B.E. COMPUTER SCIENCE AND ENGINEERING
(Artificial Intelligence and Machine Learning)
DEGREE PROGRAMME

CURRICULUM AND DETAILED SYLLABI

FOR

FIRST SEMESTER

FOR THE STUDENTS ADMITTED IN THE

ACADEMIC YEAR 2026-27 ONWARDS

THIAGARAJAR COLLEGE OF ENGINEERING
(A Government Aided Autonomous Institution affiliated to Anna University)
MADURAI – 625 015, TAMILNADU

Phone: 0452 – 2482240, 41
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Web: www.tce.edu

Department of Computer Science and Engineering

Vision

Excellence in Computer Science and Engineering education and research.

Mission

- Strive for academic excellence in Computer Science and Engineering through a creative teaching-learning process.
- Transform students into technically competent, socially responsible and ethical Computer Science professionals.
- Create centres of excellence in leading areas of Computer Science and Engineering.
- Incubate, apply and spread innovative ideas by collaborating with relevant industries and R&D labs through focused research groups.
- Attain these through continuous team work by a group of committed faculty, transforming the Computer Science and Engineering department as a leader in imparting Computer Science and Engineering education and research.

Program Educational Objectives (PEOs) for B.E. CSE (AI & ML) Programme

PEO1: Professional Competence

Graduates will demonstrate the knowledge, skills and techniques required to formulate, analyze, design, validate and deploy AI and ML models

PEO2: Critical Thinking and Problem Solving

Graduates will analyze complex problems, think critically, and develop innovative solutions using appropriate methodologies and tools required for their professional practice and research

PEO3: Lifelong Learning

Graduates will equip themselves with the skills and mindset to engage in lifelong learning, adapting to evolving technologies and methodologies throughout their careers

PEO4: Ethical and Social Responsibility

Graduates will understand the ethical and societal implications of their work and will demonstrate integrity, responsibility, and respect for diversity in their professional practice.

Program Specific Outcomes (PSOs) for B.E. CSE (AI & ML) Programme

PSO1: Ability to solve multidisciplinary problems with complex datasets using AI & ML models and provide solutions in application areas such as Natural language processing and Computer Vision

PSO2: Ability to apply tools and techniques learnt through professional society events, certification programs, projects and lab exercises to provide sustainable AI driven solutions to societal and environment issues

PSO3: Ability to work as an ethical engineer and/or researcher in the evolving discipline of artificial intelligence, machine learning and data science by applying soft skills and project management skills acquired through internships, industry collaboration and project work

PROGRAM OUTCOMES

PO1: Engineering knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/development of solutions: Design creative solutions for complex engineering problems and design/develop systems/components /processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct investigations of complex problems Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering tool usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO 6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO 7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO 8: Individual and Collaborative team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO 9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.

PO10: Project management and finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO 11: Life-long learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015

B. E./ B.Tech. DEGREE PROGRAMMES

CREDIT DISTRIBUTION

(For the students admitted from the Academic Year 2026-27 onwards)

Sl. No.	Category	Credits	
		Regular	**Lateral Entry**
A.	Humanities and Social Sciences including Management Courses (HSMC)	11	8
B.	Basic Science Courses (BSC)	22	6
C.	Engineering Science Courses (ESC)	23	12
D.	Program Core Courses (PCC)	75	62
E.	Program Elective Courses (PEC)	21	21
F.	Open Elective Courses (OEC)	6	6
G.	Employability Enhancement Courses (EEC)	16	16
H.	Internship and Mandatory Audit Courses (AC) as per Regulatory authorities (Non-Credit and not included in CGPA)	-	-
	Minimum Credits to be earned for the award of the Degree	**174**	**131**

B.E. Computer Science and Engineering (Artificial Intelligence and Machine Learning) Programme

Scheduling of Courses – for those join in the year 2026– 2027

Sem	Theory / Theory cum Practical / Practical										Credit
	1	2	3	4	5	6	7	8	9	Audit Courses (Mandatory Non-credit}	
I	26MASA0 Applied Calculus for Engineers (BSC-4)	26PHSA0 Physics (BSC-3)	26EGHA0 Technical English (HSMC-3) (TCP)	26AMCA0 Problem Solving and Programming (PCC-3) TCP	26AMEA0 Introduction to Computer Systems (ESC-3)		26PHSB0 Physics Laboratory (BSC-1.5)		26CCEA0 Introduction to Engineering (ESC-2) (TCP)	26TAAA0 Heritage of Tamil 26CCAA0 Vision and Speed Maths (AC-0)	19.5
II	26AMSA0 Numerical Techniques and Linear Algebra (BSC-3)	26CHSB0 Applied Chemistry (BSC-3)	26AMCB0 Digital System Design (PCC-3)	26AMCC0 Cognitive Science (PCC-3) 26AMCD0 Graphics and Interactive Techniques (PCC-3) (TCP)	26AMEB0 Programming Paradigms (ESC-3)	26AMCE0 Programming Languages Lab (PCC-1)	26CHSC0 Chemistry Laboratory (BSC-1.5)	26CCEB0 Biology for Engineers (ESC-3)		26TAAB0 Tamil and Technology 26CCAB0 Foundations of Problem Solving-1 (AC-0)	23.5
III	26AMSB0 Probabilistic and Statistical Methods (BSC-3)	26AMCF0 Data Structures and Algorithms (PCC-3) 26AMCG0 Object Oriented Programming (PCC-3)	26AMCH0 Artificial Intelligence (PCC -3)	26AMCJ0 Operating Systems (PCC-3) TCP	26AMCK0 Data Structures Lab (PCC -1.5)	26AMCL0 Object Oriented Programming Lab (PCC-1)	26AMCM0 Artificial Intelligence Lab (PCC1.5) 26AMEC0 Mind and Brain Science (ESC-3)	26CCLA0 Building Communication Skills (EEC-1))	26CCEC0 Design Thinking (ESC-3)	26CCAC0 Constitution of India	26
IV	26AMSC0 Discrete Mathematics (BSC-3)	26AMCN0 Design and Analysis of Algorithms (PCC-3)	26AMCP0 Data Communication and Networks (PCC-3) 26AMCQ0 Machine Learning (PCC-3)	26AMCR0 Data Science (PCC-3) 26AMCS0 Database Systems (PCC-3) TCP	26AMCT0 Algorithms Lab (PCC-1.5)	26AMCU0 Machine Learning Lab (PCC-1.5)	26CCED0 Environment and Sustainability (ESC-3)	26EGHB0 Professional Communication Lab (HSMC-2)	26CCLB0 Numerical Skills and Quantitative Problem Solving (EEC-1)	26CCAD0 Indian Knowledge System	27
V	26CCHA0 Project Management (HSMC-3)	26AMCV0 Deep Learning for NLP (PCC-3)	26AMCW0 Reinforcement Learning (PCC-3) 26AMCY0 Human-AI Interaction (PCC-3)	26AMCZ0 Generative AI (PCC-3) 26AMDA0 Reinforcement Learning Lab (PC-1.5)	26AMDB0 Network Programming Lab (PCC-1.5)	Basic Science Elective / Language Elective (OEC-3)	26CCLC0 Aptitude Skills (EEC-2)	26AMED0 Optimization Techniques (ESC-3)	26AMLA0 Project – I (EEC-3)	26CCAE0 Universal Human Values and Ethics	29
VI	26CCHB0 Accounting and Finance (HSMC-3)	26AMDC0 Deep Learning for Vision (PCC-3)	26AMDD0 Emotional AI (PCC-2)	26AMDE0 Ethical Aspects of AI (PCC-2) 26AMDF0 Autonomous Agents (PCC-3)	26AMDG0 Deep Learning Lab (PCC-1.5)	26AMDH0 Autonomous Agents Lab (PCC-1.5)	PEC-1 (3) PEC-2 (3)	Interdisciplinary Elective (OEC-3)	26AMLB0 Project - II (EEC-3)	26CCAF0 Disaster Management	28
VII	PEC-3 (3)	PEC-4 (3)	PEC-5 (3)	PEC-6 (3)	PEC-7 (3)				26AMLC0 Project - III (EEC-3)		18
VIII									26AMLD0 Project - IV (EEC-3)		3
										Total Credits	174

Passed in Board of Studies Meeting on 22.05.2026

71st Academic Council Meeting on 27.06.2026

THIAGARAJAR COLLEGE OF ENGINEERING, MADURAI- 625 015
(A Govt. Aided, Autonomous Institution affiliated to Anna University)
B.E. Computer Science and Engineering (Artificial Intelligence and Machine Learning) Programme
Categorization of Courses

Humanities and Social Sciences including Management Courses (HSMC) (11 Credits)

- 26EGHA0 - Technical English (3) (TCP)
- 26EGHB0 - Professional Communication Lab (2)
- 26CCHA0 - Project Management (3)
- 26CCHB0 - Accounting and Finance (3)

Basic Science Courses(BSC) (22 Credits)

- 26AMSA0 - Applied Calculus for Engineers (4)
- 26AMSA0 - Numerical Techniques and Linear Algebra (3)
- 26AMSB0 - Probabilistic and Statistical Methods (3)
- 26AMSC0 - Discrete Mathematics (3)
- 26PHSA0 - Physics (3)
- 26CHSB0 - Applied Chemistry (3)
- 26PHSB0 - Physics Laboratory (1.5)
- 26CHSC0 – Chemistry Laboratory (1.5)

Engineering Science Courses (ESC) (23 Credits)

- 26AMEA0 - Introduction to Computer Systems (3)
- 26CCEA0 - Introduction to Engineering (2) (TCP)
- 26AMEB0 - Programming Paradigms (3)
- 26CCEB0 - Biology for Engineers (3)
- 26AMEC0 - Mind and Brain Science (3)
- 26CCEC0 - Design Thinking (3)
- 26CCED0 - Environment and Sustainability (3)
- 26AMED0 - Optimization Techniques (3)

Program Core Courses (PCC) (75 Credits)

- 26AMCA0 - Problem Solving and Programming (3) TCP
- 26AMCB0 - Digital System Design (3)
- 26AMCC0 - Cognitive Science (3)
- 26AMCD0 - Graphics and Interactive Techniques (3) TCP
- 26AMCE0 - Programming Languages Lab (1)
- 26AMCF0 - Data Structures and Algorithms (3)
- 26AMCG0 - Object Oriented Programming (3)
- 26AMCH0 - Artificial Intelligence (3)
- 26AMCJ0 - Operating Systems (3) TCP
- 26AMCK0 - Data Structures Lab (1.5)
- 26AMCL0 - Object Oriented Programming Lab (1)
- 26AMCM0 - Artificial Intelligence Lab (1.5)
- 26AMCN0 - Design and Analysis of Algorithms (3)
- 26AMCP0 - Data Communication and Networks (3)
- 26AMCQ0 - Machine Learning (3)
- 26AMCR0 - Data Science (3)
- 26AMCS0 - Database Systems (3) TCP
- 26AMCT0 - Algorithms Lab (1.5)
- 26AMCU0 - Machine Learning Lab (1.5)
- 26AMCV0 - Deep Learning for NLP (3)
- 26AMCW0 - Reinforcement Learning (3)
- 26AMCY0 - Human-AI Interaction (3)
- 26AMCZ0 - Generative AI (3)
- 26AMDA0 - Reinforcement Learning Lab (1.5)
- 26AMDB0 - Network Programming Lab (1.5)
- 26AMDC0 - Deep Learning for Vision (3)
- 26AMDD0 - Emotional AI (2)
- 26AMDE0 - Ethical Aspects of AI (2)
- 26AMDF0 - Autonomous Agents (3)
- 26AMDG0 - Deep Learning Lab (1.5)
- 26AMDH0 - Autonomous Agents Lab (1.5)

Program Elective Courses (PEC) (21 Credits)

- Programme Elective – 1 (3)
- Programme Elective – 2 (3)

- Programme Elective – 3 (3)
- Programme Elective – 4 (3)
- Programme Elective – 5 (3)
- Programme Elective – 6 (3)
- Programme Elective – 7 (3)

Open Elective Courses (OEC) (6 Credits)

- Basic Science Elective / Language Elective (3)
- Interdisciplinary Elective (3)

Employability Enhancement Courses (EEC) (16 Credits)

- 26CCLA0 - Building Communication Skills (1)
- 26CCLB0 - Numerical Skills and Quantitative Problem Solving (1)
- 26CCLC0 - Aptitude Skills (2)
- 26AMLA0 - Project-I (3)
- 26AMLB0 - Project-II (3)
- 26AMLC0 - Project-III (3)
- 26AMLD0 - Project-IV (3)

Audit Courses (Mandatory Non-Credit)

- 26TAAA0 - Heritage of Tamil
- 26TAAB0 - Tamil and Technology
- 26CCAA0 - Vision and Speed Maths
- 26CCAB0 - Foundations of Problem Solving-1
- 26CCAC0 - Constitution of India
- 26CCAD0 - Indian Knowledge System
- 26CCAE0 - Universal Human Values and Ethics
  26CCAF0 - Disaster Management

THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015
B.E. / B.Tech. Degree Programmes

COURSES OF STUDY
(For the candidates admitted from 2026-27 onwards)

FIRST SEMESTER

Course Code	Name of the Course	Category	No. of Hours / Week			credits
			L	T	P	
THEORY						
26MASA0	Applied Calculus for Engineers	BSC	3	1	-	4
26PHSA0	Physics	BSC	3	-	-	3
26AMEA0	Introduction to Computer Systems	ESC	3	-	-	3
THEORY CUM PRACTICAL						
26EGHA0	Technical English	HSMC	2	-	2	3
26AMCA0	Problem Solving and Programming	PCC	2	-	2	3
26CCEA0	Introduction to Engineering	ESC	1	-	2	2
PRACTICAL						
26PHSB0	Physics Laboratory	BSC	-	-	3	1.5
AUDIT COURSES						
26TAAA0	Heritage of Tamil	AC				-
26CCAA0	Vision and Speed Maths	AC	-	-	2	-
		Total				**19.5**

BSC : Basic Science Courses
HSMC : Humanities and Social Sciences including Management Courses
ESC : Engineering Science Courses
PCC : Programme Core Courses

L : Lecture
T : Tutorial
P : Practical

Note:
1 Lecture Period/week is equivalent to 1 credit
1 Tutorial Period/week is equivalent to 1 credit
1 Practical Period/week is equivalent to 0.5 credit

THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015
B.E. / B.Tech. Degree Programme

SCHEME OF EXAMINATIONS
(For the candidates admitted from 2026-27 onwards)

FIRST SEMESTER

S.No.	Course Code	Name of the Course	Duration of Terminal Exam. in Hrs.	Marks			Minimum Marks for Pass	
				Continuous Assessment *	Terminal Exam **	Max. Marks	Terminal Exam	Total
THEORY								
1	26MASA0	Applied Calculus for Engineers	3	40	60	100	27	50
2	26PHSA0	Physics	3	40	60	100	27	50
3	26AMEA0	Introduction to Computer Systems	3	40	60	100	27	50
THEORY CUM PRACTICAL								
4	26EGHA0	Technical English	3 (Terminal Exam Type : Theory)	50	50	100	22.5	50
5	26AMCA0	Problem Solving and Programming	3 (Terminal Exam Type : Theory)	50	50	100	22.5	50
6	26CCEA0	Introduction to Engineering	3 (Terminal Exam Type : Practical)	50	50	100	22.5	50
PRACTICAL								
7	26PHSB0	Physics Laboratory	3	60	40	100	18	50

26MASA0 Applied Calculus for Engineers

Category	L	T	P	Credit
BSC	3	1	0	4

1. Preamble

Applied calculus addresses the fundamental concepts of single and multivariable calculus with emphasis on engineering applications and problem solving. Focuses on modeling and analysis of engineering systems through derivatives and integrals. Develops analytical skills to analyze and solve real-world systems using derivatives and multiple integrals.

2. Prerequisite

- Nil

3. Course Outcome

After the successful completion of the course, students will be able to:

CO	Course Outcomes	TPS Level	Performance Indicator	CO Weightage	SDG addressed	SDG Level
CO1	Use functions, limits, continuity, and derivatives to solve mathematical and technical problems.	TPS3	1.1.1	18%	SDG4	2
CO2	Apply derivatives to determine extrema and characterize behavior of single variable functions.	TPS3	1.1.1	18%	SDG4	2
CO3	Compute partial derivatives to determine extrema of multivariable functions.	TPS3	1.1.1	18%	SDG4	2
CO4	Apply techniques of double integrals to compute areas and volumes of bounded regions.	TPS3	1.1.1	16%	SDG4	2
CO5	Apply double integrals to determine physical quantities such as density,mass, moments, center of mass, and	TPS3	1.1.1	12%	SDG4	2

	moments of inertia and Surface Area.					
CO6	Compute volumes using triple integrals in Cartesian, Cylindrical, and Spherical coordinates.	TPS3	1.1.1	18%	SDG4	2

4.Assessment Pattern

CO	CAT1	Assignment 1	CAT2	Assignment 2	Terminal Exam
	% of Marks	% of Marks	% of Marks	% of Marks	% of Marks
CO1	33	33			18
CO2	33	33			18
CO3	34	34			18
CO4			38	38	16
CO5			24	24	12
CO6			38	38	18
Total	100	100	100	100	100

1. Activities are given for self-study using mathematical software. They can be tested through open ended assignments.

5.Syllabus

Foundations of Differential Calculus: New functions from old functions - Limit of a function and Continuity of a function - Limits at infinity - Derivative as a function.

Activities: Visualization of the functions, model and solve scientific and engineering phenomena using concept of function, limits, continuity, intermediate value theorem and derivatives. Solving Competitive Examination problems with emphasis to GATE

Applications of Differential Calculus: Maxima and Minima of functions of single variable - The Mean value theorem - Effect of derivatives on the shape of the graph of a function.

Activities: Model and solve scientific, engineering phenomena using concept of Maxima and Minima of a function, Rolle's Theorem and mean value theorem and derivatives. Solve Competitive Examination problems with emphasis to GATE

Partial Derivatives and its Applications: Partial derivatives - Chain rule - Maxima and minima of functions of two variables - Method of Lagrange's Multipliers for function with single constraint.

Activities: Model and solve scientific, engineering phenomena using concept Partial derivatives, Chain rule, Maxima and minima of functions of two variables, Method of Lagrange's Multipliers. Solve Competitive Examination problems with emphasis to GATE.

Double Integrals and its Applications: Iterated integrals and Fubini's theorem - Double integrals over general regions - Changing the order of integration - Properties of double integrals - Double integrals in polar coordinates – Applications of double integrals (Density, Mass, Moments & Moments of Inertia problems only) - Surface area.

Activities: Using the concept of Double integrals, model and solve scientific, engineering phenomena. Solve Competitive Examination problems with emphasis to GATE

Triple Integrals and its Applications: Triple integrals over rectangular boxes - Triple integrals over general regions - Triple integrals in cylindrical coordinates - Triple integrals in spherical coordinates.

Activities: Model and solve scientific, engineering phenomena using concept of Triple integrals in Cartesian, cylindrical and spherical coordinates. Solve Competitive Examination problems with emphasis to GATE.

6. Learning Resources

6.1 Text Book

1) James Stewart, Daniel Clegg and Saleem Watson, "Calculus Early Transcendentals", 9th edition, Cengage Learning, New Delhi, 2019.
   Foundations of Differential Calculus: [1.3, 2.2, 2.5, 2.6, 2.8]
   Applications of Differential Calculus: [4.1, 4.2, 4.3]

   Partial Derivatives and its Applications: [14.3, 14.5, 14.7, 14.8]
   Double Integrals and its Applications: [15.1, 15.2, 15.3, 15.4, 15.5]
   Triple Integrals and its Applications: [15.6, 15.7, 15.8]

6.2 Reference Books & Web Resources

1) George B. Thomas, "Thomas Calculus: Early Transcendentals", 14th Edition, Pearson Publishers, New Delhi, 2018.

2) Howard Anton, Irl Bivens and Stephen Davis, "Calculus: Early Transcendentals",12thedition, John Wiley & Sons, 2021.

3) Kuldeep Singh, "Engineering Mathematics Through Applications", 2nd edition, Blooms berry publishing, 2019,

4) Kuldip S. Rattan, Nathan W. Klingbeil, Craig M. Baudendistel, “Introductory Mathematics for Engineering Applications”, 2nd edition, John Wiley& Sons, 2021.

5) Ron Larson and David C. Falvo, “Calculus: an Applied Approach”. 10th edition Cengage Learning 2015.

6) https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ma79

7) https://ocw.mit.edu/courses/18-01-calculus-i-single-variable-calculus-fall-2020/

8) https://in.mathworks.com/matlabcentral/fileexchange/?q=calculus+applications

7. Course Contents and Lecture Schedule

Module No.	Topic	Periods
1	**Foundations of Differential Calculus**	
1.1	New functions from old functions	1
1.2	The Limit of a function	1
1.3	Continuity of a function	1
	Tutorial	1
1.4	Limits at infinity	1
1.5	The Derivative as a function	2
	Tutorial	1
2	**Applications of Differential Calculus**	
2.1	Maxima and Minima of functions of single variable	3
	Tutorial	1
2.2	The Mean value theorem	1
2.3	Effect of derivatives on the shape of a graph of a function	2
	Tutorial	1
3	**Partial Derivatives and its Applications**	
3.1	Partial derivatives	1
3.2	Chain rule	2
	Tutorial	1
3.3	Maxima and minima of functions of two variables	1
3.4	Method of Lagrange’s Multipliers for function with single constraint	2
	Tutorial	1
4	**Double Integrals**	
4.1	Iterated integrals and Fubini’s theorem	1
4.2	Double integrals over general regions	2
	Tutorial	1
4.3	Changing the order of integration	2
4.4	Properties of double integrals (without proof), Change of Variables from	1

	Cartesian to Polar Coordinates	
	Tutorial	1
4.5	Double Integrals in Polar coordinates	1
4.6	Applications of double integrals (Density, Mass, Moments)	1
4.7	Applications of double integrals (Moments of Inertia)	1
	Tutorial	1
4.8	Surface area	2
5	**Triple Integrals**	
5.1	Triple integrals over Rectangular Boxes	1
	Tutorial	1
5.2	Triple integrals over general regions	2
5.3	Change of Variables from Cartesian to Cylindrical and Spherical Coordinates	1
	Tutorial	1
5.4	Triple integrals in cylindrical coordinates	2
5.5	Triple integrals in spherical coordinates	1
	Tutorial	1
	Total	**48**

8.Course Designer(s):

1. Dr. B. Vellaikannan, Professor, Dept. of Mathematics, bvkmat@tce.edu

2. Dr. C. S.Senthilkumar , Assistant Professor, Dept. of Mathematics, kumarstays@tce.edu

3. Dr. A. Anitha, Assistant Professor, Dept. of Mathematics, anithavalli@tce.edu
4. Ms.H. Srivinodhini, Assistant Professor, Dept. of Mathematics, srivinodhini@tce.edu

5. Dr. S. Saravanakumar, Assistant Professor, Dept. of Mathematics, sskmat@tce.edu

6. Dr. P. Balamanikandan, Assistant Professor, Dept. of Mathematics, pbmmat@tce.edu

7. Dr. Pradnya Gaonkar, Senior customer success engineer, math works

pgaonkar@mathworks.com

26PHSA0	PHYSICS (COMMON TO ALL BRANCHES)	Category*	L	T	P	Credit
			2	1	0	3

Preamble

Physics provides a strong foundation in classical and modern physics, including mechanics, wave phenomena, electrodynamics, electronic materials, and quantum theory, relevant to engineering applications. This course connects fundamental principles with modern technologies such as solar cells, electric vehicles, MRI scanners, scanning tunneling microscopes, and emerging quantum technologies.

Prerequisite

Physics and Mathematics at Higher Secondary Level (Class XII)

Course Outcomes

After the successful completion of the course, students will be able to:

No.	Course Outcome	TPS Level	Performance Indicator	CO Weightage	SDG addressed	SDG Level
CO1	Apply the principles of mechanics of solids, including the work-energy theorem, central forces, conservation of angular momentum, and coordinate transformations, to solve problems on satellite maneuvers.	TPS3	1.2.1	15	SDG 9	1
CO2	Apply the equations of oscillatory and wave motion to solve problems on damped and forced oscillations, Q factor, impedance matching, phase and group velocity, and dispersive wave phenomena.	TPS3	1.2.1	15	SDG 11	1
CO3	Apply Maxwell's equations and Poynting's theorem to solve problems on electromagnetic wave propagation, polarization, and energy-momentum transport in vacuum and conducting media.	TPS3	1.2.1	18	SDG 3	1
CO4	Apply band theory, carrier	TPS3	1.2.1	18	SDG 7	2

	transport equations, and Fermi level concepts to compute carrier concentration and solve problems related to the operation of solar cells, batteries, supercapacitors, and EV materials.					
CO5	Apply the Schrodinger wave equation and quantum mechanical principles to solve problems on a particle in a 1D box, a quantum harmonic oscillator, and tunneling as realized in the scanning tunneling microscope.	TPS3	1.2.1	17	SDG 4	0
CO6	Apply the principles of superposition, entanglement, and quantum logic gates to solve problems, illustrating the fundamental operational differences between classical and quantum computing using qubit representations.	TPS3	1.4.1	17	SDG 9	1

Assessment Pattern

CO	CAT1	Assignment 1	CAT2	Assignment 2	Terminal Exam
	% of Marks	% of Marks	% of Marks	% of Marks	% of Marks
CO1	35	35	—	—	15
CO2	35	35	—	—	15
CO3	30	30	—	—	18
CO4	—	—	35	35	18
CO5	—	—	35	35	17
CO6	—	—	30	30	17
Total	**100**	**100**	**100**	**100**	**100**

Note: CO-wise assessment must align with CO weightage.

Syllabus

Module 1: Mechanics of Solids (6 hrs)

Scalars and Vectors Under Rotation Transformation – Work-Energy Theorem – Central Forces – Energy in Conservative and Non-Conservative Forces – Conservation of Angular Momentum – Coordinate Systems: Cartesian, Polar, Cylindrical – Satellite Maneuvers.

Module 2: Oscillations and Waves (6 hrs)
Oscillatory Motion – Damped Oscillations – Forced Oscillations (Qualitative only): Differential Equation and its Solution – Q Factor – Impedance Matching – Group Velocity and Phase Velocity – Non-Dispersive Transverse and Longitudinal Waves in a String – Dispersive Waves – Seismic Waves – Water Waves and Tsunamis.

Module 3: Electrodynamics (6 hrs)
Maxwell's Equations of Electromagnetism – Equation of Continuity – Poynting's Theorem – Electromagnetic Waves – Polarization – EM Waves in Vacuum and Conductors – Energy and Momentum in EM Waves – Application: CT/MRI Scan.

Module 4: Physics of Electronic Materials (6 hrs)
Band Theory of Solids – Kronig-Penney Model (Qualitative only) – Bloch's Theorem – Intrinsic and Extrinsic Semiconductors – Carrier Concentration and Fermi Level – Electron and Hole Transport – Solar Cells – Charge Storage in Batteries and Supercapacitors – Materials for Electric Vehicles (EV) – 2D Materials, Flexible Electronic Materials, and Quantum Materials.

Module 5: Quantum Mechanics (6 hrs)
Wave Nature of Particles – Wave Function – Expectation Values – Schrodinger Wave Equations – Uncertainty Principle – Particle in a 1D Box – Quantum Harmonic Oscillator – Quantum Tunnelling (Qualitative only) – Scanning Tunneling Microscope.

Module 6: Quantum Computing (6 hrs)
Quantum Computing – Classical and Quantum Computing: Key Differences – Bloch Sphere Representation of Qubits – Types of Qubits – Superposition – Quantum Entanglement – Quantum Logic Gates.

6. Learning Resources

6.1 Text Book

H. D. Young and R. A. Freedman, "University Physics with Modern Physics", Pearson Education, 15th Edition, 2023.
D. J. Griffiths, "Introduction to Electrodynamics", Cambridge University Press, 4th Edition, 2017.
M. Mahendran, M. Tamilelakkiya, S. Karthickprabhu, P. Sivakumar, “Engineering Physics” , Shanlax Publications, 1st edition, 2026.

6.2 Reference Books & Web resources

1. S. O. Pillai, "Solid State Physics", New Age International Publishers, 8th Edition, 2018.
N. David Mermin, "Quantum Computer Science: An Introduction", Cambridge University Press, 2007.
R. P. Feynman, R. B. Leighton and M. Sands, "The Feynman Lectures on Physics – Vol. I, II & III", Addison-Wesley, 2011.
NPTEL Course: "Engineering Physics" – https://nptel.ac.in
MIT OpenCourseWare: "Physics II: Electricity and Magnetism" – https://ocw.mit.edu

7. Course Contents and Lecture Schedule

Module	Topics	Periods
1	Scalars and Vectors Under Rotation Transformation	1
	Work-Energy Theorem; Central Forces	1
	Energy in Conservative and Non-Conservative Forces; Conservation of Angular Momentum	1
	Coordinate Systems: Cartesian, Polar, Cylindrical	2
	Satellite Maneuvers	1
2	Oscillatory Motion; Damped Oscillations	1
	Forced Oscillations – Differential Equation and Solution; Q Factor; Impedance Matching	2
	Group Velocity and Phase Velocity; Non-Dispersive Waves in a String	1
	Dispersive Waves; Seismic Waves; Water Waves and Tsunamis	2
3	Maxwell's Equations, Equation of Continuity	2
	Poynting's Theorem; Electromagnetic Waves; Polarization	1
	EM Waves in Vacuum and Conductors; Energy and Momentum in EM Waves	2
	Application: CT/MRI Scan	1
4	Band Theory of Solids; Kronig-Penney Model (Qualitative); Bloch's Theorem	1
	Intrinsic and Extrinsic Semiconductors; Carrier Concentration and Fermi Level	2
	Electron and Hole Transport; Solar Cells	1
	Charge Storage in Batteries and Supercapacitors; EV Materials, Flexible Electronic Materials, 2D and Quantum Materials	1
5	Wave Nature of Particles; Wave Function; Expectation Values	1
	Schrodinger Wave Equation (Time-dependent and Time-independent)	2
	Uncertainty Principle; Particle in a 1D Box	2
	Quantum Harmonic Oscillator; Quantum Tunnelling (Qualitative); Scanning Tunneling Microscope	1
6	Classical vs Quantum Computing: Qubit – Definition and Types	1
	Bloch Sphere Representation; Superposition	2

	Quantum Entanglement; Quantum Logic Gates	2
	Case Study: Quantum Computing Applications	1
	Total Periods	36

SDG-Aligned Academic Activities

CO	SDG	Activity	Linkage to Module	TPS	Level
CO1	SDG 9	Compute orbital velocity, period, and energy for a satellite executing a Hohmann transfer between circular orbits using conservation of angular momentum and the work-energy theorem.	Module 1 – Satellite Maneuvers	TPS 3	1
CO2	SDG 11	Use the forced-oscillation model to compute the resonant frequency and Q-factor for a seismic sensor and relate impedance matching to signal fidelity in earthquake early-warning systems.	Module 2 – Forced Oscillations, Seismic Waves	TPS 3	1
CO3	SDG 3	Apply Poynting's theorem to compute the power density of EM waves used in MRI and CT imaging and use polarization principles to explain contrast differentiation in medical scans.	Module 3 – Poynting's Theorem, CT/MRI Scan	TPS 3	1
CO4	SDG 7	Compute the efficiency of a p-n junction solar cell using given carrier concentration and Fermi level data and solve charge storage problems for a supercapacitor in an EV energy management scenario.	Module 4 – Solar Cells, EV Materials, Supercapacitors	TPS 3	2
CO5	SDG 4	Solve the particle-in-a-1D-box problem for a quantum dot of given dimensions, compute allowed energy levels and use the tunneling	Module 5 – Particle in 1D Box, Quantum Tunnelling, STM	TPS 3	0

		probability formula to explain STM tip-sample distance sensitivity.			
CO6	SDG 9	Apply Hadamard and CNOT gate matrices to given qubit input states, trace the state on the Bloch sphere, and demonstrate the creation of entangled Bell states using quantum logic gate sequences.	Module 6 – Quantum Logic Gates, Entanglement	TPS 3	1

8.Course Designer(s):

Dr. M. Mahendran manickam-mahendran@tce.edu
Dr. M. Tamilelakkiya mtphy@tce.edu
Dr. S. Karthickprabhu skphy@tce.edu

26AMEA0	INTRODUCTION TO COMPUTER SYSTEMS	Category	L	T	P	Credit
		ESC	3	0	0	3

Preamble

This course introduces the fundamental concepts of computer system organization and architecture, enabling students to understand the internal functioning of computing systems. It covers processor organization, instruction execution, pipelining, memory hierarchy, I/O systems, computer arithmetic, and modern GPU computing principles. The course provides a foundation for understanding performance-oriented computing architectures and their relevance to Artificial Intelligence and Machine Learning applications.

Prerequisite

NIL

Course Outcomes

After the successful completion of the course, students will be able to:

No.	Course Outcome	TPS Level	Performance Indicator	CO Weightage	SDG addressed	SDG Level
CO1	Explain the basic operations performed in a CPU and functional units of a Computer System	TPS2	1.3.1	10%	NC	
CO2	Analyze the data path, control path and interconnection mechanisms in computer architecture	TPS4	2.1.1	20%	SDG9	1
CO3	Apply pipelining concepts and performance enhancement techniques in processor design	TPS3	1.4.1	15%	SDG9	1
CO4	Apply computer arithmetic techniques for integer and floating point operations in computing systems	TPS3	1.3.1	15%	NC	
CO5	Examine the memory hierarchy design and I/O mechanisms in computer systems	TPS4	2.1.1	25%	SDG12	1
CO6	Analyze GPU architecture and computing techniques for enhancing system performance	TPS4	3.2.1	15%	SDG9	1

Assessment Pattern

CO	CAT1	Assignment 1	CAT2	Assignment 2	Terminal Exam
	% of Marks	% of Marks	% of Marks	% of Marks	% of Marks
CO1	20		-	-	10
CO2	40	50	-	-	20
CO3	40	50	-	-	15
CO4	-	-	20	-	15
CO5	-	-	50	50	25
CO6	-	-	30	50	15
Total	100	100	100	100	100

Syllabus

Computer System Fundamentals: Motivation, IAS Computer Structure and Operation, Functional Units, Basic concepts

Computer Function and Interconnection: Top level view of components and functions, Instruction cycle and program execution, Interrupts and instruction cycles, Multiple interrupts, Interconnection structures, Bus interconnection, Multiple buses, Synchronous and asynchronous bus timings, High Speed Interconnects

Pipelining: Basic Concepts, Data Hazards, Instruction hazards, Influence on Instruction Sets, Data path and Control Considerations, Superscalar Operation, Performance Considerations.

Memory Design: Characteristics and hierarchy of memory, Cache memory principles and operation, Cache design and mapping functions, replacement algorithms, main memory, DRAM and SRAM, Types of ROMs, Module organization, Introduction to magnetic disks, Memory bottleneck in AI Systems

I/O Systems: I/O transfer and disk performance, Interrupt driven and DMA transfers, Performance estimation and trade-offs in design.

Computer Arithmetic: Arithmetic and Logic Unit, Integer multiplication of unsigned and signed numbers, Booth's algorithm, Division of unsigned binary, Floating point arithmetic

GPU Design Principles: Need and opportunities, CPU, GPU, GPU Architecture – Overview of hardware and software technology, AI accelerators –TPU,NPU, AI co processors, Spectral functions, Case studies on different architecture, evaluation with performance metrics, sustainability, energy efficiency

Learning Resources

6.1 Text Book

1. William Stallings, Computer Organization and Architecture: Designing for Performance, 12th edition, Pearson, 2025.
2. Carl Hamacher, Computer Organization and Embedded Systems, 7th Edition, McGraw-Hill, 2024.
3. David A. Patterson and John L. Hennessy, Computer Organization and Design: RISC-V Edition, 3rd Edition, Morgan Kauffmann, 2021

6.2 Reference Books & Web resources

1. Andrew S. Tanenbaum and Todd Austin, *Structured Computer Organization*, 7th Edition, Pearson.

2. John L. Hennessy and David A. Patterson, *Computer Architecture: A Quantitative Approach*, 7th Edition, Morgan Kaufmann.
3. Shane Cook, *CUDA Programming: A Developer's Guide to Parallel Computing with GPUs*, Morgan Kaufmann.

4. **NVIDIA Developer Documentation** (for GPU architecture, AI accelerators, CUDA concepts).

7.Course Contents and Lecture Schedule

Module No.	Topic	No. of Periods
	Introduction to the course and course outcomes	
1	**Computer System Fundamentals (5)**	
1.1	Organisation and system architecture	1
1.2	Structures and functions	1
1.3	History and challenges evolution of computer and technology	1
1.4	IAS computer design and working	1
1.5	Measures of performance	1
2	**Computer Function and Interconnection (6)**	
2.1	Computer components and functions	1
2.2	Interconnection structures	
2.3	Instruction cycle and program execution	1
2.4	Multiple buses	1
2.5	Synchronous and asynchronous bus timings	1
2.6	Interrupts and handling mechanism, High Speed Interconnects	2
3	**Pipelining (4)**	
3.1	Basic concepts of pipelining	1
3.2	Hazards and its impact	1
3.3	Data path and Control Considerations	1
3.4	Superscalar Operations and performance Considerations	1
4	**Computer Arithmetic (5)**	
4.1	Arithmetic and Logic Unit	1
4.2	Integer multiplication of unsigned and signed numbers	1
4.3	Booth’s algorithm	1
4.4	Division of unsigned binary	1
4.5	Floating point arithmetic	1
5	**Memory Design (6)**	
5.1	Memory system overview and layout	1
5.2	Characteristics and hierarchy of memory	1
5.3	Cache memory principles and operation	1
5.4	Cache design its mapping functions and replacement algorithms	1
5.5	Main memory, DRAM and SRAM	1
5.6	Introduction to magnetic disks	
5.7	Memory bottleneck in AI Systems	1
6	**I/O Systems (5)**	
6.1	I/O transfer and disk performance	1
6.2	Programmed I/O	1

6.3	Interrupt driven I/O	1
6.4	DMA transfers	1
6.5	Performance estimation and trade-offs in design	1
7	**GPU Design Principles (5)**	
7.1	Need and opportunities of CPU and GPU	1
7.2	GPU Architecture – Overview of hardware and software	
7.3	Field programmable gates, AI accelerators	2
7.4	AI for Spectral functions, ML framework-Pytorch	1
7.5	Case studies on different sustainable, energy efficiency system architecture and evaluation with performance metrics	1
	Total	**36**

8. Course Designer(s):

1. Dr.S.Padmavathi, Professor/AI spmcse@tce.edu

26EGHA0 **TECHNICAL ENGLISH**

Category	L	T	P	Credit
	2	0	2	3

Preamble

Technical English is a course that develops essential communication skills for academic and engineering professional contexts. The course integrates listening, speaking, reading, and writing through practical technical and workplace-based activities.

Prerequisite

Nil

Course Outcomes

After the successful completion of the course, students will be able to:

No.	Course Outcome	TPS Level	Performance Indicator	CO Weightage	SDG addressed	SDG Level
CO1	Interpret technical texts, engineering manuals, and academic articles, extracting key information and inferring meaning from the context.	TPS3	9.1.1	20%	4	1
CO2	Use context-appropriate vocabulary and grammatical accuracy in technical writing including reports, Instructions, and graphical Interpretation.	TPS3	9.1.2	20%	4	1
CO3	Draft agendas, notices, and minutes of meetings in accordance with standard organizational formats and communication protocols.	TPS3	9.1.3	20%	5	1
CO4	Design effective technical presentation slides using visual clarity, proper formatting, and appropriate data representation techniques.	TPS3	9.2.2	20%	4	1
CO5	Apply professional and ethical communication practices in social media and workplace digital communication using proper netiquette and sentence construction.	TPS3	9.3.2	20%	11	1

Assessment Pattern

CO	Assessment 1						Assessment 2			Terminal (%)		
	Written Test 1 (%)			Assignment 1 (%)			Lab Activities					
TPS	1	2	3	1	2	3	1	2	3	1	2	3
CO1			20%						20%	-	-	20%
CO2			20%		50%				20%	-	-	20%
CO3			20%						20%	-	-	20%
CO4			20%		-				20%	-	-	20%
CO5			20%		50%				20%	-	-	20%
TOTAL	100%			100%					100%	100%		

Syllabus

Module1

Technical Reading and Vocabulary Development

Technical Reading Strategies – Skimming, Scanning, Intensive and Extensive Reading –Manuals - Academic Articles –– Technical Word Families – Prefixes and Suffixes in Engineering Terminology – Collocations in Engineering Discourse – Inferring meaning from Context- Note-making, Summarising and Paraphrasing Technical Content.

Lab Activity: Listening files and Note-taking& Reading- based note making

Module 2

Editing, Analytical Reading and Ethical AI Communication Skills

Analytical Reading and Error Identification – Sentence clarity, cohesion and transition signals – Ethical use of AI in Writing and Communication – AI-assisted Editing and Summarising – Interpreting Charts, Graphs and Diagrams.

Lab Activity: Reading-based Editing Exercises – Picture/Chart Description Activity.

Module 3

Professional and Technical Workplace Communication

Formal Letters – Permission- Bona fide - Business Letters – Formats – Letters of Inquiry, Complaint, and Recommendation – Minutes of Meetings and Notices – Agenda preparation – Recording and Circulating Minutes – Action Items and Follow-up Communication.

Lab Activity: Listening to Audio files and Preparing Minutes

Module 4

Oral Communication and Interpersonal Skills

Question Forms and Question Tags- Spotting Errors- Types of Sentences- Oral Presentation Skills – Planning and Structuring a Technical Presentation – Designing effective Slides (visual clarity, data display) – Verbal and Non-verbal Communication – Handling Q&A Sessions.

Lab Activity: Digital Presentation, Spotting Errors

Module 5

Career Communication and Digital Professionalism

Social Media and Workplace Digital Communication – Professional Use of Platforms – etiquette – Data Privacy and Ethical Communication Practices – Environmental and SDG-aligned Communication- Jumbled Sentences.

Lab Activity: Presentation on SDG topics, Jumbled Sentences

6. Learning Resources

6.1 Text Book

1. **Sanjay Kumar and Pushplata,** "Communication Skills", 3rd Edition, Oxford University Press, 2021.
2. **M. Ashraf Rizvi,** "Effective Technical Communication", 2nd Edition, McGraw-Hill Education India, 2018.
3. **John M. Lannon and Laura J. Gurak,** "Technical Communication", 15th Edition, Pearson Education, 2020.

Department of English, Technical English Work Book, 1st Edition, New Century Book House (P) Ltd., Chennai.

6.2 Reference Books & Web resources

- Michael Markel and Stuart A. Selber, "Technical Communication", 12th Edition, Bedford/St. Martin's, 2018.
- Sharon J. Gerson and Steven M. Gerson, "Technical Writing: Process and Product", 8th Edition, Pearson, 2017.
- Adrian Wall work, "English for Writing Research Papers", 2nd Edition, Springer, 2016.
- AICTE Examination Reform Policy, November 2018 – https://www.aicte-india.org
- MIT Open Courseware – Technical Writing (21W.035): https://ocw.mit.edu
- NPTEL – Communication Skills (IIT Kharagpur): https://nptel.ac.in

7. Course Contents and Lecture Schedule

S.No	Topic	No. of Hours
1.	Technical Word Families, Prefixes/Suffixes, Collocations & Contextual Meanings	1
2.	Manuals and Academic Articles	1
3.	Technical Word Families, Prefixes/Suffixes, Collocations & Contextual Meanings	1
4.	Note-making, Summarising & Paraphrasing Technical Content	1
5.	Note-taking & Reading-based Note-making	1
6.	Analytical Reading and Error Identification	1
7.	Sentence Clarity, Cohesion and Transition Signals	1
8.	Ethical Use of AI in Writing and Communication	1
9.	AI-assisted Editing and Summarising	1
10.	Interpreting Charts, Graphs and Diagrams	1
11.	Reading-based Editing Exercises & Picture/Chart Description	1
12.	Formal Letters – Permission – Bona fide – Business Letter Formats	1
13.	Letters of Inquiry, Complaint and Recommendation	1
14.	Minutes of Meetings and Notices	1
15.	Agenda Preparation – Recording, Circulating Minutes & Follow-up Communication	1

16.	Preparing Minutes	1
17.	Question Forms, Question Tags, Spotting Errors & Types of Sentences	1
18.	Oral Presentation Skills – Planning and Structuring Technical Presentation	1
19.	Designing Effective Slides, Verbal & Non-verbal Communication, Handling Q&A	1
20.	Spotting Errors	1
21.	Social Media and Workplace Digital Communication	1
22.	Professional Use of Platforms, Netiquette & Data Privacy	1
23.	Environmental and SDG-aligned Communication & Ethical Practices	1
24.	Professional Use of Platforms & etiquette	1
Total		**24**

8. Course Contents and Lab Schedule: 16 hours

1.	Listening-based Note-taking Exercises	2
2.	Reading-based Editing Exercises and Picture/Chart Description Activity.	2
3.	Preparing Minutes from Audio Files	2
4.	Jumbled sentence activities Exercises	2
5.	Presentation on SDG Topics	2
6.	Technical Presentation Practice	2
7.	Digital Presentation	2
8.	Model Exam	2
Total		**16**

9. Lab Assessment

S.No	Assessment Activity	Skills Assessed	Percentage (%)
1.	Listening to Technical Audio (CO1)	Listening comprehension	20%
2.	Spotting Errors and Jumbled Sentences (CO4 10%, CO5 20%)	Grammatical correctness, coherence, sentence organization	30%
3.	Picture Description (CO2 20%)	Vocabulary, technical description, fluency	20%
4.	Minutes and Digital Presentation (CO3 20%, CO4 10%)	Communication skill, confidence, response to question	30%

The course includes End Semester Theory Examination.

10. Course Designer(s):

1.Dr.S.Subash Assistant Professor, Department of English | ssheng@tce.edu
2. Dr.M.Arjunan, Assistant Professor, Department of English | maeng@tce.edu

26AMCA0 **PROBLEM SOLVING AND PROGRAMMING**

Category	L	T	P	Credit	TE-Type
PCC	2	0	2	3	TCP-T

Preamble

This course introduces programming as a tool for logical thinking, problem solving, and computational modeling using the C language. It enables learners to design structured programs, analyze computational processes, and develop efficient solutions for engineering applications. The course also builds confidence in translating real-world problems into reliable and maintainable software systems.

Prerequisite

NIL

Course Outcomes

On the successful completion of the course, students will be able to

No.	Course Outcome	TPS	Performance Indicator	CO Weightage	SDG Addressed	SDG Level
CO1	Explains the fundamentals of problem solving, computational thinking, algorithms, pseudocode, and flowcharts for program development.	TPS2	1.1.3	10	SDG 4	1
CO2	Apply data representation concepts, operators, expressions, and type conversion techniques to develop simple C programs.	TPS3	1.3.1	15	SDG 4	1
CO3	Apply decision-making and iterative constructs to solve computational problems using control statements and recursion.	TPS3	1.3.1	20	SDG 9	1
CO4	Develop modular programs using functions, parameter passing techniques, storage classes, and reusable code concepts.	TPS3	1.3.1	20	SDG 4	1
CO5	Implement array, string, pointer, searching, sorting, and	TPS3	1.3.1	20	SDG 9	1

	dynamic memory allocation concepts for problem solving and data processing applications.					
CO6	Develop programs using user defined data types, preprocessor directives, command line arguments in C.	TPS3	5.1.1	15	SDG 4	1

Assessment Pattern

CO	CAT1	CAT2	Model Test CO-wise (Cognitive, Psychomotor, Affective)	OCR/Continuous Assessment (Pre-lab, In-lab, Post-lab)	Terminal Exam
	% of Marks	% of Marks	% of Marks	% of Marks	% of Marks
CO1	20		10	10	10
CO2	40		10	10	20
CO3	40		20	20	20
CO4		40	20	20	20
CO5		40	20	20	20
CO6		30	20	20	10
Total	100	100	100	100	100

Assessment Pattern: Practical Component

Type of Assessment	Component	Marks	Remarks
Continuous Assessment	Pre-lab, In-lab, Post-lab	75	Conducted throughout the semester
Model Test	CO-wise (Cognitive, Psychomotor, Affective)	25	Mid/End semester internal test
Total Internal Marks		**100**	
End Semester Examination	CO-wise (Cognitive, Psychomotor, Affective)	100	As directed by COE or as per curriculum

Syllabus

Module 1: Problem Solving and Program Development

Introduction to problem solving and computational thinking – Problem analysis and decomposition – Algorithms and its Representation using flowcharts – Introduction to debugging and test case validation – Syntax, semantic, and runtime errors – Compilation and execution process – Structure of a C program.

Module 2: Data Representation and Operators

Character set, tokens, identifiers, keywords, constants, variables, and data types – Type conversion – Input and output operations – Operators and Expressions, precedence, and associativity.

Module 3: Decision Making and Iterative Problem Solving
Decision-making constructs: if, if-else, nested if and switch-case statements – Iterative constructs: while, do-while, and for loops – Nested loops – Iterative control statements.
Module 4: Functions and Modular Programming
Concepts of modular programming – Problem decomposition and reusable code development – Function declaration, definition, and return types – Scope and lifetime of variables – Storage classes – Parameter passing techniques: call by value and call by reference.
Module 5: Arrays, Strings, Pointers, and Dynamic Memory Management
One-dimensional and two-dimensional arrays – Searching techniques: linear and binary search – Sorting techniques: insertion sort and selection sort –— Pointers: Declaration, Arithmetic, Arrays, and Strings – Dynamic memory allocation.
Module 6: User Defined Data Types and File Handling
Structures, unions – Arrays of structures – Pointers to structures – Structures and functions – File handling: File input and output operations Text and binary files.

Text Book

2. B. A. Forouzan and R. F. Gilberg, Computer Programming and Problem Solving, Indian ed. Boston, MA, USA: Cengage Learning, 2020.
3. J. R. Hanly and E. B. Koffman, Problem Solving and Program Design in C, 8th ed. Boston, MA, USA: Pearson, 2015.
4. R. G. Dromey, How to Solve It by Computer: The Problem-Solving Aspects. Englewood Cliffs, NJ, USA: Prentice-Hall International, 1982.

Reference Books & web resources

1. B. W. Kernighan and D. M. Ritchie, The C Programming Language, 2nd ed. Upper Saddle River, NJ, USA: Pearson Education, 2015.
2. E. Balagurusamy, Programming in ANSI C, 8th ed. New Delhi, India: McGraw Hill Education, 2019.

SDG Alignment

Activities aligned with SDGs addressed:
SDG 4 Quality Education: Students develop quiz programs and grading tools using loops, conditionals, and arrays to understand how C programming improves access to quality learning.
SDG 8 Decent Work and Economic Growth: Students build employee record systems using dynamic memory allocation and recursion to learn essential skills for software development jobs.
SDG 9 Industry, Innovation and Infrastructure: Students design library management systems using functions, pointers, structures, and files to solve real-world data organization problems.

Course Contents and Lecture Schedule

Module No	Topics	No of Periods	Course Outcomes
1	**Introduction to C Programming Fundamentals**		
1.1	Introduction to problem solving and computational thinking	1	CO1
1.2	Problem analysis and decomposition, Algorithms and its Representation using flowcharts	1	CO1
1.3	Introduction to debugging and test case validation, Syntax, semantic, and runtime errors	1	CO1

1.4	Compilation and execution process, Structure of a C program	1	CO1
2	**Control Structures and Arrays**		
2.1	Character set, tokens, identifiers, keywords, constants, variables, and data types	1	CO2
2.2	Type conversion, Input and output operations	1	CO2
2.3	Operators and Expressions	1	CO2
2.4	precedence, and associativity	1	CO2
3	**Functions and Modular Programming**		
3.1	Decision-making constructs: if, if-else, nested if and switch-case statements	1	CO3
3.2	Iterative constructs: while, do-while, and for loops	1	CO3
3.3	Nested loops	1	CO3
3.4	Iterative control statements	1	CO3
4	**Algorithms, Recursion and Structures**		
4.1	Concepts of modular programming, Problem decomposition and reusable code development	1	CO4
4.2	Scope and lifetime of variables, Storage classes	1	CO4
4.3	Function declaration, definition, and return types	1	CO4
4.4	Parameter passing techniques: call by value and call by reference	1	CO4
5	**Pointers and Memory Management**		
5.1	One-dimensional and two-dimensional arrays	1	CO5
5.2	Searching techniques: linear and binary search	1	CO5
5.3	Sorting techniques: insertion sort and selection sort	1	CO5
5.4	Pointers: Declaration, Arithmetic, Arrays, and Strings, Dynamic memory allocation.	1	CO5
6	**File Processing and Testing**		
6.1	Structures, unions, Arrays of structures	1	CO6
6.2	Pointers to structures – Structures and functions	2	CO6
6.3	File handling: File input and output operations Text and binary files.	1	CO6
Total Hours		**24**	

List of Experiments with CO Mapping

Sl. No.	Name of the Experiment	Level of Experiment	Objective(s)	COs Addressed
1	Write a Program for Problem Solving Using Expressions and Operators	1	Design	CO2
2	Write a Program Using Decision-Making Statements in C	1	Models	CO2
3	Construct Programs Using Looping Statements	1	Learn from failures	CO2
4	Implement Modular Programs Using User-Defined Functions and Recursion	1	Design	CO3
5	Create Programs Using Header Files and User-Defined Libraries	1	Communication	CO3
6	Perform Array Operations Using One-Dimensional and Two-Dimensional Arrays	2	Data Analysis	CO4
7	Develop String Handling Programs in C	2	Creativity	CO4
8	Demonstrate Dynamic Memory Allocation Techniques	2	Learn from failures	CO5
9	Build Programs Using Structures and Unions	2	Models	CO6

10	Construct Record Management Programs Using Arrays of Structures	2	Teamwork	CO6
11	Perform File Handling Operations in C Programming	2	Ethics & Integrity	CO6
12	Develop a Mini Project Integrating C Programming Concepts	3	Communication + Creativity	CO1-CO6

Course Designer(s):

1. Ms. S. Naveena, Assistant Professor, Department of Artificial Intelligence, snacse@tce.edu

26CCEA0	INTRODUCTION TO ENGINEERING	Category	L	T	P	Credits	TE type
		ESC	1	0	2	2	TCP-P

1. Preamble

This course introduces first-year engineering students to the engineering profession, fundamental measurement techniques, and the design of simple functional systems. Through hands-on activities such as product teardown, instrument-based measurements, 3D modelling using TinkerCAD, data analysis with Excel, and team-based projects, students develop essential technical and professional skills. The course follows the CDIO (Conceive–Design–Implement–Operate) framework, fostering engineering thinking from the first semester. It also promotes awareness of engineering ethics, safety, sustainability, and the role of engineering in addressing societal challenges and the UN Sustainable Development Goals.

2. Prerequisite

Nil

3. Course Outcomes

On the successful completion of the course, students will be able to:

No.	Course Outcome	TCE Proficiency Scale	Performance Indicator	CO Weightage	SDG Addressed	SDG Level
CO1	Describe the engineering profession, major engineering disciplines, and the CDIO framework for product and system lifecycle.	TPS 2	1.1.1	15%	SDG 4	1
CO2	Decompose a product or engineering system into its functional components, sub-systems, and operational constraints using structured analysis.	TPS 3	1.2.1	20%	SDG 9	2
CO3	Apply data acquisition systems and computational tools (Excel / Python) to acquire, process, and interpret sensor data with appropriate uncertainty analysis.	TPS 3	5.2.1	20%	SDG 9	2
CO4	Implement and validate a simple engineering artefact/system by applying basic	TPS 3	4.4.1	20%	SDG 9	2

	engineering principles, tools, and teamwork.					
CO5	Demonstrate professional teamwork and technical communication competencies through a structured engineering report and oral presentation.	TPS 3	8.2.1	15%	SDG 4	2
CO6	Evaluate engineering solutions against criteria of professional ethics, occupational safety, and sustainable development, with reference to relevant SDGs.	TPS 4	7.2.1	10%	SDG 12, SDG 13	3

4. Assessment Pattern

CO	Theory		Practical		Terminal Exam (Practical)
	CAT1	CAT2	OCR/Continuous Assessment	Model Test CO-wise	
	% of Marks	% of Marks	% of Marks	% of Marks	% of Marks
CO1		**25**	**100**	**100**	100
CO2		**35**			
CO3		**30**			
CO4		**10**			
CO5					
CO6					
Total	-	100	100	100	100

5. Assessment Pattern: Practical Component

Type of Assessment	Component	Marks	Remarks
Continuous Assessment	Pre-lab, In-lab, Post-lab	75	Conducted throughout the semester
Model Test	CO-wise (Cognitive, Psychomotor, Affective)	25	Rubrics covering all Domains of learning
Total Internal Marks		**100**	
End Semester Examination	CO-wise (Cognitive, Psychomotor, Affective)	100	Rubrics covering all Domains of learning

6. Syllabus

Module 1: Engineering Around Us

What is engineering? – Major engineering disciplines – Engineering in everyday life – Engineering and society – Creativity and innovation – Engineering products and systems – Product observation and teardown activity.

Module 2: Engineering Measurements and Tools

SI units and engineering measurements – Measurement of dimensions and physical quantities using basic measuring instruments – Data recording – Accuracy, precision, and errors – Engineering estimation and reasoning – Safe use of engineering tools and instruments.

Module 3: Engineering Visualization and Simulation

Introduction to engineering drawings and visualization – Basic 2D and 3D concepts – Excel for tables and graph plotting – Introduction to ThinkerCAD – Simple 3D object creation – Basic circuit simulation.

Module 4: Engineering Making

Introduction to engineering materials – Basic fabrication techniques: cutting, joining, and assembling – Workshop safety practices – Introduction to sensors and automation concepts – Team-based engineering activity – Building a simple functional model.

Module 5: Teamwork, Ethics and Sustainability

Teamwork and collaboration – Basics of technical presentations – Engineering ethics and responsibilities – Engineering safety – Sustainability and SDGs in engineering – Engineering solutions for society.

7. Learning Resources

7.1 Text Books

1. Crawley, E., Malmqvist, J., Ostlund, S., Brodeur, D., "Rethinking Engineering Education: The CDIO Approach", Springer, 2014.
2. Eide, A., Jenison, R., Mashaw, L., Northup, L., "Introduction to Engineering Design and Problem Solving", McGraw-Hill, 3rd Edition.

7.2 Reference Books & Web Resources

1. CDIO Syllabus v3.0, Worldwide CDIO Initiative -- www.cdio.org (free download).
2. MIT Open Course Ware 2.00A: Introduction to Design -- ocw.mit.edu.
3. Python for Engineers: Google Colab notebooks (free, requires internet).
4. IEEE Engineering Ethics Resources -- www.ieee.org/ethics.

8. Course Contents and Lecture Schedule

Module No	Topics	No of Periods	**Course Outcomes**
Module 1:			
1.1	What is engineering? – Major engineering disciplines – Engineering in everyday life	2	CO1
1.2	Engineering and society – Creativity and innovation	1	CO1
1.3	Engineering products and systems – Product observation and teardown activity	1	CO1, CO2
2.1	SI units and engineering measurements – Measurement of physical quantities using basic instruments	1	CO3
2.2	Data recording – Accuracy, precision, and errors – Engineering estimation and reasoning	1	CO3

2.3	Safe use of engineering tools and instruments	1	CO3, CO6
3.1	Introduction to engineering drawings and visualization – Basic 2D and 3D concepts	1	CO2
3.2	Excel for tables and graph plotting – TinkerCAD: 3D object creation and basic circuit simulation	1	CO2, CO3
4.1	Introduction to engineering materials – Fabrication techniques: cutting, joining, assembling – Workshop safety	1	CO4, CO6
4.2	Sensors and automation concepts – Team-based engineering activity – Building a simple functional model	2	CO4
5.1	Teamwork and collaboration – Basics of technical presentations	1	CO5
5.2	Engineering ethics and responsibilities – Engineering safety	1	CO5, CO6
5.3	Sustainability and SDGs in engineering – Engineering solutions for society	1	CO5, CO6
Total (Hrs)		15	

9. List of Experiments with CO Mapping

Sl. No.	Name of the Experiment	Level of Experiment	Objective(s)	COs Addressed
1.	Product Teardown and Functional Analysis	Level 1	Obj. 3 – Experimentation	CO1, CO2, CO6
2.	Product Teardown and Design Improvement	Level 2	Obj. 5 – Design	CO1, CO2, CO4, CO6
3.	Measurement of Dimensions and Physical Quantities Using Basic Engineering Instruments.	Level 1	Obj. 1 – Instrumentation	CO3, CO6
4.	Design and Visualization of Basic 3D Geometric Objects Using TinkerCAD	Level 1	Obj. 5 – Design	CO2, CO3
5.	Design and Simulation of a Basic Electrical Circuit Using TinkerCAD	Level 2	Obj. 3 – Experimentation	CO2, CO3, CO4
6.	Data Tabulation and Graph Plotting Using Microsoft Excel	Level 1	Obj. 4 – Data Analysis	CO3
7.	Micro Project	Level 3	Obj. 5 – Design	CO2, CO4, CO5
8.	Case Study – Engineering Ethics and Responsibility	Level 2	Obj. 13 – Ethics & Integrity	CO5, CO6
9.	Technical Report Writing	Level 1	Obj. 11 – Communication	CO5

10. Course Designer(s):

- Dr. S. Baskar, Professor, EEE, and Dean (A&A), sbeee@tce.edu
- Dr. R. Rajan Prakash, Associate Professor, EEE, r_rajanprakash@tce.edu
- Dr. V. Balasubramian, Associate Professor, Mechanical, vbmech@tce.edu

26PHSB0	Physics Laboratory (Common to all branches)	Category	L	T	P	Credits
		PC	0	0	3	1.5

Preamble

Physics Laboratory enables first-year engineering students to experimentally explore the concepts taught in the co-requisite theory course (26PHSA0) through carefully designed experiments in core areas of physics. The course develops practical skills in instrumentation, data analysis, model validation, teamwork, safety, and ethical scientific reporting. It also supports Sustainable Development Goals related to quality education, clean energy, innovation, and sustainable development.

Prerequisite

- Engineering Physics (26PHSA0) co-requisite
- Physics at the Higher Secondary (Class XII) level

Course Outcomes

On the successful completion of the course, students will be able to

COs	Course Outcome Statement	TCE Proficiency Scale	Performance Indicators	Objective	SDG Addressed	SDG Level
CO1	Operate laboratory instruments, including photo detectors, solar cell setups, and logic trainers, to measure physical quantities related to core physics experiments.	TPS 3	5.2.1	1	NC	-
CO2	Analyse deviations between theoretical predictions and experimental results in mechanics, electrodynamics, and quantum physics experiments.	TPS 4	2.3.1	2	NC	-
CO3	Evaluate experimental procedures for adequacy of controls, documentation standards, and reproducibility.	TPS 5	4.2.1	3	NC	-
CO4	Examine experimental data using statistical methods to quantify uncertainty and draw valid conclusions.	TPS 3	4.3.1	4	NC	-
CO5	Demonstrate practical skills in setting up and handling optical, mechanical, and electronic experimental systems.	TPS 3	5.2.1	6	NC	-
CO6	Prepare structured laboratory reports that present experimental methods, results, and conclusions in a professional manner, with	TPS 3	9.1.2	13	NC	-

	due regard for ethical standards.					

Assessment Pattern: Cognitive Domain

Type of Assessment	Component	Marks	Remarks
Continuous Assessment	Pre-lab, In-lab, Post-lab	75	Conducted throughout the semester
Model Test	CO-wise (Cognitive, Psychomotor, Affective)	25	Mid/End semester internal test
Total Internal Marks		**100**	
End Semester Examination	CO-wise (Cognitive, Psychomotor, Affective)	100	As directed by COE or as per the curriculum

List of Experiments with CO Mapping

Sl. No.	Name of the Experiment	Level of Experiment	Objective(s)	COs Addressed
1	Determine the acceleration due to gravity (g) and the radius of gyration of a compound pendulum by studying its time period of oscillation.	1	1,2,3,4,13	CO1, CO2, CO3, CO4, CO6
2	Determine the resonant frequency, quality factor (Q), and bandwidth of an LCR series circuit by measuring the frequency response of current amplitude.	1	1,2,3,4,13	CO1, CO2, CO3, CO4, CO6
3	Determine the energy band gap (E_g) of a semiconductor material (Germanium or Silicon) by studying the variation of reverse saturation current with temperature.	1	1,2,3,4,13	CO1, CO2, CO3, CO4, CO6
4	Determine Planck's constant (h) using LEDs of different known wavelengths by measuring the threshold (knee) voltage for light emission.	1	1,2,3,4,6	CO1, CO2, CO3, CO4, CO5
5	Determine the frequency of AC supply using a sonometer and verify the laws of transverse vibrations of stretched strings.	1	1,2,3,4,6	CO1, CO2, CO3, CO4, CO5

6	Realise the Toffoli gate (CCNOT) using standard NAND, AND, and XOR logic gates, and verify its truth table, demonstrating reversibility and universality.	2	1,3,13	CO1, CO3, CO6
7	Study the I-V characteristics of a silicon solar cell under illumination and determine it short-circuit current (Isc), open-circuit voltage (Voc), fill factor (FF), and photoelectric conversion efficiency (η).	1	1,2,3,4,13	CO1, CO2, CO3, CO4, CO6
8	Determine the magnetic field along the axis of a current-carrying circular coil and verify the Biot–Savart law.	1	1,2,3,4,13	CO1, CO2, CO3, CO4, CO6

Course Designer(s):

Dr. M. Mahendran manickam-mahendran@tce.edu
Dr. M. Tamilelakkiya mtphy@tce.edu
Dr. S. Karthickprabhu skphy@tce.edu

26TAAA0	HERITAGE OF TAMILS	Category	L	T	P	Credits
		Audit	1	0	0	0

1. Preamble

Tamil heritage represents a rich blend of culture, literature, art, science, ethics, and social values that have shaped Tamil civilization for centuries. It offers valuable insights into humanism, environmental harmony, indigenous knowledge systems, and inclusive social living. The timeless ideals reflected in Tamil literature and traditions help students develop cultural awareness, ethical responsibility, and global citizenship. This course enables learners to appreciate the contributions of the Tamils and understand the relevance of their heritage in the modern world

2. Prerequisite

NIL

3. Course Outcome:

On the successful completion of the course students will be able to

No	Course Outcome	TPS Level	PO Addressed	CO Weightage	SDG addressed	SDG Level
CO1	Explain the historical development of Tamil language and literature, including Sangam literature, Tamil epics, Bhakti movements, and modern literary contributions	TPS2	PO1 – M PO2 – L	20	SDG 4	1
CO2	Explain the significance of Tamil artistic traditions, temple architecture, handicrafts, musical instruments, and their role in preserving Tamil culture.	TPS2	PO1 – M PO2 – L	20	SDG 4	1
CO3	Illustrate the role of Tamil folk and martial art forms in promoting cultural values, community participation, and traditional knowledge.	TPS3	PO1 – S PO2 – M PO3 – L	20	SDG 4	1
CO4	Illustrate the relationship between Sangam literary concepts, socio-economic life, and the environmental and cultural practices of ancient Tamil society.	TPS3	PO1 – S PO2 – M PO3 – L	20	SDG 4	1
CO5	Illustrate the impact of Tamil cultural, literary, and social contributions on Indian society and heritage.	TPS3	PO1 – S PO2 – M PO3 – L	20	SDG 4	1

4. Assessment Pattern

CO	CAT 1	Assignment 1	CAT 2 (MCQ)	Assignment 2	Terminal Exam (MCQ)
	% of marks	% of Marks	% of Marks	% of Marks	% of Marks
CO1	-	-	10	10	10
CO2	-	-	10	10	10
CO3	-	-	20	20	20
CO4	-	-	30	30	30
CO5	-	-	30	30	30
Total	**-**	**-**	**100**	**100**	**100**

* The Terminal Examination and CAT-2 shall be conducted as a Multiple-Choice Question (MCQ) examination.

5. Syllabus

Module 1:
Language Families in India – Dravidian Language – Tamil as a Classical Language – Classical Literature in Tamil – Secular Nature of Sangam Literature – Management Principles in Thirukkural – Tamil Epics and Impact of Buddhism & Jainism in Tamil Land – Bhakti Literature: Azhwars and Nayanmars – Forms of Minor Poetry – Development of Modern Literature in Tamil – Contribution of Bharathiyar and Bharathidasan.

Module 2:
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: Mridangam, Parai, Veenai, Yazh and Nadaswaram – Role of Temples in Social and Economic Life of Tamils.

Module 3:
Therukoothu, Karagattam, Villuppattu, Kaniyan Koothu, Oyilattam, Leather Puppetry, Silambattam, Valari, Tiger Dance – Sports and Games of Tamils.

Module 4:
Flora and Fauna of Tamils – Akam and Puram Concept from Tolkappiam 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.

Module 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 System of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

6. Learning Resources

- தமிழக வரலாறு - மக்களும் பண்பாடும் (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
- கணித் தமிழ் - முனைவர் இல சுந்தரம் (விகடன் பிரசுரம்)
- கீழடி - வைகை நதிக்கரையில் சங்ககால நாகரீகம் (தொல்லியல் துறை வெளியீடு)
- பொருநை ஆற்றங்கரை நாகரீகம் (தொல்லியல் துறை வெளியீடு)
- Social Life of the Tamil – The Classical Period (Dr.K.K.Pillay) A joint publication of TNTB&ESC and RMRL – (inprint)
- Social Life of the Tamils- The Classical Period (Dr.S.Singaravelu) Published by: International Institute of TamilStuies.
- Historial Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D.Thirunavukkarasu)) Published by: International Institute of TamilStuies.
- The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) Published by: International Institute of TamilStuies
- Keeladi – Sangam City Civilzation on the banks of river Vaigai (Jointly Published Department of Archaeology & Tamil Nadu Text Book and Educational Servics Corporation,Tamilnadu)
- Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillai, Publisher by The Author)

- Porunai Civilization (Jointly Published by : Department of Archaeology & Tamil Nadu Text Book and Education Service Corporation, TamilNadu)
- Journey of Civization indus to Vaigai (R.Balakrishnan) Published by: RMRL – Reference Book

1. Course Contents and Lecture Schedule

Module No.	Topics	No. of Periods
1	**LANGUAGE AND LITERATURE**	
1.1	Language Families in india – Dravidean Language – Tamil as a Classical Language – Classical Literature in Tamil – Secular Nature of Sangam Literature	1
1.2	Management Principles in Thirukural – Tamil Epics and impact of Buddhism & jainesm in Tamil Land – Bakthi Literature Azhwar and Nayanmars	1
1.3	Forms of minor Poetry – Development of Modern Literature in Tamil – Contribution of Bharathiyar and Bharathidhasan.	1
2	**HERITAGE – ROCK ART PAINTING TO MODERN ART – SUCLPUTRE**	
2.1	Hero Stone to Modern Sculputre – Bronze icons – tribes and their handicrafts – Art of Temples car making	1
2.2	Massive Terracotta Sculputres, Village deties, Thiruvalluvar State at Kanyakumari, Making of musical instruments	1
2.3	Mridhangam, Parai,Veenai, Yazh and Nadhaswaram-Role of Temples in Social and Economic Life of Tamils.	1
3	**FOLK AND MARTIAL ARTS**	
3.1	Therukoothu, Karagattam,Villu Pattu,	1
3.2	Kaniyan koothu,Oyillattam,Leather puppertry,	1
3.3	Silambattam,Valari,Tiger dance-Sports and Games of Tamils.	1
4	**THINAI COCEPT OF TAMILS**	
4.1	Flora and Fauna of Tamils &Aham and Puram Concept forTholkappiam and Sangam Litearture	1
4.2	Aram Concept of Tamils – Education and Literacy during Sangam Age	1
4.3	Ancient Cities and Ports of Sangam Age – Export and Import during Sangam Age- Overseas Conduest of Cholas.	1
5	**CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE**	
5.1	Contribution of Tamils TO Indian Freedom Struggle	1
5.2	The Cultural Influnence of Tamils over the other parts of India – Self – Respect Movement	1
5.3	Role of Siddha Medicine in Indigenous System of Medicine – Inscription & Manuscripts – Print History of Tamil Books	1
	Total	15

Course Designers:

Mr. M Babu.mbutce@tce.edu

26CCAA0	VISION and SPEED MATHS (Common to all Programmes)	Category	L	T	P	Credits
		AC	0	0	2	0

1. Preamble

This course inducts first-year students into the TCT Career Training (CT) framework. It combines a Vision induction — orientation, baseline online assessment, and group counseling — with WOWs, a structured Speed-Maths workshop that introduces mental-arithmetic methods. Together these elements build the motivation, baseline awareness, and computational fluency that support all subsequent CT courses.

2. Course Outcomes

After the successful completion of the course, students will be able to:

No.	Course Outcome	TPS Level	Performance Indicator	CO Weightage
CO1	Articulate personal and academic goals aligned with the CT programme objectives.	TPS3	2.1.1	20%
CO2	Assess baseline aptitude through diagnostic tests and identify focus areas for improvement.	TPS3	2.1.2	20%
CO3	Apply foundational mental-arithmetic methods (SAW, Oz, Mirror, High 5) to solve numeric problems.	TPS3	1.4.1	20%
CO4	Apply advanced WOWs methods (square/cube roots, Crisscross, Base multiplication) to multi-digit calculations.	TPS3	1.4.1	20%
CO5	Demonstrate computational speed and accuracy in time-bound aptitude challenges.	TPS4	2.4.1	20%

3. Assessment Pattern

CO	CAT1 (% of Marks)	CAT2 (% of Marks)	Terminal Exam (% of Marks)
CO1	50	—	10
CO2	50	—	10
CO3	—	50	20
CO4	—	50	20
CO5	—	—	40
Total	**100**	**100**	**100**

The assessment will be conducted by the Training Team, and the marks will be submitted by the respective faculty in charge.

4. Syllabus

Module 1: Vision — Orientation & Programme Overview

Programme overview – CT framework – Expectations and outcomes – Code of conduct

Module 2: Vision — Diagnostic Online Test

Baseline aptitude assessment – Section-wise diagnosis – Personal scorecard – Improvement plan

Module 3: Vision — Group Counseling & Career Mapping

Career exploration – Goal setting – Strengths / interests mapping – Sector overview – Action planning

Module 4: WOWs — Foundational Methods

SAW method – Oz method – Mirror method – High 5 method – Minion's method – King and Queen method – Square root and cube root – Butterfly method – Inception method

Module 5: WOWs — Advanced Methods

Cube of a number – Goldeneye method – Base multiplication – Crisscross method – Super power method – Cast away method

5. Learning Resources

5.1 Text Book

M. Tyra — "Magical Book on Quicker Maths", BSC Publishing.

5.2 Reference Books & Web Resources

1. Bhanu Prakash — "Quicker Maths", S. Chand Publishing.
2. Arun Sharma — "How to Prepare for Quantitative Aptitude", McGraw Hill.
3. TCT CT Internal Workshop Manual — Speed Maths (WOWs).

6. Course Designer(s)

1. Mr. S. A. R. Sheik Masthan, Asst. Professor, Mechatronics, sarsmech@tce.edu
2. Dr. R. Rajan Praksah, Associate Professor, EEE, r_rajanprakash@tce.edu

B.E. COMPUTER SCIENCE AND ENGINEERING
(Artificial Intelligence and Machine Learning)
DEGREE PROGRAMME

CURRICULUM AND DETAILED SYLLABI

FOR

SECOND SEMESTER

FOR THE STUDENTS ADMITTED IN THE

ACADEMIC YEAR 2026-27 ONWARDS

THIAGARAJAR COLLEGE OF ENGINEERING
(A Government Aided Autonomous Institution affiliated to Anna University)
MADURAI – 625 015, TAMILNADU

Phone: 0452 – 2482240, 41
Fax: 0452 2483427
Web: www.tce.edu

THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015
B.E. / B.Tech. Degree Programmes

COURSES OF STUDY
(For the candidates admitted from 2026-27 onwards)

SECOND SEMESTER

Course Code	Name of the Course	Category	No. of Hours / Week			credits
			L	T	P	
THEORY						
26AMSA0	Numerical Techniques and Linear Algebra	BSC	2	1	-	3
26CHSB0	Applied Chemistry	BSC	3	-	-	3
26AMCB0	Digital System Design	PCC	3	-	-	3
26AMCC0	Cognitive Science	PCC	3	-	-	3
26AMEB0	Programming Paradigms	ESC	3	-	-	3
26CCEB0	Biology for Engineers	ESC				3
THEORY CUM PRACTICAL						
26AMCD0	Graphics and Interactive Techniques	PCC	2	-	2	3
PRACTICAL						
26AMCE0	Programming Languages Lab	PCC	-	-	2	1
26CHSC0	Chemistry Laboratory	BSC	-	-	3	1.5
AUDIT COURSES						
26TAAB0	Tamil and Technology	AC				-
26CCAB0	Foundations of Problem Solving-1	AC				-
		Total				**23.5**

BSC : Basic Science Courses
HSMC : Humanities and Social Sciences including Management Courses
ESC : Engineering Science Courses
PCC : Programme Core Courses

L : Lecture
T : Tutorial
P : Practical

Note:
1 Lecture Period/week is equivalent to 1 credit
1 Tutorial Period/week is equivalent to 1 credit
1 Practical Period/week is equivalent to 0.5 credit

THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015
B.E. / B.Tech. Degree Programme

SCHEME OF EXAMINATIONS
(For the candidates admitted from 2026-27 onwards)

SECOND SEMESTER

S.No.	Course Code	Name of the Course	Duration of Terminal Exam. in Hrs.	Marks			Minimum Marks for Pass	
				Continuous Assessment *	Terminal Exam **	Max. Marks	Terminal Exam	Total
THEORY								
1	26AMSA0	Numerical Techniques and Linear Algebra	3	40	60	100	27	50
2	26CHSB0	Applied Chemistry	3	40	60	100	27	50
3	26AMCB0	Digital System Design	3	40	60	100	27	50
4	26AMCC0	Cognitive Science	3	40	60	100	27	50
5	26AMEB0	Programming Paradigms	3	40	60	100	27	50
6	26CCEB0	Biology for Engineers	3	40	60	100	27	50
THEORY CUM PRACTICAL								
7	26AMCD0	Graphics and Interactive Techniques	3 (Terminal Exam Type : Theory)	50	50	100	22.5	50
PRACTICAL								
8	26AMCE0	Programming Languages Lab	3	60	40	100	18	50
9	26CHSC0	Chemistry Laboratory	3	60	40	100	18	50

26AMSA0 **NUMERICAL TECHNIQUES AND LINEAR ALGEBRA**

Category	L	T	P	Credit
BSC	2	1	0	3

Preamble

Numerical Techniques and Linear Algebra delivers a comprehensive integration of numerical techniques and advanced linear algebra essential for modern engineering and data-driven computational systems. This course develops quantitative reasoning, algorithmic thinking, and structured problem-solving skills that are critical for modern computing disciplines. It bridges mathematical theory with computational practice, preparing students to model, analyse, and solve problems encountered in data science, artificial intelligence, machine learning.

Prerequisite

Nil

Course Outcomes

After the successful completion of the course, students will be able to:

No.	Course Outcome	TPS Level	Performance Indicator	CO Weightage	SDG addressed	SDG Level
CO1	Apply numerical techniques to solve equations and systems of equations	TPS3	1.1.1.	15%	SDG 4	2
CO2	Compute basis, dimension of vector spaces.	TPS3	1.1.1.	17%	SDG 4	2
CO3	Compute matrix representations of linear transformations and apply change-of-basis operations to characterize similar matrices representing the same operator.	TPS3	1.1.1.	17%	SDG 4	2
CO4	Apply the Gram-Schmidt orthogonalization process to construct an orthonormal basis from a given basis in an inner product space	TPS3	1.1.1.	17%	SDG 4	2
CO5	Compute eigenvalues and eigenvectors to perform matrix diagonalization.	TPS3	1.1.1.	17%	SDG 4	2
CO6	Apply matrix factorization techniques to compute the singular value decomposition and execute principal component analysis	TPS3	1.1.1.	17%	SDG 4	2

Assessment Pattern

CO	CAT1	Assignment 1	CAT2	Assignment 2	Terminal Exam
	% of Marks	% of Marks	% of Marks	% of Marks	% of Marks
CO1	30	30			15
CO2	35	35			17
CO3	35	35			17
CO4			34	34	17
CO5			33	33	17
CO6			33	33	17
Total	**100**	**100**	**100**	**100**	**100**

Syllabus

Numerical Techniques:
Solving Algebraic and Transcendental Equations: Newton-Raphson Method- The Secant Method. System of Linear Equations: Gauss Elimination and Gauss Jordan Method. System of Non-Linear Equations: Fixed point iteration - Newton Raphson Method.

Vector Spaces:
Introduction to Vector spaces and Subspaces -Linear Independence - Basis and Dimension- Null Space, Row space and Column space – Rank-Nullity Theorem.

Linear Transformations:
Linear Transformations - Definitions and Examples - Matrix Representations of Linear Transformations – Similarity of transformation

Orthogonality:
Inner Product spaces - Orthonormal sets - The Gram-Schmidt Orthogonalization Process- QR Decomposition.

Eigen Systems and Its Applications:
Eigenvalues and Eigenvectors of Matrices – Properties of Eigenvalues and Eigenvectors - Diagonalization of Matrices.

Singular Value Decomposition and Principal Component Analysis:
The Singular Value Decomposition of Matrices - Generalized inverse - Principal Component Analysis.

Learning Resources

6.1Text Book

1. Steven J. Leon and Lisette G.de Pillis “Linear Algebra with Application” Pearson Education, Tenth Edition, 2021.
   Vector Spaces: 3.3,3.4,3.6
   Linear Transformations: 4.1,4.2,4.3
   Orthogonality: 5.4,5.5,5.6
   Eigen Systems and its Applications: 6.1,6.3,
   Singular Value Decomposition and Generalized inverse: 6.5, 7.7
2. Steven C. Chapra and Raymond P. Canale, “Numerical Methods for Engineers” McGraw Hill Publications, 8th Edition, 2021.
   Numerical Techniques: 6.2,6.3, 9.2, 6.6
3. David C. Lay. Steven R. Lay. J.J. McDonald, “Linear Algebra and Its Applications” Pearson Education Limited, 5th Edition, 2022.
   Principal Component Analysis: 7.5

Reference Books & Web resources

1. Gilbert Strang., “Introduction to Linear Algebra”, Wellesley-Cambridge Press, 6th Edition, 2023.
2. Grewal B.S., “Numerical Methods in Engineering and Science”, Mercury Learning and Information, 1st Edition, 2019.
3. https://nptel.ac.in/courses/111106051
4. https://www.coursera.org/learn/linear-algebra-machine-learning

Course Contents and Lecture Schedule

Module No.	Topics	No of Periods
1	**Numerical Techniques**	
1.1	Solving Algebraic and Transcendental Equations: Newton-Raphson and The Secant Method	1
1.2	Linear System of Equations: Gauss Elimination, Gauss Jordan.	1
	Tutorial	1
1.3	System of Non-Linear Equations: Fixed point iteration	1
1.4	Newton Raphson Method	1
	Tutorial	1
2	**Vector Spaces**	
2.1	Introduction to vector spaces and subspaces	1
2.2	Linear Independence	1
	Tutorial	1
2.3	Basis and Dimension	1
2.4	Null Space and Row Spaces	1
	Tutorial	1
2.5	Column space & Rank-Nullity Theorem	1
3	**Linear Transformations**	
3.1	Linear Transformations- Definitions and Examples	1
	Tutorial	1
3.2	Matrix Representations of Linear Transformations	2
	Tutorial	1
3.3	Similarity of Transformations	1
4	**Orthogonality**	
4.1	Inner Product spaces Definition and Examples	1
	Tutorial	1
4.2	Orthonormal sets	1
4.3	The Gram-Schmidt process and QR-Decomposition	1
	Tutorial	1
5	**Eigen Systems and Its Applications**	
5.1	Eigenvalues and Eigenvectors of Matrices	1
5.2	Properties of Eigenvalues	1
	Tutorial	1
5.3	Diagonalization of Matrices	2
	Tutorial	1
6	**Singular Value Decomposition and Principal Component Analysis**	
6.1	The Singular Value Decomposition of Matrices	2
	Tutorial	1

6.2	Generalized inverse	1
6.3	Principal Component Analysis	1
	Tutorial	1
	Total Hours	36

Course Designer(s):

1. Dr. C. S. Senthilkumar, Assistant Professor, Mathematics kumarstays@tce.edu
2. Dr. P. Victor, Assistant Professor, Mathematics pvmat@tce.edu
3. Dr. I. Pradeepa, Assistant Professor, Mathematics ipamat@tce.edu

		Category	L	T	P	Credit
26CHSB0	**APPLIED CHEMISTRY**	BSC	3	0	0	3

1. Preamble

This course equips students of circuit and computer branches with chemical principles underlying key engineering technologies. It covers water quality assessment and treatment, spectroscopic analytical techniques, electrochemical energy storage systems, and chemistry of advanced engineering materials.

2. Prerequisite

- Nil

3. Course Outcomes

After the successful completion of the course, students will be able to

No.	Course Outcome	TPS Level	Performance Indicator	CO Weightage	SDG addressed	SDG Level
CO1	Explain water quality parameters and assessment techniques, including IOT based sensors, to assess water suitability for domestic, industrial, and boiler applications.	2	1.2.1	10	SDG 3 – Good Health and well-being SDG 6 - Clean water and sanitation	2
CO2	Apply standard estimation techniques, appropriate water treatment methods to select and justify solutions for boiler feed water preparation and industrial effluent treatment.	3	1.2.1	20	SDG 6 - Clean water and sanitation	2
CO3	Apply the principles and instrumentation of spectroscopic techniques to identify materials and interpret spectra for chemical, environmental, biomedical, and space applications.	3	1.2.1	20	SDG 3 – Good Health and well-being	2
CO4	Apply electrochemical principles to analyze energy storage systems and photovoltaic devices	3	1.2.1	16	SDG 7 – Affordable and Clean Energy	2

CO5	Use the concepts of corrosion mechanisms and surface protection techniques to select appropriate corrosion control measures for electronic devices.	3	1.2.1	14	SDG 9 – Industry, Innovation and Infrastructure	2
CO6	Apply structure–property relationships of ceramics, carbon-based nanomaterials to select suitable materials for specific applications.	3	1.2.1	20	SDG 9 - Industry, Innovation and Infrastructure SDG 12 – Responsible consumption	2

4. Assessment Pattern

CO	CAT1	Assignment 1	CAT2	Assignment 2	Terminal Exam
	% of Marks	% of Marks	% of Marks	% of Marks	% of Marks
CO1	20				10
CO2	40	50			20
CO3	40	50			20
CO4			32	50	16
CO5			28		14
CO6			40	50	20
Total	100	100	100	100	100

5. Syllabus

Water: Water Quality parameters: Physical, Chemical, Biological- Alkalinity-Hardness of water: types-determination of hardness by EDTA method –Boiler trouble –- Softening of water: Internal and External treatment methods – Ion-Exchange method, Desalination process: reverse- and forward osmosis, electrodialysis, solar and multistage flash distillation, Advanced oxidation process for Effluent Treatment. IOT-based sensor for water quality monitoring. [10 hours]

Spectroscopic techniques and applications: Principle, instrumentation, and applications: UV–Visiblespectroscopy-Fluorescence-Inductively Coupled Plasma-Optical Emission, Infra-red-Nuclear magnetic resonance, Magnetic resonance imaging - Spectroscopy in automobile, environmental, biomedical & space applications. [8 hours]

Electrochemical technologies for energy storage and surface protection: Basics of electrochemistry – Batteries: Parameters, Primary -and Secondary batteries (Lead-acid, Lithium-ion, Sodium, Air-batteries, Redox-flow battery, Numerical Problems) –Fuel cells - Photovoltaics and its types, Numerical Problems. Hydrogen generation and storage. Corrosion of electronic devices: causes, effects, Electrochemical methods of corrosion analysis. Control measures -Electroplating-Electroless plating. [11 hours]

Chemistry of Engineering materials: Bonding and the properties of materials -Ceramics and advanced ceramics: types, properties, applications – Nano-materials: Synthesis, structure, properties and applications. Carbon based materials – Graphene, Carbon fibers -. Molecular electronics - Conducting polymers and organic semiconductors, Organic light-emitting devices (OLEDs), Applications in wearable and flexible electronics. [7 hours]

6. Text Book

1. P.C. Jain and Monica Jain, A Textbook of Engineering Chemistry, Dhanpat Rai publications, New Delhi,17th edition, 2018.

Reference Books& web resources

1. S.S. Dara and S.S. Umare, "A Textbook of Engineering Chemistry", S.Chand & Company,12th Edition, Reprint, 2022.
2. V. K. Ahluwalia, Instrumental Methods of Chemical Analysis, Springer Cham, 1st Edition, 2023.
3. T. Pradeep, *A Textbook of Nanoscience and Nanotechnology*, McGraw-Hill (Indian Edition), 2012

SDG Alignment

Activities aligned with SDGs addressed:

1. Estimation of hardness in domestic water
2. Report on Spectroscopic techniques in environmental applications

7. Course Contents and Lecture Schedule

Module No	Topics	No of Periods
1	**WATER**	
1.1	Importance of water, standards for drinking water, (WHO, BIS & ICMR standards) physical, chemical & biological characteristics, Alkalinity (principle only)	2
1.2	Hardness of water- types, units. Determination of hardness by EDTA method and numerical problems	2
1.3	boiler trouble: Scale and sludge formation, Langelier saturation index, boiler corrosion, priming and foaming, caustic embrittlement	1
1.4	Internal treatment methods: Carbonate, Phosphate, Colloidal, Calgon conditioning	1
1.5	Softening of water: ion exchange process	1
1.6	External treatment method: Desalination-forward & reverse osmosis, electrodialysis, multistage flash distillation	1
1.7	Effluent Treatment -Advanced oxidation process. IOT-based sensor for water quality	1
2	**SPECTROSCOPIC TECHNIQUES AND APPLICATIONS**	
2.1	Introduction to Electromagnetic Radiation, Types of spectra	1
2.2	**Principle, Instrumentation and Applications:** UV–Visible spectroscopy	2
2.3	Fluorescence spectroscopy, Inductively Coupled Plasma-Optical Emission Spectroscopy	2
2.4	Infra-red spectroscopy	2
2.5	Nuclear magnetic resonance spectroscopy –Magnetic resonance imaging	1
2.6	Spectroscopy in environmental, biomedical & space applications	1
3	**ELECTROCHEMICAL TECHNOLOGIES FOR ENERGY STORAGE AND SURFACE PROTECTION**	
3.1	**Electrochemistry-**Introduction**–**Basics of electrochemistry–Redox process, EMF	1
3.2	Energy storage–Batteries, Battery quality parameters, Primary battery–Dry cell and Alkaline cell	1
3.3	Secondary battery–Lead-acid battery, Lithium-ion, Sodium, Air-	2

	batteries, Redox-flow battery, Numerical Problems	
3.4	P hotovoltaics and its types, Numerical Problems	1
3.5	Fuel cells– Fundamentals, types and applications. Hydrogen generation and storage	2
3.6	Corrosion of electronic devices: causes, effects, Electrochemical methods of corrosion analysis	2
3.7	Control measures - Electroplating–Introduction, Process, Applications (Gold and nickel plating). Electroless plating – Principle, process, Applications (PCB manufacturing)	2
4	**CHEMISTRY OF ENGINEERING MATERIALS**	
4.1	Bonding and the property of materials - melting point-brittleness, ductility–thermal, electrical, and ionic conductivity-magnetic - optical-hydrophobic, hydrophilic properties	2
4.2	Ceramics and advanced ceramics: types, properties, applications	2
4.3	Nanomaterials – Classification, Synthesis and properties	1
4.4	Carbon based materials Synthesis, structure, properties, and applications of graphene, carbon fibers	1
4.5	Molecular electronics - Conducting polymers and organic semiconductors, Organic light-emitting devices (OLEDs), Applications in wearable and flexible electronics	1
	Total Periods	36

8. Course Designer(s):

1. Dr. V. Velkannan, Assistant Professor, Chemistry — velkannan@tce.edu
2. Dr. M. Velayudham, Assistant Professor, Chemistry — mvchem@tce.edu
3. Dr. B. Shankar, Assistant Professor, Chemistry — bsrchem@tce.edu
4. Dr. R. Sivakumar, Assistant Professor, Chemistry — rsrchem@tce.edu
5. Dr. P. Ramkumar, Assistant Professor, Chemistry — prrchem@tce.edu

26AMCB0 DIGITAL SYSTEM DESIGN

Category	L	T	P	Credit
PCC	3	0	0	3

Preamble

Digital system design course is designed to make students familiar with the design of combinational and sequential circuits by considering the system requirements and constraints. Students will gain practical exposure to Verilog HDL for odelling and simulation of digital circuits. This course also addresses the control and data path design principles.

Prerequisite

NIL

Course Outcomes

After the successful completion of the course, students will be able to:

No.	Course Outcome	TPS Level	Performance Indicator	CO Weightage	SDG addressed	SDG Level
CO1	Explain the number systems, data encoding standards and binary arithmetic	TPS2	1.3.1	10	-	
CO2	Execute the simplification of Boolean logic functions by applying the theorems and postulates of Boolean algebra and Karnaugh map.	TPS3	1.3.1	15	SDG 4	2
CO3	Implement combinational logic circuits by using gates, multiplexers and Programmable logic devices	TPS3	2.4.1	25	SDG 9	2
CO4	Develop VHDL program for combinational circuits	TPS3	2.4.1	15	SDG 9	2
CO5	Implement the sequential logic circuits like counters and shift registers by using the given Flip flops.	TPS3	2.4.1	20	SDG 9	2
CO6	Implement Sequence detectors and RTL based control and data path design	TPS3	1.3.1	15	SDG 9	2

Assessment Pattern

CO	CAT1	Assignment 1	CAT2	Assignment 2	Terminal Exam
	% of Marks	% of Marks	% of Marks	% of Marks	% of Marks
CO1	20				10
CO2	30	40			15
CO3	50	60			25
CO4			30	30	15
CO5			40	40	20
CO6			30	30	15
Total	100	100	100	100	100

Syllabus

Module 1: Binary Number System, Data Encoding and Boolean Algebra:
Binary Number system and its conversion to hexadecimal number System-Complements, Signed Binary Numbers and Arithmetic-BinaryCoded Decimal (BCD) and decimal Addition using BCD–Precision and overflow concepts – Floating-point representation: IEEE 754 single and double precision format –Character encoding standards: ASCII and Unicode (UTF-8, UTF-16).

Module 2: Boolean theorems and Gate level minimization:
Theorems and Properties of BooleanAlgebra- Canonical and standard forms –Digital Logic Gates and Logic Operations-Simplification of logic functions using Karnaugh Map(K-map) Method- Four variable K-map-Don't cares-: Two-level implementation: AND-OR, OR-AND, NAND-NAND, NOR-NOR implementation

Module 3: Combinational Logic Design:
Design and Implementation Binary Adder, Subtractor and Multiplier – Magnitude comparator, decoder and encoder-Multiplexers – Demultiplexer and their applications in implementing combinational logic functions –Organization of ROM, PLA and PAL and their application in implementing combinational logic circuits–Introduction to Complex PLDs (CPLDs) and Field Programmable Gated Array(FPGA)- Integrated circuits (IC) and its types

Module 4: Hardware Description Language – Verilog for Combinational Circuits:
Introduction to Hardware Description Language –Modeling Combinational Circuits: Dataflow modelling using assign statements and continuous assignments – Gate-level modeling – Behavioral modeling of simple combinational circuits – User-defined primitives (UDPs) – Test Benches

Module 5: Sequential Logic Design:
Introduction- SR latch and D latch operation – Positive and negative edge-triggered D, JK, and T flip-flops – truth table- logic diagrams andconversions between them-Sequential Building Blocks: Registers: SISO, SIPO, PISO, PIPO shift registers – Universal shift register – Design of 4-bit, 8-bit registers – Synchronous counters: up-counter, down-counter, up-down counter – Ripple (asynchronous) counters: 4-bit ripple counter – Modulo-N counters – Johnson counter and ring counter

Module 6: Finite State Machines and Control-Datapath Design:
Finite state machines(FSM) – Principles and operation of Mealy and Moore type Circuits-Design of Mealy and Moore type simple sequence detectors-Introduction-Register Transfer Level (RTL) Notation-Algorithmic State Machine (ASM)- ASM Chart –ASM Block –simplifications- Timing consideration –ASMD Chart –Design examples- Sequential binary multiplier- Design for Low power Edge devices- Processors –CPU,GPU,FPGA and ASIC Comparison

Learning Resources

6.1 Text Book

1. M. Morris Mano, Micheal D. Ciletti, Digital Design: With an Introduction to the Verilog HDL,VHDL, and System Verilog, Pearson Education; Sixth edition,2018.

6.2 ReferenBooks&Web resources

1. R. P. Jain and KishorSarawadekar, “Modern Digital Electronics”, McGraw-Hill, Standard Edition, 2022.
2. Stephen Brown and ZvonkoVranesic, “Fundaentals of Digital Logic with Verilog Design”, McGraw-Hill, 3rd Edition, 2014.
3. Leach, Malvino, Saha, Digital Principles and Applications, McGraw Hill Education;
4. Eighth edition, 2014.
5. Mohammed Ferdjallah, Introduction to digital systems, Modelling, Synthesis and simulation using VHDL, Wiley,2011.
6. Alan B. Marcovitz,Introduction to Logic Design, 3rd Edition. McGraw-Hill, 2010.
7. NPTEL Course: Digital Circuits – https://nptel.ac.in/courses/108105132
8. https://stlpartners.com/articles/edge-computing/edge-computing-devices/
9. S. R. Jena, Dr. Dileep Kumar M , Dr. UppalapatiSrilakshmi, Dr. MukeshSoni“ Integrated Chip Design Using Artificial Intelligence “,NGUI USA,2025

Course Contents and Lecture Schedule

Module No.	Topics	No. of Periods
1	**Module 1: Number Systems, Data Encoding, and Boolean Algebra**	
1.1	Binary Number system and its conversion tohexadecimal number System-Complements, Signed Binary Numbers and Arithmetic-	2
1.2	BinaryCoded Decimal (BCD) and decimal Addition using BCD	
1.3	Precision and overflow concepts – Floating-point representation–Character encoding standards: ASCII and Unicode	2
2	**Module 2:Boolean theorems and Gate level minimization**	
2.1	Theorems and Properties of BooleanAlgebra- Canonical and standard forms	2
2.2	Digital Logic Gates and Logic Operations	1
2.3	Simplification of logic functions using Karnaugh Map (K-map) Method- Four variable K-map-Don’t cares	2
2.4	Two-level implementation: AND-OR, OR-AND, NAND-NAND, NOR-NOR implementation	1
3	**Module 3:Combinational Logic Circuits**	
3.1	Design and Implementation Binary Adder, Subtractor and Multiplier	2
3.2	Magnitude comparator, decoder and encoder	2
3.3	Multiplexers and their applications in implementing combinational logic functions -	1
3.4	Organizationof ROM, PLA and PALand their application in implementing combinational logic circuits	2
3.5	Introduction to Complex PLDs (CPLDs) and Field Programmable Gated Array (FPGA)	1

4	**Module 4: Hardware Description Language – Verilog for Combinational Circuits**	
4.1	Introduction to Hardware Description Language – Modeling Combinational Circuits: Dataflow modeling using assign statements and continuous assignments	1
4.2	Gate-level modeling – Behavioral modeling	2
4.3	modeling of simple combinational circuits – User-defined primitives (UDPs) – Test Benches	2
5	**Module 5: Sequential Logic Design**	
5.1	Introduction- SR latch and D latch operation –Positive and negative edge-triggered D, JK, and T flip-flops – truth table- logic diagrams and conversions between them	2
5.2	Sequential Building Blocks: Registers: SISO, SIPO, PISO, PIPO shift registers – Universal shift register	2
5.3	Synchronous counters: up-counter, down-counter, up-down counter	2
5.4	– Ripple (asynchronous) counters: 4-bit ripple counter – Modulo-N counters – Johnson counter and ring counter	1
6	**Module 6: Finite State Machines and Control-Datapath Design**	
6.1	Finite state machines (FSM) – Principles and operation of Mealy and Moore type Circuits	2
6.2	Design of Mealy andMoore type simple sequencedetectors	
6.3	Introduction-Register Transfer Level (RTL) Notation-	2
6.4	Algorithmic State Machine (ASM)- ASM Chart –ASM Block –simplifications-Timing consideration –ASMD Chart	
6.5	Design example- Sequential binary multiplier	2
	TOTAL PERIODS	36

8.Course Designer(s):

1. Dr.S.Padmavathi, Professor, AI spmcse@tce.edu
2. Dr.C.Senthilkumar, Associate Professor, CSE cskcse@tce.edu
3. Mrs.J.Vijayalakshmi, Assistant Professor, CSE jvicse@tce.edu

26AMCC0 COGNITIVE SCIENCE

Category	L	T	P	Credit
PCC	3	0	0	3

1. Preamble

This course introduces the fundamentals of Cognitive Science, the interdisciplinary study of the mind and cognition. It explores how humans perceive, process, store, and use information through perspectives from psychology, neuroscience, linguistics, and artificial intelligence. The course also examines cognitive systems, decision-making, and intelligent technologies in real-world contexts.

2. Prerequisite

Nil

3. Course Outcomes

After the successful completion of the course, students will be able to:

No.	Course Outcome	TPS Level	Performance Indicator	CO Weightage	SDG addressed	SDG Level
CO1	Explain the fundamentals of Cognitive Science, neuroscience, brain organization, and sensory information processing.	TPS2	1.2.1	15%	-	
CO2	Illustrate neural cognition, linguistic processing, memory models, and reasoning mechanisms involved in intelligent cognitive systems.	TPS2	1.3.1	15%	SDG 9	1
CO3	Apply AI-agent concepts, cognitive architectures, and knowledge representation techniques in modeling intelligent cognitive systems.	TPS3	1.4.1	20%	SDG 9	1
CO4	Use affordance learning, ecological psychology, attention models, and cognitive control mechanisms in robotics	TPS3	1.1.1	15%	SDG 9	1

	and human–computer interaction applications.					
CO5	Demonstrate machine learning, prediction, decision-making, and cognitive computing techniques for intelligent system applications.	TPS3	2.4.1	15%	-	
CO6	Solve real-world problems using cognitive science principles in UI/UX design, cognitive robotics, AR/VR environments, and AI-based systems through case studies.	TPS3	1.1.2	20%	SDG 9	1

Assessment Pattern

CO	CAT1	Assignment 1	CAT2	Assignment 2	Terminal Exam
	% of Marks	% of Marks	% of Marks	% of Marks	% of Marks
CO1	20	30			15
CO2	40	30			15
CO3	40	40			20
CO4			30	30	15
CO5			30	30	15
CO6			40	40	20
Total	100	100	100	100	100

Syllabus

Foundations of Cognitive Science

Introduction to Cognitive Science – Interdisciplinary perspectives of Cognitive Science – Cognitive psychology and neuroscience – Structure and organization of the brain – Nervous system and neural communication – Mathematical models of cognition – Brain signal analysis – EEG, fMRI, PET, and MEG – Processing of sensory information – Perception and multisensory integration – From sensation to cognition- Case Study- Social Media Analytics in Elections, Human Attention and Emotional Decision-Making

Neural and Linguistic Cognition

Neural network models – Motor and sensory systems – Information fusion and cybernetics – Analog and digital cognition – Language and cognition – Syntax, semantics, and pragmatics – Brain and language processing – Language disorders and lateralization – Memory systems – Sensory, short-term, and long-term memory – Heuristics, biases, bounded rationality, and reasoning mechanisms- Case Study- Cambridge Analytica and Psychological Operations in Elections

AI Agents and Cognitive Architectures

AI agents and intelligent cognitive systems – Cognitive architectures: ACT-R, SOAR, ICARUS, and FORR – Perception, prediction, decision making, and knowledge maintenance – Knowledge representation and organization – Knowledge acquisition, utilization, and refinement – Cognitive agents in autonomous systems – Cognitive architectures for adaptive decision making – Evaluation and applications of cognitive systems.

Robotics, Attention, and Human Cognition

Affordances and direct perception – Ecological psychology – Affordance learning in robotics – Child and robotic development – Human visual attention – Computational attention models – Cognitive control mechanisms – Human–computer interaction – Cognitive ergonomics – Applications of cognitive models in robotics, AR/VR systems, and intelligent user-interface design- Case Study- Assistive Technologies for Disability

Cognitive Computing

Machine learning and concept learning – Cognitive computing systems – Social cognition and schemas – Reasoning in intelligent systems – Explainable AI and sustainable cognitive systems – Decision making in intelligent applications – Case Studies: AlphaGo, Mobile Banking UX Design, Apple iPhone Interface Design, AI-driven Recommendation Systems, and Intelligent Healthcare Assistants

6. Learning Resources

6.1 Text Book

1. Don Norman, “The Design of Everyday Things”,Basic Books Publications,2014
2. Nir Eyal, “Hooked: How to Build Habit-Forming Products”, Penguin Books Limited,2014.
3. Jay Freidenberg and Gordon Silverman, Cognitive Science: An Introduction to the Study of Mind,SAGE, 2016.
4. Judith Hurwitz, Marcia Kaufman, Adrian Bowles, Cognitive Computing and Big Data Analytics, Wiley Publications, 2015.
5. Robert A. Wilson, Frank C. Keil, “The MIT Encyclopedia of the Cognitive Sciences”,The MIT Press, 1999.
4. 6.Jose Luis Bermúdez, Cognitive Science -An Introduction to the Science of the Mind, Cambridge University Press 2020.

6.2 Reference Books & Web resources

1. Noah D. Goodman, Andreas Stuhlmuller, “The Design and Implementation of Probabilistic Programming Languages”, Electronic version of book, https://dippl.org/.
2. Noah D. Goodman, Joshua B. Tenenbaum, The ProbMods Contributors, “Probabilistic Models of Cognition”, Second Edition, 2016.
3. Vijay V Raghavan,Venkat N.Gudivada, VenuGovindaraju, C.R. Rao, Cognitive Computing: Theory and Applications: (Handbook of Statistics 35), Elsevier publications, 2016.

7. Course Contents and Lecture Schedule

Module No	Topics	No of Periods
1	**Foundations of Cognitive Science**	
	Introduction to Cognitive Science – Interdisciplinary perspectives of Cognitive Science	1
	Cognitive psychology and neuroscience – Structure and organization of the brain	1
	Nervous system and neural communication – Mathematical models of cognition	1
	Brain signal analysis – EEG, fMRI, PET, and MEG	1
	Processing of sensory information	1
	Perception and multisensory integration – From sensation to cognition.	1
	Case Study- Social Media Analytics in Elections, Human Attention and Emotional Decision-Making	1
2	**Neural and Linguistic Cognition**	
	Neural network models – Motor and sensory systems	1
	Information fusion and cybernetics – Analog and digital cognition – Language and cognition	1
	Syntax, semantics, and pragmatics	1
	Brain and language processing – Language disorders and lateralization	1
	Memory systems – Sensory, short-term, and long-term memory	1
	Heuristics, biases, bounded rationality, and reasoning mechanisms.	1
	Case Study- Cambridge Analytica and Psychological Operations in Elections	1
3	**AI Agents and Cognitive Architectures**	
	AI agents and intelligent cognitive systems	1
	Cognitive architectures: ACT-R, SOAR, ICARUS, and FORR	2
	Perception, prediction, decision making, and knowledge maintenance	1
	Knowledge representation and organization – Knowledge acquisition, utilization, and refinement –	1
	Cognitive agents in autonomous systems – Cognitive architectures for adaptive decision making	1
	Evaluation and applications of cognitive systems	1

4	**Robotics, Attention, and Human Cognition**	
	Affordances and direct perception – Ecological psychology	1
	Affordance learning in robotics – Child and robotic development	1
	Human visual attention – Computational attention models	1
	Human–computer interaction – Cognitive ergonomics	1
	Cognitive control mechanisms –– Applications of cognitive models in robotics	1
	AR/VR systems, and intelligent user-interface design	1
	Case Study- Assistive Technologies for Disability	1
5	**Cognitive Computing**	
	Machine learning and concept learning – Cognitive computing systems ––– Decision making in intelligent applications –	1
	Social cognition and schemas – Reasoning in intelligent systems	1
	Explainable AI and sustainable cognitive systems	1
	Decision making in intelligent applications	1
	Case Studies: AlphaGo, Mobile Banking UX Design, Apple iPhone Interface Design,	2
	AI-driven Recommendation Systems, and Intelligent Healthcare Assistants	2
	Total Periods	36

8.Course Designer(s):

1. Mrs.S.Jeniba,Assistant Professor- sjacse@tce.edu

26AMEB0 PROGRAMMING PARADIGMS

Category	L	T	P	Credit
ESC	3	0	0	3

Preamble

This course introduces the evolution of programming languages and fundamental design principles of programming languages with the case study of major programming paradigms including procedural, object-oriented, functional, concurrent, logic, and scripting paradigms. It enables learners to understand how various programming models influence software design, program structure, modularity, reusability, and system efficiency. The course provides a foundation for selecting appropriate programming techniques for diverse computing applications.

Prerequisite

Nil

Course Outcomes

After the successful completion of the course, students will be able to:

No.	Course Outcome	TPS Level	Performance Indicator	CO Weightage	SDG addressed	SDG Level
CO1	Explain the basics of programming paradigms and its types	TPS2	1.3.1	15%		
CO2	Apply procedural programming concepts to solve computational problems	TPS3	1.4.1	15%		
CO3	Solve the given problems using object-oriented programming concepts	TPS3	5.1.1	20%	SDG9	1
CO4	Develop solutions to establish concurrency in programming.	TPS3	1.4.1	15%		
CO5	Demonstrate the solution for the given problems using functional and logic based declarative programming concepts	TPS3	1.4.1	15%		
CO6	Solve engineering problems using scripting programming paradigm	TPS3	5.1.1	20%	SDG9	1

Assessment Pattern

CO	CAT1	Assignment 1	CAT2	Assignment 2	Terminal Exam
	% of Marks	% of Marks	% of Marks	% of Marks	% of Marks
CO1	30	30	-	-	15
CO2	30	30	-	-	15

CO3	40	40	-	-	20
CO4	-	-	30	30	15
CO5	-	-	30	30	15
CO6	-	-	40	40	20
Total	100	100	100	100	100

Syllabus

Basics of Programming Paradigm - Introduction to Programming Paradigms, Basics of Turing Machine, Types of Programming Paradigm - Imperative Programming Paradigm - Procedural, Object-Oriented and Concurrent Programming Paradigms, Declarative – Functional and Logic Programming Paradigms, Scripting Programming Paradigms.

Imperative Programming Paradigm: **Sequential Programming Paradigm** - **Procedural Programming Paradigm -** Programming Languages and its types, Structured Programming – Von Neumann Systems, Expression and Data Semantics – Sequencing, Selection, Iteration and Recursion, Procedural Programming - Procedural Abstraction – Parameter Passing – Case Study – Basics of C Programming.

Object-Oriented Programming Paradigm - Object-Oriented Programming Design Principles: Classes and Objects – Encapsulation – Data Abstraction – Inheritance and Polymorphism – Exception Handling in OOP. Case Study: Java Programming

Concurrent Programming Paradigm - Sequential and Concurrent Execution – Concurrency Interleaving Concept – Threads and Synchronization Basics – Inter-process Communication - Safe Access to Shared Data - Case Study – Concurrent Programming using Ada.

Declarative Programming Paradigm: Functional Programming Paradigm - Basics of Functional Programming – Lambda Calculus Fundamentals - Expressions – Syntax, Parsing, Types and Values - Function Abstraction and Recursive Functions – Case Study: Haskell Programming.

Logic Programming Paradigm - Clauses and Predicates – Operations and Arithmetic – List and Operations – Unification and Backtracking – Case Study: Prolog.

Scripting Programming Paradigm - Basics of Web Design Language and Scripting Language – Case Study: JavaScript – Syntax of Writing JavaScript – Variables and Functions in JavaScript.

Case Study: Python Programming – Basics of Python.

6. Learning Resources

6.1 Text Book

1. Michael L. Scott, “Programming Language Pragmatics”, Fourth Edition, Morgan Kaufmann, 2016.
2. Seyed Mohamed Buhari, “Principles of Programming Languages A Paradigm approach”, Tata McGraw-Hill, 2011.
3. Ravi Sethi, “Programming Languages: Concepts and Constructs”, AT&T Bell Laboratories, 2nd edition, Addison Wesley, 2007.
4. Programming Languages: Design and Implementation (4th Edition), by Terrence W. Pratt, Marvin V. Zelkowitz, Pearson, 2000.
5. David A.Watt, “Programming Language Concepts and Paradigms”, Prentice Hall, 1990.
6. Bruce J. Maclennan, “Principles of Programming Languages: Design, Evaluation and Implementation”, Second Edition.

6.2 Reference Books & Web resources

1. Minh Quang Tran, “The Art of Functional Programming Paradigm”, 2022.

2. Alejandro Serrano Mena, “Practical Haskell: A Real-World Guide to Functional Programming”, Apress Media, 2019.
3. Axel Rauschmayer, “Speaking JavaScript”, O’Reilly Media, 2015.
4. Max Bramer, "Logic Programming with Prolog", Springer 2005.

7. Course Contents and Lecture Schedule

Module No	Topics	No of Periods
1	**Basics of Programming Paradigm**	
1.1	Introduction to Programming Paradigms, Basics of Turing Machine	1
1.2	Types of Programming Paradigm- Imperative Programming Paradigm - Procedural, Object-Oriented and Concurrent Programming Paradigms, Declarative – Functional and Logic Programming Paradigms, Scripting Programming Paradigms.	1
2	**Imperative Programming Paradigm**: **Sequential Programming Paradigm** - **Procedural Programming Paradigm**	
2.1	Programming Languages and its types	1
2.2	Structured Programming – Von Neumann Systems	1
2.3	Expression and Data Semantics – Sequencing, Selection, Iteration and Recursion	2
2.4	Procedural Programming - Procedural Abstraction – Parameter Passing	2
2.5	Case Study – Basics of C Programming	2
3	**Object-Oriented Programming Paradigm**	
3.1	Object-Oriented Programming Design Principles: Classes and Objects	1
3.2	Encapsulation – Data Abstraction – Inheritance and Polymorphism	1
3.3	Exception Handling in OOP	1
3.4	Case Study: Java Programming	2
4	**Concurrent Programming Paradigm**	
4.1	Sequential and Concurrent Execution – Concurrency Interleaving Concept	1
4.2	Threads and Synchronization Basics – Inter-process Communication	1
4.3	Safe Access to Shared Data	
4.4	Case Study – Concurrent Programming using Ada	1
5	**Declarative Programming Paradigm: Functional Programming Paradigm**	
5.1	Basics of Functional Programming – Lambda Calculus Fundamentals - Expressions – Syntax, Parsing, Types and Values	1
5.2	Function Abstraction and Recursive Functions	1
5.3	Case Study: Haskell Programming	2

	Logic Programming Paradigm	
5.4	Clauses and Predicates – Operations and Arithmetic – List and Operations –	1
5.5	Unification and Backtracking	2
5.6	Case Study: Prolog	2
6	**Scripting Programming Paradigm**	
6.1	Basics of Web Design Language and Scripting Language	1
6.2	Case Study: JavaScript – Syntax of Writing JavaScript	2
6.3	Variables and Functions in JavaScript	2
6.5	**Case Study:** Python Programming – Basics of Python.	4
	Total Periods	36

8.Course Designer(s):

1. Dr.G.Madhupriya, Associate Professor – gmadhupriya@tce.edu
2. Ms.S.Jeniba, Assistant Professor- sjacse@tce.edu

24AMCD0	GRAPHICS AND INTERACTIVE TECHNIQUES	Category	L	T	P	Credit	TE-Type
		PCC	2	0	2	3	TCP-T

Preamble

Graphics and Interactive Systems introduces the fundamentals of animation, and immersive technologies such as VR and AR through theory and practical sessions. Students gain hands-on experience with tools like Sketchup, Unity, and AR Foundation to develop interactive graphics applications and real-time visual systems.

Prerequisite

Nil

Course Outcomes

On the successful completion of the course, students will be able to

No.	Course Outcome	TCE Proficiency Scale	Performance Indicator	CO Weightage	SDG Addressed	SDG Level
CO1	Describe the fundamental concepts of computer graphics and rendering pipeline	TPS 2	1.3.1	15%	SDG 4	1
CO2	Understand the fundamental hardware and software for VR experiences	TPS 2	2.4.1	15%	SDG 9	1
CO3	Apply VR tools to develop a scene for interaction and navigation with in virtual world	TPS 3	1.3.1	20%	SDG 9	1
CO4	Apply animation principles, simulation methods, and Design applications using any Game Engine for 2D, 3D, AR and VR for any target platform.	TPS 3	3.4.1	20%	SDG 9	1
CO5	Design applications for Augmented Reality experiences using mobile devices.	TPS 3	1.3.1	15%	SDG 3	1
CO6	Plan and implement a team-project to develop and build an AR/ VR application or games.	TPS 4	2.4.2	15%	SDG 10	1

Assessment Pattern

CO	CAT1	CAT2	Model Test CO-wise (Cognitive, Psychomotor, Affective)	OCR/Continuous Assessment (Pre-lab, In-lab, Post-lab)	Terminal Exam
	% of Marks	% of Marks	% of Marks	% of Marks	% of Marks
CO1	27				14
CO2	27				14
CO3	46	30			24
CO4		30			24
CO5		40			24
CO6			100	100	
Total	100	100	100	100	100

Assessment Pattern: Practical Component

Type of Assessment	Component	Marks	Remarks
Continuous Assessment	Pre-lab, In-lab, Post-lab	75	Conducted throughout the semester
Model Test	CO-wise (Cognitive, Psychomotor, Affective)	25	Mid/End semester internal test
Total Internal Marks		**100**	
End Semester Examination	CO-wise (Cognitive, Psychomotor, Affective)	100	As directed by COE or as per curriculum

Syllabus

Creating Virtual Worlds with 3D Graphics

Fundamentals of Graphics in VR and AR, Rendering Pipeline, Geometric Transformations, Animation and Motion, Advanced 3D Graphics Techniques, Graphics Processing Units, Game Engines, Vestibular Immersion: Motion Sensing and Stimulation, Motion Tracking Techniques, Optical Tracking Systems, Outside–In Optical Tracking, Inside–Out Optical Tracking, Key Elements of Virtual Reality Experience, Virtual World, Augmented Reality, Tracking technologies, Augmenting displays, Position and orientation in 3d space

Defining Virtual and Augmented Reality

Exploring Virtual Reality, features, Controllers. Exploring Augmented Reality, Form Factors and Controllers. VR hardware, AR hardware Creating Content for Virtual and Augmented Reality. Design Software, Capturing Real Life, Assessing Development Software. Distributing Your Content. 360 degree videos, AR VR Usecases

Geometric Modelling

Modelling new objects using AutoCAD Fusion 360 / Sketchup. Sharing of 2D 3D objects to market place like Asset stores. Creating a sample scene for VR using Sketchup. Navigating in a Virtual World Wayfinding Travel Navigation.

Development Tools and Creating AR/VR Projects

Getting Started with Unity, Installing Unity Hub and Unity Editor, Editor Interface, Creating Projects with Templates, Asset Store. Creating a Simple 2D Game using Game Objects, Scripting in C#, Visual Scripting. Building/Publishing/Exporting to Desktop OS, Mobile OS.

Setting Up AR Development and Sample Projects

Installing XR Plugins for AR Devices, Installing the AR Foundation Package, Using AR Session and AR Session Origin, AR Camera, Adding AR Raycast Manager, Building and Running the Scene. Placing an Object on a Plane, Writing the PlaceObjectOnPlane Script, Creating a Prefab for Placing on the Scene. Building and Running the Sample Project using Unity for 3D Games, Mobile Tracking Applications, Build the Scene to run on Android/iOS Mobile Devices

A sample scene in AR/ VR

Building and running the sample project using Unity for 3D games, Mobile tracking applications, Build the scene in to application to run on Desktop and mobile devices.

Text Book

1. Achintya K. Bhowmik, “Virtual and Augmented Reality Fundamentals and Applications” John Wiley & Sons Ltd, 2026.
2. William Sherman, Alan Craig, "Understanding Virtual Reality – Interface, Application, Design”, The Morgan Kaufmann Series, second edition, 2018.
3. Paul Mealy, Virtual & Augmented Reality for Dummies” John Wiley & Sons, Inc., 2018.
4. Kent Peterson, “Unity Game Development Script, Build, Customize Your Game from Scratch for Beginners and Experts” 2020.
5. Jonathan Linowes, “Augmented Reality with Unity AR Foundation”, Packt Publishing, 2021

Reference Books & web resources

1. Alan B. Craig, William R. Sherman, Jeffrey D. Will, “Developing Virtual Reality Applications”, 2017.
2. Matjaz Mihelj, Domen Novak, Samo Begus, "Virtual Reality Technology and Applications", 1st Edition, Springer Netherlands, 2014.
3. Grigore C. Burdea, Philip Coiffet, “Virtual Reality Technology”, 2nd Edition, Wiley India, 2006.
4. John Vince, "Introduction in Virtual Reality", Springer, 2004.
5. Steve Aukstakalnis, “Practical Augmented Reality”, Addision Wesley 2017.

SDG Alignment

The course addresses the following Sustainable Development Goals (mapping level 2 – Insight from the perspective of the discipline):

SDG 4 – Quality Education: Fundamental concepts of computer graphics and visualization support digital literacy and accessible learning tools. Activity: CO1 lab on colour accessibility and image format analysis.

SDG 9 – Industry, Innovation and Infrastructure: Rendering, geometric modelling, shading, animation, and AR/VR development directly contribute to innovation in digital infrastructure and creative industries. Activities: CO2–CO5 labs on shaders, ray tracing, animation, and immersive app development.

SDG 10 – Reduced Inequalities: Ethics module (CO6) covers accessibility in immersive applications, bias in facial recognition, and inclusive design for persons with visual/motor impairments. Activity: CO6 lab discussion and ethics case study on AI-generated imagery.

Course Contents and Lecture Schedule

Module No	Topics	No of Periods	**Course Outcomes**
1	**Creating Virtual Worlds with 3D Graphics**		
1.1	Fundamentals of Graphics in VR and AR, Rendering Pipeline, Geometric Transformations	1	CO1
1.2	Animation and Motion, Advanced 3D Graphics Techniques, Graphics Processing Units, Game Engines	1	CO1
1.3	Vestibular Immersion: Motion Sensing and Stimulation, Motion Tracking Techniques, Optical Tracking Systems, Outside–In Optical Tracking, Inside–Out Optical Tracking	1	CO1
1.4	Key Elements of Virtual Reality Experience, Virtual World, Augmented Reality, Tracking technologies, Augmenting displays, Position and orientation in 3d space	1	CO1
2	**Defining Virtual and Augmented Reality**		
2.1	Exploring Virtual Reality, features, Controllers.	1	CO2
2.2	Exploring Augmented Reality, Form Factors and Controllers. VR hardware, AR hardware	1	CO2, CO6
2.3	Creating Content for Virtual and Augmented Reality. Design Software, Capturing Real Life	1	CO2
2.4	Assessing Development Software. Distributing Your Content. 360 degree videos, AR VR Use cases	1	CO2
3	**Geometric Modelling**		
3.1	Modelling new object using AutoCAD Fusioin 360 / Sketchup. Sharing of 2D 3D objects to market place like Asset stores.	1	CO3, CO6
3.2	Creating a sample scene for VR using Sketchup. Navigating in a Virtual World Wayfinding Travel Navigation.	2	CO3
	Continuous Assessment Test – I		

4	**Development Tools and Creating AR/VR Projects**		CO4
4.1	Getting Started with Unity, Installing Unity Hub and Unity Editor, Editor Interface	1	CO4
4.2	Creating Projects with Templates, Asset Store. Creating a Simple 2D Game using Game Objects	2	CO4, CO6
4.3	Scripting in C#, Visual Scripting.	1	CO4, CO6
4.4	Building/Publishing/Exporting to Desktop OS, Mobile OS	2	CO4, CO6
5	**Setting Up AR/VR Development and Sample Projects**		
5.1	Installing XR Plugins for AR Devices, Installing the AR Foundation Package, Using AR Session and AR Session Origin, AR Camera, Adding AR Raycast Manager, Building and Running the Scene.	2	CO5, CO6
5.2	Placing an Object on a Plane, Writing the PlaceObjectOnPlane Script, Creating a Prefab for Placing on the Scene.	1	CO5, CO6
5.3	Building and Running the Sample Project using Unity for 3D Games, Mobile Tracking Applications, Build the Scene to run on Android/iOS Mobile Devices	1	CO5, CO6
	Continuous Assessment Test – II		
6	**A sample scene in AR/ VR**		
6.1	Building and running the sample project using Unity for 3D games, Mobile tracking applications	2	CO6
6.2	Build the scene in to application to run on Desktop and mobile devices.	2	CO6
	Total Periods	24	

List of Experiments with CO Mapping

Sl. No.	Name of the Experiment	Level of Experiment	Objective(s)	COs Addressed
1	Modelling new objects using AutoCAD Fusion 360 / Sketchup.	1	Models; Data Analysis	CO1
2	Create a sample scene with 3d objects in SketchUp	1	Experimentation; Psychomotor Skills	CO1

3	Virtual Walkthrough using Jump and walk using fully immersive kits	2	Design; Psychomotor Skills	CO3
4	Creating a walkthrough on mobile devices for a model	3	Data Analysis; Creativity	CO6
5	Unity installation and configuration	1	Psychomotor Skills; Design	CO4
6	Applying Physics, Rigid body, materials to game objects	1	Experimentation; Design	CO4
7	Creating an APK file to run on suitable platform.	2	Experimentation; Psychomotor Skills	CO4
8	Creating a simple 2d game using scripts to get inputs from keyboard.	2	Design; Creativity	CO4
9	Placing a 3d object on a plane in AR	1	Psychomotor Skills; Design	CO4
10	Tracking of images using mobile camara in AR using Unity	2	Design; Creativity	CO4
11	Create a simple 3D game which runs on desktop computer/ mobile devices.	2	Design; Creativity	CO5

Course Designer(s):

1. Dr. N. Shivakumar Associate Professor shiva@tce.edu
2. Mrs.S.Jeniba,Assistant Professor-sjscse@tce.edu

26AMCE0 PROGRAMMING LANGUAGES LAB

Category	L	T	P	Credit
PCC	0	0	2	1

Preamble

This laboratory course gives students hands-on practice in different programming paradigms, including procedural, object-oriented, functional, logic, and concurrent programming. Students implement, test, and compare programs written in Python, Java, Haskell, Prolog, and Ada.

Prerequisite

Nil

Course Outcomes

On the successful completion of the course, students will be able to

COs	Course Outcome	TCE Proficiency Scale	Performance Indicators	SDG Addressed	SDG Level
CO1	Implement Python programs using basic syntax, variables, data types, operators, and control flow constructs to solve well-defined computational problems.	TPS 3	1.3.1		
CO2	Apply Python collection data types and array-style processing techniques to manipulate and analyse structured data.	TPS 3	5.1.1	SDG 4	L2
CO3	Implement modular Python programs using functions, recursion, lambda expressions, exception handling, and file processing techniques	TPS 3	2.4.1	SDG 9	L2
CO4	Implement object-oriented programs in Python and C++/Java by designing class hierarchies that demonstrate encapsulation, inheritance, and polymorphism.	TPS 3	1.3.1		
CO5	Analyse functional and logic programming solutions in Haskell and Prolog by comparing recursive, higher-order, and rule-based approaches with their Python equivalents.	TPS 4	2.4.2	SDG 9	L2
CO6	Analyse the correctness, concurrency behaviour, and design trade-offs of an integrated multi-paradigm application through testing, debugging, and result interpretation.	TPS 4	4.3.1	SDG 4	L2

Assessment Pattern: Cognitive Domain

Type of Assessment	Component	Marks	Remarks
Continuous Assessment	Pre-lab, In-lab, Post-lab	75	Conducted throughout the semester
Model Test	CO-wise (Cognitive, Psychomotor, Affective)	25	Mid/End semester internal test
Total Internal Marks		**100**	
End Semester Examination	CO-wise (Cognitive, Psychomotor, Affective)	100	As directed by COE or as per curriculum

List of Experiments with CO Mapping

Sl. No.	Name of the Experiment	Level of Experiment	Objective(s)	COs Addressed
1	Python Basics and I/O Operators	1	Experimentation	CO1
2	Decision Making and Loop Constructs	1	Experimentation	CO1
3	String Processing and Collections	2	Data Analysis	CO1, CO2
4	Collection Processing and NumPy Arrays	2	Data Analysis	CO2
5	Functions, Recursion and Functional Tools (Python)	2	Creativity	CO3
6	File Handling and Exception Handling (Python)	2	Learn from Failure	CO3
7	Object-Oriented Programming in Python — Shape Class Hierarchy	2	Models	CO4
8	Object-Oriented Programming in C++/Java — Encapsulation and Inheritance using Vector Classes	3	Models	CO4
9	Functional Programming using Haskell — Quicksort and Higher-Order Functions	3	Creativity	CO5
10	Logic Programming using Prolog — GCD and List Operations	3	Creativity	CO5

11	Concurrent Programming using Java/Ada — Readers-Writers Problem	3	Learn from Failure	CO6
12	Integrated Mini Project (Python)	3	Teamwork, Communication, Ethics & Integrity	CO1 to CO6

Course Designer(s):

1. Mrs.S.Jeniba,Assistant Professor- sjacse@tce.edu

26CHSC0	CHEMISTRY LABORATORY	Category	L	T	P	Credits
		BSC	0	0	2	1.0

Preamble

This course aims to provide the students with basic practical knowledge in chemistry. The objective of this course is to develop students' intellectual and psychomotor skills by providing hands-on experience in quantitative analysis, electrochemistry, physicochemistry, photocolorimetry, and green nanomaterial synthesis techniques.

Prerequisite

NIL

Course Outcomes

On the successful completion of the course, students will be able to

COs	Course Outcome	TCE Proficiency Scale	Performance Indicators	SDG Addressed	SDG Level
CO1	Operate pH meters, conductivity bridges, colourimeters, potentiometric systems, and volumetric apparatus to determine physicochemical properties of engineering samples.	TPS 3	5.2.1	SDG 9 – Industry, Innovation and Infrastructure	2
CO2	Measure readings from volumetric, and instrumental methods to determine concentration of chemical and water samples.	TPS 3	4.1.2	SDG 6 – Clean Water and Sanitation	2
CO3	Demonstrate precise laboratory techniques, including pipetting, burette handling, endpoint detection, calibration, and solution preparation during quantitative chemical analysis.	TPS 3	5.3.1	SDG 4 – Quality Education	2
CO4	Apply laboratory safety procedures, chemical handling practices, and waste disposal protocols during analytical and electrochemical experiments.	TPS 3	6.4.1	SDG 12 – Responsible Consumption and Production	2
CO5	Demonstrate structured laboratory reports by interpreting observations, calculations, graphs, error analysis, and experimental conclusions using scientific documentation practices.	TPS 3	9.1.2	SDG 4 – Quality Education	2
CO6	Apply collaborative responsibilities ethically during experimentation, data recording, analysis, and laboratory discussions.	TPS 3	8.2.1	SDG 16 – Peace, Justice and Strong Institutions	2
CO7	Analyse deviations and experimental errors in titrimetric, electrochemical, and instrumental methods, and recommend corrective measures to improve	TPS 4	4.3.1	SDG 9 – Industry, Innovation and Infrastructure	2

	analytical accuracy.				
CO8	Evaluate electrochemical behaviour, corrosion characteristics, and electroplating efficiency of metallic systems using modern electrochemical techniques.	TPS 5	3.3.1	SDG 9 – Industry, Innovation and Infrastructure	2

Assessment Pattern: Cognitive Domain

Type of Assessment	Component	Marks	Remarks
Continuous Assessment	Pre-Lab, In-Lab, and Post-Lab Activities	75	Conducted throughout the semester as per laboratory assessment framework and openness levels specified in the curriculum guidelines.
Model Test	CO-wise Assessment covering Cognitive, Psychomotor, and Affective Domains	25	Mid-semester / End-semester internal practical assessment using structured rubrics aligned with all three learning domains.
Total Internal Marks		**100**	Continuous Assessment (75) + Model Test (25).
End Semester Examination	CO-wise Assessment covering Cognitive, Psychomotor, and Affective Domains	100	Conducted as per COE regulations and curriculum requirements using structured laboratory evaluation rubrics.

List of Experiments with CO Mapping

Sl. No.	Name of the Experiment	Level of Experiment	Objective(s)	COs Addressed
1.	Estimation of Total Hardness of Water	Level 1	Instrumentation, Data Analysis, Psychomotor Skills	CO1, CO2, CO3, CO4, CO5
2.	Estimation of Calcium in a Milk Sample	Level 1	Experimentation, Data Analysis, Psychomotor Skills	CO2, CO3, CO5, CO6
3.	Estimation of Chemical Oxygen Demand in Effluent	Level 2	Experimentation, Data Analysis, Safety	CO1, CO2, CO4, CO5, CO7
4.	Determination of the Surface Tension of a Liquid	Level 2	Instrumentation, Models, Psychomotor Skills	CO1, CO2, CO3, CO5
5.	Estimation of Antacid in a Tablet	Level 1	Experimentation, Data Analysis, Psychomotor Skills	CO2, CO3, CO5

6.	Estimation of Acid Strength in Citrus Fruit	Level 1	Experimentation, Data Analysis, Psychomotor Skills	CO2, CO3, CO5, CO6
7.	Determination of the Molecular Weight of a Polymer by the Ostwald Viscometer	Level 2	Models, Instrumentation, Data Analysis	CO1, CO2, CO5, CO7
8.	Estimation of Acidic Impurities in Soft Drinks by the Conductometric Method	Level 2	Instrumentation, Data Analysis, Learn from Failure	CO1, CO2, CO5, CO7
9.	Estimation of the pH of a Soil Sample	Level 1	Instrumentation, Psychomotor Skills, Data Analysis	CO1, CO3, CO4, CO5
10.	Estimation of Fe^{2+} using the Potentiometric Method	Level 2	Instrumentation, Experimentation, Data Analysis	CO1, CO2, CO5, CO7
11.	Green Synthesis of Plasmonic Silver Nanoparticles Using Plant Extract and Quantitative Analysis by Photocolorimetry	Level 2	Instrumentation, Experimentation, Data Analysis, Creativity	CO1, CO2, CO5, CO7, CO8
12.	Estimation of the rate of Corrosion of a Metal Specimen by Electrochemical Method	Level2	Instrumentation, Experimentation, Data Analysis,	CO1, CO2, CO5, CO7, CO8

Course Designer(s):

Dr. V. Velkannan, Assistant Professor, Chemistry	velkannan@tce.edu
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26TAAB0	TAMILS AND TECHNOLOGY	Category	L	T	P	Credits
		Audit	1	0	0	0

1. Preamble

The Tamil language is not merely a tool for communication; it is a repository of the knowledge, way of life, and scientific thought of the Tamil people, spanning millennia.

Today, Tamils are making their mark in the realms of computing and the internet. Their contributions are immense, ranging from leading global technology companies to playing pivotal roles in Artificial Intelligence (AI) and space exploration (ISRO/NASA). Simultaneously, the development of 'Computational Tamil' and internet-based Tamil is gaining momentum, ensuring the language is passed on to the next generation.

The technological acumen of the Tamil people did not emerge overnight; it is ingrained in their very DNA. By cherishing tradition, embracing innovation, and keeping pace with global technological advancements, Tamils continue to stand as pioneers.

2. Prerequisite

NIL

3. Course Outcome:

On the successful completion of the course students will be able to

No	Course Outcome	TPS Level	PO Addressed	CO Weightage	SDG addressed	SDG Level
CO1	Explain the historical Sangam Age Ceramic Technology Graffiti on Potteries	TPS2	PO1 – M PO2 – L	20	SDG 4	1
CO2	Explain the durig Sangam Age Strucural Contution House & Designs in Household materials	TPS2	PO1 – M PO2 – L	20	SDG 4	1
CO3	Metallurgical studies Art of Ship steel – Copper and gold- Coins as source of history Shell beads	TPS3	PO1 – S PO2 – M PO3 – L	20	SDG 4	1
CO4	Agricuture and Agro Procesing Ancient Knowledge of Ocean	TPS3	PO1 – S PO2 – M PO3 – L	20	SDG 4	1
CO5	Development of Scientific Tamil And Tamil computing	TPS3	PO1 – S PO2 – M PO3 – L	20	SDG 4	1

4. Assessment Pattern

CO	CAT1	Assignment 1	CAT 2 (MCQ)	Assignment 2	Terminal Exam (MCQ)*
	% of marks	% of Marks	% of Marks	% of Marks	% of Marks
CO1	-	-	10	10	10
CO2	-	-	10	10	10
CO3	-	-	20	20	20
CO4	-	-	30	30	30
CO5	-	-	30	30	30
Total	**-**	**-**	**100**	**100**	**100**

* The Terminal Examination and CAT 2 shall be conducted as a Multiple-Choice Question (MCQ) examination.

5. Syllabus

Module 1:

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

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Module 2:

Desiging and Strucural Contution House & Designs in Household materials durig Sangam Age – Building materials and Hero stone os Sangam age – Details of Stage Constructions in Silappathikaram – sculptures and Temples of Mamallapuram- Great Temples of Cholas and other Worship places- Temples of Nayaka Period- Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal – Chetti Nadu House, Indo-Saracenic Architecture at Madras during British Peroiod.

Module 3:

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

Module 4:

Dam,Tank,Ponds,Stuice,Signification of Kumizhi Thoompu of Cholo Period, Animal Husbandry-Wells designed for cattle use – Agricuture and Agro Procesing – Knowledge of Sea – Fisheries-Pearl-Conche diving –Ancient Knowledge of Ocean – Knowledge Specific Society.

Module 5:

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

6. Learning Resources

- தமிழக வரலாறு - மக்களும் பண்பாடும் தமிழ்நாடு பாடநூல் :வெளியீடு) (மற்றும் கல்வியியல் பணிகள் கழகம்
- கணித் தமிழ் - முனைவர் இல.சுந்தரம் விகடன் பிரசுர)ம்(
- கீழடி - வைகை நதிக்கரையில் சங்ககால நாகரீகம் தொல்லியல் துறை) (வெளியீடு
- பொருநை ஆற்றங்கரை நாகரீகம் (தொல்லியல் துறை வெளியீடு)
- Social Life of the Tamil – The Classical Period (Dr.K.K.Pillay) A joint publication of TNTB&ESC and RMRL – (inprint)
- Social Life of the Tamils- The Classical Period (Dr.S.Singaravelu) Published by: International Institute of TamilStuies.
- Historial Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D.Thirunavukkarasu)) Published by: International Institute of TamilStuies.
- The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) Published by: International Institute of TamilStuies.
- Keeladi – Sangam City Civilzation on the banks of river Vaigai (Jointly Published Department of Archaeology & Tamil Nadu Text Book and Educational Servics Corporation,Tamilnadu)

- Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillai, Publisher by The Author)
- Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Education Service Corporation, TamilNadu)
- Journey of Civization indus to Vaigai (R.Balakrishnan) Published by: RMRL – Reference Book

2. Course Contents and Lecture Schedule

Module No.	Topics	No. of Periods
1	**WEAVING AND CERAIC TECHNOLOGY**	
1.1	Weaving Industry Sangam Age – CeramicTechnology	1
1.2	Black and Red Ware Potteries(BRW)	1
1.3	Graffiti on Potteries.	1
2	**DESIGN AND CONSTRUCTION TECHNOLOGY**	
2.1	Desiging and Strucural Contution House & Designs in Household materials durig Sangam Age – Building materials and Hero stone os Sangam age	1
2.2	Details of Stage Constructions in Silappathikaram – sculptures and Temples of Mamallapuram- Great Temples of Cholas and other Worship places- Temples of Nayaka Period- Type study (Madurai Meenakshi Temple)	1
2.3	Thirumalai Nayakar Mahal – Chetti Nadu House, Indo-Saracenic Architecture at Madras during British Peroiod.	1
3	**MANUFACTURING TECHNOLOGY**	
3.1	Art of Ship Building – Metallurgical studies – iron industry –iron smelting, steel – Copper and gold- Coins as source of history – Minting of Coins	1
3.2	Beads making – industries Stone beads- Glass beads-Terracotta beads – Shell beads / bone beats	1
3.3	Archeological evidences- Gen stone types described in Silappathikaram.	1
4	**ARGRICULTURE AND IRRIATION TECHNOLOGY**	
4.1	Dam,Tank,Ponds,Stuice,Signification of Kumizhi Thoompu of Cholo Period	1
4.2	Animal Husbandry-Wells designed for cattle use – Agricuture and Agro Procesing	1
4.3	Knowledge of Sea – Fisheries-Pearl-Conche diving –Ancient Knowledge of Ocean – Knowledge Specific Society.	1
5	**SCIENTIFIC TAMIL & TAML COMPUTING**	
5.1	Development of Scientific Tamil – Tamil computing	1
5.2	Digitalization of Tamil Books- Development of Tamil Software – Tamil Virtual Academy	1
5.3	Tamil Digital Library – Online Dictionaries – Sorkuvai Project	1
	Total	15

Course Designers:

Mr. M Babu.mbutce@tce.edu

26CCAB0	FOUNDATIONS OF PROBLEM SOLVING-1 (Common to all Programmes)	Category	L	T	P	Credits
		AC	0	0	2	0

1. Preamble

This course introduces students to the core habits of structured problem solving. Through algorithmic thinking exercises across numeric, visual, and word-puzzle formats, students learn to decompose problems, identify patterns, and design solution strategies that transfer to both academic problem solving and early recruitment-test contexts.

2. Course Outcomes

After the successful completion of the course, students will be able to:

No.	Course Outcome	TPS Level	Performance Indicator	CO Weightage
CO1	Explain the principles of algorithmic thinking and structured problem solving.	TPS2	3.3.1	20%
CO2	Apply quantitative reasoning techniques to numeric problems.	TPS3	2.1.2	20%
CO3	Use visual pattern recognition to solve diagram-based puzzles.	TPS3	2.1.2	20%
CO4	Identify shortest-path and optimization strategies in problem solving.	TPS3	2.4.1	20%
CO5	Solve complex word puzzles by decomposing them into smaller logical units.	TPS4	2.2.1	20%

3. Assessment Pattern

CO	CA1 (% of Marks)	CA2 (% of Marks)	Terminal Exam (% of Marks)
CO1	50	—	10
CO2	50	—	10
CO3	—	50	20
CO4	—	50	20
CO5	—	—	40
Total	**100**	**100**	**100**

The assessment will be conducted by the Training Team, and the marks will be submitted by the respective faculty in charge.

4. Syllabus

Module 1: Introduction to Problem Solving and Algorithmic Thinking

Problem-solving framework – Algorithmic mindset – Decomposition – Pattern recognition

Module 2: Thinking with Numbers

Numeric reasoning – Quantitative pattern recognition – Mental shortcuts

Module 3: Thinking with Visual

Diagram-based reasoning – Visual patterns – Figure analogies and series

Module 4: Shortest Path

Shortest-path problems – Optimisation – Route and grid problems

Module 5: Word Puzzles (Part 1 & 2)

Lateral thinking – Word arrangement – Logical inference puzzles – Brain teasers

5. Learning Resources

5.1 Text Book

George Polya — "How to Solve It", Princeton University Press.

5.2 Reference Books & Web Resources

1. R. G. Dromey — "How to Solve It by Computer", Pearson.
2. Edward de Bono — "Lateral Thinking: A Textbook of Creativity", Penguin.
3. Arun Sharma — "How to Prepare for Logical Reasoning", McGraw Hill.

6. Course Designer(s)

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