Department of Cognitive Sciences and Psychology

School of Social and Behavioral Sciences

Amrita Vishwa Vidyapeetham

Master of Science (MSc) in Cognitive Sciences, Learning and Technology (CSLT)

Curriculum 2026

Course Code	Course Title	LTP	Cr	Course Code	Course Title	LTP	Cr
Semester I				**Semester II**			
26CLT501	Introduction to Cognitive Sciences and Cognitive Psychology	3 0 0	3	26CLT511	Learning, Instruction, and UX Design	2 0 2	4
26CLT502	Philosophy of Cognitive Science and Mind: An Introduction	3 0 0	3	26CLT512	Cognitive Anthropology: Cross-Cultural Perspectives	3 0 0	3
26CLT503	Cognitive and Systems Neuroscience - Part I	3 0 0	3	26CLT513	Cognitive and Systems Neuroscience - Part II	3 0 0	3
26CLT504	Research Methodology I - Introduction to Research Methods	3 0 0	3	26CLT514	Research Methodology II: Advanced Quantitative Data Analysis	3 0 0	3
	*Soft Core (options)	2 0 2	3		*Soft Core (options)	2 0 2	3
26CLT598	Research Project I: Contributing to an ongoing research project for a co-authorship in a journal or conference	1 0 8	5	26CLT599	Research Project II: Qualitative Research; submit a research/dissertation proposal to EC and CSP	1 0 8	5
25AVP501	Mastery Over Mind	1 0 2	2		Amrita Value Programme	1 0 0	1
22ADM501	Glimpses of Indian Culture	2 0 1	P/F	26CUL500	Integrated Amrita Meditation Technique	0 0 2	1
26CLT590	Bridge Literature						
	Total		**22**		**Total**		**23**
Semester III				**Semester IV**			
26CLT695/ 26CLT690*	Rural field visit/ live-in Labs*	0 0 6	3	26CLT697/ 26CLT698**	Internship/Block Placement**	0 0 12	6
26CLT696	Research Project III; Collect and analyze data for their dissertation project; write an internal paper; create a poster for poster presentation	1 0 8	5	26CLT699	Organizing Conference/Symposium (student-led)	0 0 6	3
	*Soft Core (options)	2 0 2	3		Elective III	2 0 2	3
	*Soft Core (options)	2 0 2	3		*Open Elective (options)	2 0 2	3
	Elective I	2 0 2	3				
	Elective II	2 0 2	3				
	Total		**20**		**Total**		**15**
Total - 80							

Specializations with Electives (which electives are offered in S3 and S4 will be decided by the CSP faculty)

1. User Experience and Learning				2. Cognitive Neuroscience			
26CLT631	User Needs for Learning Technology	2 0 2	3	26CLT641	Current Research in Cognitive and Systems Neuroscience	2 0 2	3
26CLT632	Learning Analytics and Educational Data Mining	2 0 2	3	26CLT642	Computational Neuroscience	2 0 2	3
26CLT633	Instructional Design - Theory, Practice, and Emerging Trends	2 0 2	3	26CLT643	Electrophysiology and Neuroimaging Lab	2 0 2	3

* Students will be assigned to the soft core courses in technology from the list based on their Bachelor's degree qualification				Which Open Electives are offered in S4 will be decided by the CSP faculty			
Soft Core				**Open Electives**			
26CLT531	Natural Language Processing	2 0 2	3	26OEL631	Artificial Intelligence for Robotics	2 0 2	3
26CLT532	Deep Learning	2 0 2	3	26OEL632	Automation and Robotics	2 0 2	3
26CLT533	Foundation of Data Science	2 0 2	3	26OEL633	Machine Learning for Big Data	2 0 2	3
26CLT534	Artificial Intelligence	2 0 2	3	26OEL634	Foundations of Corporate Social Responsibility	2 0 2	3
26CLT535	Basics of Computer Programming	2 0 2	3	26OEL635	Decision Models in Management (DMM)	2 0 2	3
26CLT536	Introduction to Machine Learning Using Programming Languages	2 0 2	3	26OEL636	Individual and Group Behaviour Dynamics in Organizations (I & GBDO)	2 0 2	3
26CLT537	Computational Intelligence	2 0 2	3	26OEL637	Human Resource Management	2 0 2	3
				26OEL638	Talent Acquisition & Learning and Development (TA & LD)	2 0 2	3
				26OEL639	Multi-Modal Applications for Learning	2 0 2	3
				26OEL640	Psychomotor Skill Training to Enhance Learner Performance	2 0 2	3
				26OEL641	Product Development for Ed-Tech	2 0 2	3

**Amrita Value Programme			
22ADM502	Vedanta in day-to-day life	1-0-0	1
22AVP506	Message of Swami Vivekananda	1-0-0	1
22AVP508	Indian Arts and Literature	1-0-0	1
22AVP510	Appreciation of Kerala Mural Arts Forms	1-0-0	1
22AVP501	Message of Śrī Mātā Amritanandamayi Devi	1-0-0	1
22AVP502	Insights from the Ramayana	1-0-0	1
22AVP503	Insights from the Mahabharata	1-0-0	1
22AVP504	Insights from the Upanishads	1-0-0	1
22AVP505	Insights from Bhagavad Gita	1-0-0	1
22AVP512	Ancient Indian Science and Technology	1-0-0	1
22AVP507	Great Spiritual Teachers of India	1-0-0	1
22AVP509	Yoga and Meditation 1	1-0-0	1

MSc in Cognitive Sciences, Learning, and Technology (CSLT)

Amrita Vishwa Vidyapeetham aims to provide quality education with an emphasis on values. The university integrates scientific knowledge with spiritual understanding to benefit society and promote sustainability. Its mission is to impart 'education for life,' which includes instilling essential human values, in addition to 'education for living,' which prepares students for professional careers. The university's primary objective is to conduct research that is driven by compassion and aimed at addressing real-world problems.

The **Department of Cognitive Sciences & Psychology (CSP)** at the School of Social and Behavioural Sciences, Amrita Vishwa Vidyapeetham, adopts an interdisciplinary approach to **understanding the mind and human behavior** with the aim to nurture cognitive and psychological processes and human behavior towards individual growth as well as an **empowered and compassionate society**.

Our **MSc in Cognitive Sciences, Learning, and Technology (CSLT)** under CSP is a pioneering program that combines the disciplines of cognitive sciences with a strong emphasis **on learning, skills, and technology**. This interdisciplinary program is designed to provide students with a deep understanding of cognition and behavior in the context of lifelong learning, enhanced by technological know-how, leading to socially relevant innovation and solving crucial educational challenges.

To reach our educational goals and outcomes, the MSc program integrates **interdisciplinary perspectives** ranging from computer sciences, cognitive psychology, anthropology, philosophy, learning sciences, and neurosciences, offering a comprehensive curriculum that includes exposure to **state-of-the-art research methods and tools**.

Under the MSc in Cognitive Sciences, Learning, and Technology, we offer **two specializations**:

1. **User Experience and Learning**
2. **Cognitive Neuroscience**

Integrating the strengths of our two state-of-the-art research centers **AMMACHI Labs** and **Skill Intelligences,** we offer cutting-edge programs that provide students with a multitude of opportunities to learn first-hand in an interdisciplinary environment. With our expanding industry partnerships, we aim to enhance research, practical applications, and placement opportunities to give students the chance to apply their knowledge and gain exposure to companies in their respective fields. We are committed to providing a comprehensive and immersive educational experience to help students succeed in their careers.

This **academic-lab-industry integration** prepares students for careers in research, cognitive and brain sciences (including AI), management, engineering, design, robotics, human-machine interaction, user interface optimization, and instructional design. Our students can enter different career paths in industry, global, educational, social, and government organizations.

Graduates have the opportunity to continue their education and pursue a **PhD in Cognitive Sciences and Technology at our School of Social and Behavioural Sciences**.

We believe that our upcoming MSc in Cognitive Sciences, Learning, and Technology encompasses an innovative and unique curriculum that aims at equipping students with an interdisciplinary blend of theoretical knowledge and practical skills, preparing them for diverse real-world applications **to solve today's and tomorrow's education challenges, to foster equity, justice, and quality education while leaving no one behind.** In this way, our program will aid in achieving the United Nations Sustainable Development Goals (SDGs), particularly SDG No. 4, 'Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all' and No. 3, 'Ensure healthy lives and promote well-being for all at all ages,' among other SDGs.

Program Outcomes

- **PO1 - Scientific knowledge and training:** Gain and apply knowledge of basic and applied

scientific/analytical fundamentals, leading to a deeper understanding of the interdisciplinary nature of cognitive sciences, learning sciences, and technology application.

- **PO2 - Problem analysis:** Identify, formulate, review, and analyze educational challenges and problems to derive real-world solutions using principles of basic cognitive sciences, learning sciences, and technology.
- **PO3 - Using State-of-the-art tools:** Create, select, and apply appropriate techniques, resources, and tools, including prediction and modelling of complex biological systems with an understanding of their limitations.
- **PO4 - Science communication:** Communicate scientific concepts and theories effectively with peers, educators, the scientific community, and society at large.
- **PO5 - Ethics and values:** Understand and practice ethical principles and commit to professional ethics, responsibilities, and norms of scientific practice.
- **PO6 - Individual and teamwork:** Think critically and work independently as well as a member or leader in diverse teams in multidisciplinary settings.
- **PO7 - Science for society:** Apply reasoning through contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional scientific practice.
- **PO8 - Lifelong learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of scientific and technological changes for up-to-date research and teaching methods.
- **PO9 - Culturally inclusive and responsive perspectives:** Culturally inclusive and responsive perspectives/ multicultural/global perspectives/fostering humanitarian perspectives, equality, diversity, and inclusion.

Program Specific Outcomes (PSOs)

- **PSO1:** Develop an understanding of the fundamental principles of cognitive sciences, learning, and technology, including the interdisciplinary nature of these fields.
- **PSO2:** Develop an understanding of the human mind, its functions, and its effects on behavior and performance.
- **PSO3:** Develop an understanding of the cognitive processes underlying learning, memory, language, problem-solving, decision-making, and other cognitive functions.
- **PSO4:** Develop an understanding of the biological, psychological, and sociological factors that influence cognitive processes, learning, and skill development.
- **PSO5:** Design and/or develop educational technology and its application to solve complex problems in teaching and learning.
- **PSO6:** Develop an understanding of fundamental principles of basic and applied research.
- **PSO7:** Design and develop educational materials (online/offline) and activities that integrate cognitive sciences and learning sciences.
- **PSO8:** Develop an understanding of the implications of cognitive sciences for the design of intelligent systems and the development of artificial intelligence.
- **PSO9:** Develop scientific thinking, critical thinking, and meta-cognition skills.
- **PSO10:** Establish the culture of independent and life-long learning, innovative research, and productive teamwork.

Job Perspectives

- **Neurophysiology Lab Manager**
- **Learning and Development Manager**
- **UX Designer:** UX Designers seek to make products and services easy, effective, and delightful to use.
- **HCI/UX Researcher:** HCI/UX Researchers conduct studies to explore current challenges and identify ways to improve the overall user experience, particularly for the HCI neural network application.
- **User-Interface Optimizer**
- **Instructional Designer/Curriculum Designer:** Instructional designers create learning materials, assessments, and activities tailored to the specific needs of students, employees, and other learners. They use theories from cognitive science and educational technology to design, develop, and evaluate instructional materials and programs. They can create engaging and effective learning experiences.
- **Educational Technology Consultant:** Educational technology consultants advise organizations on how to use technology to improve learning outcomes. They provide guidance on the selection, implementation, and evaluation of educational technology solutions.
- **Cognitive Engineer**
- **Learning Analytics Specialist:** Learning analytics specialists analyze data from educational programs and technologies. They use data to identify trends and patterns in learning and teaching to inform decisions about instructional design and implementation.
- **Education Software Developer:** Educational software developers create educational software applications, including AI, to design and develop systems that can interact with humans. They use a variety of methods, such as natural language processing, to create systems that can understand and respond to human input.
- **Cognitive Data Scientist:** Cognitive data scientists analyze large amounts of data to understand how people think and behave. They use a variety of methods, such as machine learning, to understand how people process information and make decisions. This informs various stakeholders across the broader education sector.
- **Cognitive Scientist:** Cognitive scientists study the mental processes of humans and animals, such as memory, perception, problem-solving, and language. They use a variety of methods, such as experiments, computer simulations, and mathematical models, to understand how the brain works.
- **Educator:** specialized in technology-based teaching and learning
- **Human Resource Management**: Helping organizations with knowledge management tools, re-skilling/ up-skilling, and performance of employees and leadership.
- **Learning consultant:** Policy, learning, and development sections of companies, etc.
- **Higher Education Teaching and Learning Specialist**

Semester 1

26CLT501 INTRODUCTION TO COGNITIVE SCIENCES AND COGNITIVE PSYCHOLOGY
3-0-0 (3)

Prerequisite: Good reading and writing skills in English

Summary

This course introduces students to the interdisciplinary foundations of cognitive science and the cognitive psychology perspectives of learning and memory. It explores how humans think, learn, remember, and use language, and how these processes can be modeled and applied in real-world contexts such as learning, instruction, and human–computer interaction.
Students gain an understanding of classical and contemporary theories, including information processing, linguistic structures, and cognitive models of learning and memory.

Course Objectives

1. To gain a foundational understanding of cognitive science as an interdisciplinary scientific field.
2. To introduce cognitive psychology perspectives on learning and memory.
3. To gain an overview of information processing theories and cognitive architectures.
4. To gain an understanding of linguistic structures, including syntax and generativity.
5. To apply cognitive science and cognitive psychology principles to learning technologies and human-computer-interaction (HCI).

Course Outcomes (COs)

CO1: Understand the historical development, scope, and interdisciplinary nature of cognitive science.

CO2: Understand foundational cognitive psychology concepts of learning and memory.

CO3: Explain major information processing theories and their implications for learning.

CO4: Demonstrate an understanding of linguistic structures, including syntax and generativity.

CO5: Apply cognitive science principles to analyze and evaluate human–computer interaction (HCI) and learning technologies.

Skills

- Ability to analyze cognitive processes using theoretical frameworks.
- Understanding of how linguistic structures shape cognition and learning.
- Application of information processing theories to instructional design.
- Foundational skills in evaluating user interaction with learning technologies.
- Critical thinking about the relationship between cognition, learning, and technology.
- Ability to connect cognitive theory to real-world applications.

Program outcome PO - Course Outcomes CO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	**X**	-	-	-	-	-	-	**X**	-

CO2	-	**X**	-	-	-	-	-	**X**	-
CO3	-	**X**	-	-	-	-	-	**X**	-
CO4	-	**X**	-	-	-	-	-	**X**	-
CO5	**X**	**X**	-	-	-	-	**X**	**X**	-

Syllabus

Unit 1: Foundations of Cognitive Science **9 hrs.**

- Historical roots and emergence of cognitive science
- Definitions, scope, and interdisciplinary pillars (cognitive psychology, neuroscience, linguistics, AI, anthropology, philosophy)
- Relationship between cognitive science, cognitive psychology, and learning sciences
- Applications of cognitive science in learning and technology

Unit 2: Learning and Memory from a Cognitive Psychology Perspective **9 hrs.**

- Encoding, storage, and retrieval
- Short-term forms of memory (sensory, short-term, and working memory)
- Long-term forms of memory (explicit: episodic and semantic; implicit: procedural)
- Constructive nature of memory
- Knowledge representation (schemas and cognitive scripts)
- Cognitive strategies to improve recall

Unit 3: Information Processing and Cognitive Architectures **9 hrs.**

- Classical information processing theory
- Cognitive architectures (ACT-R, etc.)
- Situated approaches (embodied and distributed cognition)
- Bayesian/probabilistic information processing
- Problem-solving and decision-making
- Implications for instructional design and learning environments

Unit 4: Linguistics - Syntax, Structure, and Generativity **9 hrs.**

- Introduction to linguistics as a pillar of cognitive science
- Syntax: rules, structure, and hierarchical organization
- Generativity of language: infinite expressions from finite rules
- Language as a cognitive system
- Language, thought, and learning

Unit V – Applications of Cognitive Science in Learning Technologies **9 hrs.**

- Human–computer interaction (HCI) and cognitive principles
- Usability, mental models, and interface design
- Intelligent tutoring systems and adaptive learning
- Case studies: applying cognitive science to learning technologies

Textbooks

- Frankish, K., & Ramsey, W. M. (Eds.). (2012). *The Cambridge handbook of cognitive science*. Cambridge University Press.
- Goldstein, E. B. (2023). *Cognitive psychology: Connecting mind, research, and everyday experience* (6th ed.). Cengage Learning.
- Sawyer, R. K. (Ed.). (2022). *The Cambridge handbook of the learning sciences* (3rd ed.). Cambridge University Press.
- Spitzer, M. (1999). *The mind within the net: Models of learning, thinking, and acting*. MIT Press.

Reference Books

- Anderson, J. R. (2015). *Cognitive psychology and its implications* (8th ed.). Worth Publishers.
- Chipman, S. E. F. (2017). *The Oxford Handbook of Cognitive Science* (1st ed.). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199842193.001.0001
- Chomsky, N. (1957). *Syntactic structures*. Mouton.
- Ericsson, K. A., Charness, N., Feltovich, P., & Hoffman, R. (Eds.). (2006). *The Cambridge handbook of expertise and expert performance*. Cambridge University Press.
- Norman, D. A. (2013). *The design of everyday things* (Revised and expanded edition). Basic Books.
- Baddeley, A., Eysenck, M. W., & Anderson, M. C. (2020). *Memory* (3rd ed.). Psychology Press.
- Hutchins, E. (1995). *Cognition in the wild*. MIT Press.
- Hoadley, C. (2018). A short history of the learning sciences. In F. Fischer, C. E. Hmelo-Silver, S. R. Goldman, & P. Reimann (Eds.), *The international handbook of the learning sciences* (pp. 11–23). New York, NY: Routledge.
- McWhorter, J. (2014). *The language hoax: Why the world looks the same in any language.* Oxford University Press.
- Pinker, S. (1994). *The language instinct: How the mind creates language*. William Morrow.
- Pinker, S. (2007). *The stuff of thought: Language as a window into human nature*. Viking.
- Rogoff, B. (1990). *Apprenticeship in thinking: Cognitive development in social context*. New York, NY: Oxford University Press.
- Saxe, G. B. (1991). *Culture and cognitive development: Studies in*

mathematical understanding. Hillsdale, NJ: Erlbaum.

- Scribner, S., & Cole, M. (1973). Cognitive consequences of formal and informal education. *Science, 182*(4112), 553–559.
- Sleeman, D., & Brown, J. S. (Eds.). (1982). *Intelligent tutoring systems*. New York, NY: Academic Press.
- Yoon, S. A., & Hmelo-Silver, C. E. (2017). What do learning scientists do? A survey of the ISLS membership. *Journal of the Learning Sciences, 26*(2), 167–183.
- Rogers, Y., Sharp, H., & Preece, J. (2019). *Interaction design: Beyond human–computer interaction* (5th ed.). Wiley.

Evaluation Pattern:

Assessment	Internal	External
Midterm Exam (MCQ format)	30	
*Continuous Assessment (CA)	20	
End Semester (MCQ format)		50

*CA - Can be Quizzes, Assignments, Projects, Reports, and Presentations

26CLT502 PHILOSOPHY OF COGNITIVE SCIENCE AND MIND: AN INTRODUCTION
3-0-0 (3)

Prerequisite: Good reading and writing skills in English; Basic understanding of the field of cognitive and biological sciences.

Summary

Philosophy of cognitive science is a rich, topical and fast-growing area of philosophy. This module will address major works, concepts and theories in the history and development of philosophy of cognitive science. The approach will be philosophically oriented, involving critical debate and close reading of assigned texts. Students will be expected to engage critically with the work and supporting discussion to develop their own voice in arguing and defending their own position on the topics covered. The course will support students to engage with some of the most critical and current debates in cognitive science by understanding the role and implications of philosophy for cognitive science and cognitive science in doing philosophy.

Course Objectives

1. To gain a basic understanding of philosophical perspectives and approaches to conceptualising issues within cognitive science.
2. To develop a critical understanding of how philosophers engage with and debate cognitive science concepts and theories.
3. To understand how the role of philosophy has influenced and continues to challenge and develop the field of cognitive science.
4. To gain an overview of the foundational and contemporary issues within the field of cognitive science and philosophy of mind.
5. To gain an overview of current and emerging trends with theoretical and empirical work within cognitive sciences and related disciplines.

Course Outcomes

CO1: Acquire knowledge of the critical issues and current debates in the field of cognitive science.

CO2: Understand core concepts in cognitive science and their relation to philosophical issues.

CO3: Gain information on how philosophy has historically influenced current theories within cognitive sciences.

CO4: Gain insights into how empirical research in cognitive sciences has influenced philosophical debates and thinking.

CO5: Understand how philosophical concerns, issues, and debates can inform, clarify, and develop concepts and theories within the cognitive sciences, such as attention, memory, and perception.

Skills:

- Gain an overview of key philosophical perspectives and concepts in cognitive science.
- Develop a deeper understanding of how philosophical and conceptual analysis has influenced concepts and theories in cognitive sciences.
- Grasp how foundational assumptions have shaped cognitive science and how they can be challenged.
- Differentiate between philosophical concepts and their application within empirical research in cognitive sciences.
- Understand how the conceptualization of mind, language, and cognition has influenced empirical research in the cognitive sciences.
- Develop a basic understanding of the traditional philosophical issues that continue to challenge contemporary cognitive scientists and how empirical research has influenced philosophy.
- Demonstrate an enhanced ability to engage in critical analysis and argument through reading and group discussions.
- Demonstrate an ability to articulate their views in a systematic manner through their philosophical writing and dialogue, with a focus on clarity of idea and coherent justification.
- Demonstrate confidence in undertaking work through independent learning and taking responsibility for their learning.

Program outcome PO - Course Outcomes CO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	**X**	-	-	-	-	-	X	X	-
CO2	-	-	-	-	-	-	-	X	-
CO3	X	-	-	-	-	-	-	X	-
CO4	X	-	-	-	-	-	X	X	-
CO5	**X**	-	-	-	-	-	-	X	-

Syllabus

Unit 1: Introduction to Philosophy of Cognitive Science **9 hrs.**

- An introduction and review of long-standing philosophical problems and perennial questions regarding the nature of the mind are addressed through a global perspective, drawing on Western and Eastern philosophies.
- **Cognition in a Physical World:** introduces the mind-body problem and approaches to

theorizing the mind, including physical systems, computationalism, embodied cognition, and the nature and role of mental representational. This will briefly introduce the Turing Test, the Chinese Room Argument, The Frame Problem, Connectionism, Extended and Embodied Mind and Artificial Consciousness. This is juxtaposed to Eastern philosophies, drawing on Vedanta and Taoism, where the philosophical assumptions are rooted in non-dualistic epistemology in theorising mind and body, or world.

- **The Problems of Consciousness:** introduces the primary focus of cognitive science on cognitive capacities. The mind-body problem is related to enduring mysteries regarding consciousness. Addressing physical systems and Qualia, cognitive science is viewed from a critical perspective, and limitations are considered and debated. The Western empiricist conceptions of mind and consciousness are comparatively reviewed in light of German Idealism, Russian Psychology, Inferentialism, Advaita Vedanta and Taoism.
- **The Nature of Thought:** introducing philosophical issues revived in cognitive science, focusing on Language and Thought, Thoughts and Concepts. These concepts are comparatively considered from both Western and Eastern philosophical perspectives, including Advaita Vedanta.
- **Case Studies:** More Specific Mental Phenomena concerning attention, memory, and perception and recent empirical research on these topics. The remainder of the course will draw out and critically engage with the philosophical implications. These issues will be framed within wider debates and decolonial perspectives concerning the East-West philosophical divide, North-South relations and academic and biomedical hegemony. Implications for the future of cognitive science will be discussed from a global perspective addressing, diversity, decolonisation, and social justice.

Unit 2: Cognitive Science and its Foundational Assumptions **9 hrs.**

- **Foundational Assumptions:** Critical engagement with theoretical and philosophical problems regarding the notions of cognition, computation, representation, and consciousness. These assumptions are discussed in relation to representationalism and Cartesian dualism and critically reviewed with emerging schools of thought and Eastern non-dualist perspectives.
- **Cognitive Science and Inter-disciplinary Relations:** Critical debates on the relation between evolutionary biology and the science of cognition are discussed. Different scholars and positions on disciplinary alignments are presented and debated. These include evolutionary biology and psychology, but also AI and Neuroscience. These relations are explored in a comparative and global context of a philosophy of science as embedded within the Western Enlightenment project. Subsequent dualist epistemology and critical perspectives are explored and critically discussed.

Unit 3: Core Concepts in Cognitive Science and Philosophical Concerns **9 hrs.**

- **Innateness:** The historical role of innateness rooted in David Hume relating to contemporary debates concerning developmental issues is critically reviewed.
- **Language Faculty and The Linguistic Turn:** Developmental issues are further discussed in relation to language and cognition. Starting with Noam Chomsky and to philosophical debates and developments related to language, concepts and philosophy of mind. This includes the Linguistic Turn and its relation to empiricism and

philosophy of mind.

- **The Role of Conceptual Analysis About Mental Phenomena:** Core cognitive science concepts are discussed in relation to different disciplinary perspectives and arguments. The debates aim to consider the role and utility of cognitive science, psychology and philosophy in theorising mental phenomena in relation to consciousness, representation, and innateness. These debates are extended within a more comparative philosophical consideration related to German Idealism and its recent revival, connections to Russian psychology and Eastern theories of mind, and nondualist philosophical frameworks.

Unit 4: First-order Empirical Issues in Cognitive Science 9 hrs.

- **Theory of Mind:** Historical, philosophical theories of mind are considered (e.g., eliminativism and functionalism) and reviewed in light of empirical research and cognitive science approaches to theorising the mind (e.g., simulation theory). The discussion is extended to consider contemporary research, German Idealism and Maya theory within Advaita Vedanta.
- **Language:** Theories of language faculty and language acquisition. The role of language and linguistics in informing non-linguistic domains of cognitive science is also addressed.
- **Culture and Cognition:** Theories of social learning and cultural transmission and their relation to distinctive human cognitive features and science and technology.
- **Mind, Learning and Epistemology:** Considering developments in cognitive psychology and learning theories, the emerging relations and tensions in the philosophy of mind and education are critically discussed. This debate is extended to consider Eastern philosophical perspectives, with a focus on non-dualist epistemology.

Unit 5: Traditional Philosophical Problems and Contemporary Perspectives 9 hrs.

- **Rationality:** Debates in philosophy and cognitive science are directed at issues of reasoning and rationality. Consideration of Cartesian dualism and emerging alternative trends within philosophy and cognitive sciences as related to human judgments, decision-making, and moral psychology. This debate considers emerging arguments within contemporary Analytic Philosophy and relations to Eastern non-dualist perspectives.
- **Artificial Intelligence and Human Consciousness:** The historical development of AI is discussed, with the Turing test and Chinese Room argument revisited. These arguments are discussed in view of contemporary developments and singularity. The future of AI is discussed in view of the debate regarding the relation of machine intelligence, the human mind, and the concept of 'intelligence'. Western and Eastern conceptualisations are reviewed and critically discussed.
- **Metaphilosophical Issues:** Drawing on the various philosophical debates, the discussion debates the role of philosophy as a methodology and implications for cognitive science as a form of enquiry. Debates focus on empirical research and empiricist assumptions. These are discussed in view of methodological naturalism and experimental philosophy. These issues are critically discussed with a view to contemporary developments in non-dualist epistemology in Eastern philosophy.
- **Contemporary and Emerging Schools of Thought:** In concluding the module, the

topics are brought back to bear on foundational philosophical issues that remain at the heart of the philosophy of cognitive science, namely, representationalism, dualism, empiricism, materialism and emerging philosophical schools of thought that challenge these assumptions, in addressing intentionality, rationality, learning and consciousness from alternative non-representational and non-dualist epistemological perspectives.
These philosophical considerations draw from both Western and Eastern philosophies in discussing the future directions of Cognitive Science.

Textbooks and Papers:

- Churchland, P. (1981). Eliminative materialism and the propositional attitudes. *Journal of Philosophy,* 78(2): 67– 90. 10.2307/2025900
- Fodor, J., Garrett, M., Walker, E., and Parkes, C. (1980). Against definitions. *Cognition* 8(3): 263–67. 10.1016/0010-0277(80)90008-6
- Fodor, J., and Piattelli-Palmarini, M. (2010). *What Darwin Got Wrong.* London: Profile Books.
- Grice, P. (1987). Conceptual Analysis and the Province of Philosophy. In P. Grice (1989), *Studies in the Way of Words*. Cambridge, MA: Harvard University Press.

Reference Books:

- Anderson, J. (2007). *How Can the Human Mind Occur in the Physical Universe?* New York: Oxford University Press. 10.1093/acprof:oso/9780195324259.001.0001
- Brandom, R. (1994). *Making It Explicit: Reasoning, Representing, and Discursive Commitment*. Cambridge, MA: Harvard University Press.
- Carruthers, P. (2006). *The Architecture of the Mind: Massive Modularity and the Flexibility of Thought*. New York: Oxford University Press.
- Chalmers, D. (1996). *The Conscious Mind: In Search of a Fundamental Theory*. New York: Oxford University Press. Google Scholar
- Chomsky, N. (1957). *Syntactic Structures*. The Hague: Mouton.
- Copeland, B. J. (ed.) (2004). *The Essential Turing*. Oxford: Oxford University Press.
- Davidson, D. (1975). Thought and Talk. In D. Davidson (1984), *Inquiries into Truth and Interpretation*. Oxford: Oxford University Press.
- Dummett, M. (1993). *The Seas of Language*. Oxford: Oxford University Press.
- Fodor, J. (1975). *The Language of Thought*. Cambridge, MA: Harvard University Press.
- Hume, D. (1777/1975). *Enquiries Concerning Human Understanding and Concerning the Principles of Morals*, edited by L. A. Selby-Bigge (3rd edition revised by P. H. Nidditch). Oxford: Oxford University Press.
- Jackson, F. (1998). *From Metaphysics to Ethics: A Defence of Conceptual Analysis*. Oxford: Oxford University Press. Google Scholar
- Lewis, D. (1972). Psychophysical and theoretical identifications. *Australasian Journal of Philosophy,* 50: 249– 58. 10.1080/00048407212341301

- Marr, D. (1982). *Vision. A Computational Investigation into the Human Representation and Processing of Visual Information*. San Francisco: W. H. Freeman.
- Moore, G. E. (1966). *Lectures on Philosophy*, edited by Casimir Lewy. London: George Allen and Unwin. Nagel, T. (1974). What is it like to be a bat? *Philosophical Review* 83: 435–50. DOI: 10.2307/2183914
- Newell, A. (1980). Physical symbol systems. *Cognitive Science*, 4(2): 135–83. https://doi.org/10.1207/s15516709cog0402_2
- Newell, A., and Simon, H. (1976). Computer science as empirical inquiry: Symbols and search. *Communications of the Association for Computing Machinery* 19(3): 113–26. https://doi.org/10.1145/360018.360022
- Pinker, S. (1997). *How the Mind Works*. New York: W. W. Norton.
- Pylyshyn, Z. (1984). *Computation and Cognition. Toward a Foundation for Cognitive Science*. Cambridge, MA: MIT Press.
- Richerson, P., and Boyd, R. (2005). *Not by Genes Alone: How Culture Transformed Human Evolution*. Chicago: University of Chicago Press.
- Tooby, J., and Cosmides, L. (1992). The Psychological Foundations of Culture. In J. Barkow, L. Cosmides, and J. Tooby (eds.), *The Adapted Mind: Evolutionary Psychology and the Generation of Culture*. New York: Oxford University Press.
- Turing, A. (1951). Can Digital Computers Think? In B. J. Copeland (ed.), *The Essential Turing*. Oxford: Oxford University Press.
- Whorf, B. (1956). *Language, Thought, and Reality: Selected Writings of Benjamin Lee Whorf*, edited by J. Carroll. Cambridge, MA: MIT Press.
- Vygotsky, L. (1986). *Thought and Language*, edited by A. Kozulin. Cambridge, MA: MIT Press.

Evaluation Pattern:

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

*CA - Can be Quizzes, Assignments, Projects, Reports, and Presentations

26CLT503 COGNITIVE AND SYSTEMS NEUROSCIENCE - PART 1 3-0-0 (3)

Course outcomes for parts 1 and 2:

- Provide students with an end-to-end account of nervous system function from cellular mechanisms to cognition.
- Integrate molecular/cellular neuroscience, synaptic physiology, systems neuroscience, and cognitive neuroscience into a single coherent course.
- Establish a shared technical vocabulary (neuroanatomy, electrophysiology, neural coding, systems organization) to support advanced reading and research discussion.
- Train students to connect circuit mechanisms to perception, action, learning, memory, language, emotion, and executive control.
- Build competence in interpreting foundational experimental approaches (e.g., electrophysiology, lesion evidence, neuropharmacology, and functional imaging).
- Prepare students to reason about neurological and psychiatric disorders as disruptions of identifiable mechanisms and circuits, not just symptom lists.
- Develop students' ability to move between levels of analysis (from genes to synapses to circuits to behaviour) when forming explanations and research questions.
- Strengthen students' capacity to read primary literature that extends what they have learnt to current cognitive neuroscience problems.

Learning outcomes for parts 1 and 2:

- Explain how neurons and glia generate electrical signals and how ion channels shape excitability and conduction.
- Analyze synaptic transmission and integration, including receptor mechanisms, neuromodulation, and presynaptic release processes.
- Apply core neural coding ideas (receptive fields, population coding, topographic maps) to interpret sensory and motor representations.
- Trace major anatomical pathways and describe how distributed brain systems support perception and movement.
- Compare the neural organization of somatosensation, pain, vision, audition, vestibular function, smell, and taste, emphasizing what each system computes.
- Describe the control of movement across spinal circuits, motor cortex, premotor/parietal systems, cerebellum, and basal ganglia, including links to disorders.
- Relate brainstem, hypothalamic, and neuromodulatory systems to arousal, autonomic control, emotion, motivation, addiction, sleep, and epilepsy.
- Explain how neural circuits are built and refined during development, how

experience shapes plasticity, and how aging alters brain function.

- Distinguish major memory systems and outline cellular and systems mechanisms for implicit and explicit memory, including hippocampal–prefrontal contributions.
- Evaluate evidence from functional imaging and other methods for claims about cognition (attention, working memory, language, consciousness) and their disruption in neuropsychiatric conditions.

CO-PO Mappings (TO BE CHECKED)

Program outcome PO - Course Outcomes CO Mapping

	PO1	PO2	PO3	PO4	PO 5	PO6	PO 7	PO 8	PO9
CO1	-	-	-	-	-	-	x	-	-
CO2	x	-	-	-	-	-	x	-	-
CO3	-	-	-	-	-	-	x	x	-
CO4	-	-	-	-	-	-	x	x	-
CO5	-	-	-	-	-	-	x	-	-
CO6	-	-	-	-	-	-	x	-	x

Syllabus for Part 1:

Unit 1: Foundations—Brain, Behavior, Genes - 4hrs

- Levels of analysis linking brain activity to behavior
- Neurons, glia, and canonical circuit motifs; parallel and hierarchical organization
- Genes, gene expression, and behavior; principles of heritability and model organisms

Unit 2: Electrical Signaling, Synaptic Transmission and Integration - 16 hrs

- Cellular architecture of neurons and glia; structural specializations for signaling
- Ion gradients, membrane proteins, and ion channel classes; gating and selectivity
- Resting membrane potential, passive properties, dendritic filtering, and cable theory
- Action potentials, conduction, myelination, and reliability of spike signaling
- Chemical vs electrical synapses; quantal transmission and synaptic reliability
- Postsynaptic receptors and conductances; excitation, inhibition, and shunting
- Synaptic integration across space and time; dendritic nonlinearities
- Presynaptic release machinery; Ca^{2+} dependence, vesicle pools, short-term plasticity

Unit 3: Neurochemistry and Neuromodulation - 7hrs

- Neurotransmitter systems and neuropeptides; synthesis, packaging, clearance, and receptors
- Neuromodulation via second messengers; regulation of synapses and intrinsic excitability
- Neuromuscular junction as model synapse; motor unit organization and peripheral weakness
- Principles of pharmacologic manipulation of synaptic and transmitter systems

Unit 4: Systems Organization and Cognitive Neuroscience Methods - 10hrs

- Large-scale CNS organization; sensory-motor transformations and distributed processing
- Internal representations for space and action; navigation-related codes
- Attention, working memory, and executive control as network functions
- Foundations of functional neuroimaging signals, designs, inference limits, and multivariate decoding

Unit 5: Somatosensation and Pain - 8hrs

- General sensory coding: receptive fields, tuning, population codes, and adaptation
- Somatosensory receptors and pathways; somatotopy and cortical maps
- Touch computation: texture, vibration, proprioception, and active sensing
- Pain pathways and modulation; peripheral and central sensitization; clinical pain syndromes

Textbooks:

Goldstein, E. B. (2015). *Cognitive psychology: Connecting mind, research, and everyday experience* (5th edition). Cengage Learning.

Gazzaniga, M. S., Ivry, R. B., & Mangun, G. R. (2014). *Cognitive neuroscience. The biology of the mind* (5th edition). Norton.

Kandel, E. R., Schwartz, J. H., & Jessell, T. M. (2000). *Principles of neural science* (5th ed). McGraw-Hill.

Evaluation Pattern:

Assessment	Internal	External
Midterm Exam (MCQ format)	30	
*Continuous Assessment (CA)	20	
End Semester (MCQ format)		50

*CA - Can be Quizzes, Assignment, Projects, and Reports, and Seminar

26CLT504 RESEARCH METHODOLOGY I: INTRODUCTION TO RESEARCH METHODS
3-0-0 (3)

Prerequisite: Good reading and writing skills in English

Course Objectives:

1. To teach students a basic understanding of research methodology and its relevance for studying the human mind and brain
2. To lead students step-by-step through the different phases of the research process: identifying a researchable problem, formulating the research question, creating the research design, recruiting the sample, using research tools for data collection, analyzing and interpreting the data, and communicating the results
3. To teach students how to conduct research studies in an ethical way
4. To deepen students' critical thinking skills by using deductive logic and by thinking in a scientific way

Course Outcomes:

CO1: Understand the scientific method, as well as the role of scientific research in the field of cognitive sciences

CO2: Gain the skills to define a researchable problem and formulate a research question

CO3: Gain the ability to formulate research hypotheses in order to test theories, which include at least one independent and one dependent variable

CO4: Develop an understanding of the different research designs, including experimental designs for evaluation research, and gain the ability to recruit a sample and to apply different research tools in the field

CO5: Develop the ability to read research papers, understand the content, and think critically about the quality of the research conducted

CO6: Gain the knowledge of how to conduct a research study in an ethical way

Skills:

- Scientific thinking
- Define a researchable problem and formulate a research question
- Formulate research hypotheses to test theories
- Design a research study that has high internal validity
- Recruit a random sample
- Critically read and comprehend research papers
- Follow ethical guidelines while doing research

CO-PO Mappings

Program outcome PO - Course Outcomes CO Mapping

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

Syllabus

Unit 1:Scientific Method and Role of Research in Cognitive Sciences **9 hrs.**

- Scientific research in the natural vs social sciences
- Relevance of scientific research in the field of cognitive sciences
- Inductive vs deductive reasoning in scientific research
- Features of the scientific method

Unit 2: Qualitative vs Quantitative Research **9 hrs.**

- Philosophical assumptions of the scientific method
- Quantitative, qualitative, and mixed methods research
- Code of ethics for research with human subjects

Unit 3: Problem Formulation **9 hrs.**

- Finding researchable problems
- Conducting a literature review
- Formulating the research question
- Stating the research objectives

Unit 4: Theories and Variables **9 hrs.**

- Concepts and conceptualization
- Operationalization of concepts (constructs) as variables
- Types of variables
- Nature and role of theories in social science research
- Formulation of hypotheses

Unit 5: Research Designs, Sampling, and Tools **9 hrs.**

- Units of analysis
- Research designs for quantitative and qualitative research
- Experimental vs. survey studies
- Sampling methods
- Tools of data collection in quantitative and qualitative research
- Avoiding errors in measurement
- Psychometric properties of quantitative research tools (validity, reliability, practicality)
- Increasing the trustworthiness of qualitative studies

Textbooks:

Bhattacherjee, A. (2012). *Social science research: Principles, methods, and practices*. Textbooks Collection. Book 3. http://scholarcommons.usf.edu/oa_textbooks/3

Creswell, J. W. (2014). *Research design. Qualitative, quantitative, and mixed methods*

(4th edition). Los Angeles, CA: Sage.

Kumar, R. (2011). *Research methodology. A step-by-step guide for beginners* (3rd edition). Los Angeles, CA: Sage. Retrieved from

http://www.sociology.kpi.ua/wp-content/uploads/2014/06/Ranjit_Kumar-Research_Methodology_A_Step-by-Step_G.pdf

Reference Books:

Bacon-Shone, J. H. (2013). *Introduction to quantitative research methods*. Hong Kong: Graduate School, The University of Hong Kong. Retrieved from https://hub.hku.hk/bitstream/10722/191018/1/Content.pdf

Bryman, A. (2016): *Social research methods* (5th edition). Oxford, UK: Oxford University Press.

Goode, W. J. & Hatt, P. K. (2017). *Methods in social research*. Hyderabad, India: Asia Law House.

Kothari, C.R. (2004). *Research methodology. Methods and techniques* (2nd revised edition). New Delhi, India: New Age International Publishers. Retrieved from

https://ccsuniversity.ac.in/bridge-library/pdf/Research-Methodology-CR-Kothari.pdf

Krishnaswamy, O. R. & Ranganatham, M. (2013). *Methodology of research in social sciences* (2nd edition). New Delhi, India: Himalaya Publishing House.

Neuman, W. L. (2014). *Social research methods. Qualitative and quantitative approaches* (7th edition). Pearson Education India.

Nick, T. G. (2007). *Descriptive statistics*. In W. T. Ambrosius (Ed.), Topics in biostatistics (p. 33-52) (Series: Methods in Molecular Biology). Totowa, NJ: Humana Press. Retrieved from https://www.researchgate.net/profile/Douglas_Mahoney2/publication/5402488_Linear_Mixed_Effect s_Models/links/57e560bf08ae9227da964db4.pdf#page=42

Patel, P. (2009). *Introduction to quantitative methods*. Retrieved from https://www.studocu.com/row/document/takoradi-polytechnic/quantitative-studies/quantitative-methods-practical/2647139?origin=null

Evaluation Pattern:

Assessment	Internal	External
Midterm Exam (MCQ format)	30	
*Continuous Assessment (CA)	20	
End Semester (MCQ format)		50

*CA - Can be Quizzes, Assignment, Projects, and Reports, and Seminar

26CLT598 Research Project I: Contributing to an ongoing research project for a co-authorship in a journal or conference 1-0-8 (5)

This course is the first in a three-semester research project training designed for students to achieve co-authorship on a Scopus-indexed conference paper or journal paper (required for graduation). At the beginning of the first semester, students will be matched with an ongoing research project and guide of their preference.

Students will contribute to the project through data collection, data preparation and analysis, literature support, documentation, and other tasks deemed important by the guide. Students will simultaneously conduct a focused literature review within the broader project theme to identify a new, relevant research gap. This literature review, in combination with an ethics reflection exercise, will help students write their own research proposal to be submitted before the start of Semester II to the Institutional Human Ethics Committee (IHEC).

This submission, including continued collaboration with the guide, marks the successful conclusion of Research Project I at the end of Semester I.

Credit Allocation:
3 credits: Project Assistance – Contribution to guide's ongoing research project.
2 credits: Writing new Research Proposal for Ethics Committee – Literature review, research gap identification, ethics reflection, and submission of a research proposal to the IHEC.

25AVP501 **Mastery Over Mind (MAOM)** **1-0-2 2**

Course Outcomes

CO01: Relate to the causes of stress in one's life.

CO02: Experiment with a range of relaxation techniques

CO03: Model a meditative approach to work, study, and life.

CO04: Develop appropriate practice of MA-OM technique that is effective in one's life

CO05: Inculcate a higher level of awareness and focus.

CO06: Evaluate the impact of a meditation technique

1. Course Overview

Master Over the Mind (MAOM) is an Amrita initiative to implement schemes and organise university-wide programs to enhance health and wellbeing of all faculty, staff, and students (UN SDG -3). This program as part of our efforts for sustainable stress reduction gives an introduction to immediate and long-term benefits and equips every attendee to manage stressful emotions and anxiety facilitating inner peace and harmony.

With a meditation technique offered by Amrita Chancellor and world-renowned humanitarian and spiritual leader, Sri Mata Amritanandamayi Devi (Amma), this course has been planned to be offered to all students of all campuses of AMRITA, starting off with all first years, wherein one hour per week is completely dedicated for guided practical meditation session and one hour on the theory aspects of MAOM. The theory section comprises lecture hours within a structured syllabus and will include invited guest lecture series from eminent personalities from diverse fields of excellence. This course will enhance the understanding of experiential learning based on 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.

2. Course Syllabus

Unit 1 (4 hours)

Causes of Stress: The problem of not being relaxed. Need for meditation -basics of stress management at home and workplace. Traditions and Culture. Principles of meditation– promote a sense of control and autonomy in the Universal Human Value System. Different stages of Meditation. Various Meditation Models. Various practices of Meditation techniques in different schools of philosophy and Indian Knowledge System.

Unit 2 (4 hours)

Improving work and study performance. Meditation in daily life. Cultivating compassion and good mental health with an attitude of openness and acceptance. Research and Science of Meditation: Significance of practising meditation and perspectives from diverse fields like science, medicine, technology. philosophy, culture, arts, management, sports, economics, healthcare, environment etc. The role of meditation for stress and anxiety reduction in one's life with insights based on recent cutting-edge technology. The effect of practicing meditation for the wholesome wellbeing of an individual.

Unit 3 (4 hours)

Communications: principles of conscious communication. Relationships and empathy: meditative approach in managing and maintaining better relationships in life during the interactions in the world, role of MAOM in developing compassion, empathy and responsibility, instilling interest, and orientation to humanitarian projects as a key to harness intelligence and compassion in youth. Methodologies to evaluate effective awareness and relaxation gained from meditation. Evaluating the global transformation through meditation by instilling human values which leads to service learning and compassion driven research.

TEXT BOOKS:

1.Mata Amritanandamayi Devi, "Cultivating Strength and vitality," published by Mata Amritanandamayi Math, Dec 2019

2.Swami Amritaswarupananda Puri ,"The Color of Rainbow " published by MAM, Amritapuri.

REFERENCES:

1.Craig Groeschel, "Winning the War in Your Mind: Change Your Thinking, Change Your Life" Zondervan Publishers, February 2019

2.R Nagarathna et al, "New Perspectives in Stress Management "Swami Vivekananda Yoga Prakashana publications, Jan 1986

3. Swami Amritaswarupananda Puri "Awaken Children Vol 1, 5 and 7 - Dialogues with Amma on Meditation", August 2019

4. Swami Amritaswarupananda Puri “From Amma’s Heart - Amma’s answer to questions raised during world tours” March 2018
5. Secret of Inner Peace- Swami Ramakrishnananda Puri, Amrita Books, Jan 2018.
6. Mata Amritanandamayi Devi “Compassion :The only way to Peace:Paris Speech”, MA Center, April 2016.
7. Mata Amritanandamayi Devi “Understanding and collaboration between Religions”, MA Center, April 2016.
8. Mata Amritanandamayi Devi “Awakening of Universal Motherhood: Geneva Speech” M A center, April 2016.

22ADM501 Glimpses of Indian Culture 2 0 1 P/F

Introduction: Love is the substratum of life and spirituality. If love is absent life becomes meaningless. In the present world love is used as the string to connect the beads of values, life becomes precious, rare and beautiful like a fragrant blossom. Values are not to be learned alone. They have to be imbibed into the inner sprit and put into practice. This should happen at the right time when you have vitality and strength, when your hearts are open.

The present course in value education is a humble experience-based effort to lead and metamorphosis the students through t process of transformation of their inner self towards achieving the best. Amma’s nectarous words of wisdom and acts of love are our guiding principles. Amma’s philosophy provides an insightinto the vision of our optimistic future.

1. Invocation, Satsang and Question - Answers
2. Values - What are they? Definition, Guiding Principles with examples Sharing own experiences
3. Values - Key to meaningful life. Values in different contexts
4. Personality - Mind, Soul and Consciousness - Q and A. Body-Mind-Intellect and the Inner psycheExperience sharing
5. Psychological Significance of samskara (with e.g. From Epics)
6. Indian Heritage and Contribution and Q and A; Indian Ethos and Culture
7. Self-Discipline (Evolution and Practice) – Q and A
8. Human Development and Spiritual Growth - Q and A
9. Purpose of Life plus Q and A
10. Cultivating self-development
11. Self-effort and Divine Grace - their roles – Q and A; - Vedanta and Creation –Understanding a spiritual Master
12. Dimensions of Spiritual Education; Need for change Lecture – 1; Need for PerfectionLecture - 2
13. How to help others who have achieved less - Man and Nature Q and A, Sharing ofexperiences

REFERENCES:

1. Swami Amritaswaroopananda Puri - Awaken Children (Volume VII and VIII)
2. Swami Amritaswaroopananda Puri - Amma’s Heart
3. Swami Ramakrishnanda Puri - Rising Along the Razor’s Edge
4. Deepak Chopra - Book 1: Quantum Healing;Book 2: Alpha and Omega of God;Book 3: Seven Spiritual Rules Success
5. Dr. A. P. J. Abdul Kalam- 1. Ignited Minds 2. Talks (CD)
6. Swami RamakrishnandaPuri - Ultimate Success
7. Swami JnanamritanandaPuri - Upadesamritham (Trans: Malayalam)
8. Vedanta Kesari Publication - Values - Key to a meaningful life
9. Swami Ranganathananda - Eternal values for a changing society
10. David Megginson & Vivien Whitaker - Cultivating Self Development
11. Elizabeth B. Hurlock - Personality Development, Tata McGraw Hill
12. Swami Jagatatmananda - Learn to Live (Vol.1 and 2), RK Ashram, Mylapore

Semester 2

26CLT511 LEARNING, INSTRUCTION, AND UX DESIGN 2-0-4 (4)

Prerequisite: Good reading and writing skills in English

Summary

This course introduces foundational theories of human learning, motivational and emotional influences, instructional models, and principles for designing effective learning environments. A strong emphasis is placed on user interface (UI) and user experience (UX) design for learning, exploring how interaction design, usability, and cognitive principles shape digital learning experiences. Students will learn to analyze learning situations, evaluate instructional approaches, and connect cognitive principles with pedagogical and technological design.

Course Objectives

1. To understand foundational theories of human learning from cognitive, behavioral, and sociocultural perspectives.
2. To differentiate major instructional models and understand how they facilitate learning.
3. To examine principles for designing effective learning environments, including digital and physical spaces.
4. To explore motivational, emotional, and social factors that influence learning.
5. To understand current and emerging trends in digital learning, including AI-supported learning environments.
6. To analyze how user interface and user experience design influence learning processes, engagement, and accessibility.
7. To evaluate learning technologies using principles from learning theories and HCI.

Course Outcomes

CO1: Explain and differentiate major theories of human learning and their implications for instruction.

CO2: Apply instructional models and learning principles to design or evaluate learning activities.

CO3: Analyze how motivational, emotional, and social factors influence learning.

CO4: Evaluate digital and technology-enhanced learning environments using principles from learning theories and HCI.

CO5: Critically analyze how UI/UX design choices support or hinder learning, and map pedagogical approaches to interface affordances.

CO6: Design or critique learning interfaces with attention to usability, cognitive load, accessibility, and learner experience.

Skills

- Understanding key learning theories and their relevance for instruction
- Designing and evaluating instructional strategies
- Applying HCI and UX principles to learning technologies
- Conducting cognitive task analysis for interface design

- Evaluating usability, accessibility, and learner experience
- Critical reading, argumentation, and multidisciplinary thinking
- Collaborative work and independent learning
- Critically evaluating the limitations of digital teaching and learning

CO-PO Mappings

Program outcome PO - Course Outcomes CO Mapping

	PO1	PO2	PO3	PO4	PO 5	PO6	PO7	PO8	PO9
CO1	**X**	-	-	-	X	-	-	-	-
CO2	-	-	**X**	-	-	-	X	-	X
CO3	-	**X**	-	-	-	-	-	-	-
CO4	-	-	-	X	-	X	-	-	-
CO5	-	-	-	-	-	-	-	-	X

Syllabus:

Unit 1: Foundations of Human Learning **12 hrs.**

- Classical and operant conditioning (Watson, Skinner)
- Social learning theory (Bandura)
- Constructivist cognitive theories (Piaget, Bruner)
- Using prior knowledge
- Intelligence, Need for Cognition (Cacioppo & Petty), and individual differences
- Learning and excellence (expertise development)
- How learning theories inform interface and instructional design

Unit 2: Motivational and Emotional Aspects of Learning **12 hrs.**

- Role of emotions in learning
- Role of motivation in learning
- Role of self-concept, self-efficacy, and agency in learning
- Role of delayed gratification, grit, and perseverance in learning
- Role of instructor–learner rapport
- Designing for motivation and engagement in digital environments (e.g., feedback, autonomy, flow, gamification)

Unit 3: Instruction and Facilitating Learning 12 hrs.

- Scaffolding (Vygotsky)
- Metacognition and self-regulated learning
- Activity-based, problem-based, and inquiry-based learning
- Collaborative learning
- Transfer of knowledge
- Bloom's Taxonomy
- ICAP's (Interactive, Constructive, Active, and Passive) modes of cognitive engagement
- Applying instructional design principles to digital interfaces

Unit 4: Technology-Enhanced and Digital Learning Environments 12 hrs.

- Learning in virtual and immersive environments
- Computer-supported collaborative learning
- Technology-enhanced learning across educational contexts
- Gamification
- AI-supported learning environments and personalized learning
- Cognitive load theory (Sweller)
- Dual coding theory (Paivio)
- Opportunities and limitations of digital learning
- UX considerations in digital learning environments (e.g., navigation, feedback, accessibility, optimal cognitive load)

Unit 5: Designing and Evaluating Interfaces for Learning 12 hrs.

- Overview of HCI styles in learning technologies
- Interaction mechanisms and design choices
- Usability, accessibility, and learner experience
- Integrating pedagogical principles into interface design
- Analysis of major learning interface design approaches (strengths and weaknesses)
- Mapping interface designs to pedagogical models
- Case study: aligning a specific pedagogy with a learning technology, evaluating interface–pedagogy fit, and identifying improvements

Textbooks

Alepis, E., & Virvou, M. (2016). *Object-oriented user interfaces for personalized mobile learning* (Vol. 64). Springer.

Fischer, F., Hmelo-Silver, C. E., Goldman, S. R., & Reimann, P. (Eds.). (2018). *International handbook of the learning sciences*. Routledge.

Gagné, R. M., Wager, W. W., Golas, K. C., & Keller, J. M. (2005). *Principles of instructional design* (5th ed.). Wadsworth.

Kaur, S. (2024). *Ultimate UI/UX design for professionals: Create impactful, user-centric designs with research and collaboration techniques for seamless responsive web interfaces*. Orange Education.

Mayer, R. E. (2005). *The Cambridge handbook of multimedia learning.* Cambridge University

Press.

Norman, D. (2004). *Emotional design: Why we love (or hate) everyday things*. Basic Books.

Sawyer, R. K. (Ed.). (2014). *The Cambridge handbook of the learning sciences*. Cambridge University Press.

Slavin, R. E. (2018). *Educational psychology: Theory and practice*. Pearson.

Spitzer, M. (1999). *The mind within the net: Models of learning, thinking, and acting*. MIT Press.

Yablonski, J. (2024). *Laws of UX: Using psychology to design better products & services* (2nd ed.). Shroff/O'Reilly.

Research Articles

Ahn, J. (2022). Exploring the negative and gap-widening effects of EdTech on young children's learning achievement: Evidence from a longitudinal dataset of children in American K–3 classrooms. *International Journal of Environmental Research and Public Health, 19*(9), 5430.

Ali, Z., Janarthanan, J., & Mohan, P. (2024). Understanding digital dementia and cognitive impact in the current era of the internet: A review. *Cureus, 16*(9), e70029.

Anderson, R. C. (1984). Role of the reader's schema in comprehension, learning, and memory. In R. C. Anderson, J. Osborn, & R. J. Tierney (Eds.), *Learning to read in American schools* (pp. 243–257). Lawrence Erlbaum.

Alexander, P. A., Schallert, D. L., & Reynolds, R. E. (2009). What is learning anyway? A topographical perspective considered. *Educational Psychologist, 44*(3-4), 176–192.

Antonietti, C., Schmitz, M. L., Consoli, T., Cattaneo, A., Gonon, P., & Petko, D. (2023). Development and validation of the ICAP Technology Scale to measure how teachers integrate technology into learning activities. *Computers & Education, 192*, 104648.

Archambault, L., Leary, H., & Rice, K. (2022). Pillars of online pedagogy: A framework for teaching in online learning environments. *Educational Psychologist, 57*(3), 178-191.

Cacioppo, J. T., & Petty, R. E. (1982). The need for cognition. *Journal of Personality and Social Psychology, 42*(1), 116–131. https://doi.org/10.1037/0022-3514.42.1.116

Chi, M. T., & Wylie, R. (2014). The ICAP framework: Linking cognitive engagement to active learning outcomes. *Educational psychologist, 49*(4), 219-243.

Chi, M. T., Adams, J., Bogusch, E. B., Bruchok, C., Kang, S., Lancaster, M., ... & Yaghmourian, D. L. (2018). Translating the ICAP theory of cognitive engagement into practice. *Cognitive Science, 42*(6), 1777-1832.

Damasio, A. (1994). *Descartes' error: Emotion, reason and the human brain*. Putnam, 352. Edwards,

R. (2012). Lifelong learning: A posthuman condition? In D. Aspin, J. Chapman, K. Evans, & R. Bagnall (Eds.), *Second International Handbook of Lifelong Learning* (pp. 151–162). Springer.

Ericsson, K. A., Krampe, R. T., & Tesch-Römer, C. (1993). The role of deliberate

practice in the acquisition of expert performance. *Psychological Review, 100*(3), 363–406. https://doi.org/10.1037/0033-295X.100.3.363

EUCIS-LLP, European Civil Society Platform for Lifelong Learning. (2015). *Manifesto for the future of learning in Europe*. EUCIS-LLP.

Fauré, E., et al. (1972). *Learning to be: The world of education today and tomorrow*. Paris: UNESCO.

Fischer, F., & Opitz, A. (2022). *Learning to diagnose with simulations: Examples from teacher education and medical education*. Cham: Springer International Publishing.

Fischer, F., Sommerhoff, D., & Keune, A. (2023). Perspectives on learning from the learning sciences. In *International Encyclopedia of Education* (Fourth Edition) (pp. 44-56). Elsevier.

Greenhow, C., Graham, C. R., & Koehler, M. J. (2022). Foundations of online learning: Challenges and opportunities. *Educational Psychologist, 57*(3), 131-147.

Gunawardana, R., Perera, M., Lakshika, R., Ranasinghe, C., & Karunanayaka, K. (2025). Enhancing adaptive personalized learning interfaces with generative AI for individuals with ADHD. In *Proceedings of the 16th International Conference on Human–Computer Interaction: HCI Design and Research (IndiaHCI 2025)* (pp. 131–143).

LeDoux, J. (1996). *The emotional brain. The mysterious underpinnings of emotional life*. Simon & Schuster.

Lu, M., Tamura, K., Okamoto, T., Oi, M., Shimada, A., Hatano, K., Yamada, M., & Konomi, S. (2019). *Proposal and implementation of an elderly-oriented user interface for learning support systems.* In *Proceedings of the 6th ACM Conference on Learning at Scale (L@S 2019)* (pp. 1–4). ACM. https://doi.org/10.1145/3330430.3333650

Teasley, S. D. (2019). Learning analytics: Where information science and the learning sciences meet. *Information and Learning Sciences, 120*(1/2), 59-73.

Masveta, D., & Manyangara, M. E. (2025). The UX–UI continuum: Exploring the interplay between user experience and user interface in e-learning platforms. *Cogent Education, 12*(1), 2536531.

Muir, A. (2021, May). Where HCI meets the spiritual path: The three yogas of the Bhagavad Gītā. In *Extended Abstracts of the 2021 CHI Conference on Human Factors in Computing Systems* (pp. 1- 9).

Mallan, V. S., Gopi, S., Muir, A., & Bhavani, R. R. (2017, September). Comparative empirical usability assessment of two HRI input devices for a mobile robot. In *2017 4th International Conference on Signal Processing, Computing and Control (ISPCC)* (pp. 331-337). IEEE.

Ofosu-Asare, Y. (2024). Enhancing user experience in online learning environments: Design, evaluation, and usability techniques. *Journal of Graphic Engineering and Design, 15*(4), 45–59.

Ramesh, M. V., Muir, A., Nandanan, K., Bhavani, R. R., & Mohan, R. (2022). HCI curricula for sustainable innovation: The humanitarian focus at Amrita Vishwa

Vidyapeetham. *Interactions, 29*(1), 54-57.

Sachith, K. P., Gopal, A., Muir, A., & Bhavani, R. R. (2017). Contextualizing ICT based vocational education for rural communities: Addressing ethnographic issues and assessing design principles. In *Human-Computer Interaction-INTERACT 2017: 16th IFIP TC 13 International Conference*, Mumbai, India, September 25-29, 2017, Proceedings, Part II 16 (pp. 3-12). Springer.

Spitzer, M. (2014). Information technology in education: Risks and side effects. *Trends in Neuroscience and Education*, *3*(3-4), 81-85.

S., S., Shrivastava, A., & Karmakar, S. (2025). Identifying interface design factors impacting user experience in digital learning platforms: A pilot study. *Social Sciences & Humanities Open, 11*, 101662.

Sutcliffe, A. G., & De Angeli, A. (2005). Assessing interaction styles in web user interfaces. In M. F. Costabile & F. Paternò (Eds.), *Human-Computer Interaction – INTERACT 2005: Proceedings of the IFIP TC13 International Conference* (pp. 405–417). Springer. https://doi.org/10.1007/11555261_34

Syamala, S., Shrivastava, A., & Karmakar, S. (2025). Enhancing user experience in digital design learning environments through user interface improvements: A comprehensive approach. *IEEE Access, 13*, 182960–182976.

Unnikrishnan, R., Amrita, N., Muir, A., & Rao, B. (2016, June). Of elephants and nested loops: How to introduce computing to youth in rural India. In *Proceedings of the The 15th International Conference on Interaction Design and Children* (pp. 137-146).

Vodopivec, V. (2024). *A review of studies exploring negative effects of digital technology on student learning, academic performance, and class participation*. Canadian Journal for New Scholars in Education, 15(2).

Additional Reading Material on Teaching:

Cognitive foundations of teaching

Pasquinelli, E., & Strauss, S. (2018). Introduction: Teaching and its building blocks. *Review of Philosophy and Psychology, 9*, 719-749. https://doi.org/10.1007/s13164-018-0422-3

Biological evolution and teaching

Thornton, A., & Raihani, N. J. (2008) The evolution of teaching. *Animal Behaviour, 75(6)*, 1823–36.

Nonhuman teaching

Caro, T. M., & Hauser, M. D. (1992) Is there teaching in nonhuman animals? *Quarterly Review of Biology 67*, 151–74.

Thornton, A., & McAuliffe, K. (2006) Teaching in wild meerkats. *Science 313(5784)*, 227–29.

Teaching in prehistory as evidenced by cognitive archeology

Assaf, E., Nunziante-Cesaro, S., Gopher, A. & Venditti, F. (2023). Learning by doing: Investigating skill through techno-functional study of recycled lithic items from Qesem Cave

(Israel). *Journal of Archaeological Method and Theory 30,* 64–102. https://doi.org/10.1007/s10816-022-09590-6

Teaching in developing children

Strauss, S., & Ziv, M. (2012). Teaching is a natural cognitive ability among humans. *Mind, Brain and Education, 6(4)*, 186-196. doi: 10.1111/j1751-228X.2012.01156.x

Bonawitz, E., Shafto P., Gweon, H., Goodman, N. D., Spelke, E. & Schultz, L. (2011) The double-edged sword of pedagogy: instruction limits spontaneous exploration and discovery. Co*gnition, 120*, 322–330. doi:10.1016/j.cognition.2010. 10.001

Cultural variations of teaching: Hunter and gatherers

Hewlett B. S. & Roulette C. J. (2016). Teaching in hunter– gatherer infancy. *Royal Society of Open Science, 3*, 150403. http://dx.doi.org/10.1098/rsos.150403

Teaching and cultural transmission

Laland, K. N., & Hoppitt, W. (2003). Do animals have culture? *Evolutionary Anthropology, 12*, 150–159. doi:10.1002/evan.10111

Caldwell C. A., Cornish, H. & Kandler, A. (2016). Identifying innovation in laboratory studies of cultural evolution: Rates of retention and measures of adaptation. *Philosophical Transactions of the Royal Society, B 371: 20150193*. http://dx.doi.org/10.1098/rstb.2015.0193

Scalise Sugiyama, M. (2017) Oral storytelling as evidence of pedagogy in forager societies. *Frontiers of Psychology, 8* (471). doi: 10.3389/fpsyg.2017.00471

Evaluation Pattern:

Assessment	Internal	External
Active Participation in Class	10	
*Continuous Assessment (CA) and Mid-term	40	
End Semester Exam OR Content/project produced over the course and submitted on the last working day		50

*CA - Can be Quizzes, Assignments, Projects, Reports, and Presentations

26CLT512 COGNITIVE ANTHROPOLOGY: CROSS-CULTURAL PERSPECTIVES 3-0-0 (3)

Prerequisite: Good reading and writing skills in English; Basic understanding of cognitive anthropology and its relevance in society and culture

Course Objectives

1. To gain a basic understanding of the emergence of cognitive anthropology: Ethnosemantics, Ethnoscience, Ethnolinguistics, and New Ethnography
2. To develop a working knowledge of the relevance of cognitive anthropology in societal development- linguistic relativity
3. To gain an overview of the different principal concepts in cognitive anthropology
4. To help students learn how people from different cultures think, remember, reason, and interpret the world differently, and how these differences shape daily life and social interaction.
5. To understand the application of cognitive anthropology

Course Outcomes

CO1: Acquire knowledge of the emergence of cognitive anthropology from linguistics and the link between human thought processes and the physical and ideational aspects of culture

CO2: Understand the essential concept of linguistic relativity and influential figures in cognitive anthropology

CO3: Gain insights into various principal concepts such as culture model, folk taxonomies, knowledge structures, prototypes, and symbolic systems

CO4: Understand fundamental cognitive processes (categorization, memory, perception, reasoning) and their cultural variations

CO5: Understand the use of cognitive anthropology in education and pedagogy, cross-cultural communication, cognitive ecology

Skills:

- Develop a deeper understanding of the relationship between cognition, thought, and culture in society and the emergence of cognitive anthropology.
- Learn about the importance of Sapir–Whorf hypothesis or linguistic relativity hypothesis and other important figures in the field.
- Understand the concepts ingrained in cognitive anthropology.
- interpret how cultural contexts shape cognitive functions, including categorization, memory, reasoning, emotion, perception and thinking
- Grasp how cognitive anthropology is applied in education and pedagogy and cross-cultural communication and Cultural adaptation; cognition in human-environment interaction from a cognitive perspective.

Course objectives CO-Program outcome PO - Mappings

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9

CO1		-	-	-	-	-	-	-	-
CO2	-	-	X	-	-	-	-	X	-
CO3	X	-	-	-	-	-	-	-	-
CO4	-	-	X	-	-	-	-	-	X
CO5	-	-	-	-	-	-	X	-	-

Syllabus

Unit 1: Understanding Cognitive Anthropology and its Emergence **9 hrs.**

- Introduction: What is Cognitive Anthropology?
- Emergence of Cognitive Anthropology
- Definition, scope, and goals of Cognitive Anthropology
- Historical development of cognitive approaches in anthropology: Ethnosemantics, Ethnoscience, Ethnolinguistics, and New Ethnography

Unit 2: Culture and Thought **9 hrs.**

- Relationship between culture and cognition
- Language and its role in shaping thought
- Symbolic meaning and communication
- Cognitive aspects of ritual and symbolism
- Linguistic Relativity hypothesis or Sapir - Whorf Hypothesis

Unit 3: Principal Concepts **9 hrs.**

- Culture models, domain, prototypes, folk models, folk taxonomies, schemata, knowledge structures, mental models and their cultural variations, ethnoscience and cognitive mapping

Unit 4: Cognitive Processes in Culture **9 hrs.**

- Cultural categorization and classification
- Memory, narrative, and cultural scripts
- Decision-making and cultural logics
- Emotion, perception, and attention across cultures

Unit 5: Contemporary Applications and Future Directions **9 hrs.**

- Use of Cognitive Anthropology in various fields - research, ethnography, education, cross-cultural learning, and adaptations in human-nature interactions

Textbooks

D'Andrade, R. G. (1995). *The Development of Cognitive Anthropology.* Cambridge University Press. Geertz, C. (1973). *The Interpretation of Cultures.* Basic Books.

Lakoff, G., & Johnson, M. (2003). *Metaphors We Live By.* University of Chicago Press.

Bateson, G. (2002). *Mind and Nature: A Necessary Unity.* Hampton Press.

Atran, S. (1990). *Cognitive foundations of natural history: Towards an anthropology of science*. Cambridge University Press.

Wertsch, J. V. (2002). *Voices of collective remembering*. Cambridge University Press.

Luria, A. R. (1976). *Cognitive development: Its cultural and social foundations*. Harvard University Press.

Key Papers:

Tyler, S. A. (1969). Cognitive Anthropology. *Ethnology, 8*(2), 125–152. DOI: 10.2307/3772907

Harris, M. (1968). The Rise of Anthropological Theory: A History of Theories of Culture. *Thomas Y. Crowell Company.*

Gell, A. (1998). Art and Agency: An Anthropological Theory. *Clarendon Press.*

Sperber, D. (1985). Anthropology and Psychology: Towards an Epidemiology of Representations. *Man, 20*(1), 73–89. DOI: 10.2307/2802054

Lakoff, G., & Johnson, M. (1980). The Metaphorical Structure of the Human Conceptual System. *Cognitive Science, 4*(2), 195–208. DOI: 10.1207/s15516709cog0402_4

Nisbett, R. E. (2003). The Geography of Thought: How Asians and Westerners Think Differently... and Why. *Free Press.*

Shweder, R. A., & Bourne, E. J. (1984). Does the Concept of the Person Vary Cross-Culturally? In R. A. Shweder & R. A. LeVine (Eds.), *Culture Theory: Essays on Mind, Self, and Emotion* (pp. 158– 199). Cambridge University Press.

Mesquita, B. (2003). *Cultural variation in emotion: A comparative perspective*. In R. J. Davidson, K. R. Scherer, & H. H. Goldsmith (Eds.), *Handbook of affective sciences* (pp. 367–388). Oxford University Press.

Nisbett, R. E., Peng, K., Choi, I., & Norenzayan, A. (2001). Culture and systems of thought: Holistic versus analytic cognition. *Psychological Review, 108*(2), 291–310. https://doi.org/10.1037/0033-295X.108.2.291

Dressler, W. W., Balieiro, M. C., & dos Santos, J. E. (2018). What you know, what you do, and how you feel: Cultural competence, cultural consonance, and psychological distress. *Frontiers in Psychology, 8*, 2355. https://doi.org/10.3389/fpsyg.2017.02355

Veissière, S. P. L., Constant, A., Ramstead, M. J. D., Friston, K. J., & Kirmayer, L. J. (2020). Thinking through other minds: A variational approach to cognition and culture. *Behavioral and Brain Sciences, 43*, e90. https://doi.org/10.1017/S0140525X19001752

Evaluation Pattern:

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

*CA - Can be Quizzes, Assignment, Projects, and Reports, and Seminar

26CLT513 COGNITIVE AND SYSTEMS NEUROSCIENCE - PART II 3-0-0 (3)

Prerequisites: Good reading and writing skills in English; Basic understanding of brain anatomy and neural functioning

Course outcomes for parts 1 and 2:

- Provide students with an end-to-end account of nervous system function from cellular mechanisms to cognition.
- Integrate molecular/cellular neuroscience, synaptic physiology, systems neuroscience, and cognitive neuroscience into a single coherent course.
- Establish a shared technical vocabulary (neuroanatomy, electrophysiology, neural coding, systems organization) to support advanced reading and research discussion.
- Train students to connect circuit mechanisms to perception, action, learning, memory, language, emotion, and executive control.
- Build competence in interpreting foundational experimental approaches (e.g., electrophysiology, lesion evidence, neuropharmacology, and functional imaging).
- Prepare students to reason about neurological and psychiatric disorders as disruptions of identifiable mechanisms and circuits, not just symptom lists.
- Develop students' ability to move between levels of analysis (from genes to synapses to circuits to behaviour) when forming explanations and research questions.
- Strengthen students' capacity to read primary literature that extends what they have learnt to current cognitive neuroscience problems.

Learning outcomes for parts 1 and 2:

- Explain how neurons and glia generate electrical signals and how ion channels shape excitability and conduction.
- Analyze synaptic transmission and integration, including receptor mechanisms, neuromodulation, and presynaptic release processes.
- Apply core neural coding ideas (receptive fields, population coding, topographic maps) to interpret sensory and motor representations.
- Trace major anatomical pathways and describe how distributed brain systems support perception and movement.
- Compare the neural organization of somatosensation, pain, vision, audition, vestibular function, smell, and taste, emphasizing what each system computes.
- Describe the control of movement across spinal circuits, motor cortex, premotor/parietal systems, cerebellum, and basal ganglia, including links to disorders.

- Relate brainstem, hypothalamic, and neuromodulatory systems to arousal, autonomic control, emotion, motivation, addiction, sleep, and epilepsy.
- Explain how neural circuits are built and refined during development, how experience shapes plasticity, and how aging alters brain function.
- Distinguish major memory systems and outline cellular and systems mechanisms for implicit and explicit memory, including hippocampal–prefrontal contributions.
- Evaluate evidence from functional imaging and other methods for claims about cognition (attention, working memory, language, consciousness) and their disruption in neuropsychiatric conditions.

Program outcome PO - Course Outcomes CO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	x	-	-	-	-	-	x	x	-
CO2	x	-	-	-	-	-	x	x	-
CO3	-	-	-	-	-	-	x	x	-
CO4	-	-	-	-	-	-	x	-	-
CO5	-	-	-	-	-	-	x	-	x

Syllabus for Part 2:

Unit 1: Vision—From Retina to Recognition and Action - 12hrs

- Retina computations: phototransduction, contrast encoding, and early feature extraction
- Thalamocortical visual pathways; hierarchical processing and cortical feature maps
- Intermediate visual representations: contours, motion, depth, and segmentation primitives
- High-level vision: objects, faces, attention effects, and top-down influences
- Vision-for-action: visuomotor transformations and perceptual decision constraints

Unit 2: Auditory, Vestibular, Chemical Senses, and Multisensory Integration - 8hrs

- Auditory transduction and coding; tonotopy and temporal precision
- Central auditory processing for localization, scene analysis, and speech-relevant features
- Vestibular sensing and integration; self-motion perception and stabilization reflexes
- Smell and taste coding; integration into flavor, motivation, and memory

- Multisensory integration principles and sources of perceptual bias

Unit 3: Motor Control, Learning, and Movement Disorders - 12hrs

- Muscle and motor unit physiology; force control and EMG interpretation basics
- Spinal circuits: reflexes, gain control, and central pattern generators for locomotion
- Motor cortical control: population coding, synergies, and descending pathways
- Premotor and parietal contributions to planning, intention, and sensorimotor mapping
- Control of gaze; eye–head coordination and saccade-related computations
- Cerebellar learning signals and error-based adaptation
- Basal ganglia loops for action selection and reinforcement-learning-like control
- Mechanistic links to movement disorders and neurodegeneration, including genetic contributions

Unit 4: Autonomic Control and Sleep - 5 hrs

- Brainstem and neuromodulatory systems shaping arousal and cognitive state
- Autonomic control and hypothalamic integration; homeostasis and motivated behavior
- Emotion and feeling circuits; reward, habit, and addictive states
- Seizure mechanisms and network excitability; cognitive consequences
- Sleep architecture and sleep–wake control; sleep effects on memory and performance

Unit 5: Development, Language and Memory - 8 hrs

- Nervous system development: patterning, cell migration, axon guidance, synaptogenesis
- Activity-dependent refinement, critical periods, and lifelong plasticity
- Repair after injury and mechanisms of functional recovery; aging-related brain change
- Language systems and aphasia; neural bases of conscious and unconscious processing
- Disorders affecting thought, volition, mood, anxiety, and neurodevelopmental cognition
- Learning and memory systems; implicit vs explicit memory, cellular plasticity, hippocampal–prefrontal interactions

Textbooks and Papers:

Kandel, E. R., Schwartz, J. H., & Jessell, T. M. (2000). *Principles of neural science* (5th ed). McGraw-Hill.

Gazzaniga, M. S., Ivry, R. B., & Mangun, G. R. (2014). *Cognitive neuroscience. The biology of the mind* (5th edition). Norton.

Goldstein, E. B. (2015). *Cognitive psychology: Connecting mind, research, and everyday experience* (5th edition). Cengage Learning.

Reference Books:

Berridge, K. C. (2004). Motivation concepts in behavioral neuroscience. *Physiology & behavior, 81*(2), 179-209

Berkman, E. T. (2018). The neuroscience of goals and behavior change. *Consulting Psychology Journal: Practice and Research, 70*(1), 2

Buzsáki, G. (2020). The brain–cognitive behavior problem: A retrospective. *Eneuro, 7*(4).

Kok, A. (2020). *Functions of the brain. A conceptual approach to cognitive neuroscience.* Routledge.

Krebs, C., Weinberg, J., & Akesson, E. (2012). *Lippincott's illustrated reviews of neuroscience.* Wolters Kluwer.

Mesulam, M.-M. (2000). *Behavioral neuroanatomy: Large-scale networks, association cortex, frontal syndromes, the limbic system, and hemispheric specialization.* Association Cortex, Frontal.

Passingham, R. (2016). *Cognitive neuroscience: A very short introduction.* Oxford University Press.

Raichle, M. E. (1998). Behind the scenes of functional brain imaging: A historical and physiological perspective. *Proceedings of the National Academy of Sciences,* USA, 95, 765–772.

Silberman, S. (2017). *Neurotribes: The legacy of autism and how to think smarter about people who think differently.* Atlantic Books.

Streidter, G. (2005). *Principles of brain evolution* (pp. 217–53). Sunderland, MA: Sinawer.

Ward, J. (2020). *The student's guide to cognitive neuroscience* (4th edition). Routledge.

Zimmer, C. (2004). *Soul made flesh: The discovery of the brain – and how it changed the world.* New York: Free Press.

ACADEMIC PAPERS

Alexander, R., Aragón, O. R., Bookwala, J., Cherbuin, N., Gatt, J. M., Kahrilas, I. J., ... & Styliadis, C. (2021). The neuroscience of positive emotions and affect: Implications for cultivating happiness and wellbeing. *Neuroscience & Biobehavioral Reviews, 121*, 220-249

Barack, D. L., & Krakauer, J. W. (2021). Two views on the cognitive brain. *Nature Reviews Neuroscience, 22*(6), 359-371

Domes, G., Schulze, L., Böttger, M., Grossmann, A., Hauenstein, K., Wirtz, P. H., ... & Herpertz, S. C. (2010). The neural correlates of sex differences in emotional reactivity and emotion regulation. *Human Brain Mapping, 31*(5), 758-769

Friedman, N. P., & Robbins, T. W. (2022). The role of prefrontal cortex in cognitive control and executive function. *Neuropsychopharmacology, 47*(1), 72-89

Koenig, J., Parzer, P., Haigis, N., Liebemann, J., Jung, T., Resch, F., & Kaess, M. (2021).

Effects of acute transcutaneous vagus nerve stimulation on emotion recognition in adolescent depression. *Psychological Medicine, 51*(3), 511-520

Mussel, P., & Hewig, J. (2019). A neural perspective on when and why trait greed comes at the expense of others. *Scientific Reports, 9*(1), 10985

Nelson, C. A., Fox, N. A., & Zeanah, C. H. (2023). Romania's abandoned children: The effects of early profound psychosocial deprivation on the course of human development. *Current Directions in Psychological Science, 32*(6), 515-521

Rich, A. N., & Mattingley, J. B. (2002). Anomalous perception in synaesthesia: a cognitive neuroscience perspective. *Nature Reviews Neuroscience, 3*(1), 43-52.

Vuust, P., Heggli, O. A., Friston, K. J., & Kringelbach, M. L. (2022). Music in the brain. *Nature Reviews Neuroscience, 23*(5), 287-305.

Cash, P. J., Hartlev, C. G., & Durazo, C. B. (2017). Behavioral design: A process for integrating behavior change and design. *Design Studies, 48,* 96-128.

Hummel, D., & Maedche, A. (2019). How effective is nudging? A quantitative review on the effect sizes and limits of empirical nudging studies. *Journal of Behavioral and Experimental Economics, 80*, 47-58.

D'Lima, D., Lorencatto, F., & Michie, S. (2020). The behavior change wheel approach. In *Handbook on implementation science* (pp. 168-214). Edward Elgar Publishing.

Whitehead, M., Jones, R., & Pykett, J. (2019). Nudging around the world: a critical geography of the behavior change agenda. *Handbook of Behavioural Change and Public Policy*, 90-101.

Strassheim, H., & Beck, S. (Eds.). (2019). *Handbook of behavioral change and public policy.* Edward Elgar Publishing.

Hallsworth, M. (2023). A manifesto for applying behavioural science. *Nature Human Behaviour, 7*(3), 310-322.

Ajzen I, Fishbein M (1972) Attitudes and normative beliefs as factors influencing behavioral intentions. *J Pers Soc Psychol* 21(1):1–9

Baumeister, R. F., Vohs, K. D. (2007). *Encyclopedia of social psychology.* Sage, Thousand Oaks

Kerlinger, F. N. (1979). *Behavioral research: A conceptual approach*. Holt, Rinehart and Winston, New York

Smelser, N. J., & Baltes, P. B. (2011). International encyclopedia of the social and behavioural sciences. *Proceedings of US National Academy of Sciences, 95*(3), 922-9.

Zettle, R. D., Hayes, S. C., Barnes-Holmes, D., & Biglan, A. (2016). *The Wiley Handbook of Contextual Behavioral Science*.

Evaluation Pattern:

Assessment	Internal	External
Midterm Exam (MCQ format)	30	
*Continuous Assessment (CA)	20	
End Semester (MCQ format)		50

*CA - Can be Quizzes, Assignment, Projects, and Reports, and Seminar

26CLT514 RESEARCH METHODOLOGY II: ADVANCED QUANTITATIVE DATA ANALYSIS 3-0-0 (3)

Prerequisite: Good reading and writing skills in English; basic knowledge of research methodology

Course Objectives

1. Gain an in-depth understanding of concepts of quantitative data analysis, such as measures of central tendency and dispersion, levels of measurements, normal distribution of the data, and type I and II errors, so that they can be applied in one's research study
2. Gain the ability to distinguish between parametric and non-parametric tests and know when to use which
3. Develop more advanced skills in summarizing and presenting data as graphs and frequencies in descriptive statistics using computer software programs (e.g., Jamovi or SPSS)
4. Know how to measure group differences and test for significance using inferential statistics using computer software programs (e.g., Jamovi or SPSS): Chi-square tests, t-tests, Mann-Whitney U tests, Kruskal-Wallis H tests, as well as ANOVA (Univariate Analysis of Variance) and MANOVA (Multivariate Analysis of Variance)
5. Know how to explore the relationships between variables using Chi-square tests, , correlations, and different types of regression analyses
6. Gain the ability to calculate effect sizes and test power, as well as the ability to report results from statistical tests in a scientific research paper
7. Understand the foundations of validating research instruments in order to test for the validity and reliability

Course Outcomes

CO1: Understand the basic concepts of statistical significance tests, such as levels of measurement, measures of central tendency and dispersion, the normal distribution, significance level Alpha, as well as Type I and Type II Errors

CO2: Knowledge of how to apply statistical tests for hypothesis testing

CO3: Knowledge of how to perform and interpret quantitative statistical analyses with computer software programs (e.g., Jamovi or SPSS)

CO4: Knowledge of how to use computer software programs (e.g., Jamovi or SPSS) to summarize and present data, as well as to do inferential statistical tests for measuring differences between groups and for exploring the relationship between variables

CO5: Understand the concepts of effect size and test power to interpret the results of statistical tests

CO6: Knowledge of how to test the psychometric properties of the research instruments used to validate them for a specific population

CO7: Understand how to report the results of statistical tests in a research paper

Skills:

- Proficiency in computer software programs to perform statistical tests (e.g., Jamovi or SPSS)
- Ability to use statistical tests appropriate for the research question
- Distinguish between parametric and non-parametric tests
- Make graphs with software programs (e.g., Jamovi or SPSS)
- Perform inferential statistics to test hypotheses, such as finding differences between groups and relationships between variables
- Calculate effect size and required sample size
- Test psychometric properties of standardized psychometric scales
- Interpret results of statistical tests
- Report results of statistical tests

Program outcome PO - Course Outcomes CO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	X	-	-	-	-	-	-	-	-
CO2	X	-	-	-	-	-	-	-	-
CO3	X	-	-	-	-	-	-	-	-
CO4	X	-	-	-	-	-	-	-	-
CO5	X	-	-	-	-	-	-	-	-
CO6	X	-	-	-	-	-	-	-	-
CO7	X	-	-	X	-	-	-	-	-

Syllabus

Unit 1: Basic Concepts of Statistical Tests **9 hrs.**

- Levels of measurement
- Population vs sample
- Normal distribution
- Measures of central tendency and dispersion
- Standardization and Z Scores
- Sampling distribution and standard error

Unit 2: Descriptive Statistics versus Inferential Statistics **9 hrs.**

Descriptive Statistics:

- Purpose of descriptive statistics: summarizing and presenting data
- Graphs (e.g., bar chart, pie chart, histogram) and frequency tables

Inferential statistics:

- Purpose of inferential statistics
- Null hypothesis (H_0) and alternative hypothesis (H_A)
- Type I and type II errors
- Significance level Alpha (α)
- Critical values (t, Z) and the confidence interval
- One-tailed and two-tailed tests of significance

Unit 3:Inferential Statistics Part 1: Measuring Differences **9 hrs.**

- Parametric vs non-parametric tests
- Measuring differences: *t*-test, univariate analysis of variance (ANOVA), multivariate analysis of variance (MANOVA)
- Non-parametric equivalents: Chi-square test, McNemar's test, Mann-Whitney U test, Wilcoxon signed rank test, Kruskal-Wallis *H* test
- Effect sizes of the different statistical tests
- Test power (1-β)
- Using G*Power to calculate test power and the sample size

Unit 4: Inferential Statistics Part 2: Exploring Relationships Between Variables **9 hrs.**

- Qui-square
- Correlation (Spearman's rank correlation and Pearson's product-moment correlation)
- Linear regression
- Multiple regression analysis
- Binary logistic regression analysis

Unit 5: Bayesian Statistics; Validating Psychometric Scales **9 hrs.**

Bayesian statistics

- Differences from standard hypothesis testing
- Main principles of Bayesian statistics
- Choosing the prior for the Bayes Factor
- How to conduct a systematic literature review and meta-analysis

Validating psychometric scales

- Testing for validity (e.g., convergent vs discriminant validity)
- Testing for reliability (Cronbach's Alpha)
- Performing factor analysis to confirm subscales and assess the factorial/construct validity

Textbooks:

Bryman, A. & Cramer, D. (2005). *Quantitative data with SPSS 12 and 13. A guide for social scientists.*

London, UK: Routledge.

Kothari, C.R. (2004). *Research methodology. Methods and techniques* (2nd revised

edition). New Delhi,

India: New Age International Publishers. Retrieved from https://ccsuniversity.ac.in/bridge-library/pdf/Research-Methodology-CR-Kothari.pdf

Urdan, T. C. (2011). *Statistics in plain English* (3rd edition). London, UK and New York, NY: Routledge. Retrieved from https://www.pindex.com/uploads/post_docs/statistics%20in%20plain%20english%20(3rd,%202010)(PINDE X-DOC-6952).pdf

Reference Books:

Bacon-Shone, J. H. (2013). *Introduction to quantitative research methods*. Hong Kong: Graduate School, The University of Hong Kong. Retrieved from https://hub.hku.hk/bitstream/10722/191018/1/Content.pdf

Bhattacherjee, A. (2012). *Social science research: Principles, methods, and practices*. Textbooks Collection. Book 3. http://scholarcommons.usf.edu/oa_textbooks/3

Bryman, A., & Cramer, D. (1999). *Quantitative data analysis with SPSS release 8 for Windows. A guide for social scientists.* London and New York: Taylor & Francis Group. Retrieved from http://hcm2.trali.com.vn/upload/170/20131127/Quantitative%20analysis%20with%20SPSS.pdf

Ellis, S. M., & Steyn, H. S. (2003). Practical significance (effect sizes) versus or in combination with statistical significance (p-values): Research note. Management Dynamics: *Journal of the Southern African Institute for Management Scientists, 12(*4), 51-53. Retrieved from https://www.researchgate.net/profile/Suria_Ellis/publication/293182482_Practical_significance_effect_sizes_versus_or_in_combination_with_statistical_significance_p-values/links/574e76df08aec988526bcb6c/Practical-significance-effect-sizes-versus-or-in-combination-with-statistical-significance-p-values.pdf

Garson, G. D. (2012). *Testing statistical assumptions*. Asheboro, NC: Statistical Associates Publishing.

Gaur, A. S. & Gaur, S. S. (2006). *Statistical methods for practice and research. A guide to data analysis using SPSS*. New Delhi, India: Response Books.

Ghasemi, A. & Zahediasl, S. (2012). Normality tests for statistical analysis: A guide for non-statisticians. *International Journal of Endocrinology & Metabolism, 10*(2), 486-9. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3693611/pdf/ijem-10-486.pdf

Kumar, R. (2011). *Research methodology. A step-by-step guide for beginners* (3rd edition). Los Angeles, CA: Sage. Retrieved from

http://www.sociology.kpi.ua/wp-content/uploads/2014/06/Ranjit_Kumar-Research_Methodology_A_Step-by- Step_G.pdf

Nick, T. G. (2007). Descriptive statistics. In W. T. Ambrosius (Ed.), *Topics in biostatistics* (p. 33-52) (Series: Methods in Molecular Biology). Totowa, NJ: Humana Press. Retrieved from https://www.researchgate.net/profile/Douglas_Mahoney2/publication/5402488_Linear_Mixed_Effects_Mode ls/links/57e560bf08ae9227da964db4.pdf#page=42

Patel, P. (2009). *Introduction to quantitative methods*. Retrieved from https://hls.harvard.edu/content/uploads/2011/12/quantitative_methods.pdf

Evaluation Pattern:

Assessment	Internal	External
Midterm Exam (MCQ format)	30	
*Continuous Assessment (CA)	20	
End Semester (MCQ format)		50

*CA - Can be Quizzes, Assignments, Projects, Reports, and Presentations

26CLT599 Research Project II: Qualitative Research; submit a research/dissertation proposal to EC and CSP 1 0 8 4

This course is the second in a three-semester research project training designed for students to achieve co-authorship on a Scopus-indexed conference paper or journal paper (required for graduation). At the beginning of the second semester, students will obtain their approval from the IHEC for their submitted research proposal.

Students will be collecting new quantitative and/or qualitative data, and start drafting sections of their paper (e.g., Introduction and Method) – all with the help of their guide. Course lectures will involve extensive practicing with qualitative data collection (e.g., semi-structured interviewing). During the course, students will be sharing and reflecting on their learning experiences, do's and don't's, and research integrity. Once data collection is completed, students will draft the remaining sections of their paper (e.g., Results and Discussion). After finalizing their draft into a high-quality paper, it will be submitted to the course coordinator (before sending it to an external outlet).

Obtaining approval for external submission after internal submission will mark the successful conclusion of Research Project II, at the end of Semester II.

Credit Allocation:
3 credits: Paper Grading – Submit a full, conference/journal quality paper to the course coordinator for internal review.
1 credit: Identify high-quality, suitable conference or journal outlet, and complete external submission.

1 credit: Reflect on own learning process throughout the research process.

26CUL500	**INTEGRATED AMRITA MEDITATION TECHNIQUE**	**L-T-P-C 0-0-2-1**

A. Nature of Course: Lab/Practical

B. Course Description:

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.

C. Course Objectives:

- 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.

D. Course Outcomes:

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

CO	Course Outcomes	owledge Level loom's Taxonomy)
01	plain principles and components of IAM 20	derstand (L2)
02	monstrate and correct meditation practice independently	ply (L3)
03	alyze personal stress patterns using meditation insights	alyse (L4)
04	aluate personal growth through daily practice	aluate (L5)

E. CO-PO Mapping: [affinity: 3 – high; 2- moderate; 1- slightly]

CO's	Program Outcomes (PO's)											ogram Specific Outcomes (PSF's)		
	01	02	03	04	05	06	07	08	09	010	011	SO1	SO2	SO3
01	-	-	-	-	-	1	-	2	-	-	1	-	-	-
02	-	-	-	-	-	2	2	1	1	-	1	-	-	-
03	-	-	-	-	-	1	1	2	-	-	1	-	-	-
04	-	-	-	-	-	1	1	1	1	-	1	-	-	-

F. 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

G. Evaluation Pattern:

sessment	**ernal (60)**	**ternal (40)**
endance	Marks	
ass Participation	Marks	
tivity	Marks	
actical Demonstration		Marks
va		Marks

AMRITA VALUE PROGRAMME

22ADM502 VEDANTA IN DAY-TO-DAY LIFE 1-0-0-1

Introduction: Amrita University's Amrita Values Programme (AVP), is a new initiative to give exposure to students about richness and beauty of Indian way of life. India is a country where history, culture, art, aesthetics, cuisine and nature exhibit more diversity than nearly anywhere else in the world. Amrita Values Programmes emphasize on making students familiar with the rich tapestry of Indian life, culture, arts, science and heritage which has historically drawn people from all over the world.

Courses offered under the framework of Amrita Values Program: Art of Living through Amma

Amma's messages can be put into action in our life through pragmatism and attuning our thought process in a positive and creative manner. Every single word Amma speaks, and the guidance received on matters which we consider trivial are rich in content and touch the very inner being of our personality. Life gets enriched by Amma's guidance and She teaches us the art of exemplary life skills where we become witness to all the happenings around us, still keeping the balance of the mind.

Insights from the Ramayana

Historical significance of Ramayana, the first Epic in the world – Influence of Ramayana on Indian values and culture – Storyline of Ramayana – Study of leading characters in Ramayana – Influence of Ramayana outside India – Misinterpretation of Ramayana by Colonial powers and its impact on Indian life - Relevance of Ramayana for modern times.

Insights from the Mahabharata

Historical significance of Mahabharata, the largest Epic in the world – Influence of Mahabharata on Indian values and culture – Storyline of Mahabharata – Study of leading characters in Mahabharata – Kurukshetra War and its significance – Importance of Dharma in society – Message of the Bhagavad Gita - Relevance of Mahabharata for modern times.

Insights from the Upanishads

Introduction: Shruti versus Smrti - Overview of the four Vedas and ten Principal Upanishads - The central problems of the Upanishads – Ultimate reality – the nature of Atman - the different modes of consciousness

- Sanatana Dharma and its uniqueness - The Upanishads and Indian Culture – Relevance of Upanishads for modern times – A few Upanishad Personalities: Nachiketas, Satyakama Jabala, Aruni, Shvetaketu.

Insights from Bhagavad Gita

Introduction to Bhagavad Gita – Brief storyline of Mahabharata - Context of Kurukshetra War – The anguish of Arjuna – Counsel by Sri. Krishna – Key teachings of the Bhagavad Gita – Karma Yoga, Jnana Yoga and Bhakti Yoga - Theory of Karma and Reincarnation – Concept of Dharma – Idea of the Self and Realisation of the Self – Qualities of a Realised person -

Concept of Avatar - Relevance of Mahabharata for modern times.

Swami Vivekananda and his Message

Brief Sketch of Swami Vivekananda's Life – Meeting with Guru – Disciplining of Narendra - Travel across India - Inspiring Life incidents – Address at the Parliament of Religions – Travel in United States and Europe – Return and reception India – Message to Indians about our duties to the nation.

Great Spiritual Teachers of India

Sri Rama, Sri Krishna, Sri Buddha, Adi Shankaracharya, Sri Ramanujacharya, Sri Madhvacharya, Sri Ramakrishna Paramahamsa, Swami Vivekananda, Sri Ramana Maharshi, Mata Amritanandamayi Devi

Indian Arts and Literature:

The aim of this course is to present the rich literature and culture of Ancient India and help students appreciate their deep influence on Indian Life - Vedic culture, primary source of Indian Culture – Brief introduction and appreciation of a few of the art forms of India - Arts, Music, Dance, Theatre, Paintings, Sculpture and architecture – the wonder language, Sanskrit and ancient Indian Literature

Importance of Yoga and Meditation in Life:

The objective of the course is to provide practical training in YOGA ASANAS with a sound theoretical base and theory classes on selected verses of Patanjali's Yoga Sutra and Ashtanga Yoga. The coverage also includes the effect of yoga on integrated personality development.

Appreciation of Kerala's Mural Art Forms:

A mural is any piece of artwork painted or applied directly on a wall, ceiling or other large permanent surface. In the contemporary scenario Mural painting is not restricted to the permanent structures and are being done even on canvas. A distinguishing characteristic of mural painting is that the architectural elements of the given space are harmoniously incorporated into the picture. Kerala mural paintings are the frescos depicting mythology and legends, which are drawn on the walls of temples and churches in South India, principally in Kerala. Ancient temples, churches and places in Kerala, South India, display an abounding tradition of mural paintings mostly dating back between the 9th to 12th centuries CE when this form of art enjoyed Royal patronage. Learning Mural painting through the theory and practice workshop is the objective of this course.

Practicing Organic Farming

Life and nature are closely linked through the healthy practices of society for maintaining sustainability. When modern technological knowhow on microorganisms is applied in farming using the traditional practices we can avoid damage to the environment. The course will train the youth on modern practices of organic farming. Amma says "we have to return this land to the coming generations without allowing even the slightest damage to happen to it". Putting this philosophy to practice will bring about an awakening and enthusiasm in all to strive for good health and to restore the harmony in nature"

Ancient Indian Science and Technology

Science and technology in ancient and medieval India covered all the major branches of human knowledge and activities, including mathematics, astronomy, physics, chemistry, medical science and surgery, fine arts, mechanical, civil engineering, architecture,

shipbuilding and navigation. Ancient India was a land of sages, saints and seers as well as a land of scholars and scientists. The course gives an awareness on India's contribution to science and technology.

Semester 3

26CLT695 **RURAL FIELD VISIT** **0-0-6 (3)**

Course Objectives:

1. Making detailed and objective observations about the population and challenges observed
2. Making suggestions for solutions from the lens of Cognitive Sciences, Learning and Technology
3. Applying theories from cognitive sciences, learning sciences, UX design, and educational technology
4. Reflections on field experience

OR

26CLT690 **LIVE-IN-LABS** **0-0-6 (3)**

Course Objectives

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

Course Outcomes

On the successful completion of the Course, the student will be able to –

CO1: Understand the basic concepts and principles of sustainable development

CO2: Learn ethnographic research and utilise the methodologies to enhance participatory engagement

CO3: Prioritize challenges and derive constraints using Participatory Rural Appraisal

CO4: Identify and formulate the research challenges in rural communities

CO5: Design solutions using a human-centred approach

CO-PO Mapping

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

1 – Substantial; 2 – Moderate; 3 - Strong

Syllabus

Unit 1 - Sustainable Development

Introduction and History. Basic Concepts, Strategies, and Measurement. United Nations Initiatives and Sustainable Development Goals.

Unit 2 - Participatory Rural Appraisal (PRA)

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

Unit 3 - Human-Centered Design (HCD)

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

Unit 4 - Sustainable Social Change

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

Text Book(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.

References

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.

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.

Akella, Devi. "Learning together: Kolb's experiential theory and its application." Journal of Management & Organization 16, no. 1 (2010): 100-112.

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.

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.

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

Evaluation Pattern

Assessment	**Marks**
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**
Attendance (To be added separately)	5
Grand Total	**105**

26CLT696 Research Project III; Collect and analyze data for their dissertation project; write an internal paper; create a poster for poster presentation 1-0-8 (5)

This course is the third in a three-semester research project training designed for students to achieve co-authorship on a Scopus-indexed conference paper or journal paper (required for graduation). Students have finalized their external submission to a Scopus-indexed conference or journal *before* the start of Semester III.

Students will utilize this course for likely revisions and resubmissions, while also working on a poster presentation of their co-authored paper. Last, students will be challenged to reflect critically on some of the most common ethical issues, which their own paper may be subject to, and how to handle it optimally. Both exercises will prepare students to confidently and professionally present their new research findings at one of our Amrita conferences.

This conference presentation will mark the successful conclusion of Research Project III at the end of Semester III – and the successful achievement of co-authorship, as overarching goal.

Credit Allocation:
2 credits: Revisions and Resubmissions – Actively contribute to incorporating peer-reviewers' feedback, under supervision of guide.

1 credit: Critical ethics reflection on own research paper – Identify biggest potential issues and how to transparently and constructively communicate about it.

2 credits: Conference Presentation – Prepare a professional conference poster and prepare a conference pitch, both of which will be graded by the course coordinator.

Semester 4

26CLT697/26CLT698 INTERNSHIP/BLOCK PLACEMENT 0-0-12 (6)**

This intensive block placement occurs after the end-semester examinations. It is designed for students to immerse themselves in an organization, acquiring hands-on training and experience that aims at enhancing employability in related fields. Students will collaborate with their placement agencies, contributing to projects and initiatives. The placement offers a deep dive into the operational aspects of organizations at the intersection of cognitive sciences and education, with the potential for employment opportunities upon successful completion of the internship.

Several mandatory workshops covering topics related one or more of the following:

- Skill Gaps training
- Hands on exposure to professional tools
- Workshops and Webinars with industry experts
- Access to certification courses to boost employability
- Campus Interviews
- Professional Skills development
- Transition from Academic to Professional life (6

credits)

26CLT 699 ORGANIZING CONFERENCE/SYMPOSIUM 0-0-6 (3)

The students are expected to jointly organize a Conference / Symposium as a requirement for the course. Each student will be evaluated for their initiation, organization, coordination and active participation.

Guidance: The conference should provide a student-centered platform for undergraduate students, postgraduate students, and research scholars to critically examine and discuss emerging developments in the field of cognition, learning, and technology-enhanced environments. The conference largely organized by the students for the students will emphasize student participation, experiential learning and interdisciplinary collaboration. Possible sponsorships and collaborations with UNESCO or similar agencies may be facilitated by faculty

(3 credits)

SPECIALIZATION 1: USER EXPERIENCE AND LEARNING

26CLT631 USER NEEDS FOR LEARNING TECHNOLOGY 2-0-2 (3)

Prerequisites: none

Summary:

This course delves into understanding the users of learning technology, emphasizing the importance of designing technology that caters to the end users' needs for it to be effective. Misunderstandings or ignorance of these needs can lead to poor user interfaces and diminished learning experiences, a concern particularly acute for vulnerable communities dependent on skill training. Through a detailed exploration of learner needs, with a focus on neurodiversity and educational backgrounds, the course uses a case study of low-literacy populations in rural India to navigate the full spectrum of user needs analysis and specification.

Course Objectives:

Students will learn to:

1. To understand the diversity of user needs in learning technology.
2. To emphasize the importance of empathetic, user-centered design in technology development.
3. To equip students with the ability to conduct comprehensive user needs analyses.
4. To provide insights into the design challenges and requirements of vulnerable communities.

Course Outcomes:

CO1: User-Centered Design Proficiency: Gain understanding in designing educational technologies that prioritize user experience and learning outcomes.

CO2: Conduct user needs analysis with proficiency.

CO3: Develop detailed user personas and specify design requirements based on user needs.

CO4: Apply frameworks like Jobs to Be Done effectively in the context of learning technologies.

CO5: Utilize ethical research methods and participatory design to engage users in the design process.

Skills:

- Proficiency in user needs analysis and specification.
- Development of user personas and design requirements.
- Application of design and analysis frameworks to learning technologies.
- Competency in ethical research and participatory design methodologies.

Program outcome PO - Course Outcomes CO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO9		
CO 1	**X**	-	-	-	-	-	-	-	-		
CO 2	-	-	**X**	-	-	-	-	-	-		
CO 3	-	**X**	-	-	-	-	-	X	-		
CO 4	-	-	-	-	-	X-	-	-	-		
CO 5	**X**	-	-	-	-	-	-	-	-		

Syllabus:

Unit I: Analysis of Case Study(s) to Identify User Needs for Learning Technology 12 hrs.

- For example: Tablet-Based Training for Low-Literacy population in Rural India
- Examination of case study on the Plumbing training (2016/2017).
- Analysis of impact of social and psychological factors on user needs and design
- Discussion on Luria's tea room experiments.
- Comparison of design states before and after intervention.

Unit II Frameworks for Defining User Needs 10 hrs.

- Development and application of Personas, Goals, and Tasks.
- Exploration of the Jobs-to-Be-Done framework.
- Integration of user requirements within the Software Development Life Cycle.

Unit III: Psychology and Social Factors 13 hrs.

- Contrast between oral and textbook learning and teaching methodologies.
- Examination of the role of the implicit teacher-student relationship.

- Study of impact of prior learning experiences, socio-economic backgrounds and other factors such as age on the interaction with learning technologies

Unit IV: Research Methods for Defining User Needs **10 hrs.**

- Application of participatory design principles and methods including data collection and analysis
- Consideration of ethical implications in design research.
- Execution of a sample research study program.

References:

- Cooper, A., Reimann, R., Cronin, D., & Noessel, C. (2014). About face: The essentials of interaction design (4th ed.). Wiley.
- Cranz, G. (2016). Ethnography for designers. Routledge.
- Krug, S. (2014). Don't make me think, revisited: A common sense approach to web usability. New Riders.
- Mallan, V. S., Gopi, S., Muir, A., & Bhavani, R. R. (2017, September). Comparative empirical usability assessment of two HRI input devices for a mobile robot. In 2017 4th International Conference on Signal Processing, Computing and Control (ISPCC) (pp. 331-337). IEEE.
- Meyer, E., & Wachter-Boettcher, S. (2016). Design for real life. A Book Apart.
- Muir, A. (2021, May). Where HCI meets the spiritual path: The three yogas of the Bhagavad Gītā. In Extended Abstracts of the 2021 CHI Conference on Human Factors in Computing Systems (pp. 1-9).
- Norman, D. A. (2013). The design of everyday things: Revised and expanded edition. Basic Books.
- Norman, D. (2004). Emotional design: Why we love (or hate) everyday things.
- Ramesh, M. V., Muir, A., Nandanan, K., Bhavani, R. R., & Mohan, R. (2022). HCI curricula for sustainable innovation: The humanitarian focus at Amrita Vishwa Vidyapeetham. Interactions, 29(1), 54-57.
- Sachith, K. P., Gopal, A., Muir, A., & Bhavani, R. R. (2017). Contextualizing ICT based vocational education for rural communities: Addressing ethnographic issues and assessing design principles. In Human-Computer Interaction-INTERACT 2017: 16th IFIP TC 13 International Conference, Mumbai, India, September 25-29, 2017, Proceedings, Part II 16 (pp. 3-12). Springer International Publishing.
- Unnikrishnan, R., Amrita, N., Muir, A., & Rao, B. (2016, June). Of elephants and nested loops: How to introduce computing to youth in rural India. In Proceedings of the The 15th International Conference on Interaction Design and Children (pp.

137-146).

Evaluation Pattern:

Assessment	Internal	External
Active Participation in Class	10	
*Continuous Assessment (CA) and Mid-term	40	
End Semester Exam OR Content/project produced over the course and submitted on the last working day		50

*CA - Can be Quizzes, Assignments, Projects, Reports, and Presentations

26CLT632 LEARNING ANALYTICS & EDUCATIONAL DATA MINING 2-0-2 (3)

Prerequisites: A foundational understanding of statistics, proficiency in programming languages such as Python or R, and a basic knowledge of educational theory and practices.

Summary

This course delves into the interdisciplinary domains of data mining, machine learning, and educational theory to analyze and interpret educational data effectively. Spanning five units, the course begins with exploring Educational Data Mining (EDM), tracing its historical development, technical foundations, and key challenges. Subsequently, it transitions to Learning Analytics (LA), examining its evolution, tools, and integration challenges within formal education systems. The course then explores the intersection of EDM and LA, elucidating their philosophical, social, and computational disparities while highlighting their shared analysis techniques and data processing pipelines. Furthermore, students will gain insights into modelling and interpreting educational data, emphasizing the fusion of technical advancements with educational theories. Finally, the course culminates in Multimodal Learning Analytics (MMLA), addressing the complexities of analyzing multiple modalities in learning environments and the challenges associated with stakeholder involvement, data processing, and integration. Throughout the course, students will use diverse machine learning algorithms, data visualization techniques, and real-world case studies to develop a nuanced understanding of leveraging data for educational insights and decision-making.\

Course Objectives

1. Understand the fundamental principles and historical development of Educational Data Mining (EDM) and Learning Analytics (LA).
2. Explore diverse machine learning algorithms and data processing pipelines utilized in EDM and LA for analyzing educational data.
3. Investigate the interdisciplinary nature of EDM and LA, examining philosophical, social, and computational perspectives.
4. Develop modeling, interpreting, and visualizing educational data skills to derive actionable insights for educational stakeholders.
5. Analyze the challenges and opportunities in implementing Multimodal Learning Analytics (MMLA) solutions in educational settings.

Course Outcomes

CO1: Demonstrate proficiency in utilizing machine learning algorithms and data processing techniques for educational data analysis.

CO2: Critically evaluate EDM and LA solutions' strengths, limitations, and ethical implications in educational contexts.

CO3: Apply theoretical frameworks and analytical methods to model and interpret educational data effectively.

CO4: Communicate insights from educational data analysis to diverse stakeholders through clear and concise visualizations and reports.

CO5: Develop strategies to address integration and adoption challenges in implementing MMLA solutions, fostering data literacy among educational stakeholders.

Skill:

1. Develop proficiency in statistical analysis, data visualization, and programming, essential for interpreting and communicating insights from educational data.
2. Acquire specialized knowledge in educational theory and practices, enabling the integration of data-driven insights into instructional design and pedagogical decision-making.
3. Cultivate critical thinking and problem-solving skills to address complex challenges in educational data mining, learning analytics, and multimodal learning analytics.
4. Enhance interdisciplinary collaboration and communication skills to effectively engage with diverse stakeholders in implementing data-driven educational interventions, including educators, researchers, and policymakers.
5. Foster a commitment to ethical data practices and a deep understanding of privacy and security considerations when handling sensitive educational data, ensuring responsible use and dissemination of insights derived from data analysis.

Course Outcomes (CO) - Program Outcomes (PO) Mappings

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	X	-	X	-	-	-	-	X	-
CO2	X	X	-	-	X	-	-	-	-
CO3	X	X	-	-	-	X	-	-	-
CO4	-	-	-	X	-	X	-	-	-
CO5	-	X	-	X	-	X	X	-	-

Syllabus

Unit 1: Educational Data Mining (EDM)

Overview: Introduction to EDM; Fundamentals of EDM; Development of this field over time; Historical and recent technical perspectives in EDM; Technical and data

infrastructures in EDM; Diverse set of ML algorithms for mining used in EDM; Some evidence-based key solutions; Major failures that the EDM filed has faced; Open challenges.

Unit 2: Learning Analytics (LA)

Overview: Introduction to LA; Fundamentals of LA; Development of this field over time; Historical and interdisciplinary perspectives in LA; LA solutions, tools, infrastructures, and architectures; Monomodality in LA for more than a decade; Diverse set of ML algorithms for predicting performance across different educational constructs; Integration and adoption challenges of LA in formal education; Open research challenges; Low-cost LA and Global South.

Unit 3: EDM and LA

Overview: Differences in philosophical, social, educational, computational, and psychological stances in EDM and LA; Data processing pipelines; What theories help to build the pipelines in these two fields; ML and AI lenses in the fields; Analysis techniques used in LA and EDM; Limitations and opportunities centered to the required data in these two fields.

Unit 4: Modeling and Interpretation of Educational Data across these two fields

Overview: Latent constructs in measuring educational constructs, especially related to learning and teaching; Identification of constructs and modalities with technical advancements while keeping educational theories and pedagogies in the center; Data preparation, organization, fusion, analysis, and visualization;
Sense-making of visualized data with educational stakeholders.

Unit 5: Multimodal Learning Analytics (MMLA)

Overview: Mono-modality versus multimodality in learning; Need of MMLA over LA; Technical advancements that enable the tapping of multiple modalities from a learning situation; Complexities in designing an MMLA situation by involving cross-disciplinary stakeholders like teachers, students, researchers, and syllabus designers; Complexities in designing and following any standard multimodal data processing pipeline; Challenges in the development of MMLA solutions; Integration and adoption issues; Data literacy of educational stakeholders and MMLA.

Textbooks and Papers:

1. Peña-Ayala, A. (2014). Educational data mining. Studies in Computational Intelligence, 524.
2. Larusson, J. A., & White, B. (Eds.). (2014). Learning analytics: From research to practice (Vol. 13). Springer.
3. Romero, C., Ventura, S., Pechenizkiy, M., & Baker, R. S. (Eds.). (2010). Handbook of educational data mining. CRC press.
4. Rodriguez, C. O. (2013). Two distinct course formats in the delivery of connectivist MOOCs. Turkish Online Journal of Distance Education, 14(2), 66-80.
5. ElAtia, S., Ipperciel, D., & Zaïane, O. R. (Eds.). (2016). Data mining and learning analytics: Applications in educational research. John Wiley & Sons.

6. Lester, J., Klein, C., Johri, A., & Rangwala, H. (Eds.). (2018). Learning analytics in higher education: Current innovations, future potential, and practical applications. Routledge.
7. Romero, C., & Ventura, S. (2010). Educational data mining: a review of the state of the art. IEEE Transactions on Systems, Man, and Cybernetics, Part C (applications and reviews), 40(6),

   601-618.
8. Krumm, A., Means, B., & Bienkowski, M. (2018). Learning analytics goes to school: A collaborative approach to improving education. Routledge.
9. Siemens, G., & Baker, R. S. D. (2012, April). Learning analytics and educational data mining: towards communication and collaboration. In Proceedings of the 2nd international conference on learning analytics and knowledge (pp. 252-254).
10. Daniel, B. K. (Ed.). (2016). Big data and learning analytics in higher education: current theory and practice. Springer.
11. Oviatt, S., Schuller, B., Cohen, P., Sonntag, D., & Potamianos, G. (2017). The handbook of multimodal-multisensor interfaces, volume 1: Foundations, user modeling, and common modality combinations. Morgan & Claypool.
12. Shankar, S.K., Ruiz-Calleja, A., Prieto, L.P., Rodríguez-Triana, M.J., Chejara, P., & Tripathi, S. (2023), CIMLA: A Modular and Modifiable Data Preparation, Organization, and Fusion Infrastructure to Partially Support the Development of Context-aware MMLA Solutions. JUCS - Journal of Universal Computer Science 29(3): 265-297. https://doi.org/10.3897/jucs.84558
13. Shankar, S. K., Prieto, L. P., Rodríguez-Triana, M. J., & Ruiz-Calleja, A. (2018, July). A review of multimodal learning analytics architectures. In IEEE 18th International Conference on Advanced Learning Technologies (ICALT 2018). IEEE, (pp. 212-214). https://doi.org/10.1109/ICALT.2018.00057

Reference Books:

1. de Baker, R. S. J., & Inventado, P. S. (2014). Chapter X: Educational Data Mining and Learning Analytics. Comput. Sci, 7, 1-16.
2. Ferguson, R. (2012). Learning analytics: drivers, developments and challenges. International Journal of Technology Enhanced Learning, 4(5-6), 304-317.
3. Siemens, G., & Gasevic, D. (2012). Guest editorial-learning and knowledge analytics. Journal of Educational Technology & Society, 15(3), 1-2.
4. Romero, C., & Ventura, S. (2010). Educational data mining: a review of the state of the art. IEEE Transactions on Systems, Man, and Cybernetics, Part C (applications and reviews), 40(6),

   601-618.
5. Macfadyen, L. P., & Dawson, S. (2010). Mining LMS data to develop an "early warning system" for educators: A proof of concept. Computers & education, 54(2), 588-599.
6. Ellis, R. A., Han, F., & Pardo, A. (2017). Improving learning analytics–Combining

observational and self-report data on student learning. Journal of Educational Technology & Society, 20(3), 158-169.

7. Elmoazen, R., Saqr, M., Tedre, M., & Hirsto, L. (2022). A systematic literature review of empirical research on epistemic network analysis in education. IEEE Access, 10, 17330-17348.
8. Lynch, R., & Dembo, M. (2004). The relationship between self-regulation and online learning in a blended learning context. International Review of Research in Open and Distributed Learning, 5(2), 1-16.
9. Slade, S., & Prinsloo, P. (2013). Learning analytics: Ethical issues and dilemmas. American Behavioral Scientist, 57(10), 1510-1529.
10. Chejara, P., Prieto, L. P., Rodríguez-Triana, M. J., Ruiz-Calleja, A., Kasepalu, R., & Shankar, S.K. (2023, March). How to Build More Generalizable Models for Collaboration Quality? Lessons Learned from Exploring Multi-Context Audio-Log Datasets using Multimodal Learning Analytics. In LAK23: 13th International Learning Analytics and Knowledge Conference (LAK2023). ACM, USA, 111–121. https://doi.org/10.1145/3576050.3576144

Evaluation Pattern:

Assessment	Internal	External
Active Participation in Class	10	
*Continuous Assessment (CA) and Mid-term	40	
End Semester Exam OR Content/project produced over the course and submitted on the last working day		50

*CA - Can be Quizzes, Assignments, Projects, Reports, and Presentations

26CLT633 INSTRUCTIONAL DESIGN: THEORY, PRACTICE, AND EMERGING TRENDS
2-0-2 (3)

Duration: 45 Hours
Structure: 5 Units, each integrating into a Capstone Project (a complete instructional design package implemented in an LMS).

Course Overview

This 3-credit Master's level course provides a comprehensive introduction to instructional design theory, models, and practices. Students will examine key learning theories, design frameworks, and evidence-based strategies for creating effective and engaging learning experiences. The course combines theoretical foundations with practical application, including curriculum planning, instructional strategies, storyboard design, evaluation methods, and the use of e-learning standards. Learners will also explore emerging technologies such as XR, mobile learning and AI tools to support innovative instructional solutions. A capstone project will bring together all course components into a complete, LMS-ready instructional package.

Course Objectives:

- Understand foundational learning theories and instructional design models, and apply them to practical learning contexts.
- Conduct needs analysis and develop a curriculum aligned to measurable learning objectives.
- Design accessible and instructional materials using modern authoring tools.
- Develop evaluation tools and feedback mechanisms for continuous improvement.
- Integrate emerging technologies and AI into instructional design to enhance learner engagement.

Course Outcomes:

CO 1: Analyse and apply appropriate learning theories and design models to varied instructional contexts.

CO 2: Create a course curriculum tailored to learner needs.

CO 3: Develop an instructional design document and storyboard with integrated accessibility and adaptivity.

CO 4: Design and implement evaluation instruments that inform iterative improvements.

CO 5: Deploy a complete instructional design project in an LMS.

Skills Developed:

- Curriculum development and learning objective alignment
- Developing storyboards

- Application of UDL and accessibility standards (WCAG)
- Proficiency in authoring tools (Articulate Storyline/ Rise, H5P)
- LMS deployment and SCORM/xAPI publishing
- Creating and analysing evaluation instruments
- Integrating XR, mobile learning, and AI into instructional design

Syllabus:

Unit I – Foundations and Theoretical Frameworks (7 hours)

- Introduction to Instructional Design and its evolution
- Active and social learning, learning preferences, and instructional material types
- Learning theories and their applications: Behaviourism, Cognitivism, Constructivism, Social Constructivism
- Instructional design models – ADDIE, SAM
- Principles of learner-centred and personalised design
- Introduction to Universal Design for Learning (UDL)

Hands-on Deliverable: Learning Theory and design models, application in real training scenarios

Unit II – Analysis and Developing Curriculum (7 hours)

- Needs analysis: audience, content, context, learner gaps
- Defining goals vs. measurable learning objectives (Bloom's taxonomy)
- Aligning content with learning objectives
- Structuring course curriculum and sequencing learning activities

Hands-on Deliverable: Needs Analysis & Course Outline — prepare a written needs analysis and design a course outline with clear learning objectives.

Unit III – Designing and development (15 hours)

- Instructional strategies and approaches
- Mayer's multimedia principles
- Gagné's nine events of instruction
- Kirkpatrick evaluation model
- Accessibility and WCAG compliance in e-learning
- Creating Instructional Design Document
- Introduction to storyboarding: chunking content, scripting, graphics, narration (VO), and icon usage
- Interactivity: levels and types, including branching pathways
- Authoring tools: Articulate Storyline, Rise, H5P

Hands-on Deliverable: Instructional Design Document & Prototype Storyboard — create an IDD and develop a working storyboard prototype in Articulate Storyline or Rise, include at least one adaptive element in

the storyboard

Unit IV – Evaluation and Iteration (6 hours)

- Evaluation types: formative, summative, diagnostic
- Creating evaluation instruments (quizzes, rubrics, surveys)
- Analysing LMS data for continuous improvement
- Ethical and responsible use of learner data

Hands-on Deliverable: Evaluation Toolkit — design at least one formative, one summative, and one diagnostic assessment for the course, embedded into your storyboard.

Unit V – Implementation, AI, and Future Trends (10 hours)

- E-learning standards: SCORM, xAPI
- Gamification
- LMS deployment and publishing (Moodle, Canvas, Blackboard)
- Implementation challenges and mitigation strategies
- Emerging technologies – integrating XR, mobile learning, and AI tutors into instructional design
- AI applications in instructional design –content generation, learning analytics, and adaptive personalization
- Project planning and management for instructional design projects

Hands-on Deliverable: LMS-Ready Course — deploy your designed course in an LMS and present your final capstone project.

Capstone Project

Throughout the course, students develop components of a single instructional design project:

1. Unit I: Theory–Model Matrix
2. Unit II: Needs Analysis & Course Outline
3. Unit III: IDD & Storyboard Prototype
4. Unit IV: Evaluation Toolkit
5. Unit V: LMS-Ready Course & Presentation

The final submission will be a fully documented, implemented instructional design package with a live LMS instance and supporting documentation.

Textbooks and Papers:

Branch, R. M. (2009). *Instructional design: The ADDIE approach*. Springer.

Clark, R. C., & Mayer, R. E. (2016). *E-learning and the science of instruction: Proven guidelines for consumers and designers of multimedia learning* (4th ed.). Wiley.

Dick, W., Carey, L., & Carey, J. O. (2015). *The systematic design of instruction* (8th ed.). Pearson.

Morrison, G. R., Ross, S. M., Morrison, J. R., & Kalman, H. K. (2019). *Designing effective instruction* (8th ed.). Wiley.

Piskurich, G. M. (2015). *Rapid instructional design: Learning ID fast and right* (3rd ed.). Wiley.

Fischer, F., Hmelo-Silver, C. E., Goldman, S. R., & Reimann, P. (Eds.). (2018). *International handbook of the learning sciences*. Routledge.

Fischer, F., & Opitz, A. (2022). *Learning to diagnose with simulations: Examples from teacher education and medical education*. Cham: Springer International Publishing.

Sawyer, R. K. (2022). *An introduction to the learning sciences*. The Cambridge handbook of the learning sciences, 1-24.

Slavin, R. E. (2018). *Educational psychology: Theory and practice.* Pearson.

Teasley, S. D. (2019). Learning analytics: Where information science and the learning sciences meet. *Information and Learning Sciences, 120*(1/2), 59-73.

Evaluation Pattern:

Assessment	Internal	External
Active Participation in Class	10	
*Continuous Assessment (CA) and Mid-term	40	
End Semester Exam OR Content/project produced over the course and submitted on the last working day		50

*CA - Can be Quizzes, Assignments, Projects, Reports, and Presentations

SPECIALIZATION 2: COGNITIVE NEUROSCIENCE

26CLT641 CURRENT RESEARCH IN COGNITIVE AND SYSTEMS NEUROSCIENCE 2-0-2 (3)

Course Description

This course focuses on critical discussion of recent primary research papers spanning systems and cognitive neuroscience. Each week, one paper will be discussed and analyzed in depth by students and the instructor, emphasizing the rationale, methodology, data interpretation, and theoretical implications. The goal is to train students to read research critically, identify open questions, and connect ongoing discoveries to broader cognitive and systems neuroscience themes.

Course Outcomes

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

1. Critically evaluate original neuroscience research articles and discuss their design, analysis, and interpretation.
2. Identify the strengths, limitations, and potential confounds in current experimental neuroscience literature.
3. Integrate findings from different studies to form coherent views on contemporary issues in cognitive neuroscience.
4. Develop advanced skills in scientific communication through oral presentation and moderated discussion.
5. Formulate new, research-oriented questions and hypotheses inspired by current literature.

Learning Outcomes

Students completing the course will demonstrate the ability to:

- Read and summarize contemporary research papers efficiently.
- Critically assess neural data and methodological approaches.
- Engage in informed scientific reflection and form a deep understanding of experiments in systems and cognitive neuroscience.
- Propose follow-up experiments or theoretical extensions of current studies.

Evaluation Pattern:

Assessment	Internal	External
Active Participation in Class	10	
*Continuous Assessment (CA) and Mid-term	40	
End Semester Exam OR Content/project produced over the course and submitted on the last working day		50

*CA - Can be Quizzes, Assignments, Projects, Reports, and Presentations

26CLT642 COMPUTATIONAL NEUROSCIENCE 2-0-2 (3)

Course description:

Computational Neuroscience introduces students to the quantitative modelling of neural systems using mathematical and computational approaches. The course explores how neurons and networks process information through dynamical systems models, including integrate-and-fire and conductance-based neurons, synaptic plasticity mechanisms such as Hebbian learning and spike-timing-dependent plasticity, and population-level dynamics underlying perception, action, and cognition. Emphasis is placed on linking biological realism with computational principles to understand neural coding, learning, decision-making, and motor control. Students will implement and analyse neural models using programming tools, critically evaluate contemporary research, and develop mechanistic explanations for normal brain function and neurological dysfunction.

Learning objectives:

- This course deals with the study of the structure and function of the nervous system
- and how information is transmitted from one part to the other with an emphasis on physiology, development, anatomy, etc.
- To explore computational models of neuronal functions and applications in
- neuroscience research.
- To critically evaluate current research in the field of neuronal computations and its
- implications for understanding brain functions and dysfunctions.

Course outcomes:

CO1: Understand the basic concepts of neuroscience.

CO2: Analyse neural coding, synaptic plasticity, and network dynamics using quantitative frameworks.

CO3: Evaluate computational models of sensory, motor, and cognitive systems in terms of biological plausibility and predictive power.

CO4: Implement and simulate neural models using programming tools to interpret normal brain function and neurological dysfunction.

Program Outcomes (POs):

PO1: Demonstrate advanced knowledge of cognitive science integrating neuroscience, artificial intelligence, and computational modelling.

PO2: Apply computational methods to analyse cognitive and neural data.

PO3: Design, implement, and evaluate models of cognitive and neural processes using appropriate theoretical and computational frameworks.

PO4: Critically evaluate interdisciplinary research literature and synthesize evidence across domains.

PO5: Conduct independent research with scientific rigor, ethical responsibility, and methodological soundness.

PO6: Communicate complex cognitive and computational concepts effectively in academic and professional settings.

PO7: Apply computational neuroscience principles to real-world problems in health, technology, education, and human–machine interaction.

Program Specific Outcomes (PSOs):

PSO1: Integrate concepts from neuroscience, artificial intelligence, and computational modelling to explain cognitive processes across multiple levels of analysis.

PSO2: Develop and implement computational and data-driven models to investigate perception, memory, decision-making, language, and motor control.

PSO3: Analyze behavioral and neural datasets using statistical, machine learning techniques.

CO-PO-PSO mapping

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	2	1	1	3	3	2
CO2	3	3	2	3	2	1	1	3	2	3
CO3	3	2	3	3	2	2	2	3	2	2
CO4	3	3	3	3	3	2	2	3	3	3

Syllabus

Unit 1: Introduction to neuroscience

- Organization of nervous system, electrical properties of neurons, and action potentials.
- Systems theory for the analysis of neurons and neural circuits.
- Basic ion channels and membrane biophysics - ion channel types, channel kinetics, and biology of synaptic dynamics.

Unit 2: Computational models of neurons and theories

- Cable Theory - Spatial propagation of voltage, derivation of equation.
- Passive and active compartmental modelling, numerical integration methods.
- Basic principles behind biophysical modelling and spiking neuron modelling.
- Modelling using NEURON and different types of neural codes.

Unit 3: Biophysical basis of learning and memory

- Models of plasticity and learning
- Models of brain systems and their relationship to artificial neural networks

- Spiking neural networks
- Information Theory of neurons

Unit 4: Neuro-AI and applications

- Brain-inspired artificial intelligence – Relationship between biological neural systems and artificial neural networks.
- Hebbian learning, reward-based learning, and predictive coding frameworks.
- NeuroAI applications – brain–computer interfaces, neural decoding, adaptive robotics, and modelling of neurological and psychiatric disorders.

Textbooks:

1. "Biophysics of Computation" by Christof Koch, (1999) Oxford University Press: New York, New York,

2. "Fundamentals of computational neuroscience" by Trappenberg, Thomas., (2009) OUP Oxford.

3. "From computer to brain: foundations of computational neuroscience" by Lytton, William W., (2007), Springer Science & Business Media.

Evaluation Pattern:

Assessment	Internal	External
Active Participation in Class	10	
*Continuous Assessment (CA) and Mid-term	40	
End Semester Exam OR Content/project		50
produced over the course and submitted on the last working day		

*CA - Can be Quizzes, Assignments, Projects, Reports, and Presentations

26CLT643 ELECTROPHYSIOLOGY AND NEUROIMAGING LAB 2-0-2 (3)

Course topics: fMRI, EEG, MEG, Psychophysics (for ex. Eye tracking and behavioural tasks).

Course outcomes:

- Understanding Mechanisms: Gaining knowledge of the underlying mechanisms involved in brain electrical activity and how each of these techniques help in mapping brain functions.
- Data Acquisition & Analysis: Receiving hands-on experience in the analysis of raw EEG data, processing artifacts, deriving Event-Related Potentials (ERPs), and performing statistical analysis on neuroimaging data using software packages.
- Methodology Evaluation: Critically evaluating the strengths, weaknesses, and appropriate use of different techniques (e.g., fMRI vs. EEG/ERP) based on experimental design and research hypotheses.
- Research Design: Learning the key factors involved in the design and optimization of functional imaging experiments to ensure valid data acquisition and interpretation.

Course contents:

Unit 1 - Introduction to Neurophysiology and Neuroimaging (9 hrs)

- Primer on neural signals including basis of neural activity.
- Local field potentials and single-unit recordings.
- Neural data recording methods and differences between each of them including Signal-to-Noise ratios and advantages and disadvantages of using each method.
- Experimental design and research hypothesis for each of the neuroimaging modalities.

Unit 2 - fMRI (12hrs)

- Neurovascular coupling.
- Principles of fMRI including haemodynamic response function (HRF) and Blood-Oxygen Level Dependent (BOLD) Signal.
- MRI physics - T1, T2 and T2* weighted images.

- Conducting experiments in MRI scanners – block and event related designs in task fMRI, resting state fMRI.

- MRI image visualization and preliminary data analysis – pre-processing and General Linear Model (GLM).

Unit 3 - EEG (12hrs)

- Principles of EEG including source of signals and propagation and a note on volume conduction.

- EEG rhythms.

- Electrode placement, impedance and referencing.

- Designing tasks for EEG.

- EEG data acquisition including difference between wet and dry acquisitions.

- EEG data analysis – artifact recognition and isolation, band power and ERPs (example P300).

Unit 4 - MEG (6 hrs)

- MEG principles including magnetic field detection via SQUIDs

- Environmental noise and shielding considerations

- Advantages over EEG: reference-free, no volume conduction distortion

- MEG vs. EEG spatial/temporal resolution trade-offs

Unit 5 - Psychophysics (6hrs)

- Principles, concept of reaction time and how it differs with complexity.

- Absolute threshold for detection including minimum stimuli for detection.

- Discrimination threshold (just-noticeable difference) - Weber's law.

- Magnitude estimation and scaling using Stevens' law.

- Psychometric functions such as sigmoid curves and slopes.

- Sensory domains of use - vision, audition, touch.

Evaluation Pattern:

Assessment	Internal	External
Active Participation in Class	10	
*Continuous Assessment (CA) and Mid-term	40	
End Semester Exam OR Content/project produced over the course and submitted on the last working day		50

*CA - Can be Quizzes, Assignments, Projects, Reports, and Presentations

SOFT CORE OPTIONS

Students will be assigned to the Soft Core Options from the list based on their Bachelor's Degree Qualification.

26CLT531 NATURAL LANGUAGE PROCESSING 2-0-2 (3)

Prerequisites and skills: Foundational knowledge of Computer Programming and Machine Learning

- Capacity to understand the data needs specific to projects or cases
- Browsing and searching for data sources
- Descriptive analysis skills with excel sheets
- Scratch installation, Design process flow charts and Program concepts

Course Description

This course is intended as a theoretical and methodological introduction to the most widely used and effective current techniques, strategies and toolkits for natural language processing. The ability to harness, employ and analyze linguistic and textual data effectively is a highly desirable skill for academic work, in government, and throughout the private sectors.

Course Objectives

- Students will be able to comprehend the importance of using natural language processing when resolving issues in the real world.
- Enables students to apply and match the proper processing technique to a given situation.
- Students will be in a position to exhibit the necessary design abilities for large collection sets.
- Capability of understanding and presenting cutting-edge, sophisticated NLP research materials to an audience.

Course Outcomes

COs	Description
CO1	Discern the concept of POS tagging and CFG for the English language.
CO2	Cognize the Vector Representation of words and skip-gram models
CO3	Explore semantic analysis algorithms and deep learning techniques, to apply them in various NLP applications.
CO4	Acquainted with Mathematical and programming tools for implementing NLP applications.

Program Outcomes (POs)

- PO1 Scientific knowledge and training: Gain and apply knowledge of basic and applied scientific/analytical fundamentals, leading to a deeper understanding of the interdisciplinary nature of Cognitive Sciences, Educational and Learning Sciences
- PO2 Problem analysis: Identify, formulate, review, and analyze educational challenges and problems to derive conclusions using principles of basic Cognitive Sciences, Educational Sciences and Technology.
- PO3 Using State-of-the-art tools: Create, select, and apply appropriate techniques, resources, and tools, including prediction and modelling of complex biological systems with an understanding of their limitations.
- PO4 Science communication: Communicate scientific concepts and theories effectively with peers, educators, the science community, and society at large.
- PO5 Ethics and values: Understand and practice ethical principles and commit to professional ethics, responsibilities, and norms of scientific practice.
- PO6 Individual and teamwork: Think critically and work independently as well as a member or leader in diverse teams in multidisciplinary settings.
- PO7 Science for society: Apply reasoning through contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional scientific practice.
- PO8 Lifelong learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of scientific and technological changes for up-to-date research and teaching methods.
- PO9: Culturally inclusive and responsive perspectives: Culturally inclusive and responsive perspectives/multicultural/global perspectives/fostering humanitarian perspectives, equality, diversity and inclusion.

Program Specific Outcomes (PSOs)

- PSO1: Develop an understanding of the fundamental principles of cognitive science and educational science including the interdisciplinary nature of the field.●
- PSO2: Develop an understanding of the human mind, its functions, and its effects on behavior and performance.
- PSO3: Develop an understanding of the cognitive processes underlying perception, attention, memory, language, problem-solving, decision-making, and other cognitive functions.
- PSO4: Develop an understanding of the biological, psychological and sociological factors that influence cognitive processes, learning, and skill development.
- PSO5: Design and/or develop educational technology and their application to solve complex problems in teaching and learning.
- PSO6: Develop an understanding of fundamental principles of basic and applied research.
- PSO7: Design and develop educational materials (online/offline) and activities that integrate cognitive science and educational sciences.
- PSO8: Develop an understanding of the implications of cognitive science for the design of intelligent systems and the development of artificial intelligence.
- PSO9: Develop scientific, critical thinking, and meta-cognition skills
- PSO10: Establish the culture of independent learning, innovative research, and productive teamwork.

CO-PO Mappings:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	X				X			X	
CO2		X	X		X	X	X		
CO3		X	X					X	
CO4		X	X	X	X	X			X

CO-PSO Mappings:

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO9
CO1	X		X	X					X	
CO2		X	X		X			X	X	
CO3					X	X	X	X	X	
CO4						X	X			X

Syllabus

Unit 1: Foundations to NLP:

Introduction to Python for NLP;
Introduction to Machine Learning for NLP: Types of Learning, Types of Classification, Training Vs Testing, Bias-Variance tradeoff;
Linguistics: Syntax vs Semantics, Pragmatics vs Morphology, Basic NLP pipeline(tokenization, preprocessing, representation, task), Stemming, Lemmatization, POS tagging.

Unit 2: Text Representation & Embeddings:

One-Hot encoding, Bag of Words, N-Grams, TF-IDF, Vector Space
Models, and Word Embeddings Word2Vec, Contextual Embeddings (BERT model)

Unit 3: NLP Tasks and Taxonomies:

Core NLP tasks: Text classification, Sentiment analysis, Named Entity
Recognition (NER), Clustering (basic idea), Co-reference Resolution, Similarity Analysis

Unit 4: Methods & Modern NLP:

Classical methods: Naive Bayes, V ADER (rule-based sentiment), LDA (thematic coding); Neural methods: RNN/LSTM; Introduction to Transformers: Token, Context window, Attention,

Large Language Models (LLMs): Architectural Intuition, Prompt Engineering basics, Finetuning concepts.

Unit 5: Applied NLP & Emerging Systems (Capstone Project):
Knowledge integration in NLP systems, Pipeline design,
Agentic AI, Case-based Understanding
Basics of Machine Learning, Python Programming language, Basics of Probability, Introduction - terminologies - empirical rules – Statistical Properties of words – Probability and NLP – Vector Space Models - Pre-processing Tokenization,
Parts-Of-Speech (POS) tagging, chunking, syntax parsing, Dependency parsing.

Textbooks / References:

C.D. Manning et al, "Foundations of Statistical Natural Language Processing," MIT Press. MIT Press, 1999. isbn: 9780262133609.

James Allen, "Natural Language Processing with Python", O'Reilly Media, July 2009.

Niladri Sekhar Dash and S. Arulmozi, Features of a Corpus. Singapore: Springer Singapore,2018, pp. 17– 34. ISBN: 978-981-10-7458-5.

Ian Goodfellow, YoshuaBengio, and Aaron Courville, Deep Learning, http://www.deeplearningbook.org. MIT Press, 2016.

Nitin Indurkhya and Fred J Damerau, "Handbook of natural language processing," Chapman and Hall/CRC, 2010.

Daniel Jurafsky and James H. Martin,"Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition," 1st. Upper Saddle River, NJ, USA: Prentice Hall PTR, 2000. isbn: 0130950696.

Evaluation Pattern:

Assessment	Internal	External
Active Participation in Class	10	
*Continuous Assessment (CA) and Mid-term	40	
End Semester Exam OR Content/project produced over the course and submitted on the last working day		50

*CA - Can be Quizzes, Assignments, Projects, Reports, and Presentations

26CLT532 **DEEP LEARNING** **2-0-2 (3)**

Summary:

This course builds from a one node neural network to a multiple feature, multiple output neural networks. After an understanding of how neural networks work and the parameters that control deep learning systems, building of deep learning neural networks and various applications.

Course Objectives:

- Understand the context of neural networks and deep learning
- Know how to use a neural network
- Understand the data needs of deep learning
- Have a working knowledge of neural networks and deep learning.
- Explore the parameters for neural networks

Course Outcomes:

COs	**Description**
CO1	Identify the roles of neural networks in deep learning
CO2	Design of different Convolutional Neural Networks for problem solving
CO3	Implement various unsupervised deep learning techniques
CO4	Design convolution networks for various Computer Vision problems

CO-PO Mapping

PO/ PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO									
CO1	3	2	3	-	-	-	-	-	-
CO2	3	3	1	3	-	-	-	-	1
CO3	2	3	2	-	-	-	-	-	1
CO4	3	1	3	1	1	-	-	-	1

Syllabus:

Unit I

Introduction to Deep Neural Networks: Feed forward Neural networks. Gradient descent and the back propagation algorithm, Intuition of Neural Networks Loss functions, Optimization, Unit saturation, aka the vanishing gradient problem, and ways to mitigate it.

Unit II

Convolutional Neural Networks, Training Neural Networks, Understanding Neural Networks Through Deep Visualization and Recurrent Neural Networks: Architectures, convolution / pooling layers, LSTM, Encoder Decoder architectures.

Unit III

Deep Unsupervised Learning: Auto encoders (standard, sparse, denoising, contractive, etc), variational auto encoders, denoising encoders, Adversarial Generative Networks.

Unit IV

Deep Belief Networks: Energy Based Models, Restricted Boltzmann Machines, Sampling in an RBM. Applications of deep neural networks in handwritten character recognition, face recognition, semantic web, social networks.

Textbooks / References:

Domingos, Pedro. "A few useful things to know about machine learning." Communications of the ACM 55.10 (2012): 78-87.

Li Fei-Fei (Stanford), Rob Fergus (NYU), Antonio Torralba (MIT), “Recognizing and Learning Object Categories” (Awarded the Best Short Course Prize at ICCV 2005).

Baydin, AtilimGunes, Barak A. Pearlmutter, and Alexey AndreyevichRadul. "Automatic differentiation in machine learning: a survey." arXiv preprint arXiv:1502.05767 (2015).

Bengio, Yoshua. "Practical recommendations for gradient-based training of deep architectures." Neural Networks: Tricks of the Trade. Springer Berlin Heidelberg, 2012. 437-478.

LeCun, Yann A., et al. "Efficient backprop." Neural networks: Tricks of the trade. Springer Berlin Heidelberg, 2012. 9-48.

Simonyan, Karen, Andrea Vedaldi, and Andrew Zisserman. "Deep inside convolutional networks: Visualising image classification models and saliency maps." arXiv preprint arXiv:1312.6034 (2013).

Zeiler, Matthew D., and Rob Fergus. "Visualizing and understanding convolutional networks." Computer vision–ECCV 2014. Springer International Publishing, 2014. 818-833.

Springenberg, Jost Tobias, et al. "Striving for simplicity: The all convolutional net." arXiv preprint arXiv:1412.6806 (2014).

Russakovsky, Olga, et al. "Imagenet large scale visual recognition challenge." International Journal of Computer Vision 115.3 (2015): 211-252.

Evaluation Pattern:

Assessment	Internal	External
Active Participation in Class	10	
*Continuous Assessment (CA) and Mid-term	40	
End Semester Exam OR Content/project produced over the course and submitted on the last working day		50

*CA - Can be Quizzes, Assignments, Projects, Reports, and Presentations

26CLT533 FOUNDATIONS OF DATA SCIENCE 2-0-2 (3)

Course Objectives:

- Understand the basic concepts of data interpretation and data
- Become familiar with descriptive statistics and apply these concepts to data
- Understand and apply the concepts of regression to data

Course Outcomes:

CO1: Understand various data visualization methods.

CO2: Understand the basics of descriptive statistics.

CO3: Understand and apply the basic concepts of correlations and regressions to the given data.

CO4: Understand and apply the basic concepts of sampling techniques and simple hypothetical testing to the given data.

Syllabus

Unit 1

Introduction: What is Data Science? Big Data and Data Science – Datafication – Current landscape of perspectives – Skill sets needed; Matrices – Matrices to represent relations between data, and necessary linear algebraic operations on matrices -Approximately representing matrices by decompositions (SVD and PCA);

Introduction to Statistics, Sampling, Sample Means, and Sample Sizes; Descriptive statistics – Central tendency, dispersion, variance, covariance, kurtosis, five-point summary, Distributions, Bayes Theorem, Error Probabilities; Permutation Testing, Statistical Inference; Hypothesis Testing, Assessing Models, Decisions and Uncertainty, Comparing Samples, A/B Testing, p-Values.

Unit 2

Causality and Experiments, Data Preprocessing: Data cleaning, Data reduction, Data transformation, Data discretization. Visualization and Graphing: Visualizing Categorical Distributions, Visualizing Numerical Distributions, Overlaid Graphs, plots, and summary statistics of exploratory data analysis, Randomness, Probability.

Unit 3

Evaluation of classification methods – Confusion matrix, Student's t-tests and ROC curves- Exploratory Data Analysis – Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA – The Data Science Process.

Unit 4

Basic Machine Learning Algorithms: Association Rule mining – Linear Regression- Logistic Regression – Classifiers – k-Nearest Neighbors (k-NN), k-means -Decision tree – Naive Bayes- Ensemble Methods – Random Forest. Feature Generation and Feature Selection – Feature Selection algorithms – Filters; Wrappers; Decision Trees; Random Forests.

Estimation, Prediction, Confidence Intervals, Inference for Regression, Classification, Graphical Models, Updating Predictions.

Unit 5

Clustering: Choosing distance metrics – Different clustering approaches – hierarchical agglomerative clustering, k-means (Lloyd's algorithm), – DBSCAN – Relative merits of each method – clustering tendency and quality.

Text books

Adi Adhikari and John DeNero, "Computational and Inferential Thinking: The Foundations of Data Science", e-book

Cathy O'Neil and Rachel Schutt, "Doing Data Science, Straight Talk From The Frontline", O'Reilly, 2014.

Jiawei Han, Micheline Kamber and Jian Pei, " Data Mining: Concepts and Techniques", Third Edition. ISBN 0123814790, 2011.

Mohammed J. Zaki and Wagner Miera Jr, "Data Mining and Analysis: Fundamental Concepts and Algorithms", Cambridge University Press, 2014.

References

Data Mining for Business Analytics: Concepts, Techniques and Applications in R, by Galit Shmueli, Peter Bruce, Inbal Yahav, Nitin R. Patel, Kenneth C. Lichtendahl Jr., Wiley India, 2018.

Rachel Schutt & Cathy O'Neil, "Doing Data Science" O' Reilly, First Edition, 2013

Matt Harrison, "Learning the Pandas Library: Python Tools for Data Munging, Analysis, and Visualization , O'Reilly, 2016.

Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media, 2015.

Wes McKinney, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", O'Reilly Media, 2012.

Evaluation Pattern:

Assessment	Internal	External
Active Participation in Class	10	
*Continuous Assessment (CA) and Mid-term	40	
End Semester Exam OR Content/project produced over the course and submitted on the last working day		50

*CA - Can be Quizzes, Assignments, Projects, Reports, and Presentations

26CLT534 ARTIFICIAL INTELLIGENCE 2-0-2 (3)

Prerequisites

- Machine Learning
- Programming languages
- Probability

Summary:

Gain a historical perspective of AI and its foundations. Become familiar with basic principles of AI toward problem solving and intuitive understanding of approaches of inference, perception, knowledge representation, and learning.

Course Objectives

- Illustrate the reasoning on Uncertain Knowledge
- Explore the explanation-based learning in solving AI problems
- To explore advanced career opportunities.
- Demonstrate the applications of soft computing and Evolutionary Computing algorithms

Course Outcomes

Cos	Description
CO1	To be aware of the basics of AI and its need along with the issues in designing search problems.
CO2	Understand and apply various search algorithms in real world problems.
CO3	To get a thorough idea about the fundamentals of knowledge representation, inference and theorem proving.
CO4	Express and comprehend the working knowledge of reasoning in the presence of incomplete and/or uncertain information.
CO5	To gain the aptitude to apply knowledge representation and reasoning to real-world problems.

CO-PO Mapping

PO/PS O	PO	PO2	PO	PO4	PO	PO6	PO7	PO8	PO9	PO10	PO11	PO12

CO	1		3		5							
CO1	2	2	2	1	-	-	-	-	2	1	1	2
CO2	2	1	1	-	-	1	-	2	2	1	1	2
CO3	3	2	1	1	-	-	-	-	2	1	-	2
CO4	1	2	1	1	-	1	1	2	1	1	1	2
CO5	2	1	1	1	-	-	1	2	1	1	1	2

Syllabus

Unit I

Artificial Intelligence – Basics, The AI Problems – The Underlying Assumption – What is an AI technique – Criteria for Success. Problems, Problem Spaces and Search – Defining Problem as a State Space Search – Production Systems – Problem Characteristics – Production System Characteristics – Issues in the design of Search Programs.

Unit II

Heuristic Search Techniques - Generate – and – Test – Hill Climbing – Best-First Search – Problem Reduction – Constraint Satisfaction - Means - Ends Analysis. Knowledge Representation issues – Representations and Mapping - Approaches to knowledge Representation – Issues in knowledge Representation – The Frame Problem. Case study based on search algorithms (to be considered as part of continuous assessment).

Unit III

Using Predicate Logic – Representing simple facts in Logic – Representing Instance and Isa Relationship –

Computable Functions and Predicates – Resolution – Natural Deduction.
Representing Knowledge Using Rules

– Procedural versus Declarative knowledge – Logic Programming – Forward versus Backward Reasoning –

Matching – Control Knowledge.

Case study based on reasoning (to be considered as part of continuous assessment).

Unit IV

Reasoning under Uncertainty – Introduction to Non-monotonic Reasoning – Augmenting a Problem Solver –

Implementation: Depth - First Search, Fuzzy Logic.

Game Playing - The Minimax Search Procedure – Adding Alpha-Beta
Cut-offs. Applications of artificial intelligence- Case study on social networks using neural networks, DNA sequencing using AI techniques.

Textbooks / References:

1. Artificial Intelligence (Second Edition) – Elaine Rich, Kevin knight (Tata McGraw-Hill)
2. A Guide to Expert Systems – Donald A. Waterman (Addison-Wesley)
3. Principles of Artificial Intelligence – Nils J. Nilsson (Narosa Publishing House)
4. Introduction to Artificial Intelligence – Eugene Charnaik, Drew McDermott (Pearson Education Asia).

Evaluation Pattern:

Assessment	Internal	External
Active Participation in Class	10	
*Continuous Assessment (CA) and Mid-term	40	
End Semester Exam OR Content/project produced over the course and submitted on the last working day		50

*CA - Can be Quizzes, Assignments, Projects, Reports, and Presentations

26CLT535 BASICS OF COMPUTER PROGRAMMING 2-0-2 (3)

Prerequisite: Good reading and writing skills in English

Course Objectives:

- Understand the Evolution and Applications of Programming Languages: To familiarize students with the historical development of programming languages, their comparative strengths, and applications.
- Master Basic Programming Constructs: To ensure students can effectively use variables, data types, and operators to construct programs.
- Develop Problem-Solving Skills: To enable students to apply programming concepts and logical thinking to solve problems.
- Grasp Functions and User Interaction: To teach students how to modularize code using functions and interact with users through input and output operations.
- Introduce Object-Oriented Programming (OOP) Concepts: To provide students with a foundational understanding of OOP principles and their application in software development.

Course Outcomes:

CO1:Demonstrate an understanding of the historical development and applications of various programming languages.

CO2: Effectively utilize variables, data types, and operators in programming. CO3: Apply programming constructs and logic to solve computational problems.

CO4:Design and implement functions for modular code development and manage user inputs and outputs effectively.

CO5: Understand and apply basic object-oriented programming concepts in software development.

Skills:

- Problem-solving and logical thinking: Applying programming constructs to solve real-world problems.
- Programming proficiency: Writing efficient, readable, and maintainable code in one or more programming languages.
- Understanding of OOP: Grasping the fundamentals of object-oriented design and its implementation.
- Code modularization: Using functions to organize and modularize code for better readability and maintenance.

- User interaction management: Designing user interfaces and handling user inputs and outputs.

Course Outcomes (CO) - Program Outcomes (PO) Mappings

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	X								
CO 2			X		X		X		
CO 3									
CO 4					X				
CO 5		X							

Syllabus:

Unit I: History and Foundations of Programming 9 hrs.

Introduction to programming languages and their role in problem solving. Evolution of programming from machine language to high-level languages. Generations of programming languages and major milestones.

Programming paradigms including procedural, object-oriented, and declarative approaches. Need for programming languages and problem abstraction.

Criteria for selecting an appropriate programming language.

Influence of hardware architecture on programming language development. Open-source and proprietary programming languages and their differences. Comparative study of popular programming languages.

Contributions of notable pioneers in programming. Emerging trends and future directions in programming.

Unit II: Introduction to Python Programming 9 hrs.

Overview of Python programming language and its applications Python execution environment and basic program structure Writing and executing simple Python programs

Output statements and formatted display of results Variables, identifiers, and naming conventions Built-in data types and type conversion

Input statements and user interaction Arithmetic, relational, and logical operations
Decision making using if, if-else, and elif statements Iterative control structures using for and while loops Loop control statements such as break and continue.

Unit III: Functions and Object-Oriented Programming Basics 9 hrs.

Concept and importance of functions in modular programming Defining and invoking user-defined functions
Function parameters, arguments, and return values
Overview of built-in and user-defined functions
Introduction to object-oriented programming concepts
Definition and creation of classes and objects Attributes, methods, and constructors
Inheritance and its types Polymorphism and method overriding
Encapsulation and data hiding concepts Exception handling and File handling

Unit IV: Data Handling and Visualization 9 hrs.

Introduction to data and datasets in programming Data collections using lists, tuples, and dictionaries Basic string operations and manipulation Understanding datasets and data representation
Basic statistical operations including sum, average, minimum, and maximum Introduction to Data Science Concepts
Difference between Data Science, AI, and Machine Learning Role of data cleaning and preprocessing
Real-world applications of data science
Introduction to NumPy and array-based computation
Introduction to Pandas for data manipulation
Series and DataFrames with basic operations
Reading and writing datasets using CSV files
Introduction to data visualization concepts Data visualization using Matplotlib plots.

Unit V: Introduction to Machine Learning 9 hrs.

Fundamentals and definition of machine learning
Real-world applications of machine learning
Types of machine learning including supervised and unsupervised learning Concept of features, labels, and datasets
Training and testing data concepts
Machine learning workflow from data collection to prediction Introduction to scikit-learn library

Simple regression models using linear regression Basic concepts of classification problems Overview of model evaluation techniques Overfitting and Underfitting-Bias

Textbooks and Papers:

- Freeman, E., Robson, E., Bates, B., & Sierra, K. (2004). Head First Design Patterns: A Brain-Friendly Guide. O'Reilly Media. This guide introduces design patterns in an accessible manner, crucial for effective object-oriented design and programming.

- Gaddis, T. (2018). Starting Out with C++ from Control Structures to Objects (9th ed.). Pearson. Offers a solid foundation in C++ programming, covering basic to intermediate concepts, and introduces object-oriented programming.

- Schildt, H. (2019). Java: A Beginner's Guide (8th ed.). McGraw-Hill Education. Provides a comprehensive introduction to Java programming, focusing on fundamental programming concepts and the application of OOP principles.

- Zelle, J. (2010). Python Programming: An Introduction to Computer Science (2nd ed.). Franklin, Beedle & Associates Inc. This book is a great introduction to programming concepts and problem-solving techniques using Python, known for its readability and broad applicability in modern software development.

Evaluation Pattern:

Assessment	Internal	External
Active Participation in Class	10	
*Continuous Assessment (CA) and Mid-term	40	
End Semester Exam OR Content/project produced over the course and submitted on the last working day		50

*CA - Can be Quizzes, Assignments, Projects, Reports, and Presentations

26CLT536 INTRODUCTION TO MACHINE LEARNING USING PROGRAMMING LANGUAGES 2-0-2 (3)

Prerequisite: A foundational understanding of educational psychology, computer science principles, and basic research methodologies.

Course Objectives:

- Master Data Preprocessing Techniques: Equip students with the skills to clean, manipulate, and prepare for using real-world data for analysis, particularly emphasizing educational datasets
- Explore Machine Learning Techniques: Introduce supervised, unsupervised, and reinforcement learning, and discuss their applicability and implementation in Python for educational data analysis.
- Implement Machine Learning Algorithms: Develop hands-on proficiency in applying machine learning algorithms to datasets, emphasizing the process from data preprocessing to algorithm selection and implementation.
- Evaluate Model Performance: Teach students to assess the performance of machine learning models using various metrics, enabling them to understand model effectiveness and areas for improvement in the context of educational challenges.

Course Outcomes:

CO1: Students will be able to preprocess data, handling issues like missing values, noise, and sampling biases, to make it suitable for machine learning analysis.

CO2:Students will learn to select and apply appropriate machine learning algorithms for various educational problems, using Python as the primary tool.

CO3: Students will be able to critically analyze the outputs of machine learning models and use this analysis to propose improvements or interventions in educational settings.

Skills:

- Critical Analysis: Skill in analyzing and evaluating ed-tech tools and methodologies, including machine learning model outcomes.
- Research and Design: Proficiency in executing Learning Engineering research, covering machine learning application, data handling, and analysis.
- Evidence-Based Decision Making: Ability to use evidence-based strategies for tackling educational challenges

with machine learning tools.

- Interdisciplinary Synthesis: Competence in merging knowledge from educational science, psychology, computer science, and machine learning for Learning Engineering.
- Innovative Solutions Development: Skill in creating and proposing unique Learning Engineering solutions, utilizing machine learning for specific educational needs.

Course Outcomes (CO) - Program Outcomes (PO) Mappings

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9
CO 1	X	-	-	-	-	-	X	X	-
CO 2	X	X	-	-	-	-	-	X	-
CO 3	X	X	X	-	-	X	-	-	-
CO 4	X	X	X	-	-	-	X	-	-
CO 5	-	X	-	X	-	X	-	X	-

Syllabus:

Unit I – Basics of Data Analytics through Programming Languages 9 hrs.

- Introduction to programming languages: Covering the core concepts and syntax of a programming language (e.g., Python) for beginners.
- Data Handling with a programming language (e.g., Python): Utilizing the programming language's (e.g., Python's) essential tools and techniques, including the Pandas and Matplotlib libraries, for data discovery, visualization, manipulation, and cleaning.
- Machine Learning Landscape: A comprehensive overview of the field of machine learning, outlining key concepts, techniques, and

applications.

- Data Challenges in ML: Addressing common issues encountered in machine learning datasets, such as missing values, noise, and imbalanced data.

Unit II – Introduction to ML through Programming Languages **9 hrs.**

- Overview of Learning Paradigms: Exploring the distinctions between supervised, unsupervised, and reinforcement learning methodologies.
- Understanding the Bias-Variance Tradeoff: An introductory guide to balancing bias and variance to prevent overfitting and underfitting in machine learning models.
- Exploring Key Machine Learning Algorithms: A primer on various machine learning algorithms including linear regression, decision trees, random forests, and ensemble learning approaches.
- Examples of Classification and Regression: Demonstrating practical applications of machine learning through classification and regression scenarios.

Unit III – Training and Testing of Data Using ML Algorithms **9 hrs.**

- Building Fundamental ML models with a programming language (e.g., Python): Covers the creation of simple machine learning models, including the application of feature scaling and the development of training and testing data splits.

Unit IV – Evaluating the Performance of the Algorithm **9 hrs.**

- Assessment of ML Model Effectiveness: Utilizing various performance indicators to measure the success of machine learning models.
- Practical Application of Learned Concepts: Engaging in hands-on exercises to apply and reinforce the knowledge gained.

Reference Books:

[1] Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, 2nd Edition Aurelien Geron O'Reilly

[2] Russell and Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall. [3.] http://www.stanford.edu/class/cs229/materials.html

[4.] http://www.stanford.edu/class/cs221/handouts.html

[5.] Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.

[6.] Richard Sutton and Andrew Barto, "Reinforcement Learning: An Introduction", MIT Press, 1998.

Evaluation Pattern:

Assessment	Internal	External
Active Participation in Class	10	
*Continuous Assessment (CA) and Mid-term	40	
End Semester Exam OR Content/project produced over the course and submitted on the last working day		50

*CA - Can be Quizzes, Assignments, Projects, Reports, and Presentations

26CLT537 COMPUTATIONAL INTELLIGENCE 2-0-2 (3)

Prerequisites:

- Machine Learning
- Programming languages
- Probability

Course Objectives:

The Objective of the course is to make students familiar with basic principles of various computational methods of data processing that can commonly be called computational intelligence. This course introduces the fundamentals of key intelligent systems technologies including knowledge-based systems, neural networks, fuzzy systems, and evolutionary computation.

Course Outcomes:

COs	**Description**
CO1	Understand the need for and importance of Computational intelligence.
CO2	Understand the concepts of neural networks and backpropagation learning.
CO3	Implement associative memory using neural networks.
CO4	Understand the idea of fuzzy logic in real-world problems.
CO5	Understand hybrid approaches to solve real-world problems.

CO-PO Mapping:

PO/PS O CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3	-	-	-	-	-	-	-	-
CO2	3	2	2	-	-	-	-	-	-
CO3	3	2	3	-	-	-	-	-	-
CO4	2	3	3	-	-	-	-		

CO5	2	3	3	-	-	-	-	-	-

Syllabus:

Unit I

Artificial Intelligence – a Brief Review – Pitfalls of Traditional AI – Need for Computational Intelligence Importance of Tolerance of Imprecision and Uncertainty – Overview of Artificial Neural Networks - Fuzzy Logic-Evolutionary Computation.

Unit II

Neural Networks: Biological and Artificial Neuron, Neural Networks, Supervised and Unsupervised Learning. Single Layer Perceptron - Multilayer Perceptron – Backpropagation Learning.

Unit III

Neural Networks as Associative Memories - Hopfield Networks, Bidirectional Associative Memory. Topologically Organized Neural Networks – Competitive Learning, Kohonen Maps.

Unit IV

Fuzzy Logic: Fuzzy Sets – Properties – Membership Functions - Fuzzy Operations. Fuzzy Logic and Fuzzy Inference - Applications. Evolutionary Computation – Constituent Algorithms.

Unit V

Swarm Intelligence Algorithms - Overview of other Bio-inspired Algorithms - Hybrid Approaches (Neural Networks, Fuzzy Logic, Genetic Algorithms etc.). Case Studies: Prediction Models, Optimization Models.

Textbooks / References:

1. Laurene Fausett, Fundamentals of Neural Networks, 2nd edition, Pearson, 1993
2. Ross T J, —Fuzzy Logic with Engineering Applications‖, McGraw Hill, 1997.
3. Eiben A E and Smith J E, —Introduction to Evolutionary Computing‖, Second Edition, Springer, Natural Computing Series, 2007.
4. Kumar S, —Neural Networks - A Classroom Approach‖, Tata McGraw Hill, 2004.
5. Engelbrecht, A.P, —Fundamentals of Computational Swarm

Intelligence‖, John Wiley & Sons, 2006.

6. Konar. A, —Computational Intelligence: Principles, Techniques and Applications‖,

   Springer Verlag, 2005.

Evaluation Pattern:

Assessment	Internal	External
Active Participation in Class	10	
*Continuous Assessment (CA) and Mid-term	40	
End Semester Exam OR Content/project produced over the course and submitted on the last working day		50

*CA - Can be Quizzes, Assignments, Projects, Reports, and Presentations

OPEN ELECTIVES

(in Collaboration with other Departments and Industry Partners)

26OEL631 ARTIFICIAL INTELLIGENCE FOR ROBOTICS 2-0-2 (3)

Prerequisites:

- Data Structures and Algorithms
- Foundations of Data Science
- Linear Algebra and Optimization
- Principles of AI and ML

Summary

In recent years, several off-the-shelf robots have become available, and some of them have made their way into our homes, offices, and factories. The ability to program robots has therefore become an important skill; e.g., for robotics research as well as in several companies (such as iRobot, ReThink Robotics, Willow Garage, medical robotics, and others). We study the problem of how a robot can learn to perceive its world well enough to act in it, to make reliable plans, and to learn from its own experience. The focus will be on algorithms and machine learning techniques for the autonomous operation of robots.

Course Objectives

- To introduce students to the fundamentals of artificial intelligence and machine learning techniques and their applications to robotics, including perception, planning, and control.
- To help students understand the challenges involved in applying AI and machine learning techniques to robotics and develop the ability to design and implement intelligent robotics systems.
- To provide students with the knowledge and skills required to apply deep learning algorithms to robotics problems, including object recognition, motion planning, and robot control.
- To enable students to understand the principles of reinforcement learning, which is one of the key learning techniques for robots.
- To help students understand uncertainty handling in robotics through probabilistic approaches.
- To enable students to learn how measurements work for robots.

Course Outcomes

After completing this course, students will be able to:

CO1: Apply machine learning and deep learning algorithms to solve robotics problems.

CO2: Design intelligent agents that can perceive and act in different environments.

CO3: Evaluate different robotics and AI applications and identify their strengths and weaknesses.

CO4: Implement deep learning models for robotics tasks.

CO5: Learn the foundations of reinforcement learning for robotics

CO6: Learn different measurement techniques for robotics

CO7: Implement principles of robotics intelligence for solving real-world problems

Syllabus

Unit 1: Introduction to AI for Robotics

- Overview of AI for robotics
- Core components of a robot and how they interact
- Sensing and perception in robotics
- Planning and decision-making in robotics
- Control systems and robotics

Unit 2: Machine Learning for Robotics

- Supervised learning and its applications in robotics
- Unsupervised learning and its applications in robotics
- Reinforcement learning and its applications in robotics
- Transfer learning in robotics

Unit 3: Deep Learning for Robotics

- Neural networks and deep learning
- Convolutional neural networks for perception in robotics
- Recurrent neural networks for planning and prediction in robotics
- Deep reinforcement learning for robotics control

Unit 4: Reinforcement Learning

- Uncertainty in robotics reinforcement learning
- Tabular Solution Methods – multi-armed bandits, finite Markov decision process, dynamic programming (policy evaluation, policy iteration, value iteration), Monte Carlo methods, temporal-difference learning (Q-learning, SARSA).
- Approximate Solution Methods – on-policy prediction with approximation, value function approximation, non-linear function approximation, reinforcement learning in robotics, recursive state estimation: robot environment interaction, Bayes filters,

Gaussian filters – the Kalman filter, the extended Kalman filter, the information filter, the particle filter

- Robot motion: Velocity Motion Model, Odometry Motion Model, motion and maps.

Unit 5: Measurement

- Beam models of range finders
- Likelihood fields for range finders
- Correlation-based sensor models
- Feature-based sensor models
- Overview of POMDP

Text Books / References

Govers, F. X. Artificial Intelligence for Robotics. Packt Publishing; 2018

Nehmzow U. Mobile robotics: a practical introduction. Springer Science & Business Media; 2012.

Corke, Robotics, Vision, and Control, Springer, 2011.

Antsaklis and K. Passino, An Introduction to Intelligent and Autonomous Control, Kluwer, 1993.

Kortenkamp, R. Bonasso, and R. Murphy, ed., Artificial Intelligence and Mobile Robots, AAAI Press, 1998.

Evaluation Pattern:

Assessment	Internal	External
Active Participation in Class	10	
*Continuous Assessment (CA) and Mid-term	40	
End Semester Exam OR Content/project produced over the course and submitted on the last working day		50

*CA - Can be Quizzes, Assignments, Projects, Reports, and Presentations

26OEL632 **AUTOMATION AND ROBOTICS** **2-0-2 (3)**

Summary:

This course provides the detailed idea about the fields of robotics and its control mechanisms.

Course Objectives:

1. The main objective is to provide information on various parts of robots and ideas on the fields of robotics.
2. It also focuses on various kinematics and inverse kinematics of robots, trajectory planning of robots and to study the control of robots for some specific applications.

Course Outcomes:

COs	**Description**
CO1	Describe the fields of robotics and explain the major components
CO2	Explain about various robot processes and functions
CO3	Discuss the various Programmable Logic Control and Experiment with various control mechanisms of robotics.
CO4	Explain the kinematics of robots and trajectory,
CO5	Implement different applications of robotics

CO-PO Mapping

PO/ P SO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO8	PO9
CO1	3	-	-	-	-	-	3		
CO2	2	1	-	-			1		
CO3	3		2			3			
CO4		1				2	1		2

CO5	2							1	

Syllabus:

Unit I

Introduction - Definition and Origin of Robotics, Types of Robotics, Major Components, Historical development of Robot, Robotic System and Robot anatomy, Degrees of freedom, Coordinate System and its type Asimov's laws of robotics, Dynamic stabilization of robots.

Unit II

Power Sources and Sensors - Hydraulic, pneumatic and electric drives, determination of HP of motor and gearing ratio, variable speed arrangements, path determination, micro machines in robotics, machine vision, ranging, laser, acoustic, magnetic, fibre optic and tactile sensors.

Unit III

Manipulators, Actuators, and Grippers - Manipulators, Classification, Construction of manipulators, manipulator dynamics and force control, electronic and pneumatic manipulator control, End effectors, Loads and Forces, Grippers, design considerations, Robot motion Control, Position Sensing.

Unit IV

Kinematics and Path Planning - Solution of Inverse Kinematics Problem, Multiple Solution Jacobian Work Envelop, Hill Climbing Techniques, Robot Programming Languages. Process Control and Types, On-Off Control Systems, Proportional Control Systems, Proportional Plus Integral (PI) Control Systems, Three Mode Control (PID) Control Systems, Process Control Tuning.

Case Studies:

Multiple robots, Machine Interface, Robots in Manufacturing and not-Manufacturing Application, Robot Cell Design, Selection of a Robot.

Laboratory Works:

The laboratory work should be focused on the implementation of sensors, design of control systems. It should also deal with developing programs related to robot design and control using python.

Textbooks:

1. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., Industrial Robotics, McGraw Hill.
2. Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers.

References:

1. Jain K.C. and Aggarwal B.E., Robotics – Principles and Practice, Khanna Publishers

2. Schuler, C.A. and McNamee, W.L. Modern Industrial Electronics, Macmillan/McGraw-Hill
3. Klafter R.D., Chimielewski T.A., Negin M., Robotic Engineering – An Integrated Approach, Prentice Hall of India.
4. Deb.S.R., Robotics Technology and Flexible Automation, John Wiley, USA 1992.
5. Asfahl C.R., Robots and Manufacturing Automation, John Wiley, USA 1992
6. Mc Kerrow P.J. Introduction to Robotics, Addison Wesley, USA, 1991.
7. Issac Asimov I. Robot, Ballantine Books, New York, 1986.

Evaluation Pattern:

Assessment	Internal	External
Active Participation in Class	10	
*Continuous Assessment (CA) and Mid-term	40	
End Semester Exam OR Content/project produced over the course and submitted on the last working day		50

*CA - Can be Quizzes, Assignments, Projects, Reports, and Presentations

26OEL633 MACHINE LEARNING FOR BIG DATA 2-0-2 (3)

Summary

This course will enable students to understand the basic concepts of machine learning. It will help students to apply different machine learning models to real-world problems.

Course Objectives

- To understand basic concepts of machine learning
- To familiarize the machine learning models, such as linear and logistic regression
- To understand different classifiers
- To understand different clustering algorithms

Course Outcomes

CO1: Ability to understand the definition, tools and applications of machine learning

CO2: Ability to implement prediction models using linear regression. **CO3:**

Ability to understand different classifiers and their implementation. **CO4:**

Ability to understand the concepts of neural networks.

CO5: Ability to understand different clustering algorithms.

Syllabus

Unit I

Introduction to ML; Problems, data and tools. Learning systems, goals, challenges and applications of the machine learning systems. Aspects of developing system, training data, testing data, concept representation, classification errors, validation. Dimensionality Reduction, Data compression, PCA.

Unit II

Linear regression, SSE, gradient descent, bias and variance estimation, overfitting and underfitting, regularization, ridge and lasso regression.

Unit III

Logistic regression, hypothesis representation, decision boundary, cost function, multi-class classification. Nearest neighbour methods. Decision Tree learning, representing concepts as decision trees, picking the best splitting attribute: entropy and information gain. Probability and classification, Naïve Bayes classification, EM algorithm, kernels, Kernel regression, kernels, Support vector machine (SVM) and kernels, kernel optimization. Linear Discriminant Analysis algorithm.

Unit IV

Neural networks learning, non-linear hypothesis, model representation, perceptron, cost function, back propagation algorithm.

Unit V

Unsupervised learning, clustering, different clustering methodologies. Current problems on Machine Learning.

Textbooks / References

Machine Learning, Tom Mitchell, McGraw Hill, 1997.

Duda, Richard, Peter Hart, and David Stork, "Pattern Classification" Second Edition, New York, NY: Wiley-Interscience, 2000.

Hastie, T., R. Tibshirani, and J. H. Friedman, "The Elements of Statistical Learning: DataMining, Inference and Prediction", New York, Springer, 2001

Christopher, M. Bishop. Pattern Recognition and Machine Learning, Springer-Verlag New York, 2016.

Evaluation Pattern:

Assessment	Internal	External
Active Participation in Class	10	
*Continuous Assessment (CA) and Mid-term	40	
End Semester Exam OR Content/project produced over the course and submitted on the last working day		50

*CA - Can be Quizzes, Assignments, Projects, Reports, and Presentations

26OEL634 FOUNDATIONS OF CORPORATE SOCIAL RESPONSIBILITY (CSR) 2-0-2 (3)

Prerequisite: none

Summary:

Corporate Social Responsibility (CSR) is an emerging area of Social Work in India. This course will familiarize the students with the concept of CSR. For an individual, as for an organization, CSR gives an opportunity to participate as a responsible enlightened citizen and organization. The evolution of CSR has had a far-reaching impact on development in India.

Course Objectives:

1. Understand the environmental, social, and economic drivers and risks impacting companies – along with the major business opportunities for integrating sustainability factors within the core business strategy.
2. Understand the global perspectives of CSR and particular CSR practices in India.
3. Gain knowledge on the impact of CSR on corporate culture, particularly as it relates to social issues.
4. Provide students with conceptual clarity on the need, purpose, and relevance of research applicability in CSR practice.
5. Acquire skills to frame CSR policies and practices appropriate to the Indian workplace.

Course Outcomes:

CO1: Acquired knowledge in the global perspectives of CSR and particular CSR practices in India

CO2: Understood the impact of CSR implementation on corporate culture, particularly as it relates to social issues

CO3: Understood the need, purpose, and relevance of research applicability in CSR practice and frame CSR policies and practices appropriate to the Indian workplace

Skills:

- Gain an overview of key philosophical perspectives and concepts in cognitive science.
- Develop a deeper understanding of how philosophical and conceptual analysis has influenced concepts and theories in cognitive sciences.
- Grasp how foundational assumptions have shaped cognitive science and how they can be challenged.
- Differentiate between philosophical concepts and their application

within empirical research in cognitive sciences.

- Understand how the conceptualisation of mind, language, and cognition has influenced empirical research in the cognitive sciences.
- Develop a basic understanding of the traditional philosophical issues continue to challenge contemporary cognitive scientists and how empirical research has influenced philosophy.
- Demonstrate an enhanced ability to engage in critical analysis and argument through reading and group discussions.
- Demonstrate an ability to articulate their views in a systematic manner through their philosophical writing and dialogue, with a focus on clarity of idea and coherent justification.
- Demonstrate confidence in undertaking work through independent learning and taking responsibility for their learning.

Course objectives CO-Program outcome PO - Mappings

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO9		
CO 1		-	-	-	-	-	-	-	-		
CO 2	-	-	-	-	-	-	-	-	-		
CO 3	-	-	-	-	X	X	X	-	X		

Syllabus:

Unit I – Understanding CSR **9 hrs.**

Understanding CSR- Evolution, importance, relevance, and justification. CSR in the Indian context, corporate strategy. CSR and Indian corporate.

Unit II – Structure of CSR **9 hrs.**

In the Companies Act 2013 (Section 135); Rules under Section 13; CSR activities, CSR committees, CSR policy, CSR expenditure CSR reporting, Policies, Preparation of CSR policy and process of policy formulation, Government expectations, roles and responsibilities.

Unit III – CSR and Social Work **9 hrs.**

CSR practices in the domestic and international areas; Role and contributions of voluntary organizations to CSR initiatives. Role of the implementation agency in Section 135 of the Companies Act, 2013.Effective CSR implementation. Role and expectations of social workers in CSR programmes.

Unit IV – Project Management in CSR initiatives **9 hrs.**

Project and programme; Monitoring and evaluation of CSR Interventions. CSR Documentation and report writing. Reporting framework, format and procedure. Social Enterprise and Government Initiatives.

Unit V – Models of CSR **9 hrs.**

Business Model, Social Marketing, Crowdfunding, Social Entrepreneurship – Case studies.

Textbooks and Papers:

Corporate Governance, Ethics and Social Responsibility, V Bala Chandran and V Chandrasekaran, PHI learning Private Limited, New Delhi 2011.

UNDP (nd) Governance indicators: A users guide . Oslo: UNDP

Rao, V.S.L. (2009) Human Resource Management, New Delhi, Excel Books,

Reference Books:

White H. (2005) Challenges in evaluating development effectiveness: Working paper 242, Institute of Development Studies, Brighton.

Rao, Subbha (1996) Essentials of Human Resource Management and Industrial Relations, Mumbai, Himalaya

Evaluation Pattern:

Assessment	Internal	External
Active Participation in Class	10	
*Continuous Assessment (CA) and Mid-term	40	

End Semester Exam OR Content/project produced over the course and submitted on the last working day		50

*CA - Can be Quizzes, Assignments, Projects, Reports, and Presentations

26OEL635 DECISION MODELS IN MANAGEMENT (DMM) 2-0-2 (3)

https://www.amrita.edu/course/decision-models-in-management-dmm/

Course Description

Management science is a scientific approach to decision-making for real-world problems across a wide variety of managerial functions, such as planning, organizing, staffing, directing, and controlling. Decision-making is an essential process for every manager and can conceivably affect every segment of the organization. The complexity of
decision-making is rapidly increasing under uncertain and risky situations. Also, it depends on many factors, such as resource constraints within organizations, technological constraints, business competitiveness, and political, economic, and environmental impacts. Quantitative analysis has become an integral part of the logical approach to management science and helps managers identify decision factors that positively influence the resolution of decision-making complexity. This course is designed to impart knowledge and skills in the applications of prescriptive data analytics.

The Decision Models in Management course is organized into three units. The course opens with the introduction of management science modelling and spreadsheet applications. It then focuses on the basic concepts of linear programming and its applications to various managerial problems, followed by the second unit, which focuses on transportation, transshipment, assignment problems, network models such as the shortest path problem and maximal flow problem, and the optimization of nonlinear models. The Excel solver tool applications sessions are run alongside the theory to reinforce learning from the class using case problems. The final unit focuses on decision theory for handling problems with multiple alternatives and a discrete set of possible outcomes, Markov analysis for studying the evolution of systems over repeated time periods, analysis of waiting line models, and simulation of a real system by experimenting with a model.

Course Outcomes

The course aims to impart the learning required for a student to become a competent business professional and contribute value to a business/organization in his/her early career. It is divided into three modules, each with distinct learning outcomes. On completion of this course, students will be

- Able to formulate a real-world problem as a management science model and how to interpret the results of those models (Create)
- Able to recognize the various kinds of managerial problems and apply the appropriate quantitative analytical tools to solve those problems (Analyze)
- Able to use the prescriptive data analytics tools and techniques, in critical thinking, especially in managerial decision making in organizations (Evaluate)

Syllabus

Unit 1: Linear Programming (15 hours)

- Introduction to Management Science
- Linear Programming: Basic Concepts & Graphical Solution
- Linear Programming: General Applications
- Linear Programming: Applications in Marketing
- Linear Programming: Application in Finance
- Linear Programming: Application in Operations Management

Unit 2: Advanced Linear and Nonlinear Optimization Models (15 hours)

- Transportation & Transshipment Problem
- Assignment Problem
- Shortest Route & Maximal Flow Problem
- Nonlinear Optimization models

Unit 3: Decision Models and Application (15 hours)

- Waiting line models
- Simulation
- Decision Analysis – Decision Making Without Probabilities
- Decision Making with Probabilities
- Decision Analysis with Sample Information
- Markov Processes

Textbook

Anderson, D.R., Sweeney, D.J., Williams, T.A., Martin, K., 'An Introduction to Management Science: Quantitative Approaches to Decision Making,' 14th edition, Cengage Learning India Private Limited, 2019.

Reference Books

Vohara, D. 'Quantitative Techniques in Management', 4th edition, Tata McGraw-Hill Education Private Limited, New Delhi. 2010.

Gupta, M.P and Khanna R.B, 'Quantitative Techniques for Decision Making', 4th edition, PHI Learning Private Limited, New Delhi, 2011

Hiller, S and Hiller, M.S, 'Introduction to Management Science', 6th edition, special Indian edition, Tata McGraw Hill Education Private Limited, New Delhi. 2019.

Stevenson, J.W and Ozgur, C, 'Introduction to Management Science with Spreadsheets', First Indian edition, McGraw Hill Education (India) Private Limited, New 2007.

Evaluation Pattern:

Assessment	Internal	External
Active Participation in Class	10	
*Continuous Assessment (CA) and Mid-term	40	
End Semester Exam OR Content/project produced over the course and submitted on the last working day		50

*CA - Can be Quizzes, Assignments, Projects, Reports, and Presentations

26OEL636 INDIVIDUAL AND GROUP BEHAVIOUR DYNAMICS IN ORGANIZATIONS (I & GBDO) 2-0-2 (3)

https://www.amrita.edu/course/individual-and-group-behaviour-dynamics-in-organizations-i-gbdo/

Course Description

The course focuses on organizational behavior perspectives at the micro-level. It introduces important concepts and theories at three levels: individual, interpersonal, and collective. The theoretical basis of Organizational Behavior (OB) literature is primarily rooted in disciplines like psychology, sociology, socio-psychology, anthropology, political science, etc. This course intends to develop knowledge on understanding individuals' behavior, intergroup relationships, group performance, and decision-making to improve the well-being and effectiveness of employees and the organization. In this course, personality, motivation, and decision-making are the key focus at the individual level. At the intrapersonal level, power, influence, and negotiations are the focal points for discussions. Similarly, leadership and organizational settings are central topics to learn at the collective level.

Course Outcomes

- Able to assess important concepts, theories, and practices related to interpersonal processes in organizational settings. [L4: Analyze].
- Able to assess important concepts, theories, and practices related to intrapersonal processes in organizational settings. [L4: Analyze].
- Able to assess important concepts, theories, and practices related to social processes in organizational settings. [L4: Analyze].
- Able to critically evaluate organizational behavior-related issues & challenges and develop decision- making strategies. [L5: Evaluate].

Syllabus

Unit 1: Introduction to Organizational Behaviour (11.25 hours)

- Organizational Behaviour Issues & Challenges for Managers

Unit 2: Group or Interpersonal Processes in Organizations (11.25 hours)

- Group Dynamics
- Work Teams
- Leadership
- Conflict and Negotiation

Unit 3: Intrapersonal Processes in Organizations (11.25 hours)

- Personality, Attitude, and Values
- Perception, Attribution, Cognition, and Decision Making
- Emotions and Moods
- Motivation and Rewards

Unit 4: Social Processes and Decision-Making Strategies in Organizations (11.25 hours)

- Psychological Contracts
- Social Influence
- Social Networks
- Persuasion
- Power & Politics
- Wellbeing at Workplace
- Organization Climate & Culture

Textbooks

Robbins, S. P., Judge, T. A., & Vohra, N. (2022). Organizational behaviour by Pearson 18e. Pearson Education India. [ISBN: 9789356064270]

Greenberg, (2016). Behaviour in Organizations, 10/e. Pearson Education India. [ISBN: 9789332556997]

Evaluation Pattern:

Assessment	Internal	External
Active Participation in Class	10	
*Continuous Assessment (CA) and Mid-term	40	
End Semester Exam OR Content/project produced over the course and submitted on the last working day		50

*CA - Can be Quizzes, Assignments, Projects, Reports, and Presentations

26OEL637 HUMAN RESOURCE MANAGEMENT (HRM) 2-0-2 (3)

(has training and development in it) https://www.amrita.edu/course/human-resource-management-hrm/

Course Description

Today in the world of complex situations and ever-increasing changes happening around, the need is to identify ways and means to succeed by managing relationships in an effective and smart way. Irrespective of the sophisticated technological interventions in the Business Enterprises, success takes its place only when backed up by the human interface. Human Resources are the prime constituents of any organization. The role of Human Resources is at the centre stage, irrespective of the nature of organizations.

Human Resource Management belongs in all organizations. It is an active constituent of all strategic processes of organizations to make their ventures successful in the global scenario, which calls for a realization that the performance of a firm's human assets must be managed, led, and coached for improved effectiveness of organizations. The main objectives of the course are to help participants understand the strategic importance of human resource management activities performed in organizations and enhance participants' ability to understand the functions of HRM and energize participants' skills in the pursuit of their own self-interests in making the organization more successful and making their quality of work life more satisfying.

Course Outcomes

The main outcomes of the course are:

- Analyze and deal with HR scenarios, keeping in mind strategic and legal connotations of the same (Level 4 – Analyse)
- Present appropriate strategies to build a high-performing workforce (Level 6-Create)
- Design strategically oriented, integrated, and comprehensive HR functions for an organization (Level 6 – Create)

Syllabus

Unit 1: Importance and Relevance of Human Resource Management (HRM) (11.25 hours)

- Nature of HRM
- Functions of HRM
- Strategic orientation of HRM

Unit 2: Human Resource Planning and Placement (11.25 hours)

- Work analysis and job design
- Job design
- Hiring and Orientation

Unit 3: Managing Performance and Careers (11.25 hours)

- Performance Management
- Compensation and Benefits
- Training and Development
- Career planning and development

Unit 4: Industrial Relations and Employee Wellbeing (11.25 hours)

- Collective bargaining
- Employee safety and welfare
- Employee retention

Textbooks

Human Resource Management: Gary Dessler and Biju Varkkey, Pearson Education

Human Resource Management- A South Asian Perspective, Denisi, Griffin, and Sarkar, Cengage Learning

Evaluation Pattern:

Assessment	Internal	External
Active Participation in Class	10	
*Continuous Assessment (CA) and Mid-term	40	
End Semester Exam OR Content/project produced over the course and submitted on the last working day		50

*CA - Can be Quizzes, Assignments, Projects, Reports, and Presentations

26OEL638 TALENT ACQUISITION & LEARNING AND DEVELOPMENT (TA & LD) 2-0-2 (3)

https://www.amrita.edu/course/talent-acquisition-learning-and-developmentta-ld/

Course Description

Acquiring the 'right' talent for an organization is a critical component to an organization's functioning. Training this talent and developing their competencies are coreto the functional area of human resource management. This course includes important aspects of talent acquisition, training, and development.

Course Outcomes

The course aims to impart comprehensive knowledge and understanding of the talent acquisition, training, and development process. In this course, students will learn:

- To understand the concepts, principles, issues, and processes of acquiring human resources. [Level2]
- To create effective talent and career development plans in the context of existing and future business needs. [level 3 and 6]
- To assess and examine training needs and design training programmes in an organizational setting [level 4 and 6].
- To appraise the levels, tools, and techniques involved in the evaluation of training effectiveness [level5].

Syllabus

Unit 1 (11.25 hours)

- Concepts, principles, and processes of acquiring human resources
- Ascertaining talent needs (supply and demand) within the organization
- Recruitment process and sources
- Talent engagement models
- Job analysis in talent acquisition

Unit 2 (11.25 hours)

- Issues in talent management: succession planning, downsizing, managing mergers, acquisitions, and takeovers

- Strategic issues in talent management
- Career planning
- Career development: issues and challenges
- Role of mentoring and coaching in talent management

Unit 3 **(11.25 hours)**

- Principles of training and development
- Theoretical perspectives of Learning and Development (L&D)
- The learning process
- Theory on the principles of strategic training
- Identify training and learning needs
- Conducting a needs assessment
- Developing an L&D programme design

Unit 4 **(11.25 hours)**

- Appraising the basics of evaluating an L&D programme
- Basics of constructing evaluation designs
- Appraising the return of interest for an L&D programme
- Constructing an evaluation of the L&D programme

Recommended Texts & Reference Books

Human Resource Selection: Gatewood, Field and Barrick, Cengage Learning Staffing

Organizations: Herbert Heneman and Timothy Judge, McGraw Hill

Strategic Human Resource Planning: Monica Belcourt and Kenneth J McBey, Cengage Learning

Noe and Kodwani (2018) Employee Training and Development, 7e, McGraw-Hill Education.

Garavan et al (2020) Learning and Development Effectiveness in Organizations: An Integrated Systems-Informed Model of Effectiveness, Palgrave McMillan. [An electronic version of this book is available at Amrita University's online library).

Evaluation Pattern:

Assessment	Internal	External
Active Participation in Class	10	
*Continuous Assessment (CA) and Mid-term	40	
End Semester Exam OR Content/project produced over the course and submitted on the last working day		50

*CA - Can be Quizzes, Assignments, Projects, Reports, and Presentations

26OEL639 MULTI-MODAL APPLICATIONS FOR LEARNING 2-0-2 (3)
Prerequisite: None

Summary

This course introduces the foundations of multi-modal learning technologies and their applications in education, training, and skill development. Students explore how different sensory modalities (visual, auditory, tactile, kinesthetic, and immersive) can be combined to create effective learning experiences. The course covers the principles behind interactive systems, multimodal interfaces, simulation environments, and emerging technologies such as extended reality (XR), haptics, gesture-based systems, and sensor-driven learning platforms. Through hands-on project work, students learn to design, prototype, and evaluate multi-modal applications that support diverse learning needs across domains such as medical training, vocational education, cognitive skill development, and entertainment-based learning.

Course Objectives

1. Understand the role of multi-modal interaction in human learning and skill acquisition.
2. Identify key mechanisms of sensory processing relevant to multi-modal learning (visual, auditory, tactile, kinesthetic).
3. Explore a range of learning technologies, including XR, haptics, gesture interfaces, wearables, and simulation systems.
4. Develop skills in designing multi-modal learning applications using accessible development platforms.
5. Apply multi-modal design principles to conceptualize, prototype, and evaluate a learning-focused application.

Course Outcomes

CO1: Explain the principles of multi-modal interaction and their relevance to learning.

CO2: Describe human sensory mechanisms and how they support perception, action, and cognition.

CO3: Compare different multi-modal learning technologies and their applications in education and training.

CO4: Design and prototype a multi-modal learning experience using appropriate tools and interfaces.

CO5: Implement and evaluate a functional multi-modal learning application.

Skills

- Problem-solving using analogical and cross-modal reasoning.
- Analytical skills in interpreting sensory information, mental imagery, and multimodal representations.
- Understanding the interplay between language, perception, action, and cognition in learning.
- Basic technical skills in interactive system design and prototyping.

Program outcome PO - Course Outcomes CO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO9		
CO 1	**X**	-	-	-	-	-	-	-	-		
CO 2	-	-	**X**	-	-	-	-	-	-		
CO 3	-	**X**	-	-	-	-	-	-	-		
CO 4	-	-	-	-	-	-	-	-	-		
CO 5	**X**	-	-	-	-	-	-	-	-		

Syllabus

Unit 1: Foundations of Multi-Modal Learning Technologies (9 hours)

- Evolution of multi-modal interfaces in learning and training.
- Overview of major modalities: visual, auditory, tactile, kinesthetic, immersive.
- Introduction to XR (VR/AR/MR), haptic systems, gesture interfaces, wearables, and sensor-based technologies.
- Applications of multi-modal systems in education, medical training, vocational skills, cognitive rehabilitation, and entertainment.
- Practical Component: Begin a semester-long project to conceptualize a multi-modal learning application.

Unit 2: Tools and Platforms for Multi-Modal Application Development (9 hours)

- Introduction to user interfaces (e.g., Unity 3D)
- Overview of SDKs and APIs for multi-modal interaction (XR toolkits, haptic APIs, gesture libraries, sensor frameworks).
- Integrating hardware and software: connecting devices such as headsets, controllers, wearables, or sensors to development platforms.
- Designing simple interactive scenes or prototypes.

Unit 3: Architectures and Components of Multi-Modal Systems (9 hours)

- Understanding system architecture: input devices, sensors, actuators, rendering engines, and feedback loops.
- Principles of multimodal rendering: visual, auditory, and tactile feedback.
- Interaction design for multi-modal learning: usability, accessibility, cognitive load.
- Case studies of existing multi-modal learning applications across domains.

Unit 4: Designing Multi-Modal Learning Experiences (9 hours)

- Pedagogical principles for multi-modal learning: embodiment, experiential learning, simulation-based training.

- Mapping learning objectives to sensory modalities.
- Prototyping workflows: storyboarding, interaction mapping, iterative design.
- Evaluating multi-modal applications: user testing, feedback analysis, and learning outcomes.

Unit 5: Project Development and Implementation (9 hours)

- End-to-end design, development, and implementation of a multi-modal learning application.
- Integration of multiple modalities into a cohesive learning experience.
- Final demonstration, documentation, and reflection on design decisions.

Suggested Readings

Kern, T. A. (2009). *Engineering haptic devices: A beginner's guide for engineers*. Springer. Jerald, J. (2016). *The VR book: Human-centered design for virtual reality.* Association for Computing Machinery.

Oviatt, S., Schuller, B., Cohen, P. R., Sonntag, D., Potamianos, G., & Krüger, A. (Eds.). (2017). *The handbook of multimodal-multisensor interfaces: Foundations, user modeling, and common modality combinations* (Vol. 1). Association for Computing Machinery; Morgan & Claypool. https://doi.org/10.1145/3015783

Benyon, D. (2019). *Designing interactive systems: A comprehensive guide to HCI, UX, and interaction design* (3rd ed.). Pearson.

Evaluation Pattern:

Assessment	Internal	External
Active Participation in Class	10	
*Continuous Assessment (CA) and Mid-term	40	
End Semester Exam OR Content/project produced over the course and submitted on the last working day		50

*CA - Can be Quizzes, Assignments, Projects, Reports, and Presentations

26OEL640 PSYCHOMOTOR SKILL TRAINING TO ENHANCE LEARNER PERFORMANCE 2-0-2 (3)

Summary:

This course aims to equip students with a comprehensive understanding of the essential mechanisms underlying the acquisition of motor skills. It will cover a wide range of principles, facts, and theories related to physical, cognitive, behavioral, and social aspects of motor learning and performance. Participants will engage in critical thinking through an array of laboratory exercises and project work. The curriculum is designed to foster a deep analytical understanding of motor skill learning and its application in a variety of contexts.

Course Objectives:

1. To gain a basic understanding of the term "skill" and classify various types of skills within the context of motor learning.
2. To describe Information Processing in Motor Learning by utilizing the "Stages of processing" concept to explain how information is processed during motor learning and performance.
3. To illustrate the purpose and attributes of motor programs in motor skill acquisition.
4. To examine how individual variances contribute to the nature of motor abilities.
5. To apply principles of motor learning, along with behavioral and social theories, in teaching and learning novel motor skills.
6. To elucidate the relationship between structured learning experiences and the enhancement of skilful movement for all learners.
7. To utilize a range of feedback methods to indicate progress in the development of skilful movement.
8. To apply different methods to augment self-motivation and the motivation of learners in acquiring new motor skills.
9. To administer time, space, and equipment efficiently to facilitate the instruction of a new skill to novice learners.

Course Outcomes:

CO1: Understand and classify motor skills for effective learning.

CO2: Explain information processing in motor learning.

CO3: Illustrate the role of motor programs in skill acquisition.

CO4: Analyze individual differences in motor abilities.

CO5: Apply motor learning principles to teach and learn new skills efficiently.

Skills:

- Ability to classify various types of motor skills within the context of motor learning.
- Understanding of how information is processed during motor learning and performance using the stages of processing concept.
- Ability to describe the purpose and attributes of motor programs in motor skill acquisition.
- Capability to examine how individual differences contribute to motor abilities.
- Proficiency in applying motor learning principles, along with behavioral and social theories, in teaching and learning novel motor skills.
- Understanding of how structured learning experiences enhance skillful movement for all learners.
- Competence in utilizing a range of feedback methods to indicate progress in skillful movement development.
- Skill in applying different methods to augment self-motivation and motivation of learners in acquiring new motor skills.
- Ability to administer time, space, and equipment efficiently to facilitate the instruction of new skills to novice learners.

Course outcomes CO - Program outcome PO - Mappings

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO9		
CO 1	x	-	-	-	-	x	x	x	x		
CO 2	x	-	-	-	-	-	-	x	x		
CO 3	x	-	-	-	-	-	x	x	-		
CO 4	-	-	-	-	-	x	-	-	x		
CO 5	-	x	-	x	-	x	x	x	-		
CO 6	x	x	-	-	x	x	x	x	x		

Syllabus:

Unit I: Introduction to Motor Learning and Movement Preparation (9 hours)

Skill taxonomy - what is a skill?, Fine versus gross motor skills, discrete, serial, or continuous skills, closed-open skills, Gentile's taxonomy, Fleishman's taxonomy, approaches to perception - information processing model and ecological approach, reaction time, Hick's law, attentional capacity, arousal, selective attention, attentional focus, visual search

Unit II: Theories of Motor Control (9 hours)

Degrees of freedom, motor program theory, dynamic systems theory, generalized motor program, parameters, constraints-led approach

Unit III: Stages of Learning, Preparation for Learning and Skill Presentation (9 hours)

Fitts and Posner's three-stage model, Gentile's two-stage model, performance Improvements, learning styles, positive transfer, negative transfer, motivation for learning, hands-on instruction, hands-off instruction

Unit 4: Motor Skill Practice Design (9 hours)

Whole versus part practice, part practice methods – segmentation, fractionization, simplification, attention cueing, goal setting, cognitive rehearsal of a movement, constant practice versus variable practice, contextual interference, blocked and random practice, massed and distributed practice, rest intervals

Unit 5: Errors and Feedback (9 hours)

Conducting an observation of learner's performance, diagnosing errors, comprehension errors, errors in selection, execution errors, errors in decision making. Feedback - intrinsic feedback, augmented feedback, knowledge of results, knowledge of performance, sandwich approach to providing feedback, feedback frequency.

Textbooks and Papers:

- Coker, C. (2017). *Motor learning and control for practitioners*. Routledge.
- Schmidt, R. A., Lee, T. D., Winstein, C., Wulf, G., & Zelaznik, H. N. (2018). Motor control and learning: A behavioral emphasis. *Human Kinetics*.

Reference Books:

- Magill, R., & Anderson, D. I. (2010). *Motor learning and control*. New York: McGraw-Hill Publishing.
- Adams, J. A. (1987). Historical review and appraisal of research on the learning, retention, and transfer of human motor skills. *Psychological Bulletin, 101*(1), 41–74. https://doi.org/10.1037/0033-2909.101.1.41

- Madhavan, S., & Shah, B. (2017). Enhancing motor skill learning with transcranial direct current stimulation—A concise review with applications to stroke. *Frontiers in Psychiatry, 8*, 1–12. https://doi.org/10.3389/fpsyt.2012.00066

Evaluation Pattern:

Assessment	Internal	External
Active Participation in Class	10	
*Continuous Assessment (CA) and Mid-term	40	
End Semester Exam OR Content/project produced over the course and submitted on the last working day		50

*CA - Can be Quizzes, Assignments, Projects, Reports, and Presentations

26OEL641 PRODUCT DEVELOPMENT FOR ED-TECH 2-0-2 (3)

Prerequisites: Foundational knowledge of learning theories and instructional practices.

Course Objectives

1. Understand foundational concepts in educational technology and their relevance to designing learning products.
2. Use historical insights to inform design decisions and avoid repeating ineffective Ed-Tech practices.
3. Critically evaluate theoretical frameworks (e.g., TPACK) and apply stronger learning theories to guide product development.
4. Analyze educational policies to ensure Ed-Tech products align with child development, curricular, institutional, and national requirements.
5. Design, prototype, and iteratively refine innovative Ed-Tech products grounded in sound pedagogy and user needs.

Course Outcomes

CO1: Apply foundational Ed-Tech concepts to real-world product design challenges.

CO2: Use historical perspectives to make informed design and implementation decisions.

CO3: Integrate relevant learning theories into Ed-Tech product development and critically evaluate frameworks such as TPACK.

CO4: Align Ed-Tech product features with policy, curriculum, and implementation constraints.

CO5: Demonstrate innovative pedagogical thinking through the design, prototyping, and testing of an Ed-Tech product.

Skills

- Product design and prototyping for educational contexts.
- User needs analysis and problem framing.
- Policy-aware decision-making in Ed-Tech development.
- Application of learning theories to product features and instructional design.
- Adaptability in designing for diverse learners and evolving educational landscapes.

Syllabus:

Unit 1: Foundations of Ed-Tech for Product Designers (10 hours)

- What counts as "Ed-Tech" when building learning products
- Core concepts in Ed-Tech that influence product design (learning goals, learner variability, context)
- Scope and purpose of Ed-Tech products across formal, informal, and vocational learning
- Evidence from early childhood research showing that young children do not learn effectively from most Ed-Tech tools, and implications for age-appropriate product design.
- Introduction to the semester-long Ed-Tech product development project

Unit 2: Historical Insights for Better Product Decisions (5 hours)

- Key historical shifts in educational technologies from ancient to modern times
- Lessons from past failures and successes in Ed-Tech adoption

- How historical patterns inform product design, implementation, and sustainability

Unit 3: Learning Theories and Frameworks for Ed-Tech Products (10 hours)

- Critical examination of the TPACK framework as a knowledge-integration model, evaluating its attempt to combine technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK) into a conceptualization of teachers' ability to successfully use education technologies
- Analysis of construct validity challenges in TPACK and its subdomains (TPK, PCK, TCK, PACK), including conceptual overlap and difficulties in measuring these constructs in observable teacher performance
- Critical analysis of whether TPACK and its subdomains can play a role in Ed-Tech product development
- Stronger theoretical foundations for Ed-Tech design (e.g., evidence-based instruction, cognitive load, multimedia learning, and expertise development)
- Translating learning theories into product features and user experience

Unit 4: Policy, Curriculum, and Implementation Constraints (10 hours)

- How policies shape Ed-Tech product requirements (access, equity, assessment, data)
- Curriculum and syllabus design as constraints and opportunities for product development
- National and institutional policies relevant to Ed-Tech deployment
- Mapping product features to policy and curriculum needs
- Implementation constraints: Young children do not learn effectively from most Ed-Tech tools, so early childhood Ed-Tech requires adult mediation, embodied interaction, or non-screen-based modalities.

Unit 5: Innovative Pedagogies and Ed-Tech Product Development (10 hours)

- Active, collaborative, and project-based learning as design principles.
- Designing for mobile, outdoor, blended, and crisis-responsive learning.
- Product development cycle: problem definition, user research, prototyping, testing, iteration.
- Final Ed-Tech product demonstration and reflection.

Course Outcomes (CO) - Program Outcomes (PO) Mappings

	PO	PO	PO	PO	PO	PO	PO	PO	PO
	1	2	3	4	5	6	7	8	9
CO1	X	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	X	-	-
CO3	-	X	-	-	-	X	-	X	-
CO4	-	-	-	-	X	-	X	-	-
CO5	-	X	-	X	-	X	X	X	-

Textbooks

Ericsson, K. A., Charness, N., Feltovich, P., & Hoffman, R. (Eds.). (2006). *The Cambridge handbook of expertise and expert performance*. Cambridge University Press.

Gagné, R. M., Wager, W. W., Golas, K. C., & Keller, J. M. (2005). *Principles of instructional design* (5th ed.). Wadsworth.

Mayer, R. E. (2009). *Multimedia learning* (2nd ed.). Cambridge University Press. Saettler,

P. (2004). *The evolution of American educational technology*. IAP.

Spitzer, M. (1999). *The mind within the net: Models of learning, thinking, and acting*. MIT Press.

Wiggins, G., & McTighe, J. (2005). *Understanding by design* (2nd ed.). ASCD.

Research Articles

Ahn, J. (2022). Exploring the negative and gap-widening effects of EdTech on young children's learning achievement: Evidence from a longitudinal dataset of children in American K–3 classrooms. *International Journal of Environmental Research and Public Health, 19*(9), 5430.

Aithal, P. S., & Aithal, S. (2020). Analysis of the Indian National Education Policy 2020 towards achieving its objectives. *International Journal of Management, Technology, and Social Sciences, 5*(2), 19–41.

Ali, Z., Janarthanan, J., & Mohan, P. (2024). Understanding digital dementia and cognitive impact in the current era of the internet: A review. *Cureus, 16*(9), e70029.

Anderson, D. R., & Pempek, T. A. (2005). Television and very young children. *American Behavioral Scientist, 48*(5), 505–522.

Barr, R., & Hayne, H. (1999). Developmental changes in imitation from television during infancy. *Child Development, 70*(5), 1067–1081.

Black, P., & Wiliam, D. (1998). Assessment and classroom learning. *Assessment in Education, 5*(1), 7–74.

Brantley-Dias, L., & Ertmer, P. A. (2013). Goldilocks and TPACK: Is the construct "just right?" *Journal of Research on Technology in Education, 46*(2), 103–128.

Davies, P. (1999). What is evidence-based education? *British Journal of Educational Studies, 47*(2), 108–121.

DeLoache, J. S. (2004). Becoming symbol-minded. *Trends in Cognitive Sciences, 8*(2), 66–70.

DeLoache, J. S., Chiong, C., Sherman, K., Islam, N., Vanderborght, M., Troseth, G. L., Strouse, G. A., & O'Doherty, K. (2010). Do babies learn from baby media? *Psychological Science, 21*(11), 1570–1574.

Graham, C. R. (2011). Theoretical considerations for understanding technological pedagogical content knowledge (TPACK). *Computers & Education, 57*(3), 1953–1960.

Heift, T., Mackey, A., & Smith, B. (2019). History, pedagogy, data and new directions: An introduction to the educational technology issue. *Annual Review of Applied Linguistics, 39*, 1–7.

Heitink, M., Voogt, J., Fisser, P., Verplanken, L., & van Braak, J. (2017). Eliciting teachers' technological pedagogical knowledge. *Australasian Journal of Educational Technology, 33*(3), 96–109.

Issroff, K., & Scanlon, E. (2002). Educational technology: The influence of theory. *Journal of Interactive Media in Education, 6*, 1–13.

Johan, R., & Harlan, J. (2014). Education nowadays. *International Journal of Educational Science and Research, 4*(5), 51–56.

Koehler, M. J., & Mishra, P. (2005). What happens when teachers design educational technology? The development of technological pedagogical content knowledge. *Journal of Educational Computing Research, 32*(2), 131–152.

Lachner, A., Backfisch, I., & Stürmer, K. (2019). A test-based approach of modeling and measuring technological pedagogical knowledge. *Computers & Education, 142*, 103645.

McCarthy, J., & Wright, P. (2004). Technology as experience. *Interactions, 11*(5), 42–43.

Mishra, P., & Koehler, M. (2005). Educational technology by design: Results from a survey assessing its effectiveness. In *Society for Information Technology & Teacher Education International Conference* (pp. 1511–1517). AACE.

Preiss, M. (2014). *Digital dementia: What we and our children are doing to our minds* [Review of the book *Digital dementia*, by M. Spitzer]. *Cognitive Remediation Journal, 3*(2), 31–34.

Ramteke, R. D., Tawalare, K. A., & Tawalare, K. K. (2015). Ancient teaching learning method—Guru Shishya Parampara. *Journal of Education Technology in Health Sciences, 2*(1), 22–24.

Spitzer, M. (2014). Information technology in education: Risks and side effects. *Trends in Neuroscience and Education*, *3*(3-4), 81-85.

Troseth, G. L., Russo, C. E., & Strouse, G. A. (2016). What's next for research on young children's interactive media? *Journal of Children and Media, 10*, 54-62.

Vodopivec, V. (2024). *A review of studies exploring negative effects of digital technology on student learning, academic performance, and class participation*. Canadian Journal for New Scholars in Education, 15(2).

Wong, A., Ho, S., Olusanya, O., Antonini, M. V., & Lyness, D. (2021). The use of social media and online communications in times of pandemic COVID-19. *Journal of the Intensive Care Society, 22*(3), 255–260.

Zack, E., Barr, R., Gerhardstein, P., Dickerson, K., & Meltzoff, A. N. (2009). Infant imitation from television using novel touch-screen technology. *British Journal of Developmental Psychology, 27*(1), 13–26.

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