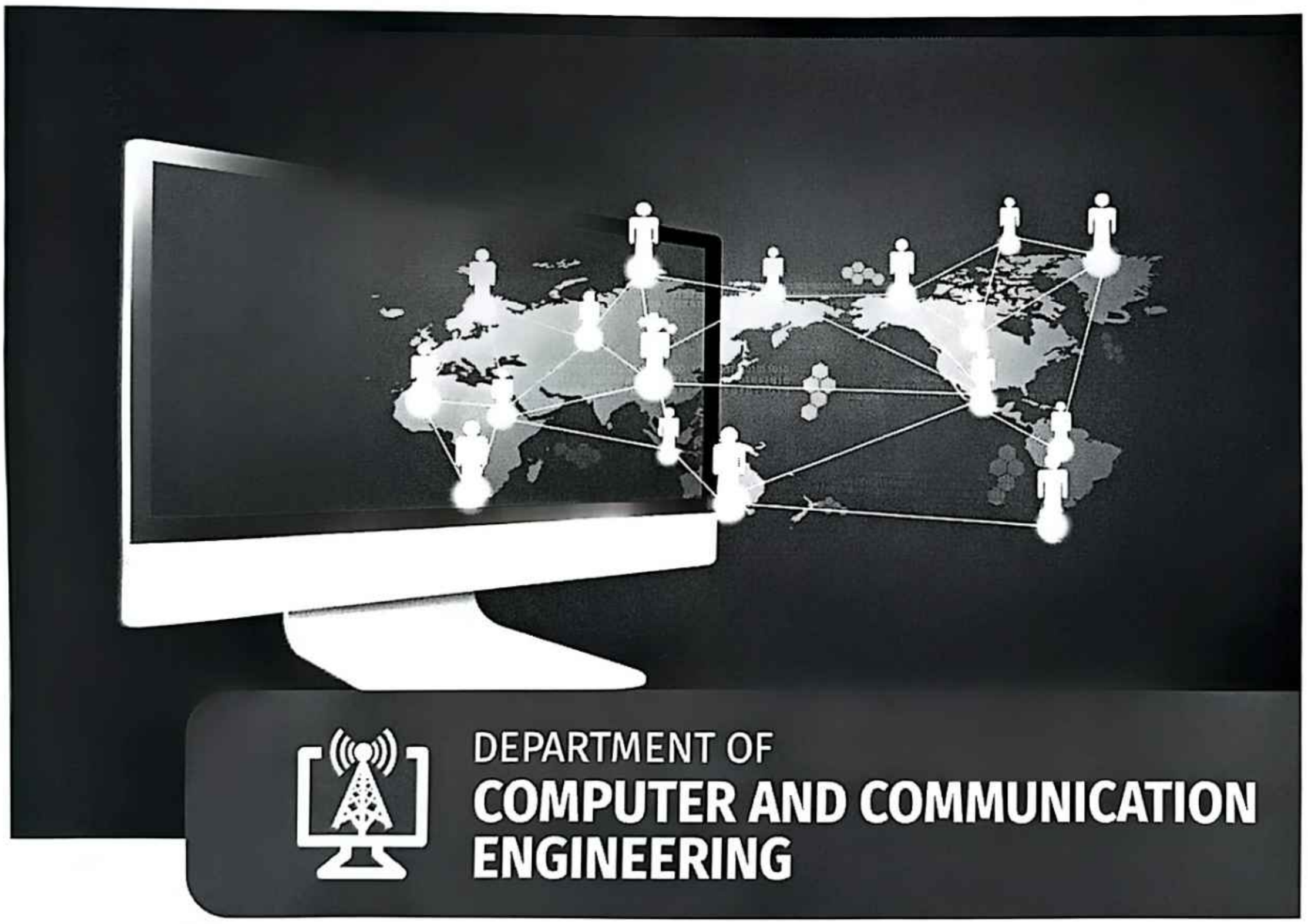
SRI SAIRAM ENGINEERING COLLEGE
IQAC
Ensuring Quality
STUDENT | MANAGEMENT | FACULTY | INDUSTRY

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 AND COMMUNICATION 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 AND COMMUNICATION ENGINEERING

VISION

To produce globally competent and socially responsible engineers who can address the engineering challenges and excel at an international level, in the advancement of Computer and Communication Engineering through research and academia.

MISSION

M1 To provide a good environment with latest technological infrastructure facilities, teaching-learning ambience and interaction with industry in the area of Computer and Communication Engineering .

M2 To inculcate graduates with high social responsibility, right attitude, discipline and an inclination towards offering their professional expertise in serving the society.

Curriculum / CCE

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	24ESPL101	Programming in C Laboratory	0	0	2	2	1
2	24ESGE102	Engineering Practices Lab	0	0	4	4	2
VALUE ADDITIONS - I							
1	24ENTP101	Functional Life Skills	1	0	1	2	1
2	24ESID101	Idea Engineering Lab - I	0	0	2	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	24BSPH201	Physics of Electronic Devices	3	0	0	3	3
4	24BSCY201	Chemistry for Environment and Sustainability	3	0	0	3	3
5	24HSTA201	Tamils and Technology	1	0	0	1	1
6	24HSNC201	NCC Course Level 1*	2	0	0	2	0
7	24ESGE101	Engineering Graphics	1	2	0	3	3
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	24ENTP201	Digital Dynamics	0	0	2	2	0
2	24ESID201	Idea Engineering Lab - II	0	0	2	2	1
ONLINE SUPPLEMENTARY							
1	24ESMC201	MS Office (Mandatory - NC)	0	0	0	0	0
				Total		31	22

*only for NCC cadets

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COMPUTER AND COMMUNICATION ENGINEERING

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	24ECPC301	Signals and Systems	3	0	0	3	3
3	24COPC301	Digital Design and Computer Organization	3	0	0	3	3
4	24COPC302	Algorithms and Data Structures	3	0	0	3	3
5	24HSMC301	Universal Human Values - II Understanding Harmony	3	0	0	3	3
6	24HSNC301	NCC course Level 2*	3	0	0	3	0
PRACTICALS							
1	24COPL301	Digital Circuits Laboratory	0	0	4	4	2
2	24COPL302	Algorithms and Data Structures Laboratory	0	0	4	4	2
VALUE ADDITIONS - III							
1	24COTP301	Aptitude Skills - I	0	0	2	2	1
2	24COID301	Innovative Design Lab - I	0	0	2	2	1
ONLINE SUPPLEMENTARY							
1	24ESMC202	Joy of Computing using Python (Mandatory - NC)					
					Total	31	22

SEMESTER IV

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			CONTACT PERIODS	CREDITS
			L	T	P		
THEORY							
1	24BSMA401	Probability Theory and Random Processes	3	1	0	4	4
2	24ECPC402	Analog and Digital Communication	3	0	0	3	3
3	24ITPW401	Operating systems with Lab	3	0	2	5	4
4	24COPC401	Database Systems	3	0	0	3	3
4	24XXOEXXX	Open Elective - I #	3	0	0	3	3
5	24HSNC401	NCC course Level 3*	3	0	0	3	0
PRACTICALS							
1	24ECPL401	Communication Systems Laboratory	0	0	4	4	2
2	24COPL401	Database Systems laboratory	0	0	4	4	2
3	24CSPT401	Object Oriented Programming Laboratory with Theory	1	0	4	5	3
VALUE ADDITIONS - IV							
10	24COTP401	Aptitude Skills - II	0	0	2	2	0
11	24COID401	Innovative Design Lab - II	0	0	2	2	1
ONLINE SUPPLEMENTARY							
		As recommended by BOS					
					Total	35	25

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#Logistics Information System

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SEMESTER V

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS L	T	P	CP	C	PREREQUISITE COURSES
		THEORY						
1	24COPW501	Data Communication Networks with laboratory	3	0	2	5	4	24COPC302, 24ECPC402
2	24HSMG501	Principles of Engineering Management	3	0	0	3	3	-
3	24MGMC501	Constitution of India	2	0	0	2	0	-
4	24COEL5XX	Professional Elective - I	3	0	0	3	3	-
5	24COEL5YY	Professional Elective - II	3	0	0	3	3	-
6	24XXOEXXX	Open Elective - II#	3	0	0	3	3	
		PRACTICALS						
1	24COPT501	Microprocessors, Microcontrollers, and Embedded Systems Laboratory with theory	1	0	4	5	3	24COPC301
		VALUE ADDITIONS						-
1	24COTP501	Skill Enhancement	0	0	2	2	1	24ESID101, 24ESID201, 24CSID301, 24CSID401
2	24COID501	Prototype Development Lab - I	0	0	2	2	1	
		ONLINE SUPPLEMENTARY						
		As recommended by BoS						
		Total				28	21	

SEMESTER VI

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS L	T	P	CONTACT PERIODS	CREDITS
		THEORY					
1	24ECPC602	Wireless Communication	3	0	0	3	3
2	24COPW601	Discrete Time Signal Processing with Laboratory	3	0	2	5	4
3	24COEL6yy	Professional Elective - III	3	0	0	3	3
4	24COEL6zz	Professional Elective - IV	3	0	0	3	3
5	24COEL6uu	Professional Elective - V	3	0	0	3	3
6	24xxOE9xx	Open Elective - III	3	0	0	3	3
		PRACTICALS					
1	24COPT601	Full Stack Laboratory with Theory	1	0	4	5	3
		VALUE ADDITIONS - IV					
1	24COTP601	Technical Skill	0	0	2	2	0
2	24COID601	Prototype Development Lab - II	0	0	2	2	1
		ONLINE SUPPLEMENTARY					
		As recommended by BOS					
		Total				29	23

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No. 11 **Dated:** 29 SEP 24

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SEMESTER VII

S. NO	COURSE CODE	COURSE TITLE	WEEK HOURS			CONTACT PERIODS	CREDITS
			L	T	P		
THEORY							
1	24COPC701	Cryptography and Network Security	3	0	0	3	3
2	24COPC702	Mobile Communication	3	0	0	3	3
3	24COEL7XX	Professional Elective - VI	3	0	0	3	3
4	24xxOEXxx	Open Elective - IV	3	0	0	3	3
5	24MGEL703	Creative Innovation and Entrepreneurship	2	0	0	2	2
PRACTICALS							
1	24COPL701	Mobile Application Development Laboratory	0	0	4	4	2
2	24COPJ701	Project Work - Phase I	0	0	8	8	4
VALUE ADDITIONS - VII							
1	24COTP701	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							
4	24COEL8xx	Professional Elective - VII	3	0	0	3	3
PRACTICALS							
1	24COPJ801	Project Work - Phase II	0	0	12	12	6
VALUE ADDITIONS - VIII							
1	24COIN801	Internship	0	0	9	9	3
					Total	**24**	**12**

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PROFESSIONAL ELECTIVES - I

S. NO	COURSE CODE	COURSE TITLE	CREDIT	DOMAIN	PREREQUISITE COURSES
1	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	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	24ITEL501	Computer Graphics and Multimedia	3	Computing Technologies	24ITPC301, 24BSMA301
2	24ITEL511	Graph Theory	3	Computing Technologies	24BSMA402, 24BSMA301
3	24ITEL502	Distributed Systems	3	Computing Technologies	24CSPC302, 24CSPC402, 24ITPW401
1	24ECEL502	Digital Communication Techniques	3	Wireless Communication	24ECPC402
2	24ECEL515	Communication Technologies for Industry 4.0	3	Wireless Communication	24ECPC304, 24ECPT401
3	24ECEL503	Statistical Theory of Communication	3	Wireless Communication	24BSMA301, 24ECPC301
1	24COEL501	Network Design and Management	3	Computer Networks	24BSMA401, 24BSMA301
2	24COEL502	Hardware Interfacing and Networking	3	Computer Networks	24BSMA401, 24BSMA301
3	24COEL503	Embedded Network Systems	3	Computer Networks	24BSMA401, 24BSMA301, 24ECPC301

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PROFESSIONAL ELECTIVES - II

S. NO	COURSE CODE	COURSE TITLE	CREDIT	DOMAIN	PREREQUISITE COURSES
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	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	24ITEL510	Advanced Analysis of Algorithms	3	Computing Technologies	24CSPC302, 24CSPC402
2	24ITEL503	Cloud Computing	3	Computing Technologies	24ITPC301, 24ITPW401
3	24ITEL512	Parallel Algorithms	3	Computing Technologies	24CSPC302, 24CSPC402, 24ITPW401
1	24ECEL513	Information Theory	3	Wireless Communication	24BSMA401, 24ECPC402
2	24ECEL514	Machine Learning for Communication and Signal Processing	3	Wireless Communication	24BSMA401
3	24ECEL501	Simulation Techniques for Communication	3	Wireless Communication	24ECPC301 24BSMA401, 24ECPC402
1	24COEL504	Network Protocols and Programming	3	Computer Networks	24BSMA401, 24BSMA301
2	24COEL505	Network on Chip	3	Computer Networks	24BSMA401, 24BSMA301
3	24COEL506	Network Routing Algorithms	3	Computer Networks	24BSMA401, 24BSMA301

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ELECTRONICS AND COMMUNICATION ENGINEERING

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).

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Department of Humanities & Sciences

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

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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 communicative and cognitive skills
- Interpret the texts and write reviews critically

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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

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

OUTCOMES:

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

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

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Meeting No. _____ Dated: 7/6/24

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CO-PO, PSO Mapping:

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

SEMESTER - I

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

OBJECTIVES:

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

MODULE - I PROPERTIES OF MATTER 8

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

MODULE - II MECHANICAL WAVES AND LASERS 7

Waves on a string – standing waves – traveling waves – Energy transfer of a wave – Reflection and refraction of light waves – interference –Theory of air wedge and experiment - Theory of laser – characteristics – Spontaneous and stimulated emission – Einstein's coefficients – population inversion – Nd-YAG laser, CO_2 laser – Basic applications of lasers in industry.

Recommended by Board of Studies of H&S dept. Meeting No. ____ Dated: 4/6/24

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MODULE - III ELECTROMAGNETIC WAVES 8

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

MODULE - IV BASIC AND APPLIED QUANTUM MECHANICS 7

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

MODULE - V CRYSTAL PHYSICS 8

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

MODULE - VI THERMAL PHYSICS 7

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

TOTAL: 45 PERIODS

TEXT BOOKS:

1. D.K. Bhattacharya & T.Poonam, "Engineering Physics". Oxford University Press, 2015.
2. R.K. Gaur & S.L. Gupta, "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. B.K. Pandey & S.Chaturvedi, "Engineering Physics", Cengage Learning India, 2017.
4. V. Rajendran, "Engineering Physics", Mc Graw Hill Publications Ltd. New Delhi, 2014.
5. M.N. Avadhanulu And P.G. Kshirsagar, "A textbook of Engineering Physics", S. Chand & Co Ltd. 2018.

Recommended by
Board of Studies of H&S dept.
Meeting No. ____ Dated: 7/6/24

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REFERENCES:

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

OUTCOMES:

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

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

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Meeting No. _____ Dated: 7/6/24

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CO-PO, PSO Mapping:

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

SEMESTER - I

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

OBJECTIVES:

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

MODULE - I POLYMER CHEMISTRY 8

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

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

Recommended by Board of Studies of H&S dept. Meeting No. ____ Dated: 7/6/24

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

MODULE - II ELECTROCHEMISTRY AND BATTERY TECHNOLOGY 7

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

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

MODULE - III PHOTOCHEMISTRY & SPECTROSCOPY 7

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

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

MODULE - IV CHEMICAL THERMODYNAMICS 8

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

MODULE - V FUELS 8

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

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

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MODULE - VI NANOCHEMISTRY 7

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

TOTAL: 45 PERIODS

TEXT BOOKS:

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

Recommended by Board of Studies of 1193 dept. Meeting No. _____ Dated: 7/6/24

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

CO-PO, Mapping:

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

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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.

Recommended by
Board of Studies of CSE (CP) Dept.
Meeting No. 7 Dated: 24/8/24

Dr. B. SREEDEVI
HEAD OF THE DEPARTMENT
COMPUTER SCIENCE AND ENGINEERING
SRI SAIRAM INSTITUTE OF TECHNOLOGY
SAI LEO NAGAR, CHENNAI - 600 044

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

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

MODULE - II BASICS OF C PROGRAMMING 7

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

MODULE - III ARRAYS AND STRINGS 8

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

MODULE - IV FUNCTIONS AND POINTERS 9

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

MODULE - V STRUCTURES 7

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

MODULE - VI FILE PROCESSING 7

Files – Types of File Processing: Sequential Access, Random Access – Sequential Access File - Example Program: Finding Average of Numbers stored in Sequential Access File - Random Access File - Example Programs

Recommended by Board of Studies of DCSE Dept. Meeting No. 7 Dated: 24/8/24

Dr. B. SREE VIDHYA
HEAD OF THE DEPARTMENT
COMPUTER SCIENCE AND ENGINEERING
SRI SAIRAM INSTITUTE OF TECHNOLOGY
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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

Recommended by
Board of Studies of IOSE | CSE dept.
Meeting No. 1 Dated 21/6/24

Dr. B. SREEDEVI
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SRI SAIRAM INSTITUTE OF TECHNOLOGY
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OUTCOMES:

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

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

CO-PO, PSO MAPPING:

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

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SEMESTER - I

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

OBJECTIVES:

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

அலகு ஐ மொழி மற்றும் இலக்கியம்

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

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Meeting No. _____ Dated: 7/6/24

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UNIT I LANGUAGE AND LITERATURE 5

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

அலகு II இடைகால மற்றும் நவீன இலக்கியங்கள்

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

Unit II MEDIEVAL AND MODERN LITERATURE 5

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

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

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

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

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

அலகு IV நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்

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

UNIT IV FOLK AND MARTIAL ARTS 5

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

அலகு V தமிழர்களின் திணைக் கோட்பாடுகள்

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

Recommended by
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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, கையெழுத்துப்படிகள் — தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

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

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

TOTAL: 30 PERIODS

TEXT-CUM-REFERENCE BOOKS

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

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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)

CO- PO, PSO MAPPING

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

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SEMESTER - I

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

OBJECTIVES:

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

LIST OF EXPERIMENTS

1. Write a program using I/O statements and expressions.
2. Write programs using decision-making constructs.
3. Write a program to find whether the given year is a leap year or not? (Hint: not every century is a leap. For example 1700, 1800 and 1900 is not a leap year).
4. Write a program to perform the Calculator operations, namely, addition, subtraction, multiplication, division and square of a number.
5. Write a program to check whether a given number is an Armstrong number or not.
6. Write a program to check whether a given number is odd or even.
7. Write a program to find the factorial of a given number.
8. Write a program to find out the average of 4 integers.
9. Write a program to print half pyramid of *.
10. Write a program to display array elements using two dimensional arrays.
11. Write a program to perform swapping using a function.
12. Write a program to display all prime numbers between two intervals using functions.
13. Write a program to solve towers of Hanoi using recursion.
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:

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(a) Total marks obtained by each student.
(b) The highest marks in each subject and the marks of the student who secured it.
(c) The student who obtained the highest total marks.

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

TOTAL: 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

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

OUTCOMES:

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

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

CO-PO, PSO MAPPING:

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

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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.

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Plumbing Works:

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

Carpentry using Power Tools only:

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

MECHANICAL ENGINEERING PRACTICE

Welding:

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

Basic Machining:

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

Sheet Metal Work:

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

Demonstration on:

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

TOTAL: 60 PERIODS

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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

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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, PSO MAPPING:

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

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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

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MODULE - V PRESENTATION SKILLS 5

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

MODULE - VI ARTICULATION ASPECTS 5

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

TOTAL : 30 PERIODS

REFERENCES:

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

WEB REFERENCES:

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

OUTCOMES:

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

1. 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
CO1	-	-	-	-	-	-	-	-	3	-	2	-	-
CO2	-	-	-	-	-	-	-	-	3	-	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)

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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.

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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 - II

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

OBJECTIVES:

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

MODULE - I LOGICS 9

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

MODULE - II COMBINATORICS 9

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

MODULE - III ALGEBRAIC STRUCTURES WITH ONE BINARY OPERATION 12

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

MODULE - IV GRAPHS 12

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

MODULE - V LATTICES 9

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

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MODULE - VI BOOLEAN ALGEBRA 9

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

TOTAL: 60 PERIODS

TEXT BOOKS:

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

REFERENCES:

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

WEB REFERENCES:

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

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/106106183
2. https://www.youtube.com/watch?v=xlUFkMKSB3Y&list=PL0862D1A947252D20
3. https://www.youtube.com/watch?v=4LlTmsfDS4Y&list=PLEAYkSg4uSQ2Wfc_l4QEZUSRdx2ZcFziO&index=13
4. https://www.youtube.com/watch?v=jBsEKyx6Rj0&list=PLwdnzlV3ogoVxVxCTll45pDVM1aoYoMHf
5. https://www.youtube.com/watch?v=rdXw7Ps9vxc&list=PLHXZ9OQGMqxerSk8RJxiUM8Ib9DBqsKZS

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OUTCOMES:

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

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

CO-PO, MAPPING:

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

SEMESTER - II

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

OBJECTIVES:

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

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MODULE - I EFFECTIVE COMMUNICATION 6

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

MODULE - II BASICS OF TECHNICAL WRITING 5

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

MODULE - III REPORT WRITING 4

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

MODULE - IV DIVERSE WRITING SKILLS 5

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

MODULE - V CAREER COMPETENCIES 6

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

MODULE - VI LEXICAL ENHANCEMENT 4

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

TOTAL: 30 PERIODS

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TEXT BOOKS:

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

REFERENCES:

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

WEB REFERENCES:

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

ONLINE RESOURCES:

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

OUTCOMES:

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

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

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

CO-PO, PSO MAPPING:

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

SEMESTER - II

24BSPH201 - SDG NO. 4,7,9	PHYSICS OF ELECTRONIC DEVICES	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To acquaint the electrical properties of materials.
- To enlighten the basic principles of semiconductor physics.
- To acquaint the applications of semiconductor devices.
- To introduce the optical properties of materials.
- To educate the properties of magnetic and dielectric materials and their uses.
- To illustrate the properties and applications of nano devices.

MODULE - I ELECTRICAL PROPERTIES OF MATERIALS 8

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

MODULE - II SEMICONDUCTOR AND TRANSPORT PHYSICS 7

Semiconductors – Energy band diagram – direct and indirect band gap semiconductors - Intrinsic semiconductor– Carrier concentration in intrinsic

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semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Variation of carrier concentration with temperature – Carrier transport in Semiconductors:, Mobility ,Drift and Diffusion Current densities.

MODULE - III SEMICONDUCTOR SWITCHING DEVICES 8

PN Junction Diode - Construction ,Working and Characteristics - Transistor - NPN, PNP working - Early effect - Current equations - Input and Output Characteristics of CB, CE and CC configurations - JFET and its characteristics - MOSFET and its characteristics - Construction and Working of D-MOSFET - UJT, SCR - CCD and Optocoupler. IoT concept and use in industry.

MODULE - IV OPTICAL PROPERTIES OF MATERIALS 7

Classification of optical materials - optical absorption and emission process in materials - charge carrier generation and recombination - optical absorption loss and gain.– Optoelectronic devices - Solar cells – LED – OLED - Nonlinear optics- Modulators, switching devices Plasmonics (Qualitative)

MODULE - V MAGNETIC AND DIELECTRIC PROPERTIES OF MATERIALS8

Magnetism in materials - Magnetic field and induction - Magnetization - permeability and susceptibility - Types of magnetic materials - microscopic classification of magnetic materials Ferromagnetism - Domain Theory - Hysteresis phenomenon - Dielectric materials – Introduction - Types of Polarization (qualitative) - internal field - Clausius-Mossotti relation – dielectric loss - dielectric breakdown (definitions) - Dielectric constant measurement by Schering bridge method.

MODULE - VI NANO DEVICES 7

Quantum Confinement - Quantum structures - Density of states in quantum well, wires, and dots (Quantitative) - Band Gap of Nano materials - Tunnelling - Single electron phenomena - Single electron transistor - Quantum DOT lasers - Conductivity of metallic nano wires - Carbon Nano Tubes (CNT): Structures, properties and applications.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. S.O. Kasap. Principles of Electronic Materials and Devices, McGraw Hill Education (Indian Edition), 2020.
2. R.F.Pierret. Semiconductor Device Fundamentals. Pearson (Indian Edition), 2006.
3. G.W.Hanson. Fundamentals of Nanoelectronics. Pearson Education (Indian Edition), 2009.
4. Dr.P.Mani. Physics for Electronic Devices, Dhanam Publications, 2024.

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REFERENCES:

1. Laszlo Solymar, Walsh, Donald, Syms and Richard R.A., Electrical Properties of Materials, Oxford Univ. Press (Indian Edition) 2015.
2. Jasprit Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Education (Indian Edition), 2019.
3. Mark Fox, Optical Properties of Solids, Oxford Univ.Press, 2001.
4. N.Gershenfeld. The Physics of Information Technology. Cambridge University Press, 2011.

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. Apply the working principles of semiconductor devices and use IoT concepts in practical applications (K3)
4. Examine the optical processes in materials and analyze the operation of optoelectronic devices (K4)
5. Demonstrate the magnetic and dielectric properties of materials and their applications (K3)
6. Analyze quantum confinement and quantum structures, examine the working principles of quantum devices, and explore the applications of carbon nanotubes (K4)

CO-PO MAPPING:

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

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SEMESTER - II

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

OBJECTIVES:

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

MODULE - I INTRODUCTION TO ENVIRONMENTAL SCIENCE 8

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

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

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

MODULE - II ATMOSPHERIC CHEMISTRY 7

Atmospheric Chemistry - Composition and structure of atmosphere. Climate change - greenhouse effect - role of greenhouse gases (CO_2, CH_4, N_2O, CFCs) on global warming. Chemical and photochemical reactions in the atmosphere - Formation of smog, PAN, acid rain (causes, effect and control measures). Oxygen and ozone chemistry - Ozone layer depletion (causes, effect and control measures).

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MODULE - III WATER CHEMISTRY 8

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

MODULE - IV SOIL CHEMISTRY AND SOLID WASTE MANAGEMENT 7

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

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

MODULE - V ENERGY AND ENVIRONMENT 8

Energy sources – Renewable and non-renewable energy sources. Principle and generation of solar energy (solar collectors, photo-voltaic modules, solar ponds), wind energy, geothermal energy; tidal energy, OTEC energy from biomass, biofuels, Nuclear energy - fission and fusion, Nuclear fuels, Nuclear reactor – principles and types. Need for energy efficiency, Energy conservation and sustainability - action strategies for sustainable energy management from a future perspective.

MODULE - VI GREEN CHEMISTRY AND SUSTAINABILITY 7

Green Chemistry: Introduction to green chemistry, Principles of Green Chemistry (12-principles), the concept of atom economy and chemical synthesis, Important techniques used in green chemistry. Application of green chemistry, viz. replacement of ozone depleting substances including CFCs, manufacture of biodegradable polymers, use of H_2O_2 as benign bleaching agents in the paper industry.

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

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goals – 17 SDG goals.

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

TOTAL: 45 PERIODS

TEXT BOOKS:

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

REFERENCES:

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

OUTCOMES:

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

1. Develop a foundational understanding of environmental science, the interactions within ecosystems, the significance of biodiversity, and the importance of conservation strategies for maintaining ecological balance. (K3)
2. Identify the primary components of the atmosphere, explain the causes of atmospheric pollution, and propose basic strategies to promote a sustainable and clean atmosphere. (K3)
3. Demonstrate complex water quality parameters, and develop innovative methods for producing cost-effective soft water suitable for both industrial use and potable consumption. (K3)
4. Describe the composition and functions of soil components, analyze the sources and characteristics of solid wastes, and evaluate the methods and strategies for sustainable solid waste management (SWM). (K3)

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5. Explain renewable and non-renewable resources, describe various methods for harnessing energy from different sources and explain their applications in various contexts. (K3)
6. Illustrate a comprehensive understanding of green chemistry principles and their alignment with sustainable development goals, preparing them to contribute to environmentally friendly and sustainable practices in their future careers.(K3)

CO-PO MAPPING:

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

SEMESTER - II

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

OBJECTIVES:

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

அலகு-I நெசவு மற்றும் பானைத் தொழில்நுட்பம்

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

UNIT-I WEAVING AND POTTERY (CERAMIC) TECHNOLOGY 5

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

அலகு -II சங்ககாலவடிவமைப்புகள்

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள்ரூசங்க காலத்தில் வீட்டுப்பொருட்களில் வடிவமைப்பு -சங்க காலத்தில் கட்டுமான பொருட்களும்நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள்

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UNIT-II SANGAM AGE DESIGNS 5

Designing and Structural construction - House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age- Details of Stage Constructions in Silappathikaram

அலகு -III பழங்காலகட்டிடத் தொழில்நுட்பம்

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

UNIT-III ANCIENT CONSTRUCTION TECHNOLOGY 5

Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses> Indo - Saracenic architecture at Madras during British Period.

அலகு- IV உற்பத்தித் தொழில்நுட்பம்

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

UNIT-IV MANUFACTURING TECHNOLOGY 5

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

அலகு - V வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம்

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

UNIT-V AGRICULTURE AND IRRIGATION TECHNOLOGY 5

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

அலகு-VI அறிவியல்தமிழ்மற்றும்கணித்தமிழ்

அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை

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Department of Humanities & Sciences

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

OUTCOMES:

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

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

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3. பண்டைய கால கட்டிடக்கலையின்நுட்பங்கள் 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 கணித்தமிழின்வளர்ச்சியையும் அதன் கணினி பயன்பாடுகளையும் புரிந்து கொள்ளுதல்.
   To understand the development of Scientific Tamil and its applications in Tamil computing.(K3)

CO- PO, PSO MAPPING

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

SEMESTER - II

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

ARMY WING

NCC GENERAL 6

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

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

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

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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

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Board of Studies of HES dept.
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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

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.

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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.

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2. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.
3. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.

WEB REFERENCES:

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

ONLINE RESOURCES:

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

OUTCOMES:

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

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

CO-PO, PSO MAPPING:

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

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SEMESTER - II

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

PHYSICS LABORATORY (Any Five Experiments to be conducted)

OBJECTIVES:

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

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

CHEMISTRY LABORATORY (Any Five Experiments to be conducted)

OBJECTIVES:

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

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- To develop and understand the basic concepts of acidic and basic nature using pH.

Sl.No.	Name of the Experiment
1	Conductometric titration of strong acid vs strong base.
2	Determination of chloride content of water sample by Argentometric method.
3	Determination of strength of acids in a mixture of acids using conductivity meter.
4	Determination of total, temporary & permanent hardness of water by EDTA method.
5	Estimation of iron content of the given solution using potentiometer.
6	Determination of DO content of water sample by Winkler's method.
7	Determination of strength of given hydrochloric acid using pH meter.
8	Estimation of iron content of the water sample using spectrophotometer (1,10- Phenanthroline / thiocyanate method).
9	Estimation of Sodium and Potassium in the given sample of water using Flame Photometer.
10	Determination of molecular weights of polymer samples using Ostwald's Viscometer.
11	Synthesis of nano-CdS by precipitation. (Demonstration only)
12	Corrosion experiment-weight loss method.

TOTAL: 60 PERIODS

TEXT BOOKS:

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

TEXTBOOK:

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

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OUTCOMES:

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

1. Apply the principles of elasticity and thermal physics to evaluate the various modulus of elasticity and conductivity of a bad conductor. (K3)
2. Explicate the properties of semi conductors by evaluating the band gap, I-V characteristics of solar cell and Hall effect of the materials. (K3)
3. Describe multiple measurement techniques, including volumetric titrations, conductivity, pH, redox potential and optical density measurements, used to estimate the amount of substance present in a solution. (K3)
4. Apply spectroscopic techniques, viscometry, synthesize nano particles, analyze the corrosion behaviour of materials in different environments. (K3)

CO-PO MAPPING:

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

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Board of Studies of H&S dept.
Meeting No. ____ Dated: 7/6/21

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SEMESTER - II

24AIPT201 - SDG NO. 4, 9	PYTHON FOR DATA SCIENCE LABORATORY WITH THEORY	L	T	P	CP	C
		1	0	4	5	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 **10**

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 **10**

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 **10**

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

Recommended by
Board of Studies of CSE | CCE dept.
Meeting No. 7 Dated: 27/1/24

Dr. B. SREEDEVI
HEAD OF THE DEPARTMENT
COMPUTER SCIENCE AND ENGG
SRI SAIRAM INSTITUTE OF TECHNOLOGY
SAI LEO NAGAR, CHENNAI - 600 044

List of Experiments

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

MODULE - IV INTRODUCTION TO NUMPY **10**

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 **10**

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 **10**

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

Recommended by Board of Studies of CSE/CCH/AIDS dept. Meeting No. 7 Dated: 27/1/24

Dr. B. SREE... HEAD OF THE DEPART... COMPUTER SCIENCE AND ENGINEERING SRI SAIRAM INSTITUTE OF ... SAI LEO NAGAR, CHENNAI

Vectorized String Functions in pandas. Plotting with pandas: Line Plots, Bar Plots, Histograms and Density Plots, Scatter or Point Plots.

List of Experiments

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

a. Handle missing data by detecting and dropping/ filling missing values.

b. Transform data using apply () and map() method

c. Detect and filter outliers.

d. Perform Vectorized String operations on Pandas Series.

e. Visualize data using Line Plots, Bar Plots, Histograms, Density Plots and Scatter Plots.

TOTAL: 60 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 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. Use Python built-in data types and their methods to solve basic data science problems and demonstrate the need for data-driven approaches. (K3)
2. Develop an application with user-defined modules and packages using OOP concept (K3)

Recommended by
Board of Studies of CSE/CCE/IT dept.
Meeting No. 3 Dated: 21/1/24

3. Apply knowledge of data acquisition, cleaning, and transformation in practical tasks. (K3)
4. Use NumPy arrays to perform data manipulation tasks such as slicing, indexing, and reshaping.(K3)
5. Apply powerful data manipulations using Pandas. (K3)
6. Implement data preprocessing and visualization using Pandas.(K3)

CO-PO, PSO MAPPING:

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

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HEAD OF THE DEPARTMENT
COMPUTER SCIENCE AND ENGINEERING

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 7

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

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

Standardization –Basic Concepts:

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

Standards Formulation Process and Challenges:

Objectives, roles and functions of BIS; Bureau of Indian Standards Act, ISO / IEC Directives

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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	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	3	-	2	-	-
CO2	-	-	-	-	-	-	-	-	3	-	2	-	-
CO3	-	-	-	-	-	-	-	3	2	-	2	-	-

SEMESTER - II

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

OBJECTIVES:

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

- To Provide awareness on Printed Circuit Board (PCB) design using ORCAD software.
- To Raise awareness of at least three Internet of Things (IoT) projects and their applications.

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- 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

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- 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. JohnJ.Craig ,Introduction to Robotics Mechanics and Control, Third edition, Pearson Education, 2009.

WEB REFERENCES

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

OUTCOMES:

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

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

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CO-PO, PSO MAPPING:

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

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SEMESTER - III

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

OBJECTIVES:

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

MODULE - I BASIC STATISTICS 9

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

MODULE - II TESTS OF SIGNIFICANCE FOR LARGE SAMPLES 9

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

MODULE - III TESTS OF SIGNIFICANCE FOR SMALL SAMPLES 9

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

MODULE - IV VECTOR SPACES 9

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

MODULE - V LINEAR TRANSFORMATION AND DIAGONALIZATION 12

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

MODULE - VI INNER PRODUCT SPACES 12

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

TOTAL : 45 PERIODS

TEXT BOOKS:

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

Recommended by Board of Studies of H&S dept. Meeting No. ____ Dated: 7/6/24

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

REFERENCES:

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

WEB REFERENCES:

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

ONLINE RESOURCES:

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

COURSE OUTCOMES

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

1. Compute measures of central tendency, dispersion, moments, skewness, kurtosis, correlation, regression, and rank correlation for given data sets using appropriate statistical methods. (K3)
2. 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)

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6. Apply the Gram-Schmidt orthogonalization process to construct an orthonormal basis from a given set of vectors and solve least squares approximation problems. (K3)

CO – PO, PSO MAPPING:

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

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SEMESTER - III

24ECPC301 108104100 SDG NO. 3, 4, 11	SIGNALS AND SYSTEMS	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To apply the fundamental concepts and properties of signal & systems.
- To examine the continuous-time signals in the frequency domain using the Fourier transform and the Laplace transform.
- To characterize continuous-time linear time-invariant systems in the time domain and frequency domain.
- To examine the discrete-time signals in the frequency domain using the Fourier transform and Z transform.
- To characterize discrete-time linear time-invariant systems in the time domain and the frequency domain.
- To realize the real-time signals and systems.

MODULE - I CLASSIFICATION OF SIGNALS AND SYSTEMS 8

Standard signals - step, ramp, pulse, impulse, real and complex exponentials and sinusoids, representation of continuous and discrete time signals, Classification of signals – Continuous-time (CT) and Discrete-Time (DT)

Recommended by
Board of Studies of ECE dept.
Meeting No. _____ Dated: _____

Dr. G. THAMARAI SELVI
Professor & Head of The Department
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Chennai - 600 044.

signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals, Classification of systems - CT systems and DT systems, Linear & Non-linear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable.

MODULE - II FREQUENCY TRANSFORMATION OF CONTINUOUS-TIME SIGNALS 7

Fourier Transform of continuous-time aperiodic signals and periodic signals - properties of continuous-time Fourier transform - Laplace Transforms and properties.

MODULE - III LINEAR TIME INVARIANT CONTINUOUS-TIME SYSTEMS 8

Impulse response - Convolution Integrals, Properties of continuous-time linear time-invariant system, Differential Equation - Causal continuous time linear time-invariant system described by differential equations - Analysis of continuous-time systems using Fourier and Laplace transforms.

MODULE - IV FREQUENCY TRANSFORMATION OF DISCRETE-TIME SIGNALS 7

Baseband signal sampling, Fourier Transform of discrete-time signals – Properties of discrete-time Fourier transform - Z Transform & Properties.

MODULE - V LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS 8

Impulse response – Convolution Sum Properties of discrete-time LTI system, Difference equations - Causal discrete-time LTI system described by differential equations - Analysis of discrete-time systems using Discrete time Fourier Transform and Z Transform.

MODULE - VI REALIZATION OF SIGNALS AND SYSTEMS 7

Interconnection of CT and DT systems connected in series and parallel. Recursive & Non-Recursive systems. Structural Realization of continuous time and discrete time systems- Direct Form I, Direct form II, Cascade and parallel - Case Study: Acquisition and analysis of real-time signals.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, "Signals and Systems", Pearson, 2015.
2. Haykin, S. & Van Veen, B. (2007). Signals and systems. John Wiley & Sons.

Recommended by Board of Studies of ECE dept. Meeting No. _____ Dated: _____

Dr. S. THAMARAI SELVI Professor & Head of the Department Department of Electronics & Communication Engg. Sri Sai Ram Institute of Technology Chennai - 600 044.

REFERENCES:

1. B. P. Lathi, "Principles of Linear Systems and Signals", Second Edition, Oxford, 2009.
2. R. E. Zeimer, W. H. Tranter and R.D.Fannin, "Signals & Systems - Continuous and Discrete", Pearson, 2007.
3. John Alan Stuller, "An Introduction to Signals and Systems", Thomson, 2007.

WEB RESOURCES:

1. https://www.tutorialspoint.com/signals_and_systems/index.htm
2. https://www.khanacademy.org/science/electrical-engineering/signals-and-systems
3. https://www.geeksforgeeks.org/signals-and-systems/

ONLINE RESOURCES:

1. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/lecture-notes/
2. https://onlinecourses.nptel.ac.in/noc20_ee15/preview
3. https://onlinecourses.nptel.ac.in/noc21_ee28/preview

OUTCOMES

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

1. Examine the continuous and discrete time signals to classify as periodic & aperiodic signals, deterministic & random signals, energy & power signals, and determine the linearity, time-invariance, causality and stability of a system. (K3)
2. Apply the Fourier and Laplace transforms to continuous-time signals and characterize the properties of these transforms in signal analysis. (K3)
3. Analyse the continuous time signals in the time and frequency domain and obtain the response of the system. (K4)
4. Apply the Fourier and Z transforms to discrete-time signals and characterize the properties of these transforms in signal analysis. (K3)
5. Analyse the discrete-time signals in the time and frequency domain and obtain the response of the system. (K4)
6. Realize the systems using direct form I, direct form II, cascade, parallel and analyze the real-time signals to identify the signal behavior using signal processing techniques. (K4)

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Head of The Department
Dept. of Electronics & Communication Engg.
Sri Sai Ram Institute of Technology
Chennai - 600 044.

CO – PO, PSO MAPPING:

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

SEMESTER - III

24COPC301 - SDG NO. 4, 9	DIGITAL DESIGN AND COMPUTER ORGANIZATION	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- Understand the principles of number systems, Boolean algebra, and logic simplification techniques.
- Design and analyze combinational and sequential digital circuits.
- Explore the structure and function of a basic computer system from a hardware design perspective.
- Understand instruction set architecture and the functioning of processor components.

MODULE - I NUMBER SYSTEMS & BOOLEAN ALGEBRA 6

Number Systems and Base Conversions - Signed and Unsigned Numbers – 1's and 2's Complements - Boolean Algebra – Basic Theorems and Properties - Logic Gates – Truth Tables - Simplification using Karnaugh Maps (K-Map)

MODULE - II COMBINATIONAL LOGIC DESIGN 8

Arithmetic Circuits – Half/Full Adders, Subtractors - Multiplexers, Demultiplexers - Encoders, Decoders - Code Converters – BCD, Excess-3, Gray Code

MODULE - III SEQUENTIAL LOGIC DESIGN 8

Flip-Flops – SR, D, JK, T - Counters – Synchronous and Asynchronous - Shift Registers - Sequential Circuit Analysis and Design

Recommended by Board of Studies of _____ dept. Meeting No. _____ Dated: _____

Dr. G. THAMARAISELVI Head of the Department Dept. of Electronics & Communication Engg. Sri Sai Ram Institute of Technology Chennai - 600 044.

Dr. R. SREEDEVI HEAD OF THE DEPARTMENT COMPUTER SCIENCE AND ENGG SRI SAIRAM INSTITUTE OF TECHNOLOGY SAI LEO NAGAR, CHENNAI

MODULE - IV BASIC COMPUTER ORGANIZATION 8

Introduction to Computer Architecture - Instruction Formats, Addressing Modes - ALU Design, Register File, Instruction Cycle - Micro-Operations and Control Signals - Hardwired and Microprogrammed Control Units

MODULE - V MEMORY AND I/O ORGANIZATION 7

Memory Classification and Hierarchy - Cache Memory – Mapping Techniques - Virtual Memory, Paging - I/O Techniques – Programmed I/O, Interrupts, DMA

MODULE - VI PIPELINING AND PERFORMANCE ENHANCEMENT 8

Basic Concepts of Pipelining - Data Hazards, Control Hazards, and Solutions - Instruction-Level Parallelism - RISC vs. CISC - Introduction to Multi-core and GPU Architectures

TOTAL : 45 PERIODS

TEXT BOOKS:

1. David Harris & Sarah Harris, Digital Design and Computer Architecture, Morgan Kaufmann, 2nd or 3rd Edition.

REFERENCE BOOKS:

1. M. Morris Mano & Michael D. Ciletti, Digital Design, Pearson Education, 5th Edition.
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer Organization and Embedded Systems, McGraw Hill, 6th Edition.
3. William Stallings, Computer Organization and Architecture, Pearson, 10th Edition.

WEB REFERENCE:

1. https://nptel.ac.in/courses/117105135
2. http://nptel.ac.in/courses/108105132
3. https://nptel.ac.in/courses/106102062
4. https://nptel.ac.in/courses/117106086

OUTCOMES

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

1. Apply Boolean algebra and logic simplification techniques to design basic combinational circuits. (K3)
2. Analyze the design of combinational logic systems such as adders, encoders, decoders and multiplexers. (K4)

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3. Apply the concepts of flip-flops to design and implement sequential circuits like counters and shift registers. (K3)
4. Analyze the structure of a basic computer organization including ALU, control unit, and registers. (K4)
5. Apply instruction execution cycle, addressing modes, and memory mapping concepts in CPU design. (K3)
6. Analyze the effects of pipelining and memory hierarchy on processor performance. (K4)

CO – PO, PSO MAPPING:

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

SEMESTER - III

24COPC302 - SDG NO. 4, 9	ALGORITHMS AND DATA STRUCTURES	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To critically analyze the efficiency of algorithmic, sorting, searching, and hashing techniques.
- To design and apply linear data structures like lists, stacks, and queues in real-world applications.
- To design and implement tree-based data structures and algorithms.
- To apply graph-based algorithms to solve complex problems.
- To implement algorithmic problem-solving paradigms: Greedy, Dynamic Programming, and Backtracking.
- To explore computational complexity and limitations of algorithms through NP-Completeness concepts.

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COMPUTER SCIENCE AND ENGINEERING
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MODULE - I INTRODUCTION TO ALGORITHMS 9

Introduction to Algorithms - Asymptotic Notations - Time Complexity -Space Complexity- recursion – analyzing recursive algorithms. Searching Algorithms: Linear Search, Divide and Conquer Methodology -Binary Search,Merge Sort and Quicksort- Sorting Algorithms: Bubble Sort, Selection Sort, Insertion Sort-hashing – hash functions – collision handling

MODULE - II LINEAR DATA STRUCTURES- STACKS, QUEUES, AND LINKED LISTS 9

List ADT – array-based implementations – linked list implementations – singly linked lists – circularly linked lists – doubly linked lists – applications of lists (Polynomial Representation, Memory Management)– Stack ADT : Operations - Applications (Expression Evaluation, Infix to Postfix Conversion) . Queue ADT : Operations - Circular Queue

MODULE - III TREES AND TREE-BASED ALGORITHMS 8

Binary Trees: Traversals (In-order, Pre-order, Post-order) - Binary Search Trees:- Operations - AVL Trees, Red-Black Trees - Heaps: Min-Heap, Max-Heap, Priority Queue

MODULE - IV GRAPHS AND GRAPH ALGORITHMS 7

Graph Representation: Adjacency Matrix, Adjacency List- Graph Traversal: Breadth-First Search (BFS), Depth-First Search (DFS)- Shortest Path Algorithms: Dijkstra's, Bellman-Ford- Minimum Spanning Tree: Kruskal's and Prim's Algorithm

MODULE - V ALGORITHM DESIGN TECHNIQUES 6

Backtracking: n-Queens problem,Branch and Bound: Solving 15-Puzzle problem - Knapsack Problem - Travelling Salesman Problem, Dynamic Programming: Matrix-Chain Multiplication – Elements of Dynamic Programming – Longest Common Subsequence- Greedy Algorithms: – Elements of the Greedy Strategy- Huffman Coding.

MODULE - VI NP COMPLETE AND NP HARD 6

NP-Completeness: Polynomial Time – Polynomial-Time Verification – NP-Completeness and Reducibility – NP-Completeness Proofs – NP-Complete Problems

TOTAL : 45 PERIODS

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Board of Studies of _____ dept.

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COMPUTER SCIENCE AND ENGINEERING
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TEXT BOOKS:

1. Alfred V. Aho, "Data Structures and Algorithms", Bell Laboratories, Murray Hill, New Jersey,2013.
2. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, Computer Algorithms/ C++, Second Edition, Universities Press, 2019.
3. Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser, —Data Structures & Algorithms in Python, John Wiley & Sons Inc., 2021.
4. Anany Levitin, "Introduction to design and analysis of algorithms",3rd Edition,Pearson Education,2017.

REFERENCES:

1. Sara Baase and Allen Van Gelder, Computer Algorithms – Introduction to Design & Analysis, Third Edition, Pearson Education, New Delhi, 2000.
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, Data Structures and Algorithms, Pearson Education, Reprint 2006.
3. "Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein (CLRS)
4. "Data Structures and Algorithm Analysis in C" by Mark Allen Weiss

WEB REFERENCES:

1. https://www.geeksforgeeks.org/c-language-set-1-introduction/
2. https://www.codechef.com/certification/data-structures-and-algorithms/prepare
3. https://www.w3schools.in/data-structures-tutorial/intro/
4. https://www.coursera.org/specializations/data-structures-algorithms
5. https://www.topcoder.com/community/competitive-programming/tutorials

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/106102064
2. https://www.w3schools.in/data-structures-tutorial/
3. https://www.tutorialspoint.com/data_structures_algorithms/

OUTCOMES

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

1. Analyze and implement basic algorithms and data structures for solving problems. (K4)
2. Design and implement linear data structures (arrays, linked lists, stacks, queues) and apply them to relevant applications. (K3)
3. Implement and perform operations on tree-based structures. (K4)

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4. Apply graph traversal and path-finding algorithms to solve problems using graphs (K3)
5. Apply design strategies like Dynamic Programming, Greedy, Backtracking and Branch & Bound to solve optimization problems.(K4)
6. Apply the concepts of algorithmic complexity classes (P, NP, NP-Complete) to classify problems and identify NP-Complete problems through appropriate reductions. (K3)

CO – PO, PSO MAPPING:

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

SEMESTER - III

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

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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

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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 ofresources and role of technology etc.

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

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

MODULE - VI UNIVERSAL HUMAN ORDER (4+3)

25. Programs to ensure Sanyam and Health
26. Case studies of typical holistic technologies, management models and production systems

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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.

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)

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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)

CO – PO, PSO MAPPING:

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

SEMESTER - III

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

ARMY WING

PERSONALITY DEVELOPMENT 9

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

PD 5 Public Speaking 3

LEADERSHIP 7

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

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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

ARMED FORCES 6

AF 1	Armed Forces, Army, CAPF, Police	6

ADVENTURE 1

AD 1	Introduction to Adventure Activities	1

BORDER & COASTAL AREAS **2**

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

TOTAL: 45 PERIODS

NAVAL WING

PERSONALITY DEVELOPMENT **9**

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

LEADERSHIP 7

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

DISASTER MANAGEMENT **13**

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

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ENVIRONMENTAL AWARENESS & CONSERVATION 3

EA 1 Environmental Awareness and Conservation 3

GENERAL AWARENESS 4

GA 1 General Knowledge 4

NAVAL ORIENTATION 6

AF 1 Armed Forces and Navy Capsule 3

EEZ 1 EEZ Maritime Security and ICG 3

ADVENTURE 1

AD 1 Introduction to Adventure Activities 1

BORDER & COASTAL AREAS 2

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

TOTAL: 45 PERIODS

AIR FORCE WING

PERSONALITY DEVELOPMENT 9

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

PD 5 Public Speaking 3

LEADERSHIP 7

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

DISASTER MANAGEMENT 13

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

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

DM 3 Fire Service & Fire Fighting 1

ENVIRONMENTAL AWARENESS & CONSERVATION 3

EA 1 Environmental Awareness and Conservation 3

GENERAL AWARENESS 4

GA 1 General Knowledge 4

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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 Actitivities	1
BORDER & COASTAL AREAS		**2**
BCA 1	History, Geography & Topography of Border/Coastal areas	2

TOTAL : 45 PERIODS

SEMESTER - III

24COPL301 - SDG NO. 3, 4, 11	DIGITAL CIRCUITS LABORATORY	L	T	P	CP	C
		0	0	4	4	2

OBJECTIVES:

- To implement and verify the basic logic gates and Boolean expressions.
- To design and analyze combinational logic circuits such as adders, multiplexers, and decoders.
- To construct and test sequential circuits like flip-flops, counters, and shift registers.
- To simulate and verify digital circuits using HDL tools like Verilog or VHDL.

LIST OF EXPERIMENTS

S. No **Experiment Title**

1. Verification of basic logic gates and realization of Boolean expressions using logic gates
2. Implementation of Boolean functions using universal gates
3. Simplification and implementation of Boolean expressions using Karnaugh Maps (K-Map)
4. Design and implementation of Half Adder and Full Adder using logic gates
5. Design and implementation of 4-bit binary adder/subtractor using ICs
6. Design and implementation of multiplexers and demultiplexers
7. Design and implementation of encoders and decoders
8. Design and implementation of 4-bit magnitude comparator

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9. Implementation of flip-flops – SR, D, JK, T using logic gates
10. Design of shift registers (Serial-In Serial-Out, Serial-In Parallel-Out)
11. Design and implementation of asynchronous and synchronous counters
12. Design of sequence detector using Mealy and Moore machines
13. Implementation of digital circuits using Verilog HDL: gates, multiplexers, adders
14. Implementation of flip-flops and counters using Verilog HDL

OUTCOMES

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

1. Design and realize basic logic gates and Boolean expressions using hardware and simulation tools. (K4)
2. Design and simulate combinational circuits like adders, subtractors, multiplexers, and decoders using digital ICs. (K4)
3. Implement and test sequential circuits such as flip-flops, counters, and shift registers using standard logic ICs. (K5)
4. Design and evaluate synchronous and asynchronous sequential circuits for given specifications. (K5)
5. Develop and simulate logic circuits using HDL tools (e.g., VHDL/Verilog) for combinational and sequential logic. (K6)
6. Evaluate the performance of digital circuits through timing analysis and identify potential hazards or glitches. (K5)

CO – PO, PSO MAPPING:

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

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SEMESTER - III

24COPL302 - SDG NO. 4, 9	ALGORITHMS AND DATA STRUCTURES LABORATORY	L	T	P	CP	C
		0	0	4	4	2

OBJECTIVES:

- To implement fundamental data structures like linked lists, stacks, queues, trees, and graphs
- Implement and Manage Basic Data Structures
- Analyze and Implement Searching and Sorting Algorithms
- Implement and Manipulate Tree-based Data Structures
- Implement Graph Algorithms and Solve Graph Problems
- Solve Optimization Problems Using Dynamic Programming, Greedy Algorithms, and Backtracking

LIST OF PROGRAMS

1. Analyze and implement a recursive algorithm (like factorial or Fibonacci)
2. Implementation of searching and sorting algorithms
3. Implement Merge Sort using recursion. (Divide and Conquer).
4. Implement Array and Linked list implementation of List ADT
5. Implement Array and Linked list implementation of Stack ADT
6. Implement Array and Linked list implementation of Queue ADT
7. Implement Applications of List, Stack and Queue ADTs.
8. Implementation of Binary trees and operations of Binary trees.
9. Implementation of Binary Search Trees
10. Implementation of AVL Trees
11. Represent graphs using adjacency matrix/list; implement DFS and BFS.
12. Implement Dijkstra's algorithms.
13. Solve N-Queens Problem using backtracking
14. Implement the 0/1 Knapsack Problem using the Greedy technique
15. Simulate Branch and Bound for 15-puzzle

TOTAL: 45 PERIODS

HARDWARE

Standalone desktops 30 Nos

SOFTWARE

C / C++ / Python /Turbo C / Equivalent Software

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OUTCOMES

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

1. Analyze and implement basic algorithms and data structures for solving problems.(K3)
2. Implement linear data structures such as stacks, queues using arrays and linked lists. (K3)
3. Develop and perform operations on Binary Trees, Binary Search Trees, and AVL Trees to demonstrate understanding of hierarchical data structures. (K6)
4. Implement graph algorithms and solve various graph-related problems including traversal, pathfinding, and shortest path(K4)
5. Solve optimization problems using dynamic programming, greedy algorithms, and backtracking techniques(K3)
6. Simulate and solve optimization problems using Greedy (e.g., 0/1 Knapsack) and Branch & Bound techniques (e.g., 15-Puzzle), demonstrating efficient problem-solving strategies. (K6)

CO – PO, PSO MAPPING:

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

SEMESTER - III

24COTP301 - 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.

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MODULE - I QUANTITATIVE ABILITY 22

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

MODULE - II QUANTITATIVE ABILITY REASONING ABILITY 16

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

MODULE - III VERBAL ABILITY 7

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

TOTAL: 45 PERIODS

REFERENCES:

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

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

OBJECTIVES:

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

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

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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 - IIIELECTROMAGNETIC 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: 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://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]

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5. Interpret language nuances in diversified situations and exhibit scouting spirits amidst communities. [K2]
6. Explain the basic principle of BIS Standards relevant to EMC and EMI. [K2]

CO – PO, PSO MAPPING:

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

SEMESTER - III

24COID301 - 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.

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- 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

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OUTCOMES:

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

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

CO – PO, PSO MAPPING:

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

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SEMESTER - IV

24BSMA401 - SDG NO. 4	PROBABILITY THEORY AND RANDOM PROCESSES	L	T	P	CP	C
		3	1	0	4	4

OBJECTIVES:

- To understand and obtain the knowledge of Random variables.
- To provide understanding of standard discrete and continuous distributions.
- To familiarize the students with the concepts of covariance, correlation and regression.
- To impart the knowledge of classification of random processes, properties of Markov, Poisson processes.
- To understand and gain the knowledge of spectral densities.
- To acquaint the students with the concepts of linear random input and output.

MODULE I RANDOM VARIABLES 9

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

MODULE II STANDARD DISTRIBUTIONS 12

Binomial, Poisson, Geometric, Uniform, Exponential and Normal Distributions - Functions of Random variables.

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 9

Classification – Stationary process – Markov process - Markov chain - Poisson process.

MODULE - V CORRELATION AND SPECTRAL DENSITIES 9

Auto correlation functions – Cross correlation functions – Properties – Power spectral density – Cross spectral density – Properties.

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MODULE - VI LINEAR SYSTEMS WITH RANDOM INPUTS 9

Linear time invariant system – System transfer function – Linear systems with random inputs – Auto correlation and cross correlation functions of input and output.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Fundamentals of Applied Probability and Random Processes, Ibe O.C., 1st Indian Reprint, Elsevier, 2007. Module I (Sections 1.3,1.7) Module II Chapter-2, Chapter-3 (Sections 3.1 - 3.5), Chapter-4 (Sections 4.1 -4.8, 4.10 & 4.11), Chapter 6 (sec 6.2); Module III Chapter 5 (Sections 5.1 - 5.7), Chapter 6 (6.8 & 6.10); Module IV Chapter-8 (8.1 - 8.6, 10.5 - 10.5.4, 10.5.5, 10.5.6, 10.6, 10.7); Module V Chapter 10 (Section 10.2, 10.4, 10.5 (10.5.1 - 10.5.6), 10.6, 10.7); Module VI Chapter 9 (Sections 9.1 - 9.3).
2. Probability and Random Processes With Applications to Signal Processing and Communications, Scott Miller & Donald Childers, 2nd edition, Elsevier Science, 2004.

REFERENCES:

1. Probability, Random Variables and Random Signal Principles, Peebles P. Z., 4th Edition, Tata Mc Graw Hill, New Delhi, 2002.
2. Probability and Statistics, Random Processes and Queueing theory, Veerarajan T., 3rd edition, Tata Mc-Graw Hill Education Pvt. Ltd., New Delhi, 2018.
3. Probability, Random Variables and Stochastic Processes, Athanasios Papoulis and S. Unnikrishna Pillai, PHI, 4th Edition, 2002.
4. Probability and Random Processes for Scientists and Engineers, Davenport, 1st edition, McGraw-Hill, 1970.
5. Probability, Random Processes and Estimations Theory for Engineers, H. Stark & J.W. Woods, 2nd edition, Prentice Hall, 1994.
6. Introduction to Random Processes, E. Wong, 1st edition, Springer Verlag, 1983.
7. Introduction to Random Processes, W. A. Gardner, 2nd edition, McGraw Hill, 1990.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc19_ma30/preview
2. https://nptel.ac.in/courses/111102111/
3. https://archive.nptel.ac.in/courses/111/103/111103158/
4. https://archive.nptel.ac.in/courses/111/102/111102014/
5. https://www.ee.iitb.ac.in/~bsraj/courses/ee325/

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ONLINE RESOURCES:

1. https://freevideolectures.com/course/2324/probability-and-random-processes
2. http://www.nptelvideos.com/course.php?id=572
3. https://archive.nptel.ac.in/courses/117/105/117105085

COURSE OUTCOMES:

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

1. Apply the concepts of probability and random variables to solve engineering problems involving uncertainty.(K3)
2. Analyze and interpret the characteristics of standard discrete and continuous probability distributions for practical applications. (K4)
3. Apply the concepts of joint, marginal, and conditional distributions to analyze relationships between random variables, and interpret correlation and regression.(K3)
4. Classify the different types of random processes (stationary, Markov, Poisson) and apply them to real-world systems. (K3)
5. Examine correlation functions and spectral density measures to understand the frequency-domain behaviour of random signals.(K4)
6. Analyse the response of linear systems to random inputs using autocorrelation, cross-correlation, and system transfer functions.(K4)

CO – PO, PSO MAPPING:

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

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Meeting No. _____ Dated: _____

SEMESTER - IV

24ECPC402 - SDG NO. 4,8,9	ANALOG AND DIGITAL COMMUNICATION	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- To introduce Amplitude Modulation Schemes
- To impart knowledge in Angle modulation methods.
- To impart knowledge in Demodulation techniques
- To introduce the importance of Sampling & Quantization
- To compare the performance of Digital modulation techniques.
- To familiarize the concept of Information theory and Coding techniques

Pre-Requisites: Basic tools for communication, Fourier Series/Transform, and Properties. Autocorrelation, Energy Spectral Density, Parseval's Relation

MODULE - I AMPLITUDE MODULATION 9

Elements of Communication systems – Need for Modulation - Amplitude Modulation- DSBSC, DSBFC, SSB, ISB, VSB - Modulation index, Spectra, Power relations and Bandwidth of AM – AM Generation – Square law and Switching modulator, DSBSC Generation – Balanced and Ring Modulator, SSB Generation – Filter, Phase Shift, VSB Generation – Filter Method. Comparison of different AM techniques.

MODULE - II ANGLE MODULATION 7

Phase and frequency modulation, Narrow Band and Wide band FM – Modulation index, Spectra, Power relations and Transmission Bandwidth of FM – PM to FM Conversion – and FM to PM Conversion – FM Generation: Direct and Indirect methods.

MODULE - III ANALOG DEMODULATORS 7

AM Demodulators: Envelope Detector, Coherent Detection of DSB – SC, SSB – SC – Costas Receiver – Frequency Translation - Super Heterodyne Receiver. FM Demodulation – FM to AM conversion, FM Discriminator – Balanced Slope Detector, Foster Seeley Discriminator, Ratio Detector.

MODULE - IV SAMPLING AND QUANTIZATION 6

Introduction to Sampling, Spectrum of Sampled Signal, Aliasing, Nyquist Criterion, Signal Reconstruction from Sampled Signal, Quantization, Uniform Quantizers – Mid rise and Midtread, Quantization noise, Lloyd Max Quantization Algorithm, Non uniform Quantizers.

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MODULE - V DIGITAL MODULATION SCHEMES **10**

PAM, PTM – Line coding – PCM, DPCM, DM & ADM Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase shift keying – BPSK, QPSK, 8 PSK, QAM-8 QAM, 16 QAM – Comparison of various digital communication systems, Inter Symbol Interference – Eye pattern.

MODULE - VI INFORMATION THEORY AND SOURCE CODING TECHNIQUES **6**

Measure of information, entropy, Channel capacity and Shannon's theorems; Source Coding Techniques - Shannon Fano coding and Huffman Coding.

TOTAL : 45 PERIODS

REFERENCES:

1. S.Haykin, "Digital Communications", John Wiley, 2005
2. J.G.Proakis, M.Salehi, "Fundamentals of Communication Systems", Pearson Education, 2014
3. Simon Haykin, "Communication Systems", Fourth Edition, Wiley, 2014.
4. B. Sklar, "Digital Communication Fundamentals and Applications", Second Edition,Pearson Education, 2009
5. B.P.Lathi, "Modern Digital and Analog Communication Systems", Third Edition, Oxford University Press, 2007
6. H P Hsu, "Schaum Outline Series – Analog and Digital Communications",Tata McGraw Hill Company, 2006
7. Proakis, J.G., Salehi, M., "Digital Communications", 5th 2008 Ed.,McGraw-Hill International
8. Roden, M.S., "Analog and Digital Communication Systems", 5th 2005 Ed., Discovery Press.
9. Couch II, L.W., "Modern Communication Systems: Principles and Applications", Prentice-Hall 1998
10. Couch II, L.W., "Digital and Analog Communication Systems", 7th 2009 Ed.,Pearson
11. Carlson, A.B., Crilly, P.B. and Rutledge, J.C., "Communication Systems: An Introduction to Signals and Noise in Electrical Communication", 4th 2002 Ed., McGraw-Hill

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc20_ee16/preview
2. https://nptel.ac.in/courses/117102059/
3. https://onlinecourses.nptel.ac.in/noc25_ee68/preview

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ONLINE RESOURCES

1. https://freevideolectures.com/course/2590/introduction-to-communication-theory

OUTCOMES

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

1. Analyze the Performance of various Amplitude Modulation Schemes for specific applications.(K4)
2. Estimate the performance metrics of Angular Modulation schemes correlating FM and PM.(K4)
3. Illustrate the concept of Heterodyning in the AM and FM receivers.(K4)
4. Evaluate the conditions for perfect reconstruction of signal in sampling process and minimum quantization error using Lloyd Max Quantization Algorithm.(K4)
5. Interpret the digital transmission using Pulse Modulation and Shift Keying Variants.(K3)
6. Estimate the impact of Source and Channel coding schemes on efficiency of transmission in digital communication.(K4)

CO – PO, PSO MAPPING:

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

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SEMESTER - IV

24ITPW401 - 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 DEAD LOCK 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

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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: 15

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

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REFERENCES:

1. Ramez Elmasri, A. Gil Carrick, David Levine, "Operating Systems – A Spiral Approach", Tata McGraw Hill Edition, 2010.
2. AchyutS.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-tooperating-systems

OUTCOMES:

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

1. Articulate the basic concepts and functions of the operating system. (K3)
2. Apply process management and CPU scheduling techniques to solve problems. (K3)
3. Experiment deadlock concepts and prevention strategies(K4)
4. Examine memory management problems and segmentation. (K4)
5. Interpret the functionality of file systems 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
CO1	3	2	-	2	-	-	-	-	-	-	-	2	-
CO2	3	3	3	2	-	-	-	-	-	-	-	2	-
CO3	3	3	2	2	-	-	-	-	-	-	-	2	-
CO4	3	3	3	3	-	-	-	-	-	-	-	-	2
CO5	3	2	-	2	-	-	-	-	-	-	-	-	2
CO6	3	3	3	3	-	-	-	-	-	-	-	-	2

SEMESTER - IV

24COPC401 - SDG NO. 4, 8	DATABASE SYSTEMS	L	T	P	CP	C
		3	0	0	3	3

OBJECTIVES:

- Understand fundamental concepts of database systems and data models.
- Design and develop relational databases using ER diagrams and normalization techniques.
- Write and optimize SQL queries for database manipulation and retrieval.
- Understand transaction management, concurrency control, and recovery techniques.
- Learn about database architectures, indexing, and emerging database technologies.

MODULE - I INTRODUCTION TO DATABASES SYSTEMS 6

Database System Applications - Purpose of Database Systems – Comparison with File Systems - View of Data – Data Abstraction – Instances and Schemas - Database Languages – DDL – DML – DCL - Database Users – System Structure- DBMS architecture -Data models: Hierarchical, Network, Relational- Object Oriented.

MODULE - II ER MODEL AND RELATIONAL MODEL 7

Entity Sets - Attributes - Relationships - Mapping Cardinality - Participation Constraints - Keys - ER Model – Generalization – Specialization –

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Aggregation - ER Diagram Notations – Design Principles- Mapping ER Model to Relational Model Relational algebra: select, project, union, set difference, Cartesian product, join, rename

MODULE - III SQL AND QUERY PROCESSING **10**

Basics of SQL: DDL, DML, DCL commands- Constraints: Domain - Key. Referential - SQL Operators : IN, LIKE, BETWEEN, EXISTS - Joins, Subqueries, Nested Queries, Aggregation, Views- Functions, Triggers, Stored Procedures- Query Processing – Query Evaluation-Integration of SQL with procedural programming (PL/SQL basics)

MODULE - IV DATABASE DESIGN AND NORMALIZATION **8**

Functional Dependency - Normal Forms – 1NF – 2NF – 3NF – BCNF- Decomposition – Lossless Join – Dependency Preservation- Use Case – Normalization for Sensor Data Storage

MODULE - V TRANSACTION MANAGEMENT AND CONCURRENCY CONTROL **7**

Transactions: ACID properties- Serializability: Conflict & View - Concurrency control: locking protocols, deadlocks- Transaction recovery: log-based recovery, checkpoints

MODULE - VI STORAGE, INDEXING, AND EMERGING TECHNOLOGIES **7**

File Organization – Heap – Sequential – Hashed - Indexing Techniques – Single-level Index – Multi-level Index – B+ Tree - Basics of RAID - NoSQL Databases – Need – Advantages Types of NoSQL – Key-Value – Document – Column-family – Graph - Case Study – NoSQL in Messaging – Social Media Platforms

TOTAL : 45 PERIODS

TEXT BOOKS:

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

REFERENCES:

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

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WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc19_cs46/
2. http://www.nptelvideos.in/2012/11/database-management-system.html
3. https://www.classcentral.com/course/swayam-database-management-system-9914
4. http://learnsql.com
5. https://www.w3schools.com/sql/default.asp
6. https://www.khanacademy.org/computing/computer-programming/sql
7. https://www.w3schools.com/sql
8. https://www.geeksforgeeks.org/dbms/
9. https://www.tutorialspoint.com/dbms/index.htm
10. https://www.mongodb.com/docs/manual/

OUTCOMES

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

1. Analyze the fundamental concepts of database systems, architectures, and data models, and apply them to real-world scenarios. (K3)
2. Develop Entity-Relationship (ER) diagrams and translate them into relational schemas. (K3)
3. Construct SQL queries for data definition, manipulation, and transaction control. (K3)
4. Utilize normalization techniques and functional dependency analysis to enhance database design efficiency. (K4)
5. Evaluate and implement transaction management, concurrency control, and recovery strategies. (K4)
6. Evaluate and compare the strengths and limitations of relational databases and NoSQL systems, and select the appropriate database model for modern application requirements. (K3)

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CO – PO, PSO MAPPING:

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

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

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MH 3	Study of Battles - Indo Pak War 1965, 1971 & Kargil	9
MH 4	War Movies	6

TOTAL: 45 PERIODS

NAVAL WING

PERSONALITY DEVELOPMENT **9**

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

LEADERSHIP 7

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

DISASTER MANAGEMENT **13**

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

ENVIRONMENTAL AWARENESS & CONSERVATION **3**

EA 1 Environmental Awareness and Conservation 3

GENERAL AWARENESS **4**

GA 1	General Knowledge	4

NAVAL ORIENTATION 6

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

ADVENTURE 1

AD 1	Introduction to Adventure Activities	1

BORDER & COASTAL AREAS **2**

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

TOTAL: 45 PERIODS

Recommended by

Board of Studies of _____ dept.

Meeting No. _____ Dated: _____

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

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SEMESTER - IV

24ECPL401 - SDG NO. 4 & 9	COMMUNICATION SYSTEMS LABORATORY	L	T	P	CP	C
		0	0	4	4	2

OBJECTIVES:

- To visualize the effects of sampling and TDM
- To implement AM & FM modulation and demodulation
- To implement PCM & DM
- To simulate Digital Modulation schemes
- To simulate Error control coding schemes

LIST OF EXPERIMENTS:

1. Signal Sampling and Reconstruction.
2. Time Division Multiplexing.
3. AM Modulator and Demodulator.
4. FM Modulator and Demodulator.
5. Pulse Code Modulation and Demodulation.
6. Delta Modulation and Demodulation.
7. Line coding schemes.
8. Simulation of ASK, FSK and BPSK generation schemes.
9. Simulation of QPSK and QAM generation schemes.
10. Simulation of signal constellations of BPSK, QPSK and QAM.
11. Simulation of ASK, FSK and BPSK detection schemes.
12. Simulation of Linear Block and Cyclic error control coding schemes.
13. Simulation of Convolutional coding scheme.

TOTAL: 45 PERIODS

LAB REQUIREMENTS FOR A BATCH OF 30 STUDENTS / 3 STUDENTS PER EXPERIMENT

1. Kits for Signal Sampling, TDM, AM, FM, PCM, DM and Line Coding Schemes.
2. CROs / DSOs – 15Nos.
3. Function Generators – 15 Nos.
4. MATLAB or equivalent software package for simulation experiments
5. PCs - 15 Nos.

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OUTCOMES:

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

1. Perform signal sampling and multiplexing schemes for baseband signals and reconstruct the signals.(K3)
2. Construct, test and simulate the Analog and Digital modulation and demodulation circuits.(K3)
3. Generate various line coding schemes using PCM and DM techniques and implement channel coding schemes.(K3)

CO – PO, PSO MAPPING:

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

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SEMESTER - IV

24COPL401 - SDG NO. 4	DATABASE SYSTEMS LABORATORY	L	T	P	CP	C
		0	0	4	4	2

OBJECTIVES:

- To provide hands-on experience in designing and implementing relational databases.
- To develop skills in writing SQL queries for data manipulation and retrieval.
- To implement concepts like normalization, indexing, transactions, and stored procedures.
- To understand NoSQL databases and basic data modeling.

LIST OF EXPERIMENTS

1. Implement DDL and DML operations (CREATE, INSERT, UPDATE, DELETE)
2. Write SQL queries using WHERE, ORDER BY, BETWEEN, IN, LIKE clauses
3. Implement different types of joins (INNER, OUTER, LEFT, RIGHT, SELF JOIN).
4. Use aggregate functions (COUNT, SUM, AVG, MAX, MIN) with GROUP BY and HAVING clauses.

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5. Design an ER diagram and convert it to a relational schema. Implement the schema in SQL.
6. Apply normalization (up to 3NF) to a given dataset with redundant data
7. Create and manipulate views; demonstrate the use of indexes for query optimization
8. Simulate transactions and demonstrate ACID properties
9. Demonstrate concurrency using lock-based mechanisms (via SQL scripts)
10. Create and execute PL/SQL procedures, functions, and triggers
11. Case study: Design a database schema for a real-world application (e.g., library, hospital, e-commerce)
12. Compare relational and NoSQL models: Implement a small use case in both (e.g., student management)
13. Mini-project: Design and implement a complete database for a real-world application (e.g., Library, e-Shop).

TOOLS REQUIRED

- MySQL / PostgreSQL / SQLite
- MongoDB
- DBMS client tools (MySQL Workbench, pgAdmin)
- Command line / GUI-based query execution environment

TOTAL: 45 PERIODS

OUTCOMES

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

1. Design and implement efficient data manipulation and definition operations to model and manage real-world databases, ensuring data integrity and consistency. (K4)
2. Formulate complex queries involving multiple clauses for comprehensive data extraction, filtering, and aggregation, and optimize query performance. (K4)
3. Create detailed ER models and translate them into normalized relational schemas, then implement the schemas using SQL to ensure data integrity and efficient access.(K4)
4. Evaluate and apply normalization techniques up to 3NF to eliminate redundancy, reduce anomalies, and optimize database design for improved data integrity. (K5)
5. Develop and manage views and indexes for improved query performance, and optimize databases for scalability and efficiency through advanced indexing and query tuning techniques. (K5)

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6. implement use cases in both relational and NoSQL models (K3)

CO – PO, PSO MAPPING:

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

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

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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.

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MODULE - III EXCEPTION HANDLING AND I/O 8

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

LIST OF EXPERIMENTS

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

MODULE - IV MULTI-THREADING AND GENERIC PROGRAMING 7

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

LIST OF EXPERIMENTS

1. Write a Java Program to calculate the sum of the array using 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 7

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

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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.

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

WEB REFERENCES:

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

OUTCOMES

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

1. Implement Object-Oriented Programming concepts in Java to develop solutions using packages and inheritance.(K3)
2. Construct Java applications using exceptions, I/O streams, multithreading, and generic classes.(K3)
3. 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
CO1	-	-	3	-	-	-	-	2	-	-	-	3	3
CO2	3	-	-	-	-	-	-		2	-	-	3	3
CO3	-	-	-	3	-	-	-	2	-	-	-	3	3

SEMESTER - IV

24COTP401 - SDG NO. 4	APTITUDE SKILLS - II	L	T	P	CP	C
		0	0	2	2	0

PROBLEM SOLVING TECHNIQUES USING C PROGRAMMING – PHASE 1

OBJECTIVES:

- Build a strong foundation in C programming concepts and problem-solving techniques.
- Develop the ability to write efficient and modular code.
- Enhance understanding of data structures, memory management, and algorithms for optimized solutions.

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MODULE - I FOUNDATIONS OF PROGRAMMING 12

- Understanding Programming Languages: Why they are essential and their various types.
- Operators in C: Exploring assignment, arithmetic, relational, and logical operators.
- Tokens and Identifiers: Learning about keywords, naming conventions, and best practices.
- Control Structures in C: Choosing the right structure for efficient programming:
- Selective Control (Decision-making statements)
- Iterative Control (Loops for repetition)
- Unconditional Control (Jump statements)

MODULE - II DATA TYPES, NUMBER SYSTEMS, AND FUNCTIONS 12

- Operators in Depth: Understanding increment, decrement, and short-circuit operators.
- Number Systems & Conversions: Mastering different number systems, conversions, and format specifiers.
- Data Types in C: Exploring signed and unsigned types (int, float, char) and their usage.
- Functions in C:
- Importance of modular programming.
- Writing and using functions effectively.

MODULE - III POINTERS, ARRAYS, AND PROBLEM-SOLVING 21

- Pointers in C:
- Understanding memory management.
- How pointers enable direct hardware communication.
- Arrays in C:
- Efficiently storing multiple elements.
- Single-dimensional and multi-dimensional arrays.
- Problem-Solving Techniques:
- Tackling challenges related to arrays and strings.
- Optimizing algorithms for efficiency.

TOTAL: 45 PERIODS

REFERENCES:

1. Let Us C – Yashavant Kanetkar
2. Programming in ANSI C – E. Balagurusamy

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3. The C Programming Language – Brian W. Kernighan and Dennis M. Ritchie
4. C: How to Program – Paul Deitel and Harvey Deitel
5. Problem Solving and Program Design in C – Jeri R. Hanly and Elliot B. Koffman

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

OBJECTIVES:

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

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

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

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

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

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

MODULE - II RANGER AND ROVER 10

Scouting for Boys: Scout Craft, Campaigning.

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

Growing Together: Understanding the growth context.

Intergenerational Dialogue: How to enhance learning and cooperation across generations.

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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. Understand and apply the fundamentals of C programming for problem-solving. (K2)
2. Utilize control structures, operators, and functions to write modular programs. (K2)
3. Implement pointers and arrays for efficient memory and data management. (K2)
4. Solve real-world problems by designing and optimizing algorithms. (K2)
5. Demonstrate career and managerial skills. (K2)
6. Understand BIS standards for Information security and AI domain. (K2)

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CO – PO, PSO MAPPING:

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

SEMESTER - IV

24COID401 - 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.

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

EVALUATION:

1. First evaluation (Immediately after first internal examination): 20 marks (Focus on refined problem statement, advanced MVP design, and detailed development plan)
2. Second evaluation (Immediately after second internal examination): 30 marks (Focus on prototype/MVP implementation, initial testing, and preliminary market validation results)
3. Final evaluation (Last week of the semester): 50 marks (Focus on the complete refined solution, comprehensive market validation, growth strategy, final project report, and viva-voce)

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

TOTAL: 45 PERIODS

OUTCOMES:

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

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

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3. Integrate multidisciplinary knowledge, field data, and emerging technologies to optimize and validate engineered solutions. (K6)

CO – PO, PSO MAPPING:

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

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SEMESTER V

COURSE CODE: 24COPW501	DATA COMMUNICATION NETWORKS WITH LABORATORY	L	T	P	CP	C
		3	0	2	5	4
NPTEL CODE: 106106003	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24COPC302, 24ECPC402					

OBJECTIVES:

- To understand data communication fundamentals and layered architectures
- To analyze transmission techniques and network protocols
- To design and evaluate network layers and services
- To gain hands-on experience using networking tools and simulators
- To implement basic network configurations and analyze performance

MODULE - I INTRODUCTION TO DATA COMMUNICATION 7

Data Communications: Components – Direction of Data flow – Networks – Components and Categories – Types of Connections – Topologies –Protocols and Standards – ISO / OSI model, Example Networks such as ATM, Frame Relay, ISDN

MODULE - II PHYSICAL LAYER & TRANSMISSION 8

Analog and Digital Signals – Transmission Impairments – Line Coding – Digital Transmission – Multiplexing (FDM, TDM) – Switching Techniques: Circuit, Packet Switching – Transmission Media (Guided & Wireless)

MODULE - III DATA LINK LAYER 8

Error Detection & Correction – Flow Control – Stop-and-Wait, Sliding Window – ARQ Protocols – HDLC – MAC Protocols – Ethernet – Wireless LAN

MODULE - IV NETWORK LAYER 7

IPv4 and IPv6 Addressing – Subnetting – Routing Algorithms – Distance Vector & Link State – IP, ICMP – Routing Protocols-Routing — Unicast Routing — Algorithms — Protocols — Multicast Routing and its basics — Overview of Intradomain and interdomain protocols — Overview of IPv6 Addressing — Transition from IPv4 to Ipv6

Recommended in Board of Studies (BoS) Meeting No. 10 **held on** 10.6.26

MODULE - V TRANSPORT LAYER **7**

Process to Process Delivery, UDP and TCP protocols, Data Traffic, Congestion, Congestion Control, QoS, Integrated Services, Differentiated Services, QoS in Switched Networks.

MODULE - VI APPLICATION LAYER & SECURITY **8**

Introduction, Web and HTTP, Web Caching, DNS, Email: SMTP, MIME, POP3, Webmail, FTP, TELNET, DHCP, SNMP . Security in the Internet: IPSec, SSUFLS, PGP, VPN, and Firewalls.

LIST OF EXPERIMENTS **15**

1. Study of Network Devices, Cables, and Network Utilities
2. Configuration of IP Addressing and Subnetting
3. Implementation of CRC Error Detection
4. Implementation of Hamming Code
5. Implementation of Stop-and-Wait ARQ Protocol
6. Implementation of Sliding Window Protocol
7. Implementation of TCP Client–Server Communication
8. Implementation of UDP Client–Server Communication
9. Implementation of Distance Vector Routing Algorithm
10. Implementation of Link State Routing Algorithm
11. Simulation of Routing Protocols and VLAN Configuration using Packet Tracer
12. Analysis of Network Traffic and Application Layer Services

TOTAL : 60 PERIODS

Software Tool Required

- Cisco Packet Tracer
- Wireshark
- Python / JDK

HARDWARE REQUIREMENT

Desktop Computers with LAN Enabled – 30 Nos.

TEXT BOOK:

1. Computer Networking A Top-Down Approach – Kurose James F, Keith W, 6th Edition, Pearson.

Recommended in Board of Studies (BoS) Meeting No. 10 **held on** 10.6.26

2. Data Communications and Networking by Behrouz A. Forouzan, 5th Edition, McGraw-Hill Education, 2013.
3. Computer Networks by Andrew S. Tanenbaum, 5th Edition, Pearson Education, 2011.

REFERENCE BOOKS

1. William Stallings, Data and Computer Communications
2. Kurose & Ross, Computer Networking: A Top-Down Approach
3. Data communication and Networks - Bhusan Trivedi, Oxford university press, 2016
4. Computer Networks -- Andrew S Tanenbaum, 4th Edition, Pearson Education
5. Understanding Communications and Networks, 3rd Edition, W. A. Shay, Cengage Learning.

WEB RESOURCES / ONLINE COURSES:

1. https://nptel.ac.in/courses/106105081
2. https://www.netacad.com/courses/networking-basics?courseLang=en-US
3. https://people.cs.clemson.edu/~jmarty/courses/kurose/KuroseCh1-2.pdf
4. http://eti2506.elimu.net/Introduction/Books/Data Communications and Networking By Behrouz A.Forouzan.pdf
5. http://intronetworks.cs.luc.edu/current/ComputerNetworks.pdf
6. https://www.tutorialspoint.com/data_communication_computer_network/data_communicati on_computer_network_tutorial.pdf

OUTCOMES

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

1. Apply data communication concepts and layered models to analyze networks.(K3)
2. Apply transmission and switching techniques for efficient communication.(K3)
3. Analyze data link layer protocols and error control mechanisms.(K4)
4. Analyze routing and addressing techniques in the network layer.(K4)
5. Apply transport layer protocols and analyze congestion control.(K4)
6. Analyze application layer protocols, basic network configurations, and security concepts (K4)

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CO - PO, PSO MAPPING:

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

SEMESTER V

COURSE CODE: 24HSMG501	PRINCIPLES OF ENGINEERING MANAGEMENT	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4,8,9,10,12				
PRE-REQUISITE COURSES	-					

OBJECTIVES:

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

MODULE - I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS **8**

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

Recommended in Board of Studies (BoS) Meeting No. 10 held on 10.6.26

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MODULE - II PLANNING **8**

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

MODULE - III ORGANISING **8**

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

MODULE - IV DIRECTING AND CONTROLLING **7**

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

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

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

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

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

TOTAL : 45 PERIODS

TEXTBOOKS:

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

Recommended in Board of Studies (BoS) Meeting No. 10 **held on** 10.6.26

REFERENCES:

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

WEB RESOURCES:

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

ONLINE RESOURCES:

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

OUTCOMES:

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

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

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

CO - PO, PSO MAPPING:

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

SEMESTER V

COURSE CODE: 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.

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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. 10 **held on** 10.6.26

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REFERENCE BOOKS:

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

ONLINE REFERENCES

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

MOOC REFERENCES

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

OUTCOMES:

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

1. Explain the historical evolution, philosophy and fundamental principles of the Constitution of India. (K2)

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

CO - PO, PSO MAPPING:

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

SEMESTER V

COURSE CODE: 24COPT501	MICROPROCESSORS, MICROCONTROLLERS, AND EMBEDDED SYSTEMS LABORATORY WITH THEORY	L	T	P	CP	C
		0	0	4	4	2
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24COPC301					

OBJECTIVES:

- To understand the architecture, instruction set, and programming of the 8086 microprocessor.
- To understand the architecture, instruction set, and programming concepts of the 8051 microcontroller.

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- To develop assembly language programs using 8086 and 8051 for arithmetic, logical, string manipulation, sorting, and searching applications.
- To learn memory and I/O interfacing techniques and interface peripherals such as stepper motors, traffic light controllers, ADCs, and DACs.
- To understand the architecture and peripheral interfacing of ARM processors and develop basic embedded applications using embedded C.
- To design and implement sensor-based embedded systems by integrating multiple peripherals and applying real-time system concepts.

MODULE - I 8086 MICROPROCESSOR **10**

Introduction to 8086 Microprocessor-Features of 8086 - Basic Functional Block of 8086-Pin Diagram of 8086-Architecture of 8086- Instruction Set and Addressing modes of 8086.

LIST OF EXPERIMENTS:

1. Basic arithmetic and Logical operation using 8086.
2. String manipulations using 8086.
3. Sorting and Searching using 8086.
4. Decimal arithmetic operations using 8086.

MODULE - II 8051 MICROCONTROLLER **10**

Introduction to 8051 Microcontroller- Features of 8051-pin diagram of 8051-Architecture of 8051- Instruction Set and Addressing modes of 8051.

LIST OF EXPERIMENTS:

1. Basic arithmetic and Logical operation using 8051
2. Square and Cube of a number using 8051.
3. To find 2's complement of a number using 8051.

MODULE - III PROGRAMMING 8051 **10**

Special Function Registers (SFR) -Timers – Handling timers-Interrupts-I/O ports.

LIST OF EXPERIMENTS:

1. Timer programming using 8051 Configure and use timers to generate delays or measure time intervals using keilμvision
2. Programming I/O ports to generate square wave using keilμvision.

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MODULE - IV I/O INTERFACING **10**

Memory Interfacing and I/O interfacing - Parallel communication interface – Serial communication interface- Interfacing stepper motor, traffic light controller, ADC & DAC.

LIST OF EXPERIMENTS:

1. Traffic light control system using 8086
2. Stepper motor control system using 8086

MODULE - V ARM PROCESSOR AND PERIPHERALS **10**

ARM Architecture Versions – ARM Architecture – Instruction Set – Stacks and Subroutines – Features of the LPC214X Family – Peripherals- Block Diagram of ARM9 and ARM Cortex M3MCU.

LIST OF EXPERIMENTS:

1. LED Interface using ARM.
2. LCD Interface using ARM.

MODULE - VI INTRODUCTION TO EMBEDDED SYSTEM DESIGN AND REAL TIME SYSTEMS **10**

Embedded system design process –Design example: Model train controller- Design methodologies- Design flows- Structure of a Real Time System- Task assignment and scheduling.

LIST OF EXPERIMENTS:

1. Sensor-Based Application : Interface a temperature sensor, ADC and DAC to create a basic monitoring system
2. Mini Project: Design a simple embedded system integrating multiple peripherals.

TOTAL : 60 PERIODS

Lab requirement for batch of 30 students / 2 student per experiment

S.No	Equipment	Quantity
1	8086 Microprocessor Trainer Kits	15
2	8051 Microcontroller Trainer Kits	15
3	ADC and DAC Interface kit	5
4	Stepper Motor Interface Boards with stepper motor	5
5	Traffic Light Interface kit	5
6	LED Interface kit	5
7	LCD Interface kit	5

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		Syllabus / CCE
8	ARM 7 trainer kit	15
9	Temperature sensor LM35	15
10	Standalone desktop PC with MASM, Keil µVision, Flash magic and UART driver software installed	15

TEXT BOOKS:

1. Yu-Cheng Liu, Glenn A.Gibson, "Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and Design", 2nd Edition, Prentice Hall of India, 2007.
2. Mohamed Ali Mazidi, Janice GillispieMazidi, RolinMcKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C",2nd Edition, Pearson education, 2011.
3. Marilyn Wolf, "Computers as Components - Principles of Embedded Computing System Design", 3rd Edition, Morgan Kaufmann Publisher (An imprint from Elsevier), 2012.
4. Jane W.S.Liu, "Real Time Systems", Pearson Education, Third Indian Reprint, 2003.

REFERENCES:

1. Douglas V.Hall, "Microprocessors and Interfacing, Programming and Hardware",TMH, 2012.
2. A.K.Ray,K.M.Bhurchandi, "Advanced Microprocessors and Peripherals", 3rd Edition, Tata McGraw Hill, 2012.
3. Lyla B.Das, "Embedded Systems: An Integrated Approach", Pearson Education, 2013.
4. C.M.Krishna, Kang G.Shin, "Real-Time Systems", International Editions, McGraw Hill, 1997.

WEB REFERENCES:

1. https://swayam.gov.in/nd1_noc20_ee42/preview
2. https://nptel.ac.in/courses/108105102/

ONLINE RESOURCES:

1. https://freevideolectures.com/course/3018/microprocessors-and-microcontrollers
2. http://www.satishkashyap.com/2012/02/video-lectures-on- micro processors-and.html

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OUTCOMES:

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

1. Apply the concepts of 8086 microprocessor, 8051 microcontroller and ARM processor architecture to develop basic embedded system applications. (K3)
2. Utilize the instruction sets, addressing modes, SFRs, timers, interrupts and I/O ports of 8086 and 8051 to design assembly language programs for data processing and control applications. (K3)
3. Analyze the memory and I/O interfacing techniques of peripherals such as stepper motors, traffic light controllers, ADCs and DACs, and explain the embedded system design process with basic real-time system concepts. (K4)
4. Develop arithmetic, logical, string manipulation, sorting, searching and decimal arithmetic programs using 8086 and 8051 micro processors/microcontrollers on trainer kits. (K3)
5. Investigate traffic light controller, stepper motor, LED and LCD interfacing applications using 8086 and ARM processors, and implement timer-based control applications using the 8051 microcontroller. (K4)
6. Examine sensor-based embedded applications by integrating temperature sensors, ADCs, DACs and multiple peripherals, and evaluate the performance of simple embedded systems through mini projects using embedded system design methodologies. (K4)

CO - PO, PSO MAPPING:

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

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Syllabus / CCE

SEMESTER V

COURSE CODE: 24COTP501	SKILL ENHANCEMENT	L	T	P	CP	C
		0	0	2	2	1
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	-					

APTITUDE & COGNITIVE SKILLS – PHASE 1

OBJECTIVES:

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

MODULE - I QUANTITATIVE ABILITY **22**

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

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

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

MODULE - III VERBAL ABILITY **7**

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

TOTAL : 45 PERIODS

REFERENCES

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

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

OBJECTIVES

To enable students to,

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

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

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

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

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

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

Scouting for Boys: Camp Life, Trekking Wood Craft.

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

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

Messengers of Peace and Scouts

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

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

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

TOTAL :30 PERIODS

REFERENCES:

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

ONLINE RESOURCES

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

OUTCOMES

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

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

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CO - PO - PSO MAPPING

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

SEMESTER V

COURSE CODE: 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.
- To develop proficiency in problem analysis, feasibility assessment, requirement engineering, and prototype implementation.
- To instill a foundation of innovation and entrepreneurship by integrating ethical design principles, sustainability values, and responsible technology development.
- To enable data-driven solution development through literature survey, user feedback analysis, and technology exploration.
- To facilitate multidisciplinary problem-solving through engineering design, prototype realization, testing, validation, and technical communication.

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COURSE METHODOLOGY

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

EVALUATION

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

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

TOTAL : 30 PERIODS

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OUTCOMES:

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

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

CO - PO, PSO MAPPING:

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

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Syllabus / CCE

PROFESSIONAL ELECTIVES - I

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

OBJECTIVES:

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

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

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

MODULE - II EXPLORATORY DATA ANALYSIS AND UNIVARIATE VISUALIZATION 8

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

MODULE - III UNIVARIATE ANALYSIS AND MEASURES OF DATA DISTRIBUTION 7

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

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MODULE - IV STATISTICAL MEASURES OF DISPERSION AND DATA TRANSFORMATION 8

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

MODULE - V ASSOCIATION ANALYSIS AND CORRELATION OF VARIABLES 7

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

MODULE - VI MULTIVARIATE DATA ANALYSIS AND REGRESSION TECHNIQUES 8

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

TOTAL : 45 PERIODS

TEXT BOOKS:

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

REFERENCES

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

WEB REFERENCES

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

ONLINE REFERENCES

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

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OUTCOMES:

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

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

CO - PO, PSO MAPPING:

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

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PROFESSIONAL ELECTIVES - I

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

OBJECTIVES:

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

MODULE - I INTRODUCTION TO ARTIFICIAL INTELLIGENCE 7

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

MODULE - II PROBLEM SOLVING AND SEARCH TECHNIQUES 8

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

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MODULE - III KNOWLEDGE REPRESENTATION AND REASONING 8

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

MODULE - IV MACHINE LEARNING FOUNDATIONS 8

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

MODULE - V NEURAL NETWORKS AND DEEP LEARNING 7

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

MODULE - VI ETHICS AND AI APPLICATIONS 7

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

TOTAL : 45 PERIODS

TEXT BOOKS:

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

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

REFERENCES:

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

WEB REFERENCES:

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

ONLINE RESOURCES:

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

OUTCOMES:

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

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

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

CO - PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVES - I

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

OBJECTIVES:

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

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MODULE - I FOUNDATIONS OF HCI **8**

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

MODULE - II INTERACTION DESIGN PROCESS **8**

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

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

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

MODULE - IV PROTOTYPING AND IMPLEMENTATION **7**

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

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MODULE - V EVALUATION TECHNIQUES 7

Goals and types of evaluation — formative vs summative. Expert-based evaluation methods — heuristic evaluation, cognitive walkthrough, pluralistic walkthrough. User-based evaluation methods — usability testing, think-aloud protocol, A/B testing, eye-tracking studies. Quantitative metrics — task completion time, error rate, success rate, System Usability Scale (SUS), Net Promoter Score (NPS). Qualitative analysis — affinity diagrams, thematic analysis. Remote vs lab-based testing. Use of analytics and heatmaps. Ethics in user research and informed consent.

MODULE - VI ADVANCED TOPICS AND EMERGING INTERFACES 7

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

TOTAL : 45 PERIODS

TEXT BOOKS:

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

REFERENCES

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

WEB REFERENCES:

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

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

ONLINE RESOURCES:

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

OUTCOMES:

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

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

CO - PO, PSO MAPPING:

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

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PROFESSIONAL ELECTIVES - I

COURSE CODE: 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

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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

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OUTCOMES:

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

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

CO - PO, PSO MAPPING:

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

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Syllabus / CCE

PROFESSIONAL ELECTIVES - I

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

OBJECTIVES:

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

MODULE - I INTRODUCTION TO DATA ANALYTICS 7

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

MODULE - II PYTHON PROGRAMMING BASICS 7

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

MODULE - III DATA HANDLING USING PANDAS 8

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

MODULE - IV EXPLORATORY DATA ANALYSIS 7

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

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MODULE - V DATA VISUALIZATION 8

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

MODULE - VI STATISTICAL ANALYSIS AND APPLICATIONS 8

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

TOTAL : 45 PERIODS

TEXT BOOKS:

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

REFERENCES

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

WEB REFERENCES

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

ONLINE RESOURCES

1. https://www.youtube.com/playlist?list=PLZoTAELRMXVNUL99R4bDlVtR5Xl4cY1M
2. https://www.youtube.com/playlist?list=PL-osiE80TeTsqhIuOqKhwlXsIBIdSeYtc

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3. https://www.youtube.com/playlist?list=PL9ooVrP1hQOEDSc5QEbIhJWl2PyaO8R1n

OUTCOMES:

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

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

CO - PO, PSO MAPPING:

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

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PROFESSIONAL ELECTIVES - I

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

OBJECTIVES:

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

MODULE - I UNDERSTANDING BIG DATA AND ITS APPLICATIONS 8

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

MODULE – II FUNDAMENTALS OF HADOOP 8

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

MODULE - III MAP REDUCE FRAMEWORK 8

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

MODULE - IV HADOOP ECOSYSTEM AND TOOLS 7

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

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

MODULE - V INTRODUCTION TO SPARK PROGRAMMING 7

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

MODULE - VI GPU COMPUTING AND CUDA FOR BIG DATA 7

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

TOTAL : 45 PERIODS

TEXT BOOKS:

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

REFERENCES

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

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

WEB REFERENCES

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

ONLINE RESOURCES

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

OUTCOMES:

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

1. Utilize Big Data concepts, characteristics, and technologies to address data-intensive applications across various domains. (K3)
2. Implement Hadoop architecture, HDFS, and data ingestion tools for efficient storage and management of large-scale data. (K3)
3. Execute MapReduce applications using Hadoop and YARN for distributed data processing. (K3)
4. Analyze the use of Pig, Hive, and HBase in managing and processing Big Data workloads. (K4)
5. Analyze Spark components and develop scalable data processing applications using Spark frameworks. (K4)
6. Analyze CUDA-based GPU computing techniques and evaluate their integration with Spark for high-performance Big Data analytics. (K4)

CO - PO, PSO MAPPING:

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

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PROFESSIONAL ELECTIVES - I

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

OBJECTIVES:

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

MODULE - I OUTPUT PRIMITIVES 7

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

MODULE - II 2D GRAPHICS 7

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

MODULE - III 3D GRAPHICS 7

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

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MODULE - IV ILLUMINATION, COLOR MODELS AND ANIMATION 8

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

MODULE - V MULTIMEDIA SYSTEMS DESIGN AND FILE HANDLING 8

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

MODULE - VI HYPERMEDIA 6

Multimedia Authoring and User Interface - Hypermedia Messaging -Mobile Messaging – Hypermedia Message Component – Creating Hypermedia Message – Integrated Multimedia Message Standards – Integrated Document Management – Distributed Multimedia Systems - Case Study: Blender Graphics -Blender Fundamentals–Drawing Basic Shapes – Modelling-Shading & Textures

TOTAL : 45 PERIODS

BOOKS AND REFERENCES:

1. Donald Hearn and Pauline Baker M, "Computer Graphics", Prentice Hall, New Delhi,2007
2. Andleigh, P. K and KiranThakrar, "Multimedia Systems and Design", PHI, 2003

REFERENCES:

1. Judith Jeffcoate, "Multimedia in practice: Technology and Applications", PHI, 1998.
2. Foley, Vandam, Feiner and Hughes, "Computer Graphics: Principles and Practice", 2nd Edition, Pearson Education, 2003.
3. Jeffrey McConnell, "Computer Graphics: Theory into Practice", Jones and Bartlett Publishers,2006.
4. Hill F S Jr., "Computer Graphics", Maxwell Macmillan , 1990.

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5. Peter Shirley, Michael Ashikhmin, Michael Gleicher, Stephen R Marschner, Erik Reinhard, KelvinSung, and AK Peters, "Fundamentals of Computer Graphics", CRC Press, 2010.
6. William M. Newman and Robert F.Sproull, "Principles of Interactive Computer Graphics", McGraw Hill 1978.

ONLINE RESOURCES:

1. https://www.blender.org/support/tutorials
2. http://www.doc.ic.ac.uk/~dfg/graphics/graphics.html
3. http://www.nptelvideos.in/2012/11/computer-graphics.html
4. http://cs.wellesley.edu/~cs110/lectures/M01-color/graphics.pdf
5. www.scratchapixel.com
6. http://dl.finebook.ir/book/9e/11032.pdf
7. https://www.blender.org/support/tutorials
8. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-837-computer-graphics-fall-2012/download-course-materials

OUTCOMES:

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

1. Implement output primitives and drawing algorithms to create basic graphical objects with attributes. (K3)
2. Perform 2D transformations, viewing and clipping techniques using matrix representations. (K3)
3. Illustrate 3D transformations, projections and visible surface detection methods for object representation. (K3)
4. Utilize illumination models, color models and animation techniques for realistic graphics. (K3)
5. Apply multimedia system design concepts including architecture, databases and file handling techniques. (K3)
6. Construct hypermedia applications and create basic 3D scenes using Blender. (K3)

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CO - PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVES - I

COURSE CODE: 24ITEL511	GRAPH THEORY	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106105847	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24BSMA402, 24BSMA301					

OBJECTIVES:

- Enable learners to apply graph theory concepts to solve real-world and computational problems.
- To introduce fundamental concepts of graph theory, including vertices, edges, paths, and connectivity.
- To utilize graph theory to model and solve practical problems in logistics, biology, and computer science.
- To apply algorithms for finding shortest paths, spanning trees, and network flow.

MODULE - I FUNDAMENTALS OF GRAPHS **8**

Introduction to graphs - Basic properties of graphs - Definition and types of graphs (simple, multigraph, directed, weighted) - Graph representation (adjacency matrix, adjacency list) - Degree of vertices, Handshaking Lemma -Sub graphs and induced graphs - Complete and bi-partite graphs - Isomorphism of graphs.

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MODULE - II PATHS AND CONNECTIVITY 7

Paths and circuits - Walks, paths, trails, circuits - Connected and disconnected graphs - Open and closed walks - Simple paths and cycles - Length of a path - Components of a graph - Cut vertices and bridges - Circuits and cycles in graphs - Directed and undirected cycles - Detection of cycles in graphs.

MODULE - III EULER AND HAMILTONIAN GRAPHS 7

Euler paths and circuits (Fleury's Algorithm) - Hamiltonian paths and cycles - Necessary and sufficient conditions - Eulerian Graphs - Hamiltonian cycles - Matrix representation of graphs - Chordal graphs - Weighted graphs.

MODULE - IV TREES AND SPANNING TREES 9

Definition and properties of trees - Spanning trees and minimal spanning trees - Algorithms: Prim's and Kruskal's - Independence sets and covering in graphs - Minimum Spanning Trees (MST) - Concept of weighted graphs - Definition and significance of MST Applications (network design, cost minimization)- Algorithms for MST - Prim's Algorithm- Greedy approach - Step-by-step construction - Implementation logic..

MODULE - V GRAPH COLORING AND PLANARITY 7

Vertex coloring and chromatic number - Applications of graph coloring (scheduling, map coloring) - Planar graphs and Euler's formula – Cut Vertices and Cut edges - Edge connectivity - Vertex Colouring of graphs - Edge Colouring of graphs - The four-colour and five-colour theorems..

MODULE - VI APPLICATIONS OF GRAPH THEORY 7

Perfect graphs – applications of graph in switching theory –Directed graphs or (Digraphs) - Shortest path algorithms (Dijkstra's Algorithm) Network flows (basic idea) - Applications in computer science, transportation, and social networks.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. R. Balakrishnan & K. Ranganathan, "A Textbook of Graph Theory", 2012, (Springer edition).
2. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice-Hall, 2017.
3. Douglas B. West, "Introduction to Graph Theory",2nd Edition, 2001.

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REFERENCES:

1. R. Balakrishnan, K. Ranganathan, "A Textbook of Graph Theory", 1st Edition, Volume 1, 2012.
2. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall, 2017
3. Douglas B. West, "Introduction to Graph Theory", 2nd Edition, Prentice Hall,2001.
4. Frank Harary, "Graph Theory", 1st Edition, Addison-Wesley,1969.
5. Jonathan L. Gross, Jay Yellen, Ping Zhang , "Handbook of Graph Theory", 2nd Edition, Volume 1, CRC Press, 2014.
6. J.A. Bondy, U.S.R. Murty, "Graph Theory–Graduate Texts in Mathematics", Springer, 2008.
7. Alan Gibbons, "Algorithmic Graph Theory", 1st Edition,Cambridge University Press, 1985.

ONLINE RESOURCES:

1. https://www.geeksforgeeks.org/dsa/graph-data-structure-and-algorithms/
2. https://www.geeksforgeeks.org/dsa/eulerian-path-and-circuit/
3. https://www.geeksforgeeks.org/quizzes/minimum-spanning-tree/
4. https://www.geeksforgeeks.org/dsa/graph-coloring-applications/
5. ONLINE REFERENCES:
6. https://www.getyoureducation.net/course/advanced-graph-theory
7. https://www.coursera.org/learn/graphs?utm_source=chatgpt.com
8. https://www.mygreatlearning.com/academy/learn-for-free/courses/introduction-to-graph-theory
9. https://nptel.ac.in/courses/111106050
10. https://nptel.ac.in/courses/111107058
11. https://ocw.mit.edu/courses/18-225-graph-theory-and-additive-combinatorics-fall-2023/

OUTCOMES:

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

1. Apply graph representations and basic properties to model problems (K3)
2. Analyze connectivity and solve problems involving paths and circuits (K3)

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3. Apply Euler and Hamiltonian concepts to real-world problems (K3)
4. Construct and optimize spanning trees using standard algorithms (K3)
5. Apply graph coloring and planarity concepts in practical scenarios (K3)
6. Use graph algorithms to solve real-world applications (K3)

CO - PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVES - I

COURSE CODE: 24ITEL502	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.

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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.

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

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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.

ONLINE RESOURCES:

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

OUTCOMES:

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

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

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CO - PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVES - I

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

OBJECTIVES:

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

MODULE - I COHERENT AND NON-COHERENT COMMUNICATION 8

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

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COMPUTER AND COMMUNICATION ENGINEERING

MODULE - II CODING FOR DIGITAL COMMUNICATION - I 7

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

MODULE - III CODING FOR DIGITAL COMMUNICATION - II 7

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

MODULE - IV MULTICARRIER COMMUNICATIONS 8

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

MODULE - V MULTIPLE ACCESS COMMUNICATION SYSTEM AND ARCHITECTURE 8

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

MODULE - VI SYNCHRONIZATION TECHNIQUES 7

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

TOTAL : 45 PERIODS

TEXT BOOK

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

REFERENCES:

1. M.K.Simon, S.M.Hinedi and W.C.Lindsey, "Digital communication techniques; Signal Design and Detection", Prentice Hall of India, New Delhi, 1995.
2. Richard Van Nee & Ramjee Prasad, "OFDM for Multimedia Communications" Artech House Publication, 2001.

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COMPUTER AND COMMUNICATION ENGINEERING

3. Simon Haykin, "Digital communications", John Wiley and sons, 1998.
4. Stephen G. Wilson, "Digital Modulation and Coding", First Indian Reprint, Pearson Education, 2003.
5. Theodore S.Rappaport, 'Wireless Communications", 2nd edition, Pearson Education, 2002.

WEB REFERENCES

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

OUTCOMES:

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

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

CO - PO, PSO MAPPING:

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

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COMPUTER AND COMMUNICATION ENGINEERING

PROFESSIONAL ELECTIVES - I

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

OBJECTIVES:

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

MODULE - I OVERVIEW OF INTERNET OF THINGS 7

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

MODULE - II INDUSTRY 4.0 BASICS 7

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

MODULE - III ARCHITECTURE OF INDUSTRIAL INTERNET OF THINGS 8

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

MODULE - IV TECHNOLOGIES OF INDUSTRIAL INTERNET OF THINGS 8

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

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MODULE - V INDUSTRIAL DATA TRANSMISSION, ACQUISITION AND ANALYTICS **8**

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

MODULE - VI APPLICATIONS AND CASE STUDIES **7**

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

TOTAL : 45 PERIODS

BOOKS AND REFERENCES:

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

OUTCOMES:

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

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

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CO - PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVES - I

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

OBJECTIVES:

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

MODULE - I GENERALIZED HARMONIC ANALYSIS 8

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

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MODULE - II PROBABILITY AND RANDOM VARIABLES 8

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

MODULE - III AVERAGES AND DISTRIBUTIONS 8

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

MODULE - IV RANDOM PROCESSES AND POWER SPECTRUMS 7

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

MODULE - V LINEAR SYSTEMS WITH RANDOM INPUTS 7

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

MODULE - VI OPTIMUM LINEAR SYSTEMS 8

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

TOTAL : 45 PERIODS

TEXT BOOKS

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

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REFERENCE BOOKS

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

WEB REFERENCES:

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

ONLINE RESOURCES:

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

OUTCOMES:

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

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

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CO - PO, PSO MAPPING:

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

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PROFESSIONAL ELECTIVES - I

COURSE CODE: 24COEL501	NETWORK DESIGN AND MANAGEMENT	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106105195	SYLLABUS VERSION 1.0	SDG NO. 4				
PRE-REQUISITE COURSES	24COPC301					

OBJECTIVES:

- Learn network devices functions and configurations hub, switch, tap and routers.
- Be familiar with network Security Devices.
- Analyze routing, switching, and network management techniques
- Design secure and scalable enterprise networks
- Apply network monitoring and performance optimization methods
- Explore cloud, wireless, and software-defined networking concepts
- Develop practical skills in network configuration and administration

MODULE - I FUNDAMENTALS OF NETWORK DESIGN AND ARCHITECTURE 8

Introduction to Computer Networks and Network Design-Network Topologies and Architectures-OSI and TCP/IP Reference Models-Enterprise Network Design Concepts-Network Devices: Routers, Switches, Firewalls, Gateways-IP Addressing: IPv4, IPv6, Subnetting, CIDR-Network Design Methodologies and Hierarchical Models-Network Performance Metrics: Delay, Throughput, Reliability

MODULE - II SWITCHING TECHNOLOGIES AND LAN DESIGN 7

Ethernet Technologies and LAN Standards-Switching Concepts and MAC Addressing-VLANs and Inter-VLAN Routing-VTP and Spanning Tree Protocol (STP)-Link Aggregation and Redundancy-Wireless LAN Concepts and Wi-Fi Standards-LAN Design for Campus Networks-Troubleshooting LAN Connectivity Issues

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MODULE - III ROUTING AND WAN TECHNOLOGIES 7

Static and Dynamic Routing-Routing Algorithms: Dijkstra and Bellman-Ford-Routing Protocols: RIP, EIGRP, OSPF, BGP Overview-WAN Technologies: PPP, MPLS, Frame Relay–NAT and PAT-VPN Concepts and Remote Access-Traffic Engineering and Load Balancing-WAN Design Considerations

MODULE - IV NETWORK MANAGEMENT AND SECURITY 7

Network Management Concepts and Models-SNMP and Network Monitoring Tools-Fault, Configuration, Accounting, Performance, and Security (FCAPS) Management-Network Security Principles-Firewalls, IDS, IPS-Access Control Lists (ACLs)-Authentication and Authorization Mechanisms-Network Backup and Disaster Recovery

MODULE - V CLOUD, WIRELESS, AND EMERGING NETWORKING TECHNOLOGIES 8

Wireless Network Design and Mobility Management-Cloud Networking Concepts-Data Center Networks-Software Defined Networking (SDN)-Network Function Virtualization (NFV)-Internet of Things (IoT) Networking-Virtual LANs and Overlay Networks-Quality of Service (QoS) Techniques

MODULE - VI NETWORK AUTOMATION AND ADMINISTRATION 8

Network Configuration and Administration-Network Automation Concepts–Basics of Python for Network Automation-Configuration Management Tools–Socket Programming Basics-Client–Server Communication-Multithreaded Network Applications-Network Troubleshooting and Performance Optimization

TOTAL: 45 HOURS

TEXT BOOKS

1. Mani Subramanian, Network Management Principles and Practice: 2nd Edition, Pearson Education.
2. Morris Mano. Network Management, Pearson Education.

REFERENCES:

1. Mark Burges, Principles of Network and System Administration, Wiley.

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OUTCOMES:

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

1. Apply network architecture principles, addressing schemes, and design methodologies in enterprise network environments. (K3)
2. Analyze and implement LAN switching technologies, VLAN configurations, and campus network designs for efficient communication. (K4)
3. Examine and implement routing protocols and WAN technologies for scalable and reliable network communication. (K4)
4. Analyze network management techniques and security mechanisms to ensure secure and reliable network operations. (K4)
5. Examine and evaluate cloud, wireless, and emerging networking technologies for modern enterprise infrastructures. (K4)
6. Develop and manage automated network solutions and network applications using administration and programming techniques. (K4)

CO - PO, PSO MAPPING:

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

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Syllabus / CCE

PROFESSIONAL ELECTIVES - I

COURSE CODE: 24COEL502	HARDWARE INTERFACING AND NETWORKING	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	24BSMA401					

OBJECTIVES:

- Understand the fundamentals of hardware interfacing techniques.
- Learn the operation of microcontrollers and peripheral devices.
- Study serial and parallel communication methods.
- Understand networking basics and communication protocols.
- Learn interfacing techniques used in embedded and networked systems.
- Understand modern hardware networking applications and IoT concepts

MODULE - I INTRODUCTION TO HARDWARE INTERFACING 8

Introduction to Embedded Systems – Hardware Components – Sensors and Actuators – Microprocessor and Microcontroller Basics – Interfacing Concepts – Memory Interfacing – Input and Output Devices – Bus Structures – Addressing Techniques.

MODULE - II MICROCONTROLLER INTERFACING 8

Architecture of 8051 Microcontroller – GPIO Interfacing – LED and Switch Interfacing – Seven Segment Display – LCD Interfacing – Timer and Counter Concepts – Interrupts – ADC and DAC Basics – Simple Embedded Applications.

MODULE - III SERIAL AND PARALLEL COMMUNICATION 7

Data Communication Basics – Serial Communication – Parallel Communication – UART – RS232 – SPI – I2C – USB Basics – Data Transfer Techniques – Communication Error Detection Methods.

MODULE - IV COMPUTER NETWORKING FUNDAMENTALS 7

Introduction to Computer Networks – Types of Networks – Network Topologies – OSI Reference Model – TCP/IP Model – IP Addressing Basics – Routing Concepts – Switching Techniques – Network Devices.

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MODULE - V NETWORK INTERFACING AND SECURITY 7

Network Interface Cards – Ethernet Basics – Wireless Communication Basics – Wi-Fi and Bluetooth – Network Configuration Concepts – Firewalls – Basic Network Security – Secure Communication Concepts – VPN Basics.

MODULE - VI IoT AND MODERN HARDWARE NETWORKING APPLICATIONS 8

Introduction to Internet of Things – IoT Architecture – Sensor Networks – Smart Home Applications – Cloud Connectivity Basics – Embedded Networking Applications – Industrial Automation – Future Trends in Hardware Networking.

TOTAL: 45 HOURS

TEXT BOOKS

1. The 8051 Microcontroller and Embedded Systems, Pearson Education, 2008.
2. Data Communications and Networking, McGraw Hill, 2022.

REFERENCE BOOKS

1. Embedded Systems: Architecture, Programming and Design, McGraw Hill, 2017.
2. Computer Networks, Pearson Education, 2021.
3. Microprocessor and Microcontroller Fundamentals, Pearson Education, 2014.
4. Network Security Essentials, Pearson Education, 2021.

WEB REFERENCE

1. NPTEL : Embedded Systems https://nptel.ac.in/courses/10810204

OUTCOMES:

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

1. Apply basic hardware interfacing concepts in embedded systems. (K3)
2. Utilize microcontroller interfacing techniques for peripheral communication. (K3)
3. Apply serial and parallel communication methods in hardware systems. (K3)

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4. Use networking fundamentals and Internet protocols in communication systems. (K3)
5. Apply network interfacing and security concepts for secure communication. (K3)
6. Analyze IoT and modern hardware networking applications. (K3)

CO - PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVES - I

COURSE CODE: 24COEL503	EMBEDDED NETWORK SYSTEMS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	-					

OBJECTIVES:

- Understand the fundamentals of embedded systems and networking concepts.
- Learn the architecture and operation of embedded processors and controllers.
- Study communication interfaces used in embedded network systems.
- Understand networking protocols used in embedded applications.
- Learn wireless communication and security concepts in embedded environments.
- Understand IoT and modern embedded networking applications.

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MODULE - I INTRODUCTION TO EMBEDDED SYSTEMS 8

Introduction to Embedded Systems – Characteristics and Applications – Components of Embedded Systems – Microprocessors and Microcontrollers – Embedded Hardware and Software – Real-Time Systems – Embedded System Design Process – Basic Interfacing Concepts.Introduction to real-time operating systems (RTOS)-Applications of embedded systems

MODULE - II EMBEDDED PROCESSORS AND INTERFACING 8

8051 Microcontroller Architecture – GPIO Interfacing – LED and LCD Interfacing – Sensors and Actuators – Timers and Counters – Interrupts – ADC and DAC Basics – Embedded Programming Concepts.

MODULE - III EMBEDDED COMMUNICATION INTERFACES 7

Serial Communication – Parallel Communication – UART – SPI – I2C – CAN Bus Basics – USB Basics – Data Transfer Methods – Communication Error Detection – Embedded Communication Applications.

MODULE - IV NETWORKING FUNDAMENTALS FOR EMBEDDED SYSTEMS 7

Computer Network Basics – OSI and TCP/IP Models – IP Addressing – Ethernet Basics – Routing Concepts – Network Devices – Embedded Networking Architecture – Internet Protocol Basics.

MODULE - V WIRELESS EMBEDDED NETWORKS AND SECURITY 7

Wireless Sensor Networks – Wi-Fi – Bluetooth – ZigBee – Mobile Communication Basics – Embedded Network Security – Firewall Basics – Cryptography Concepts – Secure Data Communication.

MODULE - VI IoT AND MODERN EMBEDDED NETWORK APPLICATIONS 8

Introduction to IoT – IoT Architecture – Cloud Connectivity – Smart Home Systems – Industrial IoT Applications – Healthcare Monitoring Systems – Edge Devices – Future Trends in Embedded Networking.

TOTAL: 45 HOURS

TEXT BOOKS

1. Embedded Systems: Real-Time Interfacing to ARM Cortex-M Microcontrollers Jonathan W. Valvano(3rd Edition

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2. Embedded Systems Design,Steve Heath, 2nd Edition
3. Internet of Things: A Hands-On Approach, Arshdeep Bahga, Vijay Madisetti, 1st Edition

REFERENCE BOOKS

1. Computer Networks, Pearson Education, 2021.
2. Data Communications and Networking, McGraw Hill, 2022.
3. Embedded Systems, McGraw Hill, 2016.
4. Network Security Essentials, Pearson Education, 2021.

WEB REFERENCE

1. NPTEL : Computer Networks And Internet Protocol https://nptel.ac.in/courses/106105183?utm

OUTCOMES:

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

1. Apply basic embedded system concepts and architecture in real-time applications. (K3)
2. Utilize embedded processor interfacing techniques for peripheral communication. (K3)
3. Apply embedded communication interfaces for data transfer applications. (K3)
4. Use networking fundamentals and Internet protocols in embedded network systems. (K3)
5. Apply wireless embedded networking and security concepts in communication systems. (K3)
6. Analyze IoT and modern embedded networking applications. (K3)

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CO - PO, PSO MAPPING:

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

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Syllabus / CCE

PROFESSIONAL ELECTIVES - II

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

OBJECTIVES:

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

MODULE - I INTRODUCTION TO BUSINESS INTELLIGENCE 7

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

MODULE - II DATA WAREHOUSING AND DATA MANAGEMENT 7

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

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MODULE - III DATA ANALYTICS AND STATISTICAL TECHNIQUES 8

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

MODULE - IV DATA VISUALIZATION AND DASHBOARD DESIGN 8

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

MODULE - V BUSINESS INTELLIGENCE TOOLS AND APPLICATIONS 8

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

MODULE - VI EMERGING TRENDS IN BUSINESS INTELLIGENCE 7

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

TOTAL : 45 PERIODS

TEXT BOOKS:

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

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REFERENCES:

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

WEB REFERENCES:

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

ONLINE RESOURCES:

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

OUTCOMES:

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

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

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

CO - PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVES - II

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

OBJECTIVES:

- Understand the fundamental concepts, techniques, and applications of Machine Learning.
- Apply data preprocessing and feature engineering techniques for machine learning models.

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- Analyze supervised and unsupervised learning algorithms for predictive analytics.
- Implement machine learning models using appropriate tools and frameworks.
- Evaluate and optimize machine learning models using performance metrics.
- Apply machine learning techniques to solve real-world intelligent system problems.

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

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

MODULE - II `DATA PREPROCESSING AND FEATURE ENGINEERING **8**

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

MODULE - III SUPERVISED LEARNING ALGORITHMS **7**

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

MODULE - IV UNSUPERVISED LEARNING AND CLUSTERING TECHNIQUES **8**

Introduction to Unsupervised Learning – Clustering Concepts and Applications – K-Means Clustering – Hierarchical Clustering – Density-based Clustering – Association Rule Mining – Market Basket Analysis –

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Dimensionality Reduction for Visualization – Anomaly Detection – Recommendation Systems – Applications of Unsupervised Learning in Business and Industry.

MODULE - V NEURAL NETWORKS AND DEEP LEARNING FUNDAMENTALS **8**

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

MODULE - VI MACHINE LEARNING APPLICATIONS AND EMERGING TRENDS **7**

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

TOTAL : 45 PERIODS

TEXT BOOKS:

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

REFERENCES:

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

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

WEB REFERENCES:

1. Scikit-learn Official Documentation: https://scikit-learn.org/stable/
2. TensorFlow Official Documentation: https://www.tensorflow.org/
3. Keras Documentation: https://keras.io/

ONLINE RESOURCES:

1. Google Machine Learning Crash Course: https://developers.google.com/machine-learning/crash-course
2. Coursera – Machine Learning by Andrew Ng: https://www.coursera.org/learn/machine-learning
3. Kaggle Learn – Machine Learning Courses: https://www.kaggle.com/learn

OUTCOMES:

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

1. Apply machine learning concepts, workflows, data preparation techniques, and Python-based tools to develop basic machine learning solutions for real-world problems. (K3)
2. Analyze and preprocess datasets using data cleaning, feature engineering, dimensionality reduction, and exploratory data analysis techniques to improve model performance. (K4)
3. Apply supervised learning algorithms such as regression, classification, decision trees, random forests, and support vector machines for predictive modeling tasks. (K3)
4. Analyze unsupervised learning techniques including clustering, association rule mining, anomaly detection, and recommendation systems for pattern discovery and knowledge extraction. (K4)
5. Apply neural network architectures and deep learning frameworks to develop solutions for image, speech, and natural language processing applications. (K3)
6. Analyze emerging machine learning technologies, responsible AI practices, and domain-specific applications to address complex challenges in intelligent systems. (K4)

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CO - PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24AIEL506	DECISION SUPPORT SYSTEMS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 110105147	SYLLABUS VERSION 1.0	SDG NO. 9, 11, 13				
PRE-REQUISITE COURSES	24CSPC301, 24BSMA301					

OBJECTIVES:

- Understand the fundamentals, concepts, and applications of Decision Support Systems (DSS).
- Analyze organizational decision-making processes and the role of DSS in improving business performance.
- Apply data management, model management, and knowledge-based techniques in DSS design.
- Develop skills in data analysis, visualization, and reporting for managerial decision-making.
- Explore intelligent and group decision support systems using modern analytical tools.
- Apply DSS concepts to real-world business, healthcare, industrial, and strategic decision-making scenarios.

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MODULE - I CLOUD ARCHITECTURE AND MODELS 7

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

MODULE - II INTRODUCTION TO VIRTUALIZATION 8

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

MODULE - III CLOUD INFRASTRUCTURE 8

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

MODULE - IV CLOUD DEPLOYMENT ENVIRONMENT 7

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

MODULE - V CLOUD SECURITY 7

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

MODULE - VI CLOUD SIMULATOR & CLOUD APPLICATIONS 8

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

TOTAL : 45 PERIODS

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COMPUTER AND COMMUNICATION ENGINEERING

TEXT BOOKS:

1. Efraim Turban, Ramesh Sharda, and Dursun Delen, "Decision Support and Business Intelligence Systems", Pearson Education, 10th Edition, 2017.
2. Marakas George M., "Decision Support Systems in the Twenty-First Century", Prentice Hall, 2nd Edition, 2003.
3. Power D.J., "Decision Support, Analytics, and Business Intelligence", Business Expert Press, 2019.

REFERENCES:

1. Daniel J. Power, "Decision Support Systems: Concepts and Resources for Managers", Greenwood Publishing.
2. Ralph H. Sprague and Hugh J. Watson, "Decision Support Systems: Putting Theory into Practice", Prentice Hall.
3. Sauter Vicki L., "Decision Support Systems for Business Intelligence", Wiley Publications.
4. James O'Brien and George Marakas, "Management Information Systems", McGraw Hill Education.
5. Jiawei Han, Micheline Kamber, and Jian Pei, "Data Mining: Concepts and Techniques", Morgan Kaufmann.

WEB REFERENCES:

1. Decision Support Systems Journal – Elsevier: https://www.journals.elsevier.com/decision-support-systems
2. IBM Business Analytics Resources: https://www.ibm.com/analytics
3. Microsoft Power BI Documentation: https://learn.microsoft.com/power-bi/

ONLINE RESOURCES:

1. Tableau Learning Resources: https://www.tableau.com/learn
2. Coursera – Business Intelligence and Decision Support Courses: https://www.coursera.org/
3. Google Cloud Decision Intelligence Resources: https://cloud.google.com/solutions

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OUTCOMES:

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

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

CO - PO, PSO MAPPING:

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

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Syllabus / CCE

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	24BSMA301					

OBJECTIVES:

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

MODULE - I INTRODUCTION TO LEARNING ANALYTICS 7

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

MODULE - II DATA COLLECTION AND PREPROCESSING 7

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

MODULE - III DESCRIPTIVE AND DIAGNOSTIC ANALYTICS 7

Overview of Descriptive Analytics - Key Statistics: Mean, Median, Mode, Standard Deviation - Data Visualization: Histograms, Bar Charts, Box Plots - Diagnostic Analytics & Pattern Recognition - Correlation Analysis & Causal Relationships - Visualization: Scatter Plots, Heatmaps, Correlation Matrices - Advanced Analytics: Principal Component Analysis (PCA) - Case Studies

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MODULE - IV PREDICTIVE ANALYTICS 8

Introduction to Predictive Analytics - Supervised vs. Unsupervised Learning - Key ML Models: Linear & Logistic Regression, Decision Trees - Naïve Bayes for Classification - Model Evaluation: Accuracy, Precision, Recall, F1-Score - Tools: Weka, Orange, Scikit-learn

MODULE - V TEXT ANALYTICS AND ADVANCED TECHNIQUES 8

Introduction to Text Analytics - Text Mining: Tokenization, Lemmatization, Stopword Removal -Sentiment Analysis & Topic Modeling (LDA) - NLP for Educational Data - Process & Sequence Mining in Learning Paths - Advanced Models: Random Forest, SVM

MODULE - VI APPLICATIONS AND ETHICS 8

Real-World Learning Analytics Applications - Designing Data-Driven Interventions - Ethics & Legal Considerations in Education Data - Communicating & Visualizing Analytics Results - Case Studies on Effective Implementation

TOTAL : 45 PERIODS

TEXT BOOKS:

1. 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. Siemens, G., & Gasevic, D. (Eds.). (2017). Handbook of Learning Analytics (1st ed.). Society for Learning Analytics Research (SoLAR). ISBN: 978-0-9952408-0-3.
2. Romero, C., Ventura, S., Pechenizkiy, M., & Baker, R. S. J. (Eds.). (2010). Handbook of Educational Data Mining. CRC Press / Taylor & Francis Group. ISBN: 978-1-4398-0457-5.

REFERENCES:

1. Witten, I. H., Frank, E., Hall, M. A., & Pal, C. J. (2016). Data Mining: Practical Machine Learning Tools and Techniques (4th ed.). Morgan Kaufmann / Elsevier. ISBN: 978-0-12-804291-5.
2. Manning, C. D., Raghavan, P., & Schütze, H. (2008). Introduction to Information Retrieval. Cambridge University Press. ISBN: 978-0-521-86571-5.

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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

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)

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

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24ITEL517	DATA SCIENCE FOR ENGINEERS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: 106106179	SYLLABUS VERSION 1.0	SDG NO. 4, 8, 9				
PRE-REQUISITE COURSES	24BSMA301, 24ITPT401					

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.

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COMPUTER AND COMMUNICATION ENGINEERING

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.

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.

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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)
2. https://scikit-learn.org/stable/user_guide.html – Scikit-Learn User Guide
3. https://pandas.pydata.org/docs/ – Pandas Documentation
4. https://www.kaggle.com/learn – Kaggle Learn (Practical Data Science)
5. https://archive.ics.uci.edu/ml/ – UCI Machine Learning Repository

OUTCOMES:

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

1. Apply Python and data science libraries for data preprocessing, analysis, and visualization. (K3)
2. Apply mathematical and optimization techniques in data science and machine learning. (K3)
3. Apply statistical methods and hypothesis testing for data-driven decision-making. (K3)
4. Analyze and evaluate supervised machine learning models using performance metrics. (K4)
5. Analyze data using clustering, dimensionality reduction, and feature engineering techniques. (K4)
6. Analyze advanced techniques such as ensemble learning, deep learning, time series analysis, and big data frameworks. (K4)

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CO - PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24ITEL518	DATA MINING FOR DECISION MAKING	L	T	P	CP	C
		3	0	0	4	3
NPTEL CODE: 110104118	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	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.

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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.

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.

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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.
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.

REFERENCE BOOKS

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.

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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)
4. Analyze complex decision problems using DEA, AHP, and ANP models. (K4)
5. Apply ranking and outranking techniques such as TOPSIS, ELECTRE, PROMETHEE, and MACBETH for decision support. (K3)
6. Develop decision support solutions using fuzzy logic and advanced decision-making frameworks. (K4)

CO - PO, PSO MAPPING:

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

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PROFESSIONAL ELECTIVES - II

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

OBJECTIVES:

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

MODULE - I AMORTIZED ANALYSIS & ADVANCED DATA STRUCTURES 8

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

MODULE - II NETWORK FLOW ALGORITHMS 8

Maximum Flow Problem – Flow Networks – Ford-Fulkerson Method – Edmond-Karp Algorithm– Dinic's Algorithm – Push-Relabel Method – Correctness and Complexity Analysis.

MODULE - III MATCHING AND FLOW APPLICATIONS 8

Applications of Maximum Flow – Hall's Marriage Theorem – Maximum Bipartite Matching –König's Theorem – Edmonds' Blossom Algorithm for Maximum Matching in General Graphs – Stable Matching Problem – Gale-Shapley Algorithm.

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MODULE - IV ORDER STATISTICS, STRING MATCHING AND RANDOMIZED ALGORITHMS 7

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

MODULE - V COMPUTATIONAL COMPLEXITY & NP - COMPLETENESS 7

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

MODULE - VI APPROXIMATION ALGORITHMS 8

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

TOTAL : 45 PERIODS

TEXT BOOKS:

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

REFERENCES:

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

ONLINE RESOURCES:

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

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

OUTCOMES:

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

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

CO - PO, PSO MAPPING:

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

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PROFESSIONAL ELECTIVES - II

COURSE CODE: 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.

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.

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MODULE - V CLOUD SECURITY 7

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

MODULE - VI CLOUD SIMULATOR & CLOUD APPLICATIONS 8

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

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Kai Hwang, Geoffery C Fox, Jack J Dongarra, "Distributed and Cloud Computing: Clus- ters, Grids, Clouds and the Future of Internet", 1st Edition, Morgan Kaufman Publisher, Oxford, an Imprint of Elsevier, 2012.
2. Srinivasan A, Suresh J, "Cloud Computing: A practical Approach for Learning and Implementation", Pearson Education India, 2014.

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.

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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

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)

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CO - PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVES - II

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

OBJECTIVES:

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

MODULE - I INTRODUCTION TO PARALLEL ALGORITHMS 7

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

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MODULE - II MODELS & COMPLEXITY ANALYSIS 8

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

MODULE - III PERFORMANCE AND BASIC PARALLEL TECHNIQUES 7

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

MODULE - IV PARALLEL SORTING & SEARCHING 8

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

MODULE - V ALGEBRAIC, GRAPH & GEOMETRY ALGORITHMS 7

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

MODULE - VI ADVANCED PREFIX ALGORITHMS AND APPLICATIONS 8

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

TOTAL : 45 PERIODS

TEXT BOOKS:

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

REFERENCES:

1. Xavier & Iyengar, "Introduction to Parallel Algorithms", Wiley, 1998.
2. Sanders et al., "Sequential and Parallel Algorithms and Data Structures", Springer, 2019.
3. Barry Wilkinson & Michael Allen, "Parallel Programming: Techniques and Applications Using Networked Workstations and Parallel Computers", Pearson, 2005.

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4. Selim G. Akl , "Design and Analysis of Parallel Algorithms", Prentice Hall, 1989.

ONLINE RESOURCES:

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

OUTCOMES:

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

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

CO - PO, PSO MAPPING:

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

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PROFESSIONAL ELECTIVES - II

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

OBJECTIVES:

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

MODULE -I INFORMATION MEASURES & ENTROPY **8**

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

MODULE - II SOURCE CODING **8**

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

MODULE - III CHANNEL CAPACITY & COMMUNICATION CHANNELS **7**

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

MODULE - IV ERROR CONTROL CODING **7**

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

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MODULE - V ADVANCED CODING TECHNIQUES 8

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

MODULE - VI ADVANCED INFORMATION THEORY 7

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

TOTAL : 45 PERIODS

TEXT BOOKS

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

ONLINE RESOURCES:

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

OUTCOMES:

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

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

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

CO - PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVES - II

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

OBJECTIVES:

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

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

MODULE - I INTRODUCTION TO MACHINE LEARNING 7

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

MODULE - II PARAMETRIC ESTIMATION 7

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

MODULE - III MIXTURE MODELLING 7

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

MODULE - IV PERCEPTRON CRITERIA 8

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

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

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

MODULE - VI ML APPLICATIONS IN MIMO 8

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

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

TOTAL : 45 PERIODS

BOOKS AND REFERENCES:

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

OUTCOMES:

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

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

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CO - PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVES - II

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

OBJECTIVES:

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

MODULE - I FUNDAMENTALS OF SIGNAL SIMULATION 7

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

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MODULE - II NOISE CHARACTERIZATION 7

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

MODULE - III RANDOM VARIABLES AND WIRELESS CHANNEL MODELING 8

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

MODULE - IV SPREAD SPECTRUM TECHNIQUES AND VISUALIZATION 7

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

MODULE - V ANALYSIS OF DIGITAL MODULATION TECHNIQUES 8

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

MODULE - VI INTRODUCTION TO R-PROGRAMMING 8

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

TOTAL : 45 PERIODS

BOOKS AND REFERENCES:

1. Rudra Pratap. Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers. Oxford University Press, Inc., USA, 2009.
2. Proakis, J.G., Salehi, M., Bauch, G., Contemporary Communication Systems Using MATLAB, Third edition, Cengage Learning, 2012.

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3. Sheldon M. Ross, Introduction to Probability Models, (Twelfth Edition), Academic Press, 2019.
4. TheArt of R Programming,Norman Matloff,CengageLearning.
5. Lander, "R for Everyone",Pearson

OUTCOMES:

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

1. Apply MATLAB to develop scripts/functions for signal representation and data visualization. (K3)
2. Analyze the noise characteristics of cascaded communication systems to determine overall system performance using MATLAB. (K4)
3. Analyze and compute channel matrices for wireless systems and interpret their impact on signal transmission and reception using simulation. (K4)
4. Examine the spectrum of DSSS and FHSS using simulation. (K4)
5. Examine and compare the Error performance of various modulation schemes over AWGN channels using analytical and simulation approaches. (K4)
6. Illustrate the data visualization tools and functions in R programming. (K3)

CO - PO, PSO MAPPING:

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

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PROFESSIONAL ELECTIVES - II

COURSE CODE: 24COEL504	NETWORK PROTOCOLS AND PROGRAMMING	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	-					

OBJECTIVES:

- To define and explain the concept of networking protocols and layered communication models.
- To understand protocol design requirements and engineering processes.
- To develop and specify network protocols using standard specification languages.
- To verify, validate, and test communication protocols using formal methods.
- To analyze protocol performance, scalability, and interoperability.
- To implement network protocols using programming and simulation tools.

MODULE - I INTRODUCTION TO NETWORK PROTOCOLS 7

Communication Model-Software and Subsystems-Protocol Concept-Protocol Engineering Process-Layered Architecture-Network Services and Interfaces-Protocol Functions-OSI and TCP/IP Models-Wireless Protocol Challenges-Application Protocols

MODULE - II PROTOCOL SPECIFICATION 7

Protocol Components and Services-Protocol Entity and Interfaces-Protocol Interactions- Multimedia and Internet Protocols-Specification Languages:-SDL,SPIN,Estelle,CPN,UML-Formal Specification Concepts

MODULE - III PROTOCOL VERIFICATION AND VALIDATION 8

Finite State Machines (FSM)-Design Errors in Protocols-Verification Approaches-SDL-Based Verification-Conformance Testing Principles-Test Execution and Methodology-Test Architecture Test Generation Methods

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MODULE - IV PROTOCOL PERFORMANCE TESTING 8

Protocol Performance Testing-TCP and OSPF Analysis (SDL-based)-CSMA/CD and CSMA/CA Analysis-Interoperability Testing-Scalability Analysis-Protocol Synthesis Techniques SDL from MSC-Protocol Resynthesis

MODULE - V IMPLEMENTATION OF PROTOCOLS 7

Protocol Implementation Requirements-Object-Based Protocol Design-Protocol Compilers Tools for Protocol Engineering-Software Implementation of Protocols-Real-Time Implementation Issues-Protocol Programming Models

MODULE - VI PROGRAMMING AND EXPERIMENTS 8

AODV / DSR Routing Implementation-Network Setup and Protocol Configuration-Socket Programming (TCP & UDP Client–Server)-MAC Protocol Implementation (Wired & Wireless) LAN and VLAN Configuration-WLAN Configuration-Multi-Subnet Network Design Network Services Configuration.

TOTAL: 45 HOURS

TEXT BOOKS

1. Mario Tokoro – Protocols for High-Speed Networks, Prentice Hall.
2. G. J. Holzmann – Design and Validation of Computer Protocols, Prentice Hall.
3. William Stallings – Data and Computer Communications, Pearson Education.

REFERENCE BOOKS

1. Behrouz A. Forouzan – TCP/IP Protocol Suite, McGraw Hill.
2. Andrew S. Tanenbaum – Computer Networks, Pearson.
3. Douglas Comer – Internetworking with TCP/IP, Pearson.

OUTCOMES:

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

1. Apply networking protocol concepts and layered architectures for communication systems.
2. Analyze protocol specification languages and design methodologies.
3. Apply verification and validation techniques for communication protocols.
4. Analyze protocol performance, scalability, and interoperability in network systems.

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5. Apply protocol implementation techniques using programming and engineering tools.
6. Analyze and evaluate real-world network protocols using simulation and programming models.

CO - PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24COEL505	NETWORK ON CHIP (NoC)	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	-					

OBJECTIVES:

- To understand the fundamentals of Network-on-Chip architecture and on-chip communication principles.
- To analyze interconnection networks, topologies, and switching techniques used in NoC systems.
- To apply routing strategies and flow control mechanisms for efficient data communication.
- To design and evaluate router architectures and packet-based communication models.
- To study fault tolerance, testing, and security aspects in Network-on-Chip infrastructures.
- To explore advanced concepts such as 3D NoC architectures and QoS-based resource allocation techniques.

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MODULE - I INTRODUCTION TO NETWORK ON CHIP 8

Introduction to Network-on-Chip (NoC)-OSI Layer Rules in NoC- Interconnection Networks in NoC- Network Topologies (Mesh, Torus, Ring, Tree, etc.)- Switching Techniques - Routing Strategies- Flow Control Protocols- Quality of Service (QoS) Support in NoC

MODULE - II ARCHITECTURE DESIGN OF NOC 7

Switching Techniques and Packet Format- Asynchronous FIFO Design GALS (Globally Asynchronous Locally Synchronous)- Communication Style Wormhole Router Architecture Design - Virtual Channel (VC) Router Architecture Design- Adaptive Router Architecture Design- Router Microarchitecture Concepts

MODULE - III ROUTING ALGORITHMS AND FLOW CONTROL 8

Packet Routing Concepts- QoS in NoC Communication- Congestion Control and Flow Control Mechanisms- Router Design Principles- Network Link Design- Tree-Based Multicast Routing Methods (Deadlock-Free)- Path-Based Multicast Routing for 2D and 3D Mesh Networks-Fault-Tolerant Routing Algorithms Reliable and Adaptive Routing Algorithms

MODULE - IV TESTING AND FAULT TOLERANCE IN NOC 7

Design Issues in NoC Systems- Security in Networks-on-Chip- Formal Verification of NoC Communications- Testing Techniques for NoC Infrastructures- Fault Tolerance in NoC Systems- Monitoring Services for NoC Systems- Reliability and Error Detection Methods

MODULE - V THREE-DIMENSIONAL NETWORK-ON-CHIP 8

Introduction to 3D Networks-on-Chip Architectures- Dimensionally-Decomposed Router Design for 3D NoC- Resource Allocation for QoS in On-Chip Communication- NoC Protocols for 3D Architectures- On-Chip Processor Traffic Modeling- Thermal and Power Issues in 3D NoC- Performance Analysis of 3D NoC Systems

MODULE - VI NOC IMPLEMENTATION AND APPLICATIONS 7

System-Level Design Methodologies for NoC- FPGA and ASIC Implementation of NoC Architectures- Energy-Efficient and Low-Power NoC Design Techniques- Network Interface (NI) Design in NoC Systems- Performance Evaluation Metrics for NoC- Simulation and Modeling Tools for NoC-

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Applications of NoC in Multi-core and Many-core Processors- Emerging Trends in AI and Heterogeneous Computing using NoC

TOTAL: 45 HOURS

TEXT BOOKS

1. William J. Dally, Brian Towles – Principles and Practices of Interconnection Networks, 1st Edition, Morgan Kaufmann.
2. Natalie Enright Jerger, Tushar Krishna – On-Chip Networks, 1st Edition, Morgan & Claypool Publishers.
3. Luca Benini, Giovanni De Micheli – Networks on Chips: Technology and Tools, 1st Edition, Morgan Kaufmann.

REFERENCE BOOKS

1. José Duato, Sudhakar Yalamanchili, Lionel Ni – Interconnection Networks: An Engineering Approach, 1st Edition, Morgan Kaufmann.
2. Andrew B. Kahng – VLSI Interconnects: Theory and Practice, Springer.
3. Trung A. Nguyen – Network-on-Chip Architectures: A Holistic Design Exploration, IEEE Press/Wiley.
4. Tushar Krishna, Natalie Enright Jerger – NoC Design and Verification, Morgan & Claypool Publishers.
5. Chris J. Myers – Asynchronous Circuit Design for VLSI Signal Processing, IEEE Press.

OUTCOMES:

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

1. Apply the fundamentals of Network-on-Chip architecture, OSI mapping, topologies, and communication principles. (K3)
2. Analyze switching techniques, router architectures, and communication protocols used in NoC systems. (K4)
3. Design deadlock-free and efficient routing algorithms including multicast and adaptive routing methods. (K3)
4. Analyze fault tolerance, testing methods, and security mechanisms in NoC infrastructures. (K4)
5. Apply GALS-based communication and router design techniques in NoC architecture development. (K3)
6. Analyze 3D Network-on-Chip architectures, resource allocation, and performance optimization techniques. (K4)

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CO - PO, PSO MAPPING:

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

PROFESSIONAL ELECTIVES - II

COURSE CODE: 24COEL506	NETWORK ROUTING ALGORITHMS	L	T	P	CP	C
		3	0	0	3	3
NPTEL CODE: -	SYLLABUS VERSION 1.0	SDG NO. 4, 9				
PRE-REQUISITE COURSES	-					

OBJECTIVES:

- Network Routing: Basics and Foundations
- Study routing protocols (IGP & EGP)
- Evaluate advanced routing and security techniques
- Routing in IP Networks
- Router Architectures
- Introduction to Next Generation Routing

MODULE - I NETWORKING AND NETWORK ROUTING **6**

Addressing and Internet Service: An Overview, Network Routing: An Overview, IP Addressing, On Architectures, Service Architecture, Protocol Stack Architecture, Router Architecture, Network Topology Architecture

MODULE - II ROUTING ALGORITHMS **8**

Bellman–Ford Algorithm and the Distance Vector Approach, Dijkstra's Algorithm, Comparison of the Bellman–Ford Algorithm and Dijkstra's Algorithm, Shortest Path Computation with Candidate Path Caching, Widest

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Path Computation with Candidate Path Caching, Widest Path Algorithm, kShortest Paths Algorithm

MODULE - III ROUTING PROTOCOLS 8

Routing Protocol, Routing Algorithm and Routing Information, Representation and Protocol Messages, Distance Vector Routing Protocol, Link State Routing Protocol, Path Vector Routing Protocol, Link Cost.Routers, Networks, and Routing Information: Some Basics, Static Routes, Routing Information Protocol Version 1 (RIPv1), Routing Information Protocol Version 2 (RIPv2), Interior Gateway Routing Protocol (IGRP), Enhanced Interior Gateway Routing Protocol (EIGRP), Route Redistribution

MODULE - IV GATEWAY PROTOCOLS 9

OSPF and Integrated IS-IS: OSPF: Protocol Features, OSPF Packet Format, Examples of Router LSAs and Network LSAs, Integrated IS-IS: Key Features, Similarities and Differences Between IS-IS and OSPF BGP: A Brief Overview, Basic Terminology, BGP Operations: Message Operations, BGP Timers, BGP Configuration Initialization, Two Faces of BGP: External BGP and Internal BGP, Path Attributes, BGP Decision Process, Internal BGP Scalability, Significance of Route Flap Dampening, BGP Additional Features, Finite State Machine of a BGP Connection Router Architectures: Functions of a Router, Types of Routers, Elements of a Router, Packet Flow, Packet Processing: Fast Path versus Slow Path, Router Architectures

MODULE - V TOWARDS NEXT GENERATION ROUTINGADVANCED ROUTING TECHNIQUES 7

Background of QoS and QoS Routing, QoS Attribues, Traffic Engineering Extension to Routing Protocols, Multiprotocol Label Switching (MPLS), Generalized MPLS, MPLS Virtual Private Networks

Routing in Ad hoc Network: Introduction to Ad hoc Networks – Features/ Characteristics, Types and Applications, Limitations, Advantages and Disadvantages, Classification of Routing Protocols in Ad hoc Networks – Proactive Routing Protocols (DSDV, OLSR), Reactive Routing Protocols (DSR, AODV), Hybrid Routing Protocols (ZRP)

MODULE - VI ROUTING SECURITY AND PERFORMANCE 7

Routing attacks: spoofing, blackhole, wormhole-Secure routing protocols-Authentication and encryption-Performance metrics (throughput, delay, packet loss)-Network simulation tools (NS2, NS3, Packet Tracer)-Case studies

TOTAL: 45 HOURS

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TEXT BOOKS

1. Deep Medhi, Karthik Ramasamy, "Network Routing: Algorithms, Protocols and Architecture", Morgan Kaufmann publishers, 2nd Edition, 2018.
2. M. Steen Strub, "Routing in Communication network, Prentice –Hall International, New york, 1995

REFERENCES:

1. Jochen H.Schiller, "Mobile Communication", Pearson Ed, 2nd Edition, 2014.
2. William Stallings, "High speed networks and Internets Performance and Quality of Service", Pearson Education Asia. Reprint India, 2nd Edition, 2002
3. Keshav, „An engineering approach to computer networking" Addison Wesley 1999.
4. William Stallings, "Data and Computer Communications", Pearson Education, 2006

OUTCOMES:

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

1. Apply the fundamental concepts of computer networks and apply the role of routing in data communication.(K3)
2. Classify and analyze different routing algorithms, including static and dynamic routing techniques.(K4)
3. Analyze shortest path algorithms such as Dijkstra's algorithm and Bellman-Ford algorithm for network routing.(K4)
4. Develop the working of distance vector and link state routing protocols.(K3)
5. Discover the performance of routing algorithms based on metrics such as convergence time, scalability, and overhead.(K4) 6.Examine routing algorithms using simulation tools to solve real-world communication problems.(K4)

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CO - PO, PSO MAPPING:

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

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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

Sairam SDG ACTION PROGRAM

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

CEO - Sairam Institutions