School of Computing

(AMARAVATI, AMRITAPURI, BANGALORE, COIMBATORE, CHENNAI, HARIDWAR, NAGERCOIL)

Curriculum and Syllabi

B.Tech. - Computer Science and Engineering (Quantum Computing)

CURRICULUM & SYLLABUS 2026 onwards

GENERAL INFORMATION

ABBREVIATIONS USED IN THE CURRICULUM
Cat - Category
L - Lecture
T - Tutorial
P - Practical
Cr - Credits
ENGG - Engineering Sciences (including General, Core and Electives)
HUM - Humanities (including Languages and others)
SCI - Basic Sciences (including Mathematics)
PRJ - Project Work (including Seminars)
AES - Aerospace Engineering
AIE - Computer Science and Engineering – Artificial Intelligence
BIO - Biology
CCE - Computer and Communication Engineering
CHE - Chemical Engineering
CHY - Chemistry
CSE - Computer Science and Engineering
CSQ - Computer Science and Engineering – Quantum Computing
CVL - Civil Engineering
CUL - Cultural Education
EAC - Electronics and Computer Engineering
ECE - Electronics and Communication Engineering
EEE - Electrical and Electronics Engineering
ELC - Electrical and Computer Engineering
HUM - Humanities
MAT - Mathematics
MEE - Mechanical Engineering
PHY – Physics
CGPA - Cumulative Grade Point Average

Course Outcome (CO) – Statements that describe what students are expected to know and are able to do at the end of each course. These relate to the skills, knowledge and behaviour that students acquire in their progress through the course.

Program Outcomes (POs) – Program Outcomes are statements that describe what students are expected to know and be able to do upon graduating from the Program. These relate to the skills, knowledge, attitude and behaviour that students acquire through the program. NBA has defined the Program Outcomes for each discipline.

KNOWLEDGE AND ATTITUDE PROFILES

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.
WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.
WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.
WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.
WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, reuse of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.
WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.
WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.
WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.
WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

PROGRAM OUTCOMES (POs)

1. **Engineering knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
3. **Design/development of solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5).
4. **Conduct investigations of complex problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
5. **Engineering tool usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6).
6. **The engineer and the world:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
7. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
8. **Individual and Collaborative teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
9. **Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.
10. **Project management and finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
11. **Life-long learning:** Recognize the need for and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8).

PROGRAM SPECIFIC OUTCOMES (PSOs)

- Ability to design and implement innovative, optimal, well-structured and elegant computing solutions to diverse problems using standard practices, tools and technologies.
- Ability to explore, comprehend, and apply emerging computing paradigms - including quantum computing principles and algorithms to drive research, innovation, and the develop advanced computational solutions.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

- Graduates will demonstrate a strong foundation in Computer Science and Engineering, enabling them to pursue successful careers on a global context.
- Graduates will possess the industry driven technical skills to contribute to innovative solutions addressing real-world challenges.
- Graduates will be competent to pursue higher studies at world-class universities and conduct impactful research in multidisciplinary domains.
- Graduates will demonstrate professionalism, ethical responsibility, and respect for diverse cultures, with a strong commitment to society and the environment.

B. Tech. in Computer Science and Engineering (Quantum Computing)

July 2026 onwards

General Framework

CATEGORY	DESCRIPTION	No. of COURSES	CREDITS	AICTE Reco For CSE
HUM	Humanities	13	18	16
ENGG	Engineering	11	22	29
SCI	Science	7	24	23
PRJ	Project	3	15	15
CSQ	Computer Science (Quantum)-Core	21	65	59
CSQ/CSE	Computer Science (Quantum)-Electives	6	18	9
	Mandatory Courses [Environmental Sciences, Induction Program, Indian Constitution, Essence of Indian Knowledge Tradition]	2	(Non-Credit)	(Non-Credit)
	TOTAL	**61**	**162**	**163**

CURRICULUM July 2026 onwards

Semester 1					
Cat	**Code**	**Title**	**L - T - P**	**Credit**	**Evaluation Pattern**
HUM	23ENG101	Technical Communication	2-0-3	3	70:30
SCI	26MAT106	Calculus	3-0-0	3	60:40
SCI	26PHY102	Mechanics	3-0-0	3	60:40
CSQ	26CSQ101	Computer Programming	3-0-0	3	60:40
CSQ	26CSQ181	Computer Programming Lab	0-0-2	1	80:20
CSQ	26CSQ102	Discrete Mathematical Structures	3-0-0	3	60:40
ENGG	23CSE102	Computer Hardware Essentials	1-0-2	2	70:30
HUM	22ADM101	Foundations of Indian Heritage	2-0-1	2	60:40
HUM	22AVP103	Mastery Over Mind	1-0-2	2	80:20
		Total (18L + 0T + 10P = 28 hrs)		**22**	

Semester 2					
Cat	**Code**	**Title**	**L - T - P**	**Credit**	**Evaluation Pattern**
ENGG	26EEE111	Introduction to Electrical and Electronics Engineering	2-0-2	3	70:30
SCI	26MAT113	Linear Algebra	3-0-2	4	70:30
SCI	26PHY111	Introduction to Electrodynamics	3-0-0	3	60:40
CSQ	26CSQ111	Object Oriented Programming	3-0-0	3	60:40
CSQ	26CSQ182	Object Oriented Programming Lab	0-0-2	1	80:20
ENGG	26ECE111	Digital Electronics	3-0-0	3	60:40
ENGG	26ECE182	Digital Electronics Lab	0-0-3	1	80:20
ENGG	23MEE115	Manufacturing Practice	0-0-3	1	80:20
HUM	22ADM111	Glimpses of Glorious India	2-0-1	2	60:40
		Total (16L + 0T + 13P = 29 hrs)		**21**	

Semester 3					
Cat	**Code**	**Title**	**L - T - P**	**Credit**	**Evaluation Pattern**
SCI	26MAT205	Probability & Random Process	3-0-0	3	60:40
SCI	26PHY201	Quantum Mechanics	3-1-0	4	60:40
CSQ	26CSQ201	Operating Systems	3-0-2	4	70:30
CSQ	26CSQ202	Data Structures and Algorithms	3-1-0	4	60:40
CSQ	26CSQ281	Data Structures and Algorithms Lab	0-0-2	1	80:20
ENGG	26CSQ203	Computer Organization & Architecture	3-0-2	4	70:30
ENGG	26CSQ204	Python Programming	1-0-2	2	70:30
HUM	23LSE201	Life Skills for Engineers I	1-0-2	P/F	60:40
HUM		Amrita Value Programme I	1-0-0	1	60:40
		Total (18L + 2T + 10P = 30 hrs)		**23 + P/F**	

Semester 4					
Cat	**Code**	**Title**	**L - T - P**	**Credit**	**Evaluation Pattern**
SCI	26MAT216	Differential Equations & Complex Variables	3-1-0	4	60:40
CSQ	26CSQ211	Design and Analysis of Algorithms	3-0-2	4	70:30
CSQ	26CSQ212	Machine Learning	3-0-2	4	70:30
CSQ	26CSQ213	Fundamentals of Quantum Computing	3-0-0	3	60:40
CSQ	26CSQ282	Quantum Computing Lab	0-0-2	1	80:20
CSQ	26CSQ214	Database Management Systems	3-0-2	4	70:30
HUM	23LSE211	Life Skills for Engineers II	1-0-2	2	60:40
HUM		Amrita Value Programme II	1-0-0	1	60:40
HUM	26CUL200	Integrated Amrita Meditation Technique (IAM)	0-0-2	1	60:40
		Total (17L + 1T + 12P = 30 hrs)		**24**	

Semester 5					
Cat	**Code**	**Title**	**L - T - P**	**Credit**	**Evaluation Pattern**
CSQ	26CSQ301	Theory of Computation	3-1-0	4	60:40
CSQ	26CSQ302	Computer Networks	3-0-2	4	70:30
CSQ	26CSQ303	Quantum Machine Learning	3-0-2	4	70:30
CSQ	26CSQ304	Quantum Information Theory	3-0-0	3	60:40
CSQ/CSE		Professional Elective I	3-0-0	3	70:30
CSQ/CSE		Professional Elective II	3-0-0	3	60:40
HUM	23LSE301	Life Skills for Engineers III	1-0-2	2	60:40
ENGG	23LIV390	Live-in –Labs I***	3-0-0	[3]	0:0
HUM	23ENV300	Environmental Science	0-0-0	P/F	0:0
		Total (22L + 1T + 6P = 29 hrs)		**23 + [3] + P/F**	

Semester 6					
Cat	**Code**	**Title**	**L - T - P**	**Credit**	**Evaluation Pattern**
ENGG	26CSQ311	Software Engineering	3-0-2	4	70:30
CSQ	26CSQ312	Quantum Communication	3-0-0	3	60:40
CSQ	26CSQ313	Quantum Error Correction	3-0-0	3	60:40
CSQ/CSE		Professional Elective III	3-0-0	3	70:30
CSQ	26CSQ314	Compiler Design	3-0-2	4	70:30
PRJ	26CSQ399	Project Phase-I	0-0-6	3	70:30
HUM	23LSE311	Life Skills for Engineers IV	1-0-2	2	60:40
ENGG	23LIV490*	Live-in –Labs II***	3-0-0	[3]	0:0
		Total (19L + 0T + 12P = 31 hrs)		**22 + [3]**	

Semester 7					
Cat	**Code**	**Title**	**L - T - P**	**Credit**	**Evaluation Pattern**
CSQ	26CSQ401	Advanced Quantum Algorithms	3-0-2	4	70:30
PRJ	26CSQ498	PROJECT – PHASE II	0-0-12	6	70:30
CSQ/CSE		Professional Elective IV	3-0-0	3	70:30
CSQ/CSE		Professional Elective V	3-0-0	3	70:30
CSQ/CSE		Professional Elective VI	3-0-0	3	70:30
ENGG		Free Elective I	2-0-0	2	60:40
HUM	23LAW300	Indian Constitution	0-0-0	P/F	0:100
		Total (14L + 0T + 14P = 28 hrs)		**21 + P/F**	

Semester 8					
Cat	**Code**	**Title**	**L - T - P**	**Credit**	**Evaluation Pattern**
PRJ	26CSE499	PROJECT – PHASE III	0-0-12	6	70:30
		Total (0L + 0T + 12P = 12 hrs)		**6**	
		Total Credits		**162**	

*Professional Electives categorized under Quantum, Engineering, Computing, Science, Mathematics, Live-in- Labs, and NPTEL Courses. Students can opt for such electives across departments/campuses. Students with CGPA of 7.0 and above can opt for a maximum of 4 NPTEL courses with credits not exceeding 12. If one student would like to opt for specialization, the student must take the professional electives from the respective specialization baskets.
** Free Electives will include courses offered by Faculty of Humanities and Social Sciences/ Faculty Arts, Commerce and Media / Faculty of Management/Amrita Darshanam - (International Centre for Spiritual Studies)
***Live-in-Labs - Students undertaking and registering for a Live-in-Labs project, can be exempted from registering for an Elective course in the higher semester
+ As quantum computing is a fast-evolving field, with strides and breakthroughs being made every often, the course syllabus, scope and references can be altered to suit the necessity at the time of offering the course.

Professional Electives					
Cat	**Code**	**Title**	**L - T - P**	**Credit**	**Evaluation Pattern**
Quantum Electives					
Cat	**Code**	**Title**	**L - T - P**	**Credit**	**Evaluation Pattern**
CSQ	26CSQ431	QUANTUM OPTICS COMPUTING AND PHOTONICS	3-0-0	3	60:40
CSQ	26CSQ432	POST QUANTUM CRYPTOGRAPHY	3-0-0	3	60:40
CSQ	26CSQ433	QUANTUM MEASUREMENT AND SENSING	3-0-0	3	60:40
CSQ	26CSQ434	QUANTUM PROGRAMMING	3-0-0	3	60:40
CSQ	26CSQ435	QUANTUM HARDWARE AND ARCHITECTURES	3-0-0	3	60:40
CSQ	26CSQ436	QUANTUM INTERNET ARCHITECTURE AND PROTOCOLS	3-0-0	3	60:40
CSQ	26CSQ437	QUANTUM CHEMISTRY FOR QUANTUM COMPUTING	3-0-0	3	60:40

List of courses in Amrita Value Programme I & II

Course Code	Title	L-T-P	Credits
22ADM201	Strategic Lessons from Mahabharatha	1-0-0	1
22ADM211	Leadership from Ramayana	1-0-0	1
22AVP210	Kerala Mural Art and Painting	1-0-0	1
22AVP218	Yoga Therapy and Lessons	1-0-0	1
22AVP212	Introduction to Traditional Indian Systems of Medicine	1-0-0	1
22AVP201	Amma's Life and Message to the modern world	1-0-0	1
22AVP204	Lessons from the Upanishads	1-0-0	1
22AVP205	Message of the Bhagavad Gita	1-0-0	1
22AVP206	Life and Message of Swami Vivekananda	1-0-0	1
22AVP207	Life and Teachings of Spiritual Masters of India	1-0-0	1
22AVP208	Insights into Indian Arts and Literature	1-0-0	1
22AVP213	Traditional Fine Arts of India	1-0-0	1
22AVP214	Principles of Worship in India	1-0-0	1
22AVP215	Temple Mural Arts in Kerala	1-0-0	1
22AVP218	Insights into Indian Classical Music	1-0-0	1
22AVP219	Insights into Traditional Indian Painting	1-0-0	1
22AVP220	Insights into Indian Classical Dance	1-0-0	1
22AVP221	Indian Martial Arts and Self Defense	1-0-0	1
22AVP209	Yoga and Meditation	1-0-0	1

PROFESSIONAL ELECTIVES UNDER SCIENCE STREAM

CHEMISTRY				
Cat.	Course Code	Title	L T P	Credit
SCI	23CHY240	Computational Chemistry and Molecular Modelling	3 0 0	3
SCI	23CHY241	Electrochemical Energy Systems and Processes	3 0 0	3
SCI	23CHY242	Fuels and Combustion	3 0 0	3
SCI	23CHY243	Green Chemistry and Technology	3 0 0	3
SCI	23CHY244	Instrumental Methods of Analysis	3 0 0	3
SCI	23CHY245	Batteries and Fuel Cells	3 0 0	3
SCI	23CHY246	Corrosion Science	3 0 0	3
PHYSICS				
SCI	23PHY240	Advanced Classical Dynamics	3 0 0	3
SCI	23PHY241	Electrical Engineering Materials	3 0 0	3
SCI	23PHY242	Physics of Lasers and Applications	3 0 0	3
SCI	23PHY243	Concepts of Nanophysics and Nanotechnology	3 0 0	3
SCI	23PHY244	Physics of Semiconductor Devices	3 0 0	3
SCI	23PHY245	Astrophysics	3 0 0	3
Mathematics				
SCI	23MAT240	Statistical Inference	3 0 0	3
SCI	23MAT241	Introduction to Game Theory	3 0 0	3
SCI	23MAT242	Numerical Methods and Optimization	3 0 0	3

FREE ELECTIVES OFFERED UNDER MANAGEMENT STREAM				
Cat.	**Course Code**	**Title**	**L T P**	**Credit**
HUM	23MNG331	Financial Management	3 0 0	3
HUM	23MNG332	Supply Chain Management	3 0 0	3
HUM	23MNG333	Marketing Management	3 0 0	3
HUM	23MNG334	Project Management	3 0 0	3
HUM	23MNG335	Enterprise Management	3 0 0	3
HUM	23MNG336	Operations Research	3 0 0	3
HUM	23MEE321	Industrial Engineering	3 0 0	3
HUM	23MEE322	Managerial Statistics	3 0 0	3
HUM	23MEE323	Total Quality Management	3 0 0	3
HUM	23MEE324	Lean Manufacturing	3 0 0	3
HUM	23CSE321	Software Project Management	3 0 0	3
HUM	23CSE322	Financial Engineering	3 0 0	3
HUM	23CSE323	Engineering Economic Analysis	3 0 0	3
HUM	23CSE324	Information Systems	3 0 0	3

FREE ELECTIVES

FREE ELECTIVES OFFERED UNDER HUMANITIES / SOCIAL SCIENCE STREAMS				
Cat.	**Course Code**	**Title**	**L T P**	**Credit**
HUM	23CUL230	Achieving Excellence in Life - An Indian Perspective	2 0 0	2
HUM	23CUL231	Excellence in Daily Life	2 0 0	2
HUM	23CUL232	Exploring Science and Technology in Ancient India	2 0 0	2
HUM	23CUL233	Yoga Psychology	2 0 0	2
HUM	23ENG230	Business Communication	1 0 3	2
HUM	23ENG231	Indian Thought through English	2 0 0	2
HUM	23ENG232	Insights into Life through English Literature	2 0 0	2
HUM	23ENG233	Technical Communication	2 0 0	2
HUM	23ENG234	Indian Short Stories in English	2 0 0	2
HUM	23FRE230	Proficiency in French Language (Lower)	2 0 0	2
HUM	23FRE231	Proficiency in French Language (Higher)	2 0 0	2
HUM	23GER230	German for Beginners I	2 0 0	2
HUM	23GER231	German for Beginners II	2 0 0	2
HUM	23GER232	Proficiency in German Language (Lower)	2 0 0	2
HUM	23GER233	Proficiency in German Language (Higher)	2 0 0	2
HUM	23HIN230	Hindi I	2 0 0	2
HUM	23HIN231	Hindi II	2 0 0	2
HUM	23HUM230	Emotional Intelligence	2 0 0	2
HUM	23HUM231	Glimpses into the Indian Mind - the Growth of Modern India	2 0 0	2
HUM	23HUM232	Glimpses of Eternal India	2 0 0	2
HUM	23HUM233	Glimpses of Indian Economy and Polity	2 0 0	2
HUM	23HUM234	Health and Lifestyle	2 0 0	2
HUM	23HUM235	Indian Classics for the Twenty-first Century	2 0 0	2
HUM	23HUM236	Introduction to India Studies	2 0 0	2
HUM	23HUM237	Introduction to Sanskrit Language and Literature	2 0 0	2
HUM	23HUM238	National Service Scheme	2 0 0	2
HUM	23HUM239	Psychology for Effective Living	2 0 0	2
HUM	23HUM240	Psychology for Engineers	2 0 0	2
HUM	23HUM241	Science and Society - An Indian Perspective	2 0 0	2
HUM	23HUM242	The Message of Bhagwat Gita	2 0 0	2

HUM	23HUM243	The Message of the Upanishads	2 0 0	2
HUM	23HUM244	Understanding Science of Food and Nutrition	2 0 0	2
HUM	23HUM245	Service Learning	2 0 0	2
HUM	23JAP230	Proficiency in Japanese Language (Lower)	2 0 0	2
HUM	23JAP231	Proficiency in Japanese Language (Higher)	2 0 0	2
HUM	23KAN230	Kannada I	2 0 0	2
HUM	23KAN231	Kannada II	2 0 0	2
HUM	23MAL230	Malayalam I	2 0 0	2
HUM	23MAL231	Malayalam II	2 0 0	2
HUM	23SAN230	Sanskrit I	2 0 0	2
HUM	23SAN231	Sanskrit II	2 0 0	2
HUM	23SWK230	Corporate Social Responsibility	2 0 0	2
HUM	23SWK231	Workplace Mental Health	2 0 0	2
HUM	23TAM230	Tamil I	2 0 0	2
HUM	23TAM231	TAMIL II	2 0 0	2

B. Tech. in Computer Science and Engineering (Quantum Computing)

SYLLABUS July 2026 onwards

SEMESTER 1

23ENG101	TECHNICAL COMMUNICATION	L-T-P-C: 2-0-3-3

Course Objectives

- Learn the fundamentals of mechanics of writing.
- Acquire the ability to draft formal correspondence and various technical documents.
- Develop abilities in critical thinking and analysis.
- Acquire skills of scanning for specific information, comprehension, and organization of ideas.
- Enhance competency in technical presentation skills.

Course Outcomes

CO1: Apply the mechanics of writing in formal correspondence

CO2: Write technical documents with appropriate form and content

CO3: Organize technical information or ideas in a logical and coherent manner

CO4: Compose grammatically and stylistically accurate project reports/ term papers

CO5: Make effective technical presentations

CO-PO Mapping

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

Syllabus

Unit 1 - Error Analysis

Mechanics of Writing: Grammar rules -articles, tenses, auxiliary verbs (primary & modal) prepositions, subject-verb agreement, pronoun-antecedent agreement, discourse markers and sentence linkers, impersonal passive, modifiers, phrasal verbs

General Reading and Listening comprehension - rearrangement & organization of sentences

Unit 2

Different kinds of written documents: Definitions- Descriptions- Instructions-Recommendations- User manuals - Reports –Proposals

Formal Correspondence: Writing Formal Letters/Emails

Punctuation

Scientific Reading & Listening Comprehension

Unit 3

Technical paper writing: Documentation style - Document editing – Proof reading - Organizing and Formatting

Tone and style
Graphical representation
Reading and listening comprehension of technical documents
Mini Technical project / Term paper (10 -12 pages)
Technical presentations

Reference(s)

Hirsh, Herbert. L, "Essential Communication Strategies for Scientists, Engineers and Technology Professionals". II Edition. New York: IEEE press, 2002.
Anderson, Paul. V. "Technical Communication: A Reader-Centred Approach". V Edition. Harcourt Brace College Publication, 2003.
Strunk, William Jr. and White. EB. "The Elements of Style" New York. Alliyan & Bacon, 1999.
Riordan, G. Daniel and Pauley E. Steven. "Technical Report Writing Today", VIII Edition (Indian Adaptation).New Delhi: Biztantra, 2004.
Michael Swan. "Practical English Usage", Oxford University Press, 2000.

Evaluation Pattern: 70:30

Assessment	Internal	External
Mid Term	20	
*Continuous Assessment (Theory)	20	
**Continuous Assessment (Lab)	30	
End Semester		30 (50 marks; 2 hours exam)

*CA Theory – Quizzes, Assignments etc.

**CA Lab - User Manual, Abstract, Project Report, Presentation

26MAT106	CALCULUS	L-T-P-C: 3-0-0-3

Course Objectives

- Understand the various functions and their graphs. The basic concept of continuous function and find the extreme values of the continuous functions. Also, to understand parameterisation of curves and to find arc length and familiarise with calculus of multiple variables.

Course Outcomes

CO1: Articulate and apply the concepts of shifting, scaling of functions, limits, continuity, and differentiability.
CO2: Compute the definite integrals of standard functions and apply them in finding volume and area.
CO3: Articulate and apply the concepts of limits, continuity, and partial derivatives of multivariable functions.
CO4: Apply the concepts of scalar and vector fields, as well as the gradient, divergence, and curl of vector fields, along with their physical interpretations.
CO5: Apply the concepts of line integral, surface integral and volume integrals.

CO-PO Mapping

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

Syllabus

Unit 1 - Graphs

Functions and their Graphs. Shifting and Scaling of Graphs. Limit and Continuity: Limit (One Sided and Two Sided) of Functions. Continuous Functions, Discontinuities, Monotonic Functions, Infinite Limits and Limit at Infinity. Graphing: Extreme Values of Functions, Concavity and Curve Sketching, Integration: Definite Integrals, The Mean Value Theorem for definite integrals, Fundamental Theorem of Calculus, Integration Techniques.

Unit 2 - Functions of Severable Variables

Functions, limit and continuity. Partial differentiations, total derivatives, differentiation of implicit functions and transformation of coordinates by Jacobian. Taylor's series for two variables. Vector Differentiation: Vector and Scalar Functions, Derivatives, Curves, Tangents, Arc Length, Curves in Mechanics, Velocity and Acceleration, Gradient of a Scalar Field, Directional Derivative, Divergence of a Vector Field, Curl of a Vector Field.

Unit 3 - Vector Integration

Line Integral, Line Integrals Independent of Path. Green's Theorem in the Plane, Surfaces for Surface Integrals, Surface Integrals, Triple Integrals – Gauss Divergence Theorem, Stoke's Theorem.

Textbook(s)

G.B. Thomas, "Calculus", Pearson Education, 2009, Eleventh Edition.

Reference(s)

Monty J. Strauss, Gerald J. Bradley and Karl J. Smith, "Calculus", 3rd Edition, 2002.

E Kreyszig, “Advanced Engineering Mathematics”, John Wiley and Sons, Tenth Edition, 2018.
Dennis G. Zill and Michael R.Cullen, “Advanced Engineering Mathematics”, second edition CBS Publishers, 2012.

Evaluation Pattern: 60:40

Assessment	Internal	External
Mid term	20	
*Continuous Assesment	40	
End Semester		40

*CA -Can be Quizzes, Assignments

26PHY102	MECHANICS	L-T-P-C: 3-0-0-3

Course Objectives

- This course builds a firm conceptual foundation for understanding the physical universe and serves as a building block for modern scientific thinking and problem solving. It uses mechanics as a framework to develop general problem-solving and visualization skills through the study of kinematics and dynamics, energy, momentum and angular momentum methods, central-force motion, oscillations, and elements of special theory of relativity. These concepts provide a foundation for advanced areas of physics such as electrodynamics and quantum mechanics and form an essential basis for mathematical modelling across the physical sciences and engineering.

Course Outcomes

CO1: Apply Newton's laws and conservation principles to analyse motion of particles in inertial and non-inertial frames.
CO2: Solve problems involving kinematics and dynamics in different coordinate systems.
CO3: Analyse systems using energy, momentum, and angular momentum conservation laws.
CO4: Demonstrate an introductory understanding of relativistic concepts and recognize the limits of classical mechanics.

CO-PO Mapping

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

Syllabus

Unit 1 - Kinematics and Dynamics of Particles

Motion in one, two, and three dimensions; position vector, velocity, and acceleration; Newton's laws of motion; equations of motion and analytical solutions for motion under constant force and variable forces; motion under gravity; simple harmonic motion and damped oscillations; basic ideas of driven oscillations and resonance; motion in polar coordinates and circular motion.

Unit 2 - Work, Energy, and Momentum

Work done by a force; work–energy theorem; conservative and non-conservative forces; potential energy and force. Centre of mass and its motion; momentum and its conservation; impulse forces; collisions: elastic and inelastic collisions in one dimension.

Unit 3 - Angular Momentum, Central Force Motion, and Rotational Dynamics

Angular momentum, torque, and conservation of angular momentum; central forces and motion under central forces; Kepler's laws of planetary motion; rotational motion of a rigid body, moment of inertia, and work–energy theorem in rotational motion.

Unit 4 - Foundational Aspects of Classical Mechanics

Inertial and non-inertial reference frames; fictitious forces, including centrifugal and Coriolis forces (qualitative), laboratory as an approximation to an inertial frame; homogeneity of space and time, and isotropy of space; Galilean transformations and invariance of Newton's laws.

Unit 5 - Introduction to Special Theory of Relativity

Limitations of classical mechanics; postulates of special relativity; relativity of simultaneity; time dilation and length contraction; Lorentz transformations and relativistic velocity addition formula; invariant time interval, or proper time (measured by a clock comoving with a particle); conceptual introduction to relativistic momentum, energy, and energy–momentum relation; mass–energy equivalence, Newtonian limit and photon

Reference(s)

Charles Kittel, et al., Mechanics, Berkeley Physics Course, Vol. 1, 2nd ed.

R. P. Feynman, Feynman Lectures on Physics, Vol. I

Resnick and Halliday, Fundamentals of Physics, 10 th ed.

Evaluation Pattern: 60:40

Assessment	Internal	External
Midterm Exam	20	
Continuous Assessment (*CA)	40	
**End Semester		40

*CA – Can be Quizzes, Assignments.

**End Semester examination is theory based (100 Marks, 3 hours exam).

26CSQ101	COMPUTER PROGRAMMING	L-T-P-C: 3-0-0-3

Course Objectives

- This course aims to provide the procedural/imperative programming principles to the students through C programming language.

Course Outcomes

CO1: Develop C programs using basic constructs such as data types, operators, control structures, and input/output operations.

CO2: Implement arrays, strings, structures, and unions for effective data organization and manipulation.

CO3: Develop modular and reusable programs using functions, recursion, and parameter passing techniques.

CO4: Apply pointers and dynamic memory allocation techniques for runtime memory management.

CO5: Identify and resolve syntax, logical, and runtime errors.

CO-PO Mapping

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

Syllabus

Unit 1 - Introduction to C programming

Introduction to C programming, structure of a C program, data types, variables, constants, type casting, operators, expressions, control structures (if, if-else, switch, nested), loops (for, while, do-while), and input/output operations including console and file I/O.

Unit 2 - Data types in C

One-dimensional and two-dimensional arrays, string and string handling functions, structures, unions, and typedef.

Unit 3 - Functions in C

User-defined functions, function declaration and definition, parameter passing (call by value and call by reference), scope and lifetime of variables, recursion, and modular program design.

Unit 4 - Pointers in C

Pointers and pointer arithmetic, pointers and arrays, pointers and functions, dynamic memory allocation using malloc, calloc, realloc, and free.

Unit 5 - - Advanced topics

Complexity analysis, debugging and testing

Textbook(s)

C How to Program — Paul Deitel & Harvey Deitel, Pearson, Eighth Edition, 2016

Reference(s)

Head First C — David Griffiths & Dawn Griffiths, O'Reilly, 2012
The C Programming Language — Brian W. Kernighan & Dennis M. Ritchie (2E)
Let Us C — Yashavant Kanetkar (17 E)

Evaluation Pattern: 60:40

Assessment	Internal	External
Midterm Exam	20	
*Continuous Assessment	40	
End Semester		40

* Continuous assessment can be quizzes, class tests, assignments, programming contests.

26CSQ181	COMPUTER PROGRAMMING LAB	L-T-P-C: 0-0-2-1

Course Objectives

- This course aims to provide the procedural/imperative programming principles to the students through C programming language.

Course Outcomes

CO1: Write and execute C programs using data types, bitwise operators, enumerated types, control structures, loops, and input/output functions to solve basic computational problems.
CO2: Develop C programs applying arrays, strings, structures, unions, functions, recursion, and pointers with dynamic memory allocation for modular problem solving.
CO3: Build and test C programs involving file handling, command line arguments, and debugging techniques to produce error-free solutions.

CO-PO Mapping

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

Textbook(s)

C How to Program — Paul Deitel & Harvey Deitel (8E)

Reference(s)

Head First C — David Griffiths & Dawn Griffiths, O'Reilly
Computer Science A structured programming approach using C — Behrouz A. Forouzan and Richard F. Filberg, Cengage Learning.
Let Us C — Yashavant Kanetkar (17 E)

Lab Experiments

1. Programs using bitwise operators and enumerated data types.
2. Programs using control structures (if, if else, switch, & loops).
3. Programs using numeric one dimensional array.
4. Programs using numeric multidimensional array.
5. Programs using strings & string handling functions.
6. Functions using static, external and auto variables.
7. Programs using recursive functions.
8. Programs using call by reference and pointer arithmetic.
9. Pointer to array & array of pointers using dynamic memory allocation.
10. Structures – arrays, structure within structure.
11. Array of structures, unions.
12. Programs using text files
13. Programs using binary files.
14. Programs using random access of files
15. Programs using command line arguments

16. Debugging C programming, Code tracing, Edge cases

Evaluation Pattern: 80:20

Assessment	Internal	External
*Continuous Assessment	80	
**Final Exam		20

* Continuous assessment can be lab assignments, programming contests, viva

** Final exam can be project, lab exam, or programming contest

26CSQ102	DISCRETE MATHEMATICAL STRUCTURES	L-T-P-C: 3-0-0-3

Course Objectives

- Develop logical reasoning and proof techniques for mathematical and computational problem solving.
- Understand sets, relations, functions, and algebraic structures used in computer science.
- Apply counting principles, recurrence relations, and discrete models in algorithm design.
- Analyze graphs, trees, and networks arising in real-world and computational applications.

Course Outcomes

CO1: Apply propositional and predicate logic, rules of inference, and proof techniques to solve reasoning problems

CO2: Apply the concepts of sets, relations, functions, partial orders, and algebraic structures to solve computational problems.

CO3: Solve combinatorial problems using counting techniques, pigeonhole principle, recurrence relations, and generating functions.

CO4: Model and solve network problems using graphs, trees, traversals, shortest paths, Euler/Hamilton concepts, and spanning trees

CO-PO Mapping

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

Syllabus

Unit 1 - Logic and Mathematical Reasoning

Propositions and logical connectives: negation, conjunction, disjunction, Implication and equivalence, Truth tables and logical equivalences, Predicate logic, predicates and quantifiers, Rules of inference and natural deduction, Methods of proof: direct proof, contradiction, contraposition, Mathematical induction and recursive definitions

Unit 2 - Sets, Relations and Functions

Set theory and operations on sets, Paradoxes in set theory, Inductive definition of sets, Peano postulates, Relations and their properties, Representation of relations using matrices and graphs, Equivalence relations and partitions, Partial orderings, posets, linear and well-ordered sets, Functions: injective, surjective, bijective mappings, Composition and inverse functions, Recursive functions.

Unit 3 - Counting Techniques and Algebraic Structures

Basic counting principles, Pigeonhole principle, Permutations and combinations, Inclusion–Exclusion principle, Recurrence relations and solutions, Divide and conquer recurrences, Generating functions, Semigroups, monoids, groups, Rings, fields, vector spaces, lattices.

Unit 4 - Graph Theory

Graphs and subgraphs, Isomorphism of graphs, Graph matrices, Degree, walks, paths, cycles,
connected graphs, shortest path algorithms, Euler graphs and Euler's theorem, Fleury's algorithm, Hamiltonian paths and cycles, Chinese postman problem, Approximate Traveling Salesman Problem, Closest neighbour algorithm, Trees,spanning trees, traversals.

Reference(s)

Kenneth H. Rosen – Discrete Mathematics and Its Applications
J. P. Tremblay and R. Manohar – Discrete Mathematical Structures with Applications to Computer Science
C. L. Liu – Elements of Discrete Mathematics

Evaluation Pattern: 60:40

Assessment	**Internal**	**External**
Midterm Exam	20	
*Continuous Assessment	40	
End Semester		40

* Continuous assessment can be quizzes and assignments.

23CSE102	COMPUTER HARDWARE ESSENTIALS	L-T-P-C: 1-0-2-2

Course Objectives

- This course is designed to introduce the students to the basics of computing devices, operating systems,installation, configuration, and troubleshooting.
- Elementary concepts of physical computing and Internet of Things are also covered.

Course Outcomes

CO1: Demonstrate a comprehensive understanding of computer hardware architecture, including component identification, function, and assembly.

CO2: Troubleshoot common hardware and software issues in a computer system.

CO3: Install OS - Linux and Supporting, upgrading, troubleshooting and solving OS related issues.

CO4: Develop a basic understanding of embedded systems concepts through hands-on experience with a Raspberry Pi and apply fundamental programming concepts to control physical devices through GPIO interfaces

CO-PO Mapping

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

Syllabus

Unit 1

An overview of the hardware components used to build general purpose and single board computers, mobile phones and laptops, chipsets, interface standards, specifications, and configurations. Installation of operating systems and dual booting.

Unit 2

Introduction to physical computing, Sensors, actuators, digital and analog I/O ports, communicating over a wired/wireless network.

Unit 3

Introduction to Raspberry Pi, GPIO programming, interfacing sensors and actuators. Introduction to IoT, communicating sensor data to cloud platforms.

Textbook(s)

Banzi, Massimo, and Michael Shiloh. "Getting started with Arduino". Maker Media, Inc., 4th edition 2022.New Textbook

Pan, T., Zhu, Y., "Getting Started with Arduino. In: Designing Embedded Systems with Arduino". Springer, Singapore, 2018New Textbook

Molloy, Derek. "Exploring Raspberry Pi: interfacing to the real world with embedded Linux". John Wiley & Sons, 2016.New Textbook

Reference(s)

Singh, Rajesh, et al. "Internet of things with Raspberry Pi and Arduino". CRC Press, 2019.New Reference

Evaluation Pattern: 70:30

Assessment	Internal	External
Midterm	20	
*Continuous Assessments (CA)	50	
**End Semester		30

*CA – Can be Quizzes/Assignment/Lab Practice

**End Semester - lab-based examination

22ADM101	FOUNDATIONS OF INDIAN HERITAGE	L-T-P-C: 2-0-1-2

Course Objectives

- To introduce students to the depths and richness of the Indian culture and knowledge traditions, and to enable them to obtain a synoptic view of the grandiose achievements of India in diverse fields. To equip students with a knowledge of their country and its eternal values.

Course Outcomes

CO1: Increase student understanding of true essence of India's cultural and spiritual heritage. Emancipating Indian histories and practices from manipulation, misunderstandings, and other ideological baggage thus, shows its contemporary relevance.
CO2: Understand the ethical and political strategic concepts to induce critical approach to various theories about India.
CO3: Familiarize students with the multidimension of man's interaction with nature, fellow beings and society in general.
CO4: Appreciate the socio-political and strategic innovations based on Indian knowledge systems. Gives an understanding of bringing Indian teaching into practical life.

CO-PO Mapping

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

Syllabus

Unit 1

Educational Heritage of Ancient India, Life and Happiness, Impact of Colonialism and Decolonization, A timeline of Early Indian Subcontinent, Pinnacle of Selflessness and ultimate freedom, Indian approach towards life, Circle of Life, Ocean of love; Indian Mahatmas, Man's association with Nature, Celebrating life 24/7, Metaphors and Tropes, Become A Strategic Thinker (Games / Indic activity), India: In the Views of Other Scholars and Travellers, Personality Development Through Yoga, Hallmark of Indian Traditions: Advaita Vedanta, Theory of oneness, Conversations on Compassion with Amma.

Textbook(s)

"Foundations of Indian Heritage", In house publication (In print).

Reference(s)

The beautiful tree by Dharampal.
Peasants and Monks in British India by William Pinch.
India, that is Bharat: Coloniality, Civilisation, Constitution by J Sai Deepak.
Awaken Children Dialogues with Mata Amritanandamayi.
Man and Nature by Mata Amritanandamayi Devi.
What Becomes of the Soul After Death, Divine Life Society.

Evaluation Pattern: 60:40

Assessment	Internal	External

Mid Term	20	
*Continuous Assessment (CA)	40	
End Semester		40

*CA includes Quizzes and Tutorials

22AVP103	MASTERY OVER MIND	L-T-P-C: 1-0-2-2

Course Objectives

- Mastery Over Mind (MaOM) is an Amrita initiative to implement schemes and organize university-wide programs to enhance health and wellbeing of all faculty, staff, and students (UN SDG -3).
- It gives an introduction to immediate and long-term benefits of MA OM meditation and equips every attendee to manage stressful emotions and anxiety, in turn facilitating inner peace and harmony.
- This course will enhance the understanding of experiential learning based on the University's mission: "Education for Life along with Education for Living" and is aimed to allow learners to realize and rediscover the infinite potential of one's true Being and the fulfilment of life's goals.

Course Outcomes

CO1: To be able to describe what meditation is and to understand its health benefits.
CO2: To understand the causes of stress and how meditation improves well-being.
CO3: To understand the science of meditation.
CO4: To learn and practice MA OM meditation in daily life.
CO5: To understand the application of meditation to improve communication and relationships.
CO6: To be able to understand the power of meditation in compassion-driven action.

CO-PO Mapping

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

Syllabus

Unit 1 - Describe Meditation and Understand its Benefits (CO1)

A: Importance of meditation. How does meditation help to overcome obstacles in life (Pre- recorded video with Swami Shubhamritananda Puri)
Reading 1: Why Meditate? (Swami Shubamritananda ji)
Reading 2: 'Stillness of the Mind' Chapter 17 in Amritam Gamaya (2022). Mata Amritanandamayi Mission Trust.
Additional Reading: Abhyasa Yoga: The Yoga of Practice. (Br. Achyutamrita Chaitanya)
B: Understand how meditation works. Understand how meditation helps in improving physical and mental health. Understand how meditation helps in the development of personality (Pre-recorded video with Dr. Ram Manohar)
Reading 1: Allen, Cynthia (2020) The Potential Health Benefits of Meditation
Additional Reading: Sharma, Hari (2022) Meditation: Process and EffectsNew Content

Unit 2 - Causes of Stress and How Meditation Improves Well-being (CO2)

A: Learn how to prepare for meditation. Understand the aids that can help in effectively practicing meditation. Understand the role of sleep, physical activity, and a balanced diet in supporting meditation. (Pre-recorded video with Dr. Ram Manohar)
B: Causes of Stress. The problem of not being relaxed. Effects of stress on health. How meditation helps to relieve stress. Basics of stress management at home and the workplace. (Pre-recorded video with Prof Udhaykumar)

Reading 1: Mayo Clinic Staff (2022, April 29). Meditation: A Simple, Fast Way to Reduce Stress. Mayo Clinic. https://www.mayoclinic.org/tests-procedures/meditation/in- depth/meditation/art-20045858 (PDF provided)
Reading 2: 'Efficient Action.' Chapter 28 in Amritam Gamaya (2022). Mata Amritanandamayi Mission Trust.

Unit 3 - The Science of Meditation (CO3)

A: A preliminary understanding of the Science of meditation. What can modern science tell us about this tradition-based method? (Pre-recorded video with Dr. Shyam Diwakar)
B: How meditation helps humanity according to what we know from scientific research
(Pre-recorded video with Dr. Shyam Diwakar)
Reading 1: Does Meditation Aid Brain and Mental Health (Dr Shyam Diwakar)
Reading 2: 'Sci.ence and Spirituality.' Chapter 85 in Amritam Gamaya (2022). Mata Amritanandamayi Mission Trust.New Content

Unit 4 - Practicing MA OM Meditation in Daily Life (CO4)

Guided Meditation Sessions following scripts provided (Level One to Level Five)
Reading 1: MA OM and White Flower Meditation: A Brief Note (Swami Atmananda Puri)
Reading 2: 'Live in the Present Moment.' Chapter 71 in Amritam Gamaya (2022). Mata Amritanandamayi Mission Trust.

Unit 5 - Improving Communication and Relationships (CO5)

How meditation and mindfulness influence interpersonal communication. The role of meditation in improving relationship quality in the family, at the university and in the workplace. (Pre-recorded video with Dr Shobhana Madhavan)
Reading 1: Seppala E (2022, June 30th) 5 Unexpected Ways Meditation Improves Relationships a Lot. Psychology Today. https://www.psychologytoday.com/intl/blog/feeling-it/202206/5-unexpected-ways- meditation-improves-relationships-lot
Reading 2: 'Attitude.' Chapter 53 in Amritam Gamaya (2022). Mata Amritanandamayi Mission Trust.

Unit 6 - Meditation and Compassion-driven Action (CO6)

Understand how meditation can help to motivate compassion-driven action. (Pre- recorded video with Dr Shobhana Madhavan)
Reading 1: Schindler, S., & Friese, M. (2022). The relation of mindfulness and prosocial behavior: What do we (not) know?. Current Opinion in Psychology, 44, 151-156.New Content
Reading 2: 'Sympathy and Compassion.' Chapter 100 in Amritam Gamaya (2022). Mata Amritanandamyi Mission Trust.

Textbook(s)

Meditation and Spiritual Life-Swami Yatiswarananda, Ramakrishna Math
The Complete Works of Swami Vivekananda Vol Vii by Advaita Ashram Mayavati Almora Himalayas
Dhyana Yoga-Holy Gita Swami Chinmayanda
Voice of God, Chandrasekharendra Saraswati, 68th Acharya of Sri Kanchi Kamakoti Peetam,
Hindu Dharma-Chandrasekharendra Saraswati, 68th Acharya of Sri Kanchi Kamakoti Peetam.
Mind: It's Mysteries and control-Swami Sivananda Saraswati.
Amritam Gamaya (2022). Mata Amritanandamayi Mission Trust.
Books on Amma's teachings like Awaken children, From Amma's Heart etc.
The Science of Meditation: How to Change Your Brain, Mind and Body by Daniel Goleman and Richard. J. Davidson.
Allen, Cynthia (2020) The Potential Health Benefits of Meditation
Seppala E (2022, June 30th Unexpected Ways Meditation Improves Relationships a Lot.Psychology Today
Sharma, Hari (2022) Meditation: Process and Effects
Mayo Clinic Staff (2022, April 29). Meditation: A Simple, Fast Way to Reduce Stress.
Schindler, S., & Friese, M. (2022). The relation of mindfulness and prosocial behavior: What do we (not) know? Current Opinion in Psychology, 44, 151-156

Evaluation Pattern: 80:20

Assessment	Internal	External
Reflective Journal	20	
Group Activities	20	
Class Participation	40	
End Semester		20

SEMESTER 2

26EEE111	INTRODUCTION TO ELECTRICAL AND ELECTRONICS ENGINEERING	L-T-P-C: 2-0-2-3

Course Objectives

- To impart basic knowledge of electrical quantities and provide working knowledge for the analysis of DC and AC circuits.
- Understand the characteristics and applications of diode and Transistors
- To facilitate understanding of Thyristors and operational amplifier circuits.

Course Outcomes

CO1: Ability to understand the basic electric and magnetic circuits.
CO2: Ability to analyze DC and AC circuits.
CO3: Ability to understand the basic principles of pn junctions and transistors
CO4: Ability to analyze basic transistor and op amp-based circuits.

CO-PO Mapping

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

Syllabus

Unit 1

Introduction to Electrical Engineering, current and voltage sources, Resistance, Inductance and Capacitance; Ohm's law, Kirchhoff's law, Energy and Power – Series parallel combination of R, L, C components,Voltage Divider and Current Divider Rules – Super position Theorem, Network Analysis – Mesh and Node methods- Faraday's Laws of Electro-magnetic Induction, Magnetic Circuits, Self and Mutual Inductance, Generation of sinusoidal voltage, Instantaneous, Average andeffective values of periodic functions, Phasor representation. Introduction to 3-phase systems, Introduction to electric grids

Unit 2

PN Junction diodes, Diode Characteristics, Diode approximation- Clippers and Clampers, Rectifiers: Half wave, Full wave,Bridge- Zener Diode- Design of regulator and characteristics, Optoelectronic devices, Introduction to BJT, Characteristics and configurations, Transistor as a Switch

Unit 3

Field Effect Transistors – Characteristics, Thyristors – operation and characteristics, Diac, Triac –Thyristor based power control, IC 555 based Timer-multi-vibrators, Operational Amplifiers – Inverting and Non-inverting amplifier, Oscillators,Instrumentation amplifiers

Textbook(s)

Edward Hughes. "Electrical and Electronic Technology", 10th Edition, Pearson Education Asia, 2019
Lab Manual

Reference(s)

Lab Manual

S. K. Bhattcharya, "Basic Electrical and Electronics Engineering", Pearson, 2012

Vincent Del Toro, "Electrical Engineering Fundamentals", Prentice Hall of India Private Limited, 2nd Edition, 2003

David A. Bell, "Electronic Devices and Circuits", 5th Edition, Oxford University Press, 2008

(Michael Tooley B. A., "Electronic circuits: Fundamentals and Applications", 3rd Edition, Elsevier Limited, 2006.

A. P. Malvino, "Electronic Principles", 7th Edition, Tata McGraw Hill, 2007.

Lab Experiments

1. Electrical Wiring practices.
2. Study of Electrical protection systems.
3. Verification of circuit theorem.
4. VI characteristics of PN junction and Zener diode.
5. Implementation of Half wave and Full wave rectifier using PN junction diode.
6. Transistor as a switch.
7. Characteristics of BJT.
8. Experiment on Thyristor.
9. Implementation of inverting and non-inverting amplifier using Op-amp.
10. Experiments on Oscillators and Multivibrators

Evaluation Pattern: 70:30

Assessment	Internal	External
Mid Term	20	
*Continuous Assessment - Theory (CAT)	20	
**Continuous Assessment - Lab (CAL)	30	
End Semester		30 (50 marks; 2 hours exam)

*CAT – Can be Quizzes, Assignment, and Tutorials

**CAL - Can be Lab assignments, Lab evaluation and Viva

26MAT113	LINEAR ALGEBRA	L-T-P-C: 3-0-2-4

Course Objectives

- Understand the basic concepts of vector space, subspace, basis and dimension. Also to understand the orthogonality concepts and apply to various problems computer science.

Course Outcomes

CO1: To understand the basic concepts of vector space, subspace, basis and dimension
CO2: To understand the basic concepts of inner product space, norm, angle, Orthogonality and projection and implementing the Gram-Schmidt process, to compute least square solution
CO3: To understand and compute the linear transformations.
CO4: To compute the eigen values and eigen vectors and apply to transformation problems.
CO5: To perform case studies on least square and image transformations

CO-PO Mapping

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

Syllabus

Unit 1 - Vector Spaces

Vector spaces - Sub spaces - Linear independence - Basis – Dimension; Inner Product Spaces: Inner products - Orthogonality - Orthogonal basis - Gram Schmidt Process - Change of basis - Orthogonal complements - Projection on subspace - Least Square Principle. QR- Decomposition

Unit 2 - Linear Transformations

Linear transformation - Relation between matrices and linear transformations - Kernel and range of a linear transformation - Change of basis - Nilpotent transformations. Symmetric and Skew Symmetric Matrices, Adjoint and Hermitian Adjoint of a Matrix, Hermitian, Unitary and Normal Transformations, Self-Adjoint and Normal Transformations

Unit 3 - Eigen values and Eigen vectors

Eigen Values and Eigen Vectors, Diagonalization, Orthogonal Diagonalization, Quadratic Forms, Diagonalizing Quadratic Forms, Conic Sections. Similarity of linear transformations - Diagonalization and its applications - Jordan form and rational canonical form. Case Studies: Applications on least square and image transformations.

Textbook(s)

Howard Anton and Chris Rorres, "Elementary Linear Algebra", Tenth Edition, John Wiley & Sons, 2010

Reference(s)

Nabil Nassif, Jocelyne Erhel, Bernard Philippe, "Introduction to Computational Linear Algebra", CRC press, 2015.
Sheldon Axler, "Linear Algebra Done Right", Springer, 2014.
Gilbert Strang, "Linear Algebra for Learning Data", Cambridge press, 2019

Kenneth Hoffmann and Ray Kunze, “Linear Algebra”, Second Edition, Prentice Hall, 1971.
Mike Cohen, “Practical Linear Algebra for Data Science”, Oreilly Publisher, 2022

Lab Experiments

1. Matrix operations, Generation of random matrices with given rank
2. Solution to linear system of equations, Left Inverse, Right Inverse, Pseudo Inverse
3. Revision of curve and surface plots using parametric representations
4. Span of a set (scatter plots for span of different sets)
5. Finding basis for row space, column space, null space and left null space
6. Finding orthogonal compliment of a given vector space
7. QR decomposition
8. Projections onto subspaces, Least Square Approximation, Linear Regression
9. Eigenvalues, Eigenvectors, characteristic polynomial.
10. Similar matrices, diagonalization, Cayley Hamilton Theorem.
11. Scaling, Shifting, Rotation of images using Linear Transformations

Evaluation Pattern: 70:30

Assessment	Internal	External
Midterm	20	
*Continuous Assessments Theory (CAT)	20	
*Continuous Assessments Lab (CAL)	30	
**End Semester		30 (50 marks; 2 hours exam)

*CAT – Can be Quizzes, Assignment,

*CAL – Can be Lab Practice, Projects, and Reports

**End Semester can be theory examination/ lab-based examination

26PHY111	INTRODUCTION TO ELECTRODYNAMICS	L-T-P-C: 3-0-0-3

Course Objectives

- To develop visualization, mathematical formulation, and problem-solving skills for analysing key concepts in electromagnetism.
- To prepare students for the next course in quantum physics by building familiarity with potentials, waves, oscillations,energy methods, and field-based descriptions.
- To expose students to electrodynamics concepts that support later understanding of quantum technologies.

Course Outcomes

CO1: Explain and apply the fundamental principles of electrostatics to determine electric fields and potentials for simple charge distributions.
CO2: Explain and apply the concepts of electrostatic energy, conductors, capacitance, and dielectric behaviour in simple electrostatic configurations.
CO3: Apply the principles of magnetostatics to determine magnetic fields for simple current distributions, and explain magnetic vector potential, magnetic dipoles, magnetization, and magnetic fields in matter at an introductory level.
CO4: Explain and apply the principles of electromagnetic induction and Maxwell's equations in vacuum to analyse induced emf, self-inductance, energy in magnetic fields, electromagnetic waves, energy and momentum transport, and polarization

CO-PO Mapping

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

Syllabus

Unit 1 - Electrostatics – Fields and Potentials

Coulomb's law and superposition principle, electric field and field lines, electric flux, Gauss's law in integral form and simple applications. Basic ideas of Gauss's law in differential form; divergence and curl of electric fields; electric potential and its relation to electric field;
Laplace's and Poisson's. Potentials of simple continuous and discrete charge distributions;
electric dipole potential and field;
Qualitative introduction to multipole expansion up to the dipole term

Unit 2 - Calculation of potentials

Laplace's and Poisson's equations, boundary-value problems in electrostatics, multipole expansion, method of images. [6+2]

Unit 3 - Magnetostatics

Lorentz force, crossed electric and magnetic fields, force on a current-carrying conductor; Biot-Savart law and Ampere's law with applications to simple current distributions, divergence and curl of magnetic field, magnetic vector potential. [6+2]

Unit 4 - Electromagnetic induction

Electromotive force, motional emf; electromagnetic induction; Faraday's law in integral and differential forms; induced electric field. Mutual and self-inductance at an introductory level; energy in magnetic fields. [4+1]

Lumped-circuit model; Kirchhoff's laws; RC, RL and LC circuits; series RLC circuits; transient and steady-state response; impedance and phasor representation; resonance, bandwidth, quality factor and power in AC circuits; analogy between mechanical and electrical oscillators; qualitative bridge to quantum LC oscillators and superconducting quantum circuits. [6+2]

Unit 5 - Maxwell's equations and electromagnetic waves

Changing electric fields and displacement current; continuity equation and Maxwell–Ampere law; Maxwell's equations in vacuum; Poynting theorem and Poynting vector; brief qualitative remarks on electromagnetic momentum and angular momentum; wave equations for electric and magnetic fields in vacuum; plane-wave solutions and relation among electric field, magnetic field, wave vector and direction of propagation; energy and momentum in electromagnetic waves; linear and circular polarization, Malus law; basic ideas of spherical waves. [8+2]

Textbook(s)

D. J. Griffiths, Introduction to Electrodynamics, 4th Ed., selections from Ch. 1–3, 5, 7–9.

Purcell, E.M., and Morin, D.J., Electricity and Magnetism (Berkeley Physics Series Vol.2), 3rd Ed., CUP

Resnick, Halliday and Walker, Fundamentals of Physics, 10th Ed, Wiley India, sections on current, circuits,electromagnetic induction, electromagnetic oscillations, and AC circuits

R. P. Feynman, R. B. Leighton, and M. Sands, The Feynman Lectures on Physics, Vol. 2

Evaluation Pattern: 60:40

Assessment	Internal	External
Midterm Exam	20	
Continuous Assessment (*CA)	40	
**End Semester		40

*CA – Can be Quizzes, Assignments, Projects, Reports.

**End Semester examination is theory based (100 Marks, 3 hours exam)

26CSQ111	OBJECT ORIENTED PROGRAMMING	L-T-P-C: 3-0-0-3

Course Objectives

- The course aims at teaching students to develop Object-Oriented software using the Unified Modelling Language and the Java Programming Language to first year students.
- This course motivates the students to think of problem solving in an Object-Oriented way using the methods and tools that support the paradigm.

Course Outcomes

CO1: Design and implement Java programs using encapsulation, inheritance, polymorphism, and abstraction to model real-world problems.
CO2: Build type-safe, reusable software components by effectively applying Java interfaces, generic classes, and appropriate collection types.
CO3: Write robust Java applications that gracefully handle runtime errors and read/write structured data using Java's I/O and NIO.2 APIs.
CO4: Use lambda expressions, the Stream API, and functional interfaces to write concise, declarative data-processing pipelines in Java.
CO5: Apply common OOP design patterns, follow SOLID principles, and validate software correctness using JUnit 5 and test-driven development practices.

CO-PO Mapping

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

Syllabus

Unit 1

Classes, objects & encapsulation: Defining classes & creating objects - Instance vs static members - Constructors & constructor chaining - Access modifiers - Getters & setters - this keyword - Object references & memory model -Packages & import statements - JavaDoc comments - String class

Inheritance & Polymorphism: Extending classes with extends - Method overriding & @Override - super keyword - Upcasting & downcasting - Runtime polymorphism (dynamic dispatch) - Abstract classes & abstract methods - final keyword - Object class & its methods - instanceof operator - IS-A vs HAS-A relationships

Unit 2

Interfaces & Abstraction: Defining & implementing interfaces - Multiple interface implementation - Default & static interface methods (Java 8+) - Interface vs abstract class — Functional interfaces & intro to lambdas - Common built-in interfaces: Comparable, Iterable - Loose coupling via interfaces - Interface segregation principle - Sealed classes (Java 17+) - Records (Java 16+)

Exception handling & I/O: Checked vs unchecked exceptions -

try / catch / finally blocks - Multi-catch & exception chaining - Creating custom exception classes - try-with-resources - File I/O with FileReader, BufferedReader - Writing files with FileWriter - NIO.2 - Path, Files, Paths -
Serialization & deserialization - Reading / writing JSON

Unit 3

Generics & Collections framework: Why generics — type safety without casting - Generic classes & methods - Bounded type parameters (extends, super) - List, Set, Map interfaces

ArrayList, LinkedList, HashSet, TreeSet - HashMap, LinkedHashMap, TreeMap - Iterating collections - for-each, Iterator - Sorting with Comparator & Comparable - Collections utility class - Choosing the right collection for the job

Multi-threading & GUI: Thread class & Runnable interface - Thread lifecycle: new, runnable, blocked, terminated - Creating threads via Callable & Future - synchronized keyword & intrinsic locks - Race conditions, deadlocks & how to avoid them - wait(), notify(), notifyAll() - Intro to Swing — JFrame, JPanel, layout managers - Common widgets: JButton, JLabel, JTextField, JComboBox - Event handling with ActionListener & anonymous classes - SwingWorker for background tasks in GUI

Textbook(s)

Y.Daniel Liang, "Introduction to Java Programming", Tenth Edition, PHI, 2013.

Grady Booch and Robert A. Maksimchuk, "Object-oriented Analysis and Design with Applications", Third Edition,Pearson Education, 2009.

Reference(s)

Naughton P. and Schildt H., "Java2 Complete Reference", Eighth Edition, Tata McGraw- Hill, 2011.

Ali Bahrami, "Object Oriented Systems Development", Second Edition, McGraw-Hill,2008.

Jaime Nino, Fredrick A Hosch, "An Introduction to Programming and Object Oriented Design using Java", Wiley India Private Limited, 2010

Evaluation Pattern: 60:40

Assessment	Internal	External
Midterm	20	
Continuous Assessment Theory (CAT)	40	
End Semester		40

CAT includes, Assignments, Quizzes and Tutorials

26CSQ182	OBJECT ORIENTED PROGRAMMING LAB	L-T-P-C: 0-0-2-1

Course Objectives

- This course aims to provide the object oriented programming principles to the students through Java programming language.

Course Outcomes

CO1: Write and execute Java programs using 'class' construct, object creation, abstraction through access modifiers and method implementation and method overloading.
CO2: Write and execute reusable Java programs by composing objects within classes and extending subclasses from class and understand the semantics associated with them including super, protected, overriding.
CO3: Implement Java programs with features including interface, exception handling, generics, object comparison
CO4: Implement Java programs that uses files, collections, graphical user interface, threads and other common libraries.

CO-PO Mapping

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

Textbook(s)

Deitel & Deitel: Java How to Program

Lab Experiments

1. Class Basics and Object Creation
2. Constructors and Method Overloading
3. Encapsulation and Access Modifiers
4. Inheritance (Single & Multilevel)
5. Runtime Polymorphism (Method Overriding)
6. Abstract classes, Interfaces and Multiple Inheritance Hierarchy
7. Exception Handling and Defining Custom Exceptions
8. File Handling, Strings, Immutability, String Builders, Numbers
9. Generics and Collections
10. Multi-threading and Synchronization
11. GUI Programming
12. Mini Project

Evaluation Pattern: 80:20

Assessment	Internal	External
Continuous Assessment	80	
Final Exam		20

26ECE111	DIGITAL ELECTRONICS	L-T-P-C: 3-0-0-3

Course Objectives

- To provide an understanding of basic building blocks of digital circuits
- To enable the understanding of Boolean algebra and logic function optimization
- To enable design of combinational and sequential circuits

Course Outcomes

CO1: Realize a given expression in terms of basic building blocks

CO2: Minimize a given logic expression

CO3: Design combinational circuits

CO4: Design Sequential circuits.

CO-PO Mapping

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

Syllabus

Unit 1

Introduction to logic circuits - Variables and functions, inversion - Truth tables - Logic gates and Networks - Boolean algebra- Synthesis using gates - Design examples - Optimized implementation of logic functions - Karnaugh map - Strategy for minimization - Minimization of product of sums forms - Incompletely specified functions - Multiple output circuits - Tabular method for minimization

Unit 2

Combinational circuit building blocks - Number representation and arithmetic circuits: Addition of unsigned numbers - Signed numbers - Fast adders - Multiplexers - Decoders - Encoders - Code converters - Arithmetic comparison circuits

Unit 3

Sequential circuit building blocks - Basic latch - Gated SR latch - Gated D latch - Master slave and edge triggered - D flip-flops - T flip-flop - JK flip-flop, Registers, Asynchronous Counters, Synchronous Counters, Ring Counter and Johnson Counter, Synchronous sequential circuits - Basic design steps - State assignment problem – Design of Mealy and Moore state models

Textbook(s)

Stephen Brown, Zvonko Vranesic, "Fundamentals of Digital logic with Verilog Design", Tata McGraw Hill Publishing Company Limited, Special Indian Edition, 2007

R. D. Sudhakar Samuel, "Logic Design: A Simplified Approach", Sanguine Technical Publishers, Edition 1, 2006

Reference(s)

M Morris Mano and Michael D Ciletti, "Digital Design with Introduction to the Verilog HDL", Pearson Education, Fifth Edition, Fifth Edition, 2015

John F. Wakerly, “Digital Design Principles and Practices”, Fourth Edition, Pearson Education, 3rd Ed, 2008.
Donald D Givone, “Digital Principles and Design”, Tata McGraw Hill Publishing Company Limited, 2003

Evaluation Pattern: 60:40

Assessment	Internal	External
Mid Sem Examination	30	
*Continuous Assessment (CAT)	30	
End Semester		40

*CAT includes Quizzes, Assignments and Tutorials

26ECE182	DIGITAL ELECTRONICS LAB	L-T-P-C: 0-0-3-1

Course Objectives

- To provide hands-on experience in realizing simple logic expressions
- To demonstrate the power of logic function optimization
- To enable the implementation of combinational and sequential circuits

Course Outcomes

CO1: Use datasheets & simulation tools effectively

CO2: Realize simple logic circuits

CO3: Design & implement combinational circuits

CO4: Design & implement sequential circuits

CO-PO Mapping

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

Syllabus

Unit 1 - Logic Gates

Implement logic gates using NAND / NOR.

Unit 2 - Boolean functions

Using logic gates

Unit 3 - Combinational circuits

Mux, De-Mux, Code Converters, Adders & Subtractors

Unit 4 - Sequential Circuits

Flip-Flops, Counters, State Machines

Textbook(s)

Stephen Brown, Zvonko Vranesic, "Fundamentals of Digital logic with Verilog Design", Tata McGraw Hill Publishing Company Limited, Special Indian Edition, 2007

Reference(s)

John F. Wakerly, "Digital Design Principles and Practices", Pearson Education, Fourth Edition, 2008.

K A Navas, "Electronic Lab Manual" – Volume 1, Fifth Edition, Prentice Hall of India, 2015

M Morris Mano and Michael D Ciletti, "Digital Design with Introduction to the Verilog HDL", Pearson Education, Fifth Edition, Fifth Edition, 2015

Lab Experiments

1. Verification of Basic Logic Gates
2. Realization of Basic Gates using Universal Logic Gates
3. Simplification and Realization of a given Boolean Expression i) Using basic gates ii) SOP Using NAND gates only iii) SOP Using NOR gates only iv) POS Using NAND gates only v) POS Using NOR gates only and vi) Compare and analyze the above implementations
4. Design and verification of Adders and Subtractors.
5. Design and verification of Adders and Subtractors.
6. Design and verification of Binary to Gray code converter and vice versa
7. Design and verification of BCD to Excess-3 code converter and vice versa
8. Design and verification of 2-bit Magnitude Comparator.
9. Design and verification of Multiplexers
10. Implementation and verification of Half adder, full adder, half subtractor and full subtractor using multiplexers.
11. Design and verification of Flip-flops (D, T and JK flipflop).
12. Design and verification of shift Registers.
13. Design and verification of Ring and Johnson Counters
14. Design and verification of 4-bit asynchronous Up and Down Counters

Evaluation Pattern: 80:20

Assessment	**Internal**	**External**
Mid Sem Examination	20	
*Continuous Assessment Laboratory (CAL)	60	
End Semester		20

*CAL includes Lab Evaluations, Assignments

23MEE115	MANUFACTURING PRACTICE	L-T-P-C: 0-0-3-1

Course Objectives

- Imparting the knowledge of general safety procedures that should be observed on the shop floor.
- Use modelling software to design and print simple geometry for additive manufacturing processes.
- Hands-on experience - arc welding and soldering operations.
- Use of different tools and accessories used for basic manufacturing processes.
- Familiarize with the essential pneumatic and electro-pneumatic components for automation and design pneumatic / electropneumatic circuits for the given simple application
- Understanding the functioning of various sub-systems of automobiles, such as the power train, steering system, suspension system, and braking system and realize the importance of recent developments in automotive technologies.

Course Outcomes

CO1: Practice safety procedures in a shop floor environment

CO2: Select appropriate tools and methods for basic manufacturing processes

CO3: Build simple geometries using additive manufacturing process

CO4: Perform basic metals joining using welding and soldering.

CO5: Design, simulate and test simple pneumatic and electro pneumatic circuit for automation application

CO6: Understand the functioning of automotive systems and realize the importance of recent developments in automotive technologies

CO-PO Mapping

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

Syllabus

Unit 1 - Additive Manufacturing Laboratory - (12 hours)

Introduction to digital manufacturing. Introduction to Additive Manufacturing - types – additive manufacturing applications - Materials for 3D printing, CAD Modelling for Additive manufacturing, Slicing and STL file generation- G code generation - 3D printing of simple geometries.

Unit 2 - Mechanical Engineering Laboratory - (12 hours)

Study of tools and equipment used for basic manufacturing processes.
Manual arc welding practice for making Butt and Lap joints - Soldering Practice
Introduction to Machine Tools and Machining Processes

Unit 3 - Automation lab - (12 hours)

Design, simulate and test pneumatic and electro-pneumatic circuits. Introduction to PLC –PLC programming for automation applications.

Unit 4 - Automobile Engineering lab - (9 hours)

Overview of automobiles – components –functioning of various sub-systems; Power train, steering system, suspension system and braking system. Introduction to electric vehicles, hybrid vehicles, alternate fuels. Introduction to E Mobility.

Reference(s)

Lab Manual

Evaluation Pattern: 80:20

Assessment	Internal	External
Continuous Assessment (CA)	80	
End Semester		20

CA – Can be Quizzes, Assignment, Lab Practice, Projects, and Reports

22ADM111	GLIMPSES OF GLORIOUS INDIA	L-T-P-C: 2-0-1-2

Course Objectives

- The course aims at introducing Bhārath in nutshell to the student, which includes the sources of Indian thoughts, eminent personalities who shaped various disciplines, India's significant contribution to the man kind, the current stature of Indian in the geopolitics and Indian approach to science and ecology

Course Outcomes

CO1: Will be able to recognise the call of Upanishads and outstanding personalities for confronting the wicked in the real world while admiring the valour, pursuit and divinity in both classical and historical female characters of India.
CO2: Will get introduced to Acharya Chanakya, his works, and his views on polity and nation to find synchrony between public and personal life, alongside understanding India's cultural nuances and uniqueness concerning the comprehension of God across major global communities
CO3: Will be able to appreciate Bhagavad Gita as the source of the Indian worldview through the various Yogic lessons enshrined in it, making it one of India's numerous soft powers, and also understand the faith-oriented mechanism of preserving nature.
CO4: Will be informed about the enormous contribution of Indian civilisation over two and a half millennia to humanity and develop awareness about India's approach toward science, devoid of dogmas and rooted in humanism

CO-PO Mapping

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

Syllabus

Unit 1

Face the Brutes, Role of Women in India, Acharya Chanakya, God and Iswara, Bhagavad Gita: From Soldier to Samsarin to Sadhaka, Lessons of Yoga from Bhagavad Gita, Indian Soft powers, Preserving Nature through Faith, Ancient Indian Cultures (Class Activity), Practical Vedanta, To the World from India, Indian Approach to Science

Textbook(s)

"Glimpses of Glorious India", In house publication (In print)

Reference(s)

The Kautilya Arthashastra by Chankaya – Translation with critical and explanatory note by R P Kangle – Motilal Banarasidass Publishers- 1972
Chanakya Neeti – Strategies for success – Radhakrishnan pillai – Jaico Publishing house -2020
Universal Message of the Bhagavad Gita: An exposition of the Gita in the Light of Modern Thought and Modern Needs. - Swami Ranganathananda, Advaita Ashrama Belur Math, 2000.
A Concise History Of Science In India – D M Bose, S N Sen, B V Subbarayappa,The Indian National Science Academy 1971.
Indian Culture and India's Future – Michel Danino - D.K. Printworld (P) Ltd -2011.

Evaluation Pattern: 60:40

Assessment	Internal	External
Mid Term	20	
*Continuous Assessment (CA)	40	
End Semester		40

*CA includes Quizzes and Tutorials

SEMESTER 3

26MAT205	PROBABILITY & RANDOM PROCESS	L-T-P-C: 3-0-0-3

Course Objectives

- To understand the concepts of basic probability and random variables.
- To understand some standard distributions and apply them to some problems.
- To understand the concepts of random process, stationarity, and autocorrelation functions.
- To understand Markov process and Markov chain and related concepts.

Course Outcomes

CO1: Understand the basic concepts of probability and probability modeling.

CO2: Understand statistical distributions of one- and two-dimensional random variables and correlations.

CO3: Understand the basic concepts of stochastic processes and stationarity.

CO4: Understand the purpose of some special processes.

CO5: Understand spectrum estimation and spectral density function.

CO-PO Mapping

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

Syllabus

Unit 1

Review of probability concepts - conditional probability- Bayes theorem. Random Variable and Distributions: Introduction to random variables – discrete and continuous random variables and their distribution functions- mathematical expectations – moment generating function and characteristic function.

Unit 2

Binomial, Poisson, Geometric, Uniform, Exponential, Normal distribution functions (moment generating function, mean, variance and simple problems) – Chebyshev's theorem.

Unit 3

Stochastic Processes: General concepts and definitions - stationary in random processes - strict sense and wide sense stationary processes - autocorrelation and properties- special processes – Poisson points, Poisson and Gaussian processes and properties- systems with stochastic inputs - power spectrum- spectrum estimation, ergodicity –Markov process and Markov chain, transition probabilities, Chapman Kolmogrov theorem, limiting distributions classification of states. Markov decision process.

Textbook(s)

Douglas C. Montgomery and George C. Runger, "Applied Statistics and Probability for Engineers", (2005) John Wiley and Sons Inc.

A. Papoulis, and Unnikrishna Pillai, "Probability, Random Variables and Stochastic Processes", Fourth Edition, McGraw Hill, 2002.

Reference(s)

J. Ravichandran, “Probability and Random Processes for Engineers”, First Edition, IK International, 2015.
Scott L. Miller, Donald G. Childers, “Probability and Random Processes”, Academic press, 2012..

Evaluation Pattern: 60:40

Assessment	Internal	External
Mid Term	20	
*Continuous Assessment (CA)	40	
End Semester		40

*CA – Can be Quizzes, Assignments, Lab Practice, Projects, and Reports

26PHY201	QUANTUM MECHANICS	L-T-P-C: 3-1-0-4

Course Objectives

- To develop conceptual clarity on why quantum descriptions are needed beyond classical physics.
- To strengthen students' ability to connect physical intuition with abstract quantum formalism.
- To build mathematical and problem-solving readiness for elementary quantum systems.
- To cultivate a quantum way of thinking based on superposition, measurement, probability amplitudes, and non-classical behavior, relevant to emerging areas such as quantum computing and quantum technologies.

Course Outcomes

CO1: Explain the experimental and conceptual origins of quantum theory and perform basic calculations related to photons, matter waves, uncertainty relations, and quantum stability.
CO2: Apply the Schrödinger equation and wave-function interpretation to perform basic calculations for one-dimensional quantum systems, including potential wells, harmonic oscillator, free particles, barriers, and tunnelling.
CO3: Use the postulates and mathematical structure of quantum mechanics to describe and calculate states, observables, measurements, commutators, uncertainty relations, and simple quantum dynamics.
CO4: Analyse quantum mechanics of particles in two and three dimensions to perform basic calculations involving rigid boxes, central potentials, orbital angular momentum, spherical harmonics, quantum states of a rigid rotor and the hydrogen atom.
CO5: Apply spin, polarization, and identical-particle concepts to perform basic calculations involving spin states, measurement probabilities, polarization states, exchange symmetry, and the Pauli principle.

CO-PO Mapping

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

Syllabus

Unit 1

Origins of quantum theory: Classical nature of matter; black-body radiation, photons, photoelectric effect, dual nature of electromagnetic radiation. Line spectra, Rutherford model of the atom, Bohr model of the hydrogen atom and atomic spectra, Franck-Hertz experiment; correspondence principle. de Broglie model, wave-particle duality, matter waves and their interference, electron diffraction — Davisson-Germer experiment; introductory ideas of superposition of waves, wave packets, group velocity, uncertainty relations; estimation of zero-point and ground-state energies in simple potentials and quantum stability of atoms. (Refs. 1–3, 5, 8) [8]

Unit 2

Schrödinger equation in two and three dimensions: Schrödinger equation and its basic properties; wave functions, probability amplitudes and probabilities, superposition, normalization, expectation values, momentum and energy operators; time-independent Schrödinger equation, stationary states, energy eigenvalue equation, eigenvalues, eigenstates and quantization of energies; general solutions, superposition of states, and probability calculations; infinite and finite potential wells. Simple harmonic oscillator, vibrational levels of diatomic molecules. (Refs. 1, 4) [9]

Unit 3

Free particle states: Free particles, superposition of waves, Gaussian wave packets, group velocity, probability currents, potential steps and barriers, tunnelling and elementary applications. (Refs. 1, 4) [4]

Mathematical foundations and postulates of quantum mechanics: mathematical structure of a quantum state and its properties, observables, discrete and continuous spectra of observables; measurements; compatible and incompatible observables; commutator of operators and uncertainty relations, with emphasis on results and applications to wave packets; quantum evolution and the collapse postulate; quantum dynamics in simple cases. (Refs. 1, 4, 5) [8]

Optional: Simple harmonic oscillator using the operator method.

Unit 4

Schrödinger equation in two and three dimensions: particles in rigid boxes in two and three dimensions. (Refs. 1, 4, 5) [1]

Central fields and orbital angular momentum: Orbital angular momentum operators and their properties; eigenvalues and eigenstates of Lz and Lz harmonics.; Schrödinger equation in spherical coordinates for central fields; eigenvalues and eigenfunctions of and , spherical harmonics; vector model, orbital magnetic moment and Zeeman effect; rotational quantum states and energy levels of molecules. (Ref. 1) [6]

Hydrogen atom: Radial Schrödinger equation and its solutions, complete set of wave functions, classification of energy eigenstates, basic properties and calculations with quantum states, probabilities; a word about scattering states. (Ref. 1) [4]

Optional: Particle in an infinite spherical potential well; harmonic oscillator in three dimensions.

Unit 5

Spin, polarization, and identical particles

Spin angular momentum and spin magnetic moment; Stern-Gerlach experiment; spin states and spin operators; eigenvalues, spectral representations, measurements and probabilities; time evolution of spin in a magnetic field; connection with quantum oscillations in two-level systems. (Refs. 1, 4) [6]

Photon polarization states: linear and circular polarization representations, measurements, probabilities, and quantum interpretation of Malus law. (Refs. 1, 6, 9) [2]

Many-particle systems: identical particles, exchange symmetry, two-electron systems, symmetric and antisymmetric spatial wave functions and spin states, Pauli principle; many-particle states. (Refs. 1, 4) [2]

Optional: Mach-Zehnder interferometer. (Ref. 10)

Textbook(s)

A.P. French, Introduction to Quantum Physics.

E.H. Wichmann, Quantum Physics, Berkeley Physics Course Vol. 4, Tata McGraw-Hill.

Reference(s)

A. Beiser, Concepts of Modern Physics, 6th ed., Tata McGraw-Hill.

D. J. Griffiths and D. F. Schroeter, Introduction to Quantum Mechanics, 3rd ed., Pearson Education, Chs. 1–5.

S. Trachanas, An Introduction to Quantum Physics: A First Course for Physicists, Chemists, Materials Scientists, and Engineers, Wiley, 2018.

R. P. Feynman, R. B. Leighton, and M. Sands, The Feynman Lectures on Physics, Vol. 3.

Alastair I.M. Rae and J. Napolitano, Quantum Mechanics, 6th ed., CRC Press, 2016.

R. Eisberg and R. Resnick, Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, 2nd ed., Wiley India.

P.A.M. Dirac, Principles of Quantum Mechanics, 4th ed., Oxford University Press, 1958, Ch. 1, Sections 1–3 on photon polarization.

LibreTexts, "Using a Mach-Zehnder Interferometer to Illustrate Feynman's Sum Over Histories Approach to Quantum Mechanics", available on LibreTexts Chemistry platform.

Evaluation Pattern: 60:40

Assessment	Internal	External
Mid Term	20	

Continuous Assessment (CA)	40	
End Semester		40

26CSQ201	OPERATING SYSTEMS	L-T-P-C: 3-0-2-4

Course Objectives

- This course aims at introducing the structure and implementation of modern operating systems, virtual machines and their applications
- It summarizes techniques for achieving process synchronization and managing resources like memory, CPU, and files and directories in an operation system.
- It summarizes techniques for achieving process synchronization and managing resources like memory, CPU, and files and directories in an operation system.
- It gives a broad overview of memory hierarchy and the schemes used by the operating systems to manage storage requirements efficiently.

Course Outcomes

CO1: Explain the fundamental concepts of operating systems including process management, memory management, file systems, and I/O handling.
CO2: Analyze and compare CPU scheduling algorithms, deadlock detection/avoidance strategies, and memory allocation techniques with respect to performance and efficiency.
CO3: Design and implement solutions for classical synchronization problems such as producer-consumer, readers-writers, and dining philosophers using semaphores, mutexes,
CO4: Develop programs in a Unix/Linux environment using system calls for process creation, inter-process communication, file handling, and thread management.
CO5: Evaluate the performance of operating system components by simulating and benchmarking scheduling algorithms, page replacement policies, and disk scheduling strategies through lab experiments.

CO-PO Mapping

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

Syllabus

Unit 1

Introduction to Operating Systems: OS definition, goals, and types; OS structure — monolithic, layered, microkernel, hybrid; system calls and APIs; OS services.
Process Management: Process concept and PCB; process states and transitions; process creation and termination; context switching; inter-process communication (IPC) — shared memory, message passing.
Threads: Thread concept; user-level vs kernel-level threads; multithreading models — many-to-one, one-to-one, many-to-many; POSIX Threads.
CPU Scheduling: Scheduling criteria; FCFS, SJF (preemptive & non-preemptive), Round Robin, Priority scheduling; multilevel queue and multilevel feedback queue; real-time scheduling basics.

Unit 2

Process Synchronization: Critical section problem, race conditions, and Peterson's solution; Hardware synchronization — test-and-set, compare-and-swap; Semaphores — binary and counting; mutex locks Monitors and condition variables; Classical synchronization problems — producer-consumer, readers-writers, dining philosophers.

Deadlock: Deadlock conditions; Resource allocation graph — deadlock detection using RAG; Deadlock prevention and avoidance — Banker's algorithm; Deadlock detection and recovery strategies.
Memory Management: Contiguous memory allocation — fixed and variable partitioning; Internal vs external fragmentation and compaction; Paging — logical vs physical address, page tables, TLB, address translation; Segmentation and combined segmentation with paging.

Unit 3

Virtual Memory: Demand paging — page fault handling and performance; Page replacement algorithms — FIFO, LRU, Optimal, Clock (second-chance); Thrashing, working set model, and page fault frequency; Memory-mapped files and copy-on-write.
File Systems: File concepts, attributes, types, operations, and access methods; Directory structures — single-level, two-level, tree-structured, acyclic graph; File allocation methods — contiguous, linked, indexed; Free space management — bit vector, linked list, grouping.
I/O Systems & Disk Scheduling: I/O hardware — device controllers, registers, DMA; I/O software layers — polling, interrupt-driven, buffering, caching, spooling; Disk structure and disk scheduling — FCFS, SSTF, SCAN, C-SCAN, LOOK; RAID levels (0–5) and storage systems overview.

Textbook(s)

Silberschatz A, Gagne G, Galvin PB. “Operating system concepts”. Tenth Edition, John Wiley and Sons; 2018.

Reference(s)

Andrew S. Tanenbaum, Herbert Bos, “Modern Operating Systems”, Pearson Education India; Fourth edition 2016.

Stevens WR, Rago SA. “Advanced programming in the UNIX environment”. Second Edition, Addison-Wesley; 2013. New Reference

Lab Experiments

1. Implementation of Basic Unix Commands and Shell Scripting
2. Process Creation and Termination using fork, exec and wait System Calls
3. Inter-Process Communication using Pipes and FIFOs
4. Simulation of CPU Scheduling Algorithms — FCFS, SJF, Round Robin, and Priority Scheduling
5. Implementation of Multilevel Queue and Multilevel Feedback Queue Scheduling
6. Classical Synchronization Problems using Semaphores — Producer-Consumer and Dining Philosophers
7. Thread Synchronization using Mutex and Condition Variables
8. Deadlock Detection and Avoidance using Banker's Algorithm
9. Simulation of Memory Allocation Techniques — First Fit, Best Fit, and Worst Fit
10. Implementation of Page Replacement Algorithms — FIFO, LRU, and Optimal
11. File Operations using System Calls — open(), read(), write(), close(), and lseek()
12. Simulation of Disk Scheduling Algorithms — FCFS, SSTF, SCAN, and C-SCAN

Evaluation Pattern: 70:30

Assessment	Internal	External
Midterm	20	
*Continuous Assessment (Theory) (CAT)	10	
*Continuous Assessment (Lab) (CAL)	40	
**End Semester		30 (50 Marks; 2

		hours exam)

*CA – Can be Quizzes, Assignment, Case-study Reports.

**End Semester can be theory examination/ lab-based examination

26CSQ202	DATA STRUCTURES AND ALGORITHMS	L-T-P-C: 3-1-0-4

Course Objectives

- This course aims to provide the students, an in-depth understanding of structure and implementation of the common data structures used in computer science.
- It imparts the ability to solve problems by choosing and applying the right data structures.
- It also imparts the ability to improve the efficiency of programs by applying the right data structures.

Course Outcomes

CO1: Understand the concept and functionalities of Data Structures and be able to implement them efficiently.

CO2: Identify and apply appropriate data structures and their libraries to solve problems and improve them

efficiency.

CO3: Analyze the complexity of data structures and associated algorithms.

CO4: Analyze the impact of various implementation and design choices on the data structure performance.

CO-PO Mapping

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

Syllabus

Unit 1

Introduction to Data Structures: Need and Relevance - Abstract Data Types and Data Structures - Principles, and Patterns. Basic complexity analysis – Best, Worst, and Average Cases - Asymptotic Analysis -Analyzing Programs – Space Bounds, recursion- linear, binary, and multiple recursions. Arrays, Linked Lists and Recursion: Using Arrays - Lists - Array based List Implementation – Linked Lists – LL ADT – Singly Linked List – Doubly Linked List – Circular Linked List Stacks and Queues: Stack ADT - Array based Stacks, Linked Stacks – Implementing Recursion using Stacks, Stack Applications. Queues - ADT, Array based Queue, Linked Queue, Double-ended queue, Circular queue, applications.

Unit 2

Trees: Tree Definition and Properties – Tree ADT - Basic tree traversals - Binary tree - Data structure for representing trees – Linked Structure for Binary Tree – Array based implementation. Priority queues: ADT – Implementing Priority Queue using List – Heaps. Maps and Dictionaries: Map ADT – List based Implementation – Hash Tables - Dictionary ADT. Skip Lists - Implementation - Complexity.

Unit 3

Search trees – Binary search tree, AVL tree and its rotation– Segment Trees - B-Trees. Implementation. External Memory Sorting and Searching. Graphs: ADT- Data structure for graphs - Graph traversal- Transitive Closure- Directed Acyclic graphs - Weighted graphs – Shortest Paths - Minimum spanning tree – Greedy Methods for MST.
Persistent data structures, fusion trees, Bloom filter, Game Trees (Case Study)

Textbook(s)

Michael T Goodrich, Roberto Tamassia, and Michael H Goldwsasser, "Data Structures and Algorithms in Java", Sixth Edition, Wiley, 2014

Reference(s)

Tremblay J P and Sorenson P G, "An Introduction to Data Structures with Applications", Second Edition, Tata McGraw-Hill, 2002

Clifford A. Shaffer, "Data Structures and Algorithm Analysis", Edition 3.2 (Java Version), Dover, 2013

Dinesh P. Mehta, Dinesh P. Mehta, Sartaj Sahni, "Handbook of Data Structures and Applications", Chapman and Hall/CRC, 2004.

George Heineman Gary Pollice, Stanley Selkow, "Algorithms in a Nutshell", O'Reilly; 2nd edition, 2016.

Evaluation Pattern: 60:40

Assessment	**Internal**	**External**
Mid Term Examination	20	
*Continuous Assessment (CA)	40	
End Semester		40

*CA includes Quizzes, Assignments and Tutorials

26CSQ281	DATA STRUCTURES AND ALGORITHMS LAB	L-T-P-C: 0-0-2-1

Course Objectives

- To strengthen the understanding of data structures by implementing data structures, and applying them to solve real problems, measuring their performance empirically, and developing the ability to compare and justify design choices.

Course Outcomes

CO1: Implement data structures including arrays, linked lists, stacks, queues, trees, heaps, hash tables, and graphs in C/C++ by applying appropriate ADT design principles and recursive or iterative strategies

CO2: Apply suitable data structures to solve real-world problems.

CO3: Compare and justify the choice of data structures and implementation strategies for a given problem by empirically measuring performance.

CO-PO Mapping

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

Syllabus

Unit 1

Linear search, binary search, comparison-based sorting, non-comparison sorting, external sorting, Linear recursion, binary recursion, multiple recursion,

Unit 2

Array operations, 2D arrays, sparse matrix representations, polynomial ADT, C++ templates, STL containers and iterators.

Unit 3

Stack ADT, array and linked stack, queue ADT, circular queue, double-ended queue, applications. Singly linked list, doubly linked list, circular linked list, applications.

Unit 4

Binary tree, Binary search tree, AVL tree, Expression tree, Heap, Priority queue, Hash table, separate chaining, open addressing, dictionary ADT

Unit 5

Graph representations, BFS, DFS, shortest paths, minimum spanning tree, topological sort, directed acyclic graphs, with applications

Textbook(s)

Michael T Goodrich and Roberto Tamassia and Michael H Goldwsasser, “Data Structures and Algorithms in Java”, Fifth edition, John Wiley publication, 2010

Tremblay J P and Sorenson P G, “An Introduction to Data Structures with Applications”, Second Edition, Tata McGraw-Hill, 2002

Reference(s)

Cormen, Leiserson, Rivest, Stein - Introduction to Algorithms, MIT Press

Evaluation Pattern: 80:20

Assessment	**Internal**	**External**
Continuous Assessments (CA)	80	
Lab Exam		20

26CSQ203	COMPUTER ORGANIZATION & ARCHITECTURE	L-T-P-C: 3-0-2-4

Course Objectives

- This course aims to make students, understand, analyse, and appreciate the basic principles, design choices, and trade-offs associated in the field of Computer Architecture.
- It describes overview of ARM architecture in terms of instruction set, data path and pipelining
- It introduces pipelining and memory systems in detail along with performance metrics for designing computer systems and what can be done to make it better and faster.

Course Outcomes

CO1: It introduces pipelining and memory systems in detail along with performance metrics for designing computer systems and what can be done to make it better and faster.
CO2: It introduces pipelining and memory systems in detail along with performance metrics for designing computer systems and what can be done to make it better and faster.
CO3: Understand the design of instruction execution using Multiple Clock Cycles and Analyze / Evaluate the performance of processors.
CO4: Understand Pipelined architecture and Design of multi-stage pipeline processor in ARM.
CO5: Apply the working principles of ALU, Memory and I/O in the design of processor.

CO-PO Mapping

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

Syllabus

Unit 1

Overview and history of computer architecture, combinational vs sequential logic, hardware description languages (VHDL), physical constraints (gate delay, fan-in, fan-out, energy/power). Introduction to Instruction Set Architecture, Processor Architecture with example as ARM & Instruction Set, Single Cycle Datapath Design, Control Hardware, Computer Arithmetic, Floating Point Arithmetic, Design of ALU, Introduction and Performance of Computing system and role of performance.

Unit 2

Introduction to multicycle at a path, Instruction level parallelism, instruction pipelining, Pipelining Technique – Design Issues, Hazards: Structural Hazards, Data Hazards and Control Hazards, Static Branch Prediction, Dynamic Branch Prediction, pipeline hazards and advanced concepts in pipelining.

Unit 3

Storage systems, introduction to memory hierarchy: importance of temporal and spatial locality; main memory organization, cache memory: address mapping, block size, replacement, and store policies; virtual memory system: page table and TLB.
External storage; IO fundamentals: handshaking, buffering, programmed IO, interrupt driven IO; Interrupt handling mechanism, Buses: protocols, arbitration. Introduction to modern processors like GPU and TPU, Parallel Processing.

Textbook(s)

J. L. Hennessy and D. A. Patterson (H and P), "Computer Organization and Design, Hardware-Software Interface", ARM Edition , Morgan Kaufmann Publishing Co., 2017.

L. Hennessy and D. A. Patterson (H and P), "Computer Architecture, A Quantitative Approach", Fifth or Sixth edition, J, Morgan Kaufmann Publishing Co., 2019. D. A. Patterson and J. L. Hennessy (P and H), "Computer Organization and Design, The Hardware/Software Interface", Fifth edition , Morgan Kaufmann Publishing Co., 2013. J.P. Hayes, "Computer Architecture and Organization", Mc Graw Hill 2017 William Stallings, "Computer Organization and architecture – Designing for performance", 10th Edition, 2016, Pearson Education.

Evaluation Pattern: 70:30

Assessment	Internal	External
Midterm	20	
Continuous Assessment Theory (CAT)	20	
Continuous Assessment Lab (CAT)	30	
End Semester		30

CA includes Quizzes and Tutorials

26CSQ204	PYTHON PROGRAMMING	L-T-P-C: 1-0-2-2

Course Objectives

- To bridge the paradigm shift from compiled, statically-typed languages (C and Java) to an interpreted, dynamically-typed environment using Python.
- To master native Pythonic data structures and functional paradigms, eliminating the dependency on rigid, explicit loops where streamlined abstractions are more effective.
- To expose the structural mechanics of Pythonic OOP, highlighting the architectural contrasts in resource management, dynamic attributes, and multiple inheritance resolution compared to Java.
- To build high-performance data processing pipelines utilizing compiled scientific computing backends (NumPy and Pandas) for matrix transformations and data analysis.
- To introduce modern microservice architecture and dynamic data visualization models for technical deployment and visual validation.

Course Outcomes

CO1: New Outcome

CO2: Implement memory-efficient data pipelines using Pythonic comprehension structures, generator expressions, and advanced string-slicing protocols.

CO3: Construct robust, object-oriented software architectures by overloading built-in dunder protocols and designing reliable multi-inheritance schemes using C3 method resolution order.

CO4: Create secure error-handling routines and stateful transaction scopes using context managers and customizable exception hierarchies.

CO5: Optimize numerical computations and dataset transformations by substituting traditional sequential loops with vectorized NumPy array broadcasting and multi-index Pandas aggregations.

CO6: Develop and deploy web microservices capable of handling dynamic REST payloads, mapping data trends visually using geometric Matplotlib configurations.

Syllabus

Unit 1

Python execution model: Interpretation vs. Compilation

Dynamic typing vs. Java's static typing; Duck Typing

Memory Management: Object references, mutability vs. immutability (strings, tuples vs. lists), and automated Garbage Collection.

Core Syntax and Pythonic Data Structures: Lists, Sets, Dictionaries, and Tuples. Comprehensions: List, Dictionary, and Set comprehensions as replacements for traditional nested loops. Slicing syntax on sequences.

Advanced Functional and Control Elements: First-class functions, Lambda expressions, map(), filter(), and reduce().

Generators and Iterators: The yield keyword, memory-efficient lazy evaluation vs. Java iterators.

Decorators: Function wrappers, modifying behavior dynamically (comparing Python decorators to Java annotations).

Context Managers: The with statement for automatic resource cleanup.

Unit 2

Object-Oriented Programming (Python Style): Classes, instances, and the explicit self reference (contrasting with Java's implicit this). Dunder (Double Underscore) / Magic methods: Operator overloading (__str__, __init__, __add__, __eq__).

Multiple Inheritance: The Method Resolution Order (MRO) and the C3 Linearization algorithm (how Python solves the Diamond Problem that Java avoids via interfaces). Properties: Using the @property decorator for clean encapsulation instead of explicit getters/setters.

Testing & Code Quality: Unit testing frameworks: unittest (Java-style JUnit equivalent) vs. pytest (idiomatic Python approach).

The Data Science Foundations: NumPy: High-performance vector/matrix operations, N-dimensional arrays (ndarray), broadcasting rules, and why it replaces traditional C-arrays for numerical data. Pandas: Data manipulation primitives—Series and DataFrames. Data ingestion (CSV, JSON, SQL), handling missing values, filtering, grouping (groupby), and merging operations.

Unit 3

Modern Web Architectures & APIs: FastAPI: Modern, high-performance web framework for building APIs. Data validation and serialization using Pydantic (leveraging Python's modern type hinting features). Automatic interactive API documentation (Swagger UI generation). Alternative Overview: Flask (Micro-framework paradigm) vs. Django (Batteries-included enterprise framework, comparing Django ORM to Java Hibernate).

Asynchronous & Concurrent Programming: Understanding the Global Interpreter Lock (GIL): Why Python multi-threading doesn't parallelize CPU-bound tasks like Java does. Multiprocessing vs. Multithreading in Python. Asyncio: Event-loop driven asynchronous programming (async/await primitives) for I/O-bound tasks.

Interoperability: Interfacing Python with C extensions (using ctypes or Cython) for performance-critical logic.

Textbook(s)

Ramalho, L. (2022). Fluent Python: Clear, Concise, and Effective Programming (2nd ed.). O'Reilly Media.

McKinney, W. (2022). Python for Data Analysis (3rd ed.). O'Reilly Media.

Reference(s)

Slatkin, B. (2019). Effective Python: 90 Specific Ways to Write Better Python (2nd ed.). Addison-Wesley.

Grinberg, M. (2018). Flask Web Development (2nd ed.). O'Reilly Media.

Evaluation Pattern: 70:30

Assessment	Internal	External
Mid Term	20	
Continuous Assessment - Theory (CAT)	10	
Continuous Assessment - Lab (CAL)	40	
End Semester		30 (50 marks; 2 hours exam)

23LSE201	LIFE SKILLS FOR ENGINEERS I	L-T-P-C: 1-0-2-P/F

Course Objectives

- Assist students in inculcating Soft Skills and developing a strong personality.
- Help them improve their presentation skills.
- Support them in developing their problem solving and reasoning skills.
- Facilitate the enhancement of their communication skills.

Course Outcomes

CO1: Soft Skills: To develop greater morale and positive attitude to face, analyse, and manage emotions in real life situations, like placement process.
CO2: Soft Skills: To empower students to create a better impact on a target audience through content creation, effective delivery, appropriate body language and overcoming nervousness, in situations like presentations, Group Discussions and interviews
CO3: Aptitude: To analyze, understand and employ the most suitable methods to solve questions on arithmetic and algebra
CO4: Aptitude: To investigate and apply suitable techniques to solve questions on logical reasoning and data analysis
CO5: Verbal: To infer the meaning of words and use them in the right context. To have a better understanding of the basics of English grammar and apply them effectively.

CO-PO Mapping

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

Syllabus

Unit 1 - Soft Skills

Soft Skills and its importance: Pleasure and pains of transition from an academic environment to work-environment. New-age challenges and distractions. Learning to benefit from constructive criticisms and feedback, Need for change in mindset and up-skilling to keep oneself competent in the professional world.
Managing Self: Knowing oneself, Self-perception, Importance of positive attitude, Building and displaying confidence, Avoiding being overconfident, Managing emotions, stress, fear. Developing Resilience and handling failures. Self-motivation, Self-learning, and continuous knowledge up- gradation / Life-long learning. Personal productivity - Goal setting and its importance in career planning, Self-discipline, Importance of values, ethics and integrity, Universal Human Values.

Unit 2 - Problem Solving I

Numbers: Types, Power Cycles, Divisibility, Prime, Factors & Multiples, HCF & LCM, Surds, Indices, Square roots, Cube Roots and Simplification.
Percentage: Basics, Profit, Loss & Discount, and Simple & Compound Interest. Ratio, Proportion & Variation: Basics, Alligations, Mixtures, and Partnership. Averages: Basics, and Weighted Average.
Data Interpretation: Tables, Bar Diagrams, Venn Diagrams, Line Graphs, Pie Charts, Caselets, Mixed Varieties, Network Diagrams and other forms of data representation.

Unit 3 - Verbal

Vocabulary: Familiarize students with the etymology of words, help them realize the relevance of word analysis and enable them to answer synonym and antonym questions. Create an awareness about the frequently misused words, commonly confused words and wrong form of words in English.
Grammar (Basic): Help students learn the usage of structural words and facilitate students to identify errors and correct them.
Reasoning: Stress the importance of understanding the relationship between words through analogy questions.
Speaking Skills: Make students conscious of the relevance of effective communication in today's world through various individual speaking activities.

Reference(s)

Students" Career Planning Guide, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
Students" Career Planning Guide, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
*Adair. J., (1986), "Effective Team Building: How to make * winning team", London, U.K*
Gulati. S., (1006) "Corporate Soft Skills", New Delhi, India: Rupa & Co
The hard truth about Soft Skills, by Amazon Publication.
Verbal Skills Activity Book, CIR, AVVP
English Grammar & Composition, Wren & Martin
Nova's GRE Prep Course, Jeff Kolby, Scott Thornburg & Kathleen Pierce
Cracking the New GRE 2012
Kaplan's – GRE Comprehensive Programme
Student Workbook: Quantitative Aptitude & Reasoning, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham
Quantitative Aptitude for All Competitive Examinations, Abhijit Guha.
How to Prepare for Quantitative Aptitude for the CAT, Arun Sharma
How to Prepare for Data Interpretation for the CAT, Arun Sharma

Evaluation Pattern: 60:40

Assessment	Internal	External
Continuous Assessment (CA) – Soft Skills	30	
Continuous Assessment (CA) – Aptitude	10	25
Continuous Assessment (CA) – Aptitude	10	50
Total	50	50
Pass / Fail		

*CA - Can be presentations, speaking activities and tests.

SEMESTER 4

26MAT216	DIFFERENTIAL EQUATIONS & COMPLEX VARIABLES	L-T-P-C: 3-1-0-4

Course Objectives

- To model mechanical systems using differential equations.
- To model mechanical systems using differential equations.
- To model mechanical systems using differential equations.
- To understand the residues and poles and evaluate complex integrations.

Course Outcomes

CO1: Solve homogeneous linear second order ordinary differential equations corresponding to different practical scenarios.

CO2: Model and solve homogeneous and non-homogeneous first order ordinary differential equations corresponding to different practical scenarios

CO3: Solve system of order ordinary differential equations corresponding to different practical scenarios

CO4: To carry out differentiation for complex functions and check analyticity of complex functions

CO5: To perform integral calculus in complex variables and finding residues, zeros, poles and series representations of complex functions

CO-PO Mapping

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

Syllabus

Unit 1

First order ODE: Ordinary Differential Equations – Basic concepts, modelling, first order ODEs, exact ODEs, integrating factors.

Second order ODE: Homogeneous linear ODEs, Euler-Cauchy equations, existence and uniqueness of solution, Wronskian, non-homogeneous ODEs, variation of parameters. Modelling of free and forced oscillations of spring-mass system.

Unit 2

Higher order ODEs, homogeneous and non-homogeneous linear ODEs. System of ODEs – Phase space. Fourier Series, arbitrary period, even and odd expressions, half range expressions. //will it be possible to cover?

Unit 3

Complex Functions: Complex Numbers, Complex Plane, Polar Form of Complex Numbers. Powers and Roots.
Derivative: Analytic Functions, Cauchy - Riemann Equations, Laplace Equation, Conformal mapping, Exponential Function, Trigonometric Functions, Hyperbolic Functions, Logarithms, General Power, Linear Fractional Transformation. //will it be possible to cover

Unit 4

Complex Integration: Complex Line Integral, Cauchy Integral Theorem, Cauchy Integral Formula, Derivatives of Analytic Functions.   Power Series, Taylor Series and Maclaurin Series. Laurent Series, Zeros and Singularities, Residues, Cauchy Residue Theorem

Textbook(s)

Advanced Engineering Mathematics, E Kreyszig, John Wiley and Sons, Tenth Edition, 2016.

Reference(s)

Engineering Mathematics, Srimanta Pal and Subodh Bhunia, Oxford press, 2015.

Evaluation Pattern: 60:40

Assessment	**Internal**	**External**
Midterm	20	
*Continuous Assessments (CA)	40	
End Semester		40

*CA – Can be Quizzes, Assignment, Projects, and Reports

26CSQ211	DESIGN AND ANALYSIS OF ALGORITHMS	L-T-P-C: 3-0-2-4

Course Objectives

- This course aims to provide the fundamentals of algorithm design and analysis, specifically in terms of algorithm design techniques, application of these design techniques for real-world problem solving and analysis of complexity and correctness of algorithms.

Course Outcomes

CO1: Analyze the time and space complexity of algorithms using asymptotic notations and recurrence relations, and apply techniques such as the Master Theorem to evaluate the efficiency of recursive algorithms.
CO2: Design and implement efficient algorithms using the divide and conquer paradigm (such as merge sort, quicksort, and binary search) and analyze their correctness and complexity using recurrence-based methods.
CO3: Formulate and solve optimization problems by applying greedy algorithms (such as Kruskal's, Prim's, and Huffman coding) and dynamic programming techniques (such as matrix chain multiplication, longest common subsequence, and 0/1 knapsack).
CO4: Design and analyze advanced graph algorithms including shortest path algorithms (Dijkstra's, Bellman-Ford, Floyd-Warshall), network flow, and topological sorting, and apply them to model real-world computational problems.
CO5: Classify problems into complexity classes (P, NP, NP-Complete, NP-Hard), demonstrate NP-completeness through polynomial-time reductions, apply advanced strategies such as backtracking, branch and bound, randomized, quantum and approximation algorithms to deal with them.

CO-PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	1	0						2		
CO2	3	3	3	2	1						2		
CO3	3	3	3	3	2						2	1	
CO4	3	3	3	3	2				1		2	1	
CO5	2	3	3	3	2			1			3		2

Syllabus

Unit 1

Introduction and Review-Review of Asymptotic notation: motivation and types of notations. Recurrence relations and methods to solve them: Recursion tree, Substitution, Master Method. Review of Sorting: Bubble –Insertion – Selection –Bucket – Heap, Comparison of sorting algorithms, Applications. Divide and Conquer: Merge sort, Quick Sort, Quick Select and Binary search type strategies, Pivot based strategies – Long integer multiplication – Maximum sub array sum - Closest Pair problem, convex hull etc. as examples. Greedy Algorithm - Introduction, Fractional Knapsack problem, Task Scheduling Problem, Huffman coding etc as examples.

Unit 2

Dynamic Programming: Introduction, Fibonacci numbers, 0-1 Knapsack problem, Matrix chain multiplication problem, Longest Common Subsequence, Optimal Binary search Tree and other problems including problems incorporating combinatorics as examples. Backtracking, Branch and Bound 0-1 Knapsack, N- Queen problem, subset sum as some examples. String Matching: Rabin Karp, Boyer Moore, KMP. Network Flow and Matching: Flow Algorithms Maximum Flow – Cuts Maximum Bipartite Matching.

Unit 3

Graph Algorithms – Graph Traversal: Applications of BFS: distance, connectivity and connected components and cycles in undirected graphs. Applications of DFS: Topological sort, cycles in directed graphs, Biconnected Components and Strong Connectivity. Path algorithms: shortest path algorithms (along with analysis) SSSP: Bellman Ford. APSP: Floyd Warshall's. Review of Minimum Spanning Tree (with analysis and applications). Introduction to NP class: Definitions P, NP, SAT problem NP complete, NP hard, Examples of P and NP. Quantum Complexity Classes - BPP (Bounded-error Probabilistic Polynomial-time), EQP (Exact Quantum Polynomial time), BQP (Bounded-Error Quantum Polynomial Time), Relationship between P, NP, and BQP.

Textbook(s)

Michael T Goodrich and Roberto Tamassia, "Algorithm Design and Applications ", John Wiley & Sons Inc, 2014

Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein, "Introduction to Algorithms", Fourth Edition, Prentice Hall of India Private Limited, 2022

Reference(s)

Dasgupta S, Papadimitriou C and Vazirani U, "Algorithms", Tata McGraw-Hill, 2009.

Jon Kleinberg, Eva Tardos. "Algorithm Design". First Edition, Pearson Education India; 2013.

McConnell, J. J. "Analysis of Algorithms: An Active Learning Approach", 2nd edn. Jones & Bartlett Learning, 2001 Russell, Stuart J. "Artificial intelligence a modern approach". Pearson Education, Inc., 2010.New ReferenceNew Reference

Evaluation Pattern: 70:30

Assessment	Internal	External
Midterm	20	
Continuous Assessments Theory (CAT)	10	
Continuous Assessments Lab (CAL)	40	
End Semester		30

*CA – Can be Quizzes, Assignment, Lab Practice, Projects, and Reports

26CSQ212	MACHINE LEARNING	L-T-P-C: 3-0-2-4

Course Objectives

- Machine learning covers significant ground in various verticals – including image recognition, medicine, cyber security, facial recognition, business analytics etc. Study of ML lays a strong foundation for the study on NLP, Deep Learning, Reinforcement Learning, Graphical Models, AI, Predictive Analytics etc
- The aim of this course is to provide foundational knowledge in machine learning.
- The students will learn to implement, train and validate the machine learning models and understand the recent algorithms in machine learning through case studies.
- Pre-Requisite(s): 26MATXXX Linear Algebra, 26MATXXX Probability and Random Processes

Course Outcomes

CO1: Explain the fundamental concepts of machine learning including types of learning (supervised, unsupervised, and reinforcement learning), the model training pipeline, bias-variance tradeoff, and evaluation metrics such as accuracy, precision, recall, and F1-score.

CO2: Implement and apply supervised learning algorithms — including linear regression, logistic regression, decision trees, support vector machines, and k-nearest neighbors — to build predictive models and evaluate their performance on real-world datasets.

CO3: Design and implement unsupervised learning methods such as k-means clustering, hierarchical clustering, and DBSCAN, and apply dimensionality reduction techniques including Principal Component Analysis (PCA) to extract meaningful patterns from unlabeled data.

CO4: Construct and evaluate ensemble learning models (bagging, boosting, and random forests) and design feedforward neural networks, applying backpropagation and optimization techniques to solve classification and regression problems.

CO5: Formulate end-to-end machine learning solutions for real-world engineering problems — including data preprocessing, feature engineering, model selection, tuning, and deployment considerations — while critically evaluating issues of fairness, bias, interpretability, and ethical implications of ML systems.

CO-PO Mapping

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

Syllabus

Unit 1

Introduction to machine learning, Types of Machine learning, features, class boundary, Training, Validation & Testing, Generalization - underfit, regular fit and overfit; Loss /Cost function; Issues of Explainability, algorithmic bias, data and algorithmic privacy. Curse of Dimensionality, Dimensionality Reduction Techniques – Principal component analysis, Linear Discriminant Analysis, Feature selection – sequential & bi-directional. K-Nearest Neighbour classifier, Regression: Linear, logistic, introduction to Regularization- LASSO, Ridge. Classifier Performance metrics – precision, recall, accuracy, f-score, AUC, Regression Performance metrics –RMSE, MAPE, R2 Score.

Unit 2

Supervised learning: Decision Trees, Support vector machines, Naive Bayes, Markov model, Hidden Markov Model, Artificial Neural Network - Perceptron & MLP with learning algorithms, Parameter Estimation: MLE and Bayesian Estimate, Expectation Maximization, Stacking Models, Explainability with LIME / SHAP.

Unit 3

Unsupervised learning- Clustering – hierarchical & agglomerative, K means algorithm, cluster evaluation – Elbow technique; Ensemble learning – Bagging and boosting- Adaboost, Random Forest. Introduction to Reinforcement learning. Implementation of machine learning algorithms on real world problems and analyze their performance by tuning hyper parameters.

Textbook(s)

Tom Mitchell, "Machine Learning". McGraw Hill, 2017.

Reference(s)

Kevin P. Murphey. "Machine Learning", a probabilistic perspective. MIT Press, 2012.

Christopher M Bishop. "Pattern Recognition and Machine Learning". Springer 2010.

Richard O. Duda, Peter E. Hart, David G. Stork. "Pattern Classification". Wiley, Second Edition, 2007.

Trevor Hastie, Robert Tibshirani, Jerome Friedman. "The Elements of Statistical Learning: Data Mining, Inference, and Prediction". Springer, 2017.

Pang-Ning Tan, Michael Steinbach, Vipin Kumar, "Introduction to Data Mining", Pearson Education, 2016

Konstantinos Koutroumbas, Sergios Theodoridis, "Pattern Recognition", 4th Edition, Academic Press, 2008

Evaluation Pattern: 70:30

Assessment	Internal	External
Midterm	20	
*Continuous Assessment Theory (CAT)	10	
*Continuous Assessment Lab (CAL)	40	
**End Semester		30

*CAT includes Quizzes and Tutorials

*CAL – Can be Lab Assessments, Project, Case Study and Report

**End Semester can be theory examination/ lab-based examination/ project presentation

26CSQ213	FUNDAMENTALS OF QUANTUM COMPUTING	L-T-P-C: 3-0-0-3

Course Objectives

- Introduce the foundational principles of quantum computation, emphasizing differences between classical and quantum models of information processing.
- Develop a working knowledge of qubits, quantum gates, and quantum circuits as the basic building blocks of quantum computers
- Provide an understanding of quantum algorithms that demonstrate computational advantages over classical algorithms
- Explain fundamental limitations and principles of quantum computation, including measurement, no-cloning, and query complexity.

Course Outcomes

CO1: Understand the basic principles of quantum computing, including qubits, superposition, entanglement, and quantum measurement.

CO2: Design and analyze simple quantum circuits using quantum gates and circuit operations

CO3: Explain fundamental quantum algorithms and their advantages over classical approaches.

CO-PO Mapping

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

Syllabus

Unit 1

Foundations of Quantum Computation: Classical computation vs quantum computation, Types of Quantum Computers, Review of linear algebra and Dirac notation, Hilbert spaces, Unitary, Hermitian, and Normal matrices, Inner product, Outer product, Tensor product. Postulates of quantum mechanics, Quantum Measurement, Qubit, Bloch ball, Quantum Entanglement: Bell state, Quantum Teleportation, Superdense coding.

Unit 2

Quantum Gates and Quantum Circuits: Classical bits Vs Quantum bits, Single-qubit gates: Pauli, Hadamard, phase, rotation gates, multi-qubit gates: CNOT, controlled-U, Toffoli, Universal gate sets, Quantum circuits and circuit identities, Reversible computing, no-cloning theorem.

Unit 3

Quantum Algorithms: Quantum Parallelism, Quantum Oracle, Deutsch and Deutsch-Jozsa Algorithms, Bernstein-Vazirani Algorithm, Simon's Algorithm, Quantum Fourier Transform, Quantum Phase Estimation, Shor's algorithm, Grover's Search Algorithm: amplitude amplification, query complexity and optimality.

Textbook(s)

Nielsen MA, Chuang IL. "Quantum computation and quantum information". Cambridge university Press, 2010
Eleanor Rieffel and Wolfgang Polak. "Quantum Computing: A Gentle Introduction". MIT Press, 2011

Evaluation Pattern: 60:40

Assessment	Internal	External
Midterm Exam	20	
Continuous Assessment Theory (CAT)	40	
End Semester		40

*CAT – Can be Quizzes, Assignments, and Reports, and Programming assignments

26CSQ282	QUANTUM COMPUTING LAB	L-T-P-C: 0-0-2-1

Course Objectives

- Introduce students to quantum computing platforms and simulation tools.
- Develop practical skills in designing and simulating quantum circuits using qubits and quantum gates.
- Enable implementation of basic quantum algorithms and analysis of their outputs
- Provide hands-on understanding of quantum concepts such as superposition, entanglement, and quantum measurement.

Course Outcomes

CO1: Provide hands-on understanding of quantum concepts such as superposition, entanglement, and quantum measurement.

CO2: Design and simulate quantum circuits using quantum gates and circuit operations.

CO3: Implement and analyze fundamental quantum algorithms and interpret their results.

CO-PO Mapping

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

Syllabus

The list of programs could be aligned with the following topics:

- Introduction to quantum computing platforms and simulators (Qiskit / Cirq / Quirk).
- Programs on qubit representation and quantum state visualization.
- Implementation of basic two bit and multibit quantum gates: Pauli-X, Pauli-Y, Pauli-Z, Hadamard, Phase gates, Tofolli etc
- Design and simulation of simple quantum circuits.
- Implementation of superposition using Hadamard gates, generation and analysis of entangled states and Bell states.
- Programs on quantum measurement and probability analysis.
- Implementation of quantum teleportation.
- Implementation of Quantum algorithms like - Deutsch–Jozsa algorithm, Simon’s algorithm, Grover’s search algorithm, Shor’s factorization algorithm for small integers.
- Mini project on quantum circuit design and applications.

Evaluation Pattern: 80:20

Assessment	Internal	External
Midterm Exam (Lab Exam)	30	
Continuous Assessment – Lab (*CAL)	50	
End Semester (Project)		20

CAL – Can be Lab assessments, Viva, Quiz, Project, and Report

26CSQ214	DATABASE MANAGEMENT SYSTEMS	L-T-P-C: 3-0-2-4

Course Objectives

- This course aims to understand the concept of database design, database languages, database-system implementation, and maintenance.

Course Outcomes

CO1: Design ER models for real world databases

CO2: Apply the principles of Normalization to improve the design of databases for real world applications.

CO3: Formulate queries over relational databases using SQL and PL/SQL

CO4: Apply the principles of indexing, transaction processing and concurrency control.

CO5: Apply the concepts of NoSQL databases.

CO-PO Mapping

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

Syllabus

Unit 1

Introduction: Overview of DBMS fundamentals – Overview of Relational Databases and Keys. Relational Data Model: Structure of relational databases – Database schema. Database Design: Overview of the design process - The E-R Models – Constraints - Removing Redundant Attributes in Entity Sets - E-R Diagrams - Reduction to Relational Schemas - Entity Relationship Design Issues - Extended E-R Features – Alternative E-R Notations.

Unit 2

Relational Database Design: Features of Good Relational Designs - Atomic Domains and 1NF - Decomposition using Functional Dependencies: 2NF, 3NF, BCNF and Higher Normal Forms. Functional Dependency Theory - Algorithm for Decomposition – Decomposition using multi-valued dependency: 4NF and 4NF decomposition. Database design process and its issues. SQL: review of SQL – Intermediate SQL – Advanced SQL.

Unit 3

File Organization – Indexing and Hashing - Storage Structure - Transactions: Transaction concepts- ACID Properties – Serializability – Recoverable schedules, Cascadeless schedules. Need for Concurrency -Locking Protocols- Deadlock and Recovery. Overview and applications of NoSQL databases – MongoDB, Neo4j/GraphDB.

Textbook(s)

Silberschatz A, Korth HF, Sudharshan S. "Database System Concepts". Seventh Edition, TMH publishing company limited; 2019.

Reference(s)

Garcia-Molina H, Ullman JD, Widom J. “Database System; The complete book”. Second Edition, Pearson Education India, 2011.

Elmasri R, Navathe SB. “Fundamentals of Database Systems”. Seventh Edition, Addison Wesley; 2017.

Ramakrishnan R, Gehrke J. “Database Management Systems”. Third Edition, TMH; 2003.

Evaluation Pattern: 70:30

Assessment	Internal	External
Midterm	20	
*Continuous Assessment Theory (CAT)	10	
*Continuous Assessment Lab (CAL)	40	
**End Semester		30 (50 Marks; 2 hours exam)

*CAT includes Quizzes and Tutorials

*CAL – Can be Lab Assessments, Project, Case Study and Report

**End Semester can be theory examination/ lab-based examination

23LSE211	LIFE SKILLS FOR ENGINEERS II	L-T-P-C: 1-0-2-2

Course Objectives

- Assist students in inculcating Soft Skills and developing a strong personality.
- Help them improve their presentation skills.
- Aid them in developing their problem solving and reasoning skills.
- Aid them in developing their problem solving and reasoning skills.

Course Outcomes

CO1: Soft Skills: To develop greater morale and positive attitude to face, analyse, and manage emotions in real life situations, like placement process.

CO2: Soft Skills: To empower students to create better impact on a target audience through content creation, effective delivery, appropriate body language and overcoming nervousness, in situations like presentations, Group Discussions and interviews.

CO3: Aptitude: To analyze, understand and employ the most suitable methods to solve questions on arithmetic and algebra.

CO4: Aptitude: To investigate and apply suitable techniques to solve questions on logical reasoning and data analysis.

CO5: Verbal: To learn to use more appropriate words in the given context. To have a better understanding of the nuances of English grammar and become capable of applying them effectively.

CO6: Verbal: To be able to read texts critically and arrive at/ predict logical conclusions. To learn to organize speech and incorporate feedback in order to convey ideas with better clarity.

CO-PO Mapping

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

Syllabus

Unit 1 - Soft Skills

Unit 2

Problem Solving II

Equations: Basics, Linear, Quadratic, Equations of Higher Degree and Problems on ages.

Logarithms, Inequalities and Modulus: Basics

Time and Work: Basics, Pipes & Cistern, and Work Equivalence.

Time, Speed and Distance: Basics, Average Speed, Relative Speed, Boats & Streams, Races and Circular tracks.

Logical Reasoning: Arrangements, Sequencing, Scheduling, Venn Diagram, Network Diagrams, Binary Logic, and Logical Connectives.

Unit 3 - Verbal

Vocabulary: Aid students learn to use their vocabulary to complete the given sentences with the right words. Usage of more appropriate words in different contexts is emphasized.

Grammar (Basic-intermediate): Help students master usage of grammatical forms and enable students to identify errors and correct them.

Reasoning: Emphasize the importance of avoiding the gap (assumption) in arguments/ statements/ communication.
Reading Comprehension (Basics): Introduce students to smart reading techniques and help them understand different tones in comprehension passages.
Speaking Skills: Make students be aware of the importance of impactful communication through individual speaking activities in class.
Writing Skills: Introduce formal written communication and keep the students informed about the etiquette of email writing.

Reference(s)

Students" Career Planning Guide, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
Soft Skill Handbook, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
*Adair. J., (1986), "Effective Team Building: How to make * winning team", London, U.K*
Gulati. S., (1006) "Corporate Soft Skills", New Delhi, India: Rupa & Co
The hard truth about Soft Skills, by Amazon Publication
Verbal Skills Activity Book, CIR, AVVP
English Grammar & Composition, Wren & Martin
Nova's GRE Prep Course, Jeff Kolby, Scott Thornburg & Kathleen Pierce
Cracking the New GRE 2012
Kaplan's – GRE Comprehensive Programme
Student Workbook: Quantitative Aptitude & Reasoning, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
Quantitative Aptitude for All Competitive Examinations, Abhijit Guha.
How to Prepare for Quantitative Aptitude for the CAT, Arun Sharma..
How to Prepare for Data Interpretation for the CAT, Arun Sharma

Evaluation Pattern: 60:40

Assessment	Internal	External
Continuous Assessment (CA) – Soft Skills	30	
Continuous Assessment (CA) – Aptitude	10	25
Continuous Assessment (CA) – Verbal	10	25
Total	50	50

*CA - Can be presentations, speaking activities and tests.

26CUL200	**INTEGRATED AMRITA MEDITATION TECHNIQUE (IAM)**	**L-T-P-C: 0-0-2-1**

Course Objectives

- The course introduces students to the Integrated Amrita Meditation Technique (IAM 20), a structured practice that combines yogic stretches, regulated breathing (pranayama), and guided meditation. The course integrates both theoretical understanding and experiential practice to enhance emotional balance, stress resilience, concentration, and overall holistic development.
- Aligned with United Nations Sustainable Development Goal 3 (SDG 3): Good Health and Well-Being, the course promotes preventive mental health care, emotional well-being, and sustainable lifestyle practices among students. By fostering inner stability, self-awareness, and self-regulation, the programme supports academic excellence and contributes to the development of healthy individuals and communities.
- The course is expected to improve student well-being, enhance academic focus and cognitive clarity, reduce stress-related indicators, and promote compassionate and emotionally supportive culture.
- To promote overall health and well-being of students.
- To train students in the structured practice of IAM 20.
- To develop emotional regulation and stress management skills.
- To encourage reflective awareness and compassionate living.

Course Outcomes

CO1: Explain principles and components of IAM 20 (L2)
CO2: Demonstrate and correct meditation practice independently (L3)
CO3: Analyze personal stress patterns using meditation insights (L4)
CO4: Evaluate personal growth through daily practice (L5)

CO-PO Mapping

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

Syllabus

Unit 1 - Foundations of Meditation (CO1)

· Meaning and purpose of meditation
· Demonstration and supervised training
· Overview of structure of IAM
· Guidance for safe and effective practice
· Importance of mental health

Unit 2 - Theoretical Foundations (CO2)

· Structure and components of IAM: yogic stretches, regulated breathing, and guided meditation
· Breath–mind connection
· Integration of IAM practice into daily routine and academic life
· Application of IAM for stress management, concentration, and holistic student development

Unit 3 - IAM Practical Training (CO3)

· Preparatory stretches
· Pranayama components
· Guided meditation sequence
· Corrections and common challenges

Unit 4 - Integration and Transformation (CO4)

· Building daily discipline
· Research evidence in higher education
· Compassion and mindful communication

Evaluation Pattern: 60:40

Assessment	Internal	External
Attendance	20	
Class participation	20	
Activity	20	
Practical Demonstration		30
Viva		10

SEMESTER 5

26CSQ301	THEORY OF COMPUTATION	L-T-P-C: 3-1-0-4

Course Objectives

- This course provides an overview of the problems that can be solved by various kinds of abstract machines such as finite state machines, pushdown automata and Turing machines.
- This course deals with how efficiently problems can be solved on a model of computation, using an algorithm.
- This course gives an overview on how a real-world problem could be formalized into a mathematical problem (computational model)

Course Outcomes

CO1: Analyse the properties of regular languages and construct finite state machines.

CO2: Understand the properties of context free languages and construct push down automata.

CO3: Understand the decidability of a problem and construct Turing machines for decidable problems.

CO4: Apply formal languages and automata for a real-world scenario.

CO-PO Mapping

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

Syllabus

Unit 1

Finite State machines –Deterministic finite state machine – Non-Deterministic finite state machine- Equivalence of NFA and DFA –Minimization of Finite State Machine – Regular Expression - Regular Language – Properties of Regular Languages. Designing Finite automata for real world problems.

Unit 2

Context Free Grammar – Derivations and Parse Tree - Pushdown Automata – Variants of Pushdown automata – Equivalence between PDA and CFG - Context Free Languages – Properties of CFL – Normal Forms. Designing push down automata for real world problems.

Unit 3

Context Sensitive Language- Linear Bound Automata- Turing Machine – Variants of Turing Machine – Decidability- Post correspondence problem – Introduction to undecidable problems. Case study on formalizing real world decidable and undecidable problems.

Textbook(s)

Linz P, Susan H. Rodger. An introduction to formal languages and automata. Seventh edition, Jones and Bartlett Publishers; 2022.

Reference(s)

Hopcroft JE, Motwani R, Ullman JD. Introduction to Automata Theory, Languages and Computation. Third Edition, Pearson; 2014.
Sipser M. Introduction to the Theory of Computation. Third Edition Cengage Publishers; 2012.
Martin JC. Introduction to Languages and the Theory of Computation. Fourth Edition McGraw-Hill; 2010.

Evaluation Pattern: 60:40

Assessment	Internal	External
Midterm	20	
*Continuous Assessment (CA)	40	
End Semester		40

*CA – Can be Quizzes, Assignment, Tutorials, Projects, and Reports

26CSQ302	COMPUTER NETWORKS	L-T-P-C: 3-0-2-4

Course Objectives

- This course introduces the fundamental principles of computer networks including important layers and protocols
- This course will focus on the most important layers including application layer, transport layer, network layer and link layer along with their functionalities.
- This course will help students to understand the design of the computer networks for real-time applications.

Course Outcomes

CO1: Understand the fundamentals of computer networks, network architectures, reference models, and communication protocols.

CO2: Apply network application services, protocols and programming for real-world applications.

CO3: Analyze protocols for data transfer mechanisms, buffer management and flow handling mechanisms

CO4: Apply various routing protocols and analyze routing protocols in the event of changes in network topology

CO5: Apply error handling mechanisms and Analyze network access protocols for the design of Local Area Network

CO6: Understand concepts of virtualization and data centric networking.

CO-PO Mapping

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

Syllabus

Unit 1

The Internet-The Network Edge, the Network Core, Network Topology, Types of Networks, Delay, Loss, and Throughput in Packet Switched Networks. Protocol Layers and their Service Models. Principles of Network Applications: The Web and HTTP, File Transfer: FTP, Electronic Mail in the Internet, DNS, Peer-to-Peer Applications. Video streaming and Content Distribution Networks.

Unit 2

Introduction and Transport Layer Services: Multiplexing and demultiplexing, Connectionless Transport - UDP, Principles of Reliable Data Transfer.

Transport layer - Connection Oriented Transport - TCP, Principles of Congestion Control, TCP Congestion Control.

Introduction Network Layer: Virtual Circuit and Datagram Networks, Inside a Router, The Internet Protocol (IP) - Forwarding and Addressing in the Internet, Routing Algorithms, Routing in the Internet, Broadcast and Multicast Routing.

Unit 3

The Link Layer and Local Area Networks - Introduction and Services, Error-Detection and Correction Techniques, Multiple Access Protocols - Link-Layer Addressing, Ethernet, Link-Layer Switches. Physical layer: basics of digital & analog signals, data communication, characteristics of media, signal, noise, attenuation, SNR.

Link Virtualization: A Network as a Link Layer, Multiprotocol Label Switching (MPLS), Introduction to Software Defined Networks,

Case Study: Data center Networking – Architecture and recent trends in Data center networking.

Textbook(s)

Kurose J F and Ross K W. “Computer Networking: A Top-Down Approach”. Eighth Edition, Pearson Press, 2021.

Reference(s)

Tanenbaum A S. “Computer Networks”. Sixth Edition, Pearson Education India; 2021.

Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Elsevier Science, 2021.

Forouzan B A. “Data Communication and Networking”. Fourth Edition, Tata McGraw Hill; 2017.

Evaluation Pattern: 70:30

Assessment	Internal	External
Midterm	20	
*Continuous Assessment (Theory) (CAT)	20	
*Continuous Assessment (Lab) (CAL)	30	
**End Semester		30 (50 Marks; 2 hours exam)

*CAT includes Quizzes, Assignments and Tutorials

*CAL – Can be Lab Assessments, Project, Case Study and Report

**End Semester can be theory examination/ lab-based examination

26CSQ303	QUANTUM MACHINE LEARNING	L-T-P-C: 3-0-2-4

Course Objectives

- Introduce the fundamental concepts of quantum computing relevant to machine learning.
- Develop an understanding of classical machine learning models and their quantum counterparts.
- Explore quantum data encoding, parameterized quantum circuits, and training strategies.
- Study representative quantum machine learning algorithms for classification, clustering, and generative modeling.
- Provide introductory experience with quantum programming tools used in quantum machine learning research.

Course Outcomes

CO1: Explain the fundamental principles of quantum computing and their relevance to machine learning tasks.

CO2: Compare classical and quantum machine learning models in terms of structure, training, and computational advantages.

CO3: Analyze parameterized quantum circuits and quantum data encoding techniques used in quantum machine learning.

CO4: Apply basic quantum machine learning algorithms to supervised, unsupervised, and generative learning problems using quantum programming frameworks.

CO-PO Mapping

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

Syllabus

Unit 1 — Foundations of Quantum Machine Learning

Overview of quantum computing for machine learning, Quantum circuits and basic quantum algorithms, Classical vs. quantum machine learning: motivation and scope, Examples of basic machine learning problems, Risk minimization and training concepts, Linear models in classical machine learning, Introduction to quantum programming frameworks: Qiskit/PennyLane.

Unit 2 — Parameterized Quantum Circuits and Learning Models

Parameterized (variational) quantum circuits, Training quantum models and optimization challenges, Quantum data encoding techniques, Quantum feature maps, Quantum kernel estimation and kernel-based learning, Classical and quantum principal component analysis (PCA), Clustering methods and quantum k-nearest neighbours, Quantum classifiers.

Unit 3 — Advanced Quantum Machine Learning Models

Review of Fast Fourier Transform (FFT), Quantum Fourier Transform (QFT) and applications, Classical and quantum support vector machines, Classical vs. quantum neural networks, Quantum convolutional neural networks (QCNNs), Classical and quantum generative adversarial networks (GANs).

Reference(s)

Peter Wittek, "Quantum Machine Learning – What Quantum Computing Means to Data Mining", Elsevier, 2014.

Nielsen, M. A., & Chuang, I. L., Quantum Computation and Quantum Information.Cambridge University Press, 2010.

Evaluation Pattern: 70:30

Assessment	Internal	External
Midterm	20	
*Continuous Assessment - Theory (CAT)	20	
*Continuous Assessment - Lab (CAL)	30	
**End Semester		30 (50 marks; 2 hours exam

*CAT includes Quizzes and Tutorials

*CAL – Can be Lab Assessments, Project, Case Study and Report

**End Semester can be theory examination/ lab-based examination/project

26CSQ304	QUANTUM INFORMATION THEORY	L-T-P-C: 3-0-0-3

Course Objectives

- · Provide students with the mathematical and information-theoretic foundations necessary for the study of quantum information theory.
- · Develop a rigorous understanding of quantum states, entanglement, and nonclassical correlations as physical and informational resources.
- · Introduce the formalism of quantum measurements, open quantum systems, and quantum operations, emphasizing their operational and information-processing interpretations.
- · Bridge classical and quantum information theory, highlighting similarities, differences, and fundamental limits of communication.

Course Outcomes

CO1: Apply concepts from probability theory, linear algebra, and classical information theory to analyze problems in quantum information theory.
CO2: Formulate and analyze quantum states and correlations using density matrices and explain the roles of entanglement and nonlocality in quantum information processing.
CO3: Describe and mathematically represent quantum measurements, open quantum dynamics, and quantum operations.
CO4: Evaluate fundamental limits and protocols of quantum communication, in comparison with classical information-theoretic limits.

CO-PO Mapping

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

Syllabus

Unit 1 — Mathematical Preliminaries:

Review of probability theory (random variables, joint/conditional distributions), Law of large numbers and concentration inequalities (Markov, Chebyshev, Hoeffding), Shannon entropy and typical sequences. Linear Algebra: Operator spaces and norms (trace norm, operator norm, Hilbert–Schmidt norm), Spectral theorem, Tensor products, Basics of convex sets and extreme points.

Unit 2 — Quantum states, entanglement and nonclassical correlations:

Density matrices and partial trace, Schmidt decomposition and state purification, Bipartite vs multipartite entanglement, Entanglement measures (entropy of entanglement, concurrence), Separability and entanglement criteria, Bell's inequalities, non-locality.

Unit 3 — Generalized Measurements and Open dynamics:

Projective measurements, Generalized measurements, Positive Operator-Valued Measures (POVMs), Open quantum systems, Completely Positive maps and representations of quantum operations. Introduction to Noise Channels: Bit-flip, Phase-flip, and Depolarizing models.

Unit 4 — Quantum Information Theory:

Review of classical information theory, Shannon's source coding theorem, Channel capacity, Mutual information, Quantum entropy measures, Strong subadditivity, Typical subspaces and Schumacher compression, Holevo bound and limits of quantum communication.

Textbook(s)

Nielsen MA, Chuang IL. "Quantum computation and quantum information". Cambridge university press;2010
Schumacher B and Westmoreland M, Quantum Processes, Systems, & Information, Cambridge University Press, 2010

Reference(s)

Wilde, M. M. "Quantum Information Theory". Cambridge University Press; 2017. Second Edition.

Evaluation Pattern: 60:40

Assessment	Internal	External
Midterm Exam	20	
*Continuous Assessment – Theory (CA)	40	
**End Semester		40

*CAT includes Quizzes/Tutorials/Case study

23LSE301	LIFE SKILLS FOR ENGINEERS III	L-T-P-C: 1-0-2-2

Course Objectives

- Help students understand corporate culture, develop leadership qualities and become good team players
- Assist them in improving group discussion skills
- Help students to sharpen their problem solving and reasoning skills
- Empower students to communicate effectively

Course Outcomes

CO1: Soft Skills: To improve the inter-personal communication and leadership skills, vital for arriving at win-win situations in Group Discussions and other team activities.
CO2: Soft Skills: To develop the ability to create better impact in a Group Discussions through examination, participation, perspective-sharing, ideation, listening, brainstorming and consensus.
CO3: Aptitude: To identify, investigate and arrive at appropriate strategies to solve questions on geometry, statistics, probability and combinatorics.
CO4: Aptitude: To analyze, understand and apply suitable methods to solve questions on logical reasoning.
CO5: Verbal: To be able to use diction that is more refined and appropriate and to be competent in spotting grammatical errors and correcting them.
CO6: Verbal: To be able to logically connect words, phrases, sentences and thereby communicate their perspectives/ideas convincingly.

CO-PO Mapping

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

Syllabus

Unit 1 - Soft Skills

Professional Grooming and Practices: Basics of corporate culture, key pillars of business etiquette – online and offline: socially acceptable ways of behavior, body language, personal hygiene, professional attire and Cultural adaptability and managing diversity. Handling pressure, multi-tasking. Being enterprising. Adapting to corporate life: Emotional Management (EQ), Adversity Management, Health consciousness. People skills, Critical Thinking and Problem solving.
Group Discussions: Advantages of group discussions, Types of group discussion and Roles played in a group discussion. Personality traits evaluated in a group discussion. Initiation techniques and maintaining the flow of the discussion, how to perform well in a group discussion. Summarization/conclusion.

Unit 2 - Aptitude

Problem Solving III
Geometry: 2D, 3D, Coordinate Geometry, and Heights & Distance.
Permutations & Combinations: Basics, Fundamental Counting Principle, Circular Arrangements, and Derangements.
Probability: Basics, Addition & Multiplication Theorems, Conditional Probability and Bayes' Theorem.
Statistics: Mean, Median, Mode, Range, Variance, Quartile Deviation and Standard Deviation.
Logical Reasoning: Blood Relations, Direction Test, Syllogisms, Series, Odd man out, Coding

\& Decoding, Cryptarithmetic Problems and Input - Output Reasoning.

Unit 3 - Verbal

Vocabulary: Create an awareness of using refined language through idioms and phrasal verbs. Grammar (Upper Intermediate-Advanced): Train Students to comprehend the nuances of Grammar and empower them to spot errors in sentences and correct them.
Reasoning: Enable students to connect words, phrases and sentences logically.
Oral Communication Skills: Aid students in using the gift of the gab to interpret images, do a video synthesis, try a song interpretation or elaborate on a literary quote.
Writing Skills: Practice closet tests that assess basic knowledge and skills in usage and mechanics of writing such as punctuation, basic grammar and usage, sentence structure and rhetorical skills such as writing strategy, organization, and style.

Reference(s)

1. *Students" Career Planning Guide, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.*
2. *Soft Skill Handbook, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.*
3. *Adair. J., (1986), "Effective Team Building: How to make * winning team", London, U.K*
4. *Gulati. S., (1006) "Corporate Soft Skills", New Delhi, India: Rupa & Co.*
5. *The hard truth about Soft Skills, by Amazon Publication.*
6. *Verbal Skills Activity Book, CIR, AVVP*
7. *Public Sector – Engineer Management Trainee R*
8. *Nova's GRE Prep Course, Jeff Kolby, Scott Thornburg & Kathleen Pierce*
9. *English Grammar & Composition, Wren & Martin*
10. *Student Workbook: Quantitative Aptitude & Reasoning, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.*
11. *Quantitative Aptitude for All Competitive Examinations, Abhijit Guha.*
12. *How to Prepare for Quantitative Aptitude for the CAT, Arun Sharma.*
13. *How to Prepare for Data Interpretation for the CAT, Arun Sharma.*
14. *How to Prepare for Logical Reasoning for the CAT, Arun Sharma.*
15. *Quantitative Aptitude for Competitive Examinations, R S Aggarwal.*
16. *A Modern Approach to Logical Reasoning, R S Aggarwal.*
17. *A Modern Approach to Verbal & Non-Verbal Reasoning, R S Aggarwal.*

Evaluation Pattern: 60:40

Assessment	Internal	External
Continuous Assessment (CA) – Soft Skills	30	
Continuous Assessment (CA) – Aptitude	10	25
Continuous Assessment (CA) – Verbal	10	25
Total	50	50

*CA - Can be presentations, speaking activities and tests.

23LIV390	LIVE-IN –LABS I***	L-T-P-C: 3-0-0-[3]

Course Objectives

- Understand the principles of Human Centered Design, Participatory Rural Appraisal, Sustainable Change Agents, Ethnographic Action Research and User Need Assessment.
- Learn the various tools, techniques and templates used in the mentioned concepts to identify the challenges in the villages.
- Design a sustainable technological intervention for the identified challenge.

Course Outcomes

CO1: Learn ethnographic research and utilise the methodologies to enhance participatory engagement
CO2: Prioritize challenges and derive constraints using Participatory Rural Appraisal
CO3: Identify and formulate the research challenges in rural communities
CO4: Design solutions using human centered approach

CO-PO Mapping

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

Syllabus

Unit 1 - Participatory Rural Appraisal (PRA)

Concept, Principles and Philosophy of PRA. Scope and Dimensions of PRA. Important Tools for PRA. Application of PRA.

Unit 2 - Human Centered Design I (HCD)

Fundamentals of Human Centered Design. Design Process. User Experience. User Research. Data Analysis. Ideation.

Unit 3 - Sustainable Social Change

Case Study. Introduction. Understanding and identifying the Community Communication Channels

Textbook(s)

There are no required textbooks for this course; all articles, reports and research papers assigned as required reading will be shared with the students by Live-in-Labs® faculties.

Reference(s)

1. *Ramesh, Maneesha Vinodini, Renjith Mohan, and Soumya Menon. "Live-in-Labs: Rapid translational research and implementation-based program for rural development in India." In 2016 IEEE Global Humanitarian Technology Conference (GHTC), pp. 164-171. IEEE, 2016.*
2. *Kadiveti, Hemasagar, Sahithi Eleshwaram, Renjith Mohan, S. Ariprasath, Krishna Nandanan, SG Divya Sharma, and B. Siddharth. "Water Management Through Integrated Technologies, a Sustainable Approach for Village Pandori, India." In 2019 IEEE R10 Humanitarian Technology Conference (R10- HTC)(47129), pp. 180-185. IEEE, 2019.*
3. *Akella, Devi. "Learning together: Kolb's experiential theory and its application." Journal of Management & Organization 16, no. 1 (2010): 100-112.*

4. *Harith, J., Sreeram Kongeseri, Balu M. Menon, J. V. Sivaprasad, P. Aswathi, and Rao R. Bhavani. "Exploring Digital Tool for Participatory Rural Appraisal." International Journal of Pure and Applied Mathematics 119, no. 12 (2018): 2787-2810.*
5. *Vechakul, Jessica, "Human-Centered Design for Social Impact: Case Studies of IDEO.org and the International Development Design Summit." UC Berkeley Electronic Theses and Dissertations*
6. *Sustainable Development Strategies: A Resource Book. Organization for Economic Co-operation and Development, Paris and United Nations Development Program, New York.*
7. *Field Guide to Human-Centered Design. By IDEO.org. 1st Edition © 2015. ISBN: 978-0-9914063-1-9*

Evaluation Pattern: 0:0

Assessment	Internal	External
Workshop (Group Participation)		15
Village Visit Assignments & Reports		15
Problem Identification and Assessment		15
Ideation: Defining the Needs, Proposed Designs & Review		20
Poster Presentation		10
Research Paper Submission		25
Total		100

23ENV300	ENVIRONMENTAL SCIENCE	L-T-P-C: 0-0-0-P/F

Course Objectives

- To study the nature and facts about environment
- To appreciate the importance of environment by assessing its impact on the human world
- To study the integrated themes and biodiversity, pollution control and waste management

Course Outcomes

CO1: Ability to understand aspects of nature and environment.
CO2: Ability to analyze impact of environment on human world.
CO3: Ability to comprehend pollution control and waste management.

CO-PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1						3	3						
CO2						3	3						
CO3						3	3						

Syllabus

Unit 1

Overview of the global environment crisis – Biogeochemical cycles – Climate change and related international conventions and treaties and regulations – Ozone hole and related international conventions and treaties and regulations – Overpopulation – energy crisis – Water crisis – ground water hydrogeology – surface water resource development.

Unit 2

Ecology, biodiversity loss and related international conventions – treaties and regulations – Deforestation and land degradation – food crisis – water pollution and related International and local conventions – treaties and regulations – Sewage domestic and industrial and effluent treatment – air pollution and related international and local conventions – treaties and regulations – Other pollution (land, thermal, noise).

Unit 3

Solid waste management (municipal, medical, e-waste, nuclear, household hazardous wastes) – environmental management – environmental accounting – green business – eco-labelling – environmental impact assessment – Constitutional – legal and regulatory provisions – sustainable development.

Textbook(s)

R. Rajagopalan,“Environmental Studies – From Crisis to Cure”, Oxford University Press, 2005, ISBN 0-19- 567393-X.

Reference(s)

G.T.Miller Jr., “Environmental Science”, 11th Edition, Cenage Learning Pvt. Ltd., 2008.
Benny Joseph, “Environmental Studies”, Tata McGraw-Hill Publishing company Limited, 2008.

Evaluation Pattern: 0:0

Assessment	Internal	External

*Continuous Assessment (CA)	20	
End Semester		80

*CA - 2 Assignments: 10 X 2)

SEMESTER 6

26CSQ311	SOFTWARE ENGINEERING	L-T-P-C: 3-0-2-4

Course Objectives

- ·This course addresses issues in the engineering of software systems and development using live case studies from industries.
- ·The objectives of this course are to introduce basic software engineering concepts; to introduce the Agile Software development process; hands-on training (experiential learning) using state-of-the-art tools to understand the concepts learnt in the class.
- ·The course helps students to be industry-ready in terms processes, tools and terminologies from agile and devops point of view

Course Outcomes

CO1: Understand process models and apply Agile methodologies for proficient software process management.
CO2: Apply requirement engineering principles to analyze, model, and validate requirements for effective software solutions.
CO3: Design and implement robust software architectures and intuitive user interfaces, following industry best practices.
CO4: Implement comprehensive testing strategies to ensure high software quality.
CO5: Utilize industry-standard tools and Scrum for efficient software project management and collaboration.

CO-PO Mapping

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

Syllabus

Unit 1 - Process Models :

Overview, Introduction to Agile, Agile Manifesto, principles of agile manifesto, over-view of Various Agile methodologies - Scrum, XP, Lean, and Kanban, Agile Requirements - User personas, story mapping, user stories, estimating and prioritizing stories, INVEST, acceptance criteria, Definition of Done, Release planning Key aspects of Scrum: roles - Product Owner, Scrum Master, Team, Manager in scrum and product backlog Scrum process flow: product backlog, sprints backlog, scrum meetings, demos. How sprint works: Sprint Planning, Daily scrum meeting, updating sprint backlog, Burn down chart, sprint review, sprint retrospective. Scrum Metrics- velocity, burn down, defects carried over.

Unit 2 - Traditional process Models:

Waterfall, incremental, evolutionary, concurrent. Requirements Engineering: Tasks Initiation-Elicitation-Developing Use Cases-Building the analysis Model-Negotiation- Validation Requirements Modelling - building the analysis model, Scenario based methods, UML Models, Data Models. Design engineering Design concepts, Design models, software architecture, architectural styles and patterns, Architectural design: styles and patterns, architectural design, Refining architecture to components. Performing user interface Design-Golden Rules-User Interface Analysis and Design- Interface Analysis-Interface design steps.

Unit 3 - Testing strategies and tactics:

Unit testing, integration testing, validation and system testing, Devops.

Textbook(s)

Pressman R S, Bruce R.Maxim, "Software Engineering - A Practitioner's Approach". Eighth Edition, McGraw-Hill Education, 2019.

Reference(s)

Crowder JA, Friess S. "Agile project management: managing for success". Cham: Springer International Publishing; 2015.

Stellman A, Greene J. "Learning agile: Understanding scrum, XP, lean, and kanban". O'Reilly Media, Inc.; 2015.

Gregory J, Crispin L. "More agile testing: learning journeys for the whole team". Addison-Wesley Professional; 2015.

Rubin KS. "Essential Scrum: a practical guide to the most popular agile process". Addison-Wesley; 2012.

Cohn M. "User stories applied: For agile software development". Addison-Wesley Professional; 2004.

Evaluation Pattern: 70:30

Assessment	Internal	External
Midterm	20	
*Continuous Assessment (Theory) (CAT)	10	
*Continuous Assessment (Lab) (CAL)	40	
**End Semester		30 (50 marks; 2 hours exam)

*CAT includes Quizzes and Tutorials

*CAL – Can be Sprint Reviews, Lab Assessments, Project, Case Study and Report

**End Semester can be theory examination/ lab-based examination/ project presentation

26CSQ312	QUANTUM COMMUNICATION	L-T-P-C: 3-0-0-3

Course Objectives

- Develop the quantum optical framework required for modern quantum communication.
- Understand the generation, manipulation, transmission, and detection of quantum states of light.
- Analyze quantum communication protocols using photonic implementations.
- Introduce the challenges and opportunities in practical quantum communication systems.

Course Outcomes

CO1: Analyze the generation, manipulation, and detection of quantum states of light using fundamental quantum optical devices.

CO2: Apply quantum optical concepts to understand and evaluate quantum communication protocols such as quantum key distribution, teleportation, and superdense coding.

CO3: Assess the performance of practical quantum communication systems in the presence of optical losses, decoherence, and channel noise.

CO4: Understand current developments in quantum communication technologies, including quantum repeaters, continuous-variable communication, and quantum networks.

CO-PO Mapping

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

Syllabus

Unit 1 — Fundamentals of Quantum Optics for Quantum Communication

Review of quantum mechanics: qubits, density operators, and quantum measurements, Quantization of the electromagnetic field, Single-mode electromagnetic field, Creation and annihilation operators, Number (Fock) states, Coherent states, Thermal states and photon statistics, Quadrature operators and phase space.

Unit 2 — Manipulation and Measurement of Quantum States of Light

Polarization and path encoding of photonic qubits, Beam splitters, Phase shifters, Interferometers (Mach–Zehnder, Hong–Ou–Mandel interference), Photon detectors and measurement techniques, Single-photon sources, Entangled photon generation using spontaneous parametric down-conversion, Optical losses and decoherence.

Unit 3 — Quantum Communication Protocols

Quantum entanglement, Quantum teleportation, Superdense coding, Quantum key distribution: BB84, B92, E91 protocols, Quantum random number generation, Security principles in quantum communication.

Unit 4 — Quantum Communication Networks

Quantum channels and optical fibers, Free-space quantum communication, Quantum repeaters, Entanglement swapping, Quantum memories (overview), Continuous-variable quantum communication, Quantum internet architecture, Recent advances in satellite and long-distance quantum communication.

Textbook(s)

Quantum computation and quantum information – Nielsen and Chuang Cambridge University Press, Cambridge (2010)
Ivan B. Djordjevic, Quantum Communication, Quantum Networks and Quantum Sensing: An Applied Approach, 2nd Edition, Elsevier, 2025

Evaluation Pattern: 60:40

Assessment	**Internal**	**External**
Assignments (Minimum 2)	20	
Quiz (Minimum 2)	20	
MidTerm Exam	20	
External Exam		40

26CSQ313	QUANTUM ERROR CORRECTION	L-T-P-C: 3-0-0-3

Course Objectives

- To understand the reliability challenges in quantum computing systems arising from noise and decoherence.
- To learn the principles and methodologies of quantum error detection and correction techniques.
- To study stabilizer formalism and coding approaches for protecting quantum information.
- To explore fault-tolerant quantum computing architectures and topological error correction models.

Course Outcomes

CO1: Apply quantum error correction techniques including repetition, Shor, Steane, and five-qubit codes

CO2: Implement stabilizer-based coding methods using Pauli groups.

CO3: Evaluate fault-tolerant quantum computing models and topological error-correcting schemes including surface codes.

CO-PO Mapping

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

Syllabus

Unit 1

Basics of quantum computation: qubits, quantum states, quantum gates, measurement, density matrices, trace, partial trace; the no-cloning theorem, Quantum noise models: bit flips and phase flips, depolarizing channel, amplitude damping.

Unit 2

Quantum Error Correction: Knill-Laflamme Conditions, Repetition Code, Pauli error basis; discretization of quantum errors, Steane and Shor Codes, Stabilizer Codes, Pauli Groups, CSS Codes, Five Qubit Code. Bounds: quantum Hamming bound, quantum Singleton bound, quantum Gilbert-Varshamov bound.

Unit 3

Fault-Tolerant Quantum Computing and Topological Codes: Fault-Tolerance, Error Threshold Theorem, Topological error-correcting codes (Surface and color codes).

Textbook(s)

Nielsen MA, Chuang IL. "Quantum computation and quantum information". Cambridge University Press

D. Lidar and T. Brunn, "Quantum Error Correction", Cambridge University Press.

Frank Gaitan, Quantum Error Correction and Fault Tolerant Quantum Computing, CRC Press, 2018.

Reference(s)

John Preskill, Quantum Computing Lecture Notes, California Institute of Technology, 2024.

Evaluation Pattern: 60:40

Assessment	Internal	External
Mid Term	20	

Continuous Assessment	40	
End Semester		40

26CSQ314	COMPILER DESIGN	L-T-P-C: 3-0-2-4

Course Objectives

- This course aims at introducing the major concepts in the areas of programming language translation and compiler construction.
- The course emphasizes techniques that have direct application to the construction of customized compilers.
- The course briefly covers code optimization techniques and algorithms.

Course Outcomes

CO1: Apply theoretical concepts for the analysis of program structure and identify syntax errors.

CO2: Apply theoretical concepts to associate semantic information in the program structure and translate it into intermediate representations.

CO3: Implement language translation techniques in open-source tools.

CO4: Analyze the design of data structures for compile-time and run-time code generation.

CO5: Apply code optimization algorithms to improve the performance of the translated code.

CO-PO Mapping

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

Syllabus

Unit 1 - Overview of Compilation:

Compilers and Interpreters: Definition, Objectives, Structure, Overview of Translation. Scanners. Parsers: LL, LR and LALR. Compiler Front-End Development using ANTLR.

Unit 2 - Context-Sensitive Analysis:

Attribute Grammar, Ad Hoc Syntax Directed Translation. Intermediate Representations. Symbol Tables: Stacks, Hash Table.

Unit 3 - Procedure Abstraction:

Access Links. Introduction to Optimization: Local Value Numbering, Super local Value Numbering. Data Flow Analysis: Iterative Data-Flow Analysis, SSA. Control Flow Analysis: Eliminating Useless and Unreachable Code.

Textbook(s)

Cooper, Keith, and Linda Torczon, "Engineering a Compiler", Third Edition, Elsevier, 2022.

Reference(s)

Parr T. "Language implementation patterns: create your own domain-specific and general programming languages". Pragmatic Bookshelf; First Edition, 2010.

Mak R. "Writing compilers and interpreters: a software engineering approach". John Wiley & Sons; Third Edition, 2009.

Appel W Andrew and Jens Palesberg, "Modern Compiler Implementation in Java", Cambridge University Press, Second Edition, 2002.

Aho, Alfred V., Monica S. Lam, Ravi Sethi, and Jeffrey Ullman, "Compilers: Principles, Techniques and Tools", Prentice Hall, Second Edition, 2006.

Evaluation Pattern: 70:30

Assessment	Internal	External
Midterm	20	
*Continuous Assessment (Theory) (CAT)	10	
*Continuous Assessment (Lab) (CAL)	40	
**End Semester		30 (50 Marks; 2 hours exam)

*CAT - Can be Quizzes, Assignment, and Reports

*CAL – Can be Lab Assessments, Projects, and Reports

**End Semester can be theory examination/ lab-based examination

26CSQ399	PROJECT PHASE-I	L-T-P-C: 0-0-6-3

Course Objectives

- The initial stage of the academic project involves identification of a problem domain and demonstrating a sound knowledge on the chosen domain.
- This phase offers students an opportunity to delve into the state-of-the-art within their chosen domain.
- During this phase, students are empowered to identify real-world applications within their chosen domain of study. This enables them to gain insight into their own strengths and innovate problem statements that align with practical scenarios.

Course Outcomes

CO1: Identify ongoing developments in the chosen domain and demonstrate technical knowledge pertaining to the same.
CO2: Define a problem and carry out a thorough study on the chosen problem.
CO3: Identify the research gap in the chosen area and effectively summarize the research findings.

CO-PO Mapping

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

Evaluation Pattern: 70:30

Assessment	Internal	External
Internals	70	
Externals		30

23LSE311	LIFE SKILLS FOR ENGINEERS IV	L-T-P-C: 1-0-2-2

Course Objectives

- Help students prepare resumes and face interviews with confidence
- Support them in developing their problem-solving ability
- Assist them in improving their problem solving and reasoning skills
- Enable them to communicate confidently before an audience

Course Outcomes

CO1: Soft Skills: To acquire the ability to present themselves confidently and showcase their knowledge, skills, abilities, interests, practical exposure, strengths and achievements to potential recruiters through a resume, video resume, and personal interview

CO2: Soft Skills: To have better ability to prepare for facing interviews, analyse interview questions, articulate correct responses and respond appropriately to convince the interviewer of one's right candidature through displaying etiquette, positive attitude and courteous communication.

CO3: Aptitude: To manage time while applying suitable methods to solve questions on arithmetic, algebra and statistics.

CO4: Aptitude: To investigate, understand and use appropriate techniques to solve questions on logical reasoning and data analysis.

CO5: Verbal: To use diction that is less verbose and more precise and to use prior knowledge of grammar to correct/improve sentences.

CO6: Verbal: To understand arguments, analyze arguments and use inductive/deductive reasoning to arrive at conclusions. To be able to generate ideas, structure them logically and express them in a style that is comprehensible to the audience/recipient.

CO-PO Mapping

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

Syllabus

Unit 1 - Soft Skills:

Value of teamwork in organizations, Definition of a team. Why team? Effective team building. Parameters for a good team, roles, empowerment and need for transparent communication, Factors affecting team effectiveness, Personal characteristics of members and its influence on team. Project Management Skills, Collaboration skills.

Unit 2 - Aptitude:

Problem Solving II

Sequence and Series: Basics, AP, GP, HP, and Special Series.

Data Sufficiency: Introduction, 5 Options Data Sufficiency and 4 Options Data Sufficiency.

Logical reasoning: Clocks, Calendars, Cubes, Non-Verbal reasoning and Symbol based reasoning.

Campus recruitment papers: Discussion of previous year question papers of all major recruiters of Amrita Vishwa Vidyapeetham.

Competitive examination papers:Discussion of previous year question papers of CAT, GRE, GMAT, and other management entrance examinations.
Miscellaneous: Interview Puzzles, Calculation Techniques and Time Management Strategies.

Unit 3 - Verbal :

Vocabulary: Empower students to communicate effectively through one-word substitution. Grammar: Enable students to improve sentences through a clear understanding of the rules of grammar.
Reasoning: Facilitate the student to tap his reasoning skills through Syllogisms, critical reasoning arguments and logical ordering of sentences.
Reading Comprehension (Advanced): Enlighten students on the different strategies involved in tackling reading comprehension questions.
Public Speaking Skills: Empower students to overcome glossophobia and speak effectively and confidently before an audience.
Writing Skills: Practice formal written communication through writing emails especially composing job application emails.

Reference(s)

1. *Students" Career Planning Guide, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.*
2. *Soft Skill Handbook, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.*
3. *Adair. J., (1986), "Effective Team Building: How to make * winning team", London, U.K*
4. *Gulati. S., (1006) "Corporate Soft Skills", New Delhi, India: Rupa & Co.*
5. *The hard truth about Soft Skills, by Amazon Publication.*
6. *Verbal Skills Activity Book, CIR, AVVP*
7. *English Grammar & Composition, Wren & Martin*
8. *Public Sector – Engineer Management Trainee Recruitment Exam (General English)*
9. *Nova's GRE Prep Course, Jeff Kolby, Scott Thornburg & Kathleen Pierce*
10. *A Modern Approach to Verbal Reasoning – R.S. Aggarwal*
11. *Student Workbook: Quantitative Aptitude & Reasoning, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.*
12. *Quantitative Aptitude for All Competitive Examinations, Abhijit Guha.*
13. *How to Prepare for Quantitative Aptitude for the CAT, Arun Sharma.*
14. *How to Prepare for Data Interpretation for the CAT, Arun Sharma.*
15. *How to Prepare for Logical Reasoning for the CAT, Arun Sharma.*
16. *Quantitative Aptitude for Competitive Examinations, R S Aggarwal.*
17. *A Modern Approach to Logical Reasoning, R S Aggarwal.*
18. *A Modern Approach to Verbal & Non-Verbal Reasoning, R S Aggarwal*

Evaluation Pattern: 60:40

Assessment	Internal	External
Continuous Assessment (CA) – Soft Skills	30	
Continuous Assessment (CA) – Aptitude	10	25
Continuous Assessment (CA) – Verbal	10	25
Total	50	50

*CA - Can be presentations, speaking activities and tests.

23LIV490*	LIVE-IN –LABS II***	L-T-P-C: 3-0-0-[3]

Course Objectives

- Pre-requisites: Students can enroll for Live-in-Labs® II course only if they have successfully completed Live-in- Labs® I course by meeting all the criteria set by the Live-in-Labs® team.
- Understand the principles of a. Advanced Human Centered Design b. Co-Design c. Social Change Management Models d. Project Management e. Prototyping f. Modelling g. Field Implementation.
- Learn the various tools, techniques and templates used in the mentioned concepts to implement a sustainable intervention in the villages.
- Creating awareness and training the villagers.

Course Outcomes

CO1: Learn co-design methodologies and engage in a participatory manner to finalize a solution.
CO2: Understand sustainable social change models and identify change agents in a community.
CO3: Learn Project Management to effectively manage the resources.
CO4: Lab scale implementation and validation.
CO5: Prototype implementation of the solution.

CO-PO Mapping

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

Syllabus

Unit 1 — Co-design

Introduction to co-design. Benefits of co-design. Co-design process. Co-design tools.

Unit 2 — Project Management

Introduction to Project Management. Project Triple Constraints. Difference between project and operation. Phases of Project Management. Project Planning.

Unit 3 — Human Centered Design II (HCD)

Design Process. Design evaluation. Design implementation.

Textbook(s)

There are no required textbooks for this course; all articles, reports and research papers assigned as required reading will be shared with the students by Live-in-Labs® faculties.

Reference(s)

Ramesh, Maneesha Vinodini, Renjith Mohan, and Soumya Menon. "Live-in-Labs: Rapid translational research and implementation-based program for rural development in India." In 2016 IEEE Global Humanitarian Technology Conference (GHTC), pp. 164-171. IEEE, 2016.

Sipos, Yona, Bryce Battisti, and Kurt Grimm. "Achieving transformative sustainability learning: engaging head, hands and heart." International Journal of Sustainability in Higher Education 9, no. 1 (2008): 68-86.

Moldan, Bedřich, Svatava Janoušková, and Tomáš Hák. "How to understand and measure environmental sustainability: Indicators and targets." Ecological Indicators 17 (2012): 4-13.

Lee, Yanki. "Design participation tactics: the challenges and new roles for designers in the co-design process." Co design 4, no. 1 (2008): 31-50.

Mohan, Harish T., Krishna Nandanan, Renjith Mohan, Olamide Sadipe, Iona Williams, and Teja Potocnik. "Case Study on Co-Design Methodology for Improved Cook Stove Solutions for Rural Community in India." In 2019 IEEE R10 Humanitarian Technology Conference (R10-HTC)(47129), pp. 153-158. IEEE, 2019.

Liam J. Bannon, Pelle Ehn. 06 Aug 2012, Design from: Routledge International Handbook of Participatory Design Routledge.

Sustainable Development Strategies: A Resource Book. Organization for Economic Co-operation and Development, Paris and United Nations Development Program, New York.

A Guide to the Project Management Body of Knowledge (PMBOK® Guide), Project Management Institute.

Field Guide to Human-Centered Design. By IDEO.org. 1st Edition © 2015. ISBN: 978-0-9914063-1-9.

Evaluation Pattern: 0:0

Assessment	Internal	External
Proposed Implementation Presentation Round 1	2	
Proposal Submission + Review	6	
Co-design	6	
Prototype Design	14	
Implementation	35	
Research Paper		18
Final Report		15
Poster Presentation		4
Attendance	5	

SEMESTER 7

26CSQ401	ADVANCED QUANTUM ALGORITHMS	L-T-P-C: 3-0-2-4

Course Objectives

- Understand modern quantum algorithmic frameworks beyond Grover and Shor. Analyze quantum algorithms rigorously, including lower bounds and complexity. Apply quantum algorithmic techniques to simulation, optimization, and algebraic problems. Evaluate algorithmic limitations and explore current research directions.

Course Outcomes

CO1: Explain quantum walk and Hamiltonian simulation methods.
CO2: Design or analyze quantum algorithms using Fourier, group-theoretic, or linear-algebraic techniques.
CO3: Derive quantum query complexity lower bounds.
CO4: Critically read and present recent research papers in quantum algorithms.

CO-PO Mapping

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

Syllabus

Unit 1 - Review of Basic Quantum Algorithms

Quantum circuit model, Grover and Shor Algorithms.

Unit 2 - Quantum Walks and Fourier/Group-Theoretic Methods

Quantum walks: discrete/continuous-time, Szegedy walks, Quantum Fourier transform, Hidden Subgroup Problem (HSP), abelian and non-abelian HSP.

Unit 3 - Hamiltonian Simulation and Quantum Linear Algebra

Suzuki-Trotter formula, LCU (Linear Combination of Unitaries), qubitization, HHL algorithm, block-encoding, Quantum Singular Value Transformation (QSVT).

Unit 4 - Query Complexity, Optimization, and Algorithmic Limits

Adversary method, polynomial method, oracle separations, Quantum Approximate Optimization Algorithm (QAOA), quantum annealing, limits, speedups, and optimization strategies.

Textbook(s)

Childs, A. M., & van Dam, W. – Quantum Algorithms for Algebraic Problems, Reviews of Modern Physics, 82, 2010.
Montanaro, A. – Quantum Algorithms: An Overview, npj Quantum Information, 2016.

Evaluation Pattern: 70:30

Assessment	Internal	External
Midterm Exam	20	

Continuous Assessment – Theory (CAT)	10	
Continuous Assessment – Lab (CAL)	40	
End Semester		30 (50 Marks; 2 hours exam)

26CSQ498	PROJECT – PHASE II	L-T-P-C: 0-0-12-6

Course Objectives

- In this phase, the emphasis is on fine-tuning the problem statement through the insights obtained from the identification of any existing research gaps.
- This phase involves providing a detailed representation of the solution strategy, including modules and workflow, as well as designing the solution in terms of algorithms, diagrams, or models.
- This phase exposes the students to design-develop-debug cycle.
- The implementation of the solution is carried out in this phase.

Course Outcomes

CO1: Apply the insights from the problem analysis and literature survey to formalize the problem statement

CO2: Design effective solution(s) for the identified problem.

CO3: Implement and verify the designed solution(s).

CO-PO Mapping

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

Evaluation Pattern: 70:30

Assessment	Internal	External
Internals	70	
External		30

23LAW300	INDIAN CONSTITUITION	L-T-P-C: 0-0-0-P/F

Course Objectives

- To know about Indian constitution.
- To know about central and state government functionalities in India.
- To know about Indian society.

Syllabus

Unit 1

Historical Background – Constituent Assembly of India – Philosophical Foundations of The Indian Constitution– Preamble – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties – Citizenship – Constitutional Remedies for Citizens.

Unit 2

Union Government – Structures of the Union Government and Functions – President – Vice President – Prime Minister – Cabinet – Parliament – Supreme Court of India – Judicial Review.

Unit 3

State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts.

Textbook(s)

Durga Das Basu, "Introduction to the Constitution of India ", Prentice Hall of India, New Delhi.

R.C.Agarwal, (1997) "Indian Political System" , S.Chand and Company, New Delhi.

Reference(s)

Sharma, Brij Kishore, "Introduction to the Constitution of India", Prentice Hall of India, New Delhi.

Evaluation Pattern: 0:100

Assessment	Internal	External
Online Examination		100

SEMESTER 8

26CSQ499	PROJECT – PHASE III	L-T-P-C: 0-0-12-6

Course Objectives

- This phase of the academic project requires the students to validate their solution through appropriate empirical studies.
- This phase trains the students towards critical data analysis of their experimental results towards validating their designed solution(s).
- This phase facilitates the enhancement of students' writing skills by means of their documentation.
- This phase presents an opportunity to promote the project idea through participation in contests, contribution in conferences, journals, and potentially pursuing a patent.

Course Outcomes

CO1: Formulate comprehensive design of experiments and execute simulation studies.

CO2: Analyze the experiment results quantitatively to validate the designed solution(s).

CO3: Document the complete problem solving process and effectively communicate the findings through presentation.

CO-PO Mapping

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

Evaluation Pattern: 70:30

Assessment	Internal	External
Internals	70	
Externals		30

PROFESSIONAL ELECTIVES

26CSQ431	QUANTUM OPTICS COMPUTING AND PHOTONICS	L-T-P-C: 3-0-0-3

Course Objectives

- To understand the principles of optics, light propagation, interference, diffraction, and polarization in photonic systems.
- To learn the operating principles of lasers, optical sources, photodetectors, and light-matter interaction mechanisms.
- To study photonic approaches for quantum information representation and manipulation using optical components.
- To explore linear optical quantum computing models and photonic implementations of quantum communication and computation systems.

Course Outcomes

CO1: Analyze optical phenomena including interference, diffraction, polarization, and light-matter interaction in photonic systems.

CO2: Examine the operation of lasers, semiconductor light sources, optical resonators, and photonic detection systems.

CO3: Apply photonic quantum information principles using single-photon sources, beam splitters, interferometers, and quantum optical components.

CO4: Understand linear optical quantum computing architectures and photonic implementations of quantum communication protocols and algorithms.

CO-PO Mapping

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

Syllabus

Unit 1 - Fundamentals of Optics:

Nature of light, Ray optics, Wave optics, Diffraction, Optical interferometers, Fourier optics basics, Polarization, Light-matter interaction.

Unit 2 - Lasers and Light Sources:

Einstein's coefficients, Population inversion and optical pumping, Optical resonators, Laser operation, Types of lasers, Semiconductor laser diodes, LED structures and characteristics, Applications of lasers, Laser safety principles.

Unit 3 - Fundamentals of Photonic Quantum Information:

Review of quantum mechanics, Quantum gates and quantum circuits, Photonic degrees of freedom, Single-photon sources, Single-photon detectors, Beam splitters and interferometers, Hong-Ou-Mandel effect.

Unit 4 - Linear Optical Quantum Computing:

Linear optical elements as quantum operators, Quantum gates using linear optics, Post-selection and probabilistic gate operations, Reck and Clements decomposition for universal linear optical networks, Introduction to Boson sampling, Photonic implementation of simple quantum algorithms, Optical quantum teleportation, Optical superdense coding.

Textbook(s)

P. Kok and B. W. Lovett, "Introduction to Optical Quantum Information Processing," Cambridge University Press, 2010.
Saleh, B. E. A., Quantum Photonics: Bimodes, Qubits, and Biphotons, Springer, 2025.
B. E. A. Saleh and M. C. Teich, "Fundamentals of Photonics," 3rd Edition, Wiley, 2019

Reference(s)

J. L. O'Brien, "Optical Quantum Computing," Science, 2007.
D. A. Steck, Quantum and Atom Optics, available online, 2023.

Evaluation Pattern: 60:40

Assessment	Internal	External
Midterm Exam	20	
Continuous Assessment - Theory (*CAT)	40	
End Semester		40

*CA - Can include both quizzes, theory and practical assignments, case study

26CSQ432	POST QUANTUM CRYPTOGRAPHY	L-T-P-C: 3-0-0-3

Course Objectives

- To understand the fundamentals of classical public-key cryptography and the security threats posed by quantum computers to existing cryptographic systems.
- To learn the mathematical foundations of post-quantum cryptographic schemes based on lattice, code-based, hash-based, and multivariate problems.
- To study the NIST post-quantum cryptography standardization process and the newly standardized post-quantum algorithms.
- To implement basic post-quantum cryptographic primitives using standard libraries and analyse their performance characteristics.

Course Outcomes

CO1: Understand the impact of Shor's and Grover's algorithms on RSA, ECC, and symmetric-key cryptographic systems

CO2: Understand the principles of lattice-based, code-based, multivariate, and hash-based post-quantum cryptographic schemes.

CO3: Analyse and compare the security, performance, and key sizes of NIST-standardized post-quantum cryptographic algorithms.

CO4: Implement basic post-quantum cryptographic operations using standard libraries and tools for practical

applications.

CO-PO Mapping

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

Syllabus

Unit 1 - Introduction to Post-Quantum Cryptography:

Overview of classical cryptography, Hash functions and digital signatures, Shor's algorithm and its threat to RSA and ECC, Grover's algorithm and its impact on symmetric key sizes, Quantum threats to current internet security, Need and timeline for post-quantum migration.

Unit 2 - Lattice-Based Cryptography:

Introduction to lattices and basis vectors, Shortest Vector Problem (SVP) and Closest Vector Problem (CVP), Learning with Errors (LWE) problem and its hardness, Ring-LWE and Module-LWE problems, Overview of NTRU cryptosystem, Introduction to Kyber key encapsulation mechanism, Introduction to Dilithium digital signature scheme, Key generation, encryption, and decryption using lattice-based schemes.

Unit 3 - Code-Based, Multivariate, and Hash-Based Cryptography:

Introduction to linear codes and error correction, Syndrome Decoding Problem and its NP-completeness, McEliece cryptosystem, Overview of Classic McEliece(NIST standard),Multivariate quadratic systems and the MQ problem, Overview of UOV and Rainbow signature schemes, Lamport and Winternitz One-Time Signatures(WOTS), SPHINCS+ (SLH-DSA) stateless hash-based signatures.

Unit 4 - NIST PQC Standards and Practical Migration:

NIST PQC standardization process, FIPS 203 (ML-KEM/Kyber) specification overview, FIPS 204 specification overview, FIPS 205 (SLH-DSA/SPHINCS+) specification overview, Performance comparison of PQC algorithms, Hybrid cryptography, Integration of PQC into TLS/SSL.
Hands-on: Using liboqs and PQClean libraries.

Textbook(s)

D. J. Bernstein, J. Buchmann, E. Dahmen (Eds.), "Post-Quantum Cryptography," Springer, 2009
W. Stallings, "Cryptography and Network Security: Principles and Practice," 8th Edition, Pearson, 2023.

Reference(s)

NIST Post-Quantum Cryptography Standards: FIPS 203, FIPS 204, FIPS 205, 2024.
S. Agrawal, "Quantum Algorithms and Cryptography" (NOC23_CS04), NPTEL, IIT Madras.
C. Peikert, "A Decade of Lattice Cryptography," Foundations and Trends in TCS, 2016.
liboqs: Open Quantum Safe Library Documentation, https://openquantumsafe.org/.

Evaluation Pattern: 60:40

Assessment	Internal	External
Midterm Exam	20	
Continuous Assessment - Theory (*CAT)	40	
End Semester		40

*CA - Can include both quizzes, theory and practical assignments, case study

26CSQ433	QUANTUM MEASUREMENT AND SENSING	L-T-P-C: 3-0-0-3

Course Objectives

- To understand the fundamentals of classical and quantum measurement theory, noise models, sensitivity, and estimation techniques.
- To learn quantum measurement formalisms, projective measurements, POVM, weak measurements, and quantum non-demolition measurements.
- To study quantum states of light and their applications in quantum-enhanced sensing and precision measurement.
- To explore practical quantum sensing technologies, atomic clocks, quantum magnetometers, gravimeters, and NV-center-based sensors.

Course Outcomes

CO1: Analyze the theoretical framework of quantum measurement and generalized measurement theory

CO2: Apply quantum estimation theory to evaluate the precision limits of quantum sensing protocols.

CO3: Assess the role of non-classical resources such as squeezing and entanglement in enhancing measurement sensitivity.

CO4: Understand the working principles and applications of contemporary quantum sensors in science and technology.

CO-PO Mapping

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

Syllabus

Unit 1 — Fundamentals of Quantum Measurement

Review of quantum states and density operators, Projective measurements, Generalized measurements (POVMs), Quantum state collapse and measurement postulates, Weak measurements, Continuous quantum measurements, Quantum trajectories (introductory), Measurement back-action and uncertainty relations.

Unit 2 — Quantum Measurement Techniques and Noise

Quantum measurement of optical fields, Quadrature measurements and field observables, Photon counting statistics, Homodyne and heterodyne detection, Interferometric measurements (Michelson and Mach–Zehnder interferometers), Measurement noise: shot noise, thermal noise, and technical noise, Standard Quantum Limit (SQL)

Unit 3 — Quantum Estimation and Quantum Sensing

Classical parameter estimation, Fisher information, Quantum Fisher information, Cramér–Rao bound, Heisenberg limit, Ramsey interferometry, Phase estimation, Quantum-enhanced interferometry, Spin squeezing, Entanglement-enhanced sensing.

Unit 4 — Quantum Sensors and Emerging Technologies

Atomic clocks, Atom interferometers, Magnetometry, NV-center-based quantum sensing, Optomechanical sensors, Superconducting quantum sensors, Gravitational-wave detection using squeezed light, Quantum imaging (overview), Applications in navigation, communication, medicine, and fundamental physics.

Textbook(s)

C. W. Gardiner and P. Zoller, "Quantum Noise," 3rd Edition, Springer, 2004.

Quantum Information Science – Manenti R., Motta M., 1st Edition, Oxford University Press (2023)

Reference(s)

V. Giovannetti, S. Lloyd, and L. Maccone, "Quantum-Enhanced Measurements: Beating the Standard Quantum Limit," Science, Vol. 306, No. 5700, pp. 1330–1336, 2004

M. G. Paris and J. Řeháček (Eds.), Quantum State Estimation, Springer, 2004

C. L. Degen, F. Reinhard, and P. Cappellaro, "Quantum Sensing," Reviews of Modern Physics, Vol. 89, No. 3, 2017.

Quantum Information Science – Manenti R., Motta M., 1st Edition, Oxford University Press (2023)

Evaluation Pattern: 60:40

Assessment	Internal	External
Midterm Exam	20	
Continuous Assessment - Theory (*CAT)	40	
End Semester		40

*CA - Can include both quizzes, theory and practical assignments, case study

26CSQ434	QUANTUM PROGRAMMING	L-T-P-C: 3-0-0-3

Course Objectives

- To understand quantum software development workflows using modern quantum programming frameworks and cloud platforms.
- To learn quantum circuit design, simulation, transpilation, and execution using Qiskit and Cirq frameworks.
- To implement hybrid quantum-classical applications using Amazon Braket and PennyLane environments.
- To explore quantum machine learning workflows, noise simulation, error mitigation, and practical quantum hardware execution techniques.

Course Outcomes

CO1: Implement quantum circuits, simulation workflows, transpilation, and error mitigation techniques using the Qiskit framework.

CO2: Apply Cirq programming techniques for parameterized circuits, hardware-aware circuit optimization, and noise simulation.

CO3: Develop hybrid quantum-classical applications using Amazon Braket cloud infrastructure and multi-platform execution workflows.

CO4: Design quantum machine learning and Variational applications using PennyLane and Qverse integration environments.

CO-PO Mapping

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

Syllabus

Unit 1

Introduction Qiskit, Quantum Circuit Class, Registers, Parametric Gates, Circuit Measurement & Visualization – Qiskit Aer Simulators– Noise Model, Fake Backends, Primitives API Sessions, Error Mitigation, Zero-Noise Extrapolation – Transpilation– Running Programs on IBM Quantum Hardware.

Unit 2

Cirq Fundamentals: Qubit Types, Moment-Based Circuit Construction & Gate Scheduling, Gate Decomposition, Custom Gates – Parameterized Circuits with SymPy – Circuit Optimization, Hardware-Aware Design, Unitary Synthesis, KAK Decomposition – Simulation: Cirq, Density, Matrix, Clifford Simulators, Depolarizing, Amplitude Damping, Phase Damping, Bit-Flip – Kraus Operators – NISQ.

Unit 3

Amazon Braket Architecture & Service Model – Braket SDK: Installation, Circuit Construction, Gate Support - Simulators, QPU Providers, Circuit Execution, S3 Integration for Storage – Hybrid Jobs: Creating & Running Hybrid Quantum-Classical Workloads., Multi-QPU Routing & Cross-Platform Comparison – AWS Integration.

Unit 4

PennyLane Fundamentals: Installation, Device Initialization, Angle Embedding, Amplitude Embedding, Entangler Layers, Measurement & Observables, Automatic Differentiation, Quantum Neural Networks, Generative Models – Training

Strategies – Barren Plateau Mitigation, Qverse Interactive Circuit Builder, Quantum State Bloch Sphere, State vector, Density Matrices, Qverse-PennyLane Integration.

Textbook(s)

F. S. Khan, "Quantum Computing: An Applied Approach," 2nd Edition, Springer, 2023.

M. A. Nielsen and I. L. Chuang, "Quantum Computation and Quantum Information," Cambridge University Press, 2012.

Reference(s)

IBM Qiskit Textbook (online), https://qiskit.org/textbook

Google Cirq Documentation, https://quantumai.google/cirq

Amazon Braket Developer Guide, https://docs.aws.amazon.com/braket/

PennyLane Documentation, https://pennylane.readthedocs.io

Jack D. Hidary, Quantum Computing: An Applied Approach, Springer, 2021.

Evaluation Pattern: 60:40

Assessment	Internal	External
Midterm Exam	20	
Continuous Assessment - Theory (*CAT)	40	
End Semester		40

*CA - Can include both quizzes, theory and practical assignments, case study

26CSQ435	QUANTUM HARDWARE AND ARCHITECTURES	L-T-P-C: 3-0-0-3

Course Objectives

- To understand the physical realization of qubits and the hardware constraints of quantum computing.
- To explore different quantum hardware platforms, including superconducting circuits, trapped ions, and photonics.
- To learn the principles of quantum control, readout, and the challenges of decoherence.
- To study the architecture of fault-tolerant quantum computers and quantum error correction (QEC) implementation.

Course Outcomes

CO1: Identify and compare different physical platforms for qubit implementation and their respective coherence times.

CO2: Analyze the control electronics and cryogenic requirements necessary for operating quantum processors.

CO3: Design basic quantum circuits and map them to specific hardware topologies.

CO4: Evaluate the role of surface codes and fault-tolerant architectures in scaling quantum hardware.

CO-PO Mapping

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

Syllabus

Unit 1 - Fundamentals of Quantum Hardware

Introduction to the DiVincenzo criteria for a quantum computer. Qubits: definition, state representation, and the Bloch sphere. Coherence and Decoherence: T1T1 (longitudinal) and T2T2 (transverse) relaxation times. Noise models in quantum hardware. Introduction to quantum gates from a hardware perspective.

Unit 2 - Physical Implementation Platforms

Superconducting Qubits: Josephson junctions, Transmon qubits, circuit QED. Trapped Ion Qubits: Paul traps, laser cooling, Mølmer-Sørensen gate. Photonic Quantum Computing: Linear optics, squeezed states, measurement-based quantum computing (MBQC). Other platforms: Neutral atoms, Nitrogen-Vacancy (NV) centers in diamond, and an introduction to Topological qubits (Majorana fermions).

Unit 3 - Quantum Control and Readout

Control systems: Microwave pulses, AWGs (Arbitrary Waveform Generators), and FPGA-based control. Readout techniques: Dispersive readout, quantum non-demolition (QND) measurements. Cryogenic infrastructure: Dilution refrigerators, thermal shielding, and wiring challenges. Interface between classical control and quantum processors

Unit 4 - Scaling and Fault-Tolerant Architecture

The challenge of scaling: Wiring bottlenecks and crosstalk. Introduction to Quantum Error Correction (QEC): Bit-flip and Phase-flip codes. The Surface Code: Toric code, syndrome measurement, and lattice surgery. Fault-tolerant thresholds. Roadmap to Large-Scale Quantum (LSQ) processors.

Textbook(s)

M. A. Nielsen and I. L. Chuang, "Quantum Computation and Quantum Information," Cambridge University Press.

D. Budker and R. Budker, "Quantum Optics and Quantum Hardware," (Recent Academic Press/Relevant Courseware).

Reference(s)

Preskill, J. "Lecture Notes for Physics 219: Quantum Information and Computation," Caltech.

Devoret, M. H., & Schoelkopf, R. J. "Superconducting Circuits for Quantum Information," (Review Articles/Nature).

IBM Quantum Learning / Google Quantum AI Hardware Documentation.

Evaluation Pattern: 60:40

Assessment	Internal	External
Midterm	20	
Continuous Assessment - Theory (CAT)	40	
End Semester		40

*CA - Can include both quizzes, theory and practical assignments, case study

26CSQ436	QUANTUM INTERNET ARCHITECTURE AND PROTOCOLS	L-T-P-C: 3-0-0-3

Course Objectives

- To understand the theoretical foundations of quantum communication and entanglement distribution.
- To study the architecture of a quantum network and the "Quantum Stack."
- To explore the mechanism of quantum repeaters and quantum memories.
- To analyze quantum networking protocols for distributed quantum computing and blind quantum computing.

Course Outcomes

CO1: Explain the principles of quantum teleportation, superdense coding, and entanglement swapping.
CO2: Compare different Quantum Key Distribution (QKD) protocols and their security proofs.
CO3: Analyze the role of quantum repeaters in overcoming photon loss in optical fibers.
CO4: Design a multi-layer quantum network architecture for a specific application (e.g., distributed sensing).

CO-PO Mapping

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

Syllabus

Unit 1

No-cloning theorem and its implications. Quantum Teleportation: protocol and requirements. Superdense Coding. Entanglement as a resource: Bell states and entanglement distillation. Introduction to Quantum Key Distribution (QKD): BB84, B92, and E91 protocols. Security analysis of QKD

Unit 2

New Content

Unit 3

The Quantum Network Stack: Physical layer (photons/fibers), Link layer (entanglement generation), Network layer (routing), and Transport layer. Quantum Routing: shortest path in quantum networks, entanglement routing. Quantum Switching. Network Topologies: Star, Mesh, and Ring quantum networks. Classical-Quantum hybrid networking.

Unit 4

Distributed Quantum Computing: Remote gates (non-local CNOT). Blind Quantum Computing: Computing on a remote server without revealing data. Quantum Clock Synchronization. Quantum Sensor Networks. Standards and Frameworks: ITU-T and NIST guidelines for quantum networking. Hands-on: Simulation using NetSquid or QuNetSim.

Textbook(s)

M. A. Nielsen and I. L. Chuang, "Quantum Computation and Quantum Information," Cambridge University Press.
H. J. Kimble, "The Quantum Internet," (Nature/Scientific Review Articles).

Reference(s)

S. Pirandola et al., "Advances in Quantum Cryptography," (Review papers on Quantum Internet).

NetSquid Documentation: https://netsquid.org/.

QuNetSim Documentation for Quantum Network Simulation.

• MIT OpenCourseWare: Quantum Information Science materials.

Evaluation Pattern: 60:40

Assessment	**Internal**	**External**
Midterm	20	
*Continuous Assessment (CA)	40	
End Semester		40

*CA - Can include both quizzes, theory and practical assignments, case study

26CSQ437	QUANTUM CHEMISTRY FOR QUANTUM COMPUTING	L-T-P-C: 3-0-0-3

Course Objectives

- Introduce the quantum mechanical description of atoms and molecules relevant to quantum computing.
- Develop the mathematical framework of molecular electronic structure theory.
- Formulate quantum chemistry problems for quantum algorithms.
- Explore quantum computing approaches for molecular simulation and materials discovery.

Course Outcomes

CO1: Explain the electronic structure methods that underpin molecular quantum chemistry.

CO2: Construct molecular Hamiltonians in second-quantized form and map them onto qubit representations.

CO3: Apply quantum algorithms such as VQE and QPE to molecular electronic structure problems.

CO4: Analyze the capabilities and limitations of current quantum hardware for quantum chemistry applications.

CO-PO Mapping

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

Syllabus

Unit 1 — Foundations of Quantum Chemistry

Review of quantum mechanics for many-electron systems, Born–Oppenheimer approximation, Electronic structure of atoms and molecules, Molecular orbitals and basis sets, Hartree–Fock approximation, Electron correlation (introductory concepts), Second quantization and occupation-number representation

Unit 2 — Quantum Chemistry Hamiltonians for Quantum Computing

Fermionic creation and annihilation operators, Electronic Hamiltonian in second quantization, Slater determinants, Density Functional Theory (overview), Mapping fermions to qubits: Jordan–Wigner transformation, Bravyi–Kitaev transformation, Molecular Hamiltonians on quantum computers

Unit 3 — Quantum Algorithms for Molecular Simulation

Variational Quantum Eigensolver (VQE), Ansatz design and parameterized quantum circuits, Unitary Coupled Cluster (UCC), Quantum Phase Estimation (QPE), Ground-state energy calculations, Excited-state methods (overview), Error mitigation in quantum chemistry simulations

Unit 4 — Applications and Emerging Directions

Simulation of simple molecules, Molecular properties and potential energy surfaces, Quantum simulation of chemical reactions, Quantum computing for catalysis and materials science, Quantum machine learning in chemistry (overview), Current quantum chemistry software frameworks (Qiskit Nature, PennyLane, OpenFermion), NISQ-era quantum chemistry, Future directions in fault-tolerant quantum chemistry

Textbook(s)

Alain Chancé, Keeper L. Sharkey., Quantum Chemistry and Computing for the Curious, Packt Publishing, 2024

Szabo and N. S. Ostlund, "Modern Quantum Chemistry: Introduction to Advanced Electronic Structure Theory," Dover Publications, New York, 1996

Evaluation Pattern: 60:40

Assessment	**Internal**	**External**
Midterm Exam	20	
Continuous Assessment (Lab)	40	
End Semester Exam		40