASES 8

Purpose of Database System–Views of Data–Database System Architecture-Data Models–Entity Relationship Model–ER Diagrams–Enhanced ER Model-Introduction to Relational Databases – Relational Model-ER-to-Relational Mapping– Keys –Relational Algebra – SQL Fundamentals

MODULE - II FUNCTIONAL DEPENDENCIES AND NORMALIZATION 7

Functional Dependencies–Non-loss Decomposition – First – Second - Third Normal Forms - Dependency Preservation – Boyce/Codd Normal Form – Multi Valued Dependencies and Fourth Normal Form–Join Dependencies and Fifth Normal Form

MODULE - III PL/SQL PROGRAMMING 9

Introduction of PL/SQL -Advantages of PL/SQL- PL/SQL Block Structure, PL/SQL Data Types, Variable, Constant- Control Structure- Conditional Control, Iterative Control, Sequential Control- Exception handling Predefined Exception, User defined Exception-Cursors- Implicit and Explicit Cursors, Declaring, opening and closing cursor, fetching a record from cursor ,cursor for loops, parameterized cursors- Procedures- Advantages, Create, Execute and Delete a Stored Procedure.

MODULE - IV CONCURRENT TRANSACTION PROCESSING 7

Transaction Concepts – ACID Properties – Schedules – Serializability – Concurrency Control–Need for Concurrency–Locking Protocols–Two Phase

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Locking–Deadlock–Transaction Recovery–Save Points–Isolation Levels– SQL Facilities for Concurrency and Recovery.

MODULE - V FILE ORGANIZATION AND QUERY PROCESSING **7**

RAID – File Organization – Organization of Records in Files – Indexing and Hashing –Ordered Indices – B+ Tree Index Files – B Tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Algorithms for SELECT and JOIN operations – Query optimization using Heuristics - Cost Estimation.

MODULE - VI OBJECT ORIENTED DATABASE, XML DATABASE AND NOSQL **7**

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–Xquery. Introduction to NoSQL-Four types of NoSQL database

LIST OF EXPERIMENTS 15

1. Data Definition Commands, Data Manipulation Commands for inserting, deleting, updating and retrieving Tables and Transaction Control statements.
2. Database Querying–Simple queries, Nested queries, Sub queries and Joins.
3. Implementation of Views, Sequences and Synonyms.
4. Implicit and Explicit Cursors
5. Procedures and Functions.
6. Triggers.
7. Exception Handling
8. Develop any one application using the following steps

i) Database Design using ER Model

ii) Normalization

iii) Front End and Back End Design and connectivity

TOTAL : 60 PERIODS

TEXT BOOKS:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Seventh Edition, Tata McGraw Hill, 2020.
2. Ramez Elmasri, Shamkant B.Navathe, "Fundamentals of Database Systems",SeventhEdition,PearsonEducation,2016.

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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 Education,2015.
3. G.K.Gupta,"Database Management Systems",Tata McGrawHill,2011.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc19_cs46/
2. http://www.nptelvideos.in/2012/11/database-management-system.html
3. https://www.classcentral.com/course/swayam-database-management-system-9914
4. http://learnsql.com
5. https://www.w3schools.com/sql/default.asp
6. https://www.khanacademy.org/computing/computer-programming/sql

OUTCOMES

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

1. Sketch the principles of Relational databases to design the Entity relationship diagrams for any given scenario. (K3)
2. Demonstrate the use of normalization and functional dependencies to refine the database system. (K4)
3. Implement basic control structures, Exceptions, Cursors, Procedures in PL/SQL. (K3)
4. Examine various SQL queries for Transaction Processing and Locking using the concept of Concurrency control. (K3)
5. Demonstrate indexing and hashing techniques for the organization of databases and to perform advanced query processing. (K5)
6. Examine the various types of modern and traditional databases (K4)

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Meeting No. 8 Dated: 3/9/24

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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	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

Recommended by
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Meeting No. _____ Dated: _____

SEMESTER - IV

24HSNC401 - SDG NO. 4	NCC COURSE LEVEL 3	L	T	P	CP	C
		3	0	0	3	0

ARMY WING

PERSONALITY DEVELOPMENT **9**

PD 3 Group Discussion: Team Work 2

PD 4 Career Counselling, SSB Procedure & Interview Skills 3

PD 5 Public Speaking 4

BORDER & COASTAL AREAS **4**

BCA 2 Security Setup and Border/Coastal management in the area 2

BCA 3 Security Challenges & Role of cadets in Border management 2

ARMED FORCES 3

AF 2 Modes of Entry to Army, CAPF, Police 3

COMMUNICATION **3**

C 1 Introduction to Communication & Latest Trends 3

INFANTRY **3**

INF 1 Organisation of Infantry Battalion & its weapons 3

Recommended by
Board of Studies of H&S dept.
Meeting No. 6 Dated: 30/08/2024

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Department of Humanities & Sciences

MILITARY HISTORY **23**

MH 1	Biographies of Renowned Generals	4
MH 2	War Heroes - PVC Awardees	4
MH 3	Study of Battles - Indo Pak War 1965, 1971 & Kargil	9
MH 4	War Movies	6

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

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

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AIR FORCE WING		
PERSONALITY DEVELOPMENT		**9**
PD 3	Group Discussion: Team Work	2
PD 4	Career Counselling, SSB Procedure & Interview Skills	3
PD 5	Public Speaking	4
BORDER & COASTAL AREAS		**4**
BCA 2	Security Setup and Border/Coastal management in the area	2
BCA 3	Security Challenges & Role of cadets in Border management	2
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

Recommended by
Board of Studies of HAS dept.
Meeting No. 6 Dated: 30/05/2019

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Department of Humanities & Sciences

SEMESTER - IV

24CSPT401 - SDG NO. 4 & 9	OBJECT ORIENTED PROGRAMMING LABORATORY WITH THEORY	L	T	P	CP	C
		1	0	4	5	3

MODULE - I INTRODUCTION TO OOP AND JAVA FUNDAMENTALS 9

Object Oriented Programming – Abstraction – Objects and Classes –Encapsulation– Inheritance – Polymorphism– Characteristics of Java – The Java Environment – Java Source File – Compilation – Fundamental Programming Structures in Java – Defining Classes in Java – Constructors Methods -Access Specifiers– Static Members – Comments - Data Types –Variables – Operators - Control Flow - Arrays - Packages – Javadoc Comment

LIST OF EXPERIMENTS

1. Write a program to find the sum of individual digits of a positive integer.
2. Write a program to generate the first n terms of the sequence.
3. Write a program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.
4. Write a program to find both the largest and smallest number in a list of integers.
5. Write a Java program to implement a package for currency, distance and time converter.

MODULE - II INHERITANCE AND INTERFACES 8

Inheritance – Superclasses– Subclasses –Protected Members – Constructors in SubClasses– The Object Class – Abstract Classes and Methods– FinalMethods and Classes – Interfaces – Defining an Interface – ImplementingInterface - Differences Between Classes and Interfaces - Extending interfaces –Object Cloning - Inner Classes - Strings.

LIST OF EXPERIMENTS

1. Write a Java program that creates a class hierarchy for employees of a company. The base class should be Employee, with subclasses Manager, Developer, and Programmer. Each subclass should have properties such as name, address, salary, and job title. Implement methods for calculating bonuses, generating performance reports, and managing projects.
2. Write a Java Program to create an abstract class named Shape that contains two integers and an empty method named print Area(). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of the classes contains only the method print Area () that prints the area of the given shape. Use interfaceConcept.

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

a. Find the string index.

b. Compare two strings.

c. Retrieve the single character from sting.

d. Find the substring of the given string.

e. Split the string.

MODULE - III EXCEPTION HANDLING AND I/O 7

Exceptions – Exception Hierarchy – Throwing and Catching Exceptions – BuiltIn Exceptions - Creating Own Exceptions - Stack Trace Elements - Input /Output Basics – Streams – Byte Streams and Character Streams – Reading and Writing Console – Reading and Writing Files.

LIST OF EXPERIMENTS

1. Create a Custom Exception for Invalid Age Input in a Voting System.
2. Design a Java interface for ADT Stack. Implement this interface using an array. Provide necessary exception handling in both the implementations.
3. Write a Java Program that opens a file using FileReader and handles FileNotFoundException and IOException.
4. 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.
5. Write a Java program that reads a file name from the user, displays information about whether the file exists, whether the file is readable, or writable, the type of file and the length of the file in bytes.

MODULE - IV MULTI-THREADING AND GENERIC PROGRAMING 7

Differences between Multithreading and Multitasking - Thread Life Cycle - Creating Threads - Synchronizing Threads - Inter-Thread Communication - Daemon Threads - Thread Groups - Java Concurrency Packages - Generic Programming – Generic Classes – Generic Methods – Bounded Types – Restrictions and Limitations.

LIST OF EXPERIMENTS

1. Write a Java Program to calculate the sum of the array using Multithreading.
2. Write a Java program to create a producer-consumer scenario using the wait() and notify() methods for thread synchronization.
3. Write a Java Program to implement to create multiple threads which prints the message alternatively.
4. 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.

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5. Write a Java Program using Generic Classes to count the number of occurrences of the element in a list.

MODULE - V GUI PROGRAMMING WITH SWINGS 7

Swing – Jframe, Jlabel, Jbutton, Jpanel – Handling Events – ActionListener – Layouts – Swing Components - JTextField, JCheckBox, JRadioButton, JcomboBox – Menu and Menubar – Dialog Box – Model –View Controller (MVC) – File Handling – Creating applications.

LIST OF EXPERIMENTS

1. Create a simple GUI that changes the background color of a panel based on button clicks using Swing components.
2. Write a Java Program to build a Calculator in Swings
3. Write a Java program to design student registration form using Swing controls.
4. Write a Java Program to display Digital Watch using Swings.
5. Write a Java Program using Swings to develop a simple inventory management system that allows users to add, remove, and update inventory items.

MODULE - VI LAMBDA EXPRESSIONS AND REACTIVE PROGRAMMING 7

Lambda expressions – Library Enhancements to Support Lambdas – No Parameter-Single Parameter - Multiple Parameters – With or Without Return Keyword-Comparator– Filter Collection Data-Streams-Generating Streams-Java Stream Interface Methods – For eachMap-Filter-Limit-Sorted.

LIST OF EXPERIMENTS

1. Write a Java Program to sort a list of Strings using Lambda function.
2. Write a Java Program to use map () to double each element in a list using Lambda.
3. Write a Java Program to filter even numbers from an ArrayList using Collections.
4. Write a Java program that concatenates all strings in a list into a single string using lambda expression.
5. Write a Java Program to create a stream that emits a sequence of numbers (e.g., 1 to 5) using a transformation operator.

LAB REQUIREMENTS:

1. Standalone desktops with Systems with either Netbeans or Eclipse / Windows operating system / JDK 1.8, 30 Nos..

TOTAL : 45 PERIODS

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TEXT BOOKS:

1. Herbert Schildt, "Java - The Complete Reference", 8 Edition, McGrawHill Education, 2011.
2. E.Balagursamy- "Programming with Java", 6 Edition, McGrawHill Education, 2019.

REFERENCES:

1. Paul Deitel, Harvey Deitel, "Java SE 8 for Programmers", 3 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. Kathy Sierra, Bert Bates, Trisha Gee, "Head First Java", 3rd Edition, O'Reilly, 2022.
5. Joshua Bloch, " Effective Java", Third Edition, Addison Wesley, 2018.

WEB REFERENCES:

1. https://www.w3schools.com/java/java_oop.asp
2. https://www.edureka.co/blog/object-oriented-programming/
3. https://www.ntu.edu.sg/home/ehchua/programming/java/J3a_OOPBasics.html

OUTCOMES

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

1. Comprehend Object Oriented Programming Concepts in Java. (K2)
2. Illustrate the purpose of packages, Java documents and Analyze the various types of Inheritance. (K2)
3. Construct the java applications using Java Exceptions and I/O Streams. (K3)
4. Understand the concept of Multithreading and Generic Classes in Java. (K2)
5. Apply the Object Oriented Programming Concepts to develop the Applications using Swings. (K3)
6. Make use of Lambda expressions, streams and reactive programming for real time applications. (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	-	-	-	-	-	-	-	3	2
CO2	3	3	3	2	-	-	-	-	-	-	-	2	3
CO3	3	3	3	2	-	-	-	-	-	-	-	3	2
CO4	3	1	3	2	-	-	-	-	-	-	-	2	2
CO5	3	2	3	2	-	-	-	-	-	-	-	3	2
CO6	3	2	3	2	-	-	-	-	-	-	-	3	2

SEMESTER - IV

24CIPT401 - SDG NO. 4 & 9	COMMUNICATION AND NETWORKING TECHNOLOGIES LABORATORY WITH THEORY	L	T	P	CP	C
		1	0	4	5	3

OBJECTIVES:

- To understand the protocol layering and physical level communication.
- To learn how to assess, select and customize communication.
- To understand networking technologies and standards.
- To control the network virus and provide security.
- To know how to apply various communication networks and develop an application.

MODULE - I INTRODUCTION TO NETWORKING & NETWORK MODELS 9

Networks – Types – OSI Model - Layers in OSI Model- TCP/ IP Protocol suite– Addressing- Performance – Transmission media – Switching – Circuit-switched Networks– Packet Switching- Communication Models- Client-Server- Publisher Subscriber- P2P

List of Experiments:

1. Simple Client Server Program
2. Implementation of IP address configuration.
3. Design and test Network Topology-Star, Bus, and Ring.

MODULE - II ARCHITECTURE & PROTOCOLS 8

AdHoc- WSN-MANET-VANET--Routing-Unicast, Multicast-IPV4&IPV6-MAC

List of Experiments:

1. To create scenarios and study the performance of networks with CSMA/CA protocol and compare with CSMA/CD protocols.

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CHAIRMAN Board of Studies Computer Science and Engineering (Internet of Things)

2. Implementation of distance vector routing algorithm.

MODULE - III COMMON NETWORK STANDARDS 7

802.11 & variants-Bluetooth & variants-802.15.4 & variants-Other Standards -NFC -LORA -DSRC, WAVE –Industrial & Automotive Networks –Vehicular networks (CAN, Modbus, Ethernet /Industrial Protocol,TTP/C, Flexray)

List of Experiments:

1. Bluetooth-based Appliance Control
2. Read temperature/humidity and upload to the cloud via Wi-Fi.

MODULE - IV NETWORK SECURITY & PRIVACY 7

Issues & Challenges - Security attacks - Security solutions- Electronic MailSecurity– PGP-S/MIME – IPSecurity – Web Security – System Security-Intruders - Malicious Software - Cloud Security – Transport Level Security

List of Experiments:

1. To encrypt and decrypt a file using public-key cryptography.
2. To configure basic firewall rules using ip tables.
3. To observe the Transport Layer Security (TLS) handshake in HTTPS communication.

MODULE - V EMERGING NETWORKING PARADIGMS 7

Basics of Internet of Things (IoT) networking-Deploying virtual network functions in a controlled environment, CASE STUDY:5G/6G Mobile Network Architecture and its applications.

List of Experiments:

1. Demonstrates typical IoT communication over network protocols.

MODULE - VI CASE STUDY & TOOLS 7

Asset Management, Industrial Automation, Smart Grid, Commercial Building Automation, Smart Cities

List of Experiments:

1. Motion sensors to turn off lights when no one is in a room.
2. Smart traffic lights that adapt to real-time congestion data.
3. RFID or GPS tracking of assets.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Fifth Edition, Morgan Kaufmann Publishers Inc, 2012.

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2. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6:The Evolving World of M2M Communications",ISBN:978-1-118-47347-4,Willy Publications,2016.
3. Behrouz A. Forouzan, "Data communication and Networking", Fifth Edition, Tata McGraw Hill, 2013.
4. Jan Holler, "From Machine to Machine to the Internet of Things", first edition academic Press,2014.

REFERENCE BOOKS

1. William Stallings, "Data and Computer Communications", Tenth Edition,PearsonEducation, 2014.
2. Nader F. Mir, "Computer and Communication Networks", Second EditionPrenticeHall, 2014.

WEB RESOURCES:

1. https://www.tutorialspoint.com/data_communication_computer_network/data_communication_computer_network_tutorial.pdf.
2. https:// www. khanacademy. org/ computing/ computers- and-internet/xcae6f4a7ff015e7d:the-internet/xcae6f4a7ff015e7d:connecting-networks/a/computer-networks-overview.
3. https://csc-knu.github.io/sys-prog/books/Andrew%20S.%20Tanenbaum%20-%20Computer%20Networks.pdf

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_cs19/preview.
2. https://onlinecourses.swayam2.ac.in/cec21_cs04/preview.
3. https://onlinecourses.nptel.ac.in/noc20_cs69/preview.

OUTCOMES

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

1. Apply networking concepts to build and manage data communication systems (K3)
2. Demonstrate communication standards in network-based applications. (K3)
3. Analyze and evaluate system components and workflows for effective optimization (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	1	2	1	1	-	1	-	-	1	2
CO2	3	2	2	1	2	1	1	-	1	-	-	1	2
CO3	3	2	2	1	2	1	1	-	1	-	-	1	2

SEMESTER - IV

24CITP401 - SDG NO. 4	APTITUDE SKILLS - II	L	T	P	CP	C
		0	0	2	2	0

PROBLEM SOLVING USING JAVA - PHASE 1

OBJECTIVES:

- Develop strong algorithmic problem-solving skills using Java
- Enable students to analyze problems and design efficient solutions
- Familiarize students with coding patterns used in technical interviews and prepare students for competitive programming and placement coding rounds

MODULE - I FOUNDATIONS OF JAVA PROBLEM SOLVING 16

Competitive programming mindset, Understanding problem statements and constraints, Java input and output handling, Time and space complexity, Asymptotic notations, Loop and recursion analysis, Arrays and strings problem patterns, Prefix sum, Sliding window, Two-pointer techniques.

MODULE - II SEARCHING, SORTING AND ADVANCED TECHNIQUES 15

Binary search patterns, Search on answer technique, Sorting-based problem solving, Stack and queue applications, Monotonic stack, Simulation problems, Recursion templates, Backtracking framework, Constraint-based problem solving.

MODULE - IIIDYNAMIC PROGRAMMING, GREEDY AND GRAPH BASICS14

Dynamic programming principles, Memorization and tabulation, One-dimensional and two-dimensional DP problems, Greedy strategies, Interval problems, Graph traversal basics – BFS and DFS, Competitive coding strategies.

TOTAL: 45 PERIODS

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REFERENCES:

1. Herbert Schildt, Java: The Complete Reference, McGraw Hill.
2. E. Balagurusamy, Programming with Java, McGraw Hill Education

ONLINE RESOURCES

1. LeetCode – https://leetcode.com
2. HackerRank – https://www.hackerrank.com
3. GeeksforGeeks – Java and DSA Track

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

OBJECTIVES:

- Explore core domain BIS standards related to Information security and AI.
- Implement strategies to learn career and managerial skills for career growth.

MODULE - I JEEVAN KAUSHAL 2.0 – CAREER SKILLS AND MANAGERIAL SKILLS **14**

Group Discussion Skills - Meaning and Methods of Group Discussion - Procedure of Group Discussion - Group Discussion - Simulation - Group Discussion - Common Errors.

Managerial Skills - Basic Managerial Skills - Planning for effective management - How to organize teams? - Recruiting and retaining talent - Delegation of tasks - Learn to coordinate - Conflict management - Self-management Skills - Understanding self-concept - Developing self-awareness - Self-examination - Self-reflection and Introspection - Self-regulation.

Entrepreneurial Skills - Basics of Entrepreneurship - Meaning of entrepreneurship – Classification and types of entrepreneurships - Traits and competencies of entrepreneur -. Creating Business Plan - Problem identification and idea generation - Idea validation - Pitch making.

Managing Personal Finance - Budgeting - Setting personal goals - Estimate likely expenses Monitor spending to obtain the most value for the available funds - Saving and Investing - Advantages of saving money - Concept of present and future value of money.

MODULE - II RANGER AND ROVER **10**

Scouting for Boys: Scout Craft, Campaigning.

Knots: Managing of rope, types of ropes and uses, Basic Knots: - Clove Hitch, Reef Knot, Fisherman knot, Sheet bend, Bowline, Sheep shank, whippings.

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Growing Together: Understanding the growth context.
Intergenerational Dialogue: How to enhance learning and cooperation across generations.

MODULE - III INFORMATION SECURITY & ARTIFICIAL INTELLIGENCE 6

Information security, network security and privacy protection: Introduction to the standards and concepts related to security [CIA (Confidentiality, Integrity, and Availability)] and privacy.

Software - Quality Assurance, Life Cycle & Testing: Introduction to Software life cycle processes and Software Testing (IS 16124 and IS 11291).

Artificial Intelligence: Introduction to the concepts of Artificial Intelligence and related standards:

- Overview of trustworthiness in artificial intelligence.
- Framework for Artificial Intelligence (AI) Systems Using Machine Learning (ML).
- AI system life cycle processes.
- Data life cycle framework.

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/214175?force_course_hub=true
2. https://lms.scout.org/courses/show/214194?force_course_hub=true

OUTCOMES

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

1. Interpret problem statements and develop Java programs with appropriate complexity analysis.
2. Apply array, string, searching, sorting, stack, and queue based problem-solving techniques.
3. Design solutions using recursion, backtracking, and dynamic programming approaches.
4. Solve real-time and placement-oriented problems using greedy techniques and graph traversal basics.

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5. Demonstrate career and managerial skills. (K2)
6. Understand BIS standards for Information security and AI domain. (K2)

CO – PO, PSO MAPPING:

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

SEMESTER - IV

24CIID401 - SDG NO. 4,11,15	INNOVATIVE DESIGN LAB - II	L	T	P	CP	C
		0	0	2	2	1

OBJECTIVES:

- To empower students to transform innovative ideas into viable venture blueprints through structured entrepreneurial exploration and opportunity framing.
- To provide experiential learning in adaptive product evolution by focusing on user-centric redesign, iterative testing, and technical refinement.
- To develop proficiency in assessing market traction, decoding customer behavior, and aligning product strategy with investment-readiness metrics.
- To instill a foundation of ethical entrepreneurship by integrating inclusive design principles, sustainability values, and responsible leadership.
- To enable data-driven innovation by leveraging field research, applying performance analytics, and integrating emerging technologies for solution optimization.
- To facilitate multidisciplinary problem-solving through advanced engineering integration, MVP systemization, and standards-compliant validation.

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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, focusing on the practical execution and refinement of entrepreneurial ventures.
2. The project work must involve the continuous development, iterative enhancement, and potential launch of an entrepreneurial solution. It must also include appropriate elements of the following: compliance with advanced engineering standards, iterative design analysis, enhanced prototyping, robust experimentation, real-world user feedback collection, data correlation, and advanced software/hardware development for the solution.
3. Projects can be individual work or group projects, with a maximum of Three students. In case of a group project, each student must submit an individual project report clearly specifying their unique contributions to the collective work.
4. On completion of the project, the student shall submit a detailed project report encompassing the evolution of their venture, technical implementation, market validation, and future roadmap. The project shall undergo a formal review process, after which the report will be evaluated. Students shall appear for a mandatory viva-voce examination on the project, approved jointly by the Coordinator and the respective project guide.

EVALUATION:

1. First evaluation (Immediately after first internal examination): 20 marks (Focus on refined problem statement, advanced MVP design, and detailed development plan)
2. Second evaluation (Immediately after second internal examination): 30 marks (Focus on prototype/MVP implementation, initial testing, and preliminary market validation results)
3. Final evaluation (Last week of the semester): 50 marks (Focus on the complete refined solution, comprehensive market validation, growth strategy, final project report, and 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 structured entrepreneurial exploration to convert innovative ideas into venture blueprints, incorporating user-centric and iterative design approaches. (K4)

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2. Assess customer behavior and market traction to align product strategies with ethical and sustainable entrepreneurship principles. (K5)
3. Integrate multidisciplinary knowledge, field data, and emerging technologies to optimize and validate engineered solutions. (K6)

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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SEMESTER V

COURSE CODE: 24CIPW501	VIRTUALIZATION AND CLOUD COMPUTING WITH LABORATORY	L	T	P	CP	C
		3	0	2	5	4
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 8, 9				
PRE-REQUISITE COURSES	24CIPT401, 24ITPW401					

OBJECTIVES:

- To understand the fundamentals of cloud computing and cloud architectures.
- To classify virtualization techniques and hypervisor architectures.
- To apply virtualization techniques to optimize memory, I/O, networking, and storage resources.
- To analyze virtualized computing for efficient resource management.
- To explore virtualization applications in cloud and distributed computing

MODULE - I CLOUD COMPUTING FOUNDATIONS & ARCHITECTURES 8

Evolution of Cloud Computing – System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture –Cloud Service Models (IaaS, PaaS, SaaS) – Deployment Models (Public, Private, Hybrid Clouds) – On-Demand Resource Provisioning – Commercial Cloud Platforms (Google App Engine, Amazon AWS) – Open-Source Cloud Platforms (OpenStack, Eucalyptus, Open Nebula, Nimbus).

MODULE - II FUNDAMENTALS & TAXONOMY OF VIRTUALIZATION 9

Overview: Why server virtualization –History and re-emergence, Classic virtual machines; VMware, VSphere, KVM, Xen; Taxonomy and basic principles, Architectures comparison - CPU virtualization -Privileged instructions handling - Hypervisor – Para virtualization. Hardware-assisted virtualization. Booting up. Time keeping. CPU scheduling. Commercial examples.

MODULE - III MEMORY MANAGEMENT IN VIRTUALIZATION 7

Memory management in virtualization: Virtual Storage, partitioning –reclamation – ballooning. Memory sharing. OS-level virtualization –VMWare–RedHatEnterprise Virtualization.

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MODULE - IV I/O VIRTUALIZATION 7

I/O virtualization: Virtualizing I/O devices -Monolithic model -virtual I/O server. Virtual networking –Tunneling –overlay networks. Commercial examples. Virtual storage: Granularity –Centralized and Distributed File system, system level, Blocks level.

MODULE - V VIRTUALIZED COMPUTING 7

Virtualized computing: Virtual machine based distributed computing, Elastic cloud computing, clustering, Cold and hot migration. Commercial examples. Challenges and future trends.

MODULE - VI APPLICATIONS 7

Virtualization and its applications: In distributed computing: Grid and Cloud, Virtual Machine Provisioning, Desktop Virtualization, Application Virtualization, Security for virtualized environments, Business Continuity in virtual environments..

LIST OF EXPERIMENTS 15

1. Install and configure Oracle Virtual Box or VMware Workstation, and create virtual machines by installing different operating systems such as Linux or Windows.
2. Install and configure a C compiler in the virtual machine and execute basic C programs to verify the development environment.
3. Install KVM in Linux.
4. Install and configure Google App Engine (GAE), and develop simple web applications such as a Hello World application using Python or Java.
5. Configure Virtual Disk Expansion, Snapshot Management, and RAID Storage
6. Install Desktop Virtualization using VNC 18 and Chrome Remote Desktop.
7. Install, configure, and explore Microsoft Azure by creating and managing virtual machines and other cloud resources.
8. Create and Configure VLANs in Cisco Packet Tracer.

TOTAL: 60 PERIODS

TEXT BOOK:

1. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.

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Computer Science and Engineering
(Internet of Things)

2. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010. 3.Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.

REFERENCE BOOKS:

1. Jim Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
2. Danielle Ruest, Nelson Ruest, "Virtualization: A Beginner"s Guide", McGraw-Hill Osborne Media, 2009.

OUTCOMES

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

1. Apply cloud computing architectures, service models, virtualization technologies, and hypervisor concepts to deploy and manage virtualized cloud computing environments. (K3)
2. Utilize memory management, I/O virtualization, virtual networking, and virtual storage techniques to configure and optimize resource utilization in virtualized computing environments. (K3)
3. Compare virtualized computing techniques and virtualization applications to assess their effectiveness in supporting distributed computing, resource management, security, and business continuity. (K4)
4. Make use of virtualization platforms to configure virtual machines, install development tools, and deploy basic cloud applications using Google App Engine. (K3)
5. Examine cloud application deployment and custom scheduling algorithms in CloudSim to determine their impact on cloud resource allocation and execution efficiency. (K4)
6. Contrast cloud resource provisioning and energy-efficient virtualization techniques using Microsoft Azure and GreenCloud to evaluate their effectiveness in cloud data centers. (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	2	2
CO2	3	-	-	-	2	-	-	-	-	-	1	2	2
CO3	2	2	-	-	1	-	-	-	1	-	2	2	2
CO4	2	-	-	-	2	-	-	1	1	-	2	2	2
CO5	2	2	-	-	2	-	-	1	1	-	2	2	2
CO6	2	2	-	-	2	-	-	1	1	-	2	2	2

SEMESTER V

COURSE CODE: 24HSMG501	PRINCIPLES OF ENGINEERING MANAGEMENT	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.1	SDG NO. 4,8,9,10,12				
PRE-REQUISITE COURSES	-					

OBJECTIVES:

- To Understand the Basic Management Concepts and Principles in Corporate Practices.
- To Apply Management Functions Innovatively in Organizational Practices, globally.

MODULE - I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 8

Management – Science or Art – Manager Vs Entrepreneur – types of managers – Engineers as Managers. Evolution of Management – Scientific, human relations, system and contingency approaches – Types of Business organization – Sole proprietorship, partnership, company-public and private sector enterprises – Organization culture and Environment – Current issues and future trends in Management; Industry 5.0 – Engineering management in modern business.

Recommended in Board of Studies (BoS) Meeting No. 06 **held on** 08/06/2026

Dr. K.MARAN, MBA., Ph.D.,
Professor & Director
Sai Ram Institute of Management Studies
Sri Sai Ram Engineering College
Chennai, Tamil Nadu, India.

MODULE - II PLANNING **8**

Planning, Technology Planning - Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – MBO – process - Principles and functions of engineering management – Planning Tools and Techniques – Decision-making steps and process.

MODULE - III ORGANISING **8**

Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority – centralization, and decentralization – Job Design – Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning, and management.

MODULE - IV DIRECTING AND CONTROLLING **7**

Foundations of individual and group behaviour – Motivation – theories and techniques–Leadership – Level 5 leadership - theories – Leadership as a determinant of Engineering management - Communication – process, and barriers – effective communication – Communication and IT - System and process of controlling – budgetary and non-budgetary control techniques.

MODULE - V INNOVATION AND TECHNOLOGY MANAGEMENT **7**

Innovation management of Products and Services, Role of R & D in Entrepreneurship, Breakthrough Innovation, Disruptive Innovation – Modern approaches in Engineering management – Green management, Lean management, Managing diversity. IPR – Principles of Ethics for Engineering Managers.

MODULE - VI MODERN MANAGEMENT FRAMEWORKS AND AI APPLICATIONS **7**

SWOT Analysis - PESTLE Analysis - Agile Management Principles - Design Thinking for Problem Solving - AI in Workforce Analytics and Performance Management - Generative AI for Knowledge Management and Innovation - Ethical and Responsible AI in Management.

TOTAL : 45 PERIODS

TEXTBOOKS:

1. Tripathy, P.C. and Reddy, P.N., Principles of Management, McGraw-Hill Education, 2023 Edition.

Recommended in Board of Studies (BoS) Meeting No. 06 **held on** 08/06/2026

Dr. K.MARAN, MBA., Ph.D.,
Professor & Director
Sai Ram Institute of Management Studies
Sri Sai Ram Engineering College
Chennai, Tamil Nadu, India.

REFERENCES:

1. Robbins, S.P., Coulter, M.A. and Long, L., Management, 16th Edition, Pearson, 2025.
2. Stoner, J.A.F., Freeman, R.E. and Gilbert, D.R., Management, 6th Edition, Pearson Education.
3. Robbins, S.P., Coulter, M.A. and DeCenzo, D.A., Fundamentals of Management, 11th Edition, Pearson Global Edition, 2026.
4. Kreitner, R. and Mohapatra, M., Management, Cengage Learning India.
5. Koontz, H., Weihrich, H. and Cannice, M., Essentials of Management, 11th Edition, McGraw-Hill.
6. Iansiti, M. and Lakhani, K., Competing in the Age of AI, Harvard Business Review Press.
7. Osterwalder, A. and Pigneur, Y., Business Model Generation, Strategyzer.
8. Lewrick, M., Link, P. and Leifer, L., The Design Thinking Playbook, Wiley.

WEB RESOURCES:

1. https:// www. managementstudyguide. com/ organization-management.htm
2. https://nptel.ac.in/courses/110/105/110105034/
3. https://courses.lumenlearning.com/boundless-management/chapter/principles-of-management/

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/110/105/110105033/

OUTCOMES:

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

1. Explain the fundamental concepts, theories and evolution of management in engineering organizations. (K2)
2. Apply planning principles and decision-making techniques for organizational problem solving. (K3)
3. Analyze organizational structures and human resource management practices in engineering enterprises. (K4)
4. Demonstrate leadership, communication and control mechanisms for effective organizational performance. (K3)
5. Examine innovation, technology management, sustainability and ethical practices in engineering management. (K4)

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Tamil Nadu, India.

6. Apply modern management frameworks and AI-enabled managerial tools to support strategic and operational decisions. (K3)

CO - PO, PSO MAPPING:

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

SEMESTER V

COURSE CODE: 24MGMC501	CONSTITUTION OF INDIA	L	T	P	CP	C
		2	0	0	2	0
NPTEL CODE: -	SYLLABUS VERSION 1.1	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.

Recommended in Board of Studies (BoS) Meeting No. 06 **held on** 08/06/2026.

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Sri Sai Ram Engineering College
Chennai, Tamil Nadu, India.

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.

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

Recommended in Board of Studies (BoS) Meeting No. 06 **held on** 08/06/2026.

Dr. K.MARAN, MBA., PhD.,
Professor & Director
Sai Ram Institute of Management Studies
Sri Sai Ram Engineering College
Chennai, Tamil Nadu, India.

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

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)

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Sri Sai Ram Engineering College

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)

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: 24CIPT501	ARCHITECTURE AND PROGRAMMING IN IOT LABORATORY WITH THEORY	L	T	P	CP	C
		1	0	4	5	3
NPTEL CODE: noc26-cs161	SYLLABUS VERSION 1.0	SDG NO. 4, 8, 9				
PRE-REQUISITE COURSES	24CIPC301					

OBJECTIVES:

- To understand the basic concepts, architectures, technologies, and models of IoT and M2M systems.
- To learn about IoT hardware platforms, software tools, networking, gateways, and wireless communication technologies.

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- To know about IoT application development using sensors, embedded systems, operating systems, and wireless technologies for monitoring and automation.
- To acquire knowledge of IoT technologies for developing practical solutions involving data management, security, communication, cloud integration, and smart monitoring systems.

MODULE - I AN OVERVIEW OF IOT ARCHITECTURE

IoT Conceptual Framework - IoT Architectural View - Technology Behind IoT - Sources of IoT- IoT/M2M Systems Layers and Designs Standardization- Data Enrichment, Data Consolidation and Device Management at Gateway.

List of experiments:

1. Air and Noise Pollution Monitoring System Over IOT
2. Smart Agriculture IoT Monitoring System.

MODULE - II IOT TECHNOLOGY FUNDAMENTALS

Devices and gateways- Basic devices- Gateways- The need for networking- Wide area networking- Local area networking- Managing M2M data- IoT integration with enterprise systems- Distributed business processes in IoT- A knowledge management reference architecture- Retrieval layer.

List of experiments:

1. Smart Water Level and Quality Monitoring System.
2. IoT Based Heart Monitoring System Using ECG.

MODULE - III ARCHITECTURE REFERENCE MODEL

IoT reference model- IoT domain model- Information model- Functional Model-Device functional group - Communication functional group- IoT Service functional group- Virtual Entity functional group- IoT Service organization functional group- IoT Process Management functional group- Management functional group- Security functional group- Communication model- Safety, privacy, trust, security mode- Functional view- Information view.

List of experiments:

1. IOT based Manhole Detection and Monitoring System
2. IOT based Anti-theft Flooring System

MODULE - IV HARDWARE IOT IN PRACTICE

Hardware for the IoT- Classes of Constrained Devices- Hardware Platforms- TelosB- Zolertia Z1- OpenMote- Arduino- Raspberry Pi.

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List of experiments:

1. Smart Waste Bin Monitoring System
2. IoT Smart Parking Using RFID
3. IoT Water Pollution Monitor RC Boat

MODULE - V SOFTWARE FOR THE IOT

OpenWSN- TinyOS- FreeRTOS- TI-RTOS- RIOT- Contiki OS

List of experiments:

1. IOT Based Automatic Vehicle Accident Detection and Rescue System.
2. Weather Reporting Over IoT
3. IoT based Health Monitoring System

MODULE - VI WIRELESS MODULE 9

Introduction to XBee Wireless Module – Pin Configuration – Module and Router Configuration – Firmware Loading – XBee Network Setup and Testing – Raspberry Pi Sensor Hosting – Raspberry Pi Data Collector for XBee Sensor Nodes.

List of experiments:

1. IOT based Intelligent Gas Leakage Detector.
2. Food Quality Monitoring System using XBee /Raspberry Pi

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Jan Holler,VlasiosTsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand ,David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", Elsevier Science, 2014.
2. Simone Cirani, Gianluigi Ferrari,Marco Picone, Luca Veltri," Internet Of Things Architectures, Protocols And Standards", Wiley,2019.
3. Charles Bell, "Beginning Sensor Networks with XBee, Raspberry Pi and Arduino", Second Edition, Apress,2020

REFERENCES:

1. Raj Kamal, "Internet of Things Architecture and Design Principles", McGraw Hill Education (India) Private Limited, June 2022.
2. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.

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OUTCOMES:

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

1. Identify IoT architectures, concepts, models, and standards related to IoT and M2M systems (K3).
2. Apply IoT devices, gateways, networking, enterprise integration, and data management concepts in IoT systems (K3).
3. Demonstrate the use of IoT hardware platforms, operating systems, and software tools such as Arduino, Raspberry Pi, TinyOS, FreeRTOS, RIOT, and Contiki OS (K3).
4. Implement wireless communication using XBee modules, gateways, and sensor nodes in IoT applications (K4).
5. Design and develop IoT applications for sensing, monitoring, automation, and control using appropriate hardware and software platforms (K4).
6. Analyze IoT solutions with respect to communication, security, privacy, device management, and cloud-based data processing (K4).

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	-	-	-	-	-	1	-	-	2	2
CO3	3	-	2	-	-	-	-	-	1	-	-	2	2
CO4	3	2	2	-	-	-	-	2	-	-	-	2	2
CO5	3	3	2	-	-	-	-	2	-	-	-	2	2
CO6	3	2	2	-	-	-	-	2	-	-	-	1	2

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SEMESTER V

COURSE CODE: 24CITP501	SKILL ENHANCEMENT	L	T	P	CP	C
		0	0	2	2	1
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
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)

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6. Apply the concepts of IoT, Digital Twins, and related standards in identifying applications of connected systems in modern technologies. (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	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: 24CIID501	PROTOTYPE DEVELOPMENT LABORATORY – I	L	T	P	CP	C
		0	0	2	2	1
NPTEL CODE: -	SYLLABUS VERSION 1.1	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24ESID101, 24ESID201, 24SCID301, 24SCID401					

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.

Recommended in Board of Studies (BoS) Meeting No. 6 **held on** 9/4/2026

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- 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.

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)

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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

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 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

MODULE - V IOT APPLICATIONS **8**

Business Models for IoT – Smart Mobility – Industrial IoT – Healthcare-Activity Monitoring-Environmental Monitoring – Home Automation

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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

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)

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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.
- 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

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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

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

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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)
6. Examine real-time data processing frameworks and stream analytics techniques to determine their effectiveness in processing IoT data streams. (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	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.

TOTAL : 45 PERIODS

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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

Recommended in Board of Studies (BoS) Meeting No. 6 held on 8/4/2026

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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.
5. Peter Shirley, Michael Ashikhmin, Michael Gleicher, Stephen R Marschner, Erik Reinhard, KelvinSung, and AK Peters, "Fundamentals of Computer Graphics", CRC Press, 2010.

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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.

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

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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: 24ECEL501	SIMULATION TECHNIQUES FOR COMMUNICATION	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 108103191	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24ECPC301, 24BSMA401, 24ECPC402					

OBJECTIVES:

- To understand the simulation technique for signal representation and noise characterization in communication systems.
- To encourage students to model and analyse analog and digital communication systems around them and to confidently program in MATLAB
- To develop programming models for simulating communication systems.
- Use the libraries on R programming for real time analysis.

MODULE - I FUNDAMENTALS OF SIGNAL SIMULATION 7

Review of signal classification and representation - concept of Time domain and frequency domain analysis - simulation Environment and Programming - Introduction to Arrays, Vectors, and Matrices- Loops, branches, and control-flow- Data Visualization and Plotting -Examples - Generation and analysis of continuous and discrete signals -Signal visualization in time and frequency domains

MODULE - II NOISE CHARACTERIZATION 7

Noise sources – Noise figure, noise temperature and noise bandwidth – Noise in cascaded - systems. Representation of Narrow band noise –In-phase and quadrature components, Envelope and Phase Components – Noise performance analysis in AM & FM systems - Simulation of AM and FM SNR.

MODULE - III RANDOM VARIABLES AND WIRELESS CHANNEL MODELING 8

Review of different distribution functions - Introduction to wireless channels - -Rayleigh Distribution -Rician Distribution - computation of channel matrices- Matrix Operations in Communication Systems - Evaluation of Eigen values and vectors- Simulating Random Variables and distributions ; Simulation of fading channels.

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MODULE - IV SPREAD SPECTRUM TECHNIQUES AND VISUALIZATION 7

Direct Sequence spread spectrum- Pseudo Random sequence generator- Frequency hopping spread spectrum - 2-D and 3-D Signal Visualization - Surface Plots for Channel Characteristics - Simulation of spectral analysis

MODULE - V ANALYSIS OF DIGITAL MODULATION TECHNIQUES 8

Review of Digital Modulation Techniques:-BPSK-QPSK-QAM-BER Analysis in AWGN Channels - Simulink-Based Wireless Communication Models - Performance Evaluation using Monte Carlo Simulations - Examples -BPSK over AWGN channel - QPSK over Rayleigh channel -Simulink model of a wireless link

MODULE - VI INTRODUCTION TO R-PROGRAMMING 8

R-Programming - Data types and Structures- Control Statements- Loops - Doing Math and Simulation in R - Correlation and Covariance - Probability density and Distribution functions - Normal Distribution - Binomial Distribution - Poisson Distributions, Graphics- Creating Graphs- The Workhorse of R Base Graphics- the plot ( ) Function - Customizing Graphs- Saving Graphs to Files.

TOTAL : 45 PERIODS

BOOKS AND REFERENCES:

1. Rudra Pratap. Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers. Oxford University Press, Inc., USA, 2009.
2. Proakis, J.G., Salehi, M., Bauch, G., Contemporary Communication Systems Using MATLAB, Third edition, Cengage Learning, 2012.
3. Sheldon M. Ross, Introduction to Probability Models, (Twelfth Edition), Academic Press, 2019.
4. TheArt of R Programming,Norman Matloff,CengageLearning.
5. Lander, "R for Everyone",Pearson

OUTCOMES:

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

1. Apply MATLAB to develop scripts/functions for signal representation and data visualization. (K3)
2. Analyze the noise characteristics of cascaded communication systems to determine overall system performance using MATLAB. (K4)
3. Analyze and compute channel matrices for wireless systems and interpret their impact on signal transmission and reception using simulation. (K4)

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4. Examine the spectrum of DSSS and FHSS using simulation. (K4)
5. Examine and compare the Error performance of various modulation schemes over AWGN channels using analytical and simulation approaches. (K4)
6. Illustrate the data visualization tools and functions in R programming. (K3)

CO - PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVES - I

COURSE CODE: 24ECEL502	DIGITAL COMMUNICATION TECHNIQUES	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 117105144	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24ECPC402					

OBJECTIVES:

- To understand the basics of signal-space analysis and digital transmission.
- To understand the coherent and noncoherent receivers , equalizers and its impact on different channel characteristics.
- To understand the different block coded and convolutional coded digital communication systems.
- To understand the basics of Multicarrier, Multiuser Communications. and synchronization Techniques

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MODULE - I COHERENT AND NON-COHERENT COMMUNICATION 8

Coherent receivers – Optimum receivers in WGN – IQ modulation & demodulation – Noncoherent receivers in random phase channels; MFSK receivers – Rayleigh and Rician - channels – Partially coherent receivers – DPSK - BER Performance analysis.

MODULE - II CODING FOR DIGITAL COMMUNICATION - I 7

Binary block codes, Shannon's channel coding theorem. Channel capacity – Linear block codes, Cyclic codes, Syndrome calculation – Convolution Coding.

MODULE - III CODING FOR DIGITAL COMMUNICATION - II 7

Hamming Codes, Golay, BCH Reed – Solomon codes, Trellis diagram, Viterbi algorithm, Turbo Coding.

MODULE - IV MULTICARRIER COMMUNICATIONS 8

Single Vs multicarrier modulation, orthogonal frequency division multiplexing (OFDM), Modulation and demodulation in an OFDM system, An FFT algorithmic implementation of an OFDM system, Bit and power allocation in multicarrier modulation, Peak-to-average ratio in multicarrier modulation.

MODULE - V MULTIPLE ACCESS COMMUNICATION SYSTEM AND ARCHITECTURE 8

Multiple Access design flow-Demand Assignment Multiple Access- Access Algorithms – Multiple access Techniques with INTELSAT and LAN.

MODULE - VI SYNCHRONIZATION TECHNIQUES 7

Synchronization in context of digital communication- signal parameter estimation-Carrier Phase Estimation-Symbol Timing Estimation-Joint Estimation of Carrier Phase and symbol Timing-Frame synchronization and Network synchronization.

TOTAL : 45 PERIODS

TEXT BOOK

1. Bernard Sklar, "Digital Communications", second edition, Pearson Education, 2001.
2. Proakis, J. G., & Salehi, M. (2008). Digital communications (5th ed.). McGraw-Hill.

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REFERENCES:

1. M.K.Simon, S.M.Hinedi and W.C.Lindsey, "Digital communication techniques; Signal Design and Detection", Prentice Hall of India, New Delhi, 1995.
2. Richard Van Nee & Ramjee Prasad, "OFDM for Multimedia Communications" Artech House Publication, 2001.
3. Simon Haykin, "Digital communications", John Wiley and sons, 1998.
4. Stephen G. Wilson, "Digital Modulation and Coding", First Indian Reprint, Pearson Education, 2003.
5. Theodore S.Rappaport, 'Wireless Communications", 2nd edition, Pearson Education, 2002.

WEB REFERENCES

1. https://nptel.ac.in/courses/117105144
2. https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_ee58

OUTCOMES:

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

1. Apply the principles of coherent and noncoherent receivers in digital communication systems. (K3)
2. Analyze the process of syndrome calculation for identifying and correcting transmission errors in coded data. (K4)
3. Examine the structure and working principles of Trellis diagrams, Viterbi coding used in convolution coding techniques. (K4)
4. Examine the principle and operation of Orthogonal Frequency Division Multiplexing (OFDM) for high data rate transmission. (K4)
5. Differentiate various access algorithms based on their channel allocation and performance characteristics. (K4)
6. Examine various signal parameter estimation techniques used in digital communication receivers. (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	3
CO2	3	3	-	-	-	-	-	-	-	-	–	2	2
CO3	3	3	-	-	-	-	-	-	-	-	-	3	2
CO4	3	3	-	-	-	-	-	-	-	-	-	2	2
CO5	3	2	-	-	-	-	-	-	-	-	-	2	2
CO6	3	3	-	-	-	-	-	-	-	-	-	3	2

PROFESSIONAL ELECTIVES - I

COURSE CODE: 24ECEL503	STATISTICAL THEORY OF COMMUNICATION	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 117105085	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24BSMA301, 24ECPC301					

OBJECTIVES:

- To introduce the fundamental concepts of random processes and noise in communication systems.
- To impart knowledge on generalized harmonic analysis, specifically correlation and power density spectrums.
- To familiarize students with the statistical properties of random variables and ensembles.
- To provide an understanding and design of optimum linear system design for filtering and prediction.

MODULE - I GENERALIZED HARMONIC ANALYSIS 8

Periodic and Aperiodic Functions: Exponential form of Fourier Series, Fourier Transforms - Correlation and Autocorrelation of periodic and transient functions - Crosscorrelation - Convolution and Correlation relations - Introduction to Random Functions and the Wiener Theorem for Autocorrelation.

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MODULE - II PROBABILITY AND RANDOM VARIABLES 8

Basic Probability: Outcomes, Measure of Probability, Total and Compound Probability - Random Variables: Discrete and Continuous variables, Probability Densities, and Ensembles - Stationary Ensembles: Description at one and two points in time - Statistically dependent ensembles.

MODULE - III AVERAGES AND DISTRIBUTIONS 8

Statistical Averages: Moments, Variance, and Characteristic Functions - Joint Averages of multiple random variables - Common Distributions: Poisson Distribution and the Normal (Gaussian) Density - Transformation of probability densities - Equivalence of Time and Ensemble Averages (Ergodic Hypothesis).

MODULE - IV RANDOM PROCESSES AND POWER SPECTRUMS 7

Analytical determination of Correlation functions - Power Density Spectrums - Autocorrelation of rectangular waves and pulse-width modulated waves - Detection of periodic signals in noise by autocorrelation and crosscorrelation - Measurement of correlation functions and probability densities.

MODULE - V LINEAR SYSTEMS WITH RANDOM INPUTS 7

Instantaneous Input-Output relations - Unit-Impulse Response and System Function relations - Input-Output relations in Autocorrelation and Power Spectrum - Determination of linear system behavior by crosscorrelation - Sampling Theory: Variance of sample mean for discrete and continuous samples.

MODULE - VI OPTIMUM LINEAR SYSTEMS 8

The Filter Problem and the Mean-Square-Error Criterion - Minimization of the functional and the Wiener-Hopf Equation - Spectrum Factorization - Optimum Filtering and Prediction: Zero-lag filters and pure predictors - Errors in optimum systems and Irremovable Error.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Y. W. Lee, "Statistical Theory of Communication", John Wiley & Sons, Inc., 1960.
2. Lathi, B. P. (1968). Statistical theory of communication. John Wiley & Sons.

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REFERENCE BOOKS

1. N. Wiener, "The Extrapolation, Interpolation, and Smoothing of Stationary Time Series", John Wiley and Sons, 1949.
2. A. Papoulis, "Probability, Random Variables, and Stochastic Processes", McGraw-Hill.

WEB REFERENCES:

1. https://www.itsoc.org/resources/classic-papers
2. https://ocw.mit.edu/courses/6-041sc-probabilistic-systems-analysis-and-applied-probability-fall-2013/
3. https://mathworld.wolfram.com/Autocorrelation.html

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc23_ee102/preview
2. https://www.coursera.org/specializations/digital-communications
3. https://ocw.mit.edu/courses/6-450-principles-of-digital-communication-i-fall-2006

OUTCOMES:

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

1. Apply generalized harmonic analysis to characterize periodic and random signals. (K3)
2. Examine and differentiate between discrete and continuous random variables, and analyze their probability distributions and density functions. (K3)
3. Evaluate the power density spectrum and correlation properties of random processes. (K4)
4. Examine the response of linear systems to random signals using input-output theorems. (K4)
5. Analyze the impact of noise and statistical dependencies on communication systems. (K4)
6. Examine the optimum linear filters and predictors based on the mean-square-error criterion. (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	2
CO2	3	-	-	-	-	-	-	-	-	-	-	1	2
CO3	3	3	-	-	-	-	-	-	-	-	-	1	2
CO4	3	3	-	-	-	-	-	-	-	-	-	1	2
CO5	3	3	-	-	-	-	-	-	-	-	-	1	2
CO6	3	3	-	-	-	-	-	-	-	-	-	1	3

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.

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Artificial Intelligence and Data Science

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

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.

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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/

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)

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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	-	-	-	-	-	-	-	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

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.

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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.

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.

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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.
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

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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)
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

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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.

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

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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.

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.

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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
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)

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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 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

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architecture - Compose-Building IoT with Avatars: Avatar based IoT platform - Disruption tolerant communication-Context modeling and management - 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.

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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.

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)

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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).
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

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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.
- 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.

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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 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).

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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
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)

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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

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

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(Internet of Things)

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

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

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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)
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)

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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)

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

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

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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.

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.

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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
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)

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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

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

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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.

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.

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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.

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)

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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	-	-	-	-	-	-	-	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

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

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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

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.

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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

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: 24ECEL513	INFORMATION THEORY	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 117104129	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24BSMA401, 24ECPC402					

OBJECTIVES:

- To understand fundamental concepts of information measures such as entropy and mutual information.
- To learn source and channel coding techniques for efficient and reliable data transmission.
- To analyse error control coding methods for the detection and correction of errors in Communication systems.
- To explore advanced information theory concepts and modern coding techniques.

MODULE -I INFORMATION MEASURES & ENTROPY 8

Concept of information, Self-information and entropy, Joint, conditional entropy, Relative entropy (KL divergence), Mutual information, Chain rules and properties

MODULE - II SOURCE CODING 8

Coding concepts and objectives, Prefix codes, Kraft inequality, Shannon source coding theorem, Shannon–Fano coding, Huffman coding, Arithmetic coding, Lempel–Ziv coding

MODULE - III CHANNEL CAPACITY & COMMUNICATION CHANNELS 7

Discrete Memory less Channel (DMC), Binary Symmetric Channel (BSC), Binary Erasure Channel (BEC), Mutual information of channels, Channel capacity, Shannon's channel coding theorem.

MODULE - IV ERROR CONTROL CODING 7

Linear block codes, Generator and parity check matrices, Syndrome decoding, minimum distance and error correction capability, Hamming codes, Properties of cyclic codes, Syndrome computation, Cyclic Hamming codes

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MODULE - V ADVANCED CODING TECHNIQUES **8**

Convolutional codes- State Tree and trellis representation, Viterbi decoding algorithm, Turbo codes, LDPC codes

MODULE - VI ADVANCED INFORMATION THEORY **7**

Asymptotic Equipartition Property (AEP), Rate distortion theory, Gaussian channels, Network information theory

TOTAL : 45 PERIODS

TEXT BOOKS

1. Bose, R. (2017). Information theory, coding and cryptography (3rd ed.). McGraw Hill Education India.
2. Saha, A., Manna, N., & Mandal, S. (2013). Information theory, coding and cryptography. Pearson Education India.
3. Kulkarni, M., & Shivaprakasha, K. S. (2017). Information theory and coding (as per AICTE syllabus). Wiley India.
4. Cover, T. M., & Thomas, J. A. (2006). Elements of information theory (2nd ed.). Wiley-Interscience.
5. Lin, S., & Costello, D. J. (2004). Error control coding: Fundamentals and applications (2nd ed.). Pearson.
6. MacKay, D. J. C. (2003). Information theory, inference and learning algorithms. Cambridge University Press.

ONLINE RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc25_ee03/unit?unit=40&lesson=41

OUTCOMES:

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

1. Examine the information measures and entropy concepts to interpret uncertainty and information flow in communication systems. (K4)
2. Differentiate source coding techniques and prefix code properties to assess data compression efficiency. (K4)
3. Investigate channel models and capacity concepts to determine limits of reliable communication over noisy channels. (K4)
4. Deconstruct error control coding techniques to analyse their error

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detection and correction capabilities. (K4)

5. Compare advanced coding techniques such as convolutional, Turbo, and LDPC codes for performance and reliability. (K4)
6. Examine advanced information theoretic concepts including AEP, rate distortion, and network information theory to interpret communication limits. (K4)

CO - PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24ECEL514	MACHINE LEARNING FOR COMMUNICATION AND SIGNAL PROCESSING	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106106179	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24BSMA401					

OBJECTIVES:

- To introduce basics of Machine Learning to select models based on the requirement.
- To develop the technical proficiency required to implement dimensionality reduction and ensemble strategies.

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- To bridge the gap between classical statistical methods and modern Deep Learning by mastering the architecture and application of Neural Networks, CNNs, and Generative Adversarial Networks.
- Understand MIMO system design and challenges and apply ML techniques to wireless communication problems

MODULE - I INTRODUCTION TO MACHINE LEARNING 7

Introduction to Machine Learning - Classification - Regression - Supervised Learning - Model Selection and Generalization - Dimensions of Supervised Learning algorithm - Performance Measures, Bias-Variance Trade off, Linear Regression - Bayesian Decision Theory - Classification - Losses and Risks - Discriminant functions - Utility Theory - Association Rules.

MODULE - II PARAMETRIC ESTIMATION 7

Parametric Methods - Bias and Variance - Model selection procedure - Bayesian estimation - Dimensionality reduction - Principal Component Analysis- Linear Discriminant Analysis.

MODULE - III MIXTURE MODELLING 7

Clustering - Mixture densities - k-means clustering - Expectation-Maximization Algorithm - Non Parametric methods - Generalization to Multivariate Data - Nonparametric Classification - Nonparametric Regression.

MODULE - IV PERCEPTRON CRITERIA 8

Perceptron Criteria - Discriminative models - Support Vector Machines (SVM) - Logistic Regression, Decision trees, Hidden Markov Model (HMM) - Ensemble methods: Ensemble strategies, boosting and bagging, Random Forest

MODULE - V AN INTRODUCTION TO NEURAL NETWORKS AND DEEP LEARNING 8

Neural network: Perceptron, multilayer network, backpropagation, RBF Neural Network, Applications- Introduction to Deep Learning, Convolutional Neural Networks (CNN), Vanishing and Exploding Gradients in Deep Neural Networks, LeNet - 5, AlexNet, VGGNet, GoogleNet, and ResNet

MODULE - VI ML APPLICATIONS IN MIMO 8

Limitations of traditional detectors - ML-based signal detection - Deep learning for MIMO detection - Model-driven deep learning approaches -

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Comparison with classical techniques - ML-based channel estimation techniques - Deep neural networks for channel prediction - Spectrum allocation using ML - Reinforcement learning in wireless systems - ML in beam management.

TOTAL : 45 PERIODS

BOOKS AND REFERENCES:

1. E. Alpaydin, Introduction to Machine Learning, 3rd Edition, Prentice Hall (India) 2015.
2. C. M. Bishop, Pattern Recognition and Machine Learning (Information Science and Statistics),Springer, 2006.
3. Charu C. Aggarwal, Neural Networks and Deep Learning – A Textbook , Springer, 2018.
4. David Tse and Pramod Viswanath, Fundamentals of Wireless Communication – A Textbook, Cambridge University Press, 2005.

OUTCOMES:

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

1. Examine supervised learning algorithms, including linear regression and Bayesian decision theory, to analyze model selection and performance measures. (K4)
2. Analyze parametric and non-parametric estimation methods to differentiate between bias-variance trade-offs and model selection procedures. (K4)
3. Investigate dimensionality reduction techniques, such as PCA and LDA, and mixture modelling approaches like K-means to interpret complex data structures. (K4)
4. Differentiate between discriminative models, support vector machines, and ensemble strategies (bagging and boosting) to organize efficient classification solutions. (K4)
5. Analyze neural network architectures and deep learning advancements, including CNNs, RNNs, and GANs, to analyze their application in modern case studies and system advancements. (K4)
6. Investigate the applications of ML in MIMO. (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	2	1
CO2	3	3	-	-	-	-	-	-	-	-	1	2	2
CO3	3	2	-	-	-	-	-	-	-	-	1	3	1
CO4	3	3	-	-	-	-	-	-	-	-	1	2	2
CO5	3	2	-	-	-	-	-	-	-	-	2	2	2
CO6	3	3	-	-	-	-	-	-	-	-	2	3	3

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24ECEL515	COMMUNICATION TECHNOLOGIES FOR INDUSTRY 4.0	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106105195	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24ECPC304, 24ECPT401					

OBJECTIVES:

- Understand the fundamentals of Internet of Things (IoT)
- Explain the concepts and evolution of Industry 4.0
- Analyze the architecture and working of Industrial IoT (IIoT)
- Understand industrial communication and data acquisition systems

MODULE - I OVERVIEW OF INTERNET OF THINGS 7

IoT Architecture - Enabling IoT and the Complex Interdependence of Technologies - IoT Networking Components - Addressing Strategies in IoT - Sensors - Actuators - Processing Topologies

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MODULE - II INDUSTRY 4.0 BASICS 7

Introduction Industry 4.0 - Evolution of Industry 4.0 , Impacts of Industry 4.0 , Industrial Internet, Applications of Industry 4.0- Design requirements of Industry 4.0 -Drivers of Industry 4.0

MODULE - III ARCHITECTURE OF INDUSTRIAL INTERNET OF THINGS 8

IIoT -Prerequisites of IIoT , Basics of CPS , CPS and IIoT, Applications of IIoT- Industrial Internet Systems -Industrial sensing - Reference Architecture of IIoT

MODULE - IV TECHNOLOGIES OF INDUSTRIAL INTERNET OF THINGS 8

Off-site Technologies - Cloud Computing, Fog Computing - On-site Technologies - Augmented Reality, Virtual Reality, Big Data and Advanced Analytics- Lean manufacturing system - Smart factories.

MODULE - V INDUSTRIAL DATA TRANSMISSION, ACQUISITION AND ANALYTICS 8

Data Transmission - Foundation Fieldbus - Profibus - Interbus - ISA 100.11a - Wireless HART - LoRa and LoRaWAN - Data Acquisition - Distributed Control System - PLC - SCADA -Necessity of analytics -IIoT Analytics - Categorization of analytics , Usefulness, Challenges - Applications of analytics .

MODULE - VI APPLICATIONS AND CASE STUDIES 7

Healthcare Applications -Major challenges associated with healthcare - Applications of Healthcare in Industries- Case Studies - Manufacturing Industry - Automotive Industry - Mining Industry.

TOTAL : 45 PERIODS

BOOKS AND REFERENCES:

1. S. Misra, A. Mukherjee, and A. Roy, 2020. Introduction to IoT. Cambridge University Press.
2. S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.

OUTCOMES:

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

1. Utilize IoT architectural frameworks to build real-time application models in domains such as smart homes, healthcare, and agriculture. (K3)

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2. Apply the design requirements of Industry 4.0 to develop scalable, secure, and interoperable industrial solutions. (K3)
3. Demonstrate the application of Cyber-Physical Systems (CPS) concepts in integrating physical processes with computational systems. (K3)
4. Apply advanced technologies such as cloud computing, fog computing, augmented reality, virtual reality, and big data analytics in Industry 4.0 scenarios. (K3)
5. Demonstrate the application of industrial communication protocols and data acquisition systems including PLC, DCS, SCADA, and wireless technologies for effective data transmission. (K3)
6. Apply data analytics techniques to IIoT-generated data. (K3)

CO - PO, PSO MAPPING:

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

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.

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- 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.
- 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.

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.

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5. Sebastian Raschka and Vahid Mirjalili, "Python Machine Learning", Packt Publishing.

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.

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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

OUTCOMES:

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

1. Analyze user-centered design principles to identify usability issues and recommend improvements in software applications. (K4)

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2. Utilize human-computer interaction concepts to design effective user interfaces. (K3)
3. Develop user requirements using UX research techniques such as personas and scenarios. (K3)
4. Examine interface prototypes to identify usability issues and recommend appropriate design enhancements. (K4)
5. Apply usability evaluation methods to assess and improve software interfaces. (K3)
6. Implement user-friendly software applications through iterative design and testing processes. (K3)

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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Imagine the Future and

Make it happen!





Together let's build a better world where there is **NO POVERTY** and **ZERO HUNGER.**

We have **GOOD HEALTH AND WELL BEING** **QUALITY EDUCATION** and full **GENDER EQUALITY** everywhere.

There is **CLEAN WATER AND SANITATION** for everyone. **AFFORDABLE AND CLEAN ENERGY**

which will help to create **DECENT WORK AND ECONOMIC GROWTH.** Our prosperity shall be fuelled

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.**

We will enjoy **PEACE AND JUSTICE** through **STRONG INSTITUTIONS**

and will build long term **PARTNERSHIPS FOR THE GOALS.**

For the goals to be reached, everyone needs to do their part: governments, the private sector, civil society and **People like you.**

Together we can...

Sai Prakash Leo Muthu

Chairman & CEO - Sairam Institutions