



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
B.TECH-COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE)
COURSE STRUCTURE AK26 REGULATION
(Effective for the batches admitted in 2026-27)**

INDUCTION PROGRAM (3weeks Duration)

S. No	Course Name	Category	L-T-P-C
1	Physical Activities--Sports, Yoga and Meditation, Plantation	MC	0-0-6-0
2	Career Counseling	MC	2-0-2-0
3	Orientation to all branches –career options, tools, etc.	MC	3-0-0-0
4	Orientation on admitted Branch—corresponding labs, tools and platforms	EC	2-0-3-0
5	Proficiency Modules & Productivity Tools	ES	2-1-2-0
6	Assessment on basic aptitude and mathematical skills	MC	2-0-3-0
7	Remedial Training in Foundation Courses	MC	2-1-2-0
8	Human Values & Professional Ethics	MC	3-0-0-0
9	Communication Skills –focus on Listening, Speaking, Reading, Writing skills	BS	2-1-2-0
10	Concepts of Programming	ES	2-0-2-0

Semester I (First year)

Sl. No.	Category	Course Code	Course Title	Hours per week					Credits	CIE	SEE	Total
				L	T	Pr	P	SQC /CLC				
1	BS	26ABS990505	Applied Chemistry for Computer Science	2	0	2	0	1	3	30	70	100
2	BS	26ABS9901	Linear Algebra and Calculus	3	0	2	0	1	4	30	70	100
3	HM	26AHM9901	Communicative English	2	0	0	0	1	2	30	70	100
4	ES	26AES3301	AI Tools and Applications	1	0	4	0	1	3	30	70	100
5	ES	26AES0501	Computational Thinking and Problem Solving with Python	2	0	2	0	1	3	30	70	100
6	ES	26AES0303	Engineering Graphics	1	0	4	0	0	3	30	70	100
7	BS	26ABS990605	Applied Chemistry for Computer Science Lab	0	0	0	3	0	1.5	30	70	100
8	HM	26AHM9902	Communicative English Lab	0	0	0	2	0	1	30	70	100
9	ES	26AES0502	Computational Thinking and Problem Solving with Python Lab	0	0	0	3	0	1.5	30	70	100
10	HM	26AHM9903	Health and wellness, Yoga and Sports	0	0	0	1	0	0.5	50	-	50
Total				11	0	14	09	5	22.5	320	630	950

L : Lecture SQC : Student Quality Control
T : Tutorial CLC : Collaborative Learning Class
Pr : Practice P : Practical



ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE)
COURSE STRUCTURE AK26 REGULATION
(Effective for the batches admitted in 2026-27)

Semester II (First year)

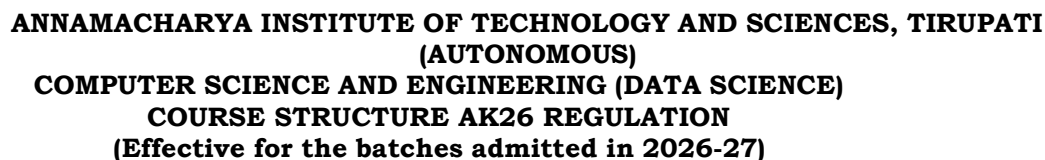
Sl. No.	Category	Course Code	Course Title	Hours per week					Credits	CIE	SEE	Total
				L	T	Pr	P	SQC /CLC	C			
1	BS	26ABS990305	Physics for Advanced Computing	2	0	2	0	1	3	30	70	100
2	ES	26ABS9902	Differential Equations and Vector Calculus	3	0	2	0	1	4	30	70	100
3	PC	26APC0501	Professional Core - I Data Structures and Efficient Problem Solving	2	0	2	0	1	3	30	70	100
4	ES	26AES0301	Design Thinking	1	0	4	0	1	3	30	70	100
5	ES	26AES0302	Engineering Workshop	0	0	0	3	0	1.5	30	70	100
6	BS	26ABS990405	Physics for Advanced Computing Lab	0	0	0	3	0	1.5	30	70	100
7	PC	26APC0502	Professional Core - I Lab Data Structures and Efficient Problem-Solving Lab	0	0	0	2	0	1	30	70	100
8	HM	26AHM9904	NSS/NCC/Scouts and Guides/Community Service	0	0	0	1	0	0.5	50	-	50
9	MC	26AMC3601	Cyber Security Awareness for Engineers	2	0	0	0	0	0	30	-	30
Total				10	00	10	09	04	17.5	300	630	930



ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE)
COURSE STRUCTURE AK26 REGULATION
(Effective for the batches admitted in 2026-27)

Semester III (Second year)

Sl. No.	Category	Course Code	Course Title	Hours per week					Credits C	CIE	SEE	Total
				L	T / CLC	Pr	P	SQC /CLC				
1			Probability and Statistics	2	0	2	0	1	3	30	70	100
2			Universal Human Values – Understanding Harmony and Ethical Human Conduct	3	0	0	0	1	3	30	-	30
3			Managerial Economics and Financial Analysis	2	0	0	0	1	2	30	70	100
4			Digital Logic and Computer Organization	3	0	0	0	1	3	30	70	100
5			Professional Core - II • Algorithms Design and Analysis	3	0	0	0	1	3	30	70	100
6			Professional Core - III • Object Oriented Design and Programming	3	0	0	0	1	3	30	70	100
7			Digital Logic and Computer Organization Lab	0	0	0	2	0	1	30	70	100
8			Professional Core - II Lab • Algorithms Design and Analysis Lab	0	0	0	3	0	1.5	30	70	100
9			Professional Core - III Lab • Object Oriented Design and Programming Lab	0	0	0	3	0	1.5	30	70	100
10			Skill Enhancement Course I • AI Assisted Application Development	1	0	0	2	0	2	30	70	100
11			Environmental Science	2	0	0	0	0	0	30	-	30
Total				19	00	02	10	06	23	330	630	960



Sl. No.	Category	Course Code	Course Title	Hours per week					Credits	CIE	SEE	Total
				L	T / CLC	Pr	P	SQC /CLC	C			
1			Biology for Engineers	2	0	0	0	1	2	30	-	30
2			Sustainability and Green Engineering	2	0	0	0	1	2	30	70	100
3			Professional Core - IV • Operating Systems and Intelligent Resource Management	3	0	0	0	1	3	30	70	100
4			Professional Core - V • Intelligent Database Management Systems	3	0	0	0	1	3	30	70	100
5			Professional Core - VI • Automata Theory and Compiler Design	2	0	2	0	1	3	30	70	100
6			Professional Core - VII • Software Engineering for AI Driven Systems	2	0	2	0	1	3	30	70	100
7			Professional Core - IVLab • Operating Systems and Intelligent Resource Management Lab	0	0	0	3	0	1.5	30	70	100
8			Professional Core - VLab • Intelligent Database Management Systems Lab	0	0	0	3	0	1.5	30	70	100
9			Skill Enhancement course - II • Data Analytics Using Python	1	0	0	2	0	2	30	70	100
10			Technical Paper Writing & IPR	2	0	0	0	0	0	30	-	30
			Total	17	00	04	08	06	21	300	560	860
		Mandatory Community Service Project Internship of 08 weeks duration during summer vacation										



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)**

AK26 REGULATIONS

B. TECH- Computer Science and Engineering (Data Science)

Course Code	Year & Sem	Applied Chemistry for Computer Science	L	T	Pr	P	SQC/CLC	C
26ABS990505	I-I		3	0	0	0	1	3

Course Outcomes (CO): At the end of the course students will be able to

CO1: Apply the fundamental concepts of quantum chemistry, quantum mechanics along with AI tools for studying molecular structures.

CO2: Apply semiconductor concepts and AI-based computational tools to study material properties and optimize semiconductor fabrication processes.

CO3: Apply electrochemical principles and AI tools to improve energy storage systems

CO4: Apply corrosion principles and AI techniques to prevent corrosion in engineering materials and electronic components.

CO5: Analyze the properties of nonmaterial's and quantum materials and AI-Tools for advanced technological applications.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Bloom's Level
CO1	Apply	the fundamental concepts of quantum chemistry, quantum mechanics	Along with AI tools	for studying molecular structures	L3
CO2	Apply	the semiconductor concepts	AI-based computational tools	to study material properties and optimize semiconductor fabrication processes.	L3
CO3	Apply	the electrochemical principles	and AI tools	to improve energy storage systems	L3
CO4	Apply	the corrosion principles	and AI techniques	to prevent corrosion in engineering materials and electronic components.	L3
CO5	Analyze	the properties and applications of nanomaterials and quantum materials,	and AI-Tools	used for their analysis.	L4

UNIT- I Quantum Chemistry

9Hrs

Fundamentals of quantum chemistry: black body radiation, photoelectric effect, wave-particle duality, de Broglie wave equation, Heisenberg's uncertainty principle. Fundamentals of Quantum Mechanics: Schrödinger wave equation; significance of Ψ and Ψ^2 ; quantum numbers. Particle in a one-dimensional box. Molecular orbital theory: bonding in homo nuclear and heteronuclear diatomic molecules; energy level diagrams of O_2 and CO . π -molecular orbitals of butadiene and benzene; calculation of bond order.

AI Integration

Simulation of quantum systems using Python (NumPy, SciPy); visualization of molecular orbitals and energy levels using computational chemistry tools (Google Colab); introduction to quantum computing simulations using Qiskit (introductory level). Free/Open-Source AI Tools: Python (NumPy, SciPy), Google Colab, Qiskit.

UNIT- II Semiconductor Chemistry

9Hrs

Atomic structure and chemical bonding relevant to semiconductors. Band theory: valence band, conduction band, band gap energy. Intrinsic and extrinsic semiconductors: silicon, germanium, gallium arsenide. Doping chemistry: n-type (phosphorus, arsenic) and p-type (boron, aluminium) dopants. Chemical vapour deposition (CVD) for thin film formation; silicon dioxide (SiO_2) formation and properties. Chemistry of compound semiconductors: GaAs, InP, SiC

AI Integration

AI-based prediction of semiconductor properties using ML models; process parameter optimization in semiconductor fabrication using machine learning; Python-based band gap prediction using regression models. Free/Open-Source AI Tools: Python, TensorFlow, Scilab.

UNIT- III Electrochemistry and Energy Storage

9Hrs

Electrochemical cells: galvanic cells, electrode potential, Nernst equation and problems; potentiometry (redox reactions); conductometry (strong acid vs. strong base, weak acid vs. strong base). Primary batteries: Zinc-air battery, Sodium-air battery. Secondary batteries: chemistry of charging and discharging of lead-acid, nickel-cadmium, nickel-metal hydride. Lithium-ion batteries: construction, working, and applications of $LiCoO_2$. Super capacitors: definition, classification, and

applications. Fuel cells: construction, working, and applications of hydrogen fuel cells and direct methanol fuel cells (DMFC). Battery management systems: overcharge protection and thermal management.

AI Integration

AI models for battery health prediction and state-of-charge optimization using scikit-learn; data analysis for energy efficiency in data centres using Python (Pandas); ML-based prediction of electrochemical impedance spectra.

Free/Open-Source AI Tools: Python (Pandas, scikit-learn), Google Colab.

UNIT- IV Chemistry of Corrosion and Protective Techniques 9Hrs

Corrosion: definition, examples, types — chemical corrosion and electrochemical corrosion; Pilling-Bedworth rule. Galvanic corrosion; concentration cell corrosion; factors affecting corrosion. Corrosion of printed circuit boards (PCBs): copper oxidation, tin whiskers; corrosion in solder joints and interconnects. Protective techniques: proper design, using pure metals, metal alloys, inhibitors; cathodic protection — sacrificial anodic protection, impressed current cathodic protection. Electroplating (nickel) and electroless plating (copper).

AI Integration

Computer vision (OpenCV) for automated defect detection in PCBs; AI-based prediction of corrosion failure in electronic components using TensorFlow; image classification models for identifying corrosion types from microscope images. Free/Open-Source AI Tools: OpenCV, TensorFlow, Python.

UNIT- V Chemistry of Nano materials 9Hrs

Introduction to nano chemistry: size-dependent properties, quantum confinement. Carbon nano materials: fullerenes, carbon nano tubes (CNTs), graphene. Synthesis methods: chemical vapour deposition (CVD), sol-gel process. Quantum dots: synthesis, properties, applications in displays and quantum computing. Metallic nanoparticles: preparation and applications of gold, silver, and copper nanoparticles. Applications: nano electronics, interconnects, sensors (optical and biosensors), memory devices. Spintronics materials: magnetic nanoparticles, topological insulators. Chemistry of quantum computing materials: superconducting materials (NbTi, Nb₃Sn); ion trap materials.

AI Integration

AI-based nanomaterial property prediction using machine learning (Python,

TensorFlow); simulation of nano-devices and quantum materials using open-source tools; generative AI for exploring nanomaterial design spaces. Free/Open-Source AI Tools: Python, TensorFlow, open-source materials simulation platforms.

Textbooks:

1. Jain and Jain, Engineering Chemistry, 16/e, Dhanpat Rai, 2013.
2. Peter Atkins, Julia de Paula and James Keeler, Atkins' Physical Chemistry, 10/e, Oxford University Press, 2010.

Reference Books:

1. Linden, D., & Reddy, T. B. (Eds.). (2001). Handbook of Batteries (3rd ed.). McGraw-Hill.
2. Rao, C. N. R., Müller, A., & Cheetham, A. K. (Eds.). (2007). The Chemistry of Nanomaterials: Synthesis, Properties and Applications (Vols. 1–2). Wiley-VCH.
3. Poole, C. P., & Owens, F. J. (2003). Introduction to Nanotechnology. John Wiley & Sons.
4. Sharma, B. K., & Gaur, H. (2019). Engineering Chemistry. Krishna Prakashan Media.
5. Dara, S. S., & Umare, S. S. (2018). Engineering Chemistry (15th ed.). S. Chand Publishing.

Mapping of COs to POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3				3								
2	3				3								
3	3				3								
4	3				3								
5	3				3								

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

C O	Percentage of contact hours over the total planned contact hours				CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Register (Hrs)	Lesson Plan (Hrs)	%	cor	Verb	BTL			
1	9			3	Apply	L3	PO1	PO1: Apply (L3)	3
2	9			3	Apply	L3	PO1	PO1: Apply (L3)	3
3	9			3	Apply	L3	PO1	PO1: Apply (L3)	3

								)	
4	9			3	Apply	L3	PO1	PO1: Apply(L3)	3
5	9			3	Analyze	L4	PO2	PO1: Apply (L3)	3

CO1: Apply quantum chemistry concepts the fundamental concepts of quantum chemistry, quantum mechanics along with AI tools for studying molecular structures

Action Verb: Apply (L3)

PO1 Verbs: Apply (L3)

CO1 Action Verb is equal to PO1 verb; Therefore, correlation is high (3).

CO2: Apply semiconductor concepts and AI-based computational tools to study material properties and optimize semiconductor fabrication processes.

Action Verb: Apply (L3)

PO1 Verbs: Apply (L3)

CO2 Action Verb is equal to PO1 verb; Therefore, correlation is high (3).

CO3: Apply electrochemical principles and AI tools to improve energy storage systems

Action Verb: Apply (L3)

PO1 Verb: **Apply** (L3)

CO3 Action Verb is one level less to PO2 verb; Therefore, correlation is high (3).

CO4: Apply corrosion principles and AI techniques to prevent corrosion in engineering materials and electronic components

Action Verb: Apply (L3)

PO1 Verb: Apply (L3)

CO4 Action Verb is equal to PO1 verb; Therefore, correlation is high (3).

CO5: Analyze the properties of nano materials and quantum materials and AI-tools for advanced technological applications.

Action Verb: Analyze (L4)

PO1 Verb: Apply (L3)

CO5 Action Verb is one level higher than to PO1 verb; Therefore, correlation is high (3).



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)**

AK26 REGULATIONS

B. TECH- Computer Science and Engineering (Data Science)

Course Code	Year & Sem	Linear Algebra and Calculus	L	T	Pr	P	SQC/C LC	C
26ABS9901	I-I		3	0	2	0	1	4

Prerequisites: Higher Secondary Mathematics

Course Outcomes (CO): Student will be able to

1. Apply matrix algebra techniques using AI-enabled computational tools (ChatGPT / Copilot) to solve engineering problems.
2. Analyze eigenvalues, eigenvectors, and quadratic forms using AI-assisted tools (Google Colab) to interpret engineering problems.
3. Apply calculus concepts and series expansions using AI-supported computational tools (Google Colab, Wolfram Alpha free tier) to solve engineering problems .
4. Analyze multivariable functions and optimization techniques using AI-enabled computational tools (Google Colab) to obtain accurate engineering solutions.
5. Evaluate multiple integrals and coordinate transformations using AI-enabled computational tools (Google Colab) for engineering applications.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Apply	matrix algebra techniques	using AI-enabled computational tools (ChatGPT / Copilot)	to solve engineering problems.	L3
2	Analyze	eigenvalues, eigenvectors, and quadratic forms	using AI-assisted computational tools (Google Colab)	to interpret engineering problems.	L4
3	Apply	calculus concepts and series expansions	using AI-supported computational tools (Google Colab, Wolfram Alpha free tier)	to solve engineering problems.	L3
4	Analyze	multivariable functions and optimization techniques	using AI-enabled computational tools (Google Colab)	to obtain accurate engineering solutions	L4
5	Evaluate	multiple integrals and coordinate transformations	using AI-enabled computational tools (Google Colab)	for engineering applications.	L5

Course Content

UNIT – 1 Matrix Algebra and Linear Systems

9 Hrs

Content

Matrices, types of matrices, operations, transpose, inverse, symmetric and skew-symmetric matrices; determinant properties; rank of a matrix; echelon and normal forms.

System of linear equations; consistency conditions; Gauss elimination and Gauss-Jordan methods; iterative methods: Jacobi and Gauss-Seidel.

Cramer's rule; matrix inversion method; applications to

engineering systems.
AI Integration Python-based solution of large linear systems using NumPy; visualization of convergence in iterative methods; AI-assisted debugging of matrix algorithms; using ChatGPT/Copilot to explain row operations and rank reduction. Free/Open-Source AI Tools: Python (NumPy, SciPy, Matplotlib) on Google Colab; SymPy; Jupyter Notebook; Scilab.

UNIT – 2 Eigenvalues, Eigenvectors, Diagonalization and 9 Hrs
Quadratic Forms

Content Eigenvalues and eigenvectors; characteristic equation; Cayley-Hamilton theorem; diagonalization; similarity transformation; powers and inverse of matrices using Cayley-Hamilton theorem.

Quadratic forms; canonical form; reduction by orthogonal transformation; rank, index, signature; positive definite forms; orthogonal, Hermitian, skew-Hermitian and unitary matrices.

AI Integration AI-assisted eigenvalue computation and verification; Python/SciPy visualization of eigenmodes and quadratic surfaces; use of AI tools to explain diagonalization and matrix classification; numerical checking of Cayley-Hamilton theorem. Free/Open-Source AI Tools: Python (NumPy, SciPy, Matplotlib); SymPy; GNU Octave; Google Colab.

UNIT – 3 Single Variable Calculus and Series Expansions 9 Hrs

Content Rolle's theorem; Lagrange's mean value theorem; Cauchy's mean value theorem; Taylor's and Maclaurin's series with remainder; approximation of functions; error estimation.

Curvature of plane curves; radius and centre of curvature; circle of curvature; applications to engineering approximations and curve design.

AI Integration SymPy-based Taylor and Maclaurin expansion generation; plotting truncation error and convergence; AI-supported derivation checking for mean value theorems; curvature plot visualization and interpretation. Free/Open-Source AI Tools: Python (SymPy, NumPy, Matplotlib); Google Colab; Jupyter Notebook; WolframAlpha free tier.

UNIT – 4 Multivariable Differentiation and Optimization 9 Hrs

Content Functions of several variables; limits and continuity; partial derivatives; higher order partial derivatives; total derivative; chain rule; gradient; tangent plane and normal line.

Jacobians; functional dependence; Taylor expansion of two-variable functions; maxima and minima; second derivative test; Lagrange multipliers and constrained optimization; divergence and curl.

AI Integration Gradient field visualization using Python; AI-assisted Jacobian computation and verification; constrained optimization using SciPy; use of AI tools to interpret saddle points, extrema, and optimization constraints. Free/Open-Source AI Tools: Python (NumPy, SciPy, SymPy, Matplotlib); Google Colab; Jupyter Notebook; SciPy optimize module.

UNIT – 5 Multiple Integrals and Coordinate 9 Hrs
Transformations

Content Double integrals; evaluation over type I and type II regions; change of order of integration; triple integrals; change of variables; polar, cylindrical and spherical coordinates.

Area and volume computation; mass, centroid and moment calculations; engineering applications of multiple integration.

AI Integration Numerical evaluation of double and triple integrals using SciPy; 2D and 3D region visualization; AI-assisted generation of integration code; interpreting Jacobian as geometric scaling factor in transformed coordinates. Free/Open-Source AI Tools: Python (NumPy, SciPy, Matplotlib); Google Colab; SymPy; Jupyter Notebook; 3D plotting tools.

CO – PO Articulation Matrix (NBA)

Scale: 3 – Strong, 2 – Moderate, 1 – Slight, – No Correlation

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

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Action Verb	BTL			
1				Apply	L3	PO1, PO5	Apply (L3)	3
2				Analyze	L4	PO1, PO2, PO5	Analyze (L4)	3
3				Apply	L3	PO1, PO5	Apply (L3)	3
4				Analyze	L4	PO1, PO2, PO5	Analyze (L4)	3
5				Evaluate	L5	PO1, PO2, PO5	Evaluate (L5)	3

CO1: Apply matrix algebra techniques using AI-enabled computational tools (ChatGPT / Copilot) to solve engineering problems.

Action Verb: Apply (L3)

PO1 Verb: Apply (L3), PO5 Verb: Apply (L3)

CO1 Action Verb is equal to PO1 and PO5 verb; Therefore correlation is high (3).

CO2: Analyze eigenvalues, eigenvectors, and quadratic forms using AI-assisted tools (Google Colab) to interpret engineering systems correctly.

Action Verb: Analyze (L4)

PO1 Verb: Apply (L3), PO2 Verb: Analyze (L4), PO5 Verb: Apply (L3)

CO2 Action Verb is high level to PO1, PO5 and equal to PO2 verb. Therefore correlation is high (3).

CO3: Apply calculus concepts and series expansions using AI-supported computational tools (Google Colab, Wolfram Alpha free tier) to solve engineering problems accurately.

Action Verb: Apply (L3)

PO1 Verb: Apply (L3), PO5 Verb: Apply (L3)

CO3 Action Verb level is equal to PO1 and PO5 verb; Therefore correlation is high (3).

CO4: Analyze multivariable functions and optimization techniques using AI-enabled computational tools (Google Colab) to obtain accurate engineering solutions..

Action Verb: Analyze (L4)

PO1 Verb: Apply (L3), PO2 Verb: Analyze (L4), PO5 Verb: Apply (L3)

CO4 Action Verb high level to PO1, PO5 and equal to PO2 verb; Therefore correlation is high (3).

CO5: Evaluate multiple integrals and coordinate transformations using AI-enabled computational tools (Google Colab) for engineering applications accurately.

Action Verb: Evaluate (L5)

PO1 Verb: Apply (L3), PO2 Verb: Analyze (L4), PO5 Verb: Apply (L3)

CO5 Action verb is high level to PO1, PO2 and PO5 verb; therefore the correlation is high (3).

LEARNING RESOURCES

Textbooks

Grewal, B. S. (2017). Higher Engineering Mathematics (44th ed.). Khanna Publishers.

Kreyszig, E. (2018). Advanced Engineering Mathematics (10th ed.). Wiley.

Reference Books

Thomas, G. B., Weir, M. D., & Hass, J. (2018). Thomas' Calculus (14th ed.). Pearson.

Jain, R. K., & Iyengar, S. R. K. (2021). Advanced Engineering Mathematics (5th ed.). Alpha Science International.

Strang, G. (2016). Introduction to Linear Algebra (5th ed.). Wellesley-Cambridge Press.

Lay, D. C., Lay, S. R., & McDonald, J. J. (2015). Linear Algebra and Its Applications (5th ed.). Pearson.

Arfken, G. B., Weber, H. J., & Harris, F. E. (2012). Mathematical Methods for Physicists (7th ed.). Academic Press.

Zill, D. G., & Wright, W. S. (2018). Advanced Engineering Mathematics (6th ed.). Jones & Bartlett.

Online Resources

NPTEL: Linear Algebra – <https://nptel.ac.in>

MIT OpenCourseWare – Linear Algebra: <https://ocw.mit.edu>

MIT OpenCourseWare – Multivariable Calculus: <https://ocw.mit.edu>

Python SymPy Documentation: <https://docs.sympy.org>

Google Colab for Python: <https://colab.research.google.com>

Recommended Free & Open-Source AI/Computational Tools

Python (NumPy, SciPy, Matplotlib) – FREE on Google Colab for matrix computation, visualization, and numerical analysis.

SymPy (free, open-source) – For symbolic algebra, calculus, matrix operations, and verification.

scikit-learn (free, open-source) – For regression, classification, and exploratory predictive modeling.

Jupyter Notebook (free, open-source) – For interactive computation and lab documentation.

OpenCV (free, open-source) – For image-based experimentation and visualization support

where needed.

GNU Octave (free, open-source) – MATLAB-like numerical computing for matrix and calculus workflows.

TensorFlow / Keras (free, open-source) – For optional AI demonstrations in regression and classification tasks.



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)**

AK26 REGULATIONS

B. TECH- Computer Science and Engineering (Data Science)

Course Code	Year & Sem	Communicative English	L	T	Pr	P	SQC/CLC	C
26AHM9901	I-I		2	0	0	0	1	2

Pre-Requisites	Basic English (Intermediate level)	Semester	I & II
Course Outcomes (CO): Student will be able to			
CO1: Understand grammatical structures, phonetic patterns, and professional vocabulary, and recall communication frameworks along with AI-assisted tools. CO2: Apply the Principles of Listening and Speaking Skills in Group discussions, Debates & Presentations along with AI tools. CO3: Understand and apply reading techniques, passages to write Paragraph writing, Creative Writing and movie reviews/ blogs along with AI-assisted tools. CO4: Apply and optimize professional communication skills by drafting and refining emails, CVs, reports, and presentations along with AI-assisted writing tools. CO6: Create professional communication materials, such as presentations, e-portfolios, and research reports, using AI tools like Copyleaks, Turnitin, and DeepL Translator			

O	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	grammatical structures, phonetic patterns, and professional vocabulary, and recall.	Communication frameworks along with AI-assisted tools.		L2
2	Apply	the Principles of Listening and Speaking Skills in Group discussions, Debates & Presentations.	along with AI tools		L3
3	Understand	and apply reading techniques, passages to write Paragraph writing, Creative Writing and movie reviews/ blogs	along with AI-assisted tools.		L2
4	Apply	and optimize professional communication skills drafting and refining emails, CVs, reports, and presentations.	along with AI-assisted writing tools		L3
5	Create	professional communication materials, such as presentations, e-portfolios, and research reports,	using AI tools like Copyleaks, Turnitin, and DeepL Translator		L6

UNIT I Foundations of English Communication

Core Content:

Basics of Communication: process, types (verbal/non-verbal), and barriers. Parts of Speech: nouns, pronouns, verbs, adjectives, adverbs. Tenses: simple, continuous, perfect, and perfect continuous. Subject-verb agreement and correction of sentences.

AI Integration:

Grammar explanation, error identification, and instant Q&A on language rules, Real-time grammar, spelling, and punctuation correction with detailed explanations, Phonetics practice – voice recording for pronunciation and intonation

feedback, Word-of-the-day, etymology, and interactive vocabulary quizzes.

Free/Open-Source AI Tools:

Grammarly (free); ChatGPT / Gemini (free tiers); Google Speech-to-Text (free); Merriam-Webster Vocabulary Builder (free)

UNIT II Listening and Speaking Skills

Core Content:

Principles of Effective Speaking and Active Listening. Group Discussion (GD): techniques, etiquette, and evaluation criteria. Presentation Skills: design principles, slide preparation, and delivery techniques. Debate: argument construction, evidence use, and rebuttal techniques.

AI Integration:

AI-powered presentation design – structured, visual, professional slides, Fluency analysis, filler-word detection, pacing, and confidence scoring, Auto-transcription and keyword analysis of spoken communication, Visual communication design – infographics, posters, and slide aesthetics

Free/Open-Source AI Tools:

Gamma.app (free); Orai AI Speech Coach (free); Otter.ai (free tier); Canva AI (free)

UNIT III Reading Comprehension & Writing Skills

Core Content:

Reading Strategies: skimming, scanning, intensive and extensive reading. Comprehension passages, synonyms, antonyms, words often confused, homonyms, homophones, and homographs. Paragraph Writing: topic sentence, supporting details, clincher sentence. Creative Writing — features and techniques — movie reviews and blogs.

AI Integration:

AI paraphrasing tool – rewrite passages at varying complexity levels, Readability scoring, passive voice detection, and sentence simplification, Essay outline generation, argument structuring, and content brainstorming, Vocabulary simplification for improving comprehension of complex texts

Free/Open-Source AI Tools:

QuillBot (free); Hemingway Editor (free online); ChatGPT (free); Rewordify (free)

UNIT IV Professional & Business Communication

Core Content:

Email Writing and Letter Writing: formal and informal. Short Report Writing: structure, types (formal/informal), and format. Note-Making and Summarization Techniques. Resume / CV Writing and LinkedIn Profile Optimization.

AI Integration:

Draft and refine professional emails, cover letters, reports, and proposals, AI-powered resume builder with ATS-optimized templates, Report structuring, agenda writing, and knowledge management, Tone detection, formality check, and professional register evaluation

Free/Open-Source AI Tools:

UNIT V Use of AI in Language Learning

Artificial Intelligence in Communication: meaning, basics, benefits and limitations of AI in human interaction. AI chat bots and virtual assistants in education: grammar correction, vocabulary building, AI-based speaking and pronunciation tools, writing assistants, e-portfolio creation. AI in Global Communication: automated translation, summarizing large texts, finding information in different languages. Digital Communication and AI Ethics: responsible use of AI in education, plagiarism and academic honesty, fake information and AI-generated content, privacy, bias, and ethical communication online.

Plagiarism detection, paraphrase checker, and academic integrity analysis, High-accuracy translation supporting intercultural communication understanding, AI literacy modules – understanding AI bias, ethics, and responsible usage, E-portfolio creation platform for showcasing communication artifacts

CopyLeaks / Turnitin (institutional access); DeepL Translator (free); Wix (free); Adobe Portfolio (free for students); ChatGPT / Gemini (free tiers)

1. Raman M. and Sharma S., Technical Communication: Principles and Practice, Oxford University Press, 4th Edition, 2022.

2. Shetty J. and Pareek R., Communicative English for Engineers and Professionals, Wiley India, 3rd Edition, 2021

1. Rizvi M.A., Effective Technical Communication, Tata McGraw-Hill, 2nd Edition, 2018.
2. Murphy H.A., Effective Business Communication, McGraw-Hill Education, 7th Edition, 2019.
3. Wren P.C. and Martin H., High School English Grammar and Composition, S. Chand, Revised Edition, 2019.

- British Council – Learn English – <https://learnenglish.britishcouncil.org>
- NPTEL – Communication Skills – <https://nptel.ac.in/courses/109104101>
- Purdue OWL (Online Writing Lab) – <https://owl.purdue.edu>
- BBC Learning English – <https://www.bbc.co.uk/learningenglish>

***3: Highly Correlated, 2: Moderately Correlated, 1: Weakly Correlated**

[illegible]

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	corr	Verb	BTL			
1				Understand	L2	PO8, PO9	Thumb Rule	2,2
2				Apply	L3	PO8,PO9	Thumb Rule	2,2
3				Understand	L2	PO9	Thumb Rule	2
4				Apply	L3	PO9	Thumb Rule	2
5				Create	L6	PO9	Thumb Rule	3

CO-PO Mapping Justification:

CO1: : Understand grammatical structures, phonetic patterns, and professional vocabulary, and recall communication frameworks along with AI-assisted tools.

Action Verb: Understand (L2)

CO1 Action Verb Understand is of BTL 2. Using Thumb rule, L2 correlates PO8 , PO9 as moderate(2).

CO2: Apply the Principles of Listening and Speaking Skills in Group discussions, Debates & Presentations along with AI tools.

CO2 Action Verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO8 to PO9 as moderate (2)

CO3: Understand and apply reading techniques, passages to write Paragraph writing, Creative Writing and movie reviews/ blogs along with AI-assisted tools.

CO3 Action Verb Understand is of BTL 2. Using Thumb rule, L2 correlates PO9 as moderate (2).

CO4: Apply and optimize professional communication skills by drafting and refining emails, CVs, reports, and presentations along with AI-assisted writing tools.

CO4 Action Verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO9 as moderate (2).

CO5: Create professional communication materials, such as presentations, e-portfolios, and research reports, using AI tools like Copyleaks, Turnitin, and DeepL Translator

CO5 Action Verb Create is of BTL 6. Using Thumb rule, L6 correlates PO9 as high (3).



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)**

AK26 REGULATIONS

B. TECH- Computer Science and Engineering (Data Science)

Course Code	Year & Sem	AI Tools and Applications	L	T	Pr	P	SQC/CLC	C
26AES3301	I-I		1	0	4	0	1	3

At the end of the course, students will be able to:

Course Outcomes

CO	Course Outcome Statement
CO1	Understand the AI fundamentals concepts and AI tool categories.
CO2	Apply the AI tools, prompt engineering, and NotebookLM for learning and content creation.
CO3	Understand the AI tools for data analysis, research, and information management.
CO4	Analyze the AI applications for visual design and engineering solutions.
CO5	Analyze the AI-assisted project using responsible AI practices.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the AI fundamentals concepts and AI tool categories.			L2
CO2	Apply	the AI tools, prompt engineering, and NotebookLM		for learning and content creation	L3
CO3	Understand	the AI tools		for data analysis, research, and information management.	L2
CO4	Analyze	the AI applications		for visual design and engineering solutions.	L4
CO5	Analyze	the AI-assisted project	using responsible AI practices.		L4

UNIT – I : UNDERSTANDING AI AND AI FOR DOCUMENTS AND PRESENTATIONS

What is AI: AI vs. ML vs. Deep Learning vs. Generative AI; brief history (Turing Test → ChatGPT → generative AI era); how LLMs work (training data, next-token prediction, temperature, hallucinations, context windows, knowledge cutoffs). AI

ecosystem: ChatGPT, Claude, Gemini, Microsoft Copilot — strengths and differences.

AI for presentations: Gamma.app — full slide deck from a paragraph prompt; Microsoft Copilot in PowerPoint — slide generation, design suggestions, speaker notes; Canva AI — Magic Design, text-to-presentation, brand kits; Beautiful.ai — smart slide layouts; comparing AI-generated vs. manually created presentations.

AI for document writing: Microsoft Copilot in Word — draft, rewrite, summarize; Gemini in Google Docs — writing assistance and inline Q&A; Notion AI — meeting notes, project plans, knowledge base; Claude Projects — organizing documents and having a persistent AI assistant over a set of files.

AI writing assistance: Grammarly — grammar, tone, clarity, plagiarism; ChatGPT and Claude for lab reports, proposals, and letters; academic integrity — AI as an assistant not an author; disclosure norms; identifying AI-generated content using GPTZero.

AI Tools Integration: Use Gamma.app to generate a presentation on an engineering topic in under 2 minutes; use Copilot in Word or Gemini in Docs to draft and improve a report; compare ChatGPT, Claude, Gemini, and Microsoft Copilot on the same writing task; use Grammarly to review your own writing.

Unit Outcomes

Explain AI concepts and the AI tool landscape to a non-technical audience.

Generate and critically refine presentations using Gamma.app, Copilot, and Canva AI. Use AI writing tools for drafting, editing, and improving academic documents.

UNIT – II : AI FOR RESEARCH, NOTE-TAKING, DATA, AND SPREADSHEETS

NotebookLM (Google): uploading lecture notes, textbooks, PDFs, and research papers as sources; asking questions grounded in uploaded documents; generating study guides, timelines, briefing documents, and audio overviews (podcast-style summaries) from sources; source-grounded answers that cite the exact passage — eliminating hallucination risk.

AI for research: Perplexity AI (real-time web search with citations), Gemini Deep Research (multi-step research reports), Elicit and Consensus (academic paper search with evidence summaries); verifying AI-generated citations on Google

Scholar; why AI fabricates references and how to detect it.

Prompt engineering: zero-shot, one-shot, few-shot, chain-of-thought, role-based prompting; iterative refinement; negative prompting; building effective prompts for summarization, comparison, explanation, and data extraction; using ChatGPT custom instructions and Claude Projects for persistent context.

AI for spreadsheets and data analysis: Microsoft Copilot in Excel — VLOOKUP, IF, COUNTIF, pivot tables from natural language; Gemini in Google Sheets — formula generation and chart creation; ChatGPT Advanced Data Analysis and Julius AI — uploading CSV files, computing statistics, generating charts, interpreting patterns — no coding required.

AI Tools Integration: Upload your own lecture notes to NotebookLM and generate a study guide and audio overview; use Perplexity AI and Gemini Deep Research to research a topic; verify citations on Google Scholar; use Wolfram Alpha or Symbolab to solve and verify equations from your current semester subjects; use Copilot in Excel or ChatGPT ADA to analyse a real dataset.

Unit Outcomes

- Use NotebookLM to generate source-grounded study aids from uploaded documents.
- Apply AI research tools (Perplexity, Gemini Deep Research, Elicit) and verify citations.
- Perform spreadsheet automation and data analysis using AI; use Wolfram Alpha, Symbolab, and Photomath to solve and verify equations.

UNIT – III : AI FOR VISUAL DESIGN, DIAGRAMS, AND MEDIA

- AI for image generation: DALL-E 3 (via ChatGPT), Canva AI (text-to-image, Magic Design, background remover), Adobe Firefly, Ideogram — writing effective image prompts (style, subject, composition, colour); iterative prompt refinement for posters, diagrams, and mockups.
- AI for diagrams and visual thinking: Napkin.ai — converting text or concepts into visual diagrams, charts, and infographics automatically; Whimsical AI — AI-generated mind maps, flowcharts, and wireframes from a description; Miro AI — collaborative whiteboard with AI summarization and diagramming.
- AI for audio and video: ElevenLabs — text-to-speech and voice cloning for presentations and voiceovers; Suno and Udio — AI music generation for project videos; Runway and Pika — generating short video clips from text prompts; HeyGen — AI avatars for video presentations; current limitations and appropriate use cases.
- AI content detection and critical evaluation: GPTZero, Originality.ai for AI-text detection; Google Lens and reverse image search for AI-generated images; fact-checking workflows — cross-referencing primary sources; deepfakes and synthetic media — recognition, risks, and responsible creation.

AI Tools Integration: Use Napkin.ai to convert a paragraph of text into a diagram; use Whimsical AI to generate a mind map of a course topic; use DALL-E 3 or Canva AI to create an event poster through 3 prompt iterations; use ElevenLabs to create a voiceover; test GPTZero on 5 samples and analyse confidence scores.

Unit Outcomes

- Create AI-generated images and visual diagrams using Napkin.ai and Whimsical AI.
- Produce AI audio and short video content for academic and project presentations.
- Evaluate AI-generated content using detection tools and critical verification workflows.

UNIT – IV : AI ACROSS ENGINEERING DISCIPLINES

- AI in Mechanical Engineering: generative design in CAD (Autodesk Fusion 360 — AI-optimized structures for weight and load); predictive maintenance using sensor data and ML; AI-assisted FEA simulation; manufacturing process optimization; digital twins.
- AI in Civil and Electrical Engineering: structural health monitoring using ML; smart grid load forecasting and energy management; AI for circuit simulation and PCB layout optimization (Altium AI); VLSI design automation — floor planning and routing; power systems fault detection.
- AI in Electronics and Communication: AI-assisted signal processing and filtering; speech recognition for embedded systems; computer vision for industrial quality inspection; AI in antenna design and spectrum management; MATLAB AI and Deep Learning Toolbox.
- AI in Computer Science and allied branches: GitHub Copilot for code generation, explanation, and review; AI-powered testing (Testim, Selenium AI); AI in cybersecurity — anomaly detection and intrusion detection; no-code/low-code platforms (Bubble, Glide, Webflow AI); AI for data science (Jupyter AI, DataRobot).

AI Tools Integration: Each student identifies 5 real AI tools in their own engineering branch using Claude or ChatGPT and verifies each using official product pages or research publications; present findings in a 3-minute class presentation with a structured comparison table.

Unit Outcomes

- Identify real AI tools and applications in at least two engineering disciplines.
- Verify AI application claims using official documentation or published research.
- Discuss how AI is changing engineering practice and what new skills engineers now need.

UNIT – V : RESPONSIBLE AI, ETHICS, AND CAPSTONE PROJECT

- AI bias and fairness: sources of bias (data, model, deployment); real documented cases — Amazon hiring algorithm (2018), COMPAS recidivism (2016), facial recognition disparities (NIST 2019); fairness metrics; misinformation, deepfakes, and synthetic media risks.
- Privacy and intellectual property: what happens to data entered into public AI tools; PII risks; data retention policies of ChatGPT (OpenAI), Claude (Anthropic), and Gemini (Google); who owns AI-generated content; copyright status globally; academic plagiarism with AI; personal data safety protocol.
- AI governance frameworks: EU AI Act risk tiers (unacceptable, high, limited, minimal); UNESCO AI Ethics Recommendation; India's NITI Aayog Responsible AI Guidelines; India Digital Personal Data Protection Act 2023 (DPDP Act); environmental cost of AI — energy and carbon footprint of LLM training and inference.
- Capstone Mini-Project: each student (or pair) defines a real engineering problem, selects at least 3 AI tool categories from Units I–IV, produces a quality-verified deliverable (report, presentation, diagram, or automation), and presents in 5 minutes. Evaluation: problem clarity, tool selection, output quality, human refinement, responsible AI disclosure.

AI Tools Integration: Read and compare data retention policies of ChatGPT, Claude, and Gemini; classify 5 daily-use AI systems using EU AI Act risk tiers; use GPTZero and Google Lens to detect AI-generated content; design and present the Capstone Mini-Project integrating tools from all five units.

Unit Outcomes

- Explain AI bias, privacy risks, and governance frameworks including India's DPDP Act 2023.
- Apply a personal data safety protocol when using public AI tools.
- Design, execute, and present an AI-assisted mini-project with responsible usage disclosure.

LEARNING RESOURCES

Reference Books

- Ethan Mollick, Co-Intelligence: Living and Working with AI, Portfolio/Penguin, 2024.
- Stuart J. Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 4th Edition, Pearson Education, 2020.
- Reid Blackman, Ethical Machines, Harvard Business Review Press, 2022.

Free Online Courses

- Google – Fundamentals of AI – grow.google/intl/en_in/ai-learning-resources
- Microsoft – AI Skills Navigator – microsoft.com/en-us/ai/ai-skills
- Andrew Ng – AI for Everyone (Coursera, free to audit) – coursera.org/learn/ai-for-everyone
- Elements of AI – University of Helsinki (free, beginner) – elementsofai.com

Tools Used in This Course (All Free-Tier Accessible)

- AI Assistants: ChatGPT – chat.openai.com | Claude – claude.ai | Gemini – gemini.google.com | Microsoft Copilot – copilot.microsoft.com
- Research & Notes: NotebookLM – notebooklm.google.com | Perplexity AI – perplexity.ai | Elicit – elicit.org | Consensus – consensus.app
- Presentations & Docs: Gamma.app | Notion AI – notion.so | Beautiful.ai | Copilot in Office 365 | Gemini in Google Workspace
- Diagrams & Design: Napkin.ai | Whimsical AI – whimsical.com | Miro AI – miro.com | Canva AI – canva.com | DALL-E 3 via ChatGPT
- Data & Spreadsheets: ChatGPT Advanced Data Analysis | Julius AI – julius.ai | Copilot in Excel | Gemini in Sheets
- Math & Equations: Wolfram Alpha – wolframalpha.com | Symbolab – symbolab.com | Mathway – mathway.com | Microsoft Math Solver – math.microsoft.com | Photomath – photomath.com | Desmos – desmos.com | GeoGebra – geogebra.org
- Audio & Video: ElevenLabs – elevenlabs.io | Suno – suno.com | Runway – runwayml.com | HeyGen – heygen.com
- Detection & Automation: GPTZero – gptzero.me | Originality.ai | Google Lens | Make.com | GitHub Copilot

Web References

- EU AI Act – eur-lex.europa.eu | UNESCO AI Ethics – unesco.org | NITI Aayog – niti.gov.in
- India DPDP Act 2023 – meity.gov.in | ProPublica COMPAS – propublica.org | MIT Technology Review – technologyreview.com

Mapping of COs to POs

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

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1				CO1 :Understand	L2	PO1 PO2	PO1: Apply(L3) PO2: Review(L2)	2 3
2				CO2 : Apply	L3	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Analyze (L4) PO3: Develop (L3) PO4: Analyze (L4) PO5:Apply(L3)	3 2 3 2 3
3				CO3 : Understand	L2	PO1 PO2 PO3 PO4 PO5	PO1: Apply (L3) PO2: Identify(L3) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3)	2 2 2 1 2
4				CO4 : Analyze	L4	PO2 PO3 PO5 PO11	PO2: Review(L2) PO3: Develop(L3) PO5: Apply(L3) PO11:Thumb Rule	3 3 3 3
5				CO5 :Analyze	L4	PO1 PO2 PO3 PO4 PO5 PO11	PO1:Apply(L3) PO2: Review (L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO11: Thumb Rule	3 3 3 3 3 3

Justification Statements :

CO1: Understand the AI fundamentals concepts and AI tool categories. Action Verb :
Understand(L2)

PO1 : Apply(L3)

CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is medium (2) PO2 : Review(L2)

CO1 Action verb is same level as PO2 verb. Therefore the correlation is high (3)

CO2: Apply the AI tools, prompt engineering, and NotebookLM for learning and content creation. Action Verb : Apply (L3)

PO1: Apply(L3)

CO2 Action verb is same level as PO1 verb. Therefore the correlation is high (3) PO2: Analyze (L4)

CO2 Action verb is less than PO2 verb by one level. Therefore the correlation is medium(2) PO3: Develop (L3)

CO2 Action verb is same level as PO3 verb. Therefore the correlation is high (3) PO4: Analyze (L4)

CO2 Action verb is less than PO4 verb by one level. Therefore the correlation is medium(2)

PO5:Apply(L3)

CO2 Action verb is same level as PO5 verb. Therefore the correlation is high (3)

CO3: Understand the AI tools for data analysis, research, and information management. Action Verb : Understand(L2)

PO1: Apply(L3)

CO3 Action verb is less than one level as PO1 verb. Therefore the correlation is medium(2) PO2: Identify(L3)

CO3 Action verb is less than one level as PO2 verb. Therefore the correlation is medium(2) PO3: Develop (L3)

CO3 Action verb is less than one level as PO3 verb. Therefore the correlation is medium(2) PO4: Analyze (L4)

CO3 Action verb is less than two level as PO4 verb. Therefore the correlation is low (1) PO5:Apply(L3)

CO3 Action verb is less than one level as PO5 verb. Therefore the correlation is medium(2)

CO4: Analyze the AI applications for visual design and engineering solutions. Action Verb : Analyze (L4)

PO2: Review(L2)

CO4 Action verb is greater than as PO2 verb. Therefore the correlation is high (3) PO3: Develop (L3)

CO4 Action verb is greater than as PO4 verb. Therefore the correlation is high (3)

PO4: Apply(L3)

CO4 Action verb is greater than as PO4 verb. Therefore the correlation is high (3) PO11: Thumb rule

Artificial intelligence learning methods are used for developing intelligent agents. Therefore the correlation is High(3)

CO5: Analyze the AI-assisted project using responsible AI practices. Action Verb : Analyze(L4)

PO1: Apply(L3)

CO5 Action verb is same level as PO1 verb. Therefore the correlation is high (3) PO2: Review (L2)

CO5 Action verb is same level as PO2 verb. Therefore the correlation is high (3) PO3: Develop (L3)

CO5 Action verb is same level as PO3 verb. Therefore the correlation is high (3) PO4: Analyze (L4)

CO5 Action verb is same level as PO4 verb. Therefore the correlation is high (3) PO5: Apply (L3)

CO3 Action verb is same level as PO5 verb. Therefore the correlation is high (3) PO11: Thumb rule

For developing expert systems some of python program concepts are used to create programs. Therefore the correlation is High(3)



ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI (AUTONOMOUS)

AK26 REGULATIONS

B. TECH- Computer Science and Engineering (Data Science)

Course Code	Year & Sem	Computational Thinking and Problem Solving with Python	L	T	Pr	P	SQC/CLC	C
26AES0501	I-I		2	0	2	0	1	3

Course Outcomes:

After studying the course, students will be able to

CO1: **Understand** computational thinking, algorithms, flowcharts & Python fundamentals.

CO2: **Apply** decision-making and looping constructs in Python for problem solving.

CO3: **Apply** Python strings, lists, tuples, and sets for problem solving.

CO4: **Analyze** dictionaries, functions, recursion, and variable scope in Python.

CO5: **Evaluate** modules, file handling, exception handling, and OOP concepts.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	Computational thinking, algorithms, flowcharts, and Python fundamentals			L2
CO2	Apply	Decision-making and looping constructs	in Python programs	For problem solving	L3
CO3	Apply	Python strings, lists, tuples, and sets		for programming tasks	L3
CO4	Analyze	Dictionaries, functions, recursion, and variable scope	in Python		L4
CO5	Evaluate	Modules, file handling, exception handling, and OOP concepts	in Python applications		L5

UNIT - I COMPUTATIONAL THINKING AND PROGRAMMING BASICS 9 Hrs

Content:

- Computational thinking: characteristics, problem-solving strategies, steps in problem solving; algorithms — definition and properties; flowcharts — symbols and construction; pseudocode — writing and conversion; abstraction, decomposition, pattern recognition, algorithm efficiency basics.
- Introduction to Python: installation and execution environment; variables, identifiers, keywords; data types, type conversion; input and output statements; expressions and operators — arithmetic, relational, logical, assignment; operator precedence.

Source: TB1: Chapters 1-3 (Spronck — computational thinking, algorithms, flowcharts, Python basics); TB2: Chapters 1-2 (Thareja — introduction to programming, Python fundamentals)

AI Integration:

Use Flowgorithm to design and simulate algorithms (e.g., largest of 3 numbers); draw flowcharts using Lucidchart; use Algorithm Visualizer to trace algorithm execution; use ChatGPT to convert pseudocode to Python and verify output.

UNIT - II DECISION MAKING AND LOOPING 9 Hrs

Content:

- Decision control statements: Boolean expressions; if, if-else, if-elif-else, nested if; conditional expressions (ternary operator).
- Looping statements: while loop, for loop, iteration techniques, nested loops, infinite loops; loop control — break, continue, pass; else with loops.
- Practical problem solving: prime number check, pattern programs using nested loops, menu-driven programs using control statements.

Source: TB2: Chapters 4-5 (Thareja — decision making, loops, control statements); TB1: Chapters 4-5 (Spronck — conditions, loops, iteration)

AI Integration:

Use Python Tutor to visualize if-else and loop execution step by step; use Thonny to debug loop-based programs; use Replit for online coding practice; use ChatGPT to generate test cases for control flow programs.

UNIT - III STRINGS AND DATA STRUCTURES 9 Hrs

Content: • Strings: representation, indexing, slicing, operations, built-in functions and methods. • Lists: creation, indexing and slicing, operations, functions, methods, nested lists. • Tuples: creation, operations, packing and unpacking. • Sets: creation, set operations — union, intersection, difference; frozen sets. Source: TB2: Chapters 6–8 (Thareja — strings, lists, tuples, sets, dictionaries); TB1: Chapters 6–7 (Spronck — strings, lists, tuples)	
AI Integration: Use NLTK and TextBlob to perform text analysis (sentiment, word frequency) on strings; use Pandas and NumPy for list and array operations; use ChatGPT to explain string slicing and list comprehensions with concrete examples.	
UNIT - IV	FUNCTIONS AND PROBLEM SOLVING
9 Hrs	
Content: • Dictionaries: creation, operations, methods; dictionary-based applications. • Functions: built-in and user-defined functions; function definition and calling; arguments — positional, keyword, default, variable-length; scope of variables (local and global). • Recursion: recursive functions — factorial, Fibonacci; lambda functions (anonymous functions); applications of functions in problem solving. Source: TB2: Chapters 9–10 (Thareja — functions, recursion, lambda, dictionaries); TB1: Chapters 8–9 (Spronck — functions, recursion, problem solving)	
AI Integration: Use Jupyter Notebook for interactive function experiments; use SymPy for symbolic mathematical expressions; use PyCharm for modular program development; use ChatGPT to trace recursive function calls step by step.	
UNIT - V	FILE HANDLING, EXCEPTION HANDLING AND OOP
9 Hrs	
Content: • Modules and packages: creating and importing modules; standard library modules. • File handling: opening, reading, writing, and closing files; file modes; working with text files; processing CSV and Excel files. • Exception handling: types of errors (syntax, runtime, logical); try, except, finally blocks; raising exceptions. • Introduction to OOP: classes, objects, attributes, methods, constructors, self keyword; basic applications of OOP in Python. Source: TB2: Chapters 11–13 (Thareja — modules, file handling, exception handling, OOP); TB1: Chapter 10 (Spronck — file handling, exceptions, object-oriented programming)	
AI Integration: Use Pandas and OpenPyXL to read and write CSV/Excel files; use Pytest for testing exception handling; use ChatGPT to explain OOP class design with real-world examples; use Django for a simple mini web application as a capstone project.	
Textbooks:	
1. Pieter Spronck, Computational Thinking with Python, (course textbook — covers computational thinking, algorithms, and Python programming). 2. Reema Thareja, Programming in Python, Oxford University Press. (Primary implementation reference — all five units.)	
Reference Books:	
1. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, 2nd Edition, O'Reilly Media. (Free at greenteapress.com) 2. Eric Matthes, Python Crash Course, 2nd Edition, No Starch Press.	
Online Learning Resources:	
1. Algorithm & Flowchart: Flowgorithm – flowgorithm.org Lucidchart – lucidchart.com Algorithm Visualizer – algorithm-visualizer.org 2. Programming & Debugging: Python Tutor – pythontutor.com Thonny – thonny.org Replit – replit.com 3. Data & Scientific: Pandas – pandas.pydata.org NumPy – numpy.org SymPy – sympy.org 4. NLP & Text: NLTK – nltk.org TextBlob – textblob.readthedocs.io 5. Development: Jupyter Notebook – jupyter.org PyCharm – jetbrains.com/pycharm OpenPyXL – openpyxl.readthedocs.io 6. NPTel – Problem Solving through Programming in C / Python – nptel.ac.in	

Mapping of course outcomes with program outcomes

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

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
	Lesson plan (Hrs)	%	Correlation	Co's Action verb	BTL			
1	9	20%	2	CO1: Understand	L2	PO1 PO2 PO11	PO1: Apply (L3) PO2: Review (L2) PO11: Thumb Rule	2 3 2
2	9	20%	2	CO2: Apply	L3	PO1 PO2 PO5 PO11	PO1: Apply (L3) PO2: Review (L2) PO5: Apply (L3) PO11: Thumb Rule	3 3 3 2
3	9	20%	2	CO3: Apply	L3	PO1 PO2 PO3 PO5 PO11	PO1: Apply (L3) PO2: Review (L2) PO3: Develop (L3) PO5: Apply (L3) PO11: Thumb Rule	3 3 3 3 2
4	9	20%	2	CO4: Analyze	L4	PO1 PO2 PO4 PO5 PO11	PO1: Apply (L3) PO2: Review (L2) PO4: Analyze (L4) PO5: Apply (L3) PO11: Thumb Rule	3 3 3 3 3
5	9	20%	2	CO5: Evaluate	L5	PO1 PO2 PO5 PO11	PO1: Apply (L3) PO2: Review (L2) PO5: Apply (L3) PO11: Thumb Rule	3 3 3 3
	45	100 %						

Justification Statements:

CO1:Understand computational thinking, algorithms, flowcharts & Python fundamentals.

Action Verb: Understand (L2)

PO1: Apply (L3)

CO1 action verb is one level less than the PO1 action verb. Therefore, the correlation is **Moderate (2)**.

PO2: Review (L2)

CO1 action verb is the same as the PO2 action verb. Therefore, the correlation is **High (3)**.

PO11: Thumb Rule

Computational thinking and Python fundamentals promote independent learning and adaptability to programming concepts. Therefore, the correlation is **Moderate (2)**.

CO2: Apply decision-making and looping constructs in Python for problem solving.

Action Verb: Apply (L3)

PO1: Apply (L3)

CO2 action verb is the same as the PO1 action verb. Therefore, the correlation is **High (3)**.

PO2: Review (L2)

CO2 action verb is greater than the PO2 action verb. Therefore, the correlation is **High (3)**.

PO5: Apply (L3)

CO2 action verb is the same as the PO5 action verb. Therefore, the correlation is **High (3)**.

PO11: Thumb Rule

Decision-making and looping concepts help students develop programming skills through continuous practice and self-learning. Therefore, the correlation is **Moderate (2)**.

CO3: Apply Python strings, lists, tuples, and sets for problem solving.

Action Verb: Apply (L3)

PO1: Apply (L3)

CO3 action verb is the same as the PO1 action verb. Therefore, the correlation is **High (3)**.

PO2: Review (L2)

CO3 action verb is greater than the PO2 action verb. Therefore, the correlation is **High (3)**.

PO3: Develop (L3)

CO3 action verb is the same as the PO3 action verb. Therefore, the correlation is **High (3)**.

PO5: Apply (L3)

CO3 action verb is the same as the PO5 action verb. Therefore, the correlation is **High (3)**.

PO11: Thumb Rule

Python data structures encourage independent programming practice and improve problem-solving skills. Therefore, the correlation is **Moderate (2)**.

CO4: Analyze dictionaries, functions, recursion, and variable scope in Python.

Action Verb: Analyze (L4)

PO1: Apply (L3)

CO4 action verb is greater than the PO1 action verb. Therefore, the correlation is **High (3)**.

PO2: Review (L2)

CO4 action verb is greater than the PO2 action verb. Therefore, the correlation is **High (3)**.

PO4: Analyze (L4)

CO4 action verb is the same as the PO4 action verb. Therefore, the correlation is **High (3)**.

PO5: Apply (L3)

CO4 action verb is greater than the PO5 action verb. Therefore, the correlation is **High (3)**.

PO11: Thumb Rule

Functions and recursion encourage analytical thinking, independent learning, and adaptation to advanced programming concepts. Therefore, the correlation is **High (3)**.

CO5: Evaluate modules, file handling, exception handling, and OOP concepts.

Action Verb: Evaluate (L5)

PO1: Apply (L3)

CO5 action verb is greater than the PO1 action verb. Therefore, the correlation is **High (3)**.

PO2: Review (L2)

CO5 action verb is greater than the PO2 action verb. Therefore, the correlation is **High (3)**.

PO5: Apply (L3)

CO5 action verb is greater than the PO5 action verb. Therefore, the correlation is **High (3)**.

PO11: Thumb Rule

Modules, file handling, exception handling, and object-oriented programming foster lifelong learning by enabling students to work with modern Python technologies and develop reliable software applications. Therefore, the correlation is **High (3)**.



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)**

AK26 REGULATIONS

B. TECH- Computer Science and Engineering (Data Science)

Course Code	Year & Sem	Engineering Graphics	L	T	Pr	P	SQC/CLC	C
26AES0303	I-I		1	0	4	0	0	3

Course Outcomes: At the end of this course, student will be able to

CO: 1	Apply engineering graphics principles to construct curves and scales using manual drafting and AI tools.
CO: 2	Analyze orthographic projections of points, lines and planes using conventional and AI-based methods.
CO: 3	Apply projection principles to represent regular solids using conventional method and AI tools.
CO: 4	Analyze sectional views and develop surface patterns using conventional and AI-based optimization methods.
CO: 5	Apply isometric and orthographic projection principles to develop 2D/3D CAD models using AI-assisted reconstruction techniques.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Apply	engineering graphics principles for constructing curves and scales	using manual drafting and AI tools	accurately construct curves and scales as per engineering drawing standards	L3
CO2	Analyze	orthographic projections of points, lines and planes	to determine true lengths, and inclinations using conventional and AI-based methods	correctly analyze and interpret orthographic projections	L4
CO3	Apply	projection principles of regular solids	using conventional projection methods and AI techniques	accurately represent and identify regular solids	L3
CO4	Analyze	sectional views and surface patterns	using conventional drafting and AI-based optimization methods	correctly analyze sectional views and develop optimized surface patterns	L4
CO5	Apply	isometric and orthographic projection principles and 2D/3D CAD modeling	using CAD software and AI-assisted reconstruction techniques	accurately develop 2D/3D CAD models from engineering projections	L3

Unit I: Introduction to Engineering Graphics, Curves, and Scales

Introduction: Principles of Engineering Graphics, signboards, BIS conventions, and lettering.

Curves: Construction of Polygons. Conic sections: Ellipse, Parabola, and Hyperbola using eccentricity/general methods. Cycloidal curves and Involute.

Scales: Plain, Diagonal, and Vernier scales.

Hands-on Experience:

Manual draft generation of an ellipse and diagonal scale, paired with a software verification loop.

- **AI Integration Module:** AI prompt engineering for generating geometric profiles; algorithmic generation of conic curves using mathematical code blocks; parsing hand-drawn geometric sketches into clean vector shapes using Computer Vision (CV) edge detection (Canny Edge/Hough Transform).

Unit II Orthographic Projections of Points, Lines

Core Syllabus: Principles of orthographic projections, projection of points in all four quadrants.

Projection of straight lines inclined to one or both reference planes, traces of lines, determination of true lengths and true inclinations.

Projections of Planes: regular planes Perpendicular to both reference planes, parallel to one reference plane and inclined to the other reference plane; plane inclined to both the reference planes.

Hands-On Experience & Application

Project: Construct a transformation script where a user inputting 2D projection endpoints automatically outputs the 3D line representation, true spatial length, and inclination angles without manual geometric tracking.

Application: Calibration setups for stereoscopic robotic arms tracking trajectories across multiple camera planes.

AI Integration Module: Machine learning pipelines for 3D coordinate estimation from 2D views; multi-view structural tracking; training neural models to predict true line length and orientation angles based solely on coordinate projections

Unit III Projection of Regular Solids

Core Syllabus:

Projection of Regular Solids: Types of solids: Polyhedra and Solids of revolution. Projections of solids in simple positions: Axis perpendicular to horizontal plane, Axis perpendicular to vertical plane and Axis parallel to both the reference planes, Projection of Solids with axis inclined to one reference plane and parallel to another plane.

Hands-On Experience & Application

- **Project:** Set up a classification notebook using scikit-learn or a simple convolutional model to automatically identify the type of solid (e.g., hexagonal prism vs. cone) present within an orthographic engineering layout image.
- **Application:** Automated component sorting inside factory staging bays and conveyor streams.

AI Integration Module: Object recognition models (e.g., YOLO / Mobile Net) trained to identify standard solid geometries; automated multi view projection generation from 3D CAD meshes using programmatic render layers.

Unit IV Sections of Solids, Development of Surfaces, and AI Generative Design

Core Syllabus:

Sections of Solids: Perpendicular and inclined section planes, Sectional views and True shape of section, Sections of solids in simple position only.

Development of Surfaces: Methods of Development: Parallel line development and radial line development. Development of a cube, prism, cylinder, pyramid and cone.

- **AI Integration Module:** Generative Adversarial Networks (GANs) for generating flat-pattern configurations; algorithmic optimization of surface layouts to minimize sheet manufacturing scrap; predictive tool path generation using physics-guided heuristic networks.

Hands-On Experience & Application

- **Project:** Use a nesting optimization script (e.g., using genetic algorithms or standard heuristics) to arrange several custom flat-surface solid developments onto a finite raw sheet grid, actively minimizing material margins and cut lines.
- **Application:** Sheet metal stamping pattern automation in automotive and aerospace chassis manufacturing.

Unit V Isometric Projections, Conversions, and 2D-to-3D Deep Reconstruction

Core Syllabus:

Principles of isometric projection, isometric scale, isometric views/projections of planes, simple and compound solids. Conversion of isometric views to orthographic views and vice-versa.

Computer graphics: Creating 2D&3D drawings of objects including PCB and Transformations using Auto CAD (*Not for end examination*).

Hands-On Experience & Application

- **Project:** Use a pre-trained depth estimation or pixel-to-voxel neural model to parse a set of front, top, and side drawings, compiling them directly into an interactive 3D point cloud or boundary surface rendering.
- **Application:** Instantly generating 3D printable mechanical files directly from archival 2D layout drafting logs.

AI Integration Module: 2D-to-3D depth reconstruction using Neural Radiance Fields (NeRF) or specialized generative models; auto-generation of 3D CAD models from simple multi-view engineering layout sketches

Text Books

1. Engineering Drawing by N.D. Bhatt, Charotar Publishing House 2016.
2. Engineering Drawing with an Introduction to AutoCAD, Dhananjay Jolhe, Tata McGraw Hill, 2017.

Reference Books

1. Engineering Graphics and Design by Pradeep Jain, A.P. Gautam, Abhishek Bhargava, Khanna Publishing.
2. Engineering Drawing, K.L. Narayana and P. Kannaiah, Tata McGraw Hill, 2013.
3. Engineering Drawing, M.B.Shah and B.C. Rana, Pearson Education Inc,2009.

Online Learning Resources:

- **Classical Drafting Fundamentals:** NPTEL Engineering Graphical Design Course by IIT Kharagpur
- **Computer Vision and Processing:** Open CV Official Python Boot camps and Tutorials
- **Generative Design and Modeling Insights:** MIT 6.S192: Deep Generative Modeling Platforms

CO – PO Articulation Matrix

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)												
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
Engineering Graphics	CO1	3	2	3		3						2		2
	CO2	3	3	3		3						3		2
	CO3	3	2	3		3						2		2
	CO4	3	3	3		3						3		2
	CO5	3	2	3		3						2		2

Correlation Matrix

CO				CO		Program Outcomes (PO)	PO(s): Action Verb and BTL (for PO1 to PO5)	Level of Correlation
	Lesson Plan (Hrs)	%	Correlation	Verb	BTL			
1	18	24	3	Apply	L3	PO1 PO2 PO3 PO5 PO11	Apply (L3) Identify (L3) Develop (L3) Apply (L3) Thumb Rule	3 3 3 3 2
2	15	20	2	Analyze	L4	PO1 PO2 PO3 PO5 PO11	Apply (L3) Identify (L3) Develop (L3) Apply (L3) Thumb Rule	3 3 3 3 3
3	15	20	2	Apply	L3	PO1 PO2 PO3 PO5 PO11	Apply (L3) Identify (L3) Develop (L3) Apply (L3) Thumb Rule	3 3 3 3 2
4	15	20	2	Analyze	L4	PO1 PO2 PO3 PO5 PO11	Apply (L3) Identify (L3) Develop (L3) Apply (L3) Thumb Rule	3 3 3 3 3
5	12	16	2	Apply	L3	PO1 PO2 PO3 PO5 PO11	Apply (L3) Identify (L3) Develop (L3) Apply (L3) Thumb Rule	3 3 3 3 2
	75	100						

Justification Statements:

CO1: Apply engineering graphics principles to construct curves and scales using manual drafting and AI tools.

Action Verb: Apply (L3)

PO1 Verb: Apply (L3). CO1 Action verb is at the same level as the PO1 verb. Therefore, the correlation is high (3).

PO2 Verb: Identify (L3). CO1 Action verb is same level as PO2 verb. Therefore, the correlation is high (3).

PO3 Verb: Develop (L3). CO1 Action verb is at the same level as the PO3 verb. Therefore, the correlation is high (3).

PO5 Verb: Apply (L3). CO1 Action verb is at the same level as the PO5 verb. Therefore, the correlation is high (3).

PO11 Verb: Thumb Rule. As per the thumb rule, CO1 correlates slightly with the PO11 verb. Therefore, the correlation is moderate (2).

CO2: Analyze orthographic projections of points, lines and planes using conventional and AI-based methods.

Action Verb: Analyze (L4)

PO1 Verb: Apply (L3). CO2 Action verb is greater than the PO1 verb. Therefore, the correlation is high (3).

PO2 Verb: Identify (L3). CO2 Action verb is at the same level as the PO2 verb. Therefore, the correlation is high (3).

PO3 Verb: Develop (L3). CO2 Action verb is greater than the PO3 verb. Therefore, the correlation is high (3).

PO5 Verb: Apply (L3). CO2 Action verb is greater than the PO5 verb. Therefore, the correlation is high (3).

PO11 Verb: Thumb Rule. As per the thumb rule, CO2 correlates strongly with the PO11 verb. Therefore, the correlation is high (3).

CO3: Apply projection principles to represent regular solids using conventional method and AI tools.

Action Verb: Apply (L3)

PO1 Verb: Apply (L3). CO3 Action verb is at the same level as the PO1 verb. Therefore, the correlation is high (3).

PO2 Verb: Identify (L3). CO3 Action verb same level as PO2 verb. Therefore, the correlation is high (3).

PO3 Verb: Develop (L3). CO3 Action verb is at the same level as the PO3 verb. Therefore, the correlation is high (3).

PO5 Verb: Apply (L3). CO3 Action verb is at the same level as the PO5 verb. Therefore, the correlation is high (3).

PO11 Verb: Thumb Rule. As per the thumb rule, CO3 correlates slightly with the PO11 verb. Therefore, the correlation is moderate (2).

CO4: Analyze sectional views and develop surface patterns using conventional and AI-based optimization methods.

Action Verb: Analyze (L4)

PO1 Verb: Apply (L3). CO4 Action verb is greater than the PO1 verb. Therefore, the correlation is high (3).

PO2 Verb: Identify (L3). CO4 Action verb is at the same level as the PO2 verb. Therefore, the correlation is high (3).

PO3 Verb: Develop (L3). CO4 Action verb is greater than the PO3 verb. Therefore, the correlation is high (3).

PO5 Verb: Apply (L3). CO4 Action verb is greater than the PO5 verb. Therefore, the correlation is high (3).

PO11 Verb: Thumb Rule. As per the thumb rule, CO4 correlates strongly with the PO11 verb. Therefore, the correlation is high (3).

CO5: Apply isometric and orthographic projection principles to develop 2D/3D CAD models using AI-assisted reconstruction techniques.

Action Verb: Apply (L3)

PO1 Verb: Apply (L3). CO5 Action verb is at the same level as the PO1 verb. Therefore,

the correlation is high (3).

PO2 Verb: Identify (L3). CO5 Action verb is same level as PO2 verb. Therefore, the correlation is high (3).

PO3 Verb: Develop (L3). CO5 Action verb is at the same level as the PO3 verb. Therefore, the correlation is high (3).

PO5 Verb: Apply (L3). CO5 Action verb is at the same level as the PO5 verb. Therefore, the correlation is high (3).

PO11 Verb: Thumb Rule. As per the thumb rule, CO5 correlates slightly with the PO11 verb. Therefore, the correlation is moderate (2).



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)**

AK26 REGULATIONS

B. TECH- Computer Science and Engineering (Data Science)

Course Code	Year & Sem	Applied Chemistry for Computer Science Lab	L	T	Pr	P	SQC/CLC	C
26ABS990605	I-I		0	0	0	3	0	1.5

Course Objectives: Students are expected to

- Verify the fundamental concepts with experiments.

Course Outcomes: At the end of the course, the students will be able to

CO1: Apply redox and conductometric titration techniques to estimate analyte concentrations.

CO2: Analyze corrosion rates and effect of environmental factors on metal corrosion.

CO3: Apply potentiometric and spectrophotometric techniques for quantitative chemical analysis

CO4: Apply **principle of IR spectroscopy to identify functional groups in organic compounds.**

CO5: **Apply laboratory techniques to synthesize and characterize advanced polymers for engineering applications.**

CO	Action Verb	Knowledge Statement	Condition	Criteria	Bloom's Level
CO1	Apply	Redox and conductometric titration techniques		to estimate analyte concentrations	L3
CO2	Analyze	Corrosion rates and environmental effects on corrosion	Using corrosion experiments	to analyze metal corrosion	L4
CO3	Apply	Potentiometric and spectrophotometric techniques	Using analytical instruments	to perform quantitative chemical analysis	L3
CO4	Apply	principle of IR spectroscopy to identify functional groups		in organic compounds	L3
CO5	Apply	laboratory techniques to synthesize and characterize advanced polymers		for engineering applications.	L3

List of Experiments:

1. Estimation of Ferrous Ion (Fe^{2+}) using Potassium Permanganate (KMnO_4) Volumetric Analysis (CO1)
2. Determination of Strength of Acid (H_2SO_4) in Battery Using Sodium Hydroxide (NaOH) (CO1)
3. Determination of Corrosion (CO2)
4. Determination of Corrosion by Environment (CO2)
5. Conductometric Titration of Strong Acid vs Strong Base (HCl vs NaOH) (CO1)
6. Conductometric Titration of Weak Acid vs Strong Base (CH_3COOH vs NaOH) (CO1)
7. Potentiometry (Redox Titration) — Estimation of Iron (Fe^{2+}) Using Potassium Dichromate ($\text{K}_2\text{Cr}_2\text{O}_7$) (CO3)
8. Determination of Wavelength (λ) and Verification of Beer-Lambert's Law (CO3)

9. Identification of Functional Groups in Organic Compound by Infra-Red (IR) Spectrum (CO4)
10. Preparation of Polymer (Phenol-Formaldehyde — Bakelite) (CO5)

AI Tools Integration (Lab)

Data analysis using Python (NumPy, Pandas, Matplotlib) for titration curve plotting and equivalence point detection. Predictive modelling for corrosion rate and material behaviour using scikit-learn regression. TensorFlow for optional IR spectrum pattern classification. OpenCV for colorimetric image-based concentration estimation. Qiskit (introductory) for exploring quantum chemistry concepts relevant to spectroscopy.

Textbooks

1. Jain, P. C., & Jain, M. (2020). Engineering Chemistry (17th ed.). Dhanpat Rai Publishing.
2. Shika Agarwal (2026). Engineering Chemistry (5th ed.). Cambridge University Press.

Reference Books

1. Dara, S. S., & Umare, S. S. (2018). Engineering Chemistry (15th ed.). S. Chand Publishing

Mapping of COs to POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3			1	3								
2	3			2	3								
3	3			1	3								
4	3			1	3								
5	3			1	3								

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	Correlation	Verb	BTL			
1				Apply	L3	PO1, PO4, PO5	PO1: Apply (L3)	3
2				Analyze	L4	PO1, PO4, PO5	PO1: Analyze (L4)	3
3				Apply	L3	PO1, PO4, PO5	PO1: Apply(L3)	3
4				Apply	L3	PO1, PO4, PO5	PO1: Apply(L3)	3
5				Apply	L3	PO1, PO4, PO5	PO1: Apply(L3)	3

CO1: Apply redox and conductometric titration techniques to estimate analyte concentrations.

Action Verb: Apply (L3)

PO1 Verb: Apply (L3)

CO1 Action Verb is equal to PO1 verb; Therefore, correlation is high (3).

CO2: Analyze corrosion rates and effect of environmental factors on metal corrosion.

Action Verb: Analyze (L4)

PO1 Verb: Apply (L3)

CO2 Action Verb is one level higher than to PO1 verb; Therefore, correlation is high (3).

CO3: Apply potentiometric and spectrophotometric techniques for quantitative chemical analysis

Action Verb: Apply (L3)

PO1 Verb: Apply (L3)

CO3 Action Verb is equal to PO1 verb; Therefore, correlation is high (3)

CO4: Apply **principle of IR spectroscopy to identify functional groups in organic compounds.**

Action Verb: Apply (L3)

PO1 Verb: Apply (L3)

CO4 Action Verb is equal to PO1 verb; Therefore, correlation is high (3)

CO5:Apply laboratory techniques to synthesize and characterize advanced polymers for engineering applications

Action Verb: Apply (L3)

PO1 Verb: Apply (L3)

CO5 Action Verb is equal to PO1 verb; Therefore, correlation is high (3).



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)**

AK26 REGULATIONS

B. TECH- Computer Science and Engineering (Data Science)

Course Code	Year & Sem	Communicative English Lab	L	T	Pr	P	SQC/CLC	C
26AHM9902	I-I		0	0	0	2	0	1

Course Outcomes (CO): By the end of the program students will be able to	Blooms Level
CO1: Apply standard phonemic symbols and AI-assisted pronunciation tools to enhance English pronunciation, fluency, and confidence in spoken communication.	L3
CO2: Apply AI-assisted language learning tools to enhance listening comprehension and communicate effectively in formal and informal contexts.	L3
CO3: Analyze information using AI-supported research tools and communicate evidence-based arguments effectively in presentations, discussions, and debates.	L4
CO4: Create professional documents using AI-powered writing and formatting tools while ensuring grammatical accuracy, coherence, and contextual appropriateness.	L6
CO5: Evaluate and utilize AI-powered language technologies to enhance English communication while ensuring accuracy, originality, and ethical use of AI-generated content.	L5

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms
CO1	Apply	standard phonemic symbols and AI-assisted pronunciation tools to enhance English pronunciation, fluency, and confidence in spoken communication.		in spoken communication.	L3
CO2	Apply	AI-assisted language learning tools to enhance listening comprehension and communicate effectively in formal and informal contexts.		in formal and informal contexts.	L3
CO3	Analyze	information using AI-supported research tools and communicate evidence-based arguments effectively in presentations,		in presentations, discussions, and debates.	L4

		discussions, and debates.			
CO4	Create	professional documents using AI-powered writing and formatting tools while ensuring grammatical accuracy, coherence, and contextual appropriateness.		professional documents	L6
CO5	Evaluate	And utilize AI-powered language technologies to enhance English communication while ensuring accuracy, originality, and ethical use of AI-generated content.		English communication	L5

S.No	Lab Topic	Lab Activity	AI Activity	AI Tools	Cos
1	Phonetics & Pronunciation Practice	Record & playback vowel/consonant articulation; IPA chart drill; Minimal pair exercises	Use AI speech-to-text to detect mispronunciations ; real-time phoneme feedback via ELSA Speak	ELSA Speak, Google Speech Recognition, Speechling	CO1
2	Listening Comprehension & Note-Taking	Listen to TED Talks/podcasts; fill-in-the-blank exercises; summarise audio passages	Auto-generate transcripts; compare student notes with AI-generated summaries using Otter.ai	Otter.ai, YouTube Auto-captions, Whisper AI	CO2
3	Spoken English & Fluency Building	Impromptu speaking (1–2 min); picture description; story completion tasks	AI analyses speech for filler words, pace, and clarity; ChatGPT prompts for spontaneous speaking	Speeko, ChatGPT, Google Assistant	CO1,CO5
4	Group Discussion Techniques	Role-based GD on current topics; turn-taking practice; consensus building	AI evaluates argument structure and language; ChatGPT generates counter-arguments for	ChatGPT, Gemini, Mentimeter	CO3

			practice		
5	Public Speaking & Presentations	Prepare and deliver 3-minute presentations; use of visual aids; Q&A handling	AI slide deck generation; real-time delivery feedback on pacing and confidence	Beautiful.ai, Gamma.app, Microsoft Copilot	CO3,CO 5
6	Interview Skills & Mock Interviews	HR round simulation; STAR method answers; body language and eye contact	AI-powered mock interview with instant feedback on content, grammar, and tone	Yoodli, Interview Warmup by Google, ChatGPT	CO2,CO 5
7	Professional Email & Business Writing	Draft formal emails, complaints, and requests; subject line formulation; netiquette	AI refines email drafts; tone & clarity check; compare student draft with AI-improved version	Grammarly, ChatGPT, Gemini	CO4
8	Resume & Cover Letter Writing	ATS-friendly resume design; action verbs usage; tailoring cover letters to job descriptions	AI resume scanner; keyword optimisation suggestions; ChatGPT cover letter generation and critique	Kickresume, Resume.io, Jobscan, ChatGPT	CO4
9	Reading Comprehension & Critical Thinking	Read articles/editorials; identify main idea, inference, and tone; speed reading drills	AI generates comprehension questions; text summarisation and comparative analysis	Quillbot, Speechify, NotebookLM	CO2
10	Debate & Argumentation Skills	Structured debate (for/against); rebuttal techniques; logical fallacy identification	AI generates arguments on both sides; evaluate logical structure using ChatGPT	ChatGPT, Claude.ai, Kialo Edu	CO3
11	Report Writing & Technical Communication	Lab report, incident report, and project report formats; headings, data presentation	AI improves report coherence and passive/active voice usage; grammar and structure feedback	Grammarly Business, ChatGPT, Hemingway Editor	CO4
12	Etiquette, Netiquette & Personal Branding	Workplace conversation role play; LinkedIn profile creation; professional social media etiquette	AI reviews LinkedIn summaries; digital personal analysis; personal brand statement via ChatGPT	ChatGPT, Canva AI, LinkedIn AI features	CO1,CO 2

Text Books:

- 1.Raman, Meenakshi & Sharma, Sangeeta. Technical Communication: Principles and Practice (3rd Ed.). Oxford University Press, 2022.
- 2.Krishnaswamy, N. & Krishnaswamy, L. The Story of English in India. Foundation Books, Cambridge University Press, 2021.

Reference Books:

- 1.Swan, Michael. Practical English Usage (4th Ed.). Oxford University Press, 2016.
- 2.Murphy, Raymond. English Grammar in Use (5th Ed.). Cambridge University Press, 2019.
- 3.Rizvi, M. Ashraf. Effective Technical Communication (2nd Ed.). McGraw-Hill Education, 2018.
- 4.Turton, N.D. & Heaton, J.B. Longman Dictionary of Common Errors. Pearson Longman, 2017.
- 5.Lesikar, Raymond V. & Flatley, Marie E. Basic Business Communication (12th Ed.). McGraw-Hill, 2020.
- 6.Rutherford, Andrea J. Basic Communication Skills for Technology (3rd Ed.). Pearson, 2019.

Online Resources

- BBC Learning English – <https://www.bbc.co.uk/learningenglish> (Grammar, pronunciation, and listening)
- British Council Learn English – <https://learnenglish.britishcouncil.org>
- TED Talks – <https://www.ted.com/talks> (Listening & speaking practice)
- Coursera English Communication Skills Specialisation – <https://www.coursera.org>
- edX English for Professional and Academic Purposes – <https://www.edx.org>
- Grammarly Blog – <https://www.grammarly.com/blog> (Writing tips)
- ELSA Speak (App) – <https://elsaspeak.com> (AI pronunciation coach)

7. YouTube Channels

- English with Lucy – @EnglishwithLucy (Vocabulary, speaking, British accent)
- Learn English with TV Series – @LearnEnglishWithTVSeries
- Rachel's English – @rachelsenglish (American accent and pronunciation)
- TED-Ed – @TEDEd (Critical thinking and communication ideas)
- Spoken English Hub – @SpokenEnglishHub (Indian context, interview prep)
- JenniferESL – @JenniferESL (Grammar and business English)

Lab Software & AI Tools Required:

Software / Tool	Type	Purpose
ELSA Speak	AI Pronunciation Coach App	Real-time speech accuracy & fluency feedback
Grammarly	AI Writing Assistant	Grammar, punctuation, style correction
ChatGPT / Claude.ai	Generative AI Chatbot	Conversation practice,

		writing assistance, debate prep
Otter.ai	AI Transcription Tool	Transcribe and analyse spoken content
Yoodli	AI Public Speaking Coach	Presentation and interview delivery analysis
Hemingway Editor	Writing Clarity Tool	Improve readability and sentence structure
Mentimeter	Interactive Presentation	Live polls, word clouds during GD sessions
Audacity	Audio Recording Software	Record and review pronunciation exercises
Google Meet / Zoom	Video Conferencing	Mock interviews and virtual presentations
Canva / Beautiful.ai	AI Presentation Design	Create professional visual presentations

**Correlation of COs with the POs & PSOs for B.Tech
AK-26 Regulations**

***3: Highly Correlated, 2: Moderately Correlated, 1: Weakly Correlated**

Course Title	Course Outcomes COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11
COMMUNICATIVE ENGLISH LAB	CO1									2		
	CO2									2		
	CO3								3	3		
	CO4									3		
	CO5									3		

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	corr	Verb	BTL			
1				Apply	L3	PO9	Thumb Rule	2
2				Apply	L3	PO9	Thumb Rule	2
3				Analyze	L4	PO8, PO9	Thumb Rule	3,3
4				Create	L6	PO9	Thumb Rule	3
5				Evaluate	L5	PO9	Thumb Rule	3

CO-PO mapping justification:

CO1: Apply standard phonemic symbols and AI-assisted pronunciation tools to enhance English pronunciation, fluency, and confidence in spoken communication.

Action Verb: Apply (L3)

CO1 Action Verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 to PO11 as moderate (2).

CO2: Apply AI-assisted language learning tools to enhance listening comprehension

and communicate effectively in formal and informal contexts.

Action Verb: Apply (L3)

CO2 Action Verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 to PO11 as moderate (2)

CO3: Analyse information using AI-supported research tools and communicate evidence-based arguments effectively in presentations, discussions, and debates.

Action Verb: Analyze (L4)

CO3 Action Verb analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 to PO11 as high (3).

CO4: Create professional documents using AI-powered writing and formatting tools while ensuring grammatical accuracy, coherence, and contextual appropriateness.

Action Verb: Create (L6)

CO4 Action Verb Create is of BTL 6. Using Thumb rule, L6 correlates PO6 to PO11 as high (3)

CO5: Evaluate and utilize AI-powered language technologies to enhance English communication while ensuring accuracy, originality, and ethical use of AI-generated content

Action Verb: Evaluate (L5)

CO5 Action Verb Evaluate is of BTL 5 Using Thumb rule, L5 correlates PO6 to PO11 as high (3).



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
AK26 REGULATIONS**

B. B. TECH- Computer Science and Engineering (Data Science)

Course Code	Year & Sem	Computational Thinking and Problem Solving with Python Lab	L	T	Pr	P	SQC/CLC	C
26AES0502	I-I		0	0	0	3	0	1.5

Course Outcomes:

After studying the course, student will be able to

CO1: **Apply** computational thinking and Python fundamentals to develop simple programs.

CO2: **Apply** decision-making and looping constructs to solve programming problems.

CO3: **Analyze** Python strings and data structures for problem solving.

CO4: **Analyze** functions, recursion, and dictionaries to develop modular Python programs.

CO5: **Evaluate** file handling, exception handling & OOP for Python applications.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms Level
CO1	Apply	Computational thinking and Python fundamentals	using python	to develop simple programs	L3
CO2	Apply	Decision-making and looping constructs	in python	for problem solving	L3
CO3	Analyze	Python strings and data structures	in python program		L4
CO4	Analyze	Functions, recursion, and dictionaries	in python	for modular programming	L4
CO5	Evaluate	File handling, exception handling, and OOP	in Python applications		L5

MODULE I COMPUTATIONAL THINKING & PROGRAMMING BASICS

Topics: Computational thinking — decomposition and abstraction; algorithms, flowcharts, and pseudocode; Python environment setup; variables, data types, input/output, and operators; basic computational problems.

AI Integration: Generate alternate solutions and test inputs; verify flowchart correctness; compare solution efficiency; explain type conversion.

Suggested Tools: Python, Flowgorithm, draw.io AI, ChatGPT, Microsoft Copilot

Experiment 1: Problem Solving using Computational Thinking — Select three daily-life problems; apply decomposition and abstraction; write algorithms, draw flowcharts, and convert them into pseudocode.

Experiment 2: Flowchart Design and Algorithm Simulation — Design flowcharts for largest of three numbers, student grade calculation, and electricity-bill generation; simulate execution and verify outputs.

Experiment 3: Python Programming Fundamentals — Install the Python environment; write programs using variables, data types, input/output, and operators; solve simple interest, area, and unit-conversion problems.

MODULE II DECISION MAKING & LOOPING

Topics: Decision-control statements; looping and iterative problem solving; nested loops and pattern generation.

AI Integration: Generate boundary and test cases; verify decision logic; trace loop execution; compare loop alternatives; optimize nested loops.

Suggested Tools: Python, Python Tutor, ChatGPT, Microsoft Copilot

Experiment 4: Decision Control Statements — Develop Python programs for largest among three numbers, grade calculation, leap-year checking, and a menu-driven calculator.

Experiment 5: Looping and Iterative Problem Solving — Implement programs for prime-number generation, Armstrong numbers, factorial computation, and multiplication tables.

Experiment 6: Nested Loops and Pattern Generation — Generate number, pyramid, diamond, and character patterns.

MODULE III STRINGS & DATA STRUCTURES

Topics: String processing; lists and nested lists; tuples and sets.

AI Integration: Generate string test cases and sample datasets; explain slicing and immutable structures; compare list approaches and suggest optimizations.

Suggested Tools: Python, Python Tutor, Algorithm Visualizer, ChatGPT

Experiment 7: String Processing Applications — Develop programs for string reversal, palindrome checking, frequency counting, and word-occurrence analysis.

Experiment 8: List and Nested List Operations — Perform sorting, searching, list merging, and matrix operations using nested lists.

Experiment 9: Tuple and Set Applications — Implement tuple packing/unpacking, student-record storage, and set union, intersection, and difference operations.

MODULE IV | FUNCTIONS & PROBLEM SOLVING

Topics: User-defined functions; recursion; dictionaries and lambda functions.

AI Integration: Generate function examples and datasets; verify outputs; generate recursion trees; compare iterative and recursive solutions; explain lambda execution.

Suggested Tools: Python, Python Tutor, Algorithm Visualizer, ChatGPT

Experiment 10: User-Defined Functions — Implement positional, keyword, default, and variable-length arguments.

Experiment 11: Recursive Problem Solving — Develop recursive solutions for factorial, Fibonacci, GCD, and Tower of Hanoi.

Experiment 12: Dictionary and Lambda Applications — Implement a student database, dictionary operations, dictionary sorting, and lambda-based computations.

MODULE V | FILE HANDLING, EXCEPTION HANDLING & OOP

Topics: File processing and data storage; exception handling and testing; object-oriented programming — classes, objects, constructors, methods.

AI Integration: Generate datasets and error scenarios; verify file outputs; recommend exception strategies; generate class diagrams and suggest object interactions.

Suggested Tools: Python, ChatGPT, Microsoft Copilot

Experiment 13: File Processing and Data Storage — Develop programs to create and read text files, count words, and process CSV data.

Experiment 14: Exception Handling and Testing — Implement try-except, finally, and custom exceptions; apply exception handling to division operations, file access, and input validation.

Experiment 15: Object-Oriented Programming Mini Project — Develop a Python application using classes, objects, constructors, and methods.

Suggested Mini Projects:

1. Student Management System
2. Library Management System
3. Banking System

Textbooks:

1. Pieter Spronck, Computational Thinking with Python.
2. Reema Thareja, Programming in Python, Oxford University Press.

Reference Books:

1. Allen B. Downey, Think Python: How to Think Like a Computer Scientist.
2. Eric Matthes, Python Crash Course.
3. John Zelle, Python Programming: An Introduction to Computer Science.

Recommended AI / Computational Tools

1. **AI Assistants:** ChatGPT, Microsoft Copilot – code generation, explanation and test-case generation.
2. **Flowchart & Diagramming:** Flowgorithm, Lucidchart AI, draw.io AI – algorithm and flowchart design.
3. **Visualization:** Algorithm Visualizer, Python Tutor – execution tracing and recursion visualization.

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PS02
CO1	3	3			3						2		
CO2	3	3			3						2		
CO3	3	3	3	3	3						3		

C04	3	3	3	3	3						3		
C05	3	3		3	3						3		

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

Correlation matrix

Unit No.	Co's Action verb	BTL	Program Outcome (PO)	PO(s) : Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
1	CO1: Apply	L3	PO1 PO2 PO5 PO11	PO1: Apply (L3) PO2: Review (L2) PO5: Apply (L3) PO11: Thumb Rule	3 3 3 2
2	CO2: Apply	L3	PO1 PO2 PO5 PO11	PO1: Apply (L3) PO2: Review (L2) PO5: Apply (L3) PO11: Thumb Rule	3 3 3 2
3	CO3: Analyze	L4	PO1 PO2 PO3 PO4 PO5 PO11	PO1: Apply (L3) PO2: Review (L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply (L3) PO11: Thumb Rule	3 3 3 3 3 3
4	CO4: Analyze	L4	PO1 PO2 PO3 PO4 PO5 PO11	PO1: Apply (L3) PO2: Review (L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply (L3) PO11: Thumb Rule	3 3 3 3 3 3
5	CO5: Evaluate	L5	PO1 PO2 PO4 PO5 PO11	PO1: Apply (L3) PO2: Review (L2) PO4: Analyze (L4) PO5: Apply (L3) PO11: Thumb Rule	3 3 3 3 3

Justification Statements:

CO1: Apply computational thinking and Python fundamentals to develop simple programs.

Action Verb: Apply (L3)

PO1: Apply (L3)

CO1 action verb is the same as the PO1 action verb. Therefore, the correlation is **High (3)**.

PO2: Review (L2)

CO1 action verb is greater than the PO2 action verb. Therefore, the correlation is **High (3)**.

PO5: Apply (L3)

CO1 action verb is the same as the PO5 action verb. Therefore, the correlation is **High (3)**.

PO11: Thumb Rule

Computational thinking and Python programming fundamentals encourage independent learning and adaptability to modern programming technologies. Therefore, the correlation is **Moderate (2)**.

CO2: Apply decision-making and looping constructs to solve programming problems.

Action Verb: Apply (L3)

PO1: Apply (L3)

CO2 action verb is the same as the PO1 action verb. Therefore, the correlation is **High (3)**.

PO2: Review (L2)

CO2 action verb is greater than the PO2 action verb. Therefore, the correlation is **High (3)**.

PO5: Apply (L3)

CO2 action verb is the same as the PO5 action verb. Therefore, the correlation is **High (3)**.

PO11: Thumb Rule

Programming using decision-making and looping constructs promotes continuous learning and problem-solving skills. Therefore, the correlation is **Moderate (2)**.

CO3: Analyze Python strings and data structures for problem solving.

Action Verb: Analyze (L4)

PO1: Apply (L3)

CO3 action verb is greater than the PO1 action verb. Therefore, the correlation is **High (3)**.

PO2: Review (L2)

CO3 action verb is greater than the PO2 action verb. Therefore, the correlation is **High (3)**.

PO3: Develop (L3)

CO3 action verb is greater than the PO3 action verb. Therefore, the correlation is **High (3)**.

PO4: Analyze (L4)

CO3 action verb is the same as the PO4 action verb. Therefore, the correlation is **High (3)**.

PO5: Apply (L3)

CO3 action verb is greater than the PO5 action verb. Therefore, the correlation is **High (3)**.

PO11: Thumb Rule

Analysis of Python data structures enhances independent learning and analytical skills. Therefore, the correlation is **High (3)**.

CO4: Analyze functions, recursion, and dictionaries in Python.

Action Verb: Analyze (L4)

PO1: Apply (L3)

CO4 action verb is greater than the PO1 action verb. Therefore, the correlation is **High (3)**.

PO2: Review (L2)

CO4 action verb is greater than the PO2 action verb. Therefore, the correlation is **High (3)**.

PO3: Develop (L3)

CO4 action verb is greater than the PO3 action verb. Therefore, the correlation is **High (3)**.

PO4: Analyze (L4)

CO4 action verb is the same as the PO4 action verb. Therefore, the correlation is **High (3)**.

PO5: Apply (L3)

CO4 action verb is greater than the PO5 action verb. Therefore, the correlation is **High (3)**.

PO11: Thumb Rule

Functions, recursion, and dictionaries strengthen analytical thinking and lifelong learning skills. Therefore, the correlation is **High (3)**.

CO5: Evaluate file handling, exception handling, and object-oriented programming applications.

Action Verb: Evaluate (L5)

PO1: Apply (L3)

CO5 action verb is greater than the PO1 action verb. Therefore, the correlation is **High (3)**.

PO2: Review (L2)

CO5 action verb is greater than the PO2 action verb. Therefore, the correlation is **High (3)**.

PO4: Analyze (L4)

CO5 action verb is greater than the PO4 action verb. Therefore, the correlation is **High (3)**.

PO5: Apply (L3)

CO5 action verb is greater than the PO5 action verb. Therefore, the correlation is **High (3)**.

PO11: Thumb Rule

File handling, exception handling, and object-oriented programming enable students to build reliable software applications and adapt to evolving technologies. Therefore, the correlation is **High (3)**.



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)**

AK26 REGULATIONS

B. TECH- Computer Science and Engineering (Data Science)

Course Code	Year & Sem	Health and wellness, Yoga and Sports	L	T	Pr	P	SQC/CLC	C
26AHM9903	I-I		0	0	0	1	0	0.5

Course Objectives:

The main objective of introducing this course is to make the students maintain their mental and physical wellness by balancing emotions in their life. It mainly enhances the essential traits required for the development of the personality.

Course Outcomes: After completion of the course the student will be able to CO1

CO1: Understand the fundamental concepts of health, wellness, fitness and the dimensions of holistic well-being.
CO2: Apply correct yogic practices – asanas, pranayama and meditation – for physical and mental health.
CO3: Apply a personal fitness plan integrating nutrition, exercise, stress management and lifestyle modification.
CO4: Understand rules, skills and safety norms for a chosen sport and participate actively with sportsmanship.
CO5: Evaluate personal health indicators and reflect on lifestyle choices using technology and evidence-based practices.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	the fundamental concepts of health, wellness, fitness and the dimensions of holistic well-being.			L2
2	Apply	correct yogic practices – asanas, pranayama and meditation – for physical and mental health.			L3
3	Apply	a personal fitness plan integrating nutrition, exercise, stress management and lifestyle modification.			L3
4	Understand	rules, skills and safety norms for a chosen sport and participate			L2

		actively with sportsmanship.			
5	Evaluate	personal health indicators and reflect on lifestyle choices using technology and evidence-based practices.			L5

Unit-wise Syllabus with Learning Outcomes

UNIT 1	Health, Wellness and Preventive Healthcare	5 Hrs
Topics	• Concept of health, wellness and fitness – definitions and seven dimensions • WHO definition of health; holistic health model (Physical, Mental, Social, Spiritual) • Nutrition basics – macronutrients, micronutrients, balanced diet, BMI calculation • Lifestyle diseases – diabetes, hypertension, obesity – causes and prevention • Mental health & stress management – causes, symptoms, COPE model • Sleep hygiene and circadian rhythm regulation • Substance abuse – awareness, prevention and rehabilitation • Personal hygiene, sanitation and communicable disease prevention • Ergonomics and occupational health for students	
Unit-wise Learning Outcomes (ULOs)	On completion of this unit, students will be able to: • ULO1.1: Define health, wellness and fitness and describe the seven dimensions of holistic well-being. [Remember] • ULO1.2: Explain the role of balanced nutrition, BMI and sleep hygiene in maintaining good health. [Understand] • ULO1.3: Identify risk factors, early signs and preventive strategies for major lifestyle diseases. [Understand] • ULO1.4: Apply stress-management techniques and healthy daily routines to personal lifestyle. [Apply] • ULO1.5: Evaluate personal health habits and propose evidence-based improvements. [Evaluate]	

UNIT 2	Yoga, Pranayama, Meditation and Mind-Body Practice	5 Hrs
Topics	• Introduction to Yoga – history, philosophy, Patanjali's Ashtanga Yoga • Surya Namaskar – 12-step sequence with correct breathing • Asanas for flexibility: Tadasana, Trikonasana, Paschimottanasana, Sarvangasana • Asanas for strength & balance: Virabhadrasana I & II, Vrikshasana, Naukasana • Pranayama techniques: Anulom-Vilom, Bhastrika, Kapalabhati, Bhramari • Meditation and mindfulness – Dharana, Dhyana, body-scan, guided relaxation • Yoga Nidra for sleep and stress relief • Yoga for specific conditions – stress, back pain, PCOD/PCOS, anxiety • Shatkarmas (cleansing processes) – an overview; International Day	

	of Yoga
Unit-wise Learning Outcomes (ULOs)	On completion of this unit, students will be able to: • ULO2.1: Describe the history, philosophy and eight limbs of Patanjali's Yoga Sutras. [Remember/Understand] • ULO2.2: Perform Surya Namaskar and a set of 8 asanas with correct posture and breath coordination. [Apply] • ULO2.3: Practise at least four pranayama techniques with proper technique and safety awareness. [Apply] • ULO2.4: Apply mindfulness meditation and Yoga Nidra for stress reduction and improved concentration. [Apply] • ULO2.5: Adapt appropriate asanas and pranayama for managing specific health conditions. [Analyse]

UNIT 3	Physical Fitness, Sports Skills and Sports Technology	5 Hrs
Topics	• Physical fitness components – strength, endurance, flexibility, agility, speed, coordination • Principles of training • – overload, progression, specificity, reversibility, individuality • Warm-up, cool-down and dynamic stretching routines • Indoor sports: Badminton, Table Tennis, Chess, Carrom – rules and basic skills • Outdoor sports: Cricket, Football, Volleyball, Kabaddi, Athletics – rules and skills • Sports injuries – types, RICE method, prevention and return-to-play protocol • Sports psychology – motivation, goal setting, concentration and visualisation • Gender equity and inclusivity in sports; Para-sports awareness • Sports technology – wearables, fitness trackers, GPS analytics, performance dashboards	
Unit-wise Learning Outcomes (ULOs)	On completion of this unit, students will be able to: • ULO3.1: Identify the components of physical fitness and explain training principles for improving each. [Understand] • ULO3.2: Demonstrate correct warm-up, cool-down and stretching routines before and after physical activity. [Apply] • ULO3.3: Apply rules, techniques and safety norms of at least one indoor and one outdoor sport. [Apply] • ULO3.4: Design a personalised 4-week physical fitness training plan with progressive overload. [Create] • ULO3.5: Use wearable/fitness-tracking technology to monitor personal performance and evaluate progress. [Evaluate]	

Text Books

S.No	Title	Author(s)	Publisher	Year
1	Health and Physical Education	Dr. S. K. Mangal & Shubhra Mangal	PHI Learning Pvt. Ltd.	2021
2	The Science of Yoga	William J. Broad	Simon & Schuster	2012

Reference Books

S.No	Title	Author(s)	Publisher	Year
1	Yoga: The Iyengar Way	Silva, Mira & Shyam Mehta	Dorling Kindersley	2019
2	Sports Medicine Essentials	Jim Clover	Cengage Learning	2020
3	Foundations of Physical Education	Charles A. Bucher	McGraw-Hill	2018

	& Sport		Education	
4	Mindfulness: An Eight-Week Plan for Finding Peace	Mark Williams & Danny Penman	Rodale Books	2011

Web Resources

- Ministry of AYUSH – <https://main.ayush.gov.in>
- Yoga for Youth (International Day of Yoga) – <https://yoga.ayush.gov.in>
- National Health Portal – <https://nhp.gov.in>
- ICMR Dietary Guidelines – <https://www.icmr.nic.in>
- Sports Authority of India – <https://www.sportsauthorityofindia.nic.in>
- WHO Physical Activity Guidelines – <https://www.who.int/news-room/fact-sheets/detail/physical-activity>
- Khelo India Programme – <https://kheloindia.gov.in>
- NIMHANS (Mental Health Resources) – <https://nimhans.ac.in>

YouTube Resources

- Surya Namaskar – Complete 12-Step Tutorial – https://youtu.be/surya_tut_01
- Pranayama for Beginners (Swami Ramdev) – https://youtu.be/pranayama_sr_02
- Mindfulness Meditation (10 Min) – https://youtu.be/mindful_med_03
- Balanced Nutrition Explained (ICMR) – https://youtu.be/nutrition_icmr_04
- Sports Injury Prevention Tips – https://youtu.be/injury_prev_05
- Mental Health Awareness for Students – https://youtu.be/mh_students_06
- Yoga for Stress Relief – Isha Foundation – https://youtu.be/yoga_isha_07
- Fit India Movement – PM Modi Launch – https://youtu.be/fitindia_pmo_08

AI-Integrated Activities

S.No	AI Activity	Description / Tool
1	AI Fitness Assessment Dashboard	Log BMI, steps and sleep for 2 weeks using Google Fit / Apple Health; generate AI health-insight reports and compare with WHO benchmarks.
2	Personalised Diet Planner with AI	Use NutriAI / Eat Right Now app to design a 7-day balanced meal plan; compare output with ICMR dietary guidelines.
3	Yoga Pose Correction using ML Camera	Use YogaNotch / KAIA Health app for real-time AI posture feedback; record before/after improvement videos.
4	Mental Health Chatbot Interaction & Reflection	Engage with Woebot / Wysa AI mental-health chatbot for one week; write a critical reflection on AI vs human counsellor effectiveness.
5	Sports Performance Analytics with Python	Analyse a cricket/football dataset on Google Colab using Pandas; visualise player performance KPIs with Matplotlib / Seaborn.

CO – PO / PSO Mapping

Correlation: 3 = Strong | 2 = Moderate | 1 = Slight | – = No correlation

- Mapping of COs to POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1						2	2						
2						2	2						
3						2	2						
4						2	2						
5						3	3						

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High) **CO-PO mapping**

justification:

CO	Percentage of contact	CO	Program	Level of
----	-----------------------	----	---------	----------

	hours over the total planned contact hours						Outcome (PO)	Correlation (0-3)
	Register (Hrs)	Lesson Plan (Hrs)	%	corr	Verb	BTL		
1					Understand	L2	P06,P07	2
2					Apply	L3	P06,P07	2
3					Apply	L3	P06, P07	2
4					Understand	L2	P06, P07	2
5					Evaluate	L5	P06,P07 PO11	3

CO1: Understand the fundamental concepts of health, wellness, fitness and the dimensions of holistic well-being

Action Verb: Understand (L2)

CO1 Action Verb is **Understand** of BTL 2.Using Thumb rule; L2 correlates PO6 and

PO7 as a moderate (2)**CO2:** Apply correct yogic practices – asanas, pranayama and meditation – for physical and mental health.

Action Verb: Apply(L3)

CO2 Action Verb is **Apply** of BTL 3.Using Thumb rule; L2 correlates PO6 and PO7 as a moderate (2)

CO3: Apply a personal fitness plan integrating nutrition, exercise, stress management and lifestyle modification.

Action Verb: APPLY (L3)

CO3 Action Verb is APPLY of BTL 3 Using Thumb rule; L3 correlates PO6 and PO7 as a moderate (2)

CO4: Understand rules, skills and safety norms for a chosen sport and participate actively with sportsmanship.

Action Verb: Understand (L2)

CO1 Action Verb is **Understand** of BTL 2.Using Thumb rule; L2 correlates PO6 and PO7 as a moderate (2)

CO5: Evaluate personal health indicators and reflect on lifestyle choices using technology and evidence-based practices.

CO5 Action Verb is **Evaluate** of BTL 5 .Using Thumb rule; L5 correlates PO6 and PO7 as a high (3)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)**

AK26 REGULATIONS

B. TECH- Computer Science and Engineering (Data Science)

Course Code	Year & Sem	Physics for Advanced Computing	L	T	Pr	P	SQC/CLC	C
26ABS990305	I-II		2	0	2	0	1	3

Prerequisites: Engineering Mathematics, Basic Electronics, Computer Science Fundamentals

Course Outcomes (COs)

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

CO	Course Outcome Statement	Bloom's Level
CO1	Analyze the intensity variation of light due to interference, diffraction and polarization along with basic AI-assisted optical analysis in engineering applications.	L4 (Analyze)
CO2	Analyze the working principle of lasers and fibre optics along with basic AI- integrated tools.	L4 (Analyze)
CO3	Apply the concepts of quantum mechanics and computing for quantum applications along with basic AI-assisted quantum simulations.	L3 (Apply)
CO4	Analyze the properties of metals and semiconductors along with the basic AI- assisted methods.	L4 (Analyze)
CO5	Apply the fundamentals of low-temperature physics and superconductivity in modern applications along with AI integrated tools	L3 (Apply)

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Analyze	The intensity variation of light due to interference, diffraction and polarization		along with basic AI-assisted optical analysis in engineering applications	L4
2	Analyze	The working principle of lasers and optical fibres		along with basic AI-integrated tools	L4
3	Apply	The concepts of quantum mechanics and computing for quantum applications		along with basic AI-assisted quantum simulations	L3
4	Analyze	The properties of metals and semiconductors		along with the basic AI-assisted methods	L4
5	Apply	The fundamentals of low-temperature		along with AI integrated tools	L3

		physics and superconductivity in modern applications			
--	--	--	--	--	--

Course Content

UNIT I: Applied Wave Optics 9hrs

Core Content:

Interference: Principle of superposition and coherence, Interference, Types of interference, Interference in thin films (reflection geometry) and Newton's rings. Applications: Determination of wavelength and refractive index.

Diffraction: Introduction to diffraction, Fresnel and Fraunhofer diffraction, Fraunhofer diffraction due to single, double and N-slits (Diffraction Grating), Dispersive power and Resolving power of grating. Applications: CD/DVD data storage, Barcode scanners.

Polarization: Types of polarization, Nicol's prism, Half-wave and Quarter-wave plates.

AI Integration:

AI-assisted polarization management for quantum key distribution. AI-integrated holographic interferometry for surface flatness analysis.

Free/Open-Source AI Tools: Python (NumPy, SciPy, Matplotlib and scikit-learn).

UNIT II: Lasers and Fibre Optics 9 hrs

Core Content:

Lasers: Interaction of radiation with matter, Requisites and conditions for laser action, He-Ne laser, Nd-YAG laser, LiDAR basics. Laser-based data communication, Free-space optical communication, Optical data storage, Photonic computing basics, Applications of lasers.

Fiber Optics: Propagation mechanism, Numerical aperture, Acceptance angle, Types of optical fibres, Classifications and Modes of optical fibres, Attenuation and Losses in optical fibers, V- Number - Distributed Fiber Optic Sensing (DFOS) with AI-Powered Signal Analysis.

AI Integration:

AI-powered signal analysis for distributed fiber optic sensing. Python simulation of laser propagation and fiber optic signal attenuation.

Free/Open-Source AI Tools: Google Colab, Python, NumPy, SciPy and Scikit-learn/ TensorFlow.

UNIT III: Introduction to Quantum Mechanics & Quantum Computing 10 hrs

Core Content:

Introduction to quantum mechanics, de-Broglie concept (matter waves), Heisenberg's Uncertainty Principle, Wave function, Postulates of Quantum Mechanics, Schrödinger's time-independent wave equation, Particle in a one-dimensional potential well, Quantum tunnelling (basic idea).

Introduction to Quantum Computing: Classical bits vs Qubits, Concept of superposition

and Entanglement, Basic Quantum Operations: Hadamard gate (idea of superposition), Pauli-X gate, Basic idea of quantum measurement. Applications: Basic idea of quantum cryptography and secure communication (Qualitative only)

AI Integration: AI-Assisted Analysis of Tunnel Diode Characteristics using Quantum Tunnelling Concepts, AI-Assisted Quantum Key Distribution for Secure Communication

Free/Open-Source AI Tools: Google Colab, Python and Scikit-learn.

UNIT IV: Semiconductors and Magnetic Materials

8 hrs

Core Content:

Semiconductors: Introduction, Fermi energy and Fermi level in intrinsic and extrinsic semiconductors, Expression for concentration of electrons in conduction band and holes in valence band, Electrical conductivity, Expressions for drift and diffusion currents, Hall effect, Expression for Hall coefficient and its applications.

Magnetism: Origin of magnetism, Dia, Para, Ferro, Ferri and Anti-ferro magnetic materials, Hysteresis, Soft and Hard magnetic materials. Applications (qualitative only): Magnetic data storage (MRAM), Hard Disk Drive and Magnetic shielding.

AI Integration: AI-Assisted Hall Effect Analysis for Semiconductor Characterization, AI-Assisted Magnetic Data Storage and MRAM Optimisation

Free/Open-Source AI Tools: Google Colab, Python and Scikit-learn.

UNIT V: Low Temperature Physics and Superconductivity

9hrs

Core Content:

Introduction: Low temperature and its importance, Properties of materials at low temperatures, Liquefaction of gases (basic concept only), Liquid nitrogen and liquid helium (basic properties and uses). Applications (basic ideas): MRI, Rocket fuels, Cryogenic Cooling of High-Performance Computing System

Superconductors: Definitions, Meissner effect, Type I and Type II superconductors, BCS theory: Cooper pairs and energy gap (qualitative), DC and AC Josephson effect. Applications (qualitative only): SQUIDs, magnetic levitation and lossless power transmission. Superconducting qubits: Charge, Flux, Phase.

AI Integration: AI-Assisted Cryogenic Cooling Optimization for High-Performance Computing Systems, AI-Assisted Stability Control in Superconducting Magnetic Levitation Systems

Free/Open-Source AI Tools: Google Colab, Python and Scikit-learn.

Textbooks

1. Avadhanulu, Kshirsagar&Arun Murthy, Engineering Physics, S. Chand, 2019.
2. D. K. Bhattacharya & Poonam Tandon, Engineering Physics, Oxford Press, 2015.

Reference Books

3. B. K. Pandey & S. Chaturvedi, Engineering Physics, Cengage Learning, 2021.
4. S. O. Pillai, Solid State Physics, New Age International.
5. Nielsen & Chuang, Quantum Computation & Quantum Information, Cambridge.

6. Saleh &Teich, Fundamentals of Photonics, Wiley.
7. G. Keiser, Optical Fiber Communications, McGraw Hill.
8. M. Tinkham, Introduction to Superconductivity, Dover Publications.
9. *Superconductivity, Superfluids and Condensates*- James F. Annett published by Oxford University Press in 2004

Web Resources & NPTEL Links

- NPTEL – npTEL.ac.in
- MIT OpenCourseWare – ocw.mit.edu
- HyperPhysics – hyperphysics.phy-astr.gsu.edu
- PhET Simulations – phet.colorado.edu
- Library of Congress – loc.gov/rr/scitech/selected-internet/physics.html

Recommended Free & Open-Source AI/Computational Tools

- Python (NumPy, SciPy, OpenCV, Matplotlib) – FREE on Google Colab for wave optics and signal analysis
- IBM Qiskit (free, open-source) – For quantum computing and superconducting qubit simulations on Google Colab
- TensorFlow / Keras (free, open-source) – For photonic and optical pattern recognition
- scikit-learn (free, open-source) – For semiconductor property prediction and LiDAR signal classification

PhET Interactive Simulations (free) – For wave optics, quantum mechanics and semiconductors

CO – PO Articulation Matrix (NBA)

Scale: 3 – Strong, 2 – Moderate, 1 – Slight, – No Correlation

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	--	--	3	3	--	--	--	--	--	--	--	--	--
CO2	3	--	1	3	3	--	--	--	--	--	--	--	--	--
CO3	3	--	3	2	3	--	--	--	--	--	--	--	--	--
CO4	3	--	--	3	3	--	--	--	--	--	--	--	--	--
CO5	3	--	--	2	3	--	--	--	--	--	--	--	--	--

CO – PO mapping justification:

CO	CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Verb	BTL			
1	Analyze	L4	PO1, PO4, PO5	PO1:Apply(L3) PO4:Analyze(L4) PO5: Apply(L3)	3 3 3

2	Analyze	L4	PO1, PO3, PO4, PO5	PO1:Apply(L3) PO3: Develop(L3) PO4: Analyze(L4) PO5: Apply(L3)	3 3 3 3
3	Apply	L3	PO1, PO3, PO4, PO5	PO1: Apply(L3) PO3: Develop(L3) PO4: Analyze(L4) PO5: Apply (L3)	3 3 2 3
4	Analyze	L4	PO1, PO4, PO5	PO1: Apply(L3) PO4: Analyze(L4) PO5: Apply (L3)	3 3 3
5	Apply	L3	PO1, PO4, PO5	PO1: Apply(L3) PO4: Analyze(L4) PO5: Apply(L3)	3 2 3

CO1: The intensity variation of light due to interference, diffraction and polarization with basic AI-assisted optical analysis in engineering applications
Action Verb: Analyze (L4)

PO1 and PO5 Action Verbs: Apply (L3)

PO4 Action Verb: Analyze (L4)

CO1 action Verb is lesser than the action verbs of PO1 and PO5; Therefore, the correlation is high (3)

CO1 action verb is equal to action verb of PO4; Therefore, the correlation is high (3).

CO2: The working principle of lasers optical fibres along with basic AI-integrated tools.

Action Verb: Analyze (L4)

PO1 and PO5 Action Verbs: Apply (L3)

PO3 Action Verb: Develop(L3)

PO4 Action Verb: Analyze (L4)

CO2action verb is lesser than the action verbs of PO1, PO3 and PO5; Therefore, the correlation is high (3)

CO2 action verb is equal to action verb of PO4; Therefore, correlation is high (3).

CO3: The concepts of quantum mechanics and computing for quantum applications along with basic AI-assisted quantum simulations

Action Verb: Apply (L3)

PO1 and PO5Action Verbs: Apply (L3)

PO3 Action Verb: Develop (L3)

PO4 Action Verb: Analyze (L4)

CO3 action Verb are equal to the action verbs PO1, PO3 and PO5; Therefore, correlation is high (3)

CO3 action verb is greater than to action verb of PO4; Therefore, correlation is moderate (2).

CO4: The properties of metals and semiconductors along with the basic AI-assisted methods.

Action Verb: Analyze (L4)

PO1 and PO5 Action Verbs: Apply (L3)

PO4 Action Verb: Analyze (L4)

CO4 action Verb is lesser than the action verb of PO1 and PO5; Therefore, the correlation is high (3)

CO4 action verb is equal to action verb of PO4; Therefore, correlation is high (3).

CO5: The fundamentals of low-temperature physics and superconductivity in modern applications along with AI integrated tools

Action Verb: Apply (L3)

PO1 and PO5 Action Verbs: Apply (L3)

PO4 Action Verb: Analyze (L4)

CO5 action verb are equal to the action verbs of PO1 and PO5; Therefore, correlation is high (3)

CO5 action verb is greater than the action verb of PO4; Therefore, correlation is moderate (2).



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)**

AK26 REGULATIONS

B. TECH- Computer Science and Engineering (Data Science)

Course Code	Year & Sem	Differential Equations and Vector Calculus	L	T	Pr	P	SQC /CLC	C
26ABS9902	I-II		3	0	2	0	1	4

Prerequisites: Linear Algebra and Calculus

Course Outcomes (CO): Student will be able to

1. Apply first-order ordinary differential equations using AI-enabled computational tools (ChatGPT / Copilot) to solve engineering problems.
2. Analyze higher-order ordinary differential equations using AI-assisted computational tools (GNU Octave, Wolfram Alpha free tier) to interpret engineering systems.
3. Apply partial differential equations using AI-enabled computational tools (Wolfram Alpha free tier) to solve engineering problems.
4. Analyze vector differential operators and vector fields using AI-enabled computational tools (ChatGPT / Copilot) to interpret engineering phenomena.
5. Evaluate vector integral theorems using AI-enabled computational tools (Wolfram Alpha free tier) to solve engineering field problems.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Apply	first-order ordinary differential equations	using AI-enabled computational tools (ChatGPT / Copilot)	to solve engineering problems	L3
2	Analyze	higher-order ordinary differential equations	using AI-assisted computational tools (GNU Octave, Wolfram Alpha free tier)	to interpret engineering systems	L4
3	Apply	partial differential equations	using AI-enabled computational tools (Wolfram Alpha free tier)	to solve engineering problems	L3
4	Analyze	vector differential operators and vector fields	using AI-enabled computational tools (ChatGPT / Copilot)	to interpret engineering phenomena	L4
5	Evaluate	vector integral theorems	using AI-enabled computational tools (Wolfram Alpha free tier)	to solve engineering field problems	L5

Course Content

UNIT I: First-Order Ordinary Differential Equations

9hrs

CONTENT:

- Classification of ODEs by order, degree, and linearity; linear first-order ODEs and integrating factor method; Bernoulli's equation; exact equations and integrating factors.
- Orthogonal trajectories; Newton's law of cooling and natural growth/decay models; electrical circuit models (RC and RL circuits); engineering applications of first-order ODEs.

AI INTEGRATION:

Python SymPy dsolve for symbolic ODE solution and verification; direction field (slope field) visualization using Matplotlib; AI-assisted debugging of integrating factor derivations; using ChatGPT/Copilot to explain solution families and physical interpretations; SciPy solve_ivp for numerical ODE solution. Free/Open-Source AI Tools: Python (SymPy, SciPy, Matplotlib) on Google Colab; Jupyter Notebook; GNU Octave.

UNIT II: Equations Reducible to Linear Differential Equations and Applications 9 hrs

CONTENT:

- Superposition principle; Wronskian and linear independence; complementary function for constant-coefficient ODEs (distinct real, repeated, and complex roots); particular integral by operator method; variation of parameters.
- Simultaneous linear ODEs; Cauchy's (Euler) equation; Legendre's equation; applications to LCR circuits.

AI INTEGRATION:

Python SciPy signal.lsim for simulation of underdamped, critically damped, and overdamped responses; resonance amplitude curve generation; AI-assisted Wronskian computation using SymPy; AI tools to explain transient vs. steady-state response. Free/Open-Source AI Tools: Python (NumPy, SciPy, SymPy, Matplotlib); GNU Octave; WolframAlpha free tier.

UNIT	III:	Partial	Differential	Equations
			9hrs	

CONTENT:

- Introduction and classification of PDEs; formation by elimination of arbitrary constants; formation by elimination of arbitrary functions; first-order linear PDEs and Lagrange's method (auxiliary equations); homogeneous linear PDEs with constant coefficients (CF and PI).

AI INTEGRATION:

Python SymPy for PDE formation and symbolic verification; 3D surface plot visualization of PDE solution families using Matplotlib; SciPy finite-difference simulation of the 1D heat equation with animation; AI-assisted PDE classification using the discriminant. Free/Open-Source AI Tools: Python (SymPy, NumPy, SciPy, Matplotlib); WolframAlpha free tier; Scilab.

UNIT IV: Vector differentiation

9 hrs

CONTENT:

- Scalar and vector fields; del (∇) operator; gradient and directional derivative; unit normal to surfaces; angle between surfaces; divergence and physical interpretation; curl and physical interpretation.
- Vector identities; conservative fields and scalar potentials; Laplacian;

AI INTEGRATION:

Python NumPy and Matplotlib for 2D and 3D gradient, divergence, and curl field visualization (quiver plots, level-surface overlays); SymPy for symbolic verification of vector identities; AI tools to interpret Maxwell's equations in terms of divergence and curl operators. Free/Open-Source AI Tools: Python (NumPy, SymPy, Matplotlib, mpl_toolkits); SciPy for numerical computation.

UNIT V: Vector integration

9 hrs

CONTENT:

- Line integrals over scalar and vector fields; work done and path independence; surface integrals and flux; Green's theorem in the plane and its applications.
- Stokes' theorem; Gauss Divergence theorem (without proof) ; applications to area and volume computation;

AI INTEGRATION:

Python SciPy integrate for numerical computation of line and surface integrals; 3D flux visualization with colour-coded normal flux using Matplotlib; numerical verification of Green's and Stokes' theorems; AI-assisted physical interpretation of the Divergence theorem. Free/Open-Source AI Tools: Python (NumPy, SciPy, Matplotlib); SymPy for symbolic integral verification; WolframAlpha free tier.

CO – PO Articulation Matrix (NBA)

Scale: 3 – Strong, 2 – Moderate, 1 – Slight, – No Correlation

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

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Action Verb	BTL			
1				Apply	L3	PO1, PO5	Apply (L3)	3
2				Analyze	L4	PO2, PO5	Analyze (L4)	3
3				Apply	L3	PO1, PO5	Apply (L3)	3
4				Analyze	L4	PO2 , PO5	Analyze (L4)	3
5				Evaluate	L5	PO2, PO5	Evaluate (L5)	3

CO1: Apply first-order ordinary differential equations using AI-enabled computational tools (ChatGPT / Copilot) to solve engineering problems.

Action Verb: Apply (L3)

PO1 Verb: Apply (L3), PO5 Verb: Apply (L3)

CO1 Action Verb is equal to PO1 and PO5 verb Therefore correlation is high (3).

CO2: Analyze higher-order ordinary differential equations using AI-assisted computational tools (GNU Octave, Wolfram Alpha free tier) to interpret engineering systems.

Action Verb: Analyze (L4)

PO1 Verb: Apply (L3), PO2 Verb: Analyze (L4), PO5 Verb: Apply (L3)

CO2 Action Verb is equal to PO1, PO2 and PO5 verb; Therefore correlation is high (3).

CO3: Apply partial differential equations using AI-enabled computational tools (Wolfram Alpha free tier) to solve engineering problems.

Action Verb: Apply (L3)

PO1 Verb: Apply (L3), PO5 Verb: Apply (L3)

CO3 Action Verb level is equal to PO1 and PO5 verb; Therefore correlation is high (3).

CO4: Analyze vector differential operators and vector fields using AI-enabled computational tools (ChatGPT / Copilot) to interpret engineering phenomena.

Action Verb: Analyze (L4)

PO1 Verb: Apply (L3), PO2 Verb: Analyze (L4), PO5 Verb: Apply (L3)

CO4 Action Verb level is equal to PO1 and PO5 verb; Therefore correlation is high (3).

CO5: Evaluate vector integral theorems using AI-enabled computational tools (Wolfram Alpha free tier) to solve engineering field problems.

Action Verb: Evaluate (L5)

PO1 Verb: Apply (L3), PO2 Verb: Analyze (L4), PO5 Verb: Apply (L3)

CO5 Action verb is high level to PO1, PO2 and PO5 verb; therefore the correlation is high (3).

LEARNING RESOURCES

Textbooks

1. Kreyszig, E. (2018). Advanced Engineering Mathematics (10th ed.). Wiley.
2. Grewal, B. S. (2017). Higher Engineering Mathematics (44th ed.). Khanna Publishers.

Reference Book

1. Thomas, G. B., Weir, M. D., & Hass, J. (2018). Thomas' Calculus (14th ed.). Pearson.
2. Jain, R. K., & Iyengar, S. R. K. (2021). Advanced Engineering Mathematics (5th ed.). Alpha Science International.
3. Zill, D. G., & Wright, W. S. (2018). Advanced Engineering Mathematics (6th ed.). Jones & Bartlett.
4. Arfken, G. B., Weber, H. J., & Harris, F. E. (2012). Mathematical Methods for Physicists (7th ed.). Academic Press.
5. Sneddon, I. N. (2006). Elements of Partial Differential Equations. Dover Publications.
6. Davis, H. F., & Snider, A. D. (1995). Introduction to Vector Analysis (7th ed.). Hawkes Publishing.

Online Resources

- NPTEL: Ordinary Differential Equations and Applications – <https://nptel.ac.in>
- NPTEL: Partial Differential Equations – <https://nptel.ac.in>
- NPTEL: Vector Calculus – <https://nptel.ac.in>
- MIT OpenCourseWare – Differential Equations (18.03): <https://ocw.mit.edu>
- MIT OpenCourseWare – Multivariable Calculus (18.02): <https://ocw.mit.edu>

Web Resources & NPTEL Links

- NPTEL: Ordinary Differential Equations and Applications – <https://nptel.ac.in>
- NPTEL: Partial Differential Equations – <https://nptel.ac.in>
- NPTEL: Vector Calculus – <https://nptel.ac.in>
- MIT OpenCourseWare – Differential Equations (18.03): <https://ocw.mit.edu>
- MIT OpenCourseWare – Multivariable Calculus (18.02): <https://ocw.mit.edu>
- Python SymPy Documentation: <https://docs.sympy.org>
- SciPy Documentation: <https://docs.scipy.org>
- Google Colab for Python: <https://colab.research.google.com>
- NumPy Documentation: <https://numpy.org/doc>

Recommended Free & Open-Source AI/Computational Tools

- Python (NumPy, SciPy, Matplotlib) – FREE on Google Colab for ODE/PDE solving, vector field visualization, and numerical integration.
- SymPy (free, open-source) – For symbolic ODE/PDE solution, gradient/divergence/curl computation, and algebraic verification.
- Jupyter Notebook (free, open-source) – For interactive computation, experiment documentation, and lab reporting.
- GNU Octave (free, open-source) – MATLAB-compatible numerical computing for ODE simulation and matrix workflows.
- WolframAlpha (free tier) – For quick verification of ODE solutions, PDE classification, and integral computation.
- Matplotlib / mpl_toolkits (free, open-source) – For 2D and 3D vector field quiver plots, solution surface visualization, and PDE animation.
- scikit-learn (free, open-source) – For optional AI demonstrations in regression and data-driven modeling tasks.



ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI (AUTONOMOUS)

AK26 REGULATIONS

B. TECH- Computer Science and Engineering (Data Science)

Course Code	Year & Sem	Professional Core-I Data Structures and Efficient Problem Solving	L	T	Pr	P	SQC/CLC	C
26APC0501	I-II		2	0	2	0	1	3

Course Outcomes:

After studying the course, students will be able to

CO1: **Understand** data structures, algorithm analysis, searching, and sorting techniques using Python.

CO2: **Apply** stacks and queues to solve computational problems using Python.

CO3: **Apply** linked lists for efficient data organization and manipulation.

CO4: **Analyze** trees and heaps for efficient data processing using Python.

CO5: **Evaluate** graph traversal and hashing techniques for solving computational problems.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	Data structures, algorithm analysis, searching, and sorting techniques	using python		L2
CO2	Apply	Stacks and queues	using python	for computational problems	L3
CO3	Apply	Linked lists	using python	for data organization	L3
CO4	Analyze	Trees and heaps	using python	for efficient data processing	L4
CO5	Evaluate	Graph traversal and hashing techniques	using python	for computational problem solving	L5

UNIT - I | INTRODUCTION, ALGORITHM ANALYSIS, AND LINEAR STRUCTURES | 9 Hrs

Content:

- Introduction to data structures; Abstract Data Types (ADTs); algorithm analysis — time and space complexity; Big-O, Big-Omega, Big-Theta notations.
- Lists in Python: operations on lists; static vs. dynamic memory allocation.
- Searching techniques: Linear Search, Binary Search, Interpolation Search — analysis and comparison.
- Sorting techniques: Bubble Sort, Selection Sort, Insertion Sort — algorithms, trace, and complexity analysis.

Source: TB1: Chapters 1–3 (Vasudevan et al.); TB2: Chapters 1, 5 (Goodrich et al.)

AI Integration:

Use VisuAlgo and Algorithm Visualizer to animate sorting and searching; use ChatGPT to explain Big-O complexity with concrete examples; use Python Tutor to trace memory representation of data structures.

UNIT - II | STACKS AND QUEUES | 9 Hrs

Content:

- Stacks: LIFO principle, push, pop, peek; implementation using Python lists; applications — expression evaluation (infix to postfix, postfix evaluation), parenthesis checking.
- Queues: FIFO principle, enqueue, dequeue; types — Circular Queue, Priority Queue, Deque; implementation using Python lists and linked structures.
- Applications of queues: BFS simulation, scheduling, real-world analogies.

Source: TB1: Chapters 4–5 (Vasudevan et al.); **TB2:** Chapter 6 (Goodrich et al.)

AI Integration:

Use VisuAlgo to animate stack and queue operations; use ChatGPT to generate edge cases (overflow, underflow, circular behaviour); use GitHub Copilot to implement expression evaluation.

UNIT - III | LINKED LISTS | 9 Hrs

Content:

- Singly Linked List: node structure, insertion at head/tail/position, deletion by value/position,

traversal, reversal. • Doubly Linked List: forward and backward traversal, insertion, deletion; Circular Linked List: traversal and operations. • Applications: polynomial representation and addition, browser history simulation (doubly linked list), symbol table implementation. Source: TB1: Chapter 6 (Vasudevan et al.); TB2: Chapter 7 (Goodrich et al.) AI Integration: Use Python Tutor to trace pointer operations and node memory; use VisuAlgo to visualize insertion and deletion step by step; use ChatGPT to identify missing edge cases in AI-generated linked list explanations.		
UNIT - IV	TREES AND HEAPS	9 Hrs
Content: - Trees: terminology, properties; Binary Trees — representation, traversals (inorder, preorder, postorder, level order). - Binary Search Trees (BST): insertion, deletion, search; applications — autocomplete, range queries, dictionary lookup. - Heaps: Min-Heap and Max-Heap, array representation, heapify, Build-Heap; Heap Sort — algorithm and complexity. Source: TB1: Chapters 7–8 (Vasudevan et al.); TB2: Chapters 8, 9 (Goodrich et al.) AI Integration: Use VisuAlgo and Algorithm Visualizer to animate tree traversals and BST operations; use ChatGPT to generate tricky tree cases (unbalanced, skewed); use GitHub Copilot to implement heap operations in Python.		
UNIT - V	GRAPHS AND HASHING	9 Hrs
Content: - Graphs: terminology, types (directed, undirected, weighted); representation — adjacency matrix and adjacency list. - Graph traversals: BFS (queue-based) and DFS (stack/recursion-based); applications — shortest path, cycle detection, social networks. - Hashing: hash functions, properties of a good hash function; collision resolution — chaining (separate chaining), open addressing (linear probing, quadratic probing, double hashing); load factor. Source: TB1: Chapters 9–10 (Vasudevan et al.); TB2: Chapters 14, 10 (Goodrich et al.) AI Integration: Use NetworkX in Python and Gephi to build and traverse graphs; use VisuAlgo to animate BFS and DFS; use ChatGPT to explain real-world graph applications; use GitHub Copilot to implement hash tables with collision resolution.		
Suggested Tools:		
NetworkX, Gephi, VisuAlgo, ChatGPT, GitHub Copilot		
Textbooks:		
1. Shriram K. Vasudevan, Abhishek S. Nagarajan & Karthick Nanmaran, Data Structures Using Python, Wiley India. 2. Michael T. Goodrich, Roberto Tamassia & Michael H. Goldwasser, Data Structures and Algorithms in Python (Indian Adaptation), Wiley India.		
Reference Books:		
1. Brad Miller & David Ranum, Problem Solving with Algorithms and Data Structures Using Python, Franklin Beedle. 2. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, Pearson Education.		
Online Learning Resources:		
1. NPTEL – Data Structures and Algorithms – nptel.ac.in 2. VisuAlgo – visualgo.net 3. Python Tutor – pythontutor.com 4. NetworkX – networkx.org 5. GeeksforGeeks – geeksforgeeks.org 6. Algorithm Visualizer – algorithm-visualizer.org		
Recommended Free & Open-Source Data Structures / AI Tools		
1. Language & Environment: Python, Jupyter Notebook – implementation and tracing.		

- 2. Visualization:** VisuAlgo, Algorithm Visualizer, Python Tutor – animate sorting, traversal and memory operations.
- 3. Graph Tools:** NetworkX, Gephi – graph build and traversal.
- 4. AI Assistants:** ChatGPT, GitHub Copilot – complexity explanation, edge-case generation and implementation.

Mapping of course outcomes with program outcomes

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

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	9	20%	2	CO1 : Understand	L2	PO1 PO2 PO11	PO1: Apply (L3) PO2: Review (L2) PO11: Thumb Rule	2 3 2
2	9	20%	2	CO2: Apply	L3	PO1 PO2 PO5 PO11	PO1: Apply (L3) PO2: Review (L2) PO5: Apply (L3) PO11: Thumb Rule	3 3 3 2
3	9	20%	2	CO3: Apply	L3	PO1 PO2 PO3 PO5 PO11	PO1: Apply (L3) PO2: Review (L2) PO3: Develop (L3) PO5: Apply (L3) PO11: Thumb Rule	3 3 3 3 2
4	9	20%	2	CO4: Analyze	L4	PO1 PO2 PO3 PO4 PO5 PO11	PO1: Apply (L3) PO2: Review (L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply (L3) PO11: Thumb Rule	3 3 3 3 3 3
5	9	20%	2	CO5: Evaluate	L5	PO1 PO2 PO4 PO5 PO11	PO1: Apply (L3) PO2: Review (L2) PO4: Analyze (L4) PO5: Apply (L3) PO11: Thumb Rule	3 3 3 3 3
	45	100 %						

Justification Statements:

CO1: Understand data structures, algorithm analysis, searching, and sorting techniques using Python.

Action Verb: Understand (L2)

PO1: Apply (L3)

CO1 action verb is one level less than the PO1 action verb. Therefore, the correlation is **Moderate (2)**.

PO2: Review (L2)

CO1 action verb is the same as the PO2 action verb. Therefore, the correlation is **High (3)**.

PO11: Thumb Rule

Fundamental knowledge of data structures and algorithm analysis promotes independent learning and adaptability to advanced computing concepts. Therefore, the correlation is **Moderate (2)**.

CO2: Apply stacks and queues to solve computational problems using Python.

Action Verb: Apply (L3)

PO1: Apply (L3)

CO2 action verb is the same as the PO1 action verb. Therefore, the correlation is **High (3)**.

PO2: Review (L2)

CO2 action verb is greater than the PO2 action verb. Therefore, the correlation is **High (3)**.

PO5: Apply (L3)

CO2 action verb is the same as the PO5 action verb. Therefore, the correlation is **High (3)**.

PO11: Thumb Rule

Stacks and queues develop problem-solving ability and encourage continuous learning. Therefore, the correlation is **Moderate (2)**.

CO3: Apply linked lists for efficient data organization and manipulation.

Action Verb: Apply (L3)

PO1: Apply (L3)

CO3 action verb is the same as the PO1 action verb. Therefore, the correlation is **High (3)**.

PO2: Review (L2)

CO3 action verb is greater than the PO2 action verb. Therefore, the correlation is **High (3)**.

PO3: Develop (L3)

CO3 action verb is the same as the PO3 action verb. Therefore, the correlation is **High (3)**.

PO5: Apply (L3)

CO3 action verb is the same as the PO5 action verb. Therefore, the correlation is **High (3)**.

PO11: Thumb Rule

Linked list implementation enhances programming skills and lifelong learning. Therefore, the correlation is **Moderate (2)**.

CO4: Analyze trees and heaps for efficient data processing using Python.

Action Verb: Analyze (L4)

PO1: Apply (L3)

CO4 action verb is greater than the PO1 action verb. Therefore, the correlation is **High (3)**.

PO2: Review (L2)

CO4 action verb is greater than the PO2 action verb. Therefore, the correlation is **High (3)**.

PO3: Develop (L3)

CO4 action verb is greater than the PO3 action verb. Therefore, the correlation is **High (3)**.

PO4: Analyze (L4)

CO4 action verb is the same as the PO4 action verb. Therefore, the correlation is **High (3)**.

PO5: Apply (L3)

CO4 action verb is greater than the PO5 action verb. Therefore, the correlation is **High (3)**.

PO11: Thumb Rule

Trees and heaps improve analytical thinking and the ability to learn advanced data structures independently. Therefore, the correlation is **High (3)**.

CO5: Evaluate graph traversal and hashing techniques for solving computational problems.

Action Verb: Evaluate (L5)

PO1: Apply (L3)

CO5 action verb is greater than the PO1 action verb. Therefore, the correlation is **High (3)**.

PO2: Review (L2)

CO5 action verb is greater than the PO2 action verb. Therefore, the correlation is **High (3)**.

PO4: Analyze (L4)

CO5 action verb is greater than the PO4 action verb. Therefore, the correlation is **High (3)**.

PO5: Apply (L3)

CO5 action verb is greater than the PO5 action verb. Therefore, the correlation is **High (3)**.

PO11: Thumb Rule

Graph traversal and hashing techniques enable students to solve complex computational problems and adapt to modern data structure technologies. Therefore, the correlation is **High (3)**.



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)**

AK26 REGULATIONS

B. TECH- Computer Science and Engineering (Data Science)

Course Code	Year & Sem	Engineering Workshop	L	T	Pr	P	SQC/CLC	C
26AES0302	I-II		0	0	0	3	0	1.5

Course Outcomes: At the end of this course, student will be able to

- CO: 1 Apply wood working skills to fabricate different types of timber joints.
- CO: 2 Apply the sheet metal and fitting operation skills to fabricate various components.
- CO: 3 Apply basic electrical wiring principles to perform house wiring practices.
- CO: 4 Understand plumbing techniques to fabricate different types of pipe joints.
- CO: 5 Apply welding and foundry techniques to fabricate welding joints and foundry patterns.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Apply	Wood working skills and timber joint fabrication techniques	using woodworking tools and workshop practices	accurately fabricate different types of timber joints as per specifications	L3
CO2	Apply	the sheet metal and fitting operation skills for component fabrication	using sheet metal and fitting tools	correctly analyze and fabricate various sheet metal and fitting components	L3
CO3	Apply	basic electrical wiring principles and house wiring practices	using electrical tools and wiring accessories	successfully perform house wiring with proper safety and functionality	L3
CO4	Understand	plumbing techniques and pipe joint fabrication methods	using plumbing tools and standard procedures	demonstrate correct fabrication of different types of pipe joints	L2
CO5	Apply	welding and foundry techniques for joint and pattern fabrication	using welding and foundry equipment	Accurately fabricate welding joints and foundry patterns as per specifications	L3

SYLLABUS

1. Safety Practices & Precautions

Demonstrate the necessity of Workshop hazards, various Personal Protective Equipment and emergency protocols.

AI Integration: Computer vision for safety compliance.

2. Wood working: Introduction to different types of woods, carpentry tools, timber joints
a) Half – Lap joint b) Mortise and Ten on joint c) Corner Dovetail joint or Bridle joint

3. Fitting: Familiarity with different types of tools used in fitting and perform fitting exercises like
a) V-fit b) Dovetail fit c) Semi-circular fit

4. Sheet Metal Working: Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from GI sheets.
a) Tapered tray b) Conical funnel c) Elbow pipe d) Brazing

5. Electrical wiring: Introduction to electrical tools, safety precautions, wiring materials. Familiarity with different types of basic electrical circuits and make the following connections.
a) Parallel and series b) Two-way switch c) God own lighting d) Tube light e) Three phase motor
f) Soldering of wires

6. Plumbing: Introduction to plumbing tools, pipe fittings, thread cutting, making a simple PVC pipe joint. Preparation of Pipe joints with coupling for same diameter and with reducer for different diameters.

7. Welding Shop: Demonstration and practice on Arc Welding and Gas welding. Preparation of a simple Lap joint/Butt joint.

8. Foundry Trade: Demonstration and practice on Moulding tools and processes, Preparation of Green Sand Moulds for a simple Patterns.

9. Introduction to 3D Printing: Demonstrate the core concepts of 3D printing, Hardware, software, Digital file and 3D printing materials. Familiarise with 3D Printing Process of complex objects.

10. Computer Components:

Disassemble and reassemble a desktop computer to understand the role of each component (CPU, motherboard, RAM, HDD/SSD, GPU, etc.).

Hardware Troubleshooting & Peripheral Installation:

Simulate common hardware issues (e.g., RAM failure, CPU overheating) and identify the procedures to resolving them.

Peripheral Installation:

Install and configure peripheral devices such as printers, scanners, and external hard drives.

Network Setup and Configuration:

Set up a small LAN network with routers, switches, and computers. Configure IP addresses, subnet masks, and basic network services.

11. Disassembly and Assembly of equipment such as Bicycle, Gear Box, Braking System: Familiarise with disassembly and assembly process

AI Integration Module: Smart energy monitoring using IoT current sensors; building machine learning load forecasting models; training anomaly detection systems to automatically flag electrical arc or leakage patterns.

Develop predictive load-monitoring models that detect faulty configurations or phantom energy drains.

Learning Resources

Textbooks

1. **Workshop Core Reference:** *Workshop Technology Vol I & II* by S.K. Hajra Choudhury, Media Promoters & Publishers.
2. **Workshop Core Reference:** *A Course in Workshop Technology* by B.S. Raghuwanshi, Dhanpat Rai & Co. 2015 & 2017
3. **Data-Driven Industrial IoT:** *Hands-On Industrial Internet of Things* by Giacomo Veneri and Antonio Capasso, Packt Publishing.
4. **Basic Workshop Technology:** *Manufacturing Process*, Felix W.; Independently Published, 2019. *Workshop Processes, Practices and Materials*; Bruce J. Black, Routledge publishers, 5th Edn. 2015.
5. **3. Wiring Estimating, Costing and Contracting**; Soni P.M. & Upadhyay P.A.; Atul Prakashan, 2021-22.

Reference Books

1. *Manufacturing Technology (Foundry, Forming and Welding)* by P.N. Rao, McGraw Hill.
2. *An Introduction to Predictive Maintenance* by R. Keith Mobley, Butterworth-Heinemann.

Video Links & Online Lectures

- **Classical Shop floor Operations:** NPTEL Workshop Practices Video Series by IIT Kharagpur
- **Industrial AI & Predictive Analytics:** Predictive Maintenance Models in Python Tutorial
- **Smart Sensors & Electronics Fabrication:** MIT 6.131: Power Electronics and Smart Grid Interfaces

CO – PO Articulation Matrix

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)												
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
Engineering Workshop	CO1	3	3	3						3			3	3
	CO2	3	3	3						3			3	3
	CO3	3	3	3						3			3	3
	CO4	2	3	2						2			3	3
	CO5	3	3	3						3			3	3

Correlation Matrix

CO	CO					Program Outcomes (PO)	PO(s): Action and (for PO1 to PO5)	Verb BTL	Level of Correlation
	Lesson Plan (Hrs)	%	Correlation	Verb	BTL				
1	9	25	3	Apply	L3	PO1 PO2 PO3 PO9	Apply-L3 Review-L2 Develop-L3 ThumbRule-L3		3 3 3 2
2	9	25	3	Apply	L3	PO1 PO2 PO3 PO9	Apply-L3 Review-L2 Develop-L3 ThumbRule-L3		3 3 3 2
3	6	16.67	2	Apply	L3	PO1 PO2 PO3 PO9	Apply-L3 Review-L2 Develop-L3 ThumbRule-L3		3 3 3 2

4	6	16.66	2	Understand	L2	PO1 PO2 PO3 PO9	Apply-L3 Review-L2 Develop-L3 ThumbRule-L3	2 3 2 2
5	6	16.67	2	Apply	L3	PO1 PO2 PO3 PO9	Apply-L3 Review-L2 Develop-L3 ThumbRule-L3	3 3 3 2
Total	36	100						

Justification Statements:

CO1: Apply woodworking skills to fabricate different types of timber joints.

Action Verb: **Apply (L3)**

PO1Verb: **Apply (L3)**

CO1 Action verb is same level as PO1verb. Therefore, the correlation is high (3)

PO2 Verb: **Review (L2)**

CO1 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)

PO3 Verb: **Develop (L3)**

CO1 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)

PO9 Verb: **Thumb Rule**

As per thumb rule CO1 co-relates slightly with PO9 verb. Therefore, the correlation is medium (2)

CO2: Apply the sheet metal and fitting operation skills to fabricate various components.

Action Verb: **Apply (L3)**

PO1Verb: **Apply (L3)**

CO2 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)

PO2Verb: **Review (L2)**

CO2 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)

PO3 Verb: **Develop (L3)**

CO2 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)

PO9Verb: **Thumb Rule**

As per thumb rule CO2 co-relates slightly with PO9 verb. Therefore, the correlation is medium (2)

CO3: Apply basic electrical wiring principles to perform house wiring practices.

Action Verb: **Apply (L3)**

PO1Verb: **Apply (L3)**

CO3 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Review (L2)**

CO3 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)

PO3 Verb: **Develop (L3)**

CO3 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)

PO9 Verb: **Thumb Rule**

As per thumb rule CO3 co-relates slightly with PO9 verb. Therefore, the correlation is medium (2)

CO4: Understand plumbing techniques to fabricate different types of pipe

joints.

Action Verb: **Understand (L2)**

PO1Verb: **Apply (L3)**

CO4 Action verb is lower than as PO1 verb. Therefore, the correlation is medium (2)

PO2 Verb: **Review (L2)**

CO4 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)

PO3 Verb: **Develop (L3)**

CO4 Action verb is lower than as PO3 verb. Therefore, the correlation is medium (2)

PO9 Verb: **Thumb Rule**

As per thumb rule CO4 co-relates slightly with PO9 verb. Therefore, the correlation is medium (2)

CO5: Apply welding and foundry techniques to fabricate welding joints and foundry patterns.

Action Verb: **Apply (L3)**

PO1Verb: **Apply (L3)**

CO5 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Review (L2)**

CO5 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)

PO3 Verb: **Develop (L3)**

CO5 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)

PO9 Verb: **Thumb Rule**

As per thumb rule CO5 co-relates slightly with PO9 verb. Therefore, the correlation is medium (2)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)**

AK26 REGULATIONS

B. TECH- Computer Science and Engineering (Data Science)

Course Code	Year & Sem	Design Thinking	L	T	Pr	P	SQC/CLC	C
26AES0301	I-II		1	0	4	0	1	3

Course Outcomes: At the end of the course, the student will be able to

- CO: 1 Analyze the principles, stages and human-centred approach of Design Thinking to identify engineering problems using systems thinking and AI-assisted tools.
- CO: 2 Apply empathy techniques to identify user needs and formulate problem statements using AI-assisted tools.
- CO: 3 Analyze innovative design solutions by using ideation techniques and AI-assisted ideation tools.
- CO: 4 Create prototypes using manual and AI-enabled prototyping tools to visualize and validate engineering solutions.
- CO: 5 Evaluate prototype performance through user testing, iterative improvements, AI-assisted feedback analysis and effective design presentations.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Analyze	the principles, stages and human-centred approach of Design Thinking	using systems thinking and AI-assisted tools	to identify engineering problems	L4
CO2	Apply	empathy techniques	using AI-assisted tools	to identify user needs and formulate problem statements	L3
CO3	Analyze	innovative design solutions	by using ideation techniques and AI-assisted ideation tools		L4
CO4	Create	Prototypes	using manual and AI-enabled prototyping tools	to visualize and validate engineering solutions	L6
CO5	Evaluate	prototype performance	through user testing, iterative improvements, AI-assisted feedback analysis and effective design presentations		L5

Unit I:

Introduction to Design Thinking:

- Design Thinking: Definition, origin (Stanford d.school, IDEO), and relevance to engineering
- The 5-Stage Model: Empathise – Define – Ideate – Prototype – Test
- Human-centred design principles: Desirability, Feasibility, Viability
- Systems Thinking vs. Linear Thinking: Understanding complexity
- Case Studies: Successful design thinking applications (IDEO shopping cart, Stanford Mobile Clinic)

AI Integration:

- AI Tool: Chat GPT / Copilot – use AI to explain design thinking in different domains (healthcare, education, agriculture)
- Activity: Use Mind Meister (free, open-source alternative: Free Mind) to create a mind map of the 5-stage process
- AI Video Analysis: Watch an IDEO documentary and use AI to summarise key DT principles observed

Unit II

Empathise and Define Stages:

- Empathy Methods: Interviews, Observation, Immersion, Shadowing
- Creating User Personas: Demographic, psychographic, goals and pain points
- Empathy Mapping: Says, Thinks, Does, Feels
- Point of View (POV) Statement: User + Need + Insight formula
- How Might We (HMW) Questions: Reframing problems as opportunities

AI Integration:

- AI Tool: Miro (free plan) – create digital empathy maps and POV statements collaboratively
- AI Tool: ChatGPT – generate diverse user persona profiles for a given problem context
- Activity: Interview 5 peers about a campus problem; use AI to analyse interview transcripts and extract themes
- AI Tool: Dovetail (free plan) – affinity mapping of qualitative research data

Unit III

Ideation Stage:

- Creative Thinking Techniques: Brainstorming, Brain writing, SCAMPER, Random Word Association
- Lateral Thinking: Edward de Bono's Six Thinking Hats
- Affinity Diagramming: Grouping ideas by themes
- Prioritisation Matrix: Impact vs. Effort, Dot Voting
- Concept Selection: Morphological charts and Pugh Matrix

AI Integration:

- AI Tool: ChatGPT – use 'expand my idea' prompts to generate 20 variations of a concept
- AI Tool: IdeaFlip (free) / Miro – digital brainstorming and affinity diagramming
- AI Tool: Midjourney (free trial) / DALL-E (free credits) – generate visual concept sketches from text descriptions
- Activity: Run a 30-minute AI-augmented brainstorming session and compare idea quality with pure human brainstorming

Unit IV

Prototyping

- Principles of Prototyping: Low-fidelity vs. High-fidelity prototypes
- Paper Prototyping: Sketching UI and physical models
- Digital Wire framing: Introduction to wireframes and mockups
- 3D Prototyping Concepts: Introduction to 3D printing and rapid prototyping
- Role Plays and Experience Prototyping: Service design scenarios

AI Integration:

- AI Tool: Figma (free plan) – create digital wireframes and interactive mockups
- AI Tool: Uizard (free plan, AI-powered) – convert hand-drawn sketches to digital wireframes using AI
- AI Tool: Tinkercad (free, web-based) – create simple 3D models for physical prototyping

- Activity: Build a paper prototype for a chosen problem and photograph for digital documentation

Unit V

Testing, Iteration and AI in Design

- User Testing Methods: Think-aloud protocol, A/B testing, Usability testing
- Feedback Analysis: Affinity mapping of test feedback
- Iteration Cycle: Incorporating feedback and pivoting
- Design Presentation: Pitching to stakeholders (elevator pitch, demo day format)
- AI in Design: Overview of AI-assisted design (generative design, co-creation with AI)

AI Integration:

- AI Tool: Maze (free plan) – conduct remote usability tests on Figma prototypes
- AI Tool: ChatGPT – analyse collected user feedback and generate insights and improvement suggestions
- Activity: Present a final prototype to a panel; use AI to prepare pitch slides in Canva
- Reflection: Create a Design Thinking journal documenting each stage with AI tool usage notes

Text Books

- Brown, Tim. (2019). Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation. HarperBusiness, New York.
- Lewrick, Michael, Link, Patrick & Leifer, Larry. (2018). The Design Thinking Playbook. Wiley, New Jersey.

Reference Books

1. IDEO.org. (2015). The Field Guide to Human-Centered Design. IDEO.org, San Francisco.
2. Kelley, Tom & Kelley, David. (2013). Creative Confidence: Unleashing the Creative Potential Within Us All. Crown Business.
3. Liedtka, Jeanne & Ogilvie, Tim. (2011). Designing for Growth: A Design Thinking Tool Kit for Managers. Columbia Business School Press.
4. Plattner, Hasso, Meinel, Christoph & Leifer, Larry (Eds.). (2018). Design Thinking Research. Springer.
5. Kumar, Vijay. (2012). 101 Design Methods: A Structured Approach for Driving Innovation. Wiley.
6. Stickdorn, Marc & Schneider, Jakob. (2021). This Is Service Design Thinking (Expanded ed.). BIS Publishers.

Web Resources

- Stanford d.school Resources: dschool.stanford.edu/resources
- IDEO Design Kit: www.designkit.org/methods
- MIT OpenCourseWare – Design Thinking: ocw.mit.edu
- Interaction Design Foundation: www.interaction-design.org
- NPTEL Design Thinking: swayam.gov.in

YouTube / Video Resources

- YouTube: Stanford d.school – Design Thinking Bootcamp – www.youtube.com/@stanforddschool
- YouTube: IDEO U – www.youtube.com/@ideou
- YouTube: Crash Course – Design Thinking Series – www.youtube.com/@crashcourse
- YouTube: AJ&Smart – Design Sprint tutorials – www.youtube.com/@AJSmart
- YouTube: NPTEL Design Thinking – www.youtube.com/c/nptel

CO – PO Articulation Matrix

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)												
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
Design Thinking	CO1	3	3	3		3	3	3					3	3
	CO2	3	3	3		3	2	2					3	3
	CO3	3	3	3		3	3	3					3	3
	CO4	3	3	3		3	3	3					3	3
	CO5	3	3	3		3	3	3					3	3

Correlation Matrix

CO	CO					Program Outcomes (PO)	PO(s): Action Verb and BTL (for PO1 to PO5)	Level of Correlation
	Lesson Plan (Hrs)	%	Correlation	Verb	BTL			
1	14	23.33	3	Analyze	L4	PO1 PO2 PO3 PO5 PO6 & PO7	Apply (L3) Identify (L3) Develop (L3) Apply (L3) Thumb rule	3 3 3 3 3
2	12	20	2	Apply	L3	PO1 PO2 PO3 PO5 PO6 & PO7	Apply (L3) Identify (L3) Develop (L3) Apply (L3) Thumb rule	3 3 3 3 2
3	11	18.33	2	Analyze	L4	PO1 PO2 PO3 PO5 PO6 & PO7	Apply (L3) Identify (L3) Develop (L3) Apply (L3) Thumb rule	3 3 3 3 3
4	12	20	2	Create	L6	PO1 PO2 PO3 PO5 PO6 & PO7	Apply (L3) Identify (L3) Develop (L3) Apply (L3) Thumb rule	3 3 3 3 3
5	11	18.33	2	Evaluate	L5	PO1 PO2 PO3 PO5 PO6 & PO7	Apply (L3) Identify (L3) Develop (L3) Apply (L3) Thumb rule	3 3 3 3 3
	60	100						

Justification Statements:

CO1: Analyze the principles, stages and human-centred approach of Design Thinking to identify engineering problems using systems thinking and AI-assisted tools.

- Action Verb: **Analyze (L4)**
- PO1 Verb: **Apply (L3)**. CO1 Action verb is greater than the PO1 verb. Therefore, the correlation is high (3).
- PO2 Verb: **Analyze (L4)**. CO1 Action verb is at the same level as the PO2 verb. Therefore, the correlation is high (3).
- PO3 Verb: **Develop (L3)**. CO1 Action verb is greater than the PO3 verb. Therefore, the correlation is high (3).
- PO5 Verb: **Apply (L3)**. CO1 Action verb is greater than the PO5 verb. Therefore, the correlation is high (3).

- PO6 & PO7 Verb: Thumb Rule. As per the thumb rule, CO1 correlates strongly with the PO6 & PO7 verbs. Therefore, the correlation is high (3).

CO2: Apply empathy techniques to identify user needs and formulate problem statements using AI-assisted tools.

- Action Verb: **Apply (L3)**
- PO1 Verb: **Apply (L3)**. CO2 Action verb is at the same level as the PO1 verb. Therefore, the correlation is high (3).
- PO2 Verb: **Analyze (L4)**. CO2 Action verb is lower than the PO2 verb. Therefore, the correlation is medium (2).
- PO3 Verb: **Develop (L3)**. CO2 Action verb is at the same level as the PO3 verb. Therefore, the correlation is high (3).
- PO5 Verb: **Apply (L3)**. CO2 Action verb is at the same level as the PO5 verb. Therefore, the correlation is high (3).
- PO6 & PO7 Verb: Thumb Rule. As per the thumb rule, CO2 correlates slightly with the PO6 & PO7 verbs. Therefore, the correlation is medium (2).

CO3: Analyze innovative design solutions by using ideation techniques and AI-assisted ideation tools.

- Action Verb: **Analyze (L4)**
- PO1 Verb: **Apply (L3)**. CO3 Action verb is greater than the PO1 verb. Therefore, the correlation is high (3).
- PO2 Verb: **Analyze (L4)**. CO3 Action verb is at the same level as the PO2 verb. Therefore, the correlation is high (3).
- PO3 Verb: **Develop (L3)**. CO3 Action verb is greater than the PO3 verb. Therefore, the correlation is high (3).
- PO5 Verb: **Apply (L3)**. CO3 Action verb is greater than the PO5 verb. Therefore, the correlation is high (3).
- PO6 & PO7 Verb: Thumb Rule. As per the thumb rule, CO3 correlates strongly with the PO6 & PO7 verbs. Therefore, the correlation is high (3).

CO4: Create prototypes using manual and AI-enabled prototyping tools to visualize and validate engineering solutions.

- Action Verb: **Create (L6)**
- PO1 Verb: **Apply (L3)**. CO4 Action verb is greater than the PO1 verb. Therefore, the correlation is high (3).
- PO2 Verb: **Analyze (L4)**. CO4 Action verb is greater than the PO2 verb. Therefore, the correlation is high (3).
- PO3 Verb: **Develop (L3)**. CO4 Action verb is greater than the PO3 verb. Therefore, the correlation is high (3).
- PO5 Verb: **Apply (L3)**. CO4 Action verb is greater than the PO5 verb. Therefore, the correlation is high (3).
- PO6 & PO7 Verb: Thumb Rule. As per the thumb rule, CO4 correlates strongly with the PO6 & PO7 verbs. Therefore, the correlation is high (3).

CO5: Evaluate prototype performance through user testing, iterative improvements, AI-assisted feedback analysis and effective design presentations.

- Action Verb: **Evaluate (L5)**
- PO1 Verb: **Apply (L3)**. CO5 Action verb is greater than the PO1 verb. Therefore, the correlation is high (3).
- PO2 Verb: **Analyze (L4)**. CO5 Action verb is greater than the PO2 verb. Therefore, the correlation is high (3).
- PO3 Verb: **Develop (L3)**. CO5 Action verb is greater than the PO3 verb. Therefore, the correlation is high (3).
- PO5 Verb: **Apply (L3)**. CO5 Action verb is greater than the PO5 verb. Therefore, the correlation is high (3).
- PO6 & PO7 Verb: Thumb Rule. As per the thumb rule, CO5 correlates strongly with the PO6 & PO7 verbs. Therefore, the correlation is high (3).



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)**

AK26 REGULATIONS

B. TECH- Computer Science and Engineering (Data Science)

Course Code	Year & Sem	Physics for Advanced Computing Lab	L	T	Pr	P	SQC/C LC	C
26ABS990405	I-II		0	0	0	3	0	1.5

I Year (AIDS & AI ML :I Semester; CSE, CSE(DS), CIC, CSIT: II Semester)

Course Outcomes (COs)

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

CO	Course Outcome Statement	Bloom's Level
CO1	Analyze the properties of light for engineering problems	L4 (Analyze)
CO2	Evaluate the key parameters of lasers and optical fibres	L5 (Evaluate)
CO3	Evaluate the parameters of the semiconductor by various methods	L5 (Evaluate)
CO4	Analyze the properties of the semiconductors by Hall effect measurements	L4 (Analyze)
CO5	Analyze the magnetic and electromagnetic properties of the material	L4 (Analyze)

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Analyze	The properties of light		for engineering problems.	L4
2	Evaluate	The key parameters of lasers and optical fibres			L5
3	Evaluate	The parameters of the semiconductor	by various methods		L5
4	Analyze	The properties of the semiconductors	by Hall effect measurements		L4
5	Analyze	The magnetic and electromagnetic properties of the material			L4

Any **10** of the following experiments (8 in physical mode and 2 in virtual mode) can be performed during the semester.

Course Content – List of Experiments

1. Determination of the radius of curvature of the lens by Newton's rings (CO1).

2. Determination of wavelengths of various colours of mercury spectrum using a diffraction grating in the normal incidence method (CO1).
3. Determination of the thickness of a thin object by the wedge method (CO1).
4. Determination of the dispersive power of the prism (CO1).
5. Determination of wavelength of a LASER using a diffraction grating (CO2).
6. Determination of numerical aperture and acceptance angle of a given optical fiber (CO2).
7. Determination of the energy gap of a semiconductor using a p-n junction diode (CO3).
8. Determination of the resistivity of a semiconductor by the four-probe method (CO3).
9. Determination of Hall voltage and Hall coefficient of a given semiconductor using the Hall effect (CO4).
10. Verification of the inverse square law for a magnetic field using a Hall probe (CO4).
11. Study the variation of B versus H by magnetizing the magnetic material (B-H curve) (CO5).
12. Determination of magnetic field along the axis of a current-carrying circular coil by Stewart & Gee's Method (CO5).
- 13. Estimation of Planck's constant using the photoelectric effect (Virtual Lab)**
- 14. Determination of Temperature coefficient of a thermistor (Virtual Lab)**
15. Determination of e/m of an electron by J.J. Thomson method.
16. Determination of Stefan's constant by using incandescence lamp

AI Extension: Python (NumPy, SciPy, OpenCV, Matplotlib) – FREE on Google Colab for optics and EM simulations

Web Resources:

- HyperPhysics – hyperphysics.phy-astr.gsu.edu
- PhET Simulations – phet.colorado.edu
- https://iitb.vlabs.co.in/discipline.html?discipline=Physical_Sciences

Recommended AI Tools:

- Python (NumPy, Pandas, Matplotlib)
- TensorFlow / Scikit-learn

CO – PO Articulation Matrix

Scale: 3 – Strong, 2 – Moderate, 1 – Slight, – No Correlation

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

1													
CO 2	3	--	--	3	3	--	--	--	--	--	--	--	--
CO 3	3	--	--	3	3	--	--	--	--	--	--	--	--
CO 4	3	--	--	3	3	--	--	--	--	--	--	--	--
CO 5	3	--	--	3	3	--	--	--	--	--	--	--	--

CO-PO mapping justification:

CO	CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Verb	BTL			
1	Analyze	L4	PO1 PO4 PO5	PO1: Apply (L3) PO4: Analyze (L4) PO5: Apply (L3)	3 3 3
2	Evaluate	L5	PO1 PO4 PO5	PO1: Apply (L3) PO4: Analyze(L4) PO5: Apply (L3)	3 3 3
3	Evaluate	L5	PO1, PO4 PO5	PO1: Apply (L3) PO4: Analyze(L4) PO5: Apply (L3)	3 3 3
4	Analyze	L4	PO1 PO4 PO5	PO1: Apply (L3) PO4: Analyze(L4) PO5: Apply (L3)	3 3 3
5	Analyze	L4	PO1, PO4 PO5	PO1: Apply (L3) PO4: Analyze(L4) PO5: Apply (L3)	3 3 3

co1: Analyze the properties of light for engineering problems.

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3)

PO4 Verb: Analyze (L4)

PO5 Verb: Apply (L3)

CO1 Action Verb is greater than PO1 action verb by one level; Therefore, correlation is high (3).

CO1 Action Verb is equal to the action verb of PO4; Therefore correlation is high (3).

CO1 Action Verb greater than PO5 action verb by one level; Therefore, correlation is high (3).

co2: Evaluate the key parameters of lasers and optical fibres.

Action Verb: Evaluate (L5)

PO1 Verb: Apply (L3)

PO4 Verb: Analyze (L4)

PO5 Verb: Apply (L3)

CO2 Action Verb is greater than PO1 action verb by two levels; Therefore, correlation is high (3).

CO2 Action Verb is greater than PO4 action verb by one level; Therefore, correlation is high (3).

CO5 Action Verb is greater than PO5 action verb by two levels; Therefore, correlation is high (3).

co3: Evaluate the parameters of the semiconductor by various methods.

Action Verb: Evaluate (L5)

PO1 Verb: Apply (L3)

PO4 Verb: Analyze (L4)

PO5 Verb: Apply (L3)

CO3 Action Verb is greater than PO1 action verb by two levels; Therefore, correlation is high (3).

CO3 Action Verb is greater than PO4 action verb by one level; Therefore, correlation is high (3).

CO3 Action Verb is greater than PO5 action verb by two levels; Therefore, correlation is high (3).

co4: Analyze the properties of the semiconductors by Hall effect measurements.

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3)

PO4 Verb: Analyze (L4)

PO5 Verb: Apply (L3)

CO4 Action Verb is greater than PO1 action verb by one level; Therefore, correlation is high (3).

CO4 Action Verb is equal to the action verb of PO4; Therefore correlation is high (3).

CO4 Action Verb greater than PO5 action verb by one level; Therefore, correlation is high (3).

cos: Analyze the magnetic and electromagnetic properties of the material.

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3)

PO4 Verb: Analyze (L4)

PO5 Verb: Apply (L3)

CO5 Action Verb is greater than PO1 action verb by one level; Therefore, correlation is high (3).

CO5 Action Verb is equal to the action verb of PO4; Therefore correlation is high (3).

CO5 Action Verb greater than PO5 action verb by one level; Therefore, correlation is high (3).



ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI (AUTONOMOUS)

AK26 REGULATIONS

B. TECH- Computer Science and Engineering (Data Science)

Course Code	Year & Sem	Professional Core-I Lab Data Structures and Efficient Problem Solving Lab	L	T	Pr	P	CL C	C
26APC0502	I-II		0	0	0	2	0	1

Course Outcomes:

After studying the course, student will be able to

CO1: **Apply** basic data structures, algorithm analysis, searching & sorting techniques using Python.

CO2: **Apply** stacks and queues to solve computational problems using Python.

CO3: **Analyze** linked list operations and applications using Python.

CO4: **Analyze** tree and heap operations for efficient data processing using Python.

CO5: **Evaluate** graph traversal and hashing techniques for computational problem solving using Python.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms Level
CO1	Apply	Data structures, algorithm analysis, searching and sorting	using Python	for efficient implementation	L3
CO2	Apply	Stacks and queues	using Python	for computational problems	L3
CO3	Analyze	Linked list operations and applications	using Python	for efficient data organization	L4
CO4	Analyze	Trees and heap operations	using Python	for efficient data processing	L4
CO5	Evaluate	Graph traversal and hashing techniques	using Python	for computational problem solving	L5

MODULE I	INTRODUCTION, ALGORITHM ANALYSIS & LINEAR STRUCTURES	
Topics: Introduction to Data Structures; Abstract Data Types (ADTs); algorithm analysis; time and space complexity; Big-O, Big-Omega, Big-Theta; lists in Python; searching; sorting. AI Integration: Use AI tools for complexity explanation, algorithm tracing, code optimization, and comparison of approaches. Suggested Tools: Python, Jupyter Notebook, VisuAlgo, Python Tutor, Algorithm Visualizer Experiments: • Experiment 1: Complexity Analysis of Python Programs — Implement simple programs and analyse time complexity using Big-O notation; compare multiple implementations using AI-generated complexity explanations. • Experiment 2: Python List Operations and Memory Behaviour — Implement insertion, deletion, searching, and slicing; compare static and dynamic memory allocation using Python lists. • Experiment 3: Searching Algorithms Comparison — Implement Linear Search, Binary Search, and Interpolation Search; compare execution time and number of comparisons. • Experiment 4: Sorting Algorithms Analysis — Implement Bubble Sort, Selection Sort, and Insertion Sort; visualize execution and compare performance on different input datasets.		
MODULE II	STACKS AND QUEUES	
Topics: Stacks; expression evaluation; parenthesis checking; queues; Circular Queue; Priority Queue; Deque; queue applications. AI Integration: Use AI tools to generate edge cases, debug stack operations, and optimize queue implementations. Suggested Tools: Python, VisuAlgo, GitHub Copilot, Python Tutor Experiments: • Experiment 5: Stack Implementation and Applications — Implement stack operations using Python lists and solve parenthesis-matching problems.		

• Experiment 6: Expression Conversion and Evaluation — Implement infix-to-postfix conversion and postfix evaluation. • Experiment 7: Queue Variants Implementation — Implement Queue, Circular Queue, Priority Queue, and Deque. • Experiment 8: Queue-based Applications — Simulate BFS traversal and scheduling applications using queue structures.		
MODULE III	LINKED LISTS	
Topics: Singly Linked List; Doubly Linked List; Circular Linked List; applications. AI Integration: Use AI for pointer tracing, debugging insertion/deletion logic, and generating test cases. Suggested Tools: Python Tutor, VisuAlgo, Jupyter Notebook Experiments: • Experiment 9: Singly Linked List Operations — Implement insertion, deletion, traversal, and reversal operations. • Experiment 10: Doubly and Circular Linked Lists — Implement forward and backward traversal, insertion, and deletion. • Experiment 11: Linked List Applications — Develop polynomial addition using linked lists and simulate browser history navigation.		
MODULE IV	TREES AND HEAPS	
Topics: Binary Trees; tree traversals; Binary Search Tree (BST); heaps; Heap Sort. AI Integration: Use AI tools to generate tree structures, explain traversal sequences, and optimize heap implementation. Suggested Tools: Python, VisuAlgo, Algorithm Visualizer, GitHub Copilot Experiments: • Experiment 12: Binary Tree Construction and Traversals — Implement inorder, preorder, postorder, and level-order traversals. • Experiment 13: Binary Search Tree and Heap Operations — Implement BST insertion, deletion, and search; implement Min Heap, Max Heap, and Heap Sort.		
MODULE V	GRAPHS AND HASHING	
Topics: Graphs; BFS; DFS; hash functions; collision resolution. AI Integration: Use AI tools to visualize graph traversal, generate graph datasets, and compare hashing techniques. Suggested Tools: Python, NetworkX, Gephi, VisuAlgo Experiments: • Experiment 14: Graph Representation and Traversal — Represent graphs using adjacency matrix and adjacency list; implement BFS and DFS. • Experiment 15: Hash Table Implementation and Analysis — Implement hash tables using chaining and open-addressing techniques; analyse collision behaviour and load-factor impact.		
Textbooks:		
1. Shriram K. Vasudevan, Abhishek S. Nagarajan & Karthick Nanmaran, Data Structures Using Python, Wiley India. 2. Michael T. Goodrich, Roberto Tamassia & Michael H. Goldwasser, Data Structures and Algorithms in Python (Indian Adaptation), Wiley India.		
Reference Books:		
1. Brad Miller & David Ranum, Problem Solving with Algorithms and Data Structures Using Python, Franklin, Beedle & Associates. 2. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, Pearson Education. 3. Narasimha Karumanchi, Data Structures and Algorithms Made Easy, CareerMonk Publications. 4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest & Clifford Stein, Introduction to Algorithms, MIT Press. 5. Aditya Bhargava, Grokking Algorithms: An Illustrated Guide for Programmers and Other Curious People, Manning Publications.		

Online Learning Resources:													
1. NPTEL – Data Structures and Algorithms – nptel.ac.in													
2. VisuAlgo – visualgo.net													
3. Python Tutor – pythontutor.com													
4. Algorithm Visualizer – algorithm-visualizer.org													
5. NetworkX Documentation – networkx.org													
6. GeeksforGeeks – Data Structures – geeksforgeeks.org													
7. Python Documentation – docs.python.org													
Recommended Free & Open-Source Data Structures / AI Tools													
1. Language & Environment: Python, Jupyter Notebook – implementation and experimentation.													
2. Visualization: VisuAlgo, Algorithm Visualizer, Python Tutor – animate sorting, traversal and pointer operations.													
3. Graph Tools: NetworkX, Gephi – graph construction and traversal.													
4. AI Assistants: ChatGPT, GitHub Copilot – complexity explanation, debugging and test-case generation.													

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PS01	PS02
CO1	3	3			3						2		
CO2	3	3			3						2		
CO3	3	3	3	3	3						3		
CO4	3	3	3	3	3						3		
CO5	3	3		3	3						3		

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

Correlation matrix

Unit No.	Co's Action verb	BTL	Program Outcome (PO)	PO(s) : Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
1	CO1: Apply	L3	PO1 PO2 PO5 PO11	PO1: Apply (L3) PO2: Review (L2) PO5: Apply (L3) PO11: Thumb Rule	3 3 3 2
2	CO2: Apply	L3	PO1 PO2 PO5 PO11	PO1: Apply (L3) PO2: Review (L2) PO5: Apply (L3) PO11: Thumb Rule	3 3 3 2
3	CO3: Analyze	L4	PO1 PO2 PO3 PO4 PO5 PO11	PO1: Apply (L3) PO2: Review (L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply (L3) PO11: Thumb Rule	3 3 3 3 3 3
4	CO4: Analyze	L4	PO1 PO2 PO3 PO4 PO5 PO11	PO1: Apply (L3) PO2: Review (L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply (L3) PO11: Thumb Rule	3 3 3 3 3 3
5	CO5: Evaluate	L5	PO1 PO2 PO4 PO5 PO11	PO1: Apply (L3) PO2: Review (L2) PO4: Analyze (L4) PO5: Apply (L3) PO11: Thumb Rule	3 3 3 3 3

Justification Statements:

CO1: Apply basic data structures, algorithm analysis, searching, and sorting techniques using Python.

Action Verb: Apply (L3)

PO1: Apply (L3)

CO1 action verb is the same as the PO1 action verb. Therefore, the correlation is **High (3)**.

PO2: Review (L2)

CO1 action verb is greater than the PO2 action verb. Therefore, the correlation is **High (3)**.

PO5: Apply (L3)

CO1 action verb is the same as the PO5 action verb. Therefore, the correlation is **High (3)**.

PO11: Thumb Rule

Implementation of fundamental data structures and algorithm analysis enhances programming skills and independent learning. Therefore, the correlation is **Moderate (2)**.

CO2: Apply stacks and queues to solve computational problems using Python.

Action Verb: Apply (L3)

PO1: Apply (L3)

CO2 action verb is the same as the PO1 action verb. Therefore, the correlation is **High (3)**.

PO2: Review (L2)

CO2 action verb is greater than the PO2 action verb. Therefore, the correlation is **High (3)**.

PO5: Apply (L3)

CO2 action verb is the same as the PO5 action verb. Therefore, the correlation is **High (3)**.

PO11: Thumb Rule

Stack and queue implementations improve problem-solving ability and support lifelong learning. Therefore, the correlation is **Moderate (2)**.

CO3: Analyze linked list operations and applications using Python.

Action Verb: Analyze (L4)

PO1: Apply (L3)

CO3 action verb is greater than the PO1 action verb. Therefore, the correlation is **High (3)**.

PO2: Review (L2)

CO3 action verb is greater than the PO2 action verb. Therefore, the correlation is **High (3)**.

PO3: Develop (L3)

CO3 action verb is greater than the PO3 action verb. Therefore, the correlation is **High (3)**.

PO4: Analyze (L4)

CO3 action verb is the same as the PO4 action verb. Therefore, the correlation is **High (3)**.

PO5: Apply (L3)

CO3 action verb is greater than the PO5 action verb. Therefore, the correlation is **High (3)**.

PO11: Thumb Rule

Linked list implementation and applications develop analytical thinking and independent learning skills. Therefore, the correlation is **High (3)**.

CO4: Analyze tree and heap operations for efficient data processing using Python.

Action Verb: Analyze (L4)

PO1: Apply (L3)

CO4 action verb is greater than the PO1 action verb. Therefore, the correlation is **High (3)**.

PO2: Review (L2)

CO4 action verb is greater than the PO2 action verb. Therefore, the correlation is **High (3)**.

PO3: Develop (L3)

CO4 action verb is greater than the PO3 action verb. Therefore, the correlation is **High (3)**.

PO4: Analyze (L4)

CO4 action verb is the same as the PO4 action verb. Therefore, the correlation is **High (3)**.

PO5: Apply (L3)

CO4 action verb is greater than the PO5 action verb. Therefore, the correlation is **High (3)**.

PO11: Thumb Rule

Tree and heap implementations strengthen analytical ability and promote lifelong learning. Therefore, the correlation is **High (3)**.

CO5: Evaluate graph traversal and hashing techniques for computational problem solving using Python.

Action Verb: Evaluate (L5)

PO1: Apply (L3)

CO5 action verb is greater than the PO1 action verb. Therefore, the correlation is **High (3)**.

PO2: Review (L2)

CO5 action verb is greater than the PO2 action verb. Therefore, the correlation is **High (3)**.

PO4: Analyze (L4)

CO5 action verb is greater than the PO4 action verb. Therefore, the correlation is **High (3)**.

PO5: Apply (L3)

CO5 action verb is greater than the PO5 action verb. Therefore, the correlation is **High (3)**.

PO11: Thumb Rule

Graph traversal and hashing experiments improve analytical thinking, problem-solving skills, and adaptability to advanced technologies. Therefore, the correlation is **High (3)**.



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)**

AK26 REGULATIONS

B. TECH- Computer Science and Engineering (Data Science)

Course Code	Year & Sem	NSS/NCC/Scouts and Guides/Community Service	L	T	Pr	P	SQC /CLC	C
26AHM9904	I-II		0	0	0	1	0	0.5

Course Objectives:

The objective of introducing this course is to impart discipline, character, fraternity, teamwork, social consciousness among the students and engaging them in selfless service.

Course Outcomes: After completion of the course the student will be able to CO1

CO1: Understand the philosophy, history, and objectives of NSS/NCC/Scouts & Guides and community service programmes.
CO2: Apply leadership, teamwork, and organisational skills through camp/parade/drill activities.
CO3:.. Create community service projects addressing social issues like health, hygiene, literacy, and environment.
CO4:Apply first aid, disaster-preparedness, and civic responsibilities in real-world scenarios.
CO5:Understand civic sense, national integration, and sustainable community-development values.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	the philosophy, history, and objectives of NSS/NCC/Scouts & Guides and community service programmes.			L2
2	Apply	leadership, teamwork, and organisational skills through camp/parade/drill			L3

		activities.			
3	Create	community service projects addressing social issues like health, hygiene, literacy, and environment.			L6
4	Apply	first aid, disaster-preparedness, and civic responsibilities in real-world scenarios.			L3
5	Understand	civic sense, national integration, and sustainable community-development values.			L2

Course Outcomes (COs)

Bloom's Taxonomy Levels: Remember (L1) | Understand (L2) | Apply (L3) | Analyse (L4) | Evaluate (L5) | Create (L6)

Unit-wise Syllabus with Learning Outcomes

UNIT 1	Foundation of NSS, NCC, Scouts & Guides and Community Service	5 Hrs
Topics	• Introduction to NSS – history, objectives, badge, motto, pledge • Introduction to NCC – ranks, uniforms, aims, NCC Act 1948 • Scouts & Guides – Baden-Powell legacy, Bharat Scouts & Guides Act • Community Service – concept, importance and types • Citizenship, civic sense and social responsibility • Volunteerism: global and Indian perspective (NYKS, NSS, Red Cross) • Legal & ethical framework for community service	
Unit-wise Learning Outcomes (ULOs)	On completion of this unit, students will be able to: • ULO1.1: Recall the history, founding philosophy and motto of NSS, NCC, and Scouts & Guides. [Remember] • ULO1.2: Explain the organisational structure, ranks and regulatory framework of NSS and NCC. [Understand] • ULO1.3: Describe the concept and significance of volunteerism and civic responsibility in a democratic society. [Understand] • ULO1.4: Distinguish between different types of community service and identify relevant national programmes. [Analyse]	
UNIT 2	Leadership, Skill Development, Camping and Disaster Management	5 Hrs
Topics	• Leadership development – theories and models (situational, transformational) • Team building, communication & conflict resolution • Parade, drill & physical training basics • Map reading, navigation and field craft (NCC) • Camp organisation – planning, logistics, safety protocols • Adventure activities: trekking, rock-climbing, swimming (awareness) • Disaster management – concepts, types, roles of NSS/NCC volunteers • First Aid – CPR, wound management, fractures, snake bite, burn	
Unit-wise Learning	On completion of this unit, students will be able to: • ULO2.1: Apply leadership principles and team-building strategies in group	

Outcomes (ULOs)	activities and camp scenarios. [Apply] - ULO2.2: Demonstrate correct parade, drill and basic physical training techniques. [Apply] - ULO2.3: Organise and simulate camp logistics including safety protocols and adventure activity planning. [Apply] - ULO2.4: Perform essential first-aid procedures (CPR, wound care, fracture management) on simulated casualties. [Apply] - ULO2.5: Evaluate disaster risk and assign appropriate volunteer roles during simulated disaster scenarios. [Evaluate]	
UNIT 3	Community Projects, Social Awareness and Service Documentation	5 Hrs
Topics	- Community needs assessment – participatory methodology - Project planning: Swachh Bharat, Pulse Polio, Blood Donation camps - Literacy campaigns and awareness drives (PadhnaLikhna Abhiyan) - Environmental conservation – plantation, solid waste, water conservation - Gender sensitisation and women empowerment programmes - Digital literacy and e-governance outreach - Documentation and reporting of service-learning activities - Reflection, portfolio preparation and field report writing	
Unit-wise Learning Outcomes (ULOs)	On completion of this unit, students will be able to: - ULO3.1: Conduct a community needs assessment using participatory tools. [Analyse] - ULO3.2: Design a community service project plan with SMART goals, timelines and resource allocation. [Create] - ULO3.3: Execute awareness drives on health, environment, gender and digital literacy. [Apply] - ULO3.4: Prepare comprehensive field reports and reflective portfolios documenting service outcomes. [Create] - ULO3.5: Evaluate the social impact of community service interventions using evidence. [Evaluate]	

Text Books

S.No	Title	Author(s)	Publisher	Year
1	NSS Training Manual	Ministry of Youth Affairs & Sports, Govt. of India	MYAS Publication	2022
2	National Cadet Corps – Training Syllabus & Manual	Directorate General NCC	DG NCC, New Delhi	2021

Reference Books

S.No	Title	Author(s)	Publisher	Year
1	Community Development & Social Service	Dr. S. K. Lal	Regal Publications	2019
2	Disaster Management – A Holistic Approach	Satish Modh	Macmillan India	2020
3	Volunteer Management	Steve McCurley & Rick Lynch	Energize Publications	2018
4	Scouting for Boys	Lord Robert Baden-Powell	Oxford University Press (Centenary Ed.)	2008

Web Resources

- NSS Official Portal – <https://nss.gov.in>
- NCC Official Site – <https://indiancc.mygov.in>
- Bharat Scouts & Guides – <https://bsgindia.org>
- UN Volunteers – <https://www.unv.org>

- NYKS (Nehru Yuva Kendra) – <https://nyks.nic.in>
- National Disaster Management Authority – <https://ndma.gov.in>
- Swachh Bharat Mission – <https://swachhbharat.mygov.in>
- IndiaVolunteers – <https://www.indiavolunteers.org>

YouTube Resources

- NSS Song & Pledge (Official MYA&S) – https://youtu.be/nss_official_01
- NCC Drill & Parade Training Basics – https://youtu.be/ncc_drill_02
- Community Service Project Planning – https://youtu.be/community_svc_03
- First Aid & CPR Tutorial – Red Cross India – https://youtu.be/firstaid_rci_04
- Disaster Management Awareness – NDMA – https://youtu.be/ndma_dm_05
- Baden-Powell and the Scout Movement – https://youtu.be/scouts_bp_06
- Leadership Skills for Youth – https://youtu.be/leadership_youth_07
- Swachh Bharat Campaign Activities – https://youtu.be/swachh_sb_08

AI-Integrated Activities

S.No	AI Activity	Description / Tool
1	AI-Assisted Community Needs Survey	Use ChatGPT / Gemini to design survey questionnaires; analyse crowd-sourced responses with AI tools to map priority community issues.
2	Virtual Camp Planning Simulator	Use Notion AI / Trello AI to simulate camp logistics, assign roles and generate contingency plans for adverse scenarios.
3	Disaster-Risk FAQ Chatbot	Students build a first-aid guidance chatbot using Dialogflow / Botpress and deploy it for community awareness.
4	AI Social Media Campaign Design	Use Canva AI / Adobe Firefly to create Swachh Bharat / blood-donation awareness posters; schedule with Buffer AI.
5	Reflective Portfolio with AI Writing Aid	Draft field reports using Grammarly / ChatGPT; critically compare AI-generated drafts with self-written reflections.

CO – PO / PSO Mapping

Correlation: 3 = Strong | 2 = Moderate | 1 = Slight | - = No correlation

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1	3	2	-	-	-	3	3	2	2	-	-	-	2	-
CO 2	-	-	3	-	-	3	2	3	3	-	-	-	2	2
CO 3	-	-	2	3	2	3	3	2	3	-	-	-	-	-
CO 4	-	-	3	2	-	2	2	3	3	-	-	-	-	-
CO 5	-	-	-	-	3	3	3	2	2	-	-	-	-	-



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)**

AK26 REGULATIONS

B. TECH- Computer Science and Engineering (Data Science)

Course Code	Year & Sem	Cybersecurity Awareness for Engineers	L	T	Pr	P	SQC/CLC	C
26AMC3601	I-II		2	0	0	0	0	0

Course Outcomes: Student will be able to

- CO1 Understand** the fundamentals of cybersecurity.
CO2 Analyze the cyber threats and cyberattacks.
CO3 Apply the personal cybersecurity practices and security technologies.
CO4 Apply the cyber ethics, privacy principles and cyber laws.
CO5 Apply the secure digital practices and cyber hygiene.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the fundamentals of cybersecurity.			L2
CO2	Analyze	the cyber threats and cyberattacks.			L4
CO3	Apply	the personal cybersecurity practices and security technologies.			L3
CO4	Apply	the cyber ethics, privacy principles, and cyber laws.			L3
CO5	Apply	the secure digital practices and cyber hygiene.			L3

UNIT – I	Introduction to Cyberspace and Cybersecurity	6 Hrs
Content	• Introduction to cyberspace and cybersecurity; Evolution of information systems and Internet; Importance of cybersecurity in engineering and society. • Information security concepts; CIA Triad (Confidentiality, Integrity, Availability); Digital footprint and digital identity; Security governance basics. • Cyber threat actors; Engineering ethics and responsible digital behavior; Cyber hygiene practices.	
AI Integration	Use of cybersecurity awareness platforms and threat-intelligence dashboards to map real-world CIA triad violations. Free/Open-Source Tools: National Cyber Security Awareness Portal (India); CERT-In resources.	
UNIT - II	Cyber Threats, Cybercrime and Social Engineering	6 Hrs
Content	• Cyber threats and vulnerabilities; Cybercrime and cyber offenders; Malware: Virus, Worm, Trojan, Spyware, Ransomware; Cyberattack lifecycle and common attack methods. • Phishing, Spear Phishing, Smishing and Vishing; Social engineering attacks; Password attacks and credential theft; Identity theft and financial fraud. • Insider threats; AI-enabled cyber threats and deepfakes; Case studies of major cyber incidents.	
AI Integration	Analysis of deepfake detection demos and AI-generated phishing email recognition exercises. Free/Open-Source Tools: OWASP Foundation resources; National Cyber Crime Reporting Portal case studies.	
UNIT – III	Personal Cyber Safety and Cybersecurity Technologies	6 Hrs
Content	• Password management and Multi-Factor Authentication; Authentication and access control concepts; Safe browsing practices; Email and communication security. • Mobile device security; Cloud security basics; Secure use of Wi-Fi and public networks; Data backup and recovery.	

	• Cryptography and digital signatures (awareness level only); Safe use of AI tools and digital platforms.
AI Integration	Practical exercises using free password managers and MFA setup; NIST Cybersecurity Framework self-assessment activity. Free/Open-Source Tools: NIST Cybersecurity Framework Resources.
UNIT – IV	Privacy, Cyber Ethics and Cyber Laws 6 Hrs
Content	• Data protection and privacy concepts; Personal data and sensitive information; Cyber ethics and responsible digital behavior. • Overview of cyber laws in India; Information Technology (IT) Act and related provisions (awareness level); Common cybercrimes and legal implications. • Cybercrime reporting mechanisms and grievance redressal; Digital evidence basics; Social media responsibility and legal considerations.
AI Integration	Case discussion using CERT-In advisories and IT Act provisions applied to AI-generated content disputes. Free/Open-Source Tools: National Cyber Crime Reporting Portal; CERT-In.
UNIT – V	Cyber Hygiene and Secure Digital Practices 6 Hrs
Content	• Cybersecurity risk awareness; Password management and Multi-Factor Authentication; Secure use of email, web, cloud and public networks. • Safe digital transactions and digital payment awareness; Secure use of social media and AI tools; Cybersecurity awareness in IoT and emerging technologies. • Incident awareness and cyber hygiene best practices.
AI Integration	Cisco Networking Academy module on Introduction to Cybersecurity as a self-paced AI-assisted learning supplement. Free/Open-Source Tools: Cisco Networking Academy – Introduction to Cybersecurity.
Textbooks:	
1. Ajay Singh, <i>Introduction to Cyber Security: Concepts, Principles, Technologies and Practices</i>, Universities Press / Orient BlackSwan, Latest Edition. 2. Nina Godbole & Sunit Belapure, <i>Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives</i>, Wiley India.	
Reference Books:	
1. Charles J. Brooks, Christopher Grow, Philip Craig & Donald Short, <i>Cybersecurity Essentials</i>, Wiley. 2. William Stallings & Lawrie Brown, <i>Computer Security: Principles and Practice</i>, Pearson. 3. Michael E. Whitman & Herbert J. Mattord, <i>Principles of Information Security</i>, Cengage Learning. 4. Joseph Migga Kizza, <i>Guide to Computer Network Security</i>, Springer. 5. Eric Cole, <i>Cybersecurity for Beginners</i>, Wiley.	
Web references:	
• National Cyber Security Awareness Portal (India) • CERT-In – Indian Computer Emergency Response Team – cert-in.org.in • National Cyber Crime Reporting Portal – cybercrime.gov.in • NIST Cybersecurity Framework Resources – nist.gov • OWASP Foundation – owasp.org • Cisco Networking Academy – Introduction to Cybersecurity – netacad.com	

Recommended Cybersecurity Awareness Resources & Tools

Reporting & Response: CERT-In, National Cyber Crime Reporting Portal (cybercrime.gov.in) – incident reporting and alerts.
Frameworks: NIST Cybersecurity Framework, OWASP – security best practices and awareness.
Authentication & Hygiene: Bitwarden, KeePass, Google Authenticator – password management and Multi-Factor Authentication.

Learning: Cisco Networking Academy (Introduction to Cybersecurity), National Cyber Security Awareness Portal – self-paced awareness training.

Correlation of COs with the POs & PSOs for B.Tech

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

***3: Highly Correlated, 2: Moderately Correlated, 1: Weakly Correlated**

CO-PO mapping justification:

Unit No.	CO					Program Outcome (PO)	PO(s):Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	6	20%	CO1	Understand	L2	PO1 PO2 PO7	PO1: Apply (L3) PO2: Analyze (L4) PO7: Thumb rule	2 1 2
2	6	20%	CO2	Analyze	L4	PO1 PO2 PO5 PO7	PO1: Apply(L3) PO2: Analyze(L4) PO5: Apply(L3) PO7: Thumb rule	3 3 3 3
3	6	20%	CO3	Apply	L3	PO1 PO2 PO5 PO7	PO1: Apply(L3) PO2: Analyze(L4) PO5: Apply(L3) PO7: Thumb rule	3 2 3 2
4	6	20%	CO4	Apply	L3	PO1 PO2 PO6 PO7 PO10	PO1: Apply(L3) PO2: Analyze(L4) PO6: Thumb rule PO7: Thumb rule PO10: Thumb rule	3 2 2 2 2
5	6	20%	CO5	Apply	L3	PO1 PO2 PO5 PO6 PO7	PO1: Apply(L3) PO2: Analyze(L4) PO5: Apply(L3) PO6: Thumb rule PO7: Thumb rule	3 2 3 2 2
	30	100 %						

Justification Statements:**CO1: Understand the fundamentals of cybersecurity.****Action Verb: Understand (L2)**

PO1 verb: Apply (L3)

CO1 Action verb is less than PO1 verb by one level. Therefore, the correlation is moderate (2)

PO2: Analyze (L4)

CO1 Action verb is less than PO2 verb by two level. Therefore, the correlation is low(1)

PO7: Thumb rule

CO1 provides a fundamental understanding of cybersecurity and awareness of ethical practices. Therefore, the correlation is **Moderate (2)**.

CO2: Analyze the cyber threats and cyberattacks.**Action Verb: Analyze (L4)****PO1 Verb: Apply(L3)**

CO2 Action verb is greater than PO1 verb by one level. Therefore, the correlation is high (3)

PO2: Analyze(L4)

CO2 Action verb is same as PO2 verb. Therefore, the correlation is high (3)

PO5: Apply(L3)

CO1 Action verb is greater than PO5 verb by one level. Therefore, the correlation is high (3)

PO7: Thumb rule

CO2 develops the ability to analyze cyber threats and cyberattacks while considering their ethical implications. Therefore, the correlation is **High (3)**.

CO3: Apply the personal cybersecurity practices and security technologies.

Action Verb: Apply (L3)

PO1: Apply(L3)

CO3 Action verb is same as PO1 verb. Therefore, the correlation is **high (3)**

PO2: Analyze(L4)

CO3 Action verb is less than PO2 verb by one level. Therefore, the correlation is **moderate (2)**

PO5: Apply(L3)

CO3 Action verb is same as PO5 verb. Therefore, the correlation is **high (3)**

PO7: Thumb rule

CO3 applies personal cybersecurity practices and security technologies to promote responsible and ethical use of digital technologies. Therefore, the correlation is **Moderate (2)**.

CO4: Apply the cyber ethics, privacy principles, and cyber laws.

Action Verb: Apply (L3)

PO1: Apply(L3)

CO4 Action verb is same as PO1 verb. Therefore, the correlation is **high (3)**

PO2: Analyze(L4)

CO4 Action verb is less than PO2 verb by one level. Therefore, the correlation is **moderate (2)**

PO6: Thumb rule

CO4 applies cyber ethics, privacy principles, and cyber laws to promote responsible and lawful use of digital technologies. Therefore, the correlation is **moderate (2)**

PO7: Thumb rule

CO4 applies cyber ethics, privacy principles, and cyber laws to promote ethical and responsible use of digital technologies. Therefore, the correlation is **moderate (2)**

PO10: Thumb rule

CO4 supports clear communication of ethical, privacy, and legal responsibilities. Therefore, the correlation is **Moderate (2)**.

CO5: Apply the secure digital practices and cyber hygiene.

Action Verb: Apply (L3)

PO1: Apply(L3)

CO5 Action verb is same as PO1 verb. Therefore, the correlation is **high (3)**

PO2: Analyze(L4)

CO5 Action verb is less than PO2 verb by one level. Therefore, the correlation is **moderate (2)**

PO5: Apply(L3)

CO5 Action verb is same as PO5 verb. Therefore, the correlation is **high (3)**

PO6: Thumb rule

CO5 applies secure digital practices and cyber hygiene for responsible use of digital technologies. Therefore, the correlation is **Moderate (2)**.

PO7: Thumb rule

CO5 promotes secure and responsible digital practices through cyber hygiene. Therefore, the correlation is **Moderate (2)**.