



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*



DEPARTMENT OF
**COMPUTER SCIENCE &
ENGINEERING**

REGULATIONS 2024

Academic Year 2024-25 onwards

AUTONOMOUS
CURRICULUM AND

SYLLABUS
I - V
SEMESTERS

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



VISION

To excel in the field of Computer Science and contribute to the research, shaping Technical professionals to outshine as entrepreneurs and enable the students to serve as a valuable resource for industry and society.



MISSION

Department of Computer Science & Engineering, Sri Sai Ram Engineering College is committed to

- M1** To provide quality education that empowers students to excel in the field of computer science and engineering.
- M2** To foster a culture of innovation among students to help them become successful innovators and Researchers.
- M3** To provide students with incubation facilities that nurtures their journey to become successful entrepreneurs.
- M4** To encourage students to take up SDG-aligned projects and emerge as responsible contributors to society and industry.

AUTONOMOUS CURRICULA AND SYLLABI

Regulations 2024

SEMESTER I

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

SEMESTER II

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

*only for NCC cadets

AUTONOMOUS CURRICULA AND SYLLABI**Regulations 2024****SEMESTER III**

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			CONTACT PERIODS	CREDITS
			L	T	P		
THEORY							
1	24BSMA301	Statistics and Linear Algebra	3	1	0	4	4
2	24CSPC301	Database Management Systems	3	0	0	3	3
3	24CSPC302	Data Structures	3	0	0	3	3
4	24ITPC302	Software Engineering	3	0	0	3	3
5	24CSPW301	Digital Design and Computer Organization with Laboratory	3	0	2	5	4
6	24HSMC301	Universal Human Values - II Understanding Harmony	2	1	0	3	3
7	24HSNC301	NCC course Level 2*	3	0	0	3	0
PRACTICALS							
1	24CSPL301	Database Management Systems Laboratory	0	0	4	4	2
2	24CSPL302	Data Structures Laboratory	0	0	4	4	2
VALUE ADDITIONS - III							
1	24CSTP301	Aptitude Skills - I	0	0	2	2	1
2	24CSID301	Innovative Design Lab – I	0	0	2	2	1
ONLINE SUPPLEMENTARY							
1	24ESMC301	Joy of Computing using Python (Mandatory - NC)	2	0	0	2	0
*only for NCC cadets			Total			36	26

SEMESTER IV

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			CONTACT PERIODS	CREDITS
			L	T	P		
THEORY							
1	24BSMA402	Probability and Queueing Theory	3	1	0	4	4
2	24CSPC401	Theoretical Computer Science	3	0	0	3	3
3	24CSPC402	Design and Analysis of Algorithms	3	0	0	3	3
4	24ITPW401	Operating Systems with Laboratory	3	0	2	5	4
5	24ESEC401	Microprocessors and Microcontrollers	3	0	0	3	3
6	24MGOExxx	Open Elective – I	3	0	0	3	3
7	24HSNC401	NCC course Level 3*	3	0	0	3	0
PRACTICALS							
1	24CSPT401	Object Oriented Programming Laboratory with Theory	1	0	4	5	3
VALUE ADDITIONS - IV							
1	24CSTP401	Aptitude Skills - II	0	0	2	2	0
2	24CSID401	Innovative Design Lab - II	0	0	2	2	1
ONLINE SUPPLEMENTARY							
		As recommended by BoS					
Total						33	24

*only for NCC cadets

Logistics Information System

AUTONOMOUS CURRICULA AND SYLLABI

Regulations 2024

SEMESTER V

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			CP	C	PREREQUISITE COURSES
			L	T	P			
THEORY								
1	24ITPC501	Computer Networks	3	0	0	3	3	24ESCS101, 24CSPC302, 24CSPC402, 24ITPW401
2	24CSPW501	Artificial Intelligence with Laboratory	3	0	2	5	4	24ESCS101, 24CSPC302, 24CSPC401
3	24XXEL5YY	Professional Elective - I	3	0	0	3	3	-
4	24YYEL5ZZ	Professional Elective - II	3	0	0	3	3	-
5	24XXOE5XX	Open Elective - II #	3	0	0	3	3	-
6	24MGMC501	Constitution of India	2	0	0	2	0	-
PRACTICALS								
1	24ITPL501	Computer Networks Laboratory	0	0	4	4	2	24CSPC302, 24CSPC402
VALUE ADDITIONS								
1	24CSTP501	Skill Enhancement	0	0	2	2	1	-
2	24CSID501	Prototype Development Lab - I	0	0	2	2	1	24ESID101, 24ESID201, 24CSID301, 24CSID401
ONLINE SUPPLEMENTARY								
		As recommended by BoS						
		Total				27	20	

Cyber Security - UGC

SEMESTER VI

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			CONTACT PERIODS	CREDITS
			L	T	P		
THEORY							
1	24CSPC601	Internet Programming	3	0	0	3	3
2	24XXEL6uu	Professional Elective - III	3	0	0	3	3
3	24XXEL6vv	Professional Elective - IV	3	0	0	3	3
4	24XXEL6ww	Professional Elective - V	3	0	0	3	3
5	24XXOE5XX	Open Elective - III	3	0	0	3	3
6	24HSMG501	Principles of Engineering Management	3	0	0	3	3
PRACTICALS							
1	24CSPL601	Internet Programming Laboratory	0	0	4	4	2
VALUE ADDITIONS - VI							
1	24CSTP601	Technical Skill	0	0	2	2	0
2	24CSID601	Prototype Development Lab - II	0	0	2	2	1
ONLINE SUPPLEMENTARY							
		As recommended by BoS					
			Total			26	21

AUTONOMOUS CURRICULA AND SYLLABI Regulations 2024

SEMESTER VII

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			CONTACT PERIODS	CREDITS
			L	T	P		
THEORY							
1	24ITPC701	Cryptography and Network Security	3	0	0	3	3
2	24XXEL7xx	Professional Elective - VI	3	0	0	3	3
3	24XXEL7yy	Professional Elective - VII	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							
1	24ITPL701	Network Security Laboratory	0	0	4	4	2
2	24CSPJ701	Project Work - Phase I	0	0	8	8	4
VALUE ADDITIONS - VII							
1	24CSTP701	Company Specific Skills	0	0	2	2	1
ONLINE SUPPLEMENTARY							
		As recommended by BoS					
Total						28	21

SEMESTER VIII

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			CONTACT PERIODS	CREDITS
			L	T	P		
THEORY							
1	24XXEL7zz	Professional Elective - VIII	3	0	0	3	3
PRACTICALS							
1	24CSPJ801	Project Work - Phase II	0	0	12	12	6
VALUE ADDITIONS - VIII							
1	24CSIN801	Internship	0	0	9	9	3
Total						24	12

Approved by
Academic Council Meeting
No. 8 Dated: 03.09.2024

B. S. S. S.
CHAIRMAN
Board of Studies
Department of Computer Science and Engineering
Sri Sairam Engineering College

AUTONOMOUS CURRICULA AND SYLLABI Regulations 2024

PROFESSIONAL ELECTIVES - I

S. NO	COURSE CODE	COURSE TITLE	CREDIT	DOMAIN	PREREQUISITE COURSES
1	24ITEL501	Computer Graphics and Multimedia	3	Computing Technologies	24ITPC301, 24BSMA301
2	24ITEL511	Graph Theory	3	Computing Technologies	24BSMA402, 24BSMA301
3	24ITEL503	Cloud Computing	3	Computing Technologies	24ITPC301, 24ITPW401
1	24AIEL501	Exploratory Data Analysis with R Software	3	Artificial Intelligence	24BSMA402, 24BSMA301
2	24AIEL502	Artificial Intelligence Fundamentals and Applications	3	Artificial Intelligence	24AIPT201
3	24AIEL503	Human Centered Computing	3	Artificial Intelligence	24ITPC302, 24ESCS101
1	24ITPC401	User Interface / User Experience (UI/UX) Designing Skills	3	Web and App Development	24ITPC302
2	24CSEL501	Introduction to Mobile Technologies	3	Web and App Development	24ITPW401, 24CSPW301
3	24CSEL502	No SQL Databases	3	Web and App Development	24AIPT201, 24CSPT401, 24CSPL301
1	24ITEL507	Data Warehousing and Data Mining	3	Data Science	24CSPC301, 24BSMA401, 24BSMA301, 24ESCS101
2	24ITEL508	Data Analytics with Python	3	Data Science	24BSMA301, 24ESCS101
3	24ITEL509	Big Data Essentials	3	Data Science	24CSPC301, 24CSPC302, 24ITPW401
1	24CSEL503	Machine Learning Algorithms	3	Machine Learning	24BSMA301, 24BSMA402, 24CSPC301, 24CSPC302
2	24CSEL504	Machine Learning for Intelligent Systems	3	Machine Learning	24BSMA301, 24BSMA402, 24CSPC301, 24CSPC302
3	24CSEL505	Machine Learning Essentials for Cyber Security	3	Machine Learning	24BSMA301, 24BSMA402, 24CSPC301, 24CSPC302
1	24CIEL501	IoT Concepts and Applications	3	Industrial IoT	24ESCS101, 24AIPT201
2	24CIEL502	Data Science for Internet of Things	3	Industrial IoT	24AIPT201, 24BSMA301
3	24CIEL503	Dynamic Paradigm in IoT	3	Industrial IoT	24ESCS101, 24AIPT201, 24ITPW401

Approved by
Academic Council Meeting
 No. 9 Dated: 12.05.26


CHAIRMAN
Board of Studies
 Department of Computer Science and Engineering
 Sri Sairam Engineering College

AUTONOMOUS CURRICULA AND SYLLABI Regulations 2024

PROFESSIONAL ELECTIVES - II

S. NO	COURSE CODE	COURSE TITLE	CREDIT	DOMAIN	PREREQUISITE COURSES
1	24ITEL510	Advanced Analysis of Algorithm	3	Computing Technologies	24CSPC302, 24CSPC402
2	24ITEL502	Distributed Systems	3	Computing Technologies	24CSPC302, 24CSPC402, 24ITPW401
3	24ITEL512	Parallel Algorithms	3	Computing Technologies	24CSPC302, 24CSPC402, 24ITPW401
1	24AIEL504	Business Intelligence	3	Artificial Intelligence	24CSPC301, 24BSMA301
2	24AIEL505	Machine Learning Essentials	3	Artificial Intelligence	24BSMA301, 24CSPC302
3	24AIEL506	Decision Support Systems	3	Artificial Intelligence	24CSPC301, 24BSMA301
1	24CSEL511	Usability Design of Software Application	3	Web and App Development	24ESCS101, 24ITPC302
2	24CSEL506	Web Design	3	Web and App Development	24ESCS101, 24CSPT401
3	24CSEL507	Mobile Application Development	3	Web and App Development	24ESCS101, 24CSPC302, 24CSPC402
1	24ITEL516	Learning Analytics Tools	3	Data Science	24CSPC301, 24BSMA401, 24BSMA301, 24ESCS101
2	24ITEL517	Data Science for Engineers	3	Data Science	24AIPT201, 24BSMA402, 24CSPC301
3	24ITEL518	Data Mining for Decision Making	3	Data Science	24CSPC301, 24BSMA401, 24BSMA301, 24ESCS101
1	24CSEL508	Machine Learning for Intrusion Detection	3	Machine Learning	24AIPT201, 24BSMA402, 24BSMA301
2	24CSEL509	Deep Learning Architectures and Applications	3	Machine Learning	24AIPT201, 24BSMA301, 24BSMA402, 24CSPC302, 24CSPC402
3	24CSEL510	Intelligent Decision Systems	3	Machine Learning	24AIPT201, 24BSMA301, 24BSMA402, 24CSPC302, 24CSPC402
1	24CIEL504	Web of Things	3	Industrial IoT	24ESCS101, 24CSPC301, 24ITPW401
2	24CIEL505	Wireless Technologies in Internet of Things	3	Industrial IoT	-
3	24CIEL506	Descriptive Analytics for IoT	3	Industrial IoT	24AIPT201

Approved by
Academic Council Meeting
No. 9 Dated: 12.05.26

B. J. J. J.
CHAIRMAN
Board of Studies
Department of Computer Science and Engineering
Sri Sairam Engineering College

INDUSTRY CONNECTED PROFESSIONAL ELECTIVES L&T BASKET

S. NO	COURSE CODE	COURSE TITLE	CREDIT	DOMAIN
1	24CSIE501	UI/UX Developer	3	Information Technology
2	24ITIE502	Software Engineering Tools	3	Information Technology
3	24ITIE601	Data-driven Storytelling and Visualization	3	Information Technology
4	24ITIE602	Fundamentals of Business Analytics	3	Information Technology
5	24ITIE603	NODE.JS - The Complete Guide	3	Cross-Platform
6	24ITIE604	Security Professional	3	Security and Risk Management
7	24CSIE601	Network Professional	3	Information Technology
8	24CSIE602	Cyber Defense	3	Information Security
9	24CSIE603	Fundamentals of Agile Methodology with DevOps Integration	3	Software Development
10	24CSIE701	Building Web Services with Java Network Programming	3	Information Technology

INDUSTRY CONNECTED PROFESSIONAL ELECTIVES HCL BASKET

S. NO	COURSE CODE	COURSE TITLE	CREDIT	DOMAIN
1	24EIIIE611	Embedded System for Connected Devices	3	Embedded
2	24CSIE612	C++ for Embedded Systems	3	Embedded
3	24ITIE711	Advanced C++ for Embedded Programming	3	Embedded
4	24EIIIE712	Product Development Process	3	Embedded
5	24CSIE712	Project Phase-I	4	Embedded
6	24CSIE811	Internship	3	Embedded
7	24CSIE812	Project Phase-II	6	Embedded

INDUSTRY CONNECTED PROFESSIONAL ELECTIVES SALESFORCE BASKET

S. NO	COURSE CODE	COURSE TITLE	CREDIT	DOMAIN
1	24ITIE503	Salesforce Administrator	3	Data Science
2	24CSIE504	Salesforce Developer	3	Data Science
3	24ITIE605	MuleSoft Anypoint Platform Fundamentals	3	Data Science
4	24CSIE606	Salesforce Business Analyst	3	Data Science

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

- PEO 1** Graduates will have a strong foundation in Mathematics, Science, and Engineering fundamentals to analyze and solve real world problems.
- PEO 2** Graduates will have the capability to succeed in diverse roles in their chosen fields.
- PEO 3** Graduates will actively pursue lifelong learning through higher education, certifications or continuous professional development.
- PEO 4** Graduates will have the ability to apply gained knowledge to uplift the society.

PROGRAM SPECIFIC OUTCOMES (PSOs)

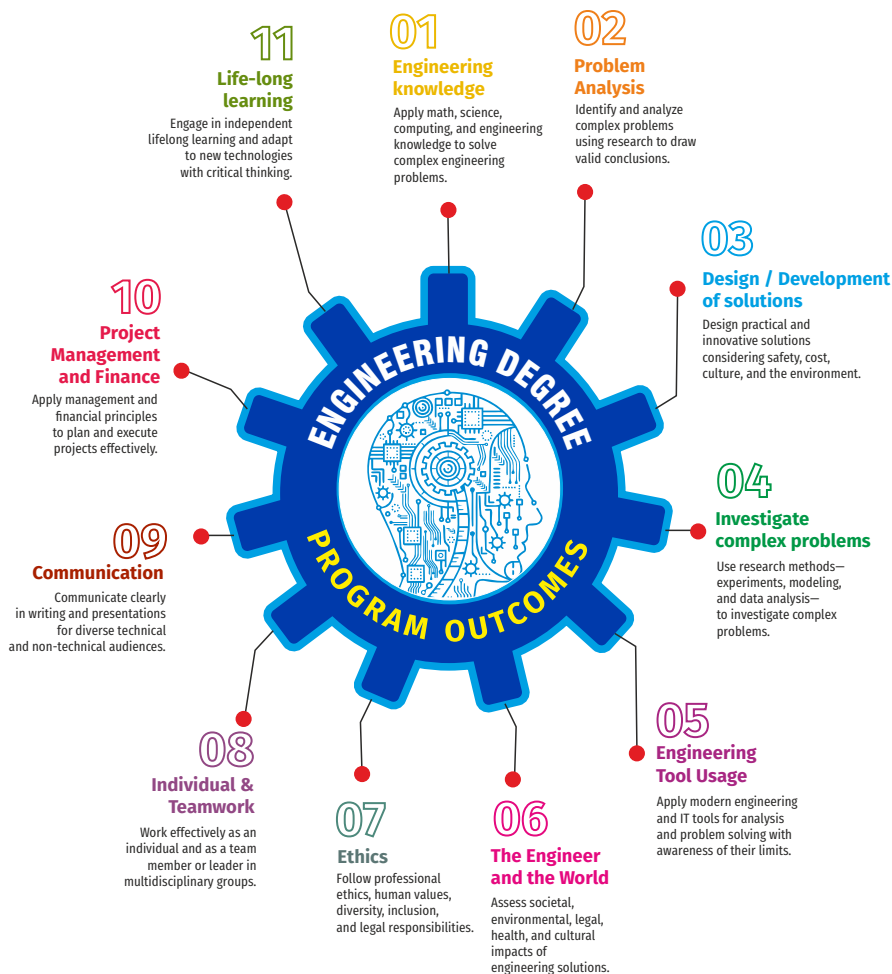
- PSO 1** Graduates will develop advanced networking and system administration skills with a focus on industry-standard tools and technologies.
- PSO 2** Graduates will be skilled in designing, developing, and automating business solutions through internships, hackathons, and coding platforms.

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)	5	12	09
Humanities and Social Sciences (HS)	8	13	13
Professional Electives (EL)	15	26	26
Program Core + Program Lab (PC+PL)	22	47	37
Program theory with Lab (PW) / Program Lab With Theory (PT)	11	25	18
Open Elective (OE)	7	12	12
Training & Placement (TP)	2	14	4
Innovation & Development (ID) / Project (PJ)	10	32	16
Internships (IN)	2	9	3
Mandatory Courses (MC)	NA	4	NA
Total		226	168

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



SEMESTER - I

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

OBJECTIVES:

- To develop a strong foundation in matrix algebra and its applications.
- To introduce the concepts of limits, continuity, differentiation, and optimization for functions of several variables.
- To familiarize students with the principles of vector calculus relevant to engineering problems.
- To provide an understanding of double and triple integrals along with their practical applications.
- To impart knowledge of Fourier series and its significance in engineering analysis.

MODULE I MATRICES

12

Eigenvalues and eigenvectors of a real matrix – Properties of eigenvalues and eigenvectors – Cayley-Hamilton theorem (excluding 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. (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 (Spherical and Cylindrical polar coordinates).

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://testbook.com/maths/cayley-hamilton-theorem>
2. <https://www.iitg.ac.in/rafik/Tutorials/MA-102/2013/lect-10.pdf>
3. https://ms.unimelb.edu.au/__data/assets/pdf_file/0007/2516596/functions_sev_var.pdf
4. <https://www.mecmath.net/VectorCalculus.pdf>
5. <https://egyankosh.ac.in/bitstream/123456789/64855/1/Unit4.pdf>
6. <https://williamsgj.people.charleston.edu/Fourier%20Series.pdf>

ONLINE RESOURCES:

1. https://www.youtube.com/watch?v=oJDlt_Xv-mM
2. <https://www.youtube.com/watch?v=8h3yY0im5XU>
3. https://www.youtube.com/watch?v=LGxE_yZYigI
4. <https://www.youtube.com/watch?v=ma1QmE1SH3I>
5. <https://www.youtube.com/watch?v=QPw4GYz5Unc>
6. <https://www.youtube.com/watch?v=1mMYaPkXcNI>



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

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)
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	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-
CO6	3	-	-	-	-	-	-	-	-	-	-

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

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

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://www.pearson.com/english/catalogue/business-english/technical-english.html>
2. <https://www.cambridgeenglish.org/learning-english/free-resources/>

OUTCOMES:

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

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

CO-PO, PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	-	-	-	-	-	-	-	-	3	-	2	-	-
C02	-	-	-	-	-	-	-	-	3	-	2	-	-
C03	-	-	-	-	-	-	-	-	3	-	2	-	-
C04	-	-	-	-	-	-	-	-	3	-	2	-	-
C05	-	-	-	-	-	-	-	-	3	-	2	-	-
C06	-	-	-	-	-	-	-	-	3	-	2	-	-

SEMESTER - I

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

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.

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 Wiley & 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
C01	3	-	-	-	-	-	-	-	-	-	-
C02	-	3	-	-	-	-	-	-	-	-	-
C03	-	3	-	-	-	-	-	-	-	-	-
C04	3	-	-	-	-	-	-	-	-	-	-
C05	-	3	-	-	-	-	-	-	-	-	-
C06	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.

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, Nernst 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 Photosensitization.

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

MODULE - IV CHEMICAL THERMODYNAMICS**8**

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

MODULE - V FUELS**8**

Fuels: Introduction –Classification of fuels – Coal – Analysis of coal (proximate and ultimate). Carbonization – manufacture of metallurgical coke (Otto

Hoffmann method) – Petroleum – manufacture of synthetic petrol (Bergius process). Knocking – Octane number and Cetane number – Gaseous fuels – Compressed natural gas (CNG), Liquefied petroleum gas (LPG). Biofuels – Gobar gas and Biodiesel.

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

MODULE - VI NANOCHEMISTRY

7

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

TOTAL: 45 PERIODS

TEXT BOOKS:

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, 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)
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	3	3

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.

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.



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MODULE -V STRUCTURES**7**

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

MODULE - VI FILE PROCESSING**7**

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

TOTAL: 45 PERIODS**TEXT BOOKS:**

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

REFERENCES:

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

WEB REFERENCES:

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

ONLINE RESOURCES:

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

OUTCOMES:

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

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

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	3	-	-	-	-	-	-	-	-	-	-	2	2
C02	-	3	-	-	-	-	-	-	-	-	-	2	2
C03	3	-	-	-	-	-	-	-	-	-	-	1	2
C04	-	3	-	-	-	-	-	-	-	-	-	2	2
C05	-	3	-	-	-	-	-	-	-	-	-	2	3
C06	-	-	3	-	-	-	-	-	-	-	-	3	3



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SEMESTER - I

24HSTA101	HERITAGE OF TAMILS	L	T	P	CP	C
- SDG NO. 4		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 Bharathiyaar 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 - ROCKART PAINTINGS TO MODERNART – 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.

அலகு IV நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்
தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஓயிலாட்டம், 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 விடுதலைப்போரில் தமிழர்களின் பங்கு — இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் — சுயமரியாதை இயக்கம் — இந்தியமருத்துவத்தில் சித்த மருத்துவத்தின் பங்கு — கல்வெட்டுகள், கையெழுத்துப்படிக்கல் — தமிழ்ப் புத்தகங்களின் அச்ச 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. பொருளை — 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. 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
C01	2	3	3	-	-	-	-	-	-	-	2	2	2
C02	2	3	3	-	-	-	-	-	-	-	2	2	2
C03	2	3	3	-	-	-	-	-	-	-	2	2	2
C04	2	3	3	-	-	-	-	-	-	-	2	2	2
C05	2	3	3	-	-	-	-	-	-	-	2	2	2
C06	2	3	3	-	-	-	-	-	-	-	2	2	2

SEMESTER - I

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.

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.

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 |
| 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)

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PS02
C01	3	-	-	-	-	-	-	-	-	-	-	2	2
C02	3	-	-	-	-	-	-	-	-	-	-	2	2
C03	3	-	-	-	-	-	-	-	-	-	-	2	2
C04	3	-	-	-	-	-	-	-	-	-	-	2	2
C05	2	-	-	-	-	-	-	-	-	-	-	2	2
C06	2	-	-	-	-	-	-	-	-	-	-	2	2

SEMESTER - I

24ESPL101 - SDG NO. 4 & 9	PROGRAMMING IN CLABORATORY	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. 1. Write a program using I/O statements and expressions.
2. Write programs using decision-making constructs.
3. Write a program to find whether the given year is a leap year or not?
(Hint: not every century is a leap. For example 1700, 1800 and 1900 is not a leap year).
4. Write a program to perform the Calculator operations, namely, addition, subtraction, multiplication, division and square of a number.
5. Write a program to check whether a given number is an Armstrong number or not.
6. Write a program to check whether a given number is odd or even.
7. Write a program to find the factorial of a given number.
8. Write a program to find out the average of 4 integers.
9. Write a program to print half pyramid of *.
10. Write a program to display array elements using two dimensional arrays.
11. Write a program to perform swapping using a function.
12. Write a program to display all prime numbers between two intervals using functions.
13. Write a program to solve towers of Hanoi using recursion.
14. Write a program to get the largest element of an array using the function.
15. Write a program to concatenate two strings.
16. Write a program to find the length of String.
17. Write a program to find the frequency of a character in a string.
18. Write a program to store Student Information in Structure and Display it.
19. The annual examination is conducted for 10 students for five subjects. Write a program to read the data and determine the following:
 - (a) Total marks obtained by each student.
 - (b) The highest marks in each subject and the marks of the student who secured it.
 - (c) The student who obtained the highest total marks.
20. Write a program to demonstrate file operations (e.g. count the number of characters, words and lines in a file, replace a specific word with the given word in the same file).

TOTAL: 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

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)

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)
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



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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

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.
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



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CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	-	-	-	-	-	-	-	-	3	-	2	-	-
C02	-	-	-	-	-	-	-	-	3	-	2	-	-
C03	-	-	-	-	-	-	-	3	2	-	2	-	-



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SEMESTER - II

24BSMA201 - SDG NO. 4	DISCRETE STRUCTURES	L	T	P	CP	C
		3	1	0	5	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.

MODUL - IV GRAPHS

12

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

MODULE-V LATTICES

9

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

MODULE - VI BOOLEAN ALGEBRA

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), 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/~aral/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=4LITmsfDS4Y&list=PLEAYkSg4uSQ2Wfc_l4QEZUSRdx2ZcFziO&index=13
4. <https://www.youtube.com/watch?v=jBsEKyx6Rj0&list=PLwdnzlV3ogovXVxCTII45pDVM1aoYoMHf>
5. <https://www.youtube.com/watch?v=rdXw7Ps9vxc&list=PLHXZ9OQG Mqxersk8fUxiUMSIx0DBqskZS>

COURSE OUTCOMES:**Upon completion of the course, the student should 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
C01	3	-	-	-	-	-	-	-	-	-	-	2	3
C02	3	-	-	-	-	-	-	-	-	-	-	2	2
C03	3	-	-	-	-	-	-	-	-	-	-	2	3
C04	3	-	-	-	-	-	-	-	-	-	-	3	2
C05	3	-	-	-	-	-	-	-	-	-	-	2	3
C06	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

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

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)

- Compose job applications and technical proposals (K3)
- 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
C01	-	-	-	-	-	-	-	-	3	-	3	-	-
C02	-	-	-	-	-	-	-	-	3	-	3	-	-
C03	-	-	-	-	-	-	-	-	3	-	3	-	-
C04	-	-	-	-	-	-	-	-	3	-	3	-	-
C05	-	-	-	-	-	-	-	1	3	-	3	-	-
C06	-	-	-	-	-	-	-	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

- 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.

4. S.O.Pillai, "Solid State Physics, New Academic Science", 2017.
5. D.K.Bhattacharya & Poonam Tandon., "Physics for Information Science and Electronics Engineering", Oxford Higher Education", 2017.

REFERENCES:

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

OUTCOMES:

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

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



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CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
C01	3	-	-	-	-	-	-	-	-	-	-
C02	-	3	-	-	-	-	-	-	-	-	-
C03	3	-	-	-	-	-	-	-	-	-	-
C04	-	3	-	-	-	-	-	-	-	-	-
C05	-	3	-	-	-	-	-	-	-	-	-
C06	3	-	-	-	-	-	-	-	-	-	-

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).

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 H₂O₂ as benign bleaching agents in the paper industry.

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

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

TOTAL: 45 PERIODS

TEXT BOOKS:

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

REFERENCES:

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



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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 பாணைத் தொழில்நுட்பம்

சங்க காலத்தில் நெசவுத் தொழில் - பாணைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பாண்டங்களில் கற்றல் 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 கட்டுமானங்கள் ருசங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு - சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகலனும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள்.

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 - சோழர்காலக்குழுதித்தூம்பின் 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 அறிவியல்தமிழ்மற்றும் கணித்தமிழ்

அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களையின் பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் 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. பொருதை — 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 பாணத்தொழில்நுட்பங்களைப் 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 கட்டிடக்கலையின் நுட்பங்கள் மற்றும் கட்டிடவடிவமைப்புகளை ஆராய்தல்.
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 கணித்தமிழின் வளர்ச்சியையும் அதன் கணினி பயன்பாடுகளையும் புரிந்து கொள்ளுதல்.
To understand the development of Scientific Tamil and its applications in Tamil computing.(K3)



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CO- PO, PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PS02
C01	3	3	2	2	-	-	-	-	-	-	1	2	2
C02	3	3	3	2	-	-	-	-	-	-	1	2	1
C03	3	3	3	3	-	-	-	-	-	-	1	2	1
C04	3	2	3	3	-	-	-	-	-	-	1	2	2
C05	3	3	3	3	-	-	-	-	-	-	1	2	1
C06	3	3	3	3	-	-	-	-	-	-	1	2	2

SEMESTER - II

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.

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.
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
C01	3	-	-	-	-	-	-	-	2	-	-	-	3
C02	3	-	-	-	-	-	-	-	2	-	-	-	3
C03	3	-	-	-	-	-	-	-	2	-	-	-	3
C04	3	-	-	-	-	-	-	-	3	-	-	-	3
C05	3	-	-	-	-	-	-	-	2	-	-	-	3
C06	3	-	-	-	-	-	-	-	3	-	-	-	3

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

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, Jhansi 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

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
SS 4	Protection of Children and Women Safety	1
SS 5	Road / Rail Travel Safety	1
SS 6	New Initiatives	2
SS 7	Cyber and Mobile Security Awareness	1

TOTAL: 30 PERIODS**SEMESTER - II**

24AIPT201 - SDG NO. 4, 9	PYTHON FOR DATA SCIENCE LABORATORY WITH THEORY	L	T	P	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
- To acquire skills in data preparatory and preprocessing steps

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

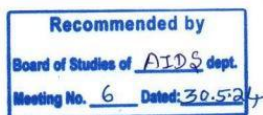
1. Create packages and import modules from packages.
2. Write a program to implement OOP concepts like Data hiding and Data Abstraction

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.



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MODULE - IV INTRODUCTION TO NUMPY**7**

NumPy Basics: Arrays and Vectorized Computation - The NumPy ndarray
 Creating ndarrays - Data Types for ndarrays - Arithmetic with NumPy Arrays -
 Basic Indexing and Slicing - Boolean Indexing-Transposing Arrays and
 Swapping Axes. Universal Functions: Fast Element -Wise Array Functions -
 Mathematical and Statistical Methods-Sorting- Unique and Other Set Logic

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**

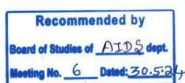
Introduction to pandas Data Structures: Series, Data Frame, Essential Functionality: Dropping Entries Indexing, Selection, and Filtering- Function Application and Mapping-Sorting and Ranking. Summarizing and Computing Descriptive Statistics- Unique Values, Value Counts, and Membership. Reading and Writing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



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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**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 Mo Mohamed Ali, "Introducing Data Science", Manning Publications, 2016.

REFERENCES:

1. Wesley 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. Implement basic Python programming constructs such as data types, operators, control structures, and user-defined functions to solve computational problems.(K3)
2. Develop Python programs using file handling, exception handling, and object-oriented programming concepts for modular and reliable applications.(K3)

3. Demonstrate data science concepts and descriptive statistical techniques using Python to analyze and interpret datasets.(K3)
4. Examine the use of NumPy arrays and vectorized operations to optimize numerical computation and improve data manipulation efficiency.(K4)
5. Perform data loading, cleaning, transformation, and exploratory data analysis using Pandas data structures and functions.(K3)
6. Interpret meaningful data visualization results and data preparation techniques using Pandas to identify patterns and draw meaningful insights.(K4)

CO-PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	3	2	-	-	-	-	-	-	2	-	-	2	-
C02	3	3	-	-	-	-	-	-	-	2	-	3	2
C03	2	2	-	-	-	2	-	-	-	-	-	2	2
C04	3	3	-	-	2	-	2	-	-	-	-	3	2
C05	3	2	-	-	2	-	-	-	-	-	-	3	3
C06	3	3	-	-	2	-	-	2	-	-	-	3	3

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.	
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
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. John J. 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 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

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

MODULE - V DIGITAL NETWORKING

Remote work and virtual teams
 Authenticity in digital interactions
 Engaging content creation
 Tools 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)

CO-PO, PSO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PS02
C01	-	-	-	-	-	-	-	-	3	-	2	-	-
C02	-	-	-	-	-	-	-	-	3	-	2	-	-
C03	-	-	-	-	-	-	-	3	2	-	2	-	-



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SEMESTER - III

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

OBJECTIVES:

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

MODULE - I BASIC STATISTICS 9

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

MODULE - II TESTS OF SIGNIFICANCE FOR LARGE SAMPLES 9

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

MODULE - III TESTS OF SIGNIFICANCE FOR SMALL SAMPLES 9

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

MODULE - IV VECTOR SPACES 9

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

MODULE - V LINEAR TRANSFORMATION AND DIAGONALIZATION 12

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

MODULE - VI INNER PRODUCT SPACES 12

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

TOTAL : 60 PERIODS

TEXT BOOKS:

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

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

REFERENCES:

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

WEB REFERENCES:

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

ONLINE RESOURCES:

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

COURSE OUTCOMES

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

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

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

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	3	-	-	-	-	-	-	-	-	-	-	3	-
C02	-	3	-	-	-	-	-	-	-	-	-	3	-
C03	-	3	-	-	-	-	-	-	-	-	-	3	-
C04	3	-	-	-	-	-	-	-	-	-	-	3	-
C05	-	3	-	-	-	-	-	-	-	-	-	3	2
C06	3	-	-	-	-	-	-	-	-	-	-	3	2

SEMESTER - III

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

OBJECTIVES:

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

MODULE - I CONCEPTUAL DATA MODELLING

6

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

MODULE - II DATABASE DESIGN**8**

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

MODULE - III RELATIONAL DATABASES**8**

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

MODULE - IV TRANSACTIONS**8**

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

MODULE - V IMPLEMENTATION TECHNIQUES**7**

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

MODULE - VI ADVANCED TOPICS**8**

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

TOTAL : 45 PERIODS**TEXT BOOKS:**

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

REFERENCES:

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

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

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

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	3	-	3	-	-	-	-	-	-	2	1	2	2
C02	3	-	3	-	-	-	-	-	-	-	1	2	2
C03	-	-	3	-	-	-	-	-	-	-	-	2	2
C04	-	3	-	-	-	-	-	-	-	-	-	2	2
C05	3	-	3	-	-	-	-	-	-	2	-	2	2
C06	-	3	-	-	-	-	-	-	-	2	-	2	2

SEMESTER - III

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

OBJECTIVES:

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

MODULE - I LINEAR DATA STRUCTURES – I 9

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

MODULE - II LINEAR DATA STRUCTURES – II 9

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

MODULE - III NON LINEAR DATA STRUCTURES – I 8

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

MODULE - IV NON LINEAR DATA STRUCTURES – II 9

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

MODULE - V SEARCHING, SORTING 5

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

MODULE - VI HASHING TECHNIQUES 5

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

TOTAL : 45 PERIODS

TEXT BOOKS:

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

REFERENCES:

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

WEB REFERENCES:

1. <https://www.programiz.com/dsa>
2. <http://masterraghu.com/subjects/Datastructures/ebooks/remathareja.pdf>

OUTCOMES

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

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



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CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	3	-	-	-	-	-	-	-	-	-	-	3	2
C02	-	3	-	-	-	-	-	-	-	-	-	3	2
C03	-	3	-	-	-	-	-	-	-	-	-	3	3
C04	-	-	-	-	-	-	3	-	-	-	-	3	2
C05	-	-	-	-	-	-	-	-	3	-	-	3	2
C06	3	-	-	-	-	-	-	-	-	-	-	2	3

SEMESTER - III

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

OBJECTIVES:

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

MODULE -I SOFTWARE PROCESS AND AGILE DEVELOPMENT 7

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

MODULE -II REQUIREMENTS ANALYSIS AND SPECIFICATION 8

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

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

MODULE -III SOFTWARE DESIGN

8

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

MODULE -IV TESTING AND MAINTENANCE

8

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

MODULE -V PROJECT MANAGEMENT

7

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

MODULE -VI RISKMANAGEMENT

7

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

TOTAL : 45 PERIODS

TEXT BOOKS:

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

REFERENCES:

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

ONLINE RESOURCES:

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

OUTCOMES

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

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

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	3	-	-	-	-	-	-	2	-	2	-	-	2
C02	-	3	-	-	-	-	-	-	2	-	-	-	1
C03	3	-	-	-	-	-	-	2	-	-	-	-	2
C04	-	3	-	-	-	-	-	-	-	-	-	2	2
C05	-	-	-	-	3	-	-	2	-	2	-	2	3
C06	-	-	3	-	-	-	-	-	-	2	-	-	3

SEMESTER - III

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

OBJECTIVES:

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

MODULE - I BOOLEAN ALGEBRA AND LOGIC GATES

8

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

MODULE - II COMBINATIONAL LOGIC

7

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

MODULE - III SYNCHRONOUS SEQUENTIAL LOGIC

8

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

MODULE - IV BASIC STRUCTURE AND ARITHMETIC OPERATIONS

7

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

MODULE - V PROCESSOR, CONTROL UNIT AND PARALLELISM 8

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

MODULE - VI MEMORY & I/O SYSTEMS 7

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

List of Experiments: 15

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

TOTAL: 60 PERIODS**LAB REQUIREMENTS:****HARDWARE:**

DIGITAL TRAINER KITS

DIGITAL IC's required for the experiments in sufficient numbers

SOFTWARE:

HDL, Verilog simulator

TEXT BOOKS:

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

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

REFERENCES:

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

OUTCOMES

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

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

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	3	-	-	-	-	-	-	-	-	-	-	3	3
C02	-	-	-	-	3	-	-	-	-	-	-	3	3
C03	-	2	-	-	-	-	-	-	-	-	-	3	2
C04	-	-	2	-	-	-	-	-	-	-	-	3	3
C05	-	-	-	3	-	-	-	-	-	-	-	3	2
C06	-	-	-	-	-	2	-	-	-	-	-	3	2

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 of relationship
13. Understanding the meaning of Trust; Difference between intention and competence
14. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
15. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals

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

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

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

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

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

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

MODULE - VI UNIVERSAL HUMAN ORDER (4+3)

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

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

TOTAL : 45 PERIODS

TEXT BOOKS:

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



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REFERENCES:

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

OUTCOMES

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

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



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CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
C01	-	-	-	-	-	3	3	2	-	-	3
C02	-	1	-	-	-	3	3	2	-	-	-
C03	-	-	3	-	-	3	3	2	-	-	-
C04	-	-	-	-	-	3	3	2	-	2	3
C05	-	-	-	-	-	3	3	-	-	-	3
C06	-	-	-	-	-	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
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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
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GENERAL AWARENESS**4**

GA 1	General Knowledge	4
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ARMED FORCES 6

AF 1	Armed Forces, Army, CAPF, Police	6
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ADVENTURE 1

AD 1	Introduction to Adventure Activities	1
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BORDER & COASTAL AREAS 2

BCA 1	History, Geography & Topography of Border/Coastal areas	2
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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
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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
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GENERAL AWARENESS 4

GA 1	General Knowledge	4
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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
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BORDER & COASTAL AREAS 2

BCA 1	History, Geography & Topography of Border/Coastal areas	2
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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
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DISASTER MANAGEMENT 13

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

ENVIRONMENTAL AWARENESS & CONSERVATION 3

EA 1	Environmental Awareness and Conservation	3
------	--	---

GENERAL AWARENESS 4

GA 1	General Knowledge	4
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GENERAL SERVICE KNOWLEDGE 6

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

ADVENTURE 1

AD 1	Introduction to Adventure Activities	1
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BORDER & COASTAL AREAS**2**

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

2**TOTAL :45 PERIODS****SEMESTER - III**

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

OBJECTIVES:

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

LIST OF EXPERIMENTS:

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

HomeLoan (HLoanid, Amount, Custid)

VehicleLoan (VLoanid, Amount, Custid)

- Create a view with customerid, Customer name and total loan amount (HomeLoan and VehicleLoan)
 - Write a trigger which displays the Home Loan details whenever the values are inserted in the respective table.
10. Database Design using ER Modeling, Normalization Implementation for any application.
 11. Develop an application for Employee payroll processing System to add, delete, update employee particulars and generate payslip with the employee table created.

TOTAL : 45 PERIODS

LAB REQUIREMENTS:

Front end: VB/VC ++/JAVA or Equivalent

Back end: Oracle 11 / SQL / MySQL/Postgres / DB2 or Equivalent

Oracle Server

OUTCOMES

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

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

CO – PO, PSO MAPPING:

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

SEMESTER - III

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

OBJECTIVES:

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

LIST OF EXPERIMENTS:

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

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

TOTAL: 45 PERIODS**LAB REQUIREMENTS:**

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

OUTCOMES

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

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

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	-	-	-	-	3	-	-	-	-	-	-	1	2
C02	-	-	-	3	-	-	-	-	-	-	-	1	2
C03	-	-	3	-	-	-	-	-	-	-	-	1	2

SEMESTER - III

24CSTP301 - SDG NO. 4	APTITUDE SKILLS - I	L	T	P	CP	C
		0	0	2	2	1

APTITUDE & COGNITIVE SKILLS – PHASE 1

OBJECTIVES:

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

MODULE - I **QUANTITATIVE ABILITY**

22

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

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

16

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

MODULE - III **VERBAL ABILITY**

7

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

TOTAL: 45 PERIODS

REFERENCES:

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

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

OBJECTIVES:

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

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

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

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

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

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

MODULE - II RANGER AND ROVER**10**

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

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

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

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

Activating the Earth Tribe Initiative in your Community.

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

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

TOTAL: 45 PERIODS**REFERENCES:**

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

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
C01	2	-	-	-	-	-	-	-	-	-	1	-	-
C02	-	-	-	-	-	2	-	-	-	-	1	-	-
C03	-	-	-	-	-	-	-	-	2	-	1	-	-
C04	-	2	-	-	-	-	-	-	-	-	1	-	-
C05	-	-	-	-	-	-	-	2	3	-	1	-	-
C06	-	-	-	-	-	3	-	-	-	-	1	-	-



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SEMESTER - III

24CSID301 - 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.

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
C01	3	3	2	-	-	-	-	2	-	-	-	2	2
C02	3	3	2	-	-	-	-	2	-	-	-	2	2
C03	3	3	3	-	-	-	-	2	-	-	-	2	2



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SEMESTER - IV

24BSMA402 - SDG NO. 4	PROBABILITY AND QUEUEING THEORY	L	T	P	CP	C
		3	1	0	5	4

OBJECTIVES:

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

MODULE - I PROBABILITY AND RANDOM VARIABLES 9

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

MODULE - II DISCRETE AND CONTINUOUS DISTRIBUTIONS 9

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

MODULE - III TWO-DIMENSIONAL RANDOM VARIABLES 12

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

MODULE - IV RANDOM PROCESSES 12

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

MODULE - V QUEUEING MODELS 9

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

MODULE - VI ADVANCED QUEUEING MODELS 9

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

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Fundamentals of Applied Probability and Random Processes, Ibe, O. C., 2nd edition, Elsevier, 2019. (1.1, 1.3, 1.6, 1.7 (1.7.1), 1.8, 1.13 - exercise problems in 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/>

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
C01	3	-	-	-	-	-	-	-	-	-	-	3	-
C02	3	-	-	-	-	-	-	-	-	-	-	3	-
C03	-	3	-	-	-	-	-	-	-	-	-	3	-
C04	-	3	-	-	-	-	-	-	-	-	-	3	-
C05	-	3	-	-	-	-	-	-	-	-	-	3	2
C06	-	3	-	-	-	-	-	-	-	-	-	3	2

SEMESTER - IV

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

OBJECTIVES:

- To construct Automata for any given pattern and its equivalent regular expressions
- To design a context free grammar for any given language and push down automata for the language

- To understand Turing machines and undecidable problems
- To learn about the various phases of the Compiler
- To learn various Parsing techniques
- To understand Intermediate code generation, code optimization & code generation.

MODULE - I AUTOMATA FUNDAMENTALS & FINITE AUTOMATA 7

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

MODULE - 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 (Chomsky Normal form)

MODULE - III PUSHDOWN AUTOMATA 8

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

MODULE - IV TURING MACHINE 8

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

MODULE - V INTRODUCTION TO COMPILERS & LEXICAL ANALYSIS 7

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

MODULE - VI SYNTAX ANALYSIS, CODE GENERATION & CODE OPTIMIZATION 7

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

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>
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=eqCkkC9AQ4>
2. <https://online.stanford.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. Apply models of computation to construct automata. (K3)
2. Build the Regular Expression and Context Free Grammar for any given language (K3)
3. Construct the PushDown Automata for the regular language (K3)
4. Develop the Turing machine for the regular language (K3)
5. Identify the role of each phase of a compiler and Lexical Analyzer (K3)
6. Develop parser, code generation and code optimization to generate the optimized code (K3)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PS02
C01	3	-	-	-	-	-	-	2	-	-	-	2	2
C02	-	-	3	-	-	-	-	-	2	-	-	2	2
C03	3	-	-	-	-	-	-	2	-	-	-	2	2
C04	-	3	-	-	-	-	-	-	-	-	-	2	2
C05	-	3	-	-	-	-	-	2	-	-	-	2	2
C06	-	-	3	-	-	-	-	-	2	-	-	2	2

SEMESTER - IV

24CSPC402 106101059 SDG NO. 4	DESIGN AND ANALYSIS OF ALGORITHM				L	T	P	CP	C
					3	0	0	3	3

OBJECTIVES:

- To understand and apply the algorithm analysis techniques
- To critically analyze the efficiency of alternative algorithmic solutions for the same problem
- To understand different algorithm design techniques
- To understand the limitations of Algorithmic power

MODULE-I INTRODUCTION**8**

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

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

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

MODULE - III DYNAMIC PROGRAMMING 7

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

MODULE - IV GREEDY TECHNIQUES 7

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

MODULE - V ITERATIVE IMPROVEMENT 7

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

MODULE - VI COPING WITH THE LIMITATIONS OF ALGORITHM POWER 8

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

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education, 2012.
2. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, "Computer Algorithms/ C++", Second Edition, Universities Press, 2007.

REFERENCES:

1. Thomas H.Cormen, Charles E.Leiserson, Ronald L.Rivest and Clifford Stein, " Introduction to Algorithms", Third Edition, PH1 Learning Private Limited,2012

2. Alfred V.Aho, John E.Hopcroft and Jeffrey D.Ullman, " Data Structures and Algorithms", Pearson Education, Reprint 2006.
3. Harsh Bhasin, "Algorithms Design and Analysis", Oxford University press,2016
4. S.Sridhar, " Design and Analysis of Algorithms", Oxford University press, 2014.

WEB REFERENCES:

1. <https://nptel.ac.in/courses/106101060/#>
2. <http://www.learnalgorithms.in/>
3. <https://courses.cs.vt.edu/csonline/Algorithms/Lessons/>

OUTCOMES

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

1. Analyze the efficiency of algorithms using various frameworks (K4)
2. Make use of algorithm design techniques like brute force and divide and conquer techniques to solve problems (K3)
3. Use Dynamic programming techniques for solving problems. (K3)
4. Implement Greedy technique concept to solve various problems (K3)
5. Apply iterative improvement techniques to formulate and solve complex optimization and matching problems (K3)
6. Solve problems using approximation algorithms and randomized algorithms (K3)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	-	3	-	-	-	-	-	-	-	-	-	1	3
C02	3	-	-	-	-	-	-	-	-	-	-	2	3
C03	3	-	-	-	-	-	-	-	-	-	-	2	3
C04	-	3	-	-	-	-	-	-	-	-	-	2	3
C05	3	-	-	-	-	-	-	-	-	-	-	2	3
C06	3	-	-	-	-	-	-	-	-	-	-	2	3



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SEMESTER - IV

24ITPW401 106106144 SDG NO. 4 & 9	OPERATING SYSTEM WITH LABORATORY	L	T	P	CP	C
		3	0	2	5	4

OBJECTIVES:

- To understand the basic concepts, functions of Operating Systems, Processes and Threads
- To analyze Scheduling algorithm and understand the concept of Deadlock
- To analyze various memory management schemes
- To Understand I/O systems basics and various file systems.
- To be familiar with the basics of virtual machines and Mobile OS like iOS and Android.

MODULE - I OPERATING SYSTEM OVERVIEW

7

Introduction – Computer System Organization – Computer System Architecture - Operating System Overview- Objectives and Functions - Evolution of Operating System - Computer System Organization Operating System Structure and Operations - System Calls - System Programs - OS Generation and System Boot

MODULE - II PROCESS MANAGEMENT

8

Processes - Process Concept - Process Scheduling - Operations on Processes - Inter-process Communication - CPU Scheduling - Scheduling Criteria - Scheduling Algorithms- Multiple - Processor Scheduling - Threads - Multithreading Models - Threading Issues - Process Synchronization - The Critical - Section Problem - Synchronization Hardware - Mutex Locks - Semaphores - Classic Problems of Synchronization - Critical Regions

MODULE - III DEADLOCK

7

Monitors - Deadlock – System Model - Deadlock Characterization - Methods for Handling Deadlocks - Deadlock Prevention - Deadlock Avoidance - Deadlock Detection - Recovery from Deadlock

MODULE - IV MEMORY MANAGEMENT

8

Main Memory – Background, Swapping, Contiguous Memory Allocation - Paging - Segmentation - Segmentation with Paging - Virtual Memory – Background - Demand Paging - Page Replacement - Allocation of Frames- Thrashing - Allocating Kernel Memory

MODULE - V FILE SYSTEMS AND I/O SYSTEMS**8**

Overview of Mass Storage Structure - Disk Structure - Disk Scheduling and Management - Swap Space Management - File-System Interface - File Concept - Access Methods - Directory Structure - Directory Organization - File System Mounting - File Sharing and Protection - File System Implementation- File System Structure - Directory Implementation - Allocation Methods - Free Space Management - I/O Systems – I/O Hardware - Application I/O Interface - Kernel I/O Subsystem.

MODULE - VI CASE STUDY**7**

Linux System - Design Principles - Kernel Modules - Process Management - Scheduling - Memory Management - Input-Output Management - File System - Inter-Process Communication - Mobile OS - iOS and Android.

LIST OF EXPERIMENTS :

1. Study UNIX Commands & Utilities.
2. Process Management using System Calls.
3. Implement the various CPU Scheduling Algorithms.
4. Implementation of Semaphore and Multi-threading
5. Implementation of Deadlock avoidance using Banker's Algorithm.
6. Implementation of Deadlock Detection Algorithm.
7. Implementation of First-fit, Best-fit and Worst-fit memory allocation strategies.
8. Implementation of page replacement algorithms.
9. Implementation of disk scheduling algorithms.
10. Implementation of the following File Allocation Strategies
 - a) Sequential b) Indexed c) Linked

TOTAL : 60 PERIODS**LAB REQUIREMENTS**

1. Standalone desktops with C / C++ / Java / Equivalent compiler 30 Nos. with Linux OS

TEXT BOOKS:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", 9th Edition, John Wiley and Sons Inc., 2012.
2. William Stallings, "Operating Systems – Internals and Design Principles", 7th Edition, Prentice Hall, 2011

REFERENCES:

1. Ramez Elmasri, A. Gil Carrick, David Levine, "Operating Systems – A Spiral Approach", Tata McGraw Hill Edition, 2010.
2. Achyut S. Godbole, Atul Kahate, "Operating Systems", McGraw Hill Education, 2016.
3. Andrew S. Tanenbaum, "Modern Operating Systems", Second Edition, Pearson Education, 2004.
4. Gary Nutt, "Operating Systems", Third Edition, Pearson Education, 2004.
5. Harvey M. Deitel, "Operating Systems", Third Edition, Pearson Education, 2004.

WEB REFERENCES:

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

ONLINE RESOURCES:

1. https://onlinecourses.swayam2.ac.in/ntr25_ed41/preview
2. <https://www.udacity.com/course/introduction-to-operating-systems--ud923>
3. <https://freevideolectures.com/course/3670/introduction-to-operating-systems>

OUTCOMES

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

1. Identify the concepts and functions of the operating system. (K3)
2. Apply process management and CPU scheduling techniques (K3)
3. Analyze deadlock concepts and prevention strategies (K4)
4. Examine memory management problems and segmentation. (K4)
5. Organize the functionalities of file and I/O systems. (K3)
6. Make use of various administrative tasks in linux environment (K3)



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CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	3	-	-	-	-	-	-	-	-	-	-	2	2
C02	-	3	-	-	-	-	-	-	-	-	-	2	2
C03	-	-	-	3	-	-	-	-	-	-	-	2	2
C04	-	-	3	-	-	-	-	-	-	-	-	2	2
C05	-	-	-	-	3	-	-	-	-	-	-	2	2
C06	-	-	-	-	3	-	-	-	-	-	-	2	2

SEMESTER - IV

24ESEC401 - SDG NO. 4	MICROPROCESSORS AND MICROCONTROLLERS					L	T	P	CP	C
						3	0	0	3	3

OBJECTIVES:

- To explore the architecture, instruction set, and programming of the 8086 microprocessor and 8051 microcontroller.
- To develop an in-depth understanding of the operation of microprocessors and microcontrollers, machine language programming & interfacing techniques.
- To study memory and I/O interfacing techniques for connecting peripheral devices.
- To design and develop Microprocessor/ microcontroller based systems for real time applications using low level language like ALP.
- To understand the concepts of ARM processors.

MODULE - I THE 8086 ARCHITECTURE**7**

Architecture of 8086, Register Organization, Programming Model, Memory addresses, Memory Segmentation, Physical Memory Organization, Signal descriptions of 8086- Common Function Signals, Minimum and Maximum mode signals, Timing diagrams.

**MODULE - II INSTRUCTION SET AND ASSEMBLY LANGUAGE
PROGRAMMING OF 8086****9**

Instruction formats, Addressing modes, Instruction Set, Assembler Directives, Procedures, Macros, Simple Programs involving Logical, Branch and Call Instructions, Sorting, Evaluating Arithmetic Expressions, String Manipulations.

MODULE - III I/O INTERFACE**9**

8255 PPI, Various Modes of Operation and Interfacing to 8086, D/A and A/D Converter, Stepper motor, Interfacing of DMA controller 8257, Memory Interfacing to 8086, Interrupt Service Routine, Serial Communication Standards, Serial Data Transfer Schemes, 8251 USART Architecture and Interfacing.

MODULE - IV INTRODUCTION TO MICROCONTROLLERS**8**

Overview of 8051 Microcontroller, Architecture, I/O Pin Ports, Memory Organization, Addressing Modes and Instruction set of 8051, Simple Programs, memory interfacing to 8051.

MODULE - V 8051 REAL TIME CONTROL**6**

Programming Timer Interrupts, Programming External Hardware Interrupts, Programming the Serial Communication Interrupts, Programming 8051 Timers and Counters.

MODULE - VI ARM PROCESSOR**6**

Fundamentals, Registers, Current program status register, Pipeline, Interrupt and the vector table.

TOTAL : 45 PERIODS**TEXT BOOKS:**

1. D. V. Hall, Microprocessors and Interfacing, TMGH, 2nd Edition 2006.
2. Nagoor Kani, "Microprocessors and Microcontrollers", McGraw Hill education (India) Private Limited, 2013.
3. Andrew N. Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide: Designing and Optimizing System Software", Elsevier Inc., 2007.

REFERENCES:

1. N.Senthilkumar, M.Saravanan, S.Jeevananthan, "Microprocessors and Microcontrollers", Oxford University Press, 2011.
2. A.K.Ray and K.M.Bhurchandi, "Advanced Microprocessor and Peripherals", Tata McGraw Hill, 3rd Edition, 2013.
3. Kenneth J Ayala, "The 8086 Microprocessor: Programming and Interfacing the PC", Cengage Learning, Reprint 2014.
4. K.Uma Rao, Andhe Pallavi, "The 8051 Microcontrollers, Architecture and Programming and Applications - Pearson, 2009.
5. Ajay. V. Deshmukh, "Microcontrollers and Application", TMGH, 2005.

ONLINE RESOURCES:

1. <http://read.pudn.com/downloads165/ebook/754892/micro.pdf>
2. http://www.openloop.com/education/classes/sjsu_engr/engr_comp.Org/spring2002/student Projects/Truc_Tran/Eng120.html
3. <https://www.intel.com/content/dam/www/public/us/en/documents/white-papers/ia-introduction-basics-paper.pdf>
4. <http://ecerelatedbooks.blogspot.com/2018/01/microprocessor-and-microcontroller.html>

OUTCOMES

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

1. Analyze the architecture, instruction set, and programming of the 8086 Microprocessor. (K4)
2. Develop an understanding of the 8086 instruction set and assembly language programming. (K6)
3. Design and implement peripheral interfacing for LCD, keyboard, ADC, DAC and Sensors, along with I/O techniques using DMA, interrupt controllers, and timers.(K6)
4. Explain the 8051 microcontroller architecture, instruction set and programming. (K5)
5. Examine hardware and software interaction and integration.(K4)
6. Conclude about the essentials of registers, current program status registers, pipelines, interrupts and the vector table in computer architecture.(K5)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	2	1	1	-	-	-	-	-	-	-	-	2	-
C02	2	1	1	-	-	-	-	-	-	-	-	2	2
C03	2	1	1	-	1	-	-	-	-	-	-	2	2
C04	2	1	2	-	1	-	-	-	-	-	-	2	2
C05	2	1	2	-	1	-	-	-	-	-	-	2	2
C06	2	1	2	-	2	-	-	-	-	-	-	2	2



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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

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
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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
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GENERAL AWARENESS 4

GA 1	General Knowledge	4
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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
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BORDER & COASTAL AREAS 2

BCA 1	History, Geography & Topography of Border/Coastal areas	2
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TOTAL: 45 PERIODS**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	

SEMESTER - IV

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

OBJECTIVES:

- To understand Object Oriented Programming concepts and principles of Packages, Inheritance and Interfaces
- To have the understanding of Exceptions and to make use I/O streams
- To develop a Java application with threads and generic classes.
- To design and build simple Graphical User Interfaces
- To build interactive applications using Lambda and Reactive Programming.

MODULE - I INTRODUCTION TO OOP AND JAVA FUNDAMENTALS 8

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 interface Concept.
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

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

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 Multi threading.
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.
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

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 each Map-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**TEXT BOOKS:**

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

REFERENCES:

1. Paul Deitel, Harvey Deitel, “Java SE 8 for Programmers”, 3rd Edition, Pearson, 2015.

- Steven Holzner, "Java 2 Blackbook", Dream Tech Press, 2011.
- Timothy Budd, "Understanding Object-Oriented Programming with Java", Updated Edition, Pearson Education, 2000.
- Kathy Sierra, Bert Bates, Trisha Gee, "Head First Java", 3rd Edition, O'Reilly, 2022.
- Joshua Bloch, "Effective Java", 3rd Edition, Addison Wesley, 2018.

WEB REFERENCES:

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

OUTCOMES

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

- Implement Object-Oriented Programming concepts in Java to develop solutions using packages and inheritance.(K3)
- Construct Java applications using exceptions, I/O streams, multithreading, and generic classes.(K3)
- Examine real-time applications using the concepts of Swing, lambda expressions, streams, and reactive programming.(K4)

CO – PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	-	-	3	-	-	-	-	2	-	-	-	3	3
C02	3	-	-	-	-	-	-		2	-	-	3	3
C03	-	-	-	3	-	-	-	2	-	-	-	3	3

SEMESTER - IV

24CSTP401 - 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 - III DYNAMIC PROGRAMMING, GREEDY AND GRAPH BASICS 14

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**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 entrepreneurs - 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.

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.
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
C01	3	3	2	2	2	-	-	-	-	-	2	2	2
C02	3	3	3	2	2	-	-	-	-	-	2	-	-
C03	3	3	3	3	2	-	-	-	-	-	2	2	2
C04	3	3	3	2	3	-	-	-	2	1	3	-	-
C05	-	-	-	-	-	3	-	-	1	-	2	2	2
C06	-	-	-	-	-	3	-	-	1	-	2	2	2



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CHAIRMAN
 Board of Studies
 Department of Computer Science and Engineering
 Sri Sairam Engineering College

SEMESTER - IV

24CSID401 - 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.

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.

- 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:

- First evaluation (Immediately after first internal examination): 20 marks (Focus on refined problem statement, advanced MVP design, and detailed development plan)
- Second evaluation (Immediately after second internal examination): 30 marks (Focus on prototype/MVP implementation, initial testing, and preliminary market validation results)
- 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:

- Apply structured entrepreneurial exploration to convert innovative ideas into venture blueprints, incorporating user-centric and iterative design approaches. (K4)
- Assess customer behavior and market traction to align product strategies with ethical and sustainable entrepreneurship principles. (K5)
- 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
C01	3	3	2	-	-	-	-	2	-	-	-	2	2
C02	3	3	2	-	-	-	-	2	-	-	-	2	2
C03	3	3	2	-	-	-	-	2	-	-	-	2	2

SEMESTER V

COURSE CODE: 24ITPC501	COMPUTER NETWORKS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24ESCS101, 24CSPC302, 24CSPC402, 24ITPW401					

OBJECTIVES:

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

MODULE - I FUNDAMENTALS OF DATA COMMUNICATION

6

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

MODULE -II PHYSICAL LAYER

7

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

MODULE -III DATA LINK LAYER

9

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

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

MODULE - IV NETWORK LAYER**9**

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

MODULE - V TRANSPORT LAYER**8**

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

MODULE - VI APPLICATION LAYER AND NETWORK SECURITY**6**

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

TOTAL : 45 PERIODS**TEXT BOOK:**

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

REFERENCES:

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

ONLINE RESOURCES:

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

OUTCOMES

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

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

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

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

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	2	2	2	-	2	-	-	-	-	-	-	2	2
C02	2	2	2	-	2	-	-	-	-	-	-	2	2
C03	2	2	2	-	2	-	-	-	-	-	-	2	2
C04	2	2	2	-	2	-	-	-	-	-	-	2	2
C05	2	2	2	-	2	-	-	-	-	-	-	2	2
C06	2	2	2	-	2	-	-	-	-	-	2	2	2

SEMESTER V

COURSE CODE: 24CSPW501	ARTIFICIAL INTELLIGENCE WITH LABORATORY	L	T	P	CP	C
		3	0	2	5	4
NPTEL CODE: 106102220	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24ESCS101, 24CSPC302, 24CSPC401					

OBJECTIVES:

- To understand the various characteristics of Intelligent agents
- To learn the different search strategies in AI
- To learn to represent knowledge in solving AI problems
- To understand the different ways of designing software agents and about the various applications of AI

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

MODULE - I INTRODUCTION TO ARTIFICIAL INTELLIGENCE 7

Introduction - Definition - Future of Artificial Intelligence – Characteristics of Intelligent Agents – Typical Intelligent Agents – Problem Solving Approach to Typical AI Problems – Search Strategies - Uninformed - Heuristics - Informed.

MODULE - II PROBLEM SOLVING METHODS 8

Local Search Algorithms and Optimization Problems - Searching with Partial Observations – Constraint Satisfaction Problems – Constraint Propagation - Backtracking Search - Game Playing – Optimal Decisions in Games – AlphaBeta Pruning - Stochastic Games.

MODULE - III REPRESENTATION OF KNOWLEDGE 7

First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining - Backward Chaining – Resolution – Knowledge Representation - Ontological Engineering - Categories and Objects - Events - Mental Events and Mental Objects - Reasoning Systems for Categories - Reasoning

MODULE - IV PLANNING AND LEARNING 8

Planning – Planning with State Space Search- Partial Order Planning Algorithm – Planning Graphs - Logical Formulation of Learning - Knowledge in Learning - Explanation-based Learning - Learning using Relevance Information

MODULE - V NATURAL LANGUAGE PROCESSING 8

Language models - Phrase Structure Grammars - Syntactic Analysis – Augmented Grammars and Semantic Interpretation - Application with NLP: Developing a Simple Chatbot - Types of Chatbot.

MODULE - VI PROBABILISTIC REASONING 7

Acting under uncertainty – Bayesian inference – naïve Bayes models- Probabilistic reasoning – Bayesian networks

LABORATORY EXERCISES

1. Installation of Python and AI libraries
2. Implementation of BFS and DFS algorithms
3. Implementation of A* search algorithm
4. Solving Constraint Satisfaction Problems
5. Development of rule-based expert systems
6. Implementation of Minimax game algorithm

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

7. Data preprocessing using Pandas
8. Implementation of NLP programs
9. Naive Bayes classifier implementation
10. Mini Project using AI concepts

TOTAL : 60 PERIODS

TEXT BOOK:

1. Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, 4th Edition, Pearson Education, 2021.
2. Machine Learning with Python Cookbook, Chris Albon, 2nd Edition, O'Reilly Media, 2023.

REFERENCES

1. Artificial Intelligence, Elaine Rich, Kevin Knight and Shivashankar B. Nair, McGraw Hill Education, 2017.
2. Andries P. Engelbrecht, "Computational Intelligence: An Introduction", John Wiley & Sons, 2nd edition, 2007
3. Python Machine Learning, Sebastian Raschka and Vahid Mirjalili, Packt Publishing, 2019.
4. Hands-On Machine Learning with Scikit-Learn, Keras and TensorFlow, Aurélien Géron, O'Reilly Media, 2022.
5. Nils.J. Nilsson, "Artificial Intelligence: A new synthesis", Elsevier, July 2003

WEB REFERENCES:

1. <https://ocw.mit.edu/courses/6-034-artificial-intelligence-fall-2010/>
2. <https://ocw.mit.edu/courses/6-867-machine-learning-fall-2006/>
3. https://www.cse.iitk.ac.in/users/piyush/courses/ml_autumn16/ML.html

OUTCOMES:

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

1. Apply Artificial Intelligence concepts and search strategies to solve typical AI problems (K3)
2. Illustrate search and game-playing techniques to solve optimization and constraint satisfaction problems. (K3)
3. Analyze logic, knowledge representation, and reasoning techniques to solve problems (K4)

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

- Utilize planning and learning approaches to solve Artificial Intelligence problems using search and relevance-based techniques (K3)
- Develop a chatbot using NLP techniques. (K3)
- Examine probabilistic reasoning methods using Bayesian inference and Bayesian networks under uncertainty. (K4)

CO - PO, PSO MAPPING:

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

SEMESTER V

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

OBJECTIVES:

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

MODULE - I INTRODUCTION**5**

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

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

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. 9 held on 12.05.26

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.drishtiiias.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)

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

- Describe the structure, powers and functions of the Union Government under the Constitution. (K2)
- Interpret the structure and functioning of State Governments and the judicial system in India. (K2)
- Analyze federal relations, constitutional amendments and constitutional functionaries. (K4)
- Examine constitutional remedies and mechanisms for protection of fundamental rights. (K4)
- 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
C01	-	1	-	-	-	2	1	2	-	-	-	2	2
C02	-	2	-	-	-	2	2	2	-	-	-	2	2
C03	-	2	-	-	-	2	2	2	-	-	-	2	2
C04	-	2	1	-	-	2	2	2	-	-	-	2	2
C05	-	2	1	-	-	2	2	2	-	-	-	2	2
C06	-	2	1	-	-	2	2	2	-	-	-	2	2

SEMESTER V

COURSE CODE: 24ITPL501	COMPUTER NETWORKS LABORATORY	L	T	P	CP	C
		0	0	4	4	2
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24CSPC302, 24CSPC402					

OBJECTIVES:

- To provide hands-on experience in designing and configuring basic computer networks using Cisco Packet Tracer.
- To develop practical skills in IP addressing, network topology creation, and connectivity testing.
- To understand and implement core networking concepts such as ARP, VLAN, DHCP, DNS, and routing protocols.

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

- To simulate and analyze client-server communication using application layer protocols like HTTP and FTP, and transport layer concepts using TCP/UDP

LIST OF EXPERIMENTS:

1. Basic LAN setup and IP addressing between PCs
2. Network topology creation (Star, Bus, Ring)
3. Ping command for connectivity testing
4. ARP protocol simulation in LAN
5. Ethernet LAN setup using switch
6. Wireless LAN (Wi-Fi) configuration
7. Static routing between two networks
8. RIP routing configuration (basic dynamic routing)
9. VLAN creation and simple switch configuration
10. Inter-VLAN communication setup
11. DHCP configuration for automatic IP allocation
12. DNS configuration and name resolution
13. HTTP web server and client communication
14. FTP file transfer between client and server
15. TCP vs UDP basic communication simulation

TOTAL : 30 PERIODS

LAB REQUIREMENTS :

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

OUTCOMES:

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

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

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	3	-	2	-	3	-	-	-	-	-	-	3	-
C02	3	2	3	-	3	-	-	-	-	-	-	3	2
C03	2	3	-	3	2	-	-	-	-	-	-	3	-

SEMESTER V

COURSE CODE: 24CSTP501	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

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

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

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

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

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

**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.waggs.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]

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4. Use ethical principles, emotional intelligence, and leadership insights from biographies to practice responsible decision-making and professional conduct. (K3)
5. Illustrate the objectives and practices of WOSM/WAGGGS and Government of India initiatives such as Messengers of Peace, Surf Smart, and Scouts of the World Award. (K3)
6. Apply the concepts of IoT, Digital Twins, and related standards in identifying applications of connected systems in modern technologies. (K3)

CO - PO - PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	2	2	2	2	-	-	-	-	-	-	2	-	-
C02	2	2	2	2	1	-	-	-	1	-	2	-	-
C03	2	2	2	2	-	-	-	-	1	-	2	-	-
C04	-	-	-	-	-	2	-	3	3	3	-	2	2
C05	-	-	-	-	-	3	2	2	2	2	1	2	2
C06	3	2	2	-	3	1	-	-	-	-	-	2	2

SEMESTER V

COURSE CODE: 24CSID501	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.

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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
C01	3	3	2	-	2	-	-	-	-	-	-	2	3
C02	3	3	3	--	3	-	-	-	-	-	-	2	3
C03	3	3	3	-	3	-	-	-	-	-	-	3	3

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

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.

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

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
C01	3	-	-	-	3	-	-	-	-	-	-	2	2
C02	3	2	-	-	-	-	-	-	-	-	-	2	2
C03	3	2	-	-	-	-	-	-	-	-	-	2	2
C04	3	2	-	-	2	-	-	-	-	-	2	2	2
C05	3	2	-	-	2	-	-	-	-	-	2	2	2
C06	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.

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

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. 9 held on 12.05.26

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
C01	3	2	-	-	1	-	-	-	-	-	-	3	1
C02	3	3	-	1	1	-	-	-	-	-	-	3	2
C03	3	3	1	1	1	-	-	-	-	-	-	3	2
C04	3	3	2	1	2	-	1	-	-	-	1	3	3
C05	3	2	2	1	1	-	1	-	-	-		2	2
C06	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.

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

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: Clusters, 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.

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

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>

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

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
C01	3	3	2	-	2	-	-	-	-	-	-	2	2
C02	2	2	3	-	3	-	-	-	-	-	-	2	2
C03	2	2	3	-	3	-	-	-	-	-	2	2	2
C04	2	2	3	-	3	-	-	-	-	-	2	2	2
C05	2	2	3	-	2	-	-	-	-	-	-	2	2
C06	2	2	3	-	3	-	-	-	-	-	2	2	2

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

PROFESSIONAL ELECTIVES - I

COURSE CODE: 24AIEL501	EXPLORATORY DATA ANALYSIS WITH R SOFTWARE	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 8, 9				
PRE-REQUISITE COURSES	24ITPW401					

OBJECTIVES:

- To understand the fundamental concepts, applications, and workflow of Data Science.
- To apply R programming concepts and commands for performing data manipulation and statistical computations.
- To prepare and preprocess datasets for analysis using appropriate data cleaning and transformation techniques.
- To perform Exploratory Data Analysis (EDA) using graphical and statistical methods to discover patterns and insights from data.
- To analyze data using measures of central tendency, dispersion, moments, and scaling techniques.

MODULE - I: INTRODUCTION TO DATA SCIENCE AND R SOFTWARE 7

Introduction to Data Science - Introduction to R software with R commands - Calculations with R software - Data Preparation and Introduction to Exploratory Data Analysis

MODULE - II EXPLORATORY DATA ANALYSIS AND UNIVARIATE VISUALIZATION 8

Introduction to Exploratory Data Analysis - Frequency Distribution - Univariate Graphics - Univariate Plots

MODULE - III UNIVARIATE ANALYSIS AND MEASURES OF DATA DISTRIBUTION 7

Univariate Graphics - Plots - Central Tendency of Data - Central Tendency of Data and Variation in Data

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

MODULE - IV STATISTICAL MEASURES OF DISPERSION AND DATA TRANSFORMATION

8

Variation in Data : Variation in Data - Variation in Data - Moments- Scaling of Data

MODULE - V ASSOCIATION ANALYSIS AND CORRELATION OF VARIABLES

7

Association of Variables with Graphic - Association of Variables and Correlation Coefficient

MODULE - VI MULTIVARIATE DATA ANALYSIS AND REGRESSION TECHNIQUES

8

Association of Variables for rank data - discrete data - Least Squares Method - Least Squares Method - EDA with Multivariate Data

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Hadley Wickham and Garrett Grolemund, "R for Data Science", O'Reilly Media, 2nd Edition, 2023.
2. Roger D. Peng, "R Programming for Data Science", Leanpub, 2016.

REFERENCES

1. Jared P. Lander, "R for Everyone: Advanced Analytics and Graphics", Addison-Wesley Professional, 2nd Edition, 2017.
2. Peter Bruce, Andrew Bruce, and Peter Gedeck, "Practical Statistics for Data Scientists: 50+ Essential Concepts Using R and Python", O'Reilly Media, 2nd Edition, 2020.
3. John M. Chambers, "Software for Data Analysis: Programming with R", Springer, 2nd Edition, 2017.

WEB REFERENCES

1. <https://r4ds.hadley.nz/>
2. <https://posit.co/resources/>
3. <https://r-graph-gallery.com/>

ONLINE REFERENCES

1. <https://r4ds.hadley.nz/>
2. <https://r-graphics.org/>
3. <https://dplyr.tidyverse.org/>

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

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

1. Apply the fundamental concepts of Data Science and R programming to perform data manipulation, computations, and preliminary data preparation tasks.(K3)
2. Utilize exploratory data analysis techniques, frequency distributions, and univariate visualizations to summarize and explore datasets..(K3)
3. Analyze data distributions using graphical methods and measures of central tendency to interpret the characteristics of datasets..(K4)
4. Examine data variability through measures of dispersion, moments, and data scaling techniques for effective data transformation..(K4)
5. Analyze the association between variables using graphical methods and correlation coefficients to identify relationships and dependencies..(K4)
6. Evaluate relationships among rank, discrete, and multivariate data using association measures and least squares regression techniques for data-driven insights.(K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	3	2	-	2	-	-	-	-	-	-	-	2	3
C02	3	1	-	2	-	-	-	-	-	-	-	2	2
C03	2	2	1	2	-	-	-	-	-	-	-	2	2
C04	3	2	-	2	-	-	-	-	-	-	-	-	2
C05	2	2	3	2	2	-	-	-	-	-	-	2	-
C06	2	2	-	2	2	-	-	-	-	-	-	3	2

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

PROFESSIONAL ELECTIVES - I

COURSE CODE: 24AIEL502	ARTIFICIAL INTELLIGENCE FUNDAMENTALS AND APPLICATIONS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106108705	SYLLABUS VERSION 1.0	SDG NO. 9, 11				
PRE-REQUISITE COURSES	24AIPT201, 24AMPC302					

OBJECTIVES:

- To introduce the fundamental concepts, techniques, and applications of Artificial Intelligence.
- To equip learners with problem-solving methods, knowledge representation, machine learning, and deep learning techniques, and to provide an understanding of the ethical implications of AI in society.
- Apply uninformed and informed search algorithms (BFS, DFS, A*, etc.).
- Analyze real-world applications such as: Natural Language Processing (NLP) Expert Systems, Robotics and Computer Vision.
- To understand the machine learning concept.
- To explore real-world AI applications.

MODULE - I INTRODUCTION TO ARTIFICIAL INTELLIGENCE 7

Foundations and history of AI, definitions and goals of AI, the Turing Test and intelligent behaviour, intelligent agents and rationality, agent architectures (reactive, deliberative, hybrid), PEAS framework (Performance measure, Environment, Actuators, Sensors), types of environments — deterministic vs stochastic, static vs dynamic, fully vs partially observable, discrete vs continuous. Applications of AI in healthcare, finance, transportation, and entertainment. Current trends, opportunities, and limitations of AI.

MODULE - II PROBLEM SOLVING AND SEARCH TECHNIQUES 8

Problem formulation and state space representation. Uninformed search strategies — Breadth-First Search (BFS), Depth-First Search (DFS), Uniform Cost Search, Depth-Limited Search, Iterative Deepening Search. Informed/heuristic search techniques — Greedy Best-First Search, A* algorithm, IDA*. Properties of heuristics: admissibility and consistency. Local search algorithms — Hill Climbing, Simulated Annealing, Genetic Algorithms. Adversarial search — Minimax algorithm, Alpha-Beta pruning. Constraint Satisfaction Problems (CSPs) and backtracking search.

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

MODULE - III KNOWLEDGE REPRESENTATION AND REASONING 8

Propositional logic — syntax, semantics, inference rules. First-order logic (predicate logic) — quantifiers, variables, functions. Resolution and unification. Forward chaining and backward chaining. Semantic networks, frames, and ontologies. Rule-based expert systems. Reasoning under uncertainty: probability basics, Bayes' theorem, Bayesian networks, Dempster-Shafer theory. Introduction to fuzzy logic — fuzzy sets, membership functions, fuzzy inference systems.

MODULE - IV MACHINE LEARNING FOUNDATIONS 8

Introduction to machine learning and its relationship with AI. Supervised, unsupervised, and reinforcement learning paradigms. Regression techniques — linear and logistic regression. Classification algorithms — Decision Trees, k-Nearest Neighbours (k-NN), Naive Bayes classifier, Support Vector Machines (SVM). Unsupervised learning — k-Means clustering, hierarchical clustering- Performance metric evaluation

MODULE - V NEURAL NETWORKS AND DEEP LEARNING 7

Biological inspiration and the artificial neuron. Perceptron and Multilayer Perceptron (MLP). Activation functions — sigmoid, tanh, ReLU, softmax. Forward propagation and the backpropagation algorithm. Gradient descent and its variants — SGD, Momentum, Adam. Convolutional Neural Networks (CNNs) — convolution, pooling, architectures like LeNet, AlexNet, ResNet. Recurrent Neural Networks (RNNs), Long Short-Term Memory (LSTM), and Gated Recurrent Units (GRU).

MODULE - VI ETHICS AND AI APPLICATIONS 7

AI ethics — bias and fairness, accountability, explainable AI (XAI), privacy and security concerns. Societal impact and the future of AI. Natural Language Processing (NLP) — tokenization, stemming, lemmatization, word embeddings (Word2Vec, GloVe), sentiment analysis, chatbots. Computer Vision — image classification, object detection, face recognition. Expert Systems — architecture and case studies (MYCIN, DENDRAL). Robotics and autonomous systems — perception, planning, control. Generative AI and Large Language Models (LLMs) — GPT, BERT, diffusion models.

TOTAL : 45 PERIODS**TEXT BOOKS:**

1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", 4th Edition, Pearson, 2021.

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

2. Elaine Rich, Kevin Knight, Shivashankar B. Nair, "Artificial Intelligence", 3rd Edition, McGraw Hill, 2017.
3. Tom M. Mitchell, "Machine Learning", McGraw Hill, 2017.
4. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016.
5. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", 3rd Edition, O'Reilly, 2022.

REFERENCES:

1. Deepak Khemani, "Search Methods in Artificial Intelligence", Cambridge University Press in 2024.
2. George F. Luger, "Artificial Intelligence: Structures and Strategies for Complex Problem Solving", Addison Wesley, 1998.

WEB REFERENCES:

1. NPTEL – Artificial Intelligence: Search Methods for Problem Solving
2. NPTEL – Introduction to Machine Learning
3. IBM Artificial Intelligence Resources

ONLINE RESOURCES:

1. NPTEL Course – Artificial Intelligence
2. NPTEL Course – Introduction to Machine Learning
3. Coursera – Artificial Intelligence Courses
4. edX – Artificial Intelligence Programs
5. Kaggle Learn – Machine Learning and AI Tutorials

OUTCOMES:

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

1. Apply the fundamental concepts, history, definitions, and goals of Artificial Intelligence to analyze intelligent systems. (K3)
2. Apply problem formulation and state space representation techniques to model Artificial Intelligence search problems. (K3)
3. Utilize propositional logic concepts including syntax, semantics, and inference rules for logical problem solving in Artificial Intelligence. (K3)
4. Examine the fundamentals of machine learning and its relationship with Artificial Intelligence, including supervised, unsupervised, and reinforcement learning paradigms. (K4)

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5. Implement artificial neuron models, Perceptron, and Multilayer Perceptron (MLP) networks for basic neural network applications. (K3)
6. Construct expert system models based on architectures and case studies such as MYCIN and DENDRAL for knowledge-based problem solving. (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	3	-	-	-	-	-	-	-	-	-	-	2	3
C02	3	-	-	-	-	-	-	-	-	-	-	3	3
C03	2	3	-	-	-	-	-	-	-	-	-	2	3
C04	3	3	-	-	-	-	-	-	-	-	-	2	2
C05	2	3	-	-	-	-	-	-	-	-	-	2	2
C06	2	3	-	-	-	-	-	-	-	-	-	3	2

PROFESSIONAL ELECTIVES - I

COURSE CODE: 24AIEL503	HUMAN CENTERED COMPUTING	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106106701	SYLLABUS VERSION 1.0	SDG NO. 9, 11, 13				
PRE-REQUISITE COURSES	24ITPC302, 24ESCS101					

OBJECTIVES:

- To understand the principles, concepts, and foundations of Human-Computer Interaction (HCI).
- To learn user-centered design methodologies and interaction design processes.
- To apply design principles, usability guidelines, and accessibility standards in interface design.
- To develop prototypes and user interfaces using modern design tools and frameworks.
- To evaluate interactive systems using qualitative and quantitative usability assessment techniques.
- To explore emerging interaction paradigms, AI-driven interfaces, and ethical considerations in HCI.

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

MODULE - I FOUNDATIONS OF HCI**8**

Introduction to Human-Computer Interaction (HCI), history and evolution of HCI, importance of human-centered design. The human — sensory perception (vision, hearing, touch), memory (sensory, short-term, long-term), cognition, attention, and motor skills. The computer — input devices (keyboard, mouse, touchscreen, voice, gesture), output devices (display, audio, haptic). Interaction styles — command line interfaces, menu-based, form fill-in, direct manipulation, GUI/WIMP, web-based, mobile, voice, and immersive interfaces. Norman's seven stages of action and the gulfs of execution and evaluation.

MODULE - II INTERACTION DESIGN PROCESS**8**

User-Centered Design (UCD) principles and philosophy. Design thinking framework — empathize, define, ideate, prototype, test. Requirements gathering techniques — interviews, surveys, questionnaires, ethnographic studies, contextual inquiry, focus groups. Personas, user profiles, and scenarios. User stories and use cases. Task analysis — Hierarchical Task Analysis (HTA), GOMS model. Participatory and co-design approaches. Iterative design cycle and the role of stakeholders.

MODULE - III DESIGN PRINCIPLES AND GUIDELINES**8**

Shneiderman's Eight Golden Rules of interface design. Nielsen's Ten Usability Heuristics. Don Norman's design principles — visibility, feedback, affordance, signifiers, mapping, constraints, consistency. Gestalt principles of visual perception — proximity, similarity, closure, continuity, figure-ground. Visual design fundamentals — color theory, typography, layout, white space, hierarchy. Accessibility — Web Content Accessibility Guidelines (WCAG), assistive technologies, universal design principles. Designing for diverse users including users with disabilities, elderly users, and children.

MODULE - IV PROTOTYPING AND IMPLEMENTATION**7**

Importance and role of prototyping in design. Low-fidelity prototyping — sketches, paper prototypes, storyboards, wireframes. High-fidelity prototyping — interactive mockups, clickable prototypes. Industry-standard prototyping tools — Figma, Adobe XD, Sketch, Balsamiq, InVision, Axure. Design systems and style guides (Material Design, Apple Human Interface Guidelines). Responsive and adaptive design. Mobile-first design approach. Cross-platform design considerations — web, iOS, Android. Handoff from designer to developer.

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

MODULE - V EVALUATION TECHNIQUES

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

Mobile and touch interfaces — gestures, multi-touch, haptics. Voice User Interfaces (VUI) and conversational design — Alexa, Siri, Google Assistant. Augmented Reality (AR) and Virtual Reality (VR) interfaces — design challenges and opportunities. Wearable computing and smart devices. Tangible and embedded interaction. Brain-Computer Interfaces (BCI). Designing for AI systems and chatbots — trust, transparency, explainability. Ethics in design — dark patterns, persuasive design, addictive design, privacy. Case studies of successful and failed interface designs.

TOTAL : 45 PERIODS**TEXT BOOKS:**

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human-Computer Interaction", Pearson/Prentice-Hall, 2004.
2. Ben Shneiderman, Catherine Plaisant, "Designing the User Interface: Strategies for Effective Human-Computer Interaction", 6th Edition, Pearson Education, 2016.

REFERENCES

1. Donald A. Norman, "The Design of Everyday Things", Revised and Expanded Edition, Basic Books, 2013.
2. Helen Sharp, Jennifer Preece, Yvonne Rogers, "Interaction Design: Beyond Human-Computer Interaction", 5th Edition, Wiley, 2019.
3. Steve Krug, "Don't Make Me Think, Revisited: A Common-Sense Approach to Web Usability", 3rd Edition, New Riders, 2014.

WEB REFERENCES:

1. <https://www.interaction-design.org>
2. <https://www.nngroup.com>

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

3. World Wide Web Consortium (W3C) Web Accessibility Initiative
<https://www.w3.org/WAI>

ONLINE RESOURCES:

1. NPTEL Course – Human Computer Interaction
2. Coursera – User Experience (UX) Design Courses
3. edX – Human Computer Interaction Courses

OUTCOMES:

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

1. Apply human cognitive and perceptual principles in interaction design. (K3)
2. Apply user-centered design methods to identify user requirements and problems. (K3)
3. Analyse usability principles and design guidelines to create user interfaces. (K4)
4. Develop low- and high-fidelity prototypes using design tools. (K3)
5. Analyse usability issues using expert reviews and user testing methods. (K4)
6. Analyse emerging interaction technologies and ethical aspects of interface design. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	3	2	-	-	-	-	-	-	-	-	-	2	-
C02	2	3	-	-	-	-	-	-	-	-	-	3	-
C03	2	3	-	-	-	-	-	-	-	-	-	2	3
C04	2	2	-	-	-	-	-	-	-	-	-	2	2
C05	2	3	-	-	-	-	-	-	-	-	-	2	2
C06	2	3	-	-	-	-	-	-	-	-	-	3	2

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

PROFESSIONAL ELECTIVES - I

COURSE CODE: 24ITPC401	USER INTERFACE /USER EXPERIENCE (UIUX) DESIGNING SKILLS	L 3	T 0	P 0	CP 4	C 3
NPTEL CODE: 106106701	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	-					

OBJECTIVES:

- To learn the basics of User Interface/User Experience Designing Skills
- To become familiar with the design technologies for individuals and persons with disabilities
- To be aware of Mobile HCI
- To learn the guidelines to design user interface
- To design an UI using UX skills.

MODULE - I OVERVIEW OF USER INTERFACE

8

Importance of User Interface – Definition – Importance of Good Design - History of HCI- Blossoming of the World Wide Web - Characteristics of Graphical and Web User Interface - Interaction Styles - The Graphical User Interface - The Web User Interface - The Merging of Graphical Business Systems and the Web

MODULE - II USER INTERFACE DESIGN PROCESS

8

Principles of User Interface Design - Obstacles and Pitfalls – Usability - Human Considerations in the Design of Business Systems - Business Function - Determining Basic Business Functions - Design Standards or Style Guides - System Training and Documentation Needs – Usability Testing – Purpose – Importance – Scope- Prototypes – Kinds of Tests

MODULE - III UI ELEMENTS

8

System Menus – Navigation Schemes – Window – Characteristics – Components- Presentation Styles – Types – Screen based Controls – Graphics, Icons, Images – Colors – Case Study: Creation of Visual designs and clickable prototypes.

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

MODULE - IV OVERVIEW OF USER EXPERIENCE**7**

UX Design Concepts - Intersection of Design, Technology, & Business- Knowing Your User - User Research Through Interviews - Refining User Research and Creating Personas- Synthesis of User Research, Journey Maps, and User Flows

MODULE - V USER EXPERIENCE ELEMENTS**7**

Wireframing – Types of Wireframing - Sketching, Prototyping - Types - User Testing - Iterating the Prototype - User Testing

MODULE - VI WEB INTERFACE DESIGN**7**

Designing Web Interfaces – Drag and Drop - Direct Selection - Contextual Tools - Overlays, Inlays and Virtual Pages - Process Flow – Case Studies – Introduction to Figma – Tools in Figma – Figma Layers Panel – Components – Design Panel – Libraries – Code Panel – Prototyping – Masks - Figma Exports – Mockup in photoshop – Plugins – Wireframing in Figma

TOTAL : 45 PERIODS**TEXT BOOKS:**

1. Edward Stull, "UX Fundamentals for Non-UX Professionals User Experience Principles for Managers, Writers, Designers, and Developers", Apress, Springer Nature Link, 2018.
2. Wilbert O. Galitz, "The Essential Guide to User Interface Design: An Introduction to GUI Design Principles and Techniques", 3rd Edition, Wiley Publishing Inc., 2007.

REFERENCES:

1. Brian Fling, "Mobile Design and Development, First Edition", O'Reilly Media Inc., 2009.
2. Bill Scott and Theresa Neil, "Designing Web Interfaces", First Edition, O'Reilly, 2009.
3. Yvonne Rogers, Helen Sharp, Jenny Preece, "Interaction Design: beyond human-computer interaction", Second Edition, John-Wiley and Sons Inc., 2009.
4. DovTe-eni, Jane Carey, Ping Zhang, "Human-Computer Interaction: Developing Effective Organizational Information Systems", John-Wiley and Sons Inc., 2007.

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

WEB REFERENCES:

1. https://onlinecourses.nptel.ac.in/noc23_cs116
2. UI/UX Design With Figma : 5+ Real World Projects | Udemy
3. <https://www.nobledesktop.com/outlines/ux-and-ui-design-certificate-syllabus.pdf>

ONLINE RESOURCES:

1. <https://freevidelectures.com/course/4491/nptel-introduction-human-computer-interaction>
2. https://www.iare.ac.in/sites/default/files/lecture_notes/HCI%20LECTURE%20NOTES.pdf
3. <https://mrcet.com/pdf/Lab%20Manuals/IT/R15A0562%20HCI.pdf>

OUTCOMES:

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

1. Utilize the basic concepts of User Interface and its types to design. (K3)
2. Make use of the design process and its testing strategy in real time UI designs. (K3)
3. Examine various UI elements in real time visual designs and prototypes. (K4)
4. Experiment with the basic fundamentals of UX designing. (K3)
5. Inspect wireframing, sketching and prototyping and test with usability testing. (K4)
6. Dissect the Web Based User Interface Design for Multimedia / Ecommerce / E-Learning Websites using Figma. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	3	2	-	-	-	-	-	-	-	-	-	2	2
C02	3	2	-	-	-	-	-	-	-	-	-	2	2
C03	3	3	2	-	3	-	-	-	-	-	2	2	2
C04	3	2	-	-		-	-	-	-	-	-	2	2
C05	3	3	2	-	3	-	-	-	-	-	2	2	2
C06	3	3	2	-	3	-	-	-	-	-	2	2	2

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

PROFESSIONAL ELECTIVES - I

COURSE CODE: 24CSEL501	INTRODUCTION TO MOBILE TECHNOLOGIES	L 3	T 0	P 0	CP 3	C 3
NPTEL CODE: 106106147	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24ITPW401, 24CSPW301					

OBJECTIVES:

- To understand the basic concepts of Mobile Computing
- To learn the basics of Mobile Telecommunication System
- To be familiar with the Mobile communication Layers
- To explore emerging future wireless communication technologies

MODULE - I INTRODUCTION

8

Introduction to Mobile Computing – Applications of Mobile Computing
Generations of Mobile Communication Technologies- Multiplexing – Spread spectrum - MAC Protocols – Wireless MAC Issues- SDMA- TDMA- FDMA- CDMA.

MODULE - II MOBILE TELE COMMUNICATION SYSTEM

8

Global System for Mobile Communication (GSM) – General Packet Radio Service (GPRS) –Universal Mobile Telecommunication System (UMTS), Long Term Evolution (LTE), 5G NR.

MODULE - III MOBILE NETWORK LAYER

7

Mobile IP –Ad Hoc- Proactive Protocol-DSDV, Reactive Routing Protocols – DSR, AODV, Hybrid routing –ZRP, Multicast Routing- ODMRP.

MODULE - IV MOBILE TRANSPORT AND APPLICATION LAYER

8

Mobile TCP– Improvements in TCP – I TCP – STCP – MTCP – WAP – Architecture – WDP – TLS – WTP – WSP – WAE – WML.

MODULE - V MOBILE OPERATING SYSTEM

7

Mobile Device Operating Systems – Commercial Mobile Operating Systems – Software Development Kit: iOS, Android, BlackBerry, Windows Phone.

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

MODULE - VI FUTURE MOBILE NETWORKS

Drone networking - Multi-UAV networks, architectures and civilian applications - Communication challenges and protocols for micro UAVs - Connected and autonomous cars – VANET - Wireless technologies for Vehicle-to-Infrastructure (V2I) and Vehicle-to-Vehicle (V2V) communications.

TOTAL : 45 PERIODS**TEXT BOOKS:**

1. Jochen Schiller, "Mobile Communications", Prentice Hall India, Second Edition, 2009.
2. Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2012.

REFERENCES:

1. Raj Kamal, "Mobile Computing", Oxford University Press; 3rd edition, 2019
2. Andre Perez, "Mobile Networks Architecture", Wiley, 2013
3. Rishabh Anand, "Mobile Computing, Khanna Publishing House", 1st Edition, 2012.
4. Prasant Kumar Pattnaik, Rajib Mall, "Fundamentals of Mobile Computing", Prentice Hall India Learning Pvt., Ltd, New Delhi, 2012.

WEB REFERENCES:

1. https://www.tutorialspoint.com/mobile_computing/index.htm
2. <https://www.techtarget.com/searchmobilecomputing/tutorials>
3. <https://www.geeksforgeeks.org/computer-networks/wireless-mobile-computing-technologies/>
4. https://www.tutorialspoint.com/mobile_computing/index.htm

ONLINE RESOURCES:

1. <https://nptel.ac.in/courses/106106147>
2. <https://www.coursera.org/learn/wireless-communications>
3. https://www.getyoureducation.net/course/5g-4g-lte-3g-2g-mobile-cellular-networks-for-beginners?utm_source=chatgpt.com
4. https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ee109
5. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ee72

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

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

1. Illustrate mobile computing concepts, wireless communication systems, multiplexing techniques, spread spectrum methods, and MAC protocols. (K3)
2. Analyze the architecture, functionality, and performance characteristics of GSM, GPRS, UMTS, LTE, and 5G NR mobile communication technologies. (K4)
3. Examine the routing strategies and performance of DSDV, DSR, AODV, ZRP, and ODMRP protocols in mobile networks. (K4)
4. Interpret the operation of Mobile TCP enhancements and WAP architecture for supporting mobile communication services. (K4)
5. Examine the architecture, features, and development environments of commercial mobile operating systems and their software development kits. (K4)
6. Investigate the architectures and communication technologies supporting drone networks, connected vehicles, and autonomous transportation systems. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	3	2	-	-	2	-	-	-	-	-	-	2	2
C02	3	3	2	-	3	-	-	-	-	-	-	2	2
C03	3	3	3	-	3	-	-	-	-	-	-	2	2
C04	2	3	2	2	3	-	-	-	-	-	-	2	2
C05	2	2	3	-	3	-	-	-	-	-	-	2	2
C06	2	3	3	-	3	-	-	-	-	-	2	2	2

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

PROFESSIONAL ELECTIVES - I

COURSE CODE: 24CSEL502	NOSQL DATABASES	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106104189	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24AIPT201, 24CSPT401, 24CSPL301					

OBJECTIVES:

- Understand RDBMS limitations and need for NoSQL
- Explain NoSQL concepts and architectures
- Apply aggregate data models
- Analyze consistency and transaction models
- Evaluate key-value and document databases
- Examine column-family, graph databases, and schema design

MODULE - I FOUNDATIONS OF RELATIONAL DATABASES AND LIMITATIONS

7

The Value of Relational Databases - Structured Data & ACID Properties - Impedance Mismatch(Object vs Relational Model) - Application vs Integration Databases - Limitations of RDBMS in Modern Applications

MODULE - II EMERGENCE OF NOSQL

8

Development of Non-Relational Technologies - The Emergence of NoSQL - CAP Theorem - NoSQL Database Management Systems (overview) - Types of NoSQL Databases

MODULE - III AGGREGATE DATA MODELS AND RELATIONSHIPS

8

Aggregate Data Models - Aggregate-Oriented Databases - Relationships in NoSQL Systems - Consequences of Aggregate Orientation - Design Considerations

MODULE - IV CONSISTENCY, TRANSACTIONS AND DISTRIBUTION

8

Consistency Models - Update Consistency - Read Consistency - Relaxing Consistency - Relaxing Durability - Business Transactions vs System Transactions - Version Stamps on Multiple Nodes

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

MODULE - V KEY-VALUE AND DOCUMENT DATABASES**7**

Key-Value Databases: Key-Value Store Concept-Features-Suitable Use Cases - Document Document Data Model - Features - Suitable Use Cases

MODULE - VI COLUMN-FAMILY STORES, GRAPH DATABASES & SCHEMA DESIGN**7**

Column-Family Databases: Data Model - Features - Suitable Use Cases - Graph Databases: Graph Model - Features - Suitable Use Cases - Schema Design and Evolution: Schema Migrations - Schema Changes - Schema Changes in RDBMS vs NoSQL

TOTAL : 45 PERIODS**TEXT BOOKS:**

1. Pramod J. Sadalage & Martin Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley, 2012.
2. Michael Kaufmann, Andreas Meier, "SQL and NoSQL Databases: Modeling, Languages, Security and Architectures for Big Data Management", Kindle Edition, 2023.

REFERENCES:

1. Martin Kleppmann, "Designing Data-Intensive Applications", O'Reilly, 2017.
2. Eric Redmond & Jim Wilson, "Seven Databases in Seven Weeks", 2nd Edition, 2018.
3. Guy Harrison, "NoSQL Database: New Era of Databases for Big Data Analytics", Apress.

WEB REFERENCES:

1. <https://www.mongodb.com/resources/basics/databases/nosql-explained>
2. <https://www.ibm.com/think/topics/nosql-databases>
3. <https://www.geeksforgeeks.org/dbms/introduction-to-nosql/>
4. <https://www.datacamp.com/tutorial/nosql-tutorial>
5. <https://www.thoughtworks.com/insights/blog/nosql-databases-overview>
6. <https://en.wikipedia.org/wiki/NoSQL>

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

ONLINE RESOURCES:

1. <https://www.freecodecamp.org/news/sql-vs-nosql-tutorial/>
2. <https://www.youtube.com/watch?v=-s29jUAkg70>

OUTCOMES:

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

1. Apply the fundamentals of relational databases to identify the limitations of RDBMS in modern applications. (K3)
2. Develop appropriate database solutions for distributed and scalable applications using NoSQL concepts. (K3)
3. Apply aggregate data models and design principles to represent relationships and design efficient NoSQL database structures for real-world applications. (K3)
4. Demonstrate the use of consistency models and distribution strategies to maintain data consistency across multiple nodes. (K3)
5. Apply key-value and document database models to implement suitable data storage solutions based on application needs. (K3)
6. Apply column-family and graph database models to design schemas and perform schema evolution in NoSQL systems. (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	3	2	-	-	2	-	-	-	-	-	-	2	2
C02	3	3	2	-	3	-	-	-	-	-	-	2	2
C03	3	3	3	-	3	-	-	-	-	-	-	2	2
C04	2	3	2	2	3	-	-	-	-	-	-	2	2
C05	2	2	3	-	3	-	-	-	-	-	-	2	2
C06	2	3	3	-	3	-	-	-	-	-	2	2	2

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

PROFESSIONAL ELECTIVES - I

COURSE CODE: 24ITEL507	DATA WAREHOUSING AND DATA MINING	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24BSMA301, 24BSMA402					

OBJECTIVES:

- To examine the concepts, architecture, and design of data warehousing systems to support efficient data management and business decision-making.
- To analyze multidimensional data models, OLAP operations, and data pre-processing techniques for transforming raw data into meaningful insights.
- To implement data mining algorithms for discovering patterns, associations, and knowledge from large datasets.
- To apply classification, clustering, and data analysis tools for building and evaluating data-driven models.

MODULE - I DATA WAREHOUSING FUNDAMENTALS

7

Basic Concepts – Data Warehousing Components – Building a Data Warehouse – Database Architectures for Parallel Processing – Parallel DBMS Vendors – Multidimensional Data Model – Data Warehouse Schemas for Decision Support - Concept Hierarchies

MODULE - II OLAP AND BUSINESS ANALYSIS

8

Multidimensional Data Model – OLAP Operations (Roll-up, Drill-down, Slice, Dice, Pivot) – OLAP vs OLTP – Characteristics of OLAP Systems – Database Architectures for Parallel Processing – Parallel DBMS

MODULE - III DATA PRE-PROCESSING AND VISUALIZATION

8

Data Mining Overview and KDD Process – Data Objects and Attribute Types – Statistical Description of Data – Data Cleaning, Integration, Reduction – Data Transformation and Discretization – Data Similarity and Dissimilarity Measures – Data Visualization Techniques

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

MODULE - IV FREQUENT PATTERN MINING**7**

Mining Frequent Patterns – Association Rule Mining – Correlation Analysis – Pattern Evaluation Methods – Multilevel and Multidimensional Pattern Mining – Constraint-Based Pattern Mining – Classification using Frequent Patterns

MODULE - V CLASSIFICATION TECHNIQUES**7**

Decision Tree Induction – Bayesian Classification – Rule-Based Classification – Support Vector Machines – Lazy Learners – Model Evaluation and Accuracy Improvement Techniques

MODULE - VI CLUSTERING AND DATA ANALYSIS TOOLS**8**

Clustering Techniques and Cluster Analysis – Partitioning Methods – Hierarchical Methods – Density-Based and Grid-Based Methods – Outlier Detection Techniques – Introduction to WEKA Tool – Classification, Clustering and Association using WEKA

TOTAL : 45 PERIODS**TEXT BOOKS:**

1. Jiawei Han, Jian Pei, Hanghang Tong, "Data Mining: Concepts and Techniques," Fourth Edition, Elsevier, 2022.
2. Pang-Ning Tan, Michael Steinbach, Anuj Karpatne, Vipin Kumar, "Introduction to Data Mining," Second Edition, Pearson, 2019.

REFERENCE BOOKS

1. Alex Berson, Stephen J. Smith, "Data Warehousing, Data Mining & OLAP," Tata McGraw-Hill, Reprint 2016.
2. Ian H. Witten, Eibe Frank, Mark A. Hall, Christopher J. Pal, "Data Mining: Practical Machine Learning Tools and Techniques," Fourth Edition, Elsevier, 2016.
3. Martin Kleppmann, "Designing Data-Intensive Applications," O'Reilly Media, 2017.
4. Parteek Bhatia, "Data Mining and Data Warehousing: Principles and Practical Techniques," Cambridge University Press, 2019.

WEB REFERENCES:

1. <https://nptel.ac.in/courses/106105174>
2. https://swayam.gov.in/nd1_noc20_cs12/preview
3. <https://www.cs.waikato.ac.nz/ml/weka/>
4. https://www.tutorialspoint.com/data_mining/index.htm

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

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

1. Apply data warehousing concepts, architectures, and multidimensional models for decision support systems. (K3)
2. Utilize OLAP operations and business analysis techniques to analyze multidimensional data. (K3)
3. Perform data pre-processing and visualization techniques to transform raw data into suitable formats for analysis. (K3)
4. Execute frequent pattern mining and association rule techniques to discover meaningful patterns in datasets. (K3)
5. Implement classification algorithms to develop predictive models and improve their performance. (K3)
6. Apply clustering techniques and data mining tools to analyze data and extract useful knowledge. (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	3	2	-	-	-	-	-	-	-	-	-	-	3
C02	3	3	-	2	-	-	-	-	-	-	-	-	2
C03	3	3	-	2	-	-	-	-	-	-	-	-	2
C04	2	3	-	-	-	-	-	-	-	-	-	-	2
C05	3	3	2	-	-	-	-	-	-	-	-	2	3
C06	2	-	-	-	3	-	-	-	-	-	-	3	3

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

PROFESSIONAL ELECTIVES - I

COURSE CODE: 24ITEL508	DATA ANALYTICS WITH PYTHON	L	T	P	CP	C
		3	0	0	4	3
NPTEL CODE: 106107220	SYLLABUS VERSION 1.0	SDG NO. 4, 8, 11				
PRE-REQUISITE COURSES	24ESCS101 , 24BSMA301					

OBJECTIVES:

- To introduce the fundamental concepts, lifecycle, and applications of Data Analytics in various domains.
- To develop proficiency in Python programming and essential libraries such as NumPy and Pandas for data manipulation and analysis.
- To enable students to perform data preprocessing, exploratory data analysis, and data visualization for extracting meaningful insights from datasets.
- To provide knowledge of statistical analysis and basic machine learning techniques for solving real-world data-driven problems and supporting decision-making.

MODULE - I INTRODUCTION TO DATA ANALYTICS

7

Data Analytics – Definition – Data Analytics Lifecycle – Types of Analytics: Descriptive, Diagnostic, Predictive, Prescriptive – Applications of Data Analytics – Data Types and Sources.

MODULE - II PYTHON PROGRAMMING BASICS

7

Python Fundamentals – Variables and Data Types – Operators – Control Structures – Functions and Modules – Introduction to NumPy, Arrays and Operations.

MODULE - III DATA HANDLING USING PANDAS

8

Data Collection – Data Formats (CSV, Excel, JSON) – Pandas Data Structures – Data Cleaning – Handling Missing Values – Data Transformation – Data Integration.

MODULE - IV EXPLORATORY DATA ANALYSIS

7

Descriptive Statistics – Data Summarization – Correlation and Covariance – Identifying Patterns and Trends – Basic Statistical Measures.

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

MODULE - V DATA VISUALIZATION**8**

Principles of Visualization – Matplotlib – Seaborn – Types of Plots: Line, Bar, Histogram, Scatter – Visualization for Decision Making.

MODULE - VI STATISTICAL ANALYSIS AND APPLICATIONS**8**

Probability Basics – Hypothesis Testing – Regression Analysis – Classification and Clustering Basics – Case Studies and Mini Project.

TOTAL : 45 PERIODS**TEXT BOOKS:**

1. Wes McKinney, Python for Data Analysis: Data Wrangling with pandas, NumPy, and Jupyter, 3rd Edition, O'Reilly Media, 2022.
2. Fabio Nelli, Python Data Analytics: Data Analysis and Data Science Using Pandas, Matplotlib and the Python Programming Language, 3rd Edition, Apress, 2023.
3. Jake Vander Plas, Python Data Science Handbook, O'Reilly Media, 1st Edition, 2016.

REFERENCES

1. Fabio Nelli, Python Data Analytics: Data Analysis and Science Using Pandas, Matplotlib and the Python Programming Language, 3rd Edition, Apress, 2023.
2. Yuli Vasiliev, Python for Data Science: A Hands-On Introduction, 2nd Edition, No Starch Press, 2024.
3. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, An Introduction to Statistical Learning, Springer, 2nd Edition, 2021.
4. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer, 2nd Edition, 2009.

WEB REFERENCES

1. https://onlinecourses.nptel.ac.in/noc23_cs116
2. <https://www.python.org/doc/>
3. <https://pandas.pydata.org/docs/>
4. <https://numpy.org/doc/>

ONLINE RESOURCES

1. <https://www.youtube.com/playlist?list=PLZoTAELRMXVNUL99R4bDIVtR5Xl4cY1M>

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

2. <https://www.youtube.com/playlist?list=PL-osiE80TeTsghluOqKhwlXslBldSeYtc>
3. <https://www.youtube.com/playlist?list=PL9ooVrP1hQOEDSc5QEblhJWl2PyaO8R1n>

OUTCOMES:

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

1. Apply fundamental concepts of data analytics and analytical approaches. (K3)
2. Apply Python programming constructs, functions, and NumPy operations to solve data analytics problems. (K3)
3. Apply Pandas-based techniques for data collection, cleaning, transformation, integration, and management of datasets. (K3)
4. Analyze datasets using exploratory data analysis techniques and statistical measures to discover patterns, trends, and relationships. (K4)
5. Analyze and interpret data using visualization techniques. (K4)
6. Analyze real-world datasets using statistical and machine learning techniques. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	3	2	-	-	-	-	-	-	-	-	-	2	2
C02	3	3	2	-	-	-	-	-	-	-	-	3	3
C03	3	3	2	-	-	-	-	-	-	-	-	3	3
C04	3	3	2	-	-	-	-	-	-	-	-	3	3
C05	3	2	3	-	-	-	-	-	-	-	-	3	3
C06	3	3	3	-	-	-	-	-	-	-	-	3	3

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

PROFESSIONAL ELECTIVES - I

COURSE CODE: 24ITEL509	BIG DATA ESSENTIALS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106104189	SYLLABUS VERSION 1.0	SDG NO. 4, 8				
PRE-REQUISITE COURSES	24ITPC301 , 24ITPW301					

OBJECTIVES:

- To provide the knowledge in the basic and advanced methods of big data technology and tools, including Hadoop and its ecosystem.
- To understand the concepts of Hadoop and HDFS.
- To perform Map Reduce analytics using Hadoop Related tools.
- To illustrate and implement the SPARK programming.

MODULE - I UNDERSTANDING BIG DATA AND ITS APPLICATIONS 8

Evolution of Big Data – Characteristics of Big Data – Value of Big Data – Structured and Unstructured Data – Big Data Applications and Use Cases – Web Analytics – Big Data in Marketing, Healthcare, Finance, and Risk Management – Big Data Technologies – Big Data Storage and Analytics.

MODULE - II FUNDAMENTALS OF HADOOP 8

Introduction to Hadoop – Hadoop Ecosystem – Hadoop Distributed File System (HDFS) – HDFS Architecture and Components – HDFS Commands and Interfaces – Data Flow in HDFS – Data Ingestion using Flume and Sqoop – Hadoop I/O – Compression and Serialization – Avro and Hadoop File Formats.

MODULE - III MAP REDUCE FRAMEWORK 8

Developing a Map Reduce Application - How Map Reduce Works - Anatomy of a Map Reduce Job Run-Failures- Job Scheduling-Shuffle and Sort – Task execution – Map Reduce Types and Formats- Map Reduce Features- Hadoop Environment. YARN – Failures in Classic Map Reduce and YARN – job scheduling – Shuffle and sort – Task execution – Map Reduce types – Input formats-Output formats.

MODULE - IV HADOOP ECOSYSTEM AND TOOLS 7

Introduction to PIG-Execution Modes of Pig-Comparison of Pig with Databases- Grunt- Pig Latin- User Defined Functions- Data Processing

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

Operators- Hive-Hive Shell-Hive Services- Hive Metastore- Comparison with Traditional Databases- HiveQL- Tables- Querying Data and User Defined Functions- Hbase-HBasics- Concepts- Clients-Hbase Versus RDBMS.

MODULE - V INTRODUCTION TO SPARK PROGRAMMING

7

Introduction to Spark – Spark Architecture – RDDs – Transformations and Actions – DataFrames and Datasets – Spark SQL – Writing Spark Applications using Scala, Python, R and Java – Spark Shell – Spark Streaming (Basic Concepts) – Introduction to Mllib.

MODULE - VI GPU COMPUTING AND CUDA FOR BIG DATA

7

Introduction to GPU Computing-CUDA Programming Model- CUDAAPI-Simple Matrix-Multiplication in CUDA- CUDA Memory Model- Shared Memory Matrix Multiplication- Additional CUDA API Features- Data Analysis with CUDA and Spark

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Tom White, Hadoop: The Definitive Guide, 5th Edition, O'Reilly Media, 2023.
2. Seema Acharya and Subhashini Chellappan, Big Data Analytics, 3rd Edition, Wiley India, 2024.
3. Bill Chambers and Matei Zaharia, Spark: The Definitive Guide – Big Data Processing Made Simple, O'Reilly Media, Reprint Edition, 2023.
4. Jason Sanders and Edward Kandrot, CUDA by Example: An Introduction to General-Purpose GPU Programming, Updated Reprint, Addison-Wesley, 2023.
5. Raj Kamal and Preeti Saxena, Big Data Analytics, 3rd Edition, McGraw Hill Education, 2024.

REFERENCES

1. Vignesh Prajapati, Big Data Analytics with Hadoop 3, Packt Publishing, 2022.
2. Holden Karau, Andy Konwinski, Patrick Wendell, and Matei Zaharia, Learning Spark: Lightning-Fast Data Analytics, 3rd Edition, O'Reilly Media, 2024.
3. Eric Sammer, Hadoop Operations, 3rd Edition, O'Reilly Media, 2023.
4. John Cheng, Max Grossman, and Ty McKercher, Professional CUDA C Programming, Wiley, Reprint Edition, 2023.

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

5. Anand Rajaraman and Jeffrey Ullman, Mining of Massive Datasets, 3rd Edition, Cambridge University Press, 2024.

WEB REFERENCES

1. <https://www.analyticsvidhya.com/resources-big-data/>
2. https://www.tutorialspoint.com/big_data_analytics/index.html
3. <https://nptel.ac.in/courses/106104189>

ONLINE RESOURCES

1. <https://www.analyticsvidhya.com/resources-big-data/>
2. <https://www.edureka.co/blog/big-data-tutorial>

OUTCOMES:

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

1. Apply the fundamental concepts of Machine Learning to identify and classify appropriate types of Machine Learning for different real-world applications. (K3)
2. Implement data preprocessing techniques, including data cleaning, data transformation, and feature selection, to prepare a dataset for Machine Learning tasks. (K3)
3. Execute MapReduce applications using Hadoop and YARN for distributed data processing. (K3)
4. Analyze the use of Pig, Hive, and HBase in managing and processing Big Data workloads. (K4)
5. Analyze Spark components and develop scalable data processing applications using Spark frameworks. (K4)
6. Analyze CUDA-based GPU computing techniques and evaluate their integration with Spark for high-performance Big Data analytics. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	3	2	3	-	-	-	-	-	-	-	-	3	3
C02	3	2	3	-	-	-	-	-	-	-	-	3	3
C03	3	3	2	-	-	-	-	-	-	-	-	3	3
C04	3	3	2	-	-	-	-	-	-	-	-	3	3
C05	3	3	2	-	-	-	-	-	-	-	-	3	3
C06	3	3	2	-	-	-	-	-	-	-	-	3	3

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

PROFESSIONAL ELECTIVES - I

COURSE CODE: 24CSEL503	MACHINE LEARNING ALGORITHMS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106106139	SYLLABUS VERSION 1.0	SDG NO. 9, 11				
PRE-REQUISITE COURSES	24BSMA301, 24BSMA402, 24CSPC301, 24CSPC302					

OBJECTIVES:

- To understand the basic concepts of Machine Learning
- To learn different types of Machine Learning approaches
- To explore data preprocessing and feature engineering techniques
- To understand fundamental algorithms in Machine Learning
- To analyze model performance and evaluation techniques

MODULE - I INTRODUCTION TO MACHINE LEARNING

9

Introduction to Machine Learning – Definition – Importance – Applications of Machine Learning – Types of Data – Supervised, Unsupervised and Reinforcement Learning – Machine Learning workflow – Role of Data in ML – Real-world examples

MODULE -II DATA PREPROCESSING

9

Data Collection – Data Cleaning – Handling missing values – Data transformation – Feature scaling – Encoding categorical data – Feature selection – Train-test split – Data normalization and standardization

MODULE -III SUPERVISED LEARNING

8

Regression - Linear Regression – Multiple Regression – Evaluation metrics (MSE, RMSE)- Classification: Logistic Regression – K-Nearest Neighbors (KNN) – Decision Trees – Applications

MODULE -IV UNSUPERVISED LEARNING

9

Clustering- K-Means Clustering – Hierarchical Clustering – Dimensionality Reduction – Principal Component Analysis (PCA) – Applications of clustering

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

MODULE - V MODEL EVALUATION**5**

Confusion Matrix – Accuracy, Precision, Recall, F1 Score – Cross-validation – Bias-Variance tradeoff – Overfitting and Underfitting

MODULE - VI INTRODUCTION TO TOOLS & APPLICATIONS**5**

Python for Machine Learning – Libraries: NumPy, Pandas, Matplotlib, Scikit-learn – Basic implementation workflow – Case studies in ML (recommendation systems, prediction models)

TOTAL : 45 PERIODS**TEXT BOOKS:**

1. Tom M. Mitchell, “Machine Learning”, McGraw Hill, 2017.
2. Aurélien Géron, “Hands-On Machine Learning with Scikit-Learn”, O’Reilly, 2019.

REFERENCES:

1. Ethem Alpaydin, “Introduction to Machine Learning”, 2nd Edition, MIT Press, 2010.
2. Bishop C.M., “Pattern Recognition and Machine Learning”, Springer, 2006.
3. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.
4. Andreas Müller, “Introduction to Machine Learning with Python”, O’REILLY, 2017.

WEB REFERENCES:

1. <https://scikit-learn.org>
2. <https://www.kaggle.com>
3. <https://machinelearningmastery.com>

OUTCOMES:

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

1. Demonstrate fundamental Machine Learning techniques such as regression and classification for solving real-world problems. (K3)
2. Implement clustering and segmentation methods for data analysis and pattern identification. (K3)
3. Apply data preprocessing methods on datasets using appropriate tools. (K3)
4. Apply supervised learning algorithms such as regression and classification for problem-solving. (K3)

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5. Apply unsupervised learning techniques like clustering for data analysis. (K3)
6. Use Machine Learning tools and libraries to implement basic ML models. (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	3	2	1	1	-	-	-	-	-	-	-	2	2
C02	3	3	2	2	-	-	-	-	-	-	-	2	2
C03	3	3	3	2	2	-	-	-	-	-	-	3	2
C04	3	3	3	2	2	-	-	-	-	-	-	3	2
C05	3	3	2	2	2	-	-	-	-	-	-	2	3
C06	3	3	3	2	3	-	-	-	-	-	-	-	3

PROFESSIONAL ELECTIVES - I

COURSE CODE: 24CSEL504	MACHINE LEARNING FOR INTELLIGENT SYSTEMS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 108104049	SYLLABUS VERSION 1.0	SDG NO. 9, 11				
PRE-REQUISITE COURSES	24BSMA301, 24BSMA402, 24CSPC301, 24CSPC302					

OBJECTIVES:

- To introduce basic machine learning techniques such as regression, classification
- To learn about introduction of clustering, types and segmentation methods
- To learn about fuzzy logic, fuzzification and defuzzification
- To learn about the basics of neural networks and neuro fuzzy networks.
- To learn about Recurrent neural networks and Reinforcement learning.

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MODULE - I INTRODUCTION TO MACHINE LEARNING 8

Philosophy of learning in computers- Overview of different forms of learning- Classifications vs. Regression- Evaluation metrics and loss functions in Classification- Evaluation metrics and loss functions in Regression- Applications of AI in Robotics.

MODULE - II CLUSTERING AND SEGMENTATION METHODS 8

Introduction to clustering- Types of Clustering- Agglomerative clustering- K-means clustering- Mean Shift clustering- K-means clustering application study- Pattern recognition- K-nearest neighbor algorithm- Principal component analysis (PCA)- Feature Selection using PCA - Case studies

MODULE - III FUZZY LOGIC 8

Introduction to Fuzzy Sets- Classical and Fuzzy Sets- Membership Function- Fuzzy rule generation- Operations on Fuzzy Sets- Numerical examples- Fuzzy Arithmetic- Numerical examples- Fuzzy Logic- Fuzzification- Defuzzification- Applications

MODULE - IV NEURAL NETWORKS 8

Mathematical Models of Neurons- ANN architecture- Learning rules- Multi-layer Perceptrons- Back propagation- Introduction of Neuro-Fuzzy Systems- Architecture of Neuro Fuzzy Networks- Applications

MODULE - V RNN AND REINFORCEMENT LEARNING 7

Recurrent neural networks- Unfolding Computational Graphs- Application of RNN- Reinforcement learning- Examples for reinforcement learning- Markov decision process- components of RL- Q-learning- Case Studies

MODULE - VI TOOLS AND APPLICATIONS 6

Python for Machine Learning – Libraries: NumPy, Pandas, Matplotlib, Scikit-learn – Implementation workflow – Case studies: robotics, prediction systems.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Micheal Negnevitsky, "Artificial Intelligence: A Guide to Intelligent Systems", 3rd Edition, Addison Wesley, England, 2011.

REFERENCES:

1. Bruno Siciliano, Oussama Khatib, "Handbook of Robotics", 2nd Edition, Springer, 2016.

Recommended in Board of Studies (BoS) Meeting No. _____ held on _____

- Simon Haykin, "Neural Networks and Learning Machines: A Comprehensive Foundation", Third Edition, Pearson, Delhi 2016.
- Timothy J Ross, "Fuzzy Logic with Engineering Applications", 4th Edition, John Wiley & sons, 2011.

WEB REFERENCES:

- Google AI – Machine Learning Crash Course
- PyTorch Official Tutorials
- Towards Data Science
- Analytics Vidhya
- KDnuggets – Machine Learning Resources
- Microsoft Learn – AI and Machine Learning

OUTCOMES:

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

- Explain fundamental machine learning techniques such as regression and classification. (K3)
- Describe clustering and segmentation methods for data analysis. (K3)
- Apply fuzzy logic concepts including fuzzification and defuzzification in real-world problems. (K3)
- Explain the architecture and learning mechanisms of neural networks and neuro-fuzzy systems. (K3)
- Apply recurrent neural networks and reinforcement learning techniques for sequential decision-making problems. (K3)
- Use machine learning tools and libraries to implement intelligent system applications. (K3)

CO - PO, PSO MAPPING:

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

Recommended in Board of Studies (BoS) Meeting No. _____ held on _____

PROFESSIONAL ELECTIVES - I

COURSE CODE: 24CSEL505	MACHINE LEARNING ESSENTIALS FOR CYBERSECURITY	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106105217	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24BSMA301, 24BSMA402, 24CSPC301, 24CSPC302					

OBJECTIVES:

- To understand the role of machine learning in cybersecurity applications.
- To learn data preprocessing and feature engineering techniques for security datasets.
- To explore supervised and unsupervised learning algorithms for cyber threat detection.
- To analyse deep learning techniques for advanced cybersecurity applications.
- To evaluate adversarial machine learning threats and defense mechanisms.
- To apply ML tools and frameworks for developing cybersecurity solutions.

MODULE - I INTRODUCTION TO MACHINE LEARNING IN CYBERSECURITY

8

Basics of Cybersecurity – Threats, Vulnerabilities and Risks – CIA Triad – Need for Intelligent Security Systems – Role of Machine Learning in Cybersecurity – Types of Machine Learning: Supervised, Unsupervised and Semi-supervised – Applications in Malware Detection, Phishing and Intrusion Detection – ML-driven Security Strategies.

MODULE - II DATA PREPROCESSING FOR CYBERSECURITY

8

Security Data Collection (Logs, Network Traffic, Alerts) – Data Cleaning and Handling Missing Values – Feature Engineering for Security Datasets – Feature Scaling and Encoding – Indicators of Compromise (IOCs) – Train-Test Split, Normalization and Standardization – Case Study: Preprocessing Security Datasets.

Recommended in Board of Studies (BoS) Meeting No. _____ held on _____

MODULE - III SUPERVISED LEARNING FOR CYBERSECURITY 8

Classification Models: Logistic Regression, Decision Trees, Random Forest, Support Vector Machines – K-Nearest Neighbors (KNN) – Applications in Malware Detection and Phishing Classification – Evaluation Metrics: Accuracy, Precision, Recall, F1 Score, ROC-AUC – Detection of Known Attacks using Supervised Learning.

MODULE - IV UNSUPERVISED AND DEEP LEARNING APPROACHES 8

Clustering Techniques: K-Means, Hierarchical Clustering – Dimensionality Reduction: PCA – Anomaly Detection Techniques – Introduction to Deep Learning – CNNs for Malware Detection – RNNs for Sequential Data – Applications in Zero-day Attack Detection and Behavioral Analysis.

MODULE - V ADVERSARIAL MACHINE LEARNING AND SECURITY 7

Adversarial Attacks: Evasion and Poisoning Attacks – Model Stealing and Membership Inference – Security Risks in ML Models – Defensive Techniques: Adversarial Training, Gradient Masking – Robustness Testing – Secure ML Model Design Principles.

MODULE - VI TOOLS, IMPLEMENTATION & CASE STUDIES 6

Python for Cybersecurity ML – Libraries: NumPy, Pandas, Scikit-learn, TensorFlow, Keras – Implementation Workflow for ML-based Security Systems – Case Studies: Phishing Detection, Network Anomaly Detection, Malware Classification – Emerging Trends: AI-driven Security, Automated Threat Intelligence.

TOTAL : 45 PERIODS**TEXT BOOKS:**

1. Aurélien Géron, “Hands-On Machine Learning with Scikit-Learn & TensorFlow”, O’Reilly, 2019.
2. William Stallings, “Cryptography and Network Security”, 5th edition, Prentice Hall, 2011.
3. Ali A. Ghorbani, “Network Intrusion Detection and Prevention”, Springer, 2010.

REFERENCES

1. Ian Goodfellow, “Deep Learning”, MIT Press, 2016.
2. Bishop C.M., “Pattern Recognition and Machine Learning”, Springer, 2006.

Recommended in Board of Studies (BoS) Meeting No. _____ held on _____

- Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.
- Chris Sanders, Applied Network Security Monitoring, Syngress, 2013.

WEB REFERENCES

- <https://scikit-learn.org>
- <https://www.kaggle.com>
- <https://machinelearningmastery.com>
- <https://www.tensorflow.org>
- <https://pytorch.org>
- <https://www.cisecurity.org>

OUTCOMES:

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

- Illustrate the use of machine learning concepts in cybersecurity applications. (K3)
- Apply preprocessing and feature engineering techniques to security datasets. (K3)
- Implement supervised learning algorithms for cyber threat detection. (K3)
- Analyse unsupervised and deep learning techniques for anomaly detection. (K3)
- Demonstrate the implementation of defense mechanisms against adversarial attacks in Machine Learning models. (K3)
- Use ML tools and frameworks to develop cybersecurity solutions. (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	3	2	1	1	-	-	-	-	-	-	-	2	2
C02	3	3	2	2	-	-	-	-	-	-	-	2	2
C03	3	3	3	2	2	-	-	-	-	-	-	3	2
C04	3	3	3	2	2	-	-	-	-	-	-	3	2
C05	3	3	2	2	2	-	-	-	-	-	-	2	3
C06	3	3	3	2	3	-	-	-	-	-	-	-	3

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

PROFESSIONAL ELECTIVES - 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

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

MODULE - V IOT APPLICATIONS**8**

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

MODULE - VI IOT ANALYTICS, SECURITY AND EMERGING TRENDS **7**

Data acquisition –Data Collection and Preprocessing Techniques- Stream analytics – Edge analytics – ML for IoT – Predictive analytics – Security challenges – Encryption – Authentication – API integration – AIoT – Digital Twin – 5G – Blockchain.

TOTAL : 45 PERIODS**TEXT BOOKS:**

1. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017
2. Samuel Greengard, The Internet of Things, The MIT Press, 2nd Edition in 2021

REFERENCES:

1. Perry Lea, "IoT and Edge Computing for Architects: Implementing edge and IoT systems from sensors to clouds with communication systems, analytics, and security", Packt Publication, 2nd Edition (2020)
2. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012
3. IOT (Internet of Things) Programming: A Simple and Fast Way of Learning, Kindle Edition (2016).
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.
5. ArshdeepBahga, Vijay Madiseti, "Internet of Things – A hands-on approach", Universities Press, 2015

WEB REFERENCES:

1. <https://nptel.ac.in/courses/106105166>
2. https://www.arduino.cc/https://www.ibm.com/smarterplanet/us/en/?ca=v_smarterplanet
3. https://link.springer.com/chapter/10.1007/978-3-030-41110-7_1

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

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. Apply cloud computing and data analytics in IoT (K3).
5. Illustrate different IoT business models and their role in delivering smart services and solutions. (K3).
6. Implement IoT security and emerging technologies (K3).

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	3	2	-	-	-	-	1	1	-	-	1	2	3
C02	3	3	-	-	-	-	1	1	-	-	2	3	3
C03	3	3	-	-	-	-	1	1	-	-	2	3	3
C04	3	3	-	-	-	-	1	1	-	-	3	3	3
C05	3	1	-	-	-	-	1	1	-	-	3	3	3
C06	3	1	-	-	-	-	1	1	-	-	3	2	3

PROFESSIONAL ELECTIVES - I

COURSE CODE: 24CIEL502	DATA SCIENCE FOR INTERNET OF THINGS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106101224	SYLLABUS VERSION 1.0	SDG NO. 4, 8 & 9				
PRE-REQUISITE COURSES	24AIPT201, 24BSMA301					

OBJECTIVES:

- Understand the fundamentals of Data Science and IoT, their integration, and practical applications.
- Acquire skills in collecting, preprocessing, analyzing, and visualizing IoT data for actionable insights.

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

- Apply machine learning techniques to IoT datasets for intelligent analytics and predictive modeling.
- Evaluate security, privacy, ethical issues, challenges, and future trends in IoT-driven data systems.

MODULE - I INTRODUCTION TO DATA SCIENCE 8

Fundamentals of Data Science--Overview, Basic Concepts, Data collection, Processing, and Analysis, Data Acquisition in IoT- Sensors and Actuators, Data Acquisition Techniques and Challenges, Data Processing and Analytics-Data Preprocessing and Cleaning, Exploratory data analysis (EDA), Statistical analysis and visualization techniques

MODULE - II MACHINE LEARNING IN DATASCIENCE 7

Introduction to Machine Learning, The Machine Learning Landscape - Main Challenges of Machine Learning, Testing and Validating, Support Vector Machines-Linear SVM Classification, Nonlinear SVM Classification, SVM Regression, Under the Hood, Decision Trees-Training and Visualizing a Decision Tree, Dimensionality Reduction-PCA, Kernel PCA, LLE, Other Dimensionality Reduction Techniques

MODULE - III WEB INTERACTIVE DATA VISUALIZATION FOR THE 8

Interactive Data Visualization--Applications & Principles, Web Technologies for Interactive Visualization--HTML--CSS—Java script, D3.js Fundamentals--Data Structures--Operations—Basic Visualizations, User Interaction in D3--Events--Dynamic Visualizations--User Experience Exploring & Preparing IoT Data for Visualization, Designing IoT Visualizations--Sensor Data--Time Series--Maps--Graphs, Advanced D3 Techniques--Animations--Custom Visualizations--Libraries, Deploying & Sharing Interactive Visualizations

MODULE - IV USAGE OF PYTHON IN DATASCIENCE 7

Python Libraries-NumPy and Pandas, Data Visualization with Python-Matplotlib and Seaborn, Machine Learning with Python - Scikit, Python for Natural Language Processing-NLTK (NaturalLanguage Toolkit), spacy.

MODULE - V SECURITY, PRIVACY & CHALLENGES 7

IoT Data Security issues - Encryption and privacy Techniques Challenges in IoT data (scalability, interoperability) - Future trends in IoT with Data Science.

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

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
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. Examine various strategies to organize and manage IoT data for effective storage, retrieval, and processing. (K4)
2. Evaluate the application of machine learning techniques to develop predictive and optimized IoT solutions. (K4)
3. Assess and construct compelling visualizations to communicate IoT insights effectively to diverse stakeholders.(K4)

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- Investigate security and privacy measures in IoT systems and design solutions that ensure user trust and compliance.(K4)
- Interpret sensor data and implement machine learning algorithms using Python to derive actionable insights.(K4)
- Examine evolving trends, challenges, and ethical considerations in IoT and their impact on society and technology. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	3	3	-	-	-	-	-	-	-	-	-	2	2
C02	3	3	2	-	-	-	-	-	-	-	-	2	2
C03	2	2	2	-	-	-	-	-	-	3	-	2	2
C04	3	2	2	-	-	-	-	-	-	-	-	2	2
C05	3	3	2	-	-	-	-	-	-	-	-	2	2
C06	3	2	2	-	-	3	-	-	-	-	-	2	2

PROFESSIONAL ELECTIVES - I

COURSE CODE: 24CIEL503	DYNAMIC PARADIGM IN IOT	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4				
PRE-REQUISITE COURSES	24ESCS101, 24ITPW401					

OBJECTIVES:

- To explore the role of the cloud in Internet of Things deployment.
- To introduce the usage of different machine learning algorithms on IoT Data.
- To explore data analytics and data visualization on IoT Data.
- To develop the ability to integrate IoT with Dev-ops.

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 –

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

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

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

TEXT BOOKS:

1. Perry Lea, "IoT and Edge Computing for Architects", Packt Publication, 2nd Edition (2020).
2. Honbo Zhou, "The Internet of Things in the Cloud A Middleware Perspective", CRC Publication, 1st Edition (2012).
3. Andrew Minter, "Analytics for the Internet of Things (IoT)", Packt Publication 1st Edition 2017.
4. Sricharan Vadapalli, "Hands-on DevOps", Packt Publication, 1st Edition 2017

REFERENCES:

1. Gautam Shroff, "Enterprise Cloud Computing", Cambridge, 2010.
2. Mastering Cloud Computing - "Foundations and Applications Programming", Raj Kumar Buyya, Christian Vecchiola, S. Thamarai Selvi, MK Publication, 2013.
3. Peter Harrington, Dream, "Machine Learning in Action", Tech Press, 1st Edition (2012).
4. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, 4th Edition (2020).
5. Agus Kurniawan, "Learning AWS IoT- Effectively Manage Connected Devices on the AWS Cloud Using Services Such as AWS Greengrass, AWS Button, Predictive Analytics and Machine Learning", Packt Publication, 1st Edition (2018).
6. Joakim Verona, "Practical Dev-Ops", 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-based solutions in IoT deployment and compare the architecture of major cloud providers.. (K3)

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

2. Illustrate the role of machine learning in improving the efficiency and performance of IoT systems. (K3)
3. Experiment with different visualization tools to analyze IoT-generated data. (K3)
4. Recognize the use of Fog Computing in the Internet of things. (K3)
5. Construct a secure communication model for IoT systems using authentication and encryption methods. (K3)
6. Apply the knowledge of Dev-ops in IoT applications. (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	1	1	-	-	-	-	-	-	1	-	1	2	-
C02	1	3	3	-	-	-	-	-	2	1	-	2	2
C03	1	3	-	-	-	-	-	-	1	-	-	-	1
C04	1	3	-	-	-	-	-	-	1	2	-	-	-
C05	1	1	-	-	-	-	-	-	1	-	1	-	-
C06	-	3	2	1	-	-	-	-	2	1	1	-	1

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24ITEL510	ADVANCED ANALYSIS OF ALGORITHMS	L	T	P	CP	C
		3	0	0	4	3
NPTEL CODE: 106105704	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24ITPC301					

OBJECTIVES:

- To understand advanced algorithmic analysis techniques including amortized analysis.
- To study advanced data structures and network flow algorithms.
- To analyze matching problems and stable matching algorithms.
- To explore randomized algorithms and order statistics techniques.
- To understand computational complexity, NP-completeness and reductions.
- To examine approximation algorithms for NP-hard optimization problems

MODULE - I AMORTIZED ANALYSIS & ADVANCED DATA STRUCTURES

8

Introduction to Amortized Complexity – Aggregate Method – Accounting Method – Potential Function Method – Applications of Amortized Analysis – Fibonacci Heaps: Structure, Operations, Amortized Cost Analysis and Applications.

MODULE - II NETWORKFLOW 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.

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

MODULE - IV ORDER STATISTICS, STRING MATCHING AND RANDOMIZED ALGORITHMS

7

Order Statistics – Selection Algorithms – String Matching Techniques – Introduction to Randomized Algorithms – Karger’s Minimum Cut Algorithm – Karger-Stein Algorithm – Analysis of Randomized Algorithms..

MODULE - V COMPUTATIONAL COMPLEXITY & NP - COMPLETENESS

7

Lower Bounds on Sorting – Decision and Optimization Problems – Complexity Classes P and NP – Introduction to NP-Completeness – Polynomial-Time Reductions – NP-Completeness Proof Techniques and Examples.

MODULE - VI APPROXIMATION ALGORITHMS

8

Approximation Algorithms – Approximation Ratio – Approximation Algorithm for 3SAT – Metric Traveling Salesman Problem (Metric TSP) – Performance Guarantees – Limitations of Approximation Algorithms.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, “Introduction to Algorithms”, Fourth Edition, MIT Press, 2022.
2. Jon Kleinberg and Éva Tardos, “Algorithm Design”, First Edition, Pearson Education, 2006.

REFERENCES:

1. Vijay V. Vazirani, “Approximation Algorithms”, Springer, First Edition, 2003.
2. Sanjoy Dasgupta, Christos Papadimitriou and Umesh Vazirani, “Algorithms”, McGraw-Hill Education, First Edition, 2008.
3. Michael T. Goodrich, Roberto Tamassia and Michael H. Goldwasser, “Data Structures and Algorithms in Python”, Wiley, Second Edition, 2013.
4. Dexter C. Kozen, “The Design and Analysis of Algorithms”, Springer, First Edition, 1992.
5. Christos H. Papadimitriou, “Computational Complexity”, Addison-Wesley, First Edition, 1994.

ONLINE RESOURCES:

1. <https://nptel.ac.in/courses/106105704>
2. <https://nptel.ac.in/courses/106106131>
3. <https://ocw.mit.edu>

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

4. <https://online.stanford.edu>
5. <https://visualgo.net>

OUTCOMES:

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

1. Apply amortized analysis techniques and advanced data structures to evaluate algorithmic efficiency. (K3)
2. Analyze and implement maximum flow algorithms for network optimization problems. (K4)
3. Solve matching problems using graph-theoretic algorithms and stable matching techniques. (K4)
4. Apply order statistics, string matching and randomized algorithms to computational problems. (K3)
5. Examine computational complexity classes and prove NP-completeness using polynomial-time reductions. (K4)
6. Design and analyze approximation algorithms for NP-hard optimization problems. (K5)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	2	2	1	-	2	-	-	-	-	-	-	2	2
C02	2	2	2	-	2	-	-	-	-	-	-	2	2
C03	2	2	2	2	2	-	-	-	-	-	-	2	2
C04	2	2	2	-	2	-	-	-	-	-	-	2	2
C05	2	3	1	-	1	-	-	-	-	-	-	2	2
C06	2	3	3	-	2	-	-	-	-	-	-	2	2

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24ITEL511	DISTRIBUTED SYSTEMS	L	T	P	CP	C
		3	0	0	4	3
NPTEL CODE: 106106168	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24CSPC302, 24CSPC402, 23ITPW401					

OBJECTIVES:

- To understand foundations of Distributed Systems
- To introduce the idea of peer to peer services and file system
- To understand in detail the system level and support required for distributed system
- To understand the issues involved in studying process and resource management

MODULE - I INTRODUCTION

5

Introduction – Examples of Distributed Systems–Trends in Distributed Systems – Focus on resource sharing – Challenges. Case study: World Wide Web.

MODULE - II COMMUNICATION IN DISTRIBUTED SYSTEM

9

System Model – Inter process Communication - the API for internet protocols – External data representation and Multicast communication. Network virtualization: Overlay networks. Case study: MPI Remote Method Invocation and Objects: Remote Invocation – Introduction - Request-reply protocols - Remote procedure call - Remote method invocation. Case study: Java RMI - Group communication - Publish-subscribe systems - Message queues - Shared memory approaches -Distributed objects - Case study: Enterprise Java Beans - from objects to components

MODULE - III PEER TO PEER SERVICES AND FILE SYSTEM

9

Peer-to-peer Systems – Introduction - Napster and its legacy - Peer-to-peer – Middleware - Routing overlays. Overlay case studies: Pastry, Tapestry- Distributed File Systems –Introduction - File service architecture – Andrew File system. File System: Features-File model -File accessing models - File sharing semantics. Naming: Identifiers, Addresses, Name Resolution – Name Space Implementation – Name Caches – LDAP.

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

MODULE - IV SYNCHRONIZATION AND REPLICATION**9**

Introduction - Clocks, events and process states - Synchronizing physical clocks- Logical time and logical clocks - Global states – Coordination and Agreement – Introduction - Distributed mutual exclusion – Elections – Transactions and Concurrency Control– Transactions -Nested transactions – Locks – Optimistic concurrency control - Timestamp ordering – Atomic Commit protocols -Distributed deadlocks – Replication – Case study – Coda

MODULE - V PROCESS & RESOURCE MANAGEMENT**6**

Process Management: Process Migration: Features, Mechanism - Threads: Models, Issues, Implementation. Resource Management: Introduction-Features of Scheduling Algorithms –Task Assignment Approach – Load Balancing Approach – Load Sharing Approach.

MODULE - VI DISTRIBUTED ALGORITHMS**7**

Synchronous network model - Algorithms: leader election, maximal independent set -Asynchronous system model: I/O automata, operations on automata, fairness - Asynchronous shared memory model - Mutual exclusion: model, the problem, stronger conditions, lockout-free mutual exclusion algorithms, lower bound on the number of registers - Asynchronous network model - Asynchronous network algorithms: leader election in a ring and an arbitrary network.

TOTAL : 45 PERIODS**TEXT BOOKS:**

1. George Coulouris, Jean Dollimore and Tim Kindberg, "Distributed Systems Concepts and Design", Fifth Edition, Pearson Education, 2012.
2. Nancy A. Lynch, "Distributed Algorithms", Hardcourt Asia Pvt. Ltd., Morgan Kaufmann, 2000.

REFERENCES:

1. Pradeep K Sinha, "Distributed Operating Systems: Concepts and Design", Prentice Hall of India, 2007.
2. Tanenbaum A.S., Van Steen M., "Distributed Systems: Principles and Paradigms", Pearson Education, 2007.
3. Liu M.L., "Distributed Computing, Principles and Applications", Pearson Education, 2004.
4. Nancy A Lynch, "Distributed Algorithms", Morgan Kaufman Publishers, USA, 2003.

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

ONLINE RESOURCES:

1. <https://www.cs.helsinki.fi/u/jakangas/Teaching/DistSys/DistSys-08f-1.pdf>
2. <https://www.vidyarthiplus.com/vp/attachment.php?aid=43022>

OUTCOMES:

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

1. Apply the use of distributed system with architecture, trends, and resource sharing in World Wide Web. (K3)
2. Articulate various communication mechanisms in distributed systems, like RPC, RMI, multicast, message-oriented middleware, and network virtualization (K3)
3. Sketch the design and operation of peer-to-peer systems and distributed file systems. (K3)
4. Examine synchronization, coordination, and replication techniques with logical clocks, mutual exclusion, elections, transactions, and concurrency control mechanisms (K3)
5. Determine the key process and resource management strategies. (K3)
6. Re-enact the use of distributed algorithms for synchronous and asynchronous systems (K3)

CO - PO, PSO MAPPING:

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

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24ITEL512	PARALLEL ALGORITHMS	L	T	P	CP	C
		3	0	0	4	3
NPTEL CODE: 106103359	SYLLABUS VERSION 1.0	SDG NO. 9				
PRE-REQUISITE COURSES	24CSPC302, 24CSPC402, 24ITPW401					

OBJECTIVES:

- To introduce the design principles of parallel algorithms
- To understand various models of parallel computation (PRAM, EREW, CREW, CRCW and DCM) and Performance analysis metrics such as cost, speedup and efficiency.
- To learn fundamental parallel algorithms for sorting and Searching
- To apply parallel algorithms to solve matrix operations, algebraic and Geometry problems.
- To apply parallel algorithm techniques in solving real-world computational problems

MODULE - I INTRODUCTION TO PARALLEL ALGORITHMS

7

Introduction to Parallel Algorithms-Parallel Programming Paradigms-Parallel Architecture-Need for Parallel Algorithms-Serial vs Parallel Computation-Concepts of Concurrency and Parallelism-Overview of Models of Computation-Applications of Parallel Algorithms

MODULE - II MODELS & COMPLEXITY ANALYSIS

8

Introduction to PRAM Model-PRAM Model (EREW, CREW, CRCW)-Distributed Computing Model (DCM – basics)-Work, Time Complexity, Cost Optimality-Brent's Theorem (basic idea)-Analysis of Parallel Algorithms

MODULE - III PERFORMANCE AND BASIC PARALLEL TECHNIQUES

7

Performance Measures: cost, speedup, efficiency-Work-time analysis-Basic Parallel Techniques-Parallel Prefix (Scan) Computation-Pointer Jumping Technique-Divide and Conquer Approach-Parallel Reduction Operations-Synchronization and Communication overheads

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

MODULE - IV PARALLEL SORTING & SEARCHING**8**

Sorting Networks and Bitonic Sort & odd-Even Transposition Sort-Cole's Merge sort-Sorting on Linear Array-Sorting in EREW, CREW, CRCW-Parallel Searching: Linear and Binary Search-Performance Comparison

MODULE - V ALGEBRAIC, GRAPH & GEOMETRY ALGORITHMS**7**

Matrix Transposition-Matrix Multiplication (Matrix-Matrix, Matrix-Vector)-Connected Components-Minimum Spanning Tree-All-Pairs Shortest Paths-Computational Geometry Problems

MODULE - VI ADVANCED PREFIX ALGORITHMS AND APPLICATIONS**8**

Prefix Sums (Advanced)-Job Sequencing Problem-Knapsack Problem-Integer Addition and Multiplication-Speedup, Efficiency, Scalability-Amdahl's Law and Gustafson's Law-Applications in AI, Big Data, Scientific Computing

TOTAL : 45 PERIODS**TEXT BOOKS:**

1. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar , "Introduction to Parallel Computing", Edition: 2nd Edition, 2003.
2. Joseph JáJá, "Introduction to Parallel Algorithms", Addison-Wesley, 1992

REFERENCES:

1. Xavier & Iyengar, "Introduction to Parallel Algorithms", Wiley, 1998.
2. Sanders et al., "Sequential and Parallel Algorithms and Data Structures", Springer, 2019.
3. Barry Wilkinson & Michael Allen, "Parallel Programming: Techniques and Applications Using Networked Workstations and Parallel Computers", Pearson, 2005.
4. Selim G. Akl, "Design and Analysis of Parallel Algorithms", Prentice Hall, 1989.

ONLINE RESOURCES:

1. <https://www.mindluster.com/lesson/221422-video?>
2. <https://slidetodoc.com/pram-model-lecture-3-efficient-parallel-algorithms-comp/>
3. <https://www.geeksforgeeks.org/dsa/bitonic-sort/>
4. https://onlinecourses-archive.nptel.ac.in/noc19_cs17/preview1
5. <https://www.nptelprep.in/courses/106104120/materials>
6. <https://ocw.mit.edu/search/?q=parallel%20algorithms&t=Algorithms%20and%20Data%20Structures>

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

1. Apply parallel algorithm design principles to solve computational problems using appropriate models.(K3)
2. Apply PRAM models (EREW, CREW, CRCW) and distributed computing concepts to implement parallel solutions.(K3)
3. Apply performance analysis metrics such as cost, speedup, efficiency and work-time analysis to evaluate parallel algorithms(K3)
4. Implement parallel sorting and searching algorithms.(K3)
5. Apply parallel algorithms to solve matrix operations, graph problems and computational geometry problems.(K3)
6. Apply parallel algorithms to solve real-world problems(K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	2	2	2	-	-	-	-	-	-	-	2	2	2
C02	2	2	2	2	2	-	-	-	-	-	2	2	2
C03	2	2	2	-	-	-	-	-	-	-	2	2	2
C04	2	2	2	2	-	-	-	-	-	-	2	2	2
C05	2	2	2	2	-	-	-	-	-	-	2	2	2
C06	2	2	2	2	-	-	-	-	-	-	2	2	2

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24AIEL504	BUSINESS INTELLIGENCE	L 3	T 0	P 0	CP 3	C 3
NPTEL CODE: 106101224	SYLLABUS VERSION 1.0	SDG NO. 9, 11				
PRE-REQUISITE COURSES	24CSPC301,24BSMA301					

OBJECTIVES:

- Understand the fundamentals, concepts, and architecture of Business Intelligence systems.
- Apply data analysis, visualization, and reporting techniques for business decision-making.
- Analyze business data using statistical and analytical tools.
- Develop dashboards, KPIs, and performance monitoring systems for organizations.
- Explore predictive analytics and intelligent business applications using BI tools.
- Apply Business Intelligence techniques to solve real-world business and industrial problems.

MODULE - I INTRODUCTION TO BUSINESS INTELLIGENCE

7

Introduction to Business Intelligence – Evolution and Importance of BI – BI Architecture and Components – Data, Information, and Knowledge – Business Analytics and Decision Support Systems – BI Process and Framework – Applications of BI in Finance, Marketing, Healthcare, Retail, Manufacturing, and Education – BI Tools and Technologies – Ethics, Privacy, and Security Issues in Business Intelligence.

MODULE - II DATA WAREHOUSING AND DATA MANAGEMENT

7

Data Warehousing Concepts – Data Sources and Data Integration – ETL (Extract, Transform, Load) Process – Data Cleaning and Data Preprocessing – Data Marts and Metadata – OLTP and OLAP Systems – Multidimensional Data Models – Star Schema and Snowflake Schema – Big Data Concepts in BI – Data Governance and Quality Management.

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MODULE - III DATA ANALYTICS AND STATISTICAL TECHNIQUES 8

Introduction to Data Analytics – Descriptive, Predictive, and Prescriptive Analytics – Statistical Analysis for BI – Correlation and Regression Analysis – Classification and Clustering Techniques – Forecasting and Trend Analysis – Association Rule Mining – Text Analytics and Sentiment Analysis – Business Metrics and KPI Analysis – Data-driven Decision Making.

MODULE - IV DATA VISUALIZATION AND DASHBOARD DESIGN 8

Importance of Data Visualization – Principles of Effective Visualization – Types of Charts and Graphs – Interactive Dashboards – Dashboard Design Process – KPI Dashboards and Executive Dashboards – Storytelling with Data – Visualization Tools: Power BI, Tableau, Google Data Studio – Designing Reports and Infographics – Common Visualization and Dashboard Design Pitfalls.

MODULE - V BUSINESS INTELLIGENCE TOOLS AND APPLICATIONS 8

Business Intelligence Tools Overview – Microsoft Power BI – Tableau – Excel for Business Analytics – Creating Reports and Dashboards – Data Modeling using BI Tools – Real-time Business Monitoring – Cloud-based BI Systems – Mobile BI Applications – BI for Customer Relationship Management (CRM) and Supply Chain Management (SCM) – Case Studies in Business Intelligence Applications.

MODULE - VI EMERGING TRENDS IN BUSINESS INTELLIGENCE 7

Artificial Intelligence and Machine Learning in BI – Predictive Analytics and Forecasting – Self-service BI – IoT and Real-time Analytics – Data Mining Techniques – Natural Language Processing in BI – Intelligent Decision Support Systems – Blockchain and BI – Cybersecurity Analytics – Future Trends and Challenges in Business Intelligence Systems.

TOTAL : 45 PERIODS**TEXT BOOKS:**

1. Efraim Turban, Ramesh Sharda, and Dursun Delen, "Decision Support and Business Intelligence Systems", Pearson Education, 10th Edition, 2017.
2. David Loshin, "Business Intelligence: The Savvy Manager's Guide", Morgan Kaufmann Publishers, 2nd Edition, 2012.
3. Cindi Howson, "Successful Business Intelligence: Unlock the Value of BI and Big Data", McGraw Hill Education.

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REFERENCES:

1. Ralph Kimball and Margy Ross, "The Data Warehouse Toolkit", Wiley Publications.
2. Larissa T. Moss and Shaku Atre, "Business Intelligence Roadmap", Addison Wesley.
3. Carlo Vercellis, "Business Intelligence: Data Mining and Optimization for Decision Making", Wiley Publications.
4. Jiawei Han, Micheline Kamber, and Jian Pei, "Data Mining: Concepts and Techniques", Morgan Kaufmann.
5. Wayne Winston, "Microsoft Excel Data Analysis and Business Modeling", Microsoft Press.

WEB REFERENCES:

1. Microsoft Power BI Documentation: <https://learn.microsoft.com/power-bi/>
2. Tableau Learning Resources: <https://www.tableau.com/learn>
3. IBM Business Analytics Resources: <https://www.ibm.com/analytics>

ONLINE RESOURCES:

1. Coursera – Business Intelligence Courses: <https://www.coursera.org/>
2. Google Looker Studio Documentation: <https://support.google.com/looker-studio>
3. NPTEL–Business Intelligence and Analytics Courses: <https://nptel.ac.in/courses/110105089>

OUTCOMES:

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

1. Apply Business Intelligence concepts, architectures, frameworks, and decision support systems to address business problems in diverse domains. (K3)
2. Analyze data warehousing architectures, ETL processes, multidimensional data models, and data management techniques for effective business intelligence solutions (K4)
3. Apply statistical and analytical techniques such as regression, classification, clustering, forecasting, and KPI analysis for data-driven decision making. (K3)
4. Analyze and design effective visualizations, dashboards, and reports using BI principles and modern visualization tools. (K4)

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5. Develop business intelligence solutions using contemporary BI tools such as Power BI, Tableau, and Excel for real-time monitoring and business analytics. (K3)
6. Analyze the impact of emerging technologies such as AI, Machine Learning, IoT, NLP, Blockchain, and cybersecurity analytics in next-generation business intelligence systems. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	3	-	-	-	-	-	-	-	-	-	-	2	3
C02	2	3	-	-	-	-	-	-	-	-	-	3	3
C03	3	-	-	-	-	-	-	-	-	-	-	2	3
C04	2	3	-	-	-	-	-	-	-	-	-	2	2
C05	3	-	-	-	-	-	-	-	-	-	-	2	2
C06	2	3		-	-	-	-	-	-	-	-	3	2

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24AIEL505	MACHINE LEARNING ESSENTIALS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106106139	SYLLABUS VERSION 1.0	SDG NO. 9, 11				
PRE-REQUISITE COURSES	24BSMA301, 24CSPC302					

OBJECTIVES:

- Understand the fundamental concepts, techniques, and applications of Machine Learning.
- Apply data preprocessing and feature engineering techniques for machine learning models.
- Analyze supervised and unsupervised learning algorithms for predictive analytics.
- Implement machine learning models using appropriate tools and frameworks.
- Evaluate and optimize machine learning models using performance metrics.

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- Apply machine learning techniques to solve real-world intelligent system problems.

MODULE - I INTRODUCTION TO MACHINE LEARNING

7

Introduction to Artificial Intelligence and Machine Learning – Types of Machine Learning: Supervised, Unsupervised, and Reinforcement Learning – Applications of Machine Learning – Machine Learning Workflow – Data Collection and Preparation – Training, Validation, and Testing Datasets – Introduction to Python Libraries for Machine Learning – Introduction to Scikit-learn – Challenges and Limitations of Machine Learning – Ethical Issues in Machine Learning.

MODULE - II `DATA PREPROCESSING AND FEATURE ENGINEERING

8

Data Cleaning and Data Integration – Handling Missing Values and Outliers – Data Transformation Techniques – Feature Scaling: Normalization and Standardization – Feature Selection Methods – Dimensionality Reduction Techniques – Principal Component Analysis (PCA) – Encoding Categorical Variables – Data Visualization for Machine Learning – Introduction to Exploratory Data Analysis (EDA).

MODULE - III SUPERVISED LEARNING ALGORITHMS

7

Introduction to Supervised Learning – Regression and Classification Concepts – Linear Regression – Logistic Regression – Decision Trees – Random Forest – Support Vector Machines – K-Nearest Neighbor Algorithm – Naive Bayes Classification – Model Training and Testing – Bias and Variance – Overfitting and Underfitting – Cross Validation Techniques – Performance Metrics: Accuracy, Precision, Recall, F1-Score, ROC Curve.

MODULE - IV UNSUPERVISED LEARNING AND CLUSTERING TECHNIQUES

8

Introduction to Unsupervised Learning – Clustering Concepts and Applications – K-Means Clustering – Hierarchical Clustering – Density-based Clustering – Association Rule Mining – Market Basket Analysis – Dimensionality Reduction for Visualization – Anomaly Detection – Recommendation Systems – Applications of Unsupervised Learning in Business and Industry.

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

MODULE - V NEURAL NETWORKS AND DEEP LEARNING FUNDAMENTALS

8

Introduction to Artificial Neural Networks – Biological Inspiration of Neural Networks – Structure of Neurons and Layers – Activation Functions – Feed forward Neural Networks – Back propagation Algorithm – Deep Learning Concepts – Convolutional Neural Networks (CNN) – Recurrent Neural Networks (RNN) – Introduction to Tensor Flow and Keras – Applications of Deep Learning in Image Processing, Speech Recognition, and Natural Language Processing.

MODULE - VI MACHINE LEARNING APPLICATIONS AND EMERGING TRENDS

7

Machine Learning for Predictive Analytics – Natural Language Processing Basics – Computer Vision Applications – Time Series Forecasting – Reinforcement Learning Fundamentals – Explainable AI and Responsible AI – Edge AI and IoT Applications – Machine Learning in Healthcare, Finance, Smart Manufacturing, and Cyber security – Model Deployment Concepts – Future Trends in Machine Learning and Intelligent Systems.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Tom M. Mitchell, "Machine Learning", McGraw Hill Education, International Edition.
2. Andreas C. Müller and Sarah Guido, "Introduction to Machine Learning with Python: A Guide for Data Scientists", O'Reilly Media, 1st Edition, 2016.
3. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", O'Reilly Media, 3rd Edition, 2022.

REFERENCES:

1. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press.
2. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer.
3. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, "Deep Learning", MIT Press.
4. Trevor Hastie, Robert Tibshirani, and Jerome Friedman, "The Elements of Statistical Learning", Springer.
5. Sebastian Raschka and Vahid Mirjalili, "Python Machine Learning", Packt Publishing.

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

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
C01	3	-	-	-	-	-	-	-	-	-	-	2	2
C02	2	3	-	-	-	-	-	-	-	-	-	3	2
C03	3	-	-	-	-	-	-	-	-	-	-	2	2
C04	2	3	-	-	-	-	-	-	-	-	-	2	3
C05	3	-	-	-	-	-	-	-	-	-	-	2	3
C06	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.

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

MODULE - I CLOUD ARCHITECTURE AND MODELS**7**

Cloud Architecture: System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture – Cloud Characteristics – Cloud deployment models – Cloud service models – Pros and Cons of Cloud.

MODULE - II INTRODUCTION TO VIRTUALIZATION**8**

Basics of Virtualization – Virtualization Types – Implementation Levels of Virtualization – Virtualization Structures / Tools and Mechanisms – Virtualization of CPU, Memory, I/O Devices – Virtual Clusters and Resource management – Virtualization for Data-Center Automation – Virtualization Support and Disaster Recovery – Taxonomy of Virtual Machines – Create VM Cluster using VMWare or Virtual Box and deploy an application.

MODULE - III CLOUD INFRASTRUCTURE**8**

Cloud Infrastructure: Architectural design of compute and storage clouds – Layered cloud architecture Development – Design Challenges – Inter Cloud Resource Management – Resource Provisioning and Platform Deployment – Global Exchange of Cloud Resources.

MODULE - IV CLOUD DEPLOYMENT ENVIRONMENT**7**

Parallel Programming Framework: Hadoop Map Reduce – Google App Engine – Amazon AWS – Microsoft Azure; Cloud Software Environments – Eucalyptus – OpenStack – OpenNebula – Aneka.

MODULE - V CLOUD SECURITY**7**

Data Security and Storage; Identity and Access Management (IAM) – IAM Challenges – IAM Architecture and Practice; Security Management in the Cloud – Security Management Standards – SaaS, PaaS and IaaS Availability Management – Access Control; Security-As-A-Service.

MODULE - VI CLOUD SIMULATOR & CLOUD APPLICATIONS**8**

CloudSim – Architecture - Cloudlets – VM creation – Broker – VM allocation – Hosts – Data Center. Web Service Architecture – Web service APIs – Web service authentication - Web service authentication methods - Technologies and the processes required when deploying web services; Deploying a web service from inside and outside a cloud architecture, advantages and disadvantages.

TOTAL : 45 PERIODS

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

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)

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

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
C01	3	-	-	-	-	-	-	-	-	-	-	2	2
C02	2	3	-	-	-	-	-	-	-	-	-	3	2
C03	3	-	-	-	-	-	-	-	-	-	-	2	2
C04	2	3	-	-	-	-	-	-	-	-	-	2	3
C05	3	-	-	-	-	-	-	-	-	-	-	2	3
C06	2	3		-	-	-	-	-	-	-	-	3	3

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24CSEL511	USABILITY DESIGN OF SOFTWARE APPLICATIONS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106105182	SYLLABUS VERSION 1.0	SDG NO. 9, 10				
PRE-REQUISITE COURSES	24ESCS101, 24ITPC302					

OBJECTIVES:

- To understand the fundamentals of User-Centered Design (UCD) and usability principles.
- To learn human-computer interaction concepts and user behavior.
- To apply usability engineering and evaluation techniques.
- To analyze user requirements using UX research methods.
- To design and develop user-friendly software interfaces.

MODULE - I INTRODUCTION TO USER-CENTERED DESIGN 7

Basics of UCD – Elements - Models and approaches - Usability concepts - UCD principles - UCD lifecycle - Agile integration.

MODULE - II HUMAN FACTORS AND INTERACTION DESIGN 8

Human perception - Cognition, Memory - Attention - User behavior - Interaction styles – accessibility - Inclusive design.

MODULE - III UX RESEARCH AND REQUIREMENT ANALYSIS 8

User analysis - Context of use - Personas - Scenarios - Essential use cases - Contextual enquiry - Interviews - Competitive analysis.

MODULE - IV INTERFACE DESIGN AND PROTOTYPING 7

Design thinking - Layout design - Navigation design - Wireframing - Prototyping (paper & digital) - Tools and techniques.

MODULE - V USABILITY EVALUATION TECHNIQUES 7

Evaluation methods - Heuristic evaluation (10 principles) - Cognitive walkthrough - Usability metrics - Case studies.

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

MODULE - VI APPLICATION DEVELOPMENT AND ITERATIVE DESIGN 8

Design life cycle: requirements - Design - Prototyping - Construction - Iteration
- Feedback –Real-world case studies.

TOTAL : 45 PERIODS**TEXT BOOKS:**

1. Jenny Preece, Helen Sharp, Yvonne Rogers, "Interaction Design: Beyond Human-Computer Interaction", 3rd Edition, Wiley, 2011.
2. Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven Jacobs, "Designing the User Interface: Strategies for Effective Human-Computer Interaction", Pearson, 2021.

REFERENCES

1. Alan Cooper, Robert Reimann, David Cronin, "About Face: The Essentials of Interaction Design", Wiley, 2007.
2. Elizabeth Goodman, Mike Kuniavsky, Andrea Moed, "Observing the User Experience: A Practitioner's Guide to User Research", 2nd Edition, 2012.
3. Jesse James Garrett, "The Elements of User Experience: User-Centered Design for the Web and Beyond", 2nd Edition, 2010.

WEB RESOURCES

1. https://onlinecourses.nptel.ac.in/noc22_de03/preview
2. <https://www.interaction-design.org>
3. <https://www.nngroup.com/articles/>

OUTCOMES:

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

1. Apply user-centered design principles to evaluate usability of software applications.
2. Utilize human-computer interaction concepts to design effective user interfaces.
3. Develop user requirements using UX research techniques such as personas and scenarios.
4. Build interface prototypes using appropriate design tools and methodologies.
5. Apply usability evaluation methods to assess and improve software interfaces.
6. Implement user-friendly software applications through iterative design and testing processes.

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	2	2	2	-	-	-	-	-	-	-	-	2	2
C02	3	3	2	-	-	-	-	-	-	-	-	2	2
C03	3	3	3	-	-	-	-	-	-	-	-	2	3
C04	3	3	3	-	-	-	-	-	-	-	-	2	3
C05	2	3	3	-	-	-	-	-	-	-	-	2	2
C06	3	3	3	-	-	-	-	-	-	-	-	2	3

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24CSEL506	WEB DESIGN	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106105084	SYLLABUS VERSION 1.0	SDG NO. 9, 11				
PRE-REQUISITE COURSES	24ESCS101, 24CSPT401					

OBJECTIVES:

- To Understand the fundamentals of Internet technologies, web communication, and web architecture.
- To Develop web pages using XHTML, XML, and Cascading Style Sheets for structured and styled web design.
- To Apply JavaScript programming concepts to create interactive and dynamic client-side web applications.
- To Implement objects, arrays, and built-in JavaScript features for developing efficient web-based solutions.

MODULE - I WEB ESSENTIALS: CLIENTS, SERVERS, AND COMMUNICATION**7**

Basic Web Essentials- Client Server Architecture- Basic Internet Protocols-The World Wide Web-HTTP Request Message-HTTP Response Message-Web Clients-Web Servers

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

MODULE - II MARKUP LANGUAGES: XHTML 1.0**8**

HTML's History and Versions-Basic XHTML Syntax and Semantics -Document Type Declaration -Attributes -HTML Elements-Headings-Spacing-Formatting Text Phrases-Horizontal Rule-Images-Links-Nesting Elements-Relative URLs-Lists-Tables-Frames-Forms

MODULE - III XML**8**

XHTML's SYNTAX - Element Type Declarations- Attribute List Declarations- Entity Declarations- DTD Files- Creating HTML Documents- XML Documents and Vocabularies- XML Versions and the XML Declaration- XML Namespaces- Transforming XML Documents

MODULE - IV STYLESHEETS**7**

Introduction to Cascading Style Sheets -CSS Features - CSS Core Syntax- Style Sheets and HTML- Style Rule Cascading and Inheritance- Text Properties- CSS Box Model- Normal Flow Box Layout.

MODULE - V CLIENT-SIDE PROGRAMMING**7**

Introduction to JavaScript - Scripting Languages- Variables and Data Types- Statements- Operators- Literals- Functions.

MODULE - VI OBJECTS AND ARRAYS**8**

Objects- Object Properties- Enumerating Properties -Array Notation - Object References- Methods- Constructors- Arrays- Creating an Array- Array Methods- Built-in Objects- String, Number, and Boolean- Date- Math- RegExp- JavaScript Debuggers.

TOTAL : 45 PERIODS**TEXT BOOKS:**

1. Jeffrey C. Jackson, "Web Technologies: A Computer Science Perspective", 1st Edition, Pearson Education, 2015, ISBN: 9788131717158.
2. Chris Minnick & Eva Holland, "HTML5 and CSS3 for the Real World", 3rd Edition, SitePoint, 2024.

REFERENCES:

1. Jon Duckett, "JavaScript and jQuery: Interactive Front-End Web Development", Updated Edition, Wiley, 2022.
2. Laura Lemay, Rafe Colburn & Jennifer Kyrnin, "Sams Teach Yourself HTML, CSS & JavaScript All in One", 2nd Edition, Pearson, 2023.

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

3. Elisabeth Robson & Eric Freeman, “Head First JavaScript Programming”, 2nd Edition, O’Reilly Media, 2024.

WEB REFERENCES:

1. <https://developer.mozilla.org/en-US/docs/Learn>
2. <https://www.w3schools.com/html/>
3. <https://www.w3schools.com/css/>
4. <https://javascript.info/>
5. <https://www.freecodecamp.org/learn/2022/responsive-web-design/>
6. <https://www.w3.org/Style/CSS/Overview.en.html>

ONLINE RESOURCES:

1. <https://www.udemy.com/course/the-complete-web-development-bootcamp/>
2. <https://www.coursera.org/specializations/web-design>
3. <https://www.edx.org/learn/web-design>
4. <https://www.freecodecamp.org/learn/responsive-web-design/>
5. <https://www.codecademy.com/learn/paths/web-development>
6. <https://www.udacity.com/course/intro-to-html-and-css--ud0011>

OUTCOMES:

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

1. Apply the concepts of Internet protocols, HTTP communication, web clients, and web servers in web-based applications.. (K3)
2. Develop web pages using XHTML elements, forms, tables, frames, images, links, and lists following standard web design principles.. (K3)
3. Construct XML documents using DTDs, namespaces, vocabularies, and XML transformation techniques. (K3)
4. Use Cascading Style Sheets (CSS) to design and format web pages with proper layout, inheritance, and styling features. (K3)
5. Implement JavaScript programs using variables, operators, statements, literals, and functions for client-side scripting. (K4)
6. Develop dynamic web applications using JavaScript objects, arrays, constructors, built-in objects, and debugging techniques. (K3)

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	3	2	1	-	2	-	-	-	-	-	-	2	2
C02	3	2	3	-	3	-	-	-	-	1	-	2	2
C03	2	2	2	1	2	-	-	-	-	-	-	2	2
C04	2	2	3	-	3	-	-	-	-	1	-	2	2
C05	3	3	3	1	3	-	-	-	-	1	-	2	2
C06	3	3	3	2	3	-	-	-	-	1	-	2	2

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24CSEL507	MOBILE APPLICATION DEVELOPMENT	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4 & 9				
PRE-REQUISITE COURSES	24ESCS101, 24CSPC302, 24CSPC402					

OBJECTIVES:

- To help students to gain basic understanding of Android application development
- To understand how to work with various mobile application development frameworks
- To inculcate working knowledge of Android Studio development tool
- To learn the basic and important design concepts and issues of development of mobile applications

MODULE - I MOBILE COMPUTING FUNDAMENTALS**7**

Introduction to Mobile Computing — Evolution of Mobile Devices — Mobile Device Operating Systems — Special Constraints & Requirements — Modern Mobile Platforms and Ecosystem — Mobile Security and Privacy — Mobile Application Development Paradigms.

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

MODULE - II MOBILE OPERATING SYSTEMS ARCHITECTURE 8

Mobile Operating Systems Architecture — Android Architecture — iOS Architecture — Android Runtime and Dalvik Virtual Machine — Android Software Stack — Android Libraries — Integration with Cloud Services and Backend APIs — Sensors and Location-Based Services.

MODULE - III INTRODUCTION TO ANDROID APPLICATION DEVELOPMENT 8

Introduction to Modern Android Platform — Android SDK and SDK Features — Android Application Architecture — Installing and Configuring Android Studio — Building First Android Application — Anatomy of Android Applications — Android Terminologies — Application Context and Application Lifecycle.

MODULE - IV ANDROID APPLICATION COMPONENTS 8

Activities — Services — Intents — Receiving and Broadcasting Intents — Android Manifest File and Common Settings — Intent Filters — Android Permissions and Security — Event Handling and User Interaction.

MODULE - V ANDROID USER INTERFACE AND MULTIMEDIA 7

User Interface Screen Elements — Designing User Interfaces with Layouts — Views and ViewGroups — Menus and Dialogs — Drawing and Working with Animation — Playing Audio and Video — Recording Audio and Video — Using Camera to Capture and Process Images.

MODULE - VI ANDROID DATA MANAGEMENT AND NETWORKING APIs 7

Using Android Data and Storage APIs — Managing Data using SQLite — Shared Preferences and File Handling — Content Providers and Sharing Data Between Applications — Android Networking APIs — Android Web APIs — Android Telephony APIs — Deploying Android Applications to the World.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Jerome F. DiMarzio, "Beginning Android Programming with Android Studio", 4th Edition, Wiley India, 2020.

REFERENCES

1. Google Developer Training, "Android Developer Fundamentals Course – Concept Reference", Google Developer Training Team, 2017.

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

2. Lauren Darcey and Shane Conder, "Android Wireless Application Development Volume II: Advanced Topics", 3rd Edition, Addison-Wesley Professional, 2012.
3. Prasanth Kumar Pattnaik, Rajib Mall, "Fundamentals of Mobile Computing", PHI Learning Pvt.Ltd, New Delhi-2012.
4. Reto Meier, "Professional Android 2 Application Development", Wiley India Pvt Ltd, 2010.
5. Mark L Murphy, "Beginning Android", Wiley India Pvt Ltd, 2009.

WEB REFERENCES:

1. <https://nptel.ac.in/courses/106106156>
2. https://www.brainkart.com/subject/Mobile-Application-Development_909/

ONLINE RESOURCES:

1. <https://developer.android.com/studio/intro>
2. <https://www.coursera.org/specializations/android-app-development>

OUTCOMES:

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

1. Apply the fundamentals of mobile computing, mobile platforms, operating systems, security, and application development paradigms. K3
2. Build, test, and debug Android applications by setting up the Android development environment. K3
3. Analyze, test, and debug Android applications by setting up the Android development environment. K4
4. Examine methods for storing, sharing, and retrieving data in Android applications. K4
5. Apply rapid prototyping techniques to design and develop sophisticated mobile interfaces. K3
6. Develop interactive Android applications using databases, multiple activities, audio, video, notifications, and deploy them in the marketplace. K3

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	3	-	1	1	2	2	-	-	-	-	-	2	2
C02	3	-	3	2	3	1	-	-	-	-	-	2	2
C03	3	-	2	3	3	1	-	-	-	-	-	2	2
C04	2	-	2	3	3	1	-	-	-	-	-	2	2
C05	2	-	3	2	3	2	-	-	-	-	-	2	2
C06	3	-	3	2	3	2	-	-	-	-	-	2	2

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24ITEL516	LEARNING ANALYTICS TOOLS	L	T	P	CP	C
		3	0	0	4	3
NPTEL CODE: 106101224	SYLLABUS VERSION 1.0	SDG NO. 4, 9, 16				
PRE-REQUISITE COURSES	24ESCS101, 24BSMA301, 24BSMA402					

OBJECTIVES:

- Understand the fundamentals, significance, and key terminologies of learning analytics in educational environments.
- Learn methods of educational data collection, preprocessing, summarization, and pattern identification techniques.
- Apply statistical and predictive modeling techniques to analyze educational data and support decision-making.
- Explore text analysis and advanced analytics techniques for extracting meaningful insights from educational data.

MODULE - I INTRODUCTION TO LEARNING ANALYTICS**7**

Role of Data Analytics in Education - Learning Analytics: Definition, Scope & Importance - Educational Data Mining (EDM) & Applications - Academic vs. Learning Analytics - Data, Information & Knowledge in Education - Four Levels of Analytics: Descriptive, Diagnostic, Predictive, Prescriptive - Ethical Issues: Data Privacy & Security - Learning Analytics Tools & Platforms

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

MODULE - II DATA COLLECTION AND PREPROCESSING**7**

Types of Educational Data (Behavior, Performance, Interaction) - Data Collection Methods: Surveys, LMS, MOOCs, OER - Data Cleaning: Handling Missing Values & Outliers - Data Transformation: Normalization, Aggregation, Standardization - Data Integration & Handling Multiple Formats - Feature Engineering for Learning Analytics - Tools: Weka, R, Python

MODULE - III DESCRIPTIVE AND DIAGNOSTIC ANALYTICS**7**

Overview of Descriptive Analytics - Key Statistics: Mean, Median, Mode, Standard Deviation - Data Visualization: Histograms, Bar Charts, Box Plots - Diagnostic Analytics & Pattern Recognition - Correlation Analysis & Causal Relationships - Visualization: Scatter Plots, Heatmaps, Correlation Matrices - Advanced Analytics: Principal Component Analysis (PCA) - Case Studies

MODULE - IV PREDICTIVE ANALYTICS**8**

Introduction to Predictive Analytics - Supervised vs. Unsupervised Learning - Key ML Models: Linear & Logistic Regression, Decision Trees - Naïve Bayes for Classification - Model Evaluation: Accuracy, Precision, Recall, F1-Score - Tools: Weka, Orange, Scikit-learn

MODULE - V TEXT ANALYTICS AND ADVANCED TECHNIQUES**8**

Introduction to Text Analytics - Text Mining: Tokenization, Lemmatization, Stopword Removal - Sentiment Analysis & Topic Modeling (LDA) - NLP for Educational Data - Process & Sequence Mining in Learning Paths - Advanced Models: Random Forest, SVM

MODULE - VI APPLICATIONS AND ETHICS**8**

Real-World Learning Analytics Applications - Designing Data-Driven Interventions - Ethics & Legal Considerations in Education Data - Communicating & Visualizing Analytics Results - Case Studies on Effective Implementation

TOTAL : 45 PERIODS**TEXT BOOKS:**

1. Siemens, G., & Gasevic, D. (Eds.). (2017). Handbook of Learning Analytics (1st ed.). Society for Learning Analytics Research (SoLAR). ISBN: 978-0-9952408-0-3.
2. Romero, C., Ventura, S., Pechenizkiy, M., & Baker, R. S. J. (Eds.). (2010). Handbook of Educational Data Mining. CRC Press / Taylor & Francis Group. ISBN: 978-1-4398-0457-5.

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

REFERENCES:

1. Witten, I. H., Frank, E., Hall, M. A., & Pal, C. J. (2016). Data Mining: Practical Machine Learning Tools and Techniques (4th ed.). Morgan Kaufmann / Elsevier. ISBN: 978-0-12-804291-5.
2. Manning, C. D., Raghavan, P., & Schütze, H. (2008). Introduction to Information Retrieval. Cambridge University Press. ISBN: 978-0-521-86571-5.

WEB RESOURCES:

1. NPTEL Course Page – Learning Analytics Tools (106101224), IIT Bombay, Prof. Ramkumar Rajendran. <https://nptel.ac.in/courses/106101224>
2. Handbook of Learning Analytics (Free PDF) – SoLAR Community (2017). <https://solaresearch.org/hla-17/>
3. Weka Machine Learning Workbench – University of Waikato. <https://www.cs.waikato.ac.nz/ml/weka/>
4. Orange Data Mining Tool – University of Ljubljana. <https://orange-datamining.com/>
5. ProM Process Mining Tool – Eindhoven University of Technology. <https://promtools.org/>
6. Open University Learning Analytics Dataset (OULAD) – anonymized student data for EDM practice. https://analyse.kmi.open.ac.uk/open_dataset
7. LAK Conference Proceedings Archive – ACM Digital Library. <https://dl.acm.org/conference/lak>
8. EDM Conference Proceedings Archive – Educational Data Mining Society. <https://educationaldatamining.org/EDM2024/proceedings/>
9. Moodle Learning Analytics Documentation (data collection, dashboards). https://docs.moodle.org/en/Learning_analytics
10. Stanford NLP Group – Introduction to Information Retrieval. <https://nlp.stanford.edu/IR-book/>
11. Google Colab Tutorials for Data Analytics in Education – practical Python notebooks. <https://colab.research.google.com/>
12. Kaggle – Educational Data Mining & Student Performance Datasets (practice data). <https://www.kaggle.com/datasets?search=student+performance>

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

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

1. Apply foundational concepts and techniques of learning analytics in educational contexts. (K3)
2. Use appropriate tools to collect and process educational data. (K3)
3. Execute statistical and machine learning techniques to extract insights from learning data. (K3)
4. Implement data-driven learning interventions based on analytical insights. (K3)
5. Practice ethical, privacy, and legal principles in learning analytics. (K3)
6. Illustrate learning analytics results effectively using visualizations and reports. (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	3	2	1	1	-	-	-	-	-	-	-	2	1
C02	2	2	-	2	-	-	-	-	-	-	-	3	2
C03	3	3	2	3	-	-	-	-	-	-	-	3	2
C04	2	3	3	2	-	-	-	-	-	-	-	2	3
C05	1	2	-	-	-	-	-	-	-	-	-	1	1
C06	-	-	-	1	-	-	-	-	-	-	-	2	2

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24ITEL517	DATA SCIENCE FOR ENGINEERS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106106179	SYLLABUS VERSION 1.0	SDG NO. 4, 8, 9				
PRE-REQUISITE COURSES	24AIPT201, 24BSMA301, 24CSPC301					

OBJECTIVES:

- To understand the fundamental concepts of data science and apply mathematical foundations such as linear algebra, probability, and statistics for data analysis.
- To develop skills in data preprocessing, feature engineering, and model selection for effective data-driven problem-solving.
- To implement and evaluate supervised and unsupervised machine learning techniques for extracting insights and making predictions from data.
- To apply Python-based data science tools and libraries, including time series analysis, to solve real-world engineering problems.

MODULE - I FOUNDATIONS OF DATA SCIENCE AND PYTHON ANALYTICS

7

Data Science overview and lifecycle – Applications in Engineering – Types of data – Python for Data Science (NumPy, Pandas, Matplotlib) – Data import/export – Exploratory Data Analysis (EDA) – Data cleaning and preprocessing – Data visualization techniques.

MODULE - II MATHEMATICAL FOUNDATIONS FOR DATA SCIENCE

7

Vectors and matrices – Matrix operations – Eigenvalues and Singular Value Decomposition (SVD) – Optimization fundamentals – Gradient and partial derivatives – Gradient Descent and variants – Convex functions – Applications in machine learning.

MODULE - III STATISTICAL METHODS AND DECISION THEORY

7

Vectors and matrices – Matrix operations – Eigenvalues and Singular Value Decomposition (SVD) – Optimization fundamentals – Gradient and partial derivatives – Gradient Descent and variants – Convex functions – Applications in machine learning.

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

MODULE - IV SUPERVISED MACHINE LEARNING TECHNIQUES 8

Linear and Logistic Regression – k-Nearest Neighbours (kNN) – Support Vector Machines (SVM) – Decision Trees – Model evaluation metrics – Cross-validation – Model selection and regularization techniques.

MODULE - V UNSUPERVISED LEARNING AND FEATURE ENGINEERING 8

Clustering techniques (k-Means, Hierarchical Clustering, DBSCAN) – Cluster validation – Dimensionality Reduction (PCA, LDA, t-SNE) – Feature engineering and selection – Ensemble learning methods (Random Forest, Boosting) – Bootstrapping and Cross-validation.

MODULE - VI ADVANCED ANALYTICS, DEEP LEARNING AND BIG DATA 8

Time Series Analysis and Forecasting – Artificial Neural Networks (ANN) – Convolutional and Recurrent Neural Networks (CNN, RNN) – Big Data fundamentals – Hadoop and Spark ecosystem – Data pipelines and cloud platforms – Engineering case studies.

TOTAL : 45 PERIODS**TEXT BOOKS:**

1. Wes McKinney, "Python for Data Analysis", 3rd Edition, O'Reilly Media, 2022.
2. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", 3rd Edition, O'Reilly Media, 2022.
3. Joel Grus, "Data Science from Scratch", 2nd Edition, O'Reilly Media, 2019.

REFERENCES

1. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, "An Introduction to Statistical Learning with Applications in Python", Springer, 2023.
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016.
3. Douglas Montgomery, George Runger, "Applied Statistics and Probability for Engineers", 7th Edition, Wiley, 2018.
4. Gilbert Strang, "Introduction to Linear Algebra", 5th Edition, Wellesley-Cambridge Press, 2016.

WEB RESOURCES

1. <https://nptel.ac.in/courses/106106179> – NPTEL Data Science for Engineers (IIT Madras)

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

2. https://scikit-learn.org/stable/user_guide.html – Scikit-Learn User Guide
3. <https://pandas.pydata.org/docs/> – Pandas Documentation
4. <https://www.kaggle.com/learn> – Kaggle Learn (Practical Data Science)
5. <https://archive.ics.uci.edu/ml/> – UCI Machine Learning Repository

OUTCOMES:

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

1. Apply Python and data science libraries for data preprocessing, analysis, and visualization. (K3)
2. Apply mathematical and optimization techniques in data science and machine learning. (K3)
3. Apply statistical methods and hypothesis testing for data-driven decision-making. (K3)
4. Analyze and evaluate supervised machine learning models using performance metrics. (K4)
5. Analyze data using clustering, dimensionality reduction, and feature engineering techniques. (K4)
6. Analyze advanced techniques such as ensemble learning, deep learning, time series analysis, and big data frameworks. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	3	2	1	-	-	-	-	-	-	-	-	3	2
C02	3	3	1	-	-	-	-	-	-	-	-	3	1
C03	3	3	1	-	-	-	-	-	-	-	-	2	2
C04	3	3	2	-	-	-	-	-	-	-	-	3	3
C05	3	3	2	-	-	-	-	-	-	-	-	3	3
C06	3	3	3	-	-	-	-	-	-	-	-	3	3

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24ITEL518	DATA MINING FOR DECISION MAKING	L	T	P	CP	C
		3	0	0	4	3
NPTEL CODE: 110104118	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24ESCS101, 24BSMA301, 24ITPW301, 24BSMA402					

OBJECTIVES:

- To apply data-driven approaches and decision support systems for organizational decision-making.
- To analyze datasets using exploratory and predictive analytics techniques for decision modeling.
- To utilize multi-criteria decision-making methods for evaluating and selecting alternatives.
- To evaluate decision problems using hierarchical, ranking, and outranking techniques.

MODULE - I DECISION SUPPORT SYSTEMS AND DATA-DRIVEN DECISION MAKING 8

Introduction to Decision Making – Types of Decisions and Decision-Making Process – Business Intelligence and Decision Support Systems – Role of Data Mining in Decision Making – Knowledge Discovery in Databases (KDD) Process – Data Mining Methodology for Decision Support – Data Warehousing Concepts for Analytical Decision Making – Exploratory Data Analysis (EDA) for Decision Support – Statistical Description of Data – Data Visualization Techniques for Decision Making – Correlation and Covariance Analysis – Ethical Issues and Challenges in Data-Driven Decision Making.

MODULE - II PREDICTIVE ANALYTICS AND DECISION MODELLING 8

Classification and Prediction for Decision Making—Decision Tree Induction—Bayesian Classification—Regression Analysis—Model Evaluation Techniques: Accuracy, Precision, Recall, F-Measure, and ROC Curve—Predictive Analytics and Decision Modelling—Principal Component Analysis (PCA) and Factor Analysis for Decision Support—Recommendation Systems—Business and Marketing Analytics—Time Series Forecasting for Strategic Decisions—Case Studies in Business Decision Making—Ethical and Privacy Issues in Predictive Modelling.

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

MODULE - III FOUNDATIONS OF DECISION MAKING AND DECISION**ANALYSIS****8**

Multi-Criteria Decision Making (MCDM): Concepts, Characteristics, and Applications – Multi-Attribute Utility Theory (MAUT) – Utility Functions and Preference Structures – Utility Theory and Risk Analysis – Pareto Optimality and Pareto Efficiency – Dominance Relationships – Decision Trees: Structure, Construction, Evaluation, and Applications in Decision Analysis.

MODULE - IV PERFORMANCE EVALUATION AND HIERARCHICAL**DECISION MODELS****8**

Data Envelopment Analysis (DEA): Concepts, Efficiency Measurement, CCR and BCC Models, Applications of DEA—Analytical Hierarchy Process (AHP): Pairwise Comparisons, Consistency Analysis, Priority Vector Estimation, Applications—Analytical Network Process (ANP): Network Structures, Dependency and Feedback Relationships, Supermatrix Concept—Comparative Analysis of AHP and ANP—Case Studies on Resource Allocation and Decision Prioritization.

MODULE - V RANKING AND OUTRANKING METHODS IN MCDM**8**

Technique for Order Preference by Similarity to Ideal Solution (TOPSIS): Concepts, Computational Procedure, Applications—ELECTRE Family of Methods: Concordance and Discordance Analysis, Outranking Relations—PROMETHEE Methods: Preference Functions, Positive and Negative Flows, Ranking Alternatives—MACBETH: Measuring Attractiveness by a Categorical-Based Evaluation Technique—Comparative Study of Ranking and Outranking Approaches—Decision Support Applications.

MODULE - VI ADVANCED DECISION SUPPORT TECHNIQUES**8**

SWOT Analysis: Internal and External Environmental Assessment—System Analysis and Systems Thinking in Decision Making—Other Decision-Making Tools: Weighted Scoring Models, Goal Programming, Decision Support Systems—Fundamentals of Fuzzy Sets and Fuzzy Logic—Fuzzy Membership Functions—Fuzzy MCDM Approaches—Applications of Fuzzy Logic in Engineering, Business, and Management Decisions—Integrated Decision-Making Frameworks and Case Studies.

TOTAL : 45 PERIODS**TEXT BOOKS:**

1. Jiawei Han, Jian Pei, and Hanghang Tong, "Data Mining: Concepts and Techniques," Fourth Edition, Elsevier, 2022.

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

2. Belton, V. and Stewart, T.J., "Multiple Criteria Decision Analysis: An Integrated Approach", Springer Science & Business Media, 2017.
3. Tzeng, G.H. and Huang, J.J., "Multiple Attribute Decision Making: Methods and Applications", CRC Press, 2011.
4. Figueira, J., Greco, S., and Ehrgott, M., "Multiple Criteria Decision Analysis: State of the Art Surveys", Springer, Second Edition, 2016.

REFERENCES

1. Saaty, T.L., "Decision Making with the Analytic Hierarchy Process", RWS Publications, 2008.
2. Saaty, T.L., "Theory and Applications of the Analytic Network Process", RWS Publications, 2013.
3. Zimmermann, H.J., "Fuzzy Set Theory and Its Applications", Fourth Edition, Springer, 2011.
4. Cooper, W.W., Seiford, L.M., and Tone, K., "Data Envelopment Analysis: A Comprehensive Text with Models, Applications, References, and DEA-Solver Software", Second Edition, Springer, 2007.
5. Goodwin, P. and Wright, G., "Decision Analysis for Management Judgment", Sixth Edition, Wiley, 2020.

WEB REFERENCES:

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_mg121
2. Scikit-Learn Documentation
3. WEKA Data Mining Software
4. IBM Decision Support Systems Resources
5. Oracle Business Intelligence Resources
6. INFORMS Decision Analysis Society
7. International Society on Multiple Criteria Decision Making

OUTCOMES:

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

1. Apply business intelligence, decision support systems, and data mining methodologies to solve decision-making problems. (K3)
2. Analyze datasets using exploratory data analysis and predictive analytics techniques for informed decision-making. (K4)
3. Utilize MCDM methodologies, including MAUT, utility theory, and decision trees for evaluating alternatives. (K3)

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

- Analyze complex decision problems using DEA, AHP, and ANP models. (K4)
- Apply ranking and outranking techniques such as TOPSIS, ELECTRE, PROMETHEE, and MACBETH for decision support. (K3)
- Develop decision support solutions using fuzzy logic and advanced decision-making frameworks. (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	3	2	-	-	-	-	-	-	-	-	-	-	3
C02	3	3	-	2	-	-	-	-	-	-	-	-	2
C03	3	3	2	-	-	-	-	-	-	-	-	-	2
C04	2	3	2	-	-	-	-	-	-	-	-	-	2
C05	3	2	-	3	-	-	-	-	-	-	-	2	3
C06	2	-	3	2	3	-	-	-	-	-	-	3	3

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24CSEL508	MACHINE LEARNING FOR INTRUSION DETECTION	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106105152	SYLLABUS VERSION 1.0	SDG NO. 9, 11				
PRE-REQUISITE COURSES	24AIPT201, 24BSMA301, 24BSMA402					

OBJECTIVES:

- To understand the role of machine learning in enhancing intrusion detection systems.
- To learn data preprocessing and feature engineering techniques specific to security datasets.
- To explore supervised and unsupervised learning algorithms for intrusion detection.
- To analyse IDS/IPS architectures integrated with ML approaches.
- To evaluate model performance using security-specific metrics and alert correlation techniques.
- To apply ML tools and libraries for building practical intrusion detection solutions.

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

MODULE - I INTRODUCTION TO MACHINE LEARNING IN SECURITY 8

Basics of Security and Intrusions – Need for Intrusion Detection Systems (IDS)
 – Role of Machine Learning in Security – Classification of IDS: Host-based, Network-based – Sources of Vulnerabilities and Attacks against Security Objectives – Countermeasures and ML-driven defense strategies.

MODULE - II DATA PREPROCESSING FOR INTRUSION DETECTION 8

Security Data Collection (logs, traffic, alerts) – Data Cleaning and Handling Missing Values – Feature Engineering for IDS datasets – Feature Scaling and Encoding Categorical Data – Train-test split, Normalization, and Standardization – Case study: Preprocessing KDD Cup / NSL-KDD dataset.

MODULE - III SUPERVISED LEARNING FOR IDS 8

Regression models for anomaly scoring – Classification models: Logistic Regression, Decision Trees, Random Forests – K-Nearest Neighbors (KNN) for intrusion detection – Evaluation metrics: Accuracy, Precision, Recall, F1 Score, ROC-AUC – Applications of supervised ML in detecting known attacks.

MODULE - IV UNSUPERVISED AND DEEP LEARNING APPROACHES 8

Clustering: K-Means, Hierarchical Clustering for anomaly detection – Dimensionality Reduction: PCA, Autoencoders – Anomaly Detection using statistical and ML-based methods – Introduction to Deep Learning for IDS: CNNs, RNNs, LSTMs – Applications in detecting zero-day and unknown attacks.

MODULE - V IDS/IPS ARCHITECTURE AND ALERT MANAGEMENT 7

IDS/IPS Architectures: Single-tiered, Multi-tiered, Peer-to-Peer – Sensor, Agent, and Manager components with ML integration – Information flow in IDS/IPS with ML models – Alert Management and Correlation: preprocessing, correlation techniques, post-processing – Cooperative Intrusion Detection and ML-based fusion techniques.

MODULE - VI TOOLS, IMPLEMENTATION & CASE STUDIES 6

Python for Security-focused ML – Libraries: NumPy, Pandas, Scikit-learn, TensorFlow, PyTorch – Implementation workflow for IDS using ML – Case studies: ML-based IDS (Snort + ML, Suricata + ML) – Emerging trends: Hybrid IDS, Federated Learning for IDS.

TOTAL : 45 PERIODS

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

TEXT BOOKS:

1. C. Endorf, E. Schultz and J. Mellander, "Intrusion Detection & Prevention", McGraw-Hill/Osborne, 2004.
2. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow", O'Reilly, 2019.
3. Ali A. Ghorbani, "Network Intrusion Detection and Prevention: Concepts and Techniques", Springer, 2010.

REFERENCES:

1. J. M. Kizza, "Computer Network Security", Springer, 2005.
2. Chris Sanders and Jason Smith, "Applied Network Security Monitoring: Collection, Detection, and Analysis", Syngress, 2013.
3. Bishop C.M., "Pattern Recognition and Machine Learning", Springer, 2006.
4. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.

WEB REFERENCES:

1. <https://scikit-learn.org>
2. <https://www.kaggle.com>
3. <https://machinelearningmastery.com>
4. <https://www.tensorflow.org>
5. <https://pytorch.org>
6. <https://www.sans.org/white-papers/intrusion-detection> (sans.org in Bing)
7. <https://www.cisecurity.org>

OUTCOMES:

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

1. Demonstrate the integration of Machine Learning concepts into intrusion detection systems for cybersecurity applications. (K3)
2. Implement preprocessing and feature engineering techniques on security datasets to prepare data for intrusion detection. (K3)
3. Implement supervised and unsupervised Machine Learning algorithms for intrusion detection. (K3)
4. Analyze IDS/IPS architectures integrated with Machine Learning components to identify their effectiveness in intrusion detection. (K4)

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5. Analyze IDS performance using security-specific metrics and alert correlation to identify system strengths and improvement opportunities. (K4)
6. Use ML tools and libraries to build and test intrusion detection models. (K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	3	2	1	1	-	-	-	-	-	-	-	2	2
C02	3	3	2	2	-	-	-	-	-	-	-	2	2
C03	3	3	3	2	2	-	-	-	-	-	-	3	2
C04	3	3	3	2	2	-	-	-	-	-	-	3	2
C05	3	3	2	2	2	-	-	-	-	-	-	2	3
C06	3	3	3	2	3	-	-	-	-	-	-	-	3

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24CSEL509	DEEP LEARNING ARCHITECTURES AND APPLICATIONS	L 3	T 0	P 0	CP 3	C 3
NPTEL CODE: 106106184	SYLLABUS VERSION 1.0	SDG NO. 9, 11				
PRE-REQUISITE COURSES	24AIPT201, 24BSMA301, 24BSMA402, 24CSPC302, 24CSPC402					

OBJECTIVES:

- Understand the fundamental techniques and principles of Neural Networks.
- Identify and apply appropriate Deep Learning architectures for analyzing data across various problem domains.
- Analyze Deep Learning concepts through Convolutional Neural Network case studies.
- Implement different Deep Learning algorithms for real-world problems.
- Study advanced Deep Learning techniques and emerging applications.

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MODULE - I FOUNDATIONS OF DEEP LEARNING & NEURAL NETWORKS

7

Historical context and motivation for Deep Learning-Machine Learning vs Deep Learning.-Fundamentals of Neural Networks. Comparison of Biological and Artificial Neurons-Perception model and its limitations-Model of Artificial Neuron-Feed forward Neural Networks. Shallow vs Deep Networks. Vanishing and exploding gradient problem Role of data, computation, and algorithms in the success of Deep Learning.

MODULE - II DEEP NEURAL NETWORK TRAINING & OPTIMIZATION APPLICATION

8

Deep Network architectures-Loss functions and optimization overview. Backpropagation algorithm (intuition and workflow)-Regularization techniques: L1, L2, Dropout, Early stopping-Model exploration and hyperparameter tuning-Bias-Variance tradeoff. Batch Normalization.

Weight initialization techniques (Xavier, He initialization)-Learning rate scheduling and optimization strategies.

MODULE - III REPRESENTATION LEARNING & UNSUPERVISED DEEP LEARNING

7

Representation Learning-Width and Depth of Neural Networks. Activation Functions: ReLU, Leaky ReLU, ELU / EReLU-Unsupervised training of Neural Networks-Autoencoders: basic, sparse, and denoising autoencoders-Restricted Boltzmann Machines (RBMs). Variational Autoencoders (conceptual)-Dimensionality reduction using deep models.

MODULE - IV CONVOLUTIONAL NEURAL NETWORKS (CNNs)

8

Introduction to Convolutional Neural Networks-Convolution operation, filters, feature maps-Stride, padding, pooling techniques-Parameter sharing and regularization in CNNs-Architectural overview of CNNs. Popular CNN architectures: AlexNet, ResNet-Applications in image and text classification. Transfer Learning-Fine-tuning pre-trained CNN models

MODULE - V SEQUENCE MODELING & RECURRENT NEURAL NETWORKS

7

Sequential data modeling concepts-Unfolding computational graphs. Recurrent Neural Networks (RNNs)-Deep RNNs-Bidirectional RNNs.

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Encoder-Decoder architecture-Sequence-to-sequence learning models-Long Short-Term Memory (LSTM) and Gated Recurrent Units (GRU).Introduction to Attention mechanisms-Applications in speech, text, and time-series analysis.

MODULE - VI ADVANCED DEEP LEARNING TECHNIQUES

8

Deep Belief Networks (DBN)-Deep Boltzmann Machines (DBM)-Deep Associative Memory Networks-Generative Adversarial Networks (GANs). Deepfake Technology – concepts and challenges-Ethical issues and societal impact of Deep Learning-Introduction to Explainable AI (XAI)-Generative Neural Networks. Case Studies: Designing Deep Learning solutions for identifying fake fingerprints. Detection of fake images and deepfake videos.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Simon Haykin, "Neural Networks, A Comprehensive Foundation", 2nd Edition, Addison Wesley Longman, 2001.
2. Ian Good fellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016.
3. Jeff Heaton, Deep Learning and Neural Networks, Heaton Research Inc, 2015.
4. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017
5. David – Foster "Generative Deep Learning"- O'Reilly Media, Inc- 2nd Edition (latest): Published April 2023

REFERENCES:

1. Cosma Rohilla Shalizi, "Advanced Data Analysis from an Elementary Point of View", 2015.
2. Deng & Yu, "Deep Learning: Methods and Applications", Now Publishers, 2013.
3. Michael Nielsen, "Neural Networks and Deep Learning", Determination Press, 2015.

WEB REFERENCES:

1. www.nptel.ac.in/courses/106/106/106106184/
2. www.nptel.ac.in/courses/106/106/106106201/
3. www.nptel.ac.in/courses/106/105/106105215/

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

4. www.ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-s191-introduction-to-deep-learning-january-iap-2020/5.
5. www.kaggle.com/learn/intro-to-deep-learning

OUTCOMES:

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

1. Implement reinforcement learning concepts using appropriate decision-making models for solving practical problems. (K3)
2. Analyze Deep Learning training, optimization, and regularization techniques to improve model performance and generalization. (K3)
3. Design and implement Convolutional Neural Networks for image-based applications such as handwriting and object recognition. (K4)
4. Design and implement Recurrent Neural Network-based models for sequential and time-series data analysis. (K4)
5. Evaluate and compare Deep Learning architectures and generative models for real-world datasets with respect to accuracy, efficiency, robustness, and ethical implications. (K5)
6. Critically assess advanced Deep Learning techniques including GANs, deep fake technologies, and Explainable AI methods to ensure responsible and interpretable AI solutions. (K5)

CO - PO, PSO MAPPING:

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

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24CSEL510	INTELLIGENT DECISION SYSTEMS	L 3	T 0	P 0	CP 3	C 3
NPTEL CODE: 106105221	SYLLABUS VERSION 1.0	SDG NO. 9, 11				
PRE-REQUISITE COURSES	24AIPT201, 24BSMA301, 24BSMA402, 24CSPC302, 24CSPC402					

OBJECTIVES:

- To understand the fundamentals of Reinforcement Learning (RL)
- To learn Markov Decision Processes (MDP) and Bellman equations
- To apply value-based and policy-based learning techniques
- To explore model-free and model-based RL algorithms
- To implement RL in real-world applications
- To evaluate performance of RL models

MODULE - I INTRODUCTION TO REINFORCEMENT LEARNING 8

Introduction to Reinforcement Learning – Agent and Environment – Reward Signal – Policy – Value Function – Exploration vs Exploitation – Multi-armed Bandit Problem – Action-value methods – ϵ -greedy method – Upper Confidence Bound (UCB).

MODULE - II MARKOV DECISION PROCESSES (MDP) 8

Markov Property – MDP Framework – State, Action, Reward – Transition Probabilities – Return – Discount Factor – Value Functions – Bellman Equations – Optimal Value Function – Policy Evaluation and Policy Improvement.

MODULE - III DYNAMIC PROGRAMMING METHODS 7

Policy Iteration – Value Iteration – Generalized Policy Iteration (GPI) – Convergence of DP algorithms – Applications and limitations of Dynamic Programming.

MODULE - IV MONTE CARLO METHODS 7

Monte Carlo Prediction – Monte Carlo Control – Exploring Starts – On-policy and Off-policy Learning – Importance Sampling – Incremental Implementation – Applications.

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

MODULE - V TEMPORAL DIFFERENCE LEARNING**8**

TD Learning – TD(0) Prediction – SARSA – Q-Learning – Expected SARSA – Comparison between MC and TD methods – Bias and Variance tradeoff.

MODULE - VI ADVANCED TOPICS IN RL**7**

Function Approximation – Deep Reinforcement Learning (Introduction) – Policy Gradient Methods – Actor-Critic Methods – Applications of RL (Gaming, Robotics, Recommendation Systems).

TOTAL : 45 PERIODS**TEXT BOOKS:**

1. Richard S. Sutton and Andrew G. Barto, “Reinforcement Learning: An Introduction”, 2nd Edition, MIT Press, 2018.
2. Csaba Szepesvári, “Algorithms for Reinforcement Learning”, Morgan & Claypool, 2010.

REFERENCES:

1. David Silver, “Reinforcement Learning Course Notes”, University College London.
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016
3. Marco Wiering, Martijn van Otterlo, “Reinforcement Learning: State-of-the-Art”, Springer.

WEB REFERENCES:

1. <https://www.geeksforgeeks.org/machine-learning/reinforcement-learning/>
2. <https://spinningup.openai.com>
3. <https://www.coursera.org/learn/reinforcement-learning>

OUTCOMES:

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

1. Explain the fundamentals of reinforcement learning and decision-making models (K2)
2. Apply MDP and Bellman equations to solve sequential decision problems (K3)
3. Implement Dynamic Programming methods for optimal policy finding (K3)

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4. Apply Monte Carlo methods for prediction and control (K3)
5. Develop Temporal Difference learning algorithms such as Q-learning and SARSA (K3)
6. Analyze advanced RL methods including deep RL and policy gradients (K4)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	3	2	2	1	-	-	-	-	-	-	-	2	2
C02	3	3	2	2	-	-	-	-	-	-	-	2	2
C03	3	3	3	2	-	-	-	-	-	-	1	2	2
C04	2	3	3	2	-	-	-	-	-	-	1	2	2
C05	3	3	3	3	-	-	-	-	-	-	1	2	2
C06	3	3	3	3	-	-	-	-	-	-	1	2	2

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24CIEL504	WEB OF THINGS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 7, 9 & 11				
PRE-REQUISITE COURSES	24ESCS101, 24CSPC301, 24ITPW401					

OBJECTIVES:

- To understand the overview in the web of things.
- To learn about WoT Reference models.
- To understand programming frameworks for the Web of Things.
- To acquire knowledge about WoT with its application.

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 -

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

Introduction to Raspberry Pi - Node.js on RaspberryPi - Connecting sensors and actuators on Pi - Modeling REST full services

MODULE - II MASHUP TOOLS AND MODEL DRIVEN ENGINEERING 8

Mashup tools - Model driven engineering for WoT - Comparing mashup and Model driven tools - Modeling of RESTful services - Modeling WoT system with generic RESTful operations - Building network of things: Topologies - Classification models - Network protocols for things: spatial considerations, Internet protocols and IoT - IoT Personal Area Networks, IoT Wide Area Networks.

MODULE - III NETWORKING IN IOT 8

Application protocols: Zigbee, Bluetooth application stack - Application protocol for things: Apple home kit, Google weave - Message Queuing Telemetry Transport (MQTT) - Constraint application protocol - WoT architecture - Compose-Building IoT with Avatars: Avatar based IoT platform - Disruption tolerant communication-Context modeling and management - 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.

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MODULE - VI SECURITY IN WOT

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 Madiseti, "Internet of Things: A Hands-on Approach", Universities Press, 2015.
3. Adrian McEwen & Hakim Cassimally, "Designing the Internet of Things", Wiley, 2013.
4. Maneesh Rao, "Internet of Things with Raspberry Pi 3", Packt Publishing, 2018.

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.

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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. Build simple IoT applications using Web of Things tools and technologies.(K3).
2. Construct a Web of Things network architecture for smart applications.(K3)
3. Select suitable Web of Things integration techniques for IoT-based applications. (K3).
4. Summarize frameworks of the web of Things.(K3).
5. Choose appropriate data representation techniques for different applications. (K3).
6. Experiment with different Web of Things security mechanisms to identify vulnerabilities and solutions.(K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	3	2	1	-	-	-	-	-	-	-	1	2	3
C02	3	3	-	-	-	-	-	-	-	-	1	3	3
C03	3	3	-	-	-	-	-	-	-	-	-	3	3
C04	3	3	-	-	-	-	-	-	-	-	-	3	3
C05	3	1	-	-	-	-	-	2	-	-	2	3	3
C06	3	1	1	-	-	-	-	-	2	-	2	2	3

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

PROFESSIONAL ELECTIVES - 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	-					

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).

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

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
C01	3	-	2	-	-	-	-	-	2	2	-	1	1
C02	2	-	1	-	-	-	-	-	1	1	-	1	1
C03	2	-	-	-	-	-	-	-	-	-	-	1	2
C04	2	2	-	-	2	-	-	2	2	2	-	1	1
C05	2	2	-	-	1	-	-	-	-	-	-	2	2
C06	3	3	-	-	-	-	-	-	1	1	-	1	2

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24CIEL506	DESCRIPTIVE ANALYTICS FOR IOT	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106105160	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	-					

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

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

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

Recommended in Board of Studies (BoS) Meeting No. 9 held on 12.05.26

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", 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).
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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. Illustrate and demonstrate 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. Build Big Data solutions using cloud computing platforms and technologies.(K3)

CO - PO, PSO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
C01	3	3	-	-	-	-	-	-	-	1	1	3	2
C02	3	3	-	-	2	-	-	-	1	2	2	3	3
C03	3	3	-	-	-	-	-	-	1	2	2	3	3
C04	3	2	-	-	2	-	-	-	-	2	1	3	3
C05	2	2	-	-	1	1	1	-	1	3	2	2	2
C06	3	2	-	-	1	1	-1	-	1	2	2	3	2

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Imagine the Future and Make it happen!



1 NO POVERTY



2 ZERO HUNGER



3 GOOD HEALTH AND WELL-BEING



4 QUALITY EDUCATION



5 GENDER EQUALITY



6 CLEAN WATER AND SANITATION



7 AFFORDABLE AND CLEAN ENERGY



8 DECENT WORK AND ECONOMIC GROWTH



9 INDUSTRY, INNOVATION AND INFRASTRUCTURE



10 REDUCED INEQUALITIES



11 SUSTAINABLE CITIES AND COMMUNITIES



12 RESPONSIBLE CONSUMPTION AND PRODUCTION



13 CLIMATE ACTION



14 LIFE BELOW WATER



15 LIFE ON LAND



16 PEACE, JUSTICE AND STRONG INSTITUTIONS



17 PARTNERSHIPS FOR THE GOALS



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

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We build a Better nation
through Quality education.



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