Sri Sivasubramaniya Nadar College of Engineering

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Regulation 2022

Curriculum and Syllabi for

M. Tech. Information Technology

SSN COLLEGE OF ENGINEERING

(An Autonomous Institution, Affiliated to Anna University Chennai)

M.E/ M.Tech. Degree Program

Department of Information Technology
(R2022)

VISION of the Institute

To be a world class institution for technical education and scientific research for public good.

MISSION of the Institute

1. Make a positive difference to society through education.
2. Empower students from across socio economic strata.
3. Be a center of excellence in education in emerging technologies in accordance with industry and industrial trends.
4. Build world class research capabilities on par with the finest in the world and broaden students' horizons beyond classroom education.
5. Nurture talent and entrepreneurship and enable all-round personality development in students.

VISION of the Department

To be an outstanding center for IT education and research for betterment of society.

MISSION of the Department

1. Impart sound knowledge of IT domains to the students.
2. Nurture students to contribute to dynamic industrial needs.
3. Empower faculty with the knowledge in the emerging areas of IT.
4. Promote sustained research to build information systems for the benefit of society

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduates of the M.Tech. Information Technology program will be able to

PEO1: Apply domain knowledge and skills of information technology to succeed in professional careers and/or higher studies

PEO2: Design and implement hardware and/or software-related engineering solutions applying the principles and practices of computing, grounded in mathematics and science, to meet industrial & societal demands and/or productively engage in research

PEO3: Function as an individual or in multi-disciplinary teams, by creatively solving problems and communicating effectively

PEO4: Contribute to society, by functioning ethically and responsibly, and involving in professional and social activities for sustainable developments

PROGRAM OUTCOMES (POs)

PO1. An ability to independently carry out research /investigation and development work to solve practical problems.

PO2. An ability to write and present a substantial technical report/document.

PO3. Students should be able to demonstrate a degree of mastery over the area as per specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

PO4. An ability to apply modern IT tools and techniques to solve engineering problems, and provide sustainable development in societal and environmental contexts, while following ethical engineering practices.

PO5. An ability to demonstrate an understanding of engineering and management principles along with an ability to adapt to technological changes towards execution and management of projects, either as an individual or as a team member.

PROGRAM SPECIFIC OUTCOMES (PSO)

PSO: Design, develop and deploy artificial intelligence-based software-intensive solutions, by applying acquired knowledge of IT and allied thrust areas, and by conducting research-based investigations.

PEOs Mapping with POS and PSOs

PEO/PO	PO1	PO2	PO3	PO4	PO5	PSO
PEO1	2	2	3	3	2	3
PEO2	3	2	3	3	2	3
PEO3	2	3	1	2	2	2
PEO4		2		3	1	1

I to IV semesters Curriculum - R 2022 (Choice Based Credit System)

	SEMESTER I							
S. No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
	THEORY							
1		Mathematics for AI & ML	PC	4	2	0	2	3
2		Advanced Data Structures & Algorithms	PC	3	3	0	0	3
3		Advanced Artificial Intelligence	PC	3	3	0	0	3
4		Machine Learning for Multimodal Data	PC	3	3	0	0	3
5		Research Methodology & IPR	MC	2	2	0	0	2
6		Audit Course (Elective)	AC	2	2	0	0	0
	PRACTICALS							
7		Advanced Data Structures & Algorithms Laboratory	PC	4	0	0	4	2
8		Machine Learning Laboratory	PC	4	0	0	4	2
			TOTAL	**25**	**15**	**0**	**10**	**18**

	SEMESTER II							
S.No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
	THEORY							
1		Deep Learning for Computer Vision	PC	3	3	0	0	3
2		Data Engineering & Management	PC	3	3	0	0	3
3		Elective –1	PE	4	2	0	2	3
4		Elective –2	PE	3	3	0	0	3
5		Elective –3	PE	3	3	0	0	3
	PRACTICALS							
6		Deep Learning for Computer Vision Lab	PC	4	0	0	4	2
7		Data Engineering & Management Lab	PC	4	0	0	4	2
8		Internship and Seminar	EEC	4	0	0	4	2
TOTAL				**28**	**14**	**0**	**14**	**21**

	SEMESTER III							
S. No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
	THEORY							
1		Deep Learning for Language and Speech Technologies	PC	5	3	0	2	4
2		Elective –4	PE	3	3	0	0	3
3		Elective –5	PE	3	3	0	0	3
4		Open Elective	OE	3	3	0	0	3
	PRACTICALS							
5		Project –Phase I	EEC	12	0	0	12	6
TOTAL				**26**	**12**	**0**	**14**	**19**

	SEMESTER IV							
S. No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
	PRACTICALS							
1		Project –Phase II	EEC	24	0	0	24	12
TOTAL				**24**	**0**	**0**	**24**	**12**

Total No of Credits: 70

Summary

Semester	PC	PE	OE	EEC	MC*	TOTAL
I	16				2	18
II	10	9		2		21
III	4	6	3	6		19
IV				12		12
Total SSN-R2022	30	15	3	20	2	70
AICTE	16	19	3	28	2	68
Anna University R2021	38	13	3	19	2	75
SSN-R2018	36	15	3	19		73
Deviation w.r.t SSN-R2018	-6	0	0	+1	+2	-3

COURSE TO PO MAPPING - GLOBAL MATRIX

Course Code	Course Title	Sem	Course Credit	PO1	PO2	PO3	PO4	PO5	PSO1
CORE COURSES									
	Mathematics for AI & ML	Sem - I	**3**	3	0	1	2	0	2
	Advanced Data Structures & Algorithms	Sem - I	**3**	2		2			1.5
	Advanced Artificial Intelligence	Sem - I	**3**	1.3	2	1	1	1	1
	Machine Learning for Multimodal Data	Sem - I	**3**	3	0.5	1.25	1.25	1	1.25
	Deep Learning for Computer Vision	Sem - II	**4**	1.7	3	1.7	1	1.3	2
	Data Engineering & Management	Sem - II	**4**	2.3	1.0	1.2	0	0	1.5
	Deep Learning for Language and Speech Technologies	Sem - III	**4**	2.2	3	2	2	3	2.2
	Research Methodology & IPR	Sem - I	**2**	1.7	0.6	0.4	0.8	0.4	0.4
PRACTICALS									
	Advanced Data Structures & Algorithms Laboratory	Sem - I	**2**	2	3	1.4		1	1.4
	Machine Learning Laboratory	Sem - I	**2**	3	0.5	1.25	1.25	1	1.25
	Deep Learning for Computer Vision Laboratory	Sem - II	**2**	1.3	0.9	0.6	1.1	0.7	1.1
	Data Engineering & Management Laboratory	Sem - II	**2**	2.3	2.3	2.0	1.0	3.0	1.7
	Internship and Seminar	Sem - II	**2**	0.3	0.4	0.6	0.3	0.6	0.7
	Project –Phase I	Sem- III	**6**	0.9	1.0	0.6	0.4	0.7	0.7
	Project –Phase II	Sem - IV	**12**	1.1	0.7	1.0	1.0	0.7	1.0
ELECTIVE BUCKET (AI & Data Science)									
	Information Theoretic Learning	Sem - II Elective-I	**3**	2	1	1.5	0	1	1
	Cloud & Edge Computing for ML Applications	Sem - II Elective-II	**3**	2.25	0.5	1.25	1.5	1	1.25
	Data Visualization and Analytics	Sem - II Elective-III	**3**	2.75	0.75	1.75	1.5	0.75	2.5
	Reinforcement Learning	Sem - III Elective-IV	**3**	1.5	0	1	1	0	1
	Healthcare, Sports and Financial Analytics	Sem - III Elective-V	**3**	2	2	2	1		2
ELECTIVE BUCKET (Cybersecurity)									
	Blockchain Technology	Sem - II Elective-I	**3**	1	3	1.8	2.4	3	3

	Ethical Hacking	Sem - II Elective-II	**3**	2.3	1.3	2	2.3	1.7	2
	Digital Forensics	Sem - II Elective-III	**3**	1.8	0	1.5	1.3	0	2
	Data Privacy	Sem - III Elective-IV	**3**	2	0	1.2	1.5	0	1.6
	Social Networks & Open-Source Intelligence	Sem - III Elective-V	**3**	1	3	1	2	3	1
ELECTIVE BUCKET (IoT & Robotics)									
	IoT Programming	Sem - II Elective-I	**3**	1.6	1	2.8	2.6	2	3
	Fog Computing	Sem - II Elective-II	**3**	2	1.3	2	2	1.7	1.8
	IoT Architectures and Software-Defined Networking	Sem - II Elective-III	**3**	2	0.8	1.6	1.8	1	1.8
	Robotic Programming	Sem - III Elective-IV	**3**	3	1	2	1	3	3
	IoT Projects	Sem - III Elective-V	**3**	3	1.5	3	2.5	3	2.8
ELECTIVE BUCKET (IT core (for non-IT UG))									
	Full Stack Web Application Development	Sem - II Elective-I	**3**	1	1	0	1	0	2
	Mobile Application Development	Sem - II Elective-II	**3**	2.3	3	2.5	2.5	3	3
	Cloud Technology	Sem - II Elective-III	**3**	1		1	1	1	1
	Software Architectures and Design	Sem - III Elective-IV	**3**	1.8	2	1.8	2	3	3
	Agile Software Development	Sem - III Elective-V	**3**	1	1.3	1	1.3	1	1

SUSTAINABLE DEVELOPMENT GOALS (SDG)

SDG		Description
SDG1	No poverty	End poverty in all its forms everywhere
SDG 2	Zero hunger	End hunger, achieve food security and improved nutrition, and promote sustainable agriculture
SDG 3	Good health and well being	Ensure healthy lives and promote well-being for all at all ages
SDG 4	Quality education	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
SDG 5	Gender equality	Achieve gender equality and empower all women and girls
SDG 6	Clean water and sanitation	Ensure availability and sustainable management of water and sanitation for all
SDG 7	Affordable and clean energy	Ensure access to affordable, reliable, sustainable, and modern energy for all
SDG 8	Decent work and economic growth	Promote sustained, inclusive, and sustainable economic growth, full and productive employment and decent work for all
SDG 9	Industry, innovation and infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation
SDG 10	Reducing inequality	Reduce income inequality within and among countries
SDG 11	Sustainable cities and communities	Make cities and human settlements inclusive, safe, resilient, and sustainable
SDG 12	Responsible consumption and production	Ensure sustainable consumption and production patterns
SDG 13	Climate action	Take urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy
SDG 14	Life below water	Conserve and sustainably use the oceans, seas and marine resources for sustainable development
SDG 15	Life on land	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
SDG 16	Peace, justice and strong institutions	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
SDG 17	Partnerships for the goals	Strengthen the means of implementation and revitalize the global partnership for sustainable development

MAPPING OF SUBJECT RELEVANT TO SDG

	Sustainable Development Goals																
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Mathematics for AI & ML				✓													
Advanced Data Structures & Algorithms				✓													
Advanced Artificial			✓	✓		✓	✓		✓		✓		✓	✓	✓		

	Sustainable Development Goals																
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Intelligence																	
Machine Learning for Multimodal Data				✓													
Research Methodology & IPR				✓												✓	
Audit Course				✓													
Advanced Data Structures & Algorithms Laboratory				✓													
Machine Learning Algorithms Laboratory				✓			✓				✓		✓				
Deep Learning for Computer Vision				✓													
Data Engineering & Management				✓													
Deep Learning for Computer Vision Lab			✓	✓					✓		✓		✓	✓	✓		
Data Engineering & Management Lab				✓				✓					✓				
Internship and Seminar				✓					✓								
Deep Learning for Language and Speech Technologies				✓					✓		✓					✓	
Project –Phase I			✓	✓		✓	✓	✓	✓		✓		✓	✓	✓		
Project –Phase II			✓	✓		✓	✓	✓	✓		✓		✓	✓	✓		
Information Theoretic Learning				✓													
Blockchain Technology				✓					✓		✓						
IoT Programming				✓													
Full Stack Web Application Development				✓					✓		✓						
Cloud & Edge Computing for ML Applications				✓					✓		✓						
Fog Computing																	
Ethical Hacking				✓					✓		✓						
Mobile Application				✓					✓		✓						

	Sustainable Development Goals																
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Development																	
Data Visualization and Analytics				✓				✓	✓				✓				
Digital Forensics				✓													
IOT Architecture & Software-Defined Networking				✓													
Cloud Technology				✓					✓		✓						
Reinforcement Learning				✓													
Data Privacy				✓													
Robotic Programming				✓					✓		✓			✓	✓		
Software Architectures and Design				✓													
Health, Sports and Financial Analytics			✓	✓		✓	✓	✓									
Social Networks &Open-Source Intelligence				✓													
IoT Projects		✓	✓	✓		✓	✓		✓		✓		✓				
Agile Software Development				✓													

ELECTIVE BUCKETS

Semester/ Elective	Elective Bucket - 1 AI & Data Science	Elective Bucket - 2 Cybersecurity	Elective Bucket - 3 IoT & Robotics	Elective Bucket - 4 IT core (for non-IT UG)
II / 1	Information Theoretic Learning	Blockchain Technology	IoT Programming	Full Stack Web Application Development
II / 2	Cloud & Edge Computing for ML Applications	Ethical Hacking	Fog Computing	Mobile Application Development
II / 3	Data Visualization and Analytics	Digital Forensics	IoT Architectures and Software-Defined Networking	Cloud Technology
III / 4	Reinforcement Learning	Data Privacy	Robotic Programming	Software Architectures and Design
III / 5	Healthcare, Sports and Financial Analytics	Social Networks & Open-Source Intelligence	IoT Projects	Agile Software Development

Elective I (II Semester)

S. No.	COURSE CODE	COURSE TITLE	BASKET	CONTACT PERIODS	L	T	P	C
1		Information Theoretic Learning	AI&DS	4	2	0	2	3
2		Blockchain Technology	CYBER	4	2	0	2	3
3		IoT Programming	IoT	4	2	0	2	3
4		Full Stack Web Application Development	IT	4	2	0	2	3

Elective II (II Semester)

S. No.	COURSE CODE	COURSE TITLE	BASKET	CONTACT PERIODS	L	T	P	C
1		Cloud & Edge Computing for ML Applications	AI&DS	3	3	0	0	3
2		Ethical Hacking	CYBER	3	3	0	0	3
3		Fog Computing	IoT	3	3	0	0	3
4		Mobile Application Development	IT	5	1	0	4	3

Elective III (II Semester)

S. No.	COURSE CODE	COURSE TITLE	BASKET	CONTACT PERIODS	L	T	P	C
1		Data Visualization and Analytics	AI&DS	4	2	0	2	3
2		Digital Forensics	CYBER	3	3	0	0	3
3		IoT Architecture & Software-Defined Networking	IoT	3	3	0	0	3
4		Cloud Technology	IT	5	1	0	4	3

Elective IV (III Semester)

S. No.	COURSE CODE	COURSE TITLE	BASKET	CONTACT PERIODS	L	T	P	C
1		Reinforcement Learning	AI&DS	3	3	0	0	3
2		Data Privacy	CYBER	3	3	0	0	3
3		Robotic Programming	IOT	5	1	0	4	3
4		Software Architectures and Design	IT	3	3	0	0	3

Elective V (III Semester)

S. No.	COURSE CODE	COURSE TITLE	BASKET	CONTACT PERIODS	L	T	P	C
1		Health, Sports, and Financial Analytics	AI&DS	3	3	0	0	3
2		Social Networks & Open-Source Intelligence	CYBER	4	2	0	2	3
3		IoT Projects	IoT	5	1	0	4	3
4		Agile Software Development	IT	4	2	0	2	3

Open Electives

Open Elective (offered during III semester)

S. No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	OE5091	Business Data Analytics	3	3	0	0	3
2	OE5092	Industrial Safety	3	3	0	0	3
3	OE5093	Operations Research	3	3	0	0	3
4	OE5094	Cost Management of Engineering Projects	3	3	0	0	3
5	OE5095	Composite Materials	3	3	0	0	3
6	OE5096	Waste To Energy	3	3	0	0	3

Audit Courses

S.No	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	AC1	English For Research Paper Writing	2	2	0	0	0
2	AC2	நற்றமிழ் இலக்கியம்	2	2	0	0	0
3	AC3	Disaster Management	2	2	0	0	0
4	AC4	Sanskrit For Technical Knowledge	2	2	0	0	0
5	AC5	Value Education	2	2	0	0	0
6	AC6	Constitution Of India	2	2	0	0	0
7	AC7	Pedagogy Studies	2	2	0	0	0
8	AC8	Stress Management by Yoga	2	2	0	0	0
9	AC9	Personality Development Through Life Enlightenment Skills	2	2	0	0	0

SEMESTER I

COURSE CODE	COURSE TITLE	L	T	P	C
	MATHEMATICS FOR AI & ML	2	0	2	3

OBJECTIVES

- To study the basics of linear space and linear transformation.
- To learn various methods in matrix theory and decomposition methods.
- To apply the concepts of differentiation and integration for solving maxima and minima problems.
- To represent networks using graph models.
- To apply and evaluate the optimization problems.

Unit I BASICS OF PROBABILITY AND RANDOM VARIABLES 6

Probability - Axioms of probability - Conditional probability - Baye's theorem - Discrete and Continuous random variables - Moments - Moment generating functions -Binomial, Poisson, Uniform, Exponential, Normal distributions- Central limit theorem.

Unit II VECTOR SPACES 6

Vector spaces –Subspaces –Linear combinations and system of Linear equations –Linear independence and Linear dependence – Basis and Dimensions.

Unit III LINEAR TRANSFORMATION AND MATRIX DECOMPOSITION 6

Linear transformations –Null spaces Range –Matrix representation of linear transformation – Eigenvalues –Eigenvectors –Diagonalization - Inner and outer products – Inner product space – orthogonality and orthonormality - Singular value decomposition -LU decomposition – Simulation using Python Programming (Practice only)..

Unit IV DIFFERENTIAL AND INTEGRAL CALCULUS 6

Functions of a single variable, limit, continuity, differentiability - Mean value theorems, indeterminate forms, L'Hospital's rule - Maxima and minima - Taylor's series, infinite series summation/integration concepts - Fundamental and mean value-theorems of integral calculus, evaluation of definite and improper integrals - Beta and gamma functions.

UNIT V CONNECTIVITY IN GRAPHS 6

Graphs: Directed and Undirected – Subgraphs – Matrix Representation of graphs– Cut-Sets and Cut-vertices: Properties of a Cut-Set – Fundamental Circuits and Cut-Sets – Connectivity and Separability – Case Studies: Applications of Bayesian networks, Principal Component Analysis (PCA), Singular Value Decomposition (SVD)

TOTAL LECTURE PERIODS: 30

LAB COMPONENT: TOTAL LAB PERIODS: 30

LIST OF EXPERIMENTS:

Experiments using open-source intelligence tools

1. Application of Bayer's theorem.

2. Solution of system of Linear equations.
3. Diagonalization of matrices.
4. Finding Cut sets of a given graphs.
5. Bayesian Networks, PCA, SVD
6. Tools: Python, MATLAB.

TEXT BOOKS:

1.Milton, J. S. and Arnold, J.C., Introduction to Probability and Statistics, Tata McGrawHill, New Delhi, 4th Edition, 3rd Reprint, 2008.
2.Friedberg A.H, Insel A.J. and Spence L, Linear Algebra, Prentice Hall of India, New Delhi, 2004.
3.Strang G, Linear Algebra and its applications, Thomson (Brooks/Cole), New Delhi, 2005.
4.O'Neil, P.V., Advanced Engineering Mathematics, Thomson Asia Pvt. Ltd., Singapore, 2003.
5.NarsinghDeo, Graph Theory with Applications to Engineering & Computer Science, Dover Publications, Inc. Mineola, New York, 2016.

REFERENCES:

1. B. S. Grewal , Higher Engineering Mathematics, Krishna Publications, 2017.
2. Linear Programming and Network Flows. by Mokhtar S. Bazaraa, Wiley; 4th edition (15 January 2010).
3. Johnson, R.A. and Gupta, C.B., Miller and Freund's Probability and Statistics for Engineers, Pearson Education, Asia, 8th Edition, 2011.

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Identify the standard distributions and apply them in solving problems.
CO2: Acquire knowledge of linear spaces and solve problems.
CO3. Apply various methods in matrix theory to solve decomposition problems.
CO4: Understand the concepts of differential and integral calculus and solve problems.
CO5: Acquire knowledge of graphs and cut-sets and apply in network flow problems.

COs	**POs**					**PSO**
	1	**2**	**3**	**4**	**5**	
1	3		1	2		2
2	3		1	2		2
3	3		1	2		2
4	3		1	2		2
5	3		1	2		2

COURSE CODE	COURSE TITLE	L	T	P	C
	ADVANCED DATA STRUCTURES AND ALGORITHMS	3	0	0	3

OBJECTIVES

- To understand the usage of algorithms in computing.
- To learn and use hierarchical data structures and its operations
- To learn the usage of graphs and its applications.
- To select and design data structures and algorithms that are appropriate for problems.
- To study about NP hard and NP Completeness of problems.

UNIT I ALGORITHM ANALYSIS AND DESIGN TECHNIQUES 10

Algorithms in computing, growth of functions, probabilistic analysis, and randomized algorithms - Randomized Divide and Conquer: Medium-Finding and Quicksort - Finding closest Pairs of Points-A Randomized Approach: Load Balancing. Greedy Algorithms - Huffman Trees and Codes, Dynamic Programming, Amortized Analysis, Approximation Algorithms - Greedy Algorithms and Bounds on the Optimum: A Load Balancing Algorithm, The Center Selection Problems, Arbitrarily Good Approximations: The Knapsack Problem.

UNIT II DATA STRUCTURES AND CONCURRENCY 9

Review of elementary data structures – List, Stack, Queue–Concurrent linked lists– coarse-grained synchronization – fine-grained synchronization – lazy synchronization – non-blocking synchronization – concurrent queues – bounded partial queues – Unbounded total Queue, Unbounded Lock Free queues – concurrent stacks: Unbounded Lock -Free Stack with Backoff.

UNIT III ADVANCED CONCURRENT STRUCTURES 9

Hashing – closed-address and open-addressed hash sets –LockFree Hash set- Lock based closed-address Concurrent hash set, Cuckoo Hashing. Lock-based concurrent skip lists –An Unbounded Heap-Based Concurrent Priority Queue – skip list based unbounded priority queues.

UNIT IV NON-LINEAR DATA STRUCTURES 9

Binary search trees, Balanced Search Trees - Height balanced and Weight balanced search trees, Red Black Tree, B-Tree, K-D Trees, Treaps and Randomized Search Trees (RSTs), Multiway Tries (MWTs) ,Ternary Search Trees (TSTs), Coding Tree.

UNIT V NP AND COMPUTATIONAL INTRACTABILITY 8

Polynomial time reduction – Satisfiability Problem - NP-Completeness - Sequencing Problem - Partitioning Problem-Graph - Graph Coloring - Strongly connected components- Network Flow - Maximum Flow and Minimum Cut – Bipartite Matching-Reductions and – Graph Coloring.

TOTAL PERIODS: 45

REFERENCES

1. The Art of Multiprocessor Programming by Maurice Herlihy and Nir Shavit, revised first edition, Morgan Kaufman, 2012. Note: be sure not to buy the unrevised edition
2. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein, “Introduction to Algorithms”, Prentice Hall of India, New Delhi, Second Edition, 2009.
3. Advanced Data Structures by Peter Brass

COURSE OUTCOMES:

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

CO 1: Apply knowledge of computing and mathematics to analyze the problem, requirements and algorithms

CO 2: Solve the complex engineering problems using hierarchical data structures

CO 3: Apply suitable design strategy in a way that demonstrates comprehension of the trade-offs involved in design choices for problem-solving

CO 4: Classify the type of the problem as P, NP Complete or NP Hard.

COs	POs					PSO
	1	2	3	4	5	
1	2		2			1
2	2		2			2
3	2		2			1
4			2			2

COURSE CODE	COURSE TITLE	L	T	P	C
	ADVANCED ARTIFICIAL INTELLIGENCE	3	0	0	3

OBJECTIVES

- To understand the role of logic in artificial intelligence
- To understand knowledge and reasoning under certainty and uncertainty
- To enable design and implement AI principles for problem solving, inference and perception
- To implement algorithms on simple and complex decision making

UNIT I KNOWLEDGE AND REASONING 9

Propositional Logic: Simple logic – Propositional theorem proving – Effective propositional model checking – Agents based on propositional logic – First order logic – Representation – syntax and semantics – using first order logic – knowledge engineering in first order logic; Propositional vs first order inference - Unification and lifting – forward and backward chaining – resolution.

UNIT II PLANNING AND REPRESENTATION 9

Classical planning: definition – algorithms for planning as state space search – planning graphs – classical planning approaches – analysis; Knowledge representation: Ontological engineering - categories and objects - events – mental events and mental objects – reasoning systems for categories – reasoning with default information – Case study: The internet shopping world.

UNIT III UNCERTAIN KNOWLEDGE 9

Uncertainty - Quantifying uncertainty - Acting under uncertainty – basic probability notation – inference using full joint distributions – independence - Bayes' rule and its use

UNIT IV PROBABILISTIC REASONING 9

Representing knowledge in an uncertain domain – semantics of Bayesian networks – efficient representation of conditional distributions – exact and approximate inference in Bayesian networks - relational and first order probability models – Time and uncertainty – inference in temporal models- Bayesian Learning: Learning with complete and hidden data – Expectation Maximization Algorithm; – Hidden Markov Models – Kalman filters – dynamic Bayesian networks – multiple object tracking.

UNIT V DECISION MAKING AND LEARNING 9

Reinforcement Learning : Basics of Reinforcement learning – Active and Passive reinforcement learning – Generalization – Applications ;Making simple decisions: combining beliefs and desires – The basis of utility theory – Utility functions – multi attribute utility functions – decision networks – The value of information – Decision theoretic expert systems; Sequential Decision problems – value iteration – policy iteration – Partially Observable MDPs ; Decisions with Multiple Agents : Game Theory – Mechanism Design.

Case Studies that map sustainable development goals 3,4,6,7,9,11,13,14,15 (3: Good health and well being, 4: Quality education, 6: Clean water and sanitation, 7: Affordable and clean energy, 9: Industry, innovation and infrastructure, 11: Sustainable cities and communities, 13: Climate action, 14: Life below water, 15: Life on land)

TOTAL PERIODS: 45

TEXT BOOK

1. Artificial Intelligence: A modern approach, by Stuart Russell and Peter Norvig, Third Edition, Pearson Series in Artificial Intelligence. 2020.

REFERENCES

1. Artificial Intelligence Engines: A Tutorial Introduction to the Mathematics of Deep Learning by James V Stone, Sebtel Press, 2019.
2. Artificial Intelligence by Example: Acquire advanced AI, machine learning, and deep learning design skills by Denis Rothman, 2nd Edition, 2020.
3. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006
4. Ethem Alpaydin, Introduction to Machine Learning, MIT Press, Prentice Hall of India, Third Edition 2014.

COURSE OUTCOMES

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

CO 1: Identify the role of propositional and first order logic in Artificial Intelligence

CO 2: Demonstrate an understanding of knowledge and reasoning under certainty and uncertainty.

CO 3: Apply principles of AI in solutions that require problem solving, inference, perception

CO 4: Implement algorithms on simple and complex decision making.

COs	**POs**					**PSO**
	1	**2**	**3**	**4**	**5**	
1	1		1			
2	2	2	1	1	1	1
3	1		1	1	1	1
4			1			1

COURSE CODE	COURSE TITLE	L	T	P	C
	MACHINE LEARNING FOR MULTIMODAL DATA	3	0	0	3

OBJECTIVES

- To learn the fundamentals of image, video and audio analysis
- To understand the working principles of machine Learning algorithms
- To enable design and implementation of machine learning solutions to classification and clustering problems.
- To gain experience on applying machine learning techniques for for image, video, speech and text analysis

UNIT I IMAGE AND VIDEO ACQUISITION, REPRESENTATION AND STORAGE 9

Human eye physiology, Image acquisition devices, Image formats, Images in the Spatial Domain, Images in the Frequency Domain, Image Segmentation, Video principles, state-of-the-art features in image and video; 3D motion and 2D optical flow

UNIT II AUDIO AND TEXT ACQUISITION, REPRESENTATION AND STORAGE 9

Speech production and perception and acquisition-Articulatory phonetics - Acoustic phonetics and signals - Time domain and frequency domain processing; state-of-the-art speech features. Text preparation - Extracting terms from tokens - Vector space representation - Similarity Computation

UNIT III MACHINE LEARNING – SUPERVISED LEARNING 9

Learning from Examples, VC Dimension, Bias-Variance trade-off, Cross validation, Logistic regression, Bayesian Classifier, Neural Networks – Single and multilayer perceptron, Support Vector Machines - linear and non-linear kernel functions, Ensemble Methods-bagging, boosting & stacking.

UNIT IV MACHINE LEARNING – UNSUPERVISED LEARNING 9

Clustering: K-Means algorithm, Hierarchical clustering, Gaussian Mixture Models, Expectation Maximization Algorithm; Feature Extraction Methods: Curse of Dimensionality, Principal Component Analysis, Independent Component Analysis

UNIT V CASE STUDIES 9

Automatic face recognition - Object detection, recognition and tracking, Speech, speaker, and language identification/recognition, Text summarization

TOTAL PERIODS :45

TEXT BOOK

1. Francesco Camastra, Alessandro Vinciarelli, Machine Learning for Audio, Image and Video Analysis -Theory and Applications, Springer, 2015
2.Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006
3. Charu C. Aggarwal, Machine Learning for Text. Springer, 2018

REFERENCES:

1. Milan Sonka, Vaclav Hlavac, Roger Boyle, Image processing, analysis, and machine vision, Cengage Learning, Fourth edition, 2015
2. Reinhard Klette Concise Computer Vision: An Introduction into Theory and Algorithms, Springer, 2014

3. Lawrence R.Rabiner, Biing-Hwang Juang, and B.Yegnanarayana, Fundamentals of Speech Recognition, Pearson, 2008
4. Tom Mitchell, Machine Learning, McGraw Hill, 3rd Edition,1997. 4. Charu C. Aggarwal, Data Classification Algorithms and Applications, CRC Press, 2014.
5. Ethem Alpaydin, Introduction to Machine Learning, MIT Press, Prentice Hall of India, Third Edition 2014.

COURSE OUTCOMES

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

CO 1: Demonstrate the image, video and speech and text data acquisition, representation, and storage approaches

CO 2: Analyse Machine Learning algorithms and their limitations

CO3: Apply Machine Learning algorithms on image, video, audio, and text data

CO4: Relate current research papers on Machine Learning and understand the issues raised by current research.

COs	**POs**					**PSO**
	1	**2**	**3**	**4**	**5**	
1	3		1			
2	3		1	2	1	1
3	3		1	2	1	1
4	3	2	2	1	2	3

COURSE CODE	**COURSE TITLE**	**L**	**T**	**P**	**C**
	ADVANCED DATA STRUCTURES LABORATORY	0	0	4	2

OBJECTIVES

- To analyze the existing algorithms and design efficient algorithms
- To learn the implementation of linear data structures for concurrency
- To learn the implementation of advanced data structures such as search trees and
- To explore the advanced concurrent data structures such as hash table, Priority Queue
- To learn to apply principles of efficient algorithm design and learn various advanced algorithms

LIST OF EXERCISES

1. Insertion sort and merge sort with complexity analysis
2. Implementation and applications of classic linear data structures, namely, linked lists, queues, and stacks
3. Implementation of various locking and synchronization mechanisms for concurrent linked lists.
4. Implementation of various locking and synchronization mechanisms for concurrent queues and stacks.
5. Application of binary search trees/2-D Tree
6. Application of Heaps
7. Dynamic programming (e.g. Longest common subsequence, 0/1 Knap-sack)
8. Recursive backtracking (e.g. N-Queen's problem)
9. Greedy technique (e.g. Job/event scheduling, Minimum spanning tree)
10. Implementation and demonstration of hashing and concurrent hashing

11. Implementation of approximation algorithms / randomized algorithms.
12. Implementation of graph algorithm
13. Mini project: For a given application, identify and solve using suitable data structures & design techniques and database

TOTAL PERIODS: 45

OUTCOMES

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

CO1: Analyze the existing algorithms.
CO2: Implement and apply concurrency in linked lists, stacks, queues, heap and hashing.
CO3: Implement advanced search trees and graph algorithms
CO4: Implement approximation, randomized, parallel algorithm, Greedy and Dynamic Algorithms
CO5: Solve real time applications using advanced algorithm concepts.

COs	POs					PSO
	1	**2**	**3**	**4**	**5**	
1	2		1			1
2	2		1			1
3	2		1			1
4	2		1			1
5	2	3	3			3

COURSE CODE	COURSE TITLE	L	T	P	C
	MACHINE LEARNING LABORATORY	0	0	4	2

OBJECTIVES

- To learn the fundamentals and practice Python codes for Data Science.
- To understand and implement machine learning algorithms using Python
- To apply machine learning algorithms for image, video and speech and text recognition

LIST OF EXERCISES

1. Python packages for Machine Learning
2. Image processing using OpenCV
3. Text processing using NLTK
4. Speech processing - time and frequency domain features
5. Implement classification using Logistic regression
6. Implement classification using Multilayer perceptron
7. Implement classification using SVM
8. Implement Adaboost and Bagging ensemble techniques
9. Implement K-means and hierarchical Clustering
10. Mini project - build image/video/speech/text application, that maps to the sustainable development goals 7, 11, 13 etc. (7: Affordable and clean energy, 11: Sustainable cities and communities, 13: Climate action)

TOTAL PERIODS: 45

OUTCOMES

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

CO 1: Use Python packages for Machine Learning applications

CO 2: Implement image/video/speech /text processing techniques using tools such as openCV and NTLK

CO3: Build and validate machine learning models using supervised and unsupervised learning methods

CO4: Design and develop Machine Learning based solutions for image, video and speech and text analysis through research/investigations.

COs	**POs**					**PSO**
	1	**2**	**3**	**4**	**5**	
1	3		1			
2	3		1	2	1	1
3	3		1	2	1	1
4	3	2	2	1	2	3

SEMESTER II

COURSE CODE	COURSE TITLE	L	T	P	C
	DEEP LEARNING FOR COMPUTER VISION	3	0	0	3

OBJECTIVES

- To study the fundamentals of computer vision and deep learning
- To introduce the concepts of Convolutional neural networks
- To learn various deep learning models for real time applications.

UNIT I INTRODUCTION TO VISUAL FEATURES AND REPRESENTATIONS 9

Image Formation, Image Representation: Linear Filtering, Correlation, Convolution; Visual Features: Edge, Blobs, Scale Space and Scale Selection, SIFT, SURF, HoG, LBP, Optical Flow.

UNIT II CONVOLUTIONAL NEURAL NETWORKS 9

Convolutions and Pooling: Color Channel Ordering Formats, Convolutional Layers, Filter Size, Padding, Stride, Pooling layers; A complete DNN architecture; Transfer learning: LeNet5, AlexNet, VGG, Inception, GoogLeNet, ResNet.

UNIT III VISUALIZATION AND UNDERSTANDING DNNs 9

Visualization of Kernels; Backprop-to-image/Deconvolution Methods; Deep Dream, Hallucination, Neural Style Transfer; CAM, Grad-CAM, Grad-CAM++; Recent Methods (IG, Segment-IG, SmoothGrad).

UNIT IV DNNs FOR RECOGNITION, VERIFICATION, SEGMENTATION 9

CNNs for Recognition and Verification: Siamese Networks, Triplet Loss, Contrastive Loss, Ranking Loss; CNNs for Detection: Object Detection, R-CNN, Fast R-CNN, Faster R-CNN, YOLO, SSD; CNNs for Segmentation: FCN, SegNet, U-Net, Mask-RCNN.

UNIT V RECURRENT NEURAL NETWORK, ATTENTION AND RECENT MODELS 9

Review of RNNs; CNN + RNN Models for Video Understanding: Spatio-temporal Models, Action/Activity Recognition; Attention Models in Vision; Vision and Language: Image Captioning, Visual QA, Visual Dialog; Spatial Transformers: Transformer Networks; Deep Generative Models: GANs, VAEs; Recent Trends: Zero-shot, One-shot, Few-shot Learning.

TOTAL PERIODS: 45

TEXT BOOK

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, 2016.
2. Simon Prince, Computer Vision: Models, Learning, and Inference, 2012.

REFERENCES:

1. Michael Nielsen, Neural Networks and Deep Learning, 2016
2. Yoshua Bengio, Learning Deep Architectures for AI, 2009
3. Richard Szeliski, Computer Vision: Algorithms and Applications, 2010.
4. David Forsyth, Jean Ponce, Computer Vision: A Modern Approach, 2002.

OUTCOMES

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

CO 1: Explain the fundamentals of computer vision techniques.
CO 2: Describe deep learning architecture models.
CO 3: Apply the deep learning algorithms and solve real-world problems.

COs	POs					PSO
	1	2	3	4	5	
1	1		1		1	1
2	1		2	1	1	2
3	3	3	2	1	2	3

COURSE CODE	COURSE TITLE	L	T	P	C
	DATA ENGINEERING & MANAGEMENT	3	0	0	4

OBJECTIVES:

- To learn relational models and transaction processing.
- To learn distributed databases
- To understand the concepts of big data and NoSQL databases.
- To learn the big data analytical frameworks

UNIT I RELATIONAL DATABASE DESIGN 9

Database Fundamentals-Data models - Types of data models - Relational DBMS – Normalization: Functional dependencies - Normal Forms-Overview of query processing and evaluation

UNIT II ADVANCED SQL AND TRANSACTION MANAGEMENT 9

Assertion and views - Cursors, triggers, and stored procedures - Embedded SQL, dynamic SQL, SQLJ, Advanced Features of SQL; Properties of Transaction - Concurrency control - Serializability - Lock Based and timestamp-based Protocols – Deadlock handling – Transaction Recovery - Use of SQL in recovery

UNIT III DISTRIBUTED DATABASES 10

Distributed DBMS-architecture -design, query processing - Distributed Transactions; Data Warehouses - ETL, ELT, Data Cube, Data Lakes, Scalable Data Processing - Hadoop - Hadoop streaming – Hadoop pipes – design of Hadoop distributed file system, Stream Concepts-Data Analysis with Spark

UNIT IV BIG DATABASES 9

Big Data - Introduction to unstructured databases- No SQL databases – MongoDB - Data Modelling - Types - NoSQL Queries– Firebase: Cloud Firestore Databases – Application development using MongoDB and Firebase-HBase and ZooKeeper

UNIT V FRAMEWORKS 8

Applications on Big Data Using Pig and Hive – Data processing operators in Pig – Hive services – HiveQL – Querying Data in Hive - fundamentals of HBase and ZooKeeper - IBM InfoSphere BigInsights and Streams.

TOTAL PERIODS: 45

REFERENCES:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, Database System Concepts, Seventh Edition, Tata McGraw Hill, 2019.
2. Ramez Elmasri and Shamkant B. Navathe, Fundamentals of Database Systems, Seventh Edition, Pearson Education, 2016.
3. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data, McGrawHill Publishing, 2012.
4. Tom White, Hadoop: The Definitive Guide, Third Edition, O'Reilley, 2012.
5. Bill Chambers, Matei Zaharia, Spark: The Definitive Guide, First Edition, O'Reilley, 2018.
6. Guy Harrison, Next Generfation Databases - No SQL, New SQL and Bigdata, Apres, 2015.
7. Programming Hive, Jason Rutherglen, Dean Wampler & Edward Capriolo, O'REILLY, 2012, First edition.
8. Programming Pig, Alan Gates,O'REILLY , 2012,First edition.

OUTCOMES:

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

CO1: Develop database designs using Relational models.
CO2: Use advanced SQL features for managing relational databases.
CO3: Apply concurrency control and recovery mechanisms for practical problems.
CO4: Store and process big data in a distributed environment.
CO5: Use various concepts of NoSQL databases.
CO6: Design and develop applications on Hadoop/Spark

COs	**POs**					**PSO**
	1	**2**	**3**	**4**	**5**	
1	2	1	2			1
2	2	1	1			1
3	1	1	1			1
4	3	1	1			2
5	3	1	1			2
6	3	1	1			2

COURSE CODE	**COURSE TITLE**	**L**	**T**	**P**	**C**
	DEEP LEARNING FOR COMPUTER VISION LABORATORY	0	0	4	2

OBJECTIVES

- To study the fundamentals and to practice computer vision and deep learning techniques
- To understand and implement deep learning models using Python
- To apply various deep learning models for real time applications.

LIST OF EXPERIMENTS:

1. Building the ImageNet dataset
2. Binary classification using CNN
3. Implementation of data augmentation techniques

4. Training deep learning models on ImageNet
5. Visualizing the network architectures
6. Vision-based recognition using State-of-the-art CNNs
7. Multi-objects tracking on road
8. Image understanding and caption generation
9. One shot and few shot learning

Projects that map to the sustainable development goals 3, 9, 11, 13, 14, 15 etc. (3: Good health and wellbeing, 9: Industry, innovation, and infrastructure, 11: Sustainable cities and communities, 13: Climate action, 14: Life below water, 15: Life on Land)

TOTAL PERIODS: 45

OUTCOMES

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

CO 1: Implement the fundamental computer vision techniques.
CO 2: Design and develop deep learning models through research/investigations
CO 3: Apply the deep learning algorithms to solve real-world problems.

COs	**POs**					**PSO**
	1	**2**	**3**	**4**	**5**	
1	3		1	2	1	2
2	3	3	1	3	2	3
3	3	3	2	3	2	3

COURSE CODE	**COURSE TITLE**	**L**	**T**	**P**	**C**
	DATA ENGINEERING & MANAGEMENT LABORATORY	0	0	4	2

OBJECTIVES

- To practice advanced SQL queries
- To realize storage of big data using Hbase and NoSQL databases.
- To develop real time applications using front end tools and connecting with databases

LIST OF EXPERIMENTS:

1. Database Design and Normalization
2. Query the database using Advanced SQL
    - Nested Queries, Correlated Subqueries, Joins, Aggregate functions, Grouping functions, Views
3. Database programming
    - PL/SQL Procedures and Functions, Triggers, Cursors
4. Develop applications using JDBC and ODBC
5. Building Web Applications using NoSQL databases
6. Applications using Map-Reduce programming
7. Big Data Analytics using Hadoop and Spark
8. Building Spark Streaming application
9. Develop Big data applications using Pig and Hive
10. Mini project that map to the sustainable development goals 8, 13 etc. (8: Decent work and Economic Growth, 13: Climate action)

Front end: Flutter/Python Flask
Back end: Oracle/MySQL/NoSQL/HBase

TOTAL PERIODS: 45

OUTCOMES

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

CO 1: Design databases and write advanced SQL queries to perform database retrieval
CO 2: Process and analyze big data using Hadoop and Spark framework
CO 3: Develop real time applications using database frameworks like MongoDB, Hbase, Pig and Hive for data analysis

COs	**POs**					**PSO**
	1	**2**	**3**	**4**	**5**	
1	3	2	2	1		1
2	2	2	1	1		1
3	2	3	3	1	3	3

COURSE CODE	**COURSE TITLE**	**L**	**T**	**P**	**C**
	INTERNSHIP AND SEMINAR	**0**	**0**	**4**	**2**

OBJECTIVES:

The objective of this course is to enable the students to

- Ability to identify and solve practical and real-world IT applications
- Ability to survey literature, identify gaps, and write well-documented report
- Display effective technical presentation skills

OUTCOMES:

On successful completion of this course, the students should be able to

CO1: Ability to learn and apply new and existing concepts for solving engineering problems
CO2: function effectively on multidisciplinary teams or as an individual
CO3: clearly communicate ideas through preparation of a well-documented internship report, and oral demonstration of technical knowledge

COs	**POs**					**PSO**
	1	**2**	**3**	**4**	**5**	
1	1		3	2		3
2		1			2	1
3	1	2	1		2	1

SEMESTER III

COURSE CODE	COURSE TITLE	L	T	P	C
	DEEP LEARNING FOR LANGUAGE AND SPEECH TECHNOLOGIES	3	0	2	4

OBJECTIVES:

The objective of this course is to enable the students to

- Understand neural language models
- Apply encoder-decoder and transformer models
- Understand conference and coherence
- Build question answering systems
- Build chatbots and dialogue systems
- Develop a speech recognition system
- Develop a speech synthesizer

UNIT IDEEP LEARNING ARCHITECTURES FOR LANGUAGE PROCESSING 11

Foundations of natural language processing – – Recurrent neural networks, RNN for language modelling, semantic embeddings – GRU, LSTM, BLSTM – Attention models and Transformers – machine translation – the encoder-decoder model, bidirectional transformer encoders - transfer learning

UNIT II SEMANTIC, PRAGMATIC AND DISCOURSE ANALYSIS 9

Word Sense and WordNet - Word Sense Disambiguation - FrameNet - Semantic Role Labeling - Implicatures - presuppositions - Speech acts theory - Linguistics pragmatics analysis -Coreference phenomena – coreference tasks and datasets – mention detection – coreference algorithms – neural mention-ranking algorithm – evaluation of coreference – gender bias in coreference – coherence relations – discourse structure parsing – centering and entity-based coherence – local coherence – global coherence

UNIT III QUESTION ANSWERING AND DIALOGUE SYSTEMS 9

Information retrieval – relation extraction – extraction of time – extracting events – template filling – review of SRL – lexicons – IR-based factoid question answering – entity linking – knowledge-based question answering – language models for QA – classic QA models – evaluation of factoid answers Properties of human conversation – chatbots – GUS a frame-based dialogue system – dialogue-state architecture – evaluating dialogue systems – design of dialogue systems

UNIT IV AUTOMATIC SPEECH RECOGNITION 8

Speech recognition: Acoustic modeling. Deep neural network (DNN) acoustic modeling; HMM, HMM-DNN systems. Feature extraction; Connectionist Temporal Classification (CTC) - Listen, Attend & Spell (LAS). Multi-task objectives for end-to-end ASR – ASR Evaluation: ord Error rate.

UNIT V TEXT TO SPEECH SYNTHESIS 8

Text to Speech (TTS): Overview. Text normalization. Letter-to-sound. Prosody, Getting TTS; Working well: Data collection. Evaluation. Signal processing. Concatenative and parametric; approaches, WaveNet and other deep learning based TTS systems

TOTAL LECTURE PERIODS: 45

LAB COMPONENTS: **TOTAL LAB PERIODS: 30**

LIST OF EXPERIMENTS:

1. Build language models using neural networks
2. Build language models using RNN
3. Simple NLP tasks using RNN
4. Build language models using transformers
5. Implement encoder-decoder model for NLP tasks
6. Transfer learning using BERT
7. Implement machine translation systems
8. Implement coreference algorithms
9. Implement information extraction tasks
10. Implement QA systems
11. Implement a chatbot system
12. Implement dialogue systems
13. Build a Speech recognition system
14. Build a Text to Speech synthesizer

Projects that map to the sustainable development goals 9, 11, 16 (9: Industry, innovation and infrastructure, 11: Sustainable cities and communities, 16: Peace, justice and string institutions)

TEXT BOOKS:

1. Daniel Jurafsky and James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Third Edition, 2022.

REFERENCES:

1. Tanveer Siddiqui, Tiwary U S, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.
2. Lawrence Rabiner, Biing-Hwang Juang, B. Yegnanarayana, "Fundamentals of Speech Recognition" 1st Edition, Pearson, 2009.
3. Shrikanth Narayanan, Abeer Alwan, "Text To Speech Synthesis – New Paradigms and Advances", Prentice Hall, 2005.
4. Steven Bird, Ewan Klein, and Edward Loper, "Natural language processing with Python", O'RREILLY.
5. Dipanjan Sarkar, "Text Analytics with Python: A Practical Real-World approach to Gaining Actionable insights from your data", APress.

OUTCOMES:

On successful completion of this course, the students should be able to

CO1: Explain existing and emerging deep learning architectures for text and speech processing
CO2: Apply deep learning techniques for NLP tasks, language modeling and machine translation
CO3: Explain coreference and coherence for text processing
CO4: Build question answering systems, chatbots and dialogue systems
CO5: Apply deep learning models for building speech recognition and text-to-speech systems

COs	**POs**					**PSO**
	1	**2**	**3**	**4**	**5**	**1**
1	1		1			1
2	3	3	2	2	3	3
3	1		1			1
4	3	3	3	2	3	3
5	3	3	3	2	3	3

COURSE CODE	COURSE TITLE	L	T	P	C
	PROJECT –PHASE I	**0**	**0**	**12**	**6**

OBJECTIVES:

The objective of this course is to enable the students to

- Identify and formulate complex engineering problem, survey literature, identify suitable technologies and computing resources required and identify research gaps
- Demonstrate technical presentation skills, both through written and oral communication

Projects that map sustainable development goals 3,4,6,7,8,9,11,13,14,15 (3: Good health and wellbeing, 4: Quality education, 6: Clean water and sanitation, 7: Affordable and clean energy, 8: Decent work and economic growth, 9: Industry, innovation, and infrastructure, 11: Sustainable cities and communities, 13: Climate action, 14: Life below water, 15: Life on land)

OUTCOMES:

On successful completion of this course, the students should be able to

CO1: Demonstrate an ability to define a precise problem statement with objectives and scope, and define a complex/ open-ended problem in engineering terms

CO2: demonstrate the skills for performing literature survey, identify gaps, analyze the technical content, and prepare a well-documented dissertation report

CO3: Communicate orally, showing knowledge on the subject and sensitivity towards social impact of the dissertation where applicable

COs	**POs**					**PSO**
	1	**2**	**3**	**4**	**5**	
1	2	1	1		2	2
2	2	3	1			1
3	2	3	2	3	3	2

SEMESTER IV

COURSE CODE	COURSE TITLE	L	T	P	C
	PROJECT –PHASE II	**0**	**0**	**24**	**12**

OBJECTIVES:

The objective of this course is to enable the students to

- Design an innovative product or an effective solution by applying current knowledge and adopt to emerging applications of engineering and technology
- Effective technical presentation and knowledge skills
- Write technical paper in scientific journal style & format

Projects that map sustainable development goals 3,4,6,7,8,9,11,13,14,15 (3: Good health and wellbeing, 4: Quality education, 6: Clean water and sanitation, 7: Affordable and clean energy, 8: Decent work and economic growth, 9: Industry, innovation, and infrastructure, 11: Sustainable cities and communities, 13: Climate action, 14: Life below water, 15: Life on land)

OUTCOMES:

On successful completion of this course, the students should be able to

CO1: Apply knowledge to design suitable software/hardware, conduct experiments and utilize modern tools for developing working models / process / systems for solving real world engineering problems

CO2: Demonstrate communication skills through effective oral presentation showing knowledge on the subject, and where applicable, sensitivity towards social impact of the dissertation

CO3: Write a dissertation paper in scientific journal style and publish in refereed journal, or patent.

COs	**POs**					**PSO**
	1	**2**	**3**	**4**	**5**	
1	3		3	3		3
2	3	2	3	3	3	3
3	2	3	1	1	2	1

COURSE CODE	COURSE TITLE	L	T	P	C
	RESEARCH METHODOLOGY & IPR	2	0	0	2

OBJECTIVES

- To equip students with a basic understanding of the underlying principles of quantitative and qualitative research methods.
- Provide students with in-depth training on the conduct and management of research from inception to completion using a wide range of techniques.

UNIT I RESEARCH FORMULATION AND DESIGN 6

Defining and formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, literature review - primary and secondary sources, reviews, monograph, patents, research databases, web as a source, searching the web, critical literature review, identifying gap areas from literature and research database, development of working hypothesis.

UNIT II DATA COLLECTION AND ANALYSIS 6

Method validation, observation and collection of data, methods of data collection, sampling methods, data processing and analysis strategies and tools, data analysis with statistical package (Sigma STAT, SPSS for student t-test, ANOVA, etc.), hypothesis testing.

UNIT III RESEARCH ETHICS, IPR AND SCHOLARY PUBLISHING 6

Ethics - ethical issues, ethical committees (human & animal); IPR- intellectual property rights and patent law, commercialization, copy right, royalty, trade related aspects of intellectual Property rights (TRIPS); scholarly publishing - IMRAD concept and design of research paper, citation and acknowledgement, plagiarism, reproducibility and accountability.

UNIT IV CONTEMPORARY ISSUES IN IPR 6

Interface between IPR and Human Rights -Interface between IPR and Competition Law -IPR and sustainable development – Impact of Internet on IPR - IPR of Biological systems & E-Commerce.

UNIT V INTERPRETATION AND REPORT WRITING 6

Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports. Case Studies that maps to sustainable development goals 4, 16 (4: Quality education, 16: Peace, justice and strong institutions)

TOTAL PERIODS: 30

REFERENCES

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., “An introduction to Research Methodology”, RBSA Publishers, 2015.
2. Kothari, C.R., “Research Methodology: Methods and Techniques”, New Age International, 2018.
3. Wadehra, B.L. “Law relating to patents, trademarks, copyright designs and geographical indications”. Universal Law Publishing, Reprint, 2011.
4. Anthony, M., Graziano, A.M. and Raulin, M.L.. Research Methods: A Process of Inquiry, Allyn and Bacon 2012.
5. Carlos, C.M., Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options. Zed Books, New York, 2000

OUTCOMES

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

CO1: Understand research problem formulation.

CO2: Analyze research related information.

CO3: Understand the research ethics.

CO4: Understanding that when IPR would take such important place in growth of individuals & Nation.

CO5: Recognize the importance of Report writing.

COs	**POs**					**PSO**
	1	**2**	**3**	**4**	**5**	**1**
1	2	1	2			1
2	2					1
3				2		
4				2	2	
5	1	2				

ELECTIVES

COURSE CODE	COURSE TITLE	L	T	P	C
	INFORMATION THEORETIC LEARNING	2	0	2	3

OBJECTIVES

- Learn random variables and Shannon's and Renyi's entropies
- Understand entropy minimization and correntropy maximization
- Learn entropy-based entropy and correntropy based classification and clustering
- Learn the maximum entropy method

UNIT I INTRODUCTION TO PROBABILITY THEORY 6

Review of Probability Theory: Probability Measure - Conditional Probability - Probability Distribution, Central Limit Theorem

UNIT II ENTROPY AND RELATIVE ENTROPY 6

Entropy - Relative Entropy - Mutual Information - Relationship Between Entropy and Mutual Information - Chain Rules for Entropy, Renyi's Entropy

UNIT III PROBABILITY AND INFERENCE 6

Maximum Likelihood and Clustering, Distance between two images based on probability - mean square error - Histogram intersection - Kullback-Leibler divergence

UNIT IV MINIMUM ERROR ENTROPY AND MAXIMUM CORRENTROPY 6

Adaptive filter: Linear - Nonlinear, Error Entropy Criterion for Adaptation, Minimum Error Entropy Algorithm, Correntropy: Maximum Correntropy, Information potential, Clustering with entropy and correntropy,

UNIT V MAXIMUM ENTROPY METHOD 6

Laplace's Method, Model Comparison and Occam's Razor, Maximum entropy, Maximum entropy classifier

TOTAL LECTURE PERIODS: 30

LAB COMPONENT **TOTAL LAB PERIODS: 30**

LIST OF EXPERIMENTS

1. Understanding central limit theorem using excel/any appropriate tool
2. Given the Discrete PDF (PMF) finding out entropy
3. Parzenwindowing based density estimation
4. KLD based image distance calculation
5. Image intersection algorithm-based classification
6. Curve fitting using error entropy
7. Take an ill posed problem and solve predict its PDF

TEXT BOOK

1.David J.C. MacKay, "Information Theory, Inference, and Learning Algorithms", Cambridge university press, 2003 (Chapter 1, 2, 3, 5)
2.Jose. C. Principe, "Information Theoretic Learning", Springer, 2010 (Chapter 4)

REFERENCES

1. Thomas Cover, Joy Thomas, "Elements of Information Theory" , Wiley Interscience, 2nd Edition, 2006.
2. Ran He, Baogang Hu, Xiaotong Yuan, Liang Wang, Robust Recognition via Information Theoretic Learning, Springer, 2014.
3. Daniel G. Silva, Denis G. Fantinato, Jˆanio C. Canuto, Leonardo T. Duarte, Aline O. Neves, Ricardo Suyama, JugurtaMontalv˜ao and Romis Attux, " An Introduction to Information Theoretic Learning, Part I: Foundation", Journal Of Communications And Information Systems, Vol. 31, No. 1, pp. 69-80, 2016.
4. Daniel G. Silva, Denis G. Fantinato, Jˆanio C. Canuto, Leonardo T. Duarte, Aline O. Neves, Ricardo Suyama, JugurtaMontalv˜ao and Romis Attux, " An Introduction to Information Theoretic Learning, Part II: Applications", Journal Of Communications And Information Systems, Vol. 31, No. 1, pp. 81-91, 2016. 5. Silverman B W, Density Estimation for Statistics and Data Analysis, Chapman & Hall/CRC, 1996

OUTCOMES

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

CO1: Explain and estimate information theory metrics, entropy, cross entropy and correntropy
CO2: Use entropy to design adaptive systems
CO3: Use entropy-based algorithms in image processing
CO4: Develop machine learning algorithms based on entropy and correntropy

COs	POs					PSO
	1	2	3	4	5	1
1	2	1	1		1	
2	2	1	2		1	1
3	2	1	2		1	1
4	2	1	1		1	1

COURSE CODE	COURSE TITLE	L	T	P	C
	BLOCKCHAIN TECHNOLOGY	2	0	2	3

OBJECTIVES

- To learn the fundamentals of Blockchain.
- To obtain knowledge about technologies of Blockchain.
- To understand the different models used in Blockchain.
- To learn solidity programming to understand Ethereum based blockchain.
- To learn to code Hyperledger Fabric to establish enterprise based blockchain.

UNIT I INTRODUCTION **6**

Basic Cryptographic primitives used in Blockchain –Secure- Collision Resistant hash functions - Digital signature – Public-key cryptosystems - Zero-knowledge proof systems - Need for Distributed Record-Keeping - Modelling faults and adversaries- Byzantine Generals problem - Consensus algorithms and their scalability problems.

UNIT II TECHNOLOGIES BORROWED IN BLOCKCHAIN 6

Technologies Borrowed in Blockchain –hash pointers- Consensus- Byzantine Models of fault tolerance- Digital cash etc.- Bitcoin blockchain - Wallet - Blocks - Merkley Tree - hardness of mining - Transaction verifiability - Anonymity - forks - Double spending.

UNIT III MODELS FOR BLOCKCHAIN 6

Models f-GARAY model -RLA Model -Proof of Work (PoW) as a random oracle - Formal treatment of consistency- Liveness and Fairness - Proof of Stake (PoS) based Chains -Hybrid models (PoW + PoS)

UNIT IV ETHEREUM 6

Ethereum -Ethereum Virtual Machine (EVM) -Wallets for Ethereum -Solidity - Smart Contracts - The Turing Completeness of Smart Contract Languages and verification challenges

UNIT V HYPERLEDGER FABRIC 6

Hyperledger fabric- the plug and play platform and mechanisms in permissioned blockchain - applications of blockchain in cyber security- integrity of information- E-Governance and other contract enforcement mechanisms - Limitations of blockchain as technology and myths vs reality of blockchain technology
Case studies that map sustainable development goals such as 9, 11 (9: Industry, innovation and infrastructure, 11: Sustainable cities and communities)

TOTAL LECTURE PERIODS: 30

LAB COMPONENT **TOTAL LAB PERIODS: 30**

LIST OF EXPERIMENTS

List of Experiments using Solidity
Environment setup
Basic syntax
First and sample application
Comments
Types, Variables and Variable scope
Operators
Loops and Decision making
Strings, Arrays and Enum
Structs, Mappings and Conversions
Ether units and special variables
Mini project

List of Experiments using Hyperledger Fabric
Introduction
Hyperledger Fabric Model
How Fabric networks are structured
Identity
Membership Service Provider (MSP)
Policies
Peers
Ledger
The Ordering Service
Smart Contracts and Chaincode

Fabric chaincode lifecycle
Private data
Channel capabilities
Security Model
Use Cases

TEXTBOOKS

1. S.Shukla, M.Dhawan, S.Sharma, S. Venkatesan "Blockchain Technology: Cryptocurrency and Applications, Oxford University Press 2019.
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, " Bitcoin and cryptocurrency technologies: a comprehensive introduction", Princeton University Press,2016.

REFERENCES

1. Joseph Bonneau et al, SoK: "Research perspectives and challenges for Bitcoin and cryptocurrency", IEEE Symposium on Security and Privacy, 2015
2. J.A.Garay et al, "The bitcoin backbone protocol - analysis and applications", EUROCRYPT 2015, Volume 2.
3. R.Pass et al, "Analysis of Blockchain protocol in Asynchronous networks", EUROCRYPT 2017.
4. Pass et al," Fruitchain- a fair blockchain", PODC 2017

OUTCOMES

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

CO1: Explain the fundamentals of Blockchain
CO2: Illustrate the technologies used to build Blockchain
CO3: Describe the models of Blockchain
CO4: Apply the solidity language to develop smart contracts
CO5: Demonstrate Hyperledger fabric for the enterprise applications

COs	**POs**					**PSO1**
	1	**2**	**3**	**4**	**5**	**1**
1	1		1	2		3
2	1		1	2		3
3	1		1	2		3
4	1	3	3	3	3	3
5	1	3	3	3	3	3

COURSE CODE	**COURSE TITLE**	**L**	**T**	**P**	**C**
	IoT PROGRAMMING	**2**	**0**	**2**	**3**

OBJECTIVES:

The objective of this course is to enable the students

- To use micro python for IoT
- To understand the concepts of Raspberry pi
- To develop IoT devices using Node MCU
- To develop IoT devices using ESP32 ss

UNIT I ADVANCED C AND INTRODUCTION TO MICRO-PYTHON 6

RTOS, Hard Real Time System, Soft Real Time System – Introduction to Hardware Programming - Introduction to Micro-Python – Micro Python Coding Fundamentals - Beyond desktop computing – Physical computing: Raspberry pi – Raspbian OS – Installation and Configuration – Remote Access – VNC, Remote Desktop Configuration

UNIT II WORKING WITH MICRO COMPUTER RASPBERRY PI 6

Architecture of raspberry Pi – Versions – Pin Diagrams – Networking with raspberry Pi- Micro Python over Raspberry Pi – GPIO pins – Digital Sensors

UNIT III MICROCONTROLLER PROGRAMMING 6

Introduction to Microcontroller – Architecture – Pin Diagram - Advantages and limitations of Micro Controller – Sketch – Programming in Arduino – Handling analog and digital sensors – PWM pins

UNIT IV ADVANCED MICRO CONTROLLER PROGRAMMING 6

Node MCU (ESP8266) – Architecture – Pin Diagram – Configuring ÈSP8266 – Flashing the controller - Programming in ESP8266 – ESP32 – Architecture – Pin diagram – Configuring ESP32 – Flashing – Programming with ESP32

UNIT V CLOUD INTERFACE 6

Google Cloud API: Drive API, Sheet API, OAuth – AWS: DynamoDB Interfacing – Mongoose DB Interfacing – FireBase Interfacing.

TOTAL PERIODS: 30

LAB COMPONENT **TOTAL PERIODS: 30**

LIST OF EXPERIMENTS:

1. Practicing structures, pointers, and far-pointers in C
2. Programming in Micro-Python
3. Circuit design for sensors
4. Programming in Sketch with Arduino Uno
5. Programming with Raspberry Pi (Digital Sensors)
6. Arduino - Raspberry Pi interface programming - master-slave architecture
7. Programming with Analog and digital sensors in ESP8266
8. Programming with ESP32
9. Program for cloud Interfacing and analytics

TEXTBOOKS:

1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547
2. Simon Monk, Programming the Raspberry Pi, Second Edition: Getting Started with Python, Second Edition, McGraw-Hill,
3. Coleman Cottrill, ESP8266 Programming Language: Nodemcu Programming, ESP8266 For Beginners, Independently Published, April 2021
4. Agus Kurniawan, Internet of Things Projects with ESP32, Packt Publishing, 2019
5. Reema Thareja, ―Programming in C, Oxford University Press, Second Edition, 2016.
6. Kernighan, B.W and Ritchie,D.M, ―The C Programming language‖, Second Edition, Pearson Education, 2006

REFERENCES:

1. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015 3. Editors OvidiuVermesan
2. Peter Friess,'Internet of Things – From Research and Innovation to Market Deployment', River Publishers, 2014
3. Juneja, B. L and Anita Seth, ―Programming in C‖, CENGAGE Learning India Pvt. Ltd., 2011
4. Peter Friess, 'Internet of Things – From Research and Innovation to Market Deployment, River Publishers, 2014

5. N. Ida, Sensors, Actuators and Their Interfaces, SciTech Publishers, 2014.
6. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759
7. Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016, ISBN 7989352133895

OUTCOMES:
On successful completion of this course, the students should be able to

CO1: Design and implement applications using arrays, strings and functions and exposure to micro python
CO2: Understanding and working with raspberry pi
CO3: Configure and programming with Node MCU
CO4: Configure and programming with ESP32
CO5: Interface the IoT devices with cloud technologies

COs	POs					PSO
	1	2	3	4	5	1
1	2		3	3	2	3
2	1		2	1	2	3
3	1	1	3	3	2	3
4	1	1	3	3	2	3
5	3	1	3	3	2	3

COURSE CODE	COURSE TITLE	L	T	P	C
	FULL STACK DEVELOPMENT	**2**	**0**	**2**	**3**

OBJECTIVES:

- Understand the python concepts for web development
- Building strong expertise to develop front end application using web essentials.
- Learn about different python web development frameworks
- Understand the APIs for web database connection
- Learn to containerize a full stack application

UNIT I - ADVANCED PYTHON FOR WEB DEVELOPMENT 9
Introduction to Object Oriented Programming: Classes, Methods, Inheritance, Abstract Classes. Working with APIs : Request library. Introduction to Developer Tools and SQL: Assert statements - Testing- Git - SQL -CRUD

Lab Component: Getting started with Python Libraries -Working with Pandas - Data Loading, Storage and file - format - Python Regular Expressions - Python Database Access

UNIT II - WEB ESSENTIALS 9
HTTP - HTML 5 - CSS 3 - Using JavaScript libraries and frameworks: JQuery - DOM- Creating asynchronous request / response using AJAX and JSON – Bootstrap

Lab Component: Develop a AJAX enabled web page using HTML, CSS, JQuerywith JSON type of request / response

UNIT III – PYHTON WEB FRAMEWORKS 9

Popular Frameworks: Django, Flask, Bottle, Pyramid, Morepath, TurboGears and several other libraries. Django: Features of Django - Django architecture - MVC and MTV - Starting a project - Django apps – View, Template, URL Mapping, Static file Handling, Model Form, Django Form, Form Validation - Integrating Bootstrap into Django - Django Middleware - Sessions and Cookies.

Lab Component: Build a basic web application using Django framework

UNIT IV– DATABASE TOOLKIT 9

Database Toolkit for Python: pyODBC, SQLAlchemy, Djongo –MongoEngine - PyMongo, Peewee, Psycopg, python-sql. Creating CURD application in Django using MongoDB.

Lab Component: Full-stack web application using Python, Django, SQL (use SQLite, MySQL, Oracle) and Bootstrap.

UNIT V REST AND CONTAINERIZATION 9

Introduction to REST and API - Restful WebServices- Django REST Framework (DRF) - Configuration and Installation - Serialization and Deserialization - API Views – Security– Microservices -Containerization - Docker basics - Understanding Dockerfile – Full stack application integration.

Lab Component: Django DRF codebase containing real world examples with CRUD that adheres to the real world API spec. Containerize the entire application with all features using docker.
Projects that map sustainable development goals such as 9, 11 (9: Industry, innovation and infrastructure, 11: Sustainable cities and communities)

TOTAL LECTURE PERIODS: 30

TOTAL LAB PERIODS: 30

TEXT BOOKS:

1. Ben Shaw , Saurabh Badhwar , Andrew Bird, Bharath Chandra K S, Chris Guest, " Web development with Django: Learn to build modern web applications with a Python-based framework", 2021.
2. Arun Ravindra, Django: Web Development with Python book, 2020.
3. Leonard Richardson, RESTful Web APIs: Services for a Changing World, 2013

REFERENCES:

1. William S. Vincent, Django for Beginners: Build websites with Python and Django, 2020
2. Fabrizio Romano, Learn Web Development with Python: Get hands-on with Python Programming and Django web development, 2020

OUTCOMES:

Upon Successful Completion of this course, the students should be able to:

CO1: Design web pages using HTML,CSS.
CO2: Developing web application in python framework
CO3: Develop full stack application with CRUD operations
CO4: Build REST based APIs
CO5: Containerize a full stack application

COs	POs					PSO
	1	2	3	4	5	1
1	1	1		1		2
2	1	1		1		2
3	1	1		1		2
4	1	1		1		2
5	1	1		1		2

COURSE CODE	COURSE TITLE	L	T	P	C
	CLOUD AND EDGE COMPUTING FOR MACHINE LEARNING APPLICATIONS	**3**	**0**	**0**	**3**

OBJECTIVES

- To learn the fundamentals of cloud and edge computing
- To understand the principles of deploying machine learning algorithms in cloud and edge computing
- To enable design and implementation of machine learning solutions using cloud and edge computing
- To gain experience on recent trends in integrating cloud and edge computing techniques for machine learning applications

Unit I - Cloud and Edge computing fundamentals **9**

Introduction to Cloud computing, Edge computing, Edge intelligence, Cloud Edge computing, Use cases

Unit II - Machine Learning and Deep Learning Models in the Cloud **9**

Defining Structure and Training Machine Learning Models in cloud, Serverless Machine Learning, using containers with Machine Learning Models, Benefits of Serverless Computing for Machine Learning

Unit III - Functions-as-a-Service and Event-Driven Programming in Cloud **9**

Software-as-a-Service, Machine Learning as a service (MLaaS), MLaaS functionality, Benefits of MLaaS, MLaaS service providers, Machine Learning Operations (MLOps), Key phases in MLOps implementation

Unit IV - Edge Machine Learning **9**

Machine learning and edge bringing AI to IoT, Challenges in machine learning and edge computing integration, Edge devices and ML frameworks, Hardware Inference Model in Edge Machine Learning – VPU, GPU, TPU

Unit V – Recent trends in Cloud and Edge computing for Machine learning 9

Cloud APIs for computer vision, Scalable inference serving on cloud, Embedded ML at Edge – Shallow RNN, ProtoNN, Resource-efficient Machine learning

Case studies that map sustainable development goals such as 9, 11 (9: Industry, innovation and infrastructure, 11: Sustainable cities and communities)

TOTAL PERIODS : 45

TEXT BOOK

1. John Biggs, Vicente Herrera García, Building Intelligent Cloud Applications, O'Reilly publisher, 2019
2. Daniel Situnayake, Jenny Plunkett, AI at the Edge, O'Reilly publisher, 2022

REFERENCES:

1. Anirudh Koul, Siddha Ganju and Meher Kasam, Practical Deep Learning for Cloud, Mobile, and Edge, O'Reilly Publication, 2020
2. Mark Treveil, Nicolas Omont, Clément Stenac, Kenji Lefevre, Du Phan, Joachim Zentici, Adrien Lavoillotte, Makoto Miyazaki, Lynn Heidmann, Introducing MLOps, O'Reilly, 2020
3. Kai Hwang, Cloud Computing for Machine Learning and Cognitive Applications, MIT press, 2017
4. Web resources: https://github.com/bisonai/awesome-edge-machine-learning/tree/master/Papers/ML_Algorithms_For_Edge

OUTCOMES

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

CO1: Demonstrate the application of cloud and edge computing in Machine learning applications

CO2: Analyse the various services and architecture of cloud and edge computing

CO3: Apply Machine Learning algorithms using cloud and edge computing

CO4: Relate current research papers on cloud and edge computing to understand the issues raised by current research

COs	POs					PSO
	1	2	3	4	5	1
1	2		1	1		
2	2		1	2	1	1
3	2		1	2	1	1
4	3	2	2	1	2	3

COURSE CODE	COURSE TITLE	L	T	P	C
	ETHICAL HACKING	**3**	**0**	**0**	**3**

OBJECTIVES

- To understand and analyse Information security threats and countermeasures
- To perform security auditing & testing
- To understand issues relating to ethical hacking
- To study & employ network defense measures

UNIT I ETHICAL HACKING OVERVIEW & VULNERABILITIES 9

Understanding the importance of security-Concept of ethical hacking and essential Terminologies Threat- Attack- Vulnerabilities- Target of Evaluation Exploit. Phases involved in hacking.

UNIT II FOOTPRINTING & PORT SCANNING 9

Foot printing - Introduction to foot printing- Understanding the information gathering methodology of the hackers-Tools used for the reconnaissance phase. Port Scanning - Introduction- using port scanning tools- Ping sweeps Scripting Enumeration-Introduction- Enumerating Windows OS & Linux OS.

UNIT III SYSTEM HACKING 9

An aspect of remote password guessing- Role of eavesdropping -Various methods of password cracking- Keystroke Loggers- Understanding Sniffers - Comprehending Active and Passive Sniffing- ARP Spoofing and Redirection DNS and IP Sniffing- HTTPS Sniffing.

UNIT IV HACKING WEB SERVICES & SESSION HIJACKING 9

Web application vulnerabilities- Application coding errors- SQL injection into Back-end Databases- Cross-site scripting- Cross-site request forging Authentication bypass- Web services and related flaws- Protective HTTP headers Understanding Session Hijacking- Phases involved in Session Hijacking-Types of Session Hijacking- Session Hijacking Tools

UNIT V HACKING WIRELESS NETWORKS 9

Introduction to 802.11-Role of WEP- Cracking WEP Keys- SniffingTrafficWirelessDOSattacks-WLANScanners-WLANSniffers-HackingTools-Securing Wireless Networks.
Case studies that map sustainable development goals such as 9, 11 (9: Industry, innovation and infrastructure, 11: Sustainable cities and communities)

TOTAL PERIODS: 45

REFERENCES

1. Kimberly Graves, "Certified Ethical Hacker", Wiley India Pvt Ltd, 2010.
2. Michael T. Simpson, "Hands-on Ethical Hacking & Network Defense", Course Technology, 2010
3. Patrick Engebretson, “The Basics of Hacking and Penetration Testing” Ethical Hacking and Penetration Testing Made Easy, Syngress Media, Second Revised Edition, 2013.
4. Rajat Khare, "Network Security and Ethical Hacking", Luniver Press, 2006.
5. Ramachandran V, “Wireless Penetration Testing Beginner’s Guide “ 3rd edition Packt Publishing, 2011.
6. Thomas Mathew, "Ethical Hacking", OSB publishers, 2003.

OUTCOMES

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

CO1: Explain and identify the vulnerabilities/threats/attacks.
CO2: Explain penetration & security testing.
CO3: Use safe penetration techniques on the World Wide Web.
CO4: Apply hardening techniques against a variety of security attacks using relevant tools.

COs	POs					PSO
	1	**2**	**3**	**4**	**5**	
1	3	1	3	3	2	3
2	2	2	1	1	1	2
3	3	1	2	3	2	1
4	1		2	2		2

COURSE CODE	COURSE TITLE	L	T	P	C
	FOG COMPUTING	**3**	**0**	**0**	**3**

OBJECTIVES

- To understand the basic concepts of Fog computing
- To understand the need for an Edge computing model
- To Acquire knowledge in Fog Data Management
- To Understand the infrastructure and middleware architectures for Fog computing
- To Acquire the knowledge of scheduling and privacy mechanism in Fog
- To Understand the Fog simulator and make use of different use cases related to Fog computing for application development

UNIT I FOG COMPUTING **9**

Introduction to Fog computing-cloud and Fog computing-Need for Fog computing-characteristics of Fog computing- History of Fog computing-Application of Fog computing – iFog simulator installation and configuration setup – Fog and IoT- Application scenarios-Pros and Cons of Fog computing-opportunities and challenges of Fog computing-Differences of Fog and Edge computing-Hierarchy of Fog and Edge computing-Needs of Fog with Edge-Needs of Fog with IoT-Business models-Examples and illustrations-Myths of Fog computing-Implementation of Fog nodes with the different configuration set up.

UNIT II EDGE COMPUTING **9**

Introduction to Edge computing resources-Networking challenges in Edge- A service-centric model-Management challenges in Edge-Discovering Edge resources-Deploying services and Applications-Implementation of application models using iFog – Migrating services across the Edge-load balancing-Edge as a service (EaaS) platform-Defined Edge nodes- Edge node resource management (ENORM) Framework-Simulation of application models using iFog master-worker application models-Unified architectures to account for heterogeneity-Public usability of Edge nodes-Interoperability with communication networks

UNIT III DATA MANAGEMENT IN FOG **9**

Introduction to Data management in Fog – Fog data management-Fog data life cycle-Data Acquisition-Processing and Analysis-Data Characteristics-Simulation of application models using iFog master sequential unidirectional application model-Command execution-Data pre-processing and Analytics-Data cleaning-Data Fusion-Edge mining-Data privacy

UNIT IV MIDDLE WARE FOR FOG AND EDGE **9**

Introduction to middleware for Fog and Edge Computing-Need for Fog and Edge computing middleware-Design Goals-State of the art middleware infrastructures-System Model-Embedded sensors or Actuators-Personal devices-Fog servers and Cloudlets-Proposed architecture-Security and authentication-Privacy and encryption-Device discovery- e-health case study-Proposed architecture-Fog and Device layer-Defining the level of data computation and storage-Future research and direction

UNIT V CASE STUDY AND SIMULATION **9**

Fog in healthcare-Architecture of healthcare with Fog-smart computing services in smart E-health gateways-Illustrations-Fog computing in Big data analytics-Big data analytics in Fog engine-Simulation of clustering in Fog nodes-Prototypes and evaluation-Smart surveillance video stream processing-Human object detection-Multiple object tracking-Tracking lost objects-Examples-Case study about Fog applications

TOTAL PERIODS: 45

REFERENCES

1. Satish NarayanaSrirama, RajkumarBuyya "Fog and Edge Computing" Wiley Publisher
2. ZaighamMahmood "Fog Computing: Concepts, Frameworks and Technologies", Springer Publications
3. Gounder,sa, Bhushan, S.Barath, Rayani, Praveen Kumar "Architecture and Security Issues in FOG Computing" IGI Global Publications.

OUTCOMES

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

CO1: Apply the Knowledge of the Fog computing model
CO2: Identify and design of Edge computing platform
CO3: Apply various data management techniques and analytics for Fog computing
CO4: Design of middleware for iFog computing using Fog servers and cloudlets
CO5: Apply the Knowledge of the iFog simulator in the design of the application
CO6: Apply the Knowledge of iFog for modelling and simulation of application development

COs	**POs**					**PSO**
	1	**2**	**3**	**4**	**5**	
1	3	1	3	3	2	3
2	2	2	1	1	1	2
3	3	1	2	3	2	1
4	1		2	2		2
5	1			1		1
6	3	1	3	3	2	3

COURSE CODE	COURSE TITLE	L	T	P	C
	MOBILE APPLICATION DEVELOPMENT	1	0	4	3

OBJECTIVES

- To learn how to use Flutter to rapidly develop a mobile app that runs on both iOS and Android devices.
- To understand the use of Flutter, including building a UI, using animations, and creating a database app.
- To explore state management and asynchronous programming in Dart &Flutter.
- To gain knowledge on how to use Flutter with Firebase.

UNIT I: GETTING STARTED WITH FLUTTER 3

Introducing Flutter – Widget Lifecycle Events – Widget Tree and Element Tree – Dart Basics

Lab Component: Installing the Flutter SDK – Configuring the Android Studio Editor – Creating a Hello World App – Creating a Starter Project Template.

UNIT II: FLUTTER USER INTERACTION, STYLES, AND ANIMATIONS 3

Flutter UI – User Interaction and gestures – Flutter forms – Flutter Animations

Lab Component: Adding Animation to an App - Creating an App's Navigation – Creating Scrolling Lists and Effects – Building Layouts – Applying Interactivity – Writing Platform-Native Code.

UNIT III: STATE MANAGEMENT 3

Routing in Flutter – Declarative routing and named routes – Routing animations – Flutter State Management.

Lab Component: Building a 2D game with Flutter state management

UNIT IV: ASYNCHRONOUS DART 3

Business Logic Components - Async Dart – Sinks and streams – Using streams in blocs – Async Flutter.

Lab Component: Build interactive live streams using Async Dart with Flutter.

UNIT V: BEYOND FOUNDATIONS 3

HTTP and Flutter – JSON Serialization – Working with Firebase in Flutter – Dependency Injection in the App - Kotlin Foundations – Simple APP Design.

Lab Component: Mini-project using Firebase Cloud Firestore and Flutter

Projects that map sustainable development goals such as 9, 11 (9: Industry, innovation and infrastructure, 11: Sustainable cities and communities)

TOTAL LECTURE PERIODS: 15

LAB COMPONENT **TOTAL PERIODS: 60**

TEXT BOOKS

1. Eric Windmill, "Flutter in Action", Manning Publications; 1st Edition, 2019.
2. Marco L. Napoli, "Beginning Flutter: A Hands On Guide to App Development", Wrox, 1st Edition, 2019.

REFERENCES:

1. Alberto Miola, Felix Angelov, Matej Rešetár, Rémi Rousselet, “Flutter Complete Reference: Create beautiful, fast and native apps for any device”, Kindle Edition, 2020.
2. Simone Alessandria, Brian Kayfitz, “Flutter Cookbook: Over 100 proven techniques and solutions for app development with Flutter 2.2 and Dart”, 1st Edition, Kindle Edition, 2021.
3. Barry Burd, “Flutter For Dummies”, 1st Edition, Kindle Edition, 2020.
4. Simone Alessandria, Flutter Projects: A practical project-based guide to building real-world cross-platform mobile applications and games, publisher: packt publishing, www.packt.com.
5. Carmine Zaccagnino, Programming Flutter: Native, Cross-Platform Apps the Easy Way (The Pragmatic Programmers), publisher: packt publishing, www.packt.com.
6. John Horton, Android Programming with Kotlin for Beginners: Build Android apps starting from zero programming experience with the new Kotlin programming language
Packt Publishing Limited, 2019.

WEB REFERENCES:

- https://aws.amazon.com/mobile/mobile-application-development/
- https://flutter.dev/(Applications)
- http://ai2.appinventor.mit.edu/ (Applications)
- https://developer.android.com/guide
- https://en.wikipedia.org/wiki/Android_10

OUTCOMES

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

CO1: Demonstrate how to use Flutter for creating cross-platform mobile apps, including how to setup the SDK and simulators; add widgets, components, and navigation.
CO2: Customize the app using sophisticated user interfaces, styles and animations.
CO3: Apply state management techniques and asynchronous programming in Dart & Flutter.
CO4: Build Firebase's real-time database in a Flutter App.

COs	**POs**					**PSO**
	1	**2**	**3**	**4**	**5**	**1**
1	2		1	3		
2	2		3	2		
3	2		3	2		
4	3	3	3	3	3	3

COURSE CODE	COURSE TITLE	L	T	P	C
	DATA VISUALIZATION AND ANALYTICS	2	0	2	3

OBJECTIVES

- To learn data visualization techniques.
- To understand the usage of tools for Data Visualization.
- To apply statistical methods and predictive models for data analysis.
- To learn about mining data streams.

UNIT I DATA VISUALIZATION **6**

Visualization: Classification of Visual data analysis techniques - Data Types -Visualization Techniques - Interaction techniques; Specific Visual Data Analysis Techniques -Tools for Visualization.

UNIT II VISUALIZATION TECHNIQUES **6**

Visualizing Data : Amounts, Distributions, Proportions, Time Series Data, Trends, geospatial Analysis, Dashboard and storyboard.

UNIT III STATISTICAL ANALYTICS **6**

Intelligent Data Analysis - Analysis vs reporting – Modern data analytic tools, Statistical concepts: Sampling distributions, statistical inference, prediction error, Inferential statistics – Hypothesis testing, Analysis of Variance (ANOVA).

UNIT IV PREDICTIVE MODELING **6**

Regression modeling, Multivariate analysis, Bayesian Regression, Bayesian networks, Support vector and kernel methods– Rule induction – Neural networks; Fuzzy logic: extracting fuzzy models from data, fuzzy decision trees

UNIT V DATA STREAM ANALYTICS **6**

Introduction to Streams Concepts – Stream data model and architecture – Stream Computing, Sampling data in a stream – Filtering streams – Counting distinct elements in a stream – Estimating moments – Counting oneness in a window – Decaying window – Real Time Analytics Platform (RTAP) applications, Case studies: real time sentiment analysis, stock market predictions, etc. that maps to the sustainable development goals such as 8, 9, 13 (8: Decent work and economic growth, 9: Industry, innovation and infrastructure, 13: Climate action)

TOTAL LECTURE PERIODS: 30

LAB COMPONENT **TOTAL LAB PERIODS: 30**

LIST OF EXPERIMENTS

1. Visualizing Data with Tableau / Power Bi.
2. Statistical Analysis
3. Prediction techniques
4. Stream Data analysis
5. Mini Project

TEXTBOOK

1. Class O Wilke, “Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures”, O’Reilly Media Inc., 2019.
2. Benjamin Smith, “Data Analytics for Beginners: Basic Guide to Master Data Analytics”, 2020

REFERENCES:

1. Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea Press, 2014.
2. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.
3. Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 2012.

OUTCOMES

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

CO 1: Apply tools for effective visualization of data
CO 2: Analyse data to make statistical inferences
CO 3: Implement algorithms for stream data analysis
CO 4: Build and validate models for data analysis

COs	POs					PSO
	1	2	3	4	5	1
1	3		2	1		2
2	3		2	1		3
3	2		1	2		2
4	3	3	2	2	3	3

COURSE CODE	COURSE TITLE	L	T	P	C
	DIGITAL FORENSICS	3	0	0	3

OBJECTIVES:

- To learn the security issues network layer and transport layer.
- To get exposed to security issues of the application layer.
- To learn computer forensics.
- To be familiar with forensics tools.
- To learn to model and interpret forensics data.

UNIT I NETWORK AND TRANSPORT LAYER SECURITY 9

Introduction, Network layer security: IPSec protocol – Authentication header – Key management protocol, Transport layer security: SSL and TLS, Introduction to E-mail security, Introduction to firewalls: Terminology – Types of firewalls.

UNIT II UNDERSTANDING DIGITAL FORENSICS AND INVESTIGATION 9

Overview of digital forensics, Preparation for digital investigation, Professional conduct, preparing digital forensics investigation, conducting an investigation, Procedures for private sector investigations.

UNIT III DATA ACQUISITION AND PROCESSING 9

Understanding storage formats, determining acquisition methods, Contingency planning, using acquisition tools and validating, Identifying and collecting digital evidence, preparing for a search, Storing digital evidence.

UNIT IV DIGITAL FORENSICS ANALYSIS AND VALIDATION 9

Determining the data to collect and analyze, validating forensics data, addressing data hiding techniques, performing live acquisition.

UNIT V E-MAIL AND SOCIAL MEDIA INVESTIGATIONS 9

Introduction, Role of client and server in E-Mail, Investigating E-mail crimes: Understanding forensics linguistics – Examining E-mail headers and messages – Tracing E-mail files, Social media forensics on mobile devices: Forensics tools for social media investigations– OSINT.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Man Young Rhee, Internet Security: Cryptographic Principles, Algorithms and Protocols, Wiley Publications, 2003.
2. Warren G. Kruse II and Jay G. Heiser, "Computer Forensics: Incident Response Essentials", Addison Wesley, 2002.

REFERENCES:

1. Nelson, Phillips, Enfinger, Steuart, Computer Forensics and Investigations", Cengage Learning, India Edition, 2008.
2. John R.Vacca, Computer Forensics, Cengage Learning, 2005.
3. Richard E.Smith, Internet Cryptography, 3rd Edition Pearson Education, 2008.
4. Marjie T.Britz, Computer Forensics and Cyber Crime: An Introduction, 3rd Edition, Prentice Hall, 2013.

OUTCOMES:

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

CO1: Explain the security issues network layer and transport layer.
CO2: Explain computer forensics.
CO3: Make use of forensics tools.
CO4: Analyze and validate forensics data.

COs	**POs**					**PSO**
	1	**2**	**3**	**4**	**5**	
1	1					
2	1			1		
3	2		1	2		2
4	3		2	1		2

COURSE CODE	COURSE TITLE	L	T	P	C
	IOT ARCHITECTURE & SOFTWARE-DEFINED NETWORKING	**3**	**0**	**0**	**3**

OBJECTIVES

- To understand the fundamentals of the Internet of Things
- To learn about the IoT architecture and protocols
- To learn about modern networking elements
- To understand the role of cloud computing and big data in SDN and IoT
- To understand the concepts of Software Defined Networks

UNIT I INTRODUCTION TO IoT **9**

Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates – Domain-Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology

UNIT II IoT ARCHITECTURE **9**

M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - Information model - Functional model - Communication model - IoT Reference architecture.

UNIT III IoT PROTOCOLS **9**

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACnet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP – MQQT-RPL-Security

UNIT IV MODERN NETWORKING **9**

Cloud Computing - Types of Networks and Internet Traffic - Demand: Big Data, Cloud Computing, and Mobile Traffic - SDN and NFV: Modern Networking Elements, Background and Motivation for SDN and NFV.

UNIT V SOFTWARE DEFINED NETWORKS **9**

Virtual Machines -The Virtual Machine Monitor-NFV Architectural -Container Virtualization. NFV Principles -High-Level NFV Framework NFV Benefits and Requirements. Network Virtualization -Virtual LANs. Open flow simulations of SDN infrastructure mode network

. **TOTAL PERIODS: 45**

TEXTBOOKS

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015
2. William Stallings,“Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud” Publisher: Addison-Wesley 2015 ISBN: 9780134175393

REFERENCES

1. Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things – Key applications and Protocols”, Wiley, 2012

2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet of Things”, Springer, 2011.
3. Honbo Zhou,” The Internet of Things in the Cloud: A Middleware Perspective”, CRC Press, 2012.
4. Jan Holler, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.

OUTCOMES

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

CO1: Understand the different designs used for building IoT
CO2: Demonstrate the standard architectures of IoT
CO3: Illustrate protocols used in Wireless sensor and IoT networks
CO4: Interpret the role of modern networking and cloud computing in SDN
CO5: Understand the architecture of Network Functions Virtualization components and their roles in SDN

COs	**POs**					**PSO**
	1	**2**	**3**	**4**	**5**	
1	3	1	3	3	2	3
2	2	2	1	1	1	2
3	3	1	2	3	2	1
4	1		2	2		2
5	1			1		1

COURSE CODE	**COURSE TITLE**	**L**	**T**	**P**	**C**
	CLOUD TECHNOLOGY	**1**	**0**	**4**	**3**

OBJECTIVES

- Deployment of cloud services for the application.
- The implementation of cloud virtualized environment
- Study the cloud native infrastructure with Azure.
- Orchestration of cloud services

UNIT I INTRODUCTION TO CLOUD NATIVE **15**

Introduction to cloud - virtualization - virtual machine - types of virtualization - Constrainers - Architecture - Comparing VM with Implementation tool.
Use case: Installation - configuration – Creating virtual machine – Start containerizing – VM images - Customizing container on your own.

UNIT II CLOUD INFRASTRUCTURE **15**

Building blocks of cloud environments – Cloud technology architecture –IaaS: Introduction to virtualization, Different approaches to virtualization, Hypervisors, Machine Image, Virtual Machine (VM) – Resource Virtualization - Infrastructure components - Infrastructural constraints. - Network environment - Ready-Made environment
Use case: Installing and creating the customized cloud infrastructure. Amazon EC2 Renting, EC2 Compute Unit, Platform and Storage, pricing, customers – Eucalyptus.

UNIT III CLOUD PLATFORM **15**

Resource management system mechanism - Rapid provisioning structure - Scalability requirements - Workload distribution structure - PaaS-based IT resources - Equipping PaaS.

Use case: Development and deployment platforms - Google App Engine, Microsoft Azure, SalesForce.com's Force.com platform

UNIT IV CLOUD ORCHESTRATION **15**

Kubernetes: Components - API Server Objects - Kubernetes Clusters - Kubernetes architecture

Use case: Creating a Kubernetes Cluster from Scratch - Kubernetes Service - Deploying Applications and Services.

UNIT V CLOUD MANAGEMENT **15**

Introduction to observability - monitoring metrics with Prometheus - logging - tracing - monitor - Service discovery - Service mesh - Serverless functions.

Use case: Cloud management and monitoring services.

Case studies that map sustainable development goals such as 9, 11 (9: Industry, innovation and infrastructure, 11: Sustainable cities and communities)

TOTAL LECTURE PERIODS: 15

LAB COMPONENT **TOTAL PERIODS: 60**

Practical components:

1. Azure management scripts
2. Source control.
3. Visual studio online
4. Web development best practices
5. Data storage options on Azure

TEXT BOOKS:

1. Boris Scholl, Trent Swanson & Peter Jausovec, "Cloud Native Using Containers, Functions, and Data to Build Next-Generation Applications", O'Reilly Media, Inc., First Edition, September 2019.
2. Nishant Singh & Michael Kehoe, "Cloud Native Infrastructure with Azure : Building and Managing Cloud Native Applications", O'Reilly Media, Inc., First Edition, February 2022.

REFERENCES:

1. Massimo Cafaro (Editor), Giovanni Aloisio (Editor), "Grids, Clouds and Virtualization" Springer; edition [ISBN: 978-0857290489] 2011.
2. Gautam Shroff, "Enterprise Cloud Computing Technology Architecture Applications", Cambridge University Press; 1 edition, [ISBN: 978-0521137355], 2010.
3. Greg Schulz, "Cloud and Virtual Data Storage Networking", Auerbach Publications [ISBN: 978-1439851739], 2011.
4. SilvanoGai, Claudio DeSanti,"I/O Consolidation in the Data Center" Cisco Press; 1 edition [ISBN: 9781587058882]. 2009.
5. Tim Mather, Subra Kumaraswamy, ShahedLatif, "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance" O'Reilly Media; 1 edition [ISBN: 0596802765], 2009

OUTCOMES

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

CO1: Deployment of cloud services for the application.

CO2: The implementation of cloud virtualized environment

CO3: Study the cloud native infrastructure with Azure.

CO4: Orchestration of cloud services

.

COs	**POs**					**PSO**
	1	**2**	**3**	**4**	**5**	
1	1		1	1	1	1
2	1		1		1	1
3	1		1	1	1	1
4	1		1	1	1	1

ELECTIVES (III SEMESTER)

COURSE CODE	COURSE TITLE	L	T	P	C
	REINFORCEMENT LEARNING	**3**	**0**	**0**	**3**

OBJECTIVES

- Introduce the different basic elements of Reinforcement Learning (RL).
- Study about Tabular methods and Q-networks.
- Study about policy optimization.
- Learn current advancements and applications in RL.

UNIT I Basics of Reinforcement Learning (RL) 9

Elements of RL, RL framework, Markov property, Partially Observable Markov Decision Process, Policies, value functions and Bellman equations.

UNIT II Tabular methods 9

Planning with dynamic Programming, Monte Carlo control, Temporal-Difference learning methods - TD(0), SARSA, Q-Learning.

UNIT III Q-networks 8

Deep Q-networks - DQN, DDQN, Dueling DQN, Prioritised Experience Replay.

UNIT IV Policy optimizations 9

Optimal policies and optimal value functions, Bellman optimality equations, Vanilla Policy Gradient, REINFORCE algorithm and stochastic policy search, Actor-critic methods - A2C and A3C, Advanced policy gradient - PPO, TRPO, DDPG.

UNIT V Recent Advancements and Applications 10

Meta-learning, Multi-Agent RL, Model-based RL approach, Code Standards and Python Libraries used in RL: SuperSuit, Stable Baselines3, Pistonball and MAgent

RL for real-world problems: Implementation of value iteration, discount grid, action selection and Q-Learning.

TOTAL PERIODS: 45

TEXTBOOK

1. Richard S. Sutton and Andrew G. Barto, “Reinforcement Learning: An Introduction”, MIT Press, 2nd edition, 2018.

REFERENCES:

1. Russell, Stuart J., and Peter Norvig. "Artificial intelligence: a modern approach."Pearson Education Limited, 2016.
2. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective".
3. Csaba Szepesvari, “Algorithms for Reinforcement learning”.
4. Wiering, Marco, and Martijn Van Otterlo. "Reinforcement learning." Adaptation, learning, and optimization 12 (2012): 3
5. Li, Yuxi. "Deep reinforcement learning." arXiv preprint arXiv:1810.06339 (2018).
6. Goodfellow, Ian, Yoshua Bengio, and Aaron Courville. "Deep learning." MIT press, 2016.

OUTCOMES

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

CO 1: Explain the elements of reinforcement learning.
CO 2: Apply tabular methods and Q-networks to solve classical problems.
CO 3: Interpret policy gradient methods from vanilla to more complex cases.
CO 4: Implement real-world problems applying code standards.

COs	POs					PSO
	1	2	3	4	5	
1	1		1			
2	2		1			
3	2		1			
4	1		1	1		1

COURSE CODE	COURSE TITLE	L	T	P	C
	DATA PRIVACY	3	0	0	3

OBJECTIVES

- To introduce the basics of information privacy
- To make the learner aware of the globally used privacy principles and guidelines
- To make the learner understand various privacy risk, threats, violation and adopt privacy by design for building IT solutions
- To understand and apply privacy enhancing technologies.

UNIT I Privacy in Digital Age 7

What is privacy ?: Nissenbaum's Contextual Integrity, AlanWestin's privacy states, Ryan Calo's Harm Dimensions, Sloove's taxonomy-Privacy, security and data governance – The data life cycle: harms in each stage, solution in each stage- Online issues causing privacy breach- Identity and Anonymity – Tracking and Surveillance

UNIT II Recent Technologies, Privacy Principles, Standards and Regulations 7

Technologies With Privacy Considerations: Cloud Computing, Wireless Technology and Devices, Location-Based Services (LBS), Surveillance of Individuals, Video/Audio Surveillance, Data Surveillance, Biometric Recognition, AI and VR, Standards-ISO/IEC 27701, PCIDSS- Regulations: PIPEDA, EU DPD, GDPR, Hongkong's Personal Data Ordinance- India's Privacy Data protection bill- Based on domain: HIPPA, CALOPPA-COPPA- e Privacy Directive

UNIT III Privacy Risk Quantification 11

Risk analysis: FAIR method, organizational risk, domain redux-Quantifying risk:Risk of Exposure, Opportunity Frequency, Probability of Action, Attempt Frequency, Vulnerability, Action Frequency, Population Magnitude, Risk, Adverse Consequence Risk, Case Study : Risk of Secondary Use of the population data

UNIT IV Adopting Privacy By Design 11

Foundational principles – Challenges of principles - The Privacy by Design Process:requirements engineering for privacy, understanding quality attributes, identify information needs, High level design, Low Level Design and Implementation, imposing controls, Testing and validation - Integrating Privacy by Design into the Business

UNIT V Privacy Enhancing Technologies **9**

Data Oriented Strategies: Separate, minimize, abstract, hide – Techniques: Aggregation,De-identification, Encryption, Identity and access management, Authentication -Process Oriented Strategies: Informing the Individual, User Control, Policy and Process, Demonstrate Compliance.

TOTAL PERIODS: 45

REFERENCES

1. An Introduction to Privacy for Technology Professionals ,ExecutiveEditorTravis D. BreauxYashavant P. Kanetkar, K, Let Us C, BPB Publications, 2011.
2. Strategic Privacy by Design R. Jason Cronk, CIPP/US, CIPM, CIPT, FIP
3. Privacy in Technology Standards and Practices for Engineers and Security and IT Professionals by JC Cannon
4. Alessandro Acquisti, Leslie John, and George Loewenstein, "What Is Privacy Worth?" Carnegie Mellon University- Heinz College, Heinz CMU, 2010, accessed July 5, 2018, www.heinz.cmu.edu/~acquisti/papers/acquisti-ISRworth.pdf

OUTCOMES

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

CO1: Explain the basics of privacy and possible breaches across the life cycle stages
CO2: Appreciate the role of Privacy Principles, Standards and Regulations
CO3: Explain the role of available Privacy Principles, Standards & Regulations
CO4: Perform risk analysis
CO5: Apply privacy by design
CO6: Apply privacy enhancing technologies

COs	**POs**					**PSO**
	1	**2**	**3**	**4**	**5**	
1	1		1	1		
2	2		1	2		1
3	2			2		1
4	3		2	2		2
5	2		1	1		2
6	2		1	1		2

COURSE CODE	**COURSE TITLE**	**L**	**T**	**P**	**C**
	ROBOTIC PROGRAMMING	**1**	**0**	**4**	**3**

COURSE OBJECTIVES

- To introduce the fundamental aspects of Robotics.
- To analyse trade-offs among position control, velocity control, and force control in simulation problem.
- To study the importance of Robotic Operating System
- To develop the programming skills related to kinematics, control, optimization.
- To have hands on interfacing the different sensors and actuators through ROS.

Unit I Fundamentals of Robotics **3**

Robot - Definition - Robot Anatomy - Coordinate Systems, Robot Parts and their Functions-Need for Robots-Drives-Effectors-Sensors-Forward and Inverse Kinematics- Different Applications.

Unit II Simulation of programmable robots **3**

Programming functions for perception vs reality of robots-Control functions for different desired behaviour-Differential drive functions for mobility in robot-API interface functions for sensors and actuators-Functions for regulating the velocity in robot

Unit III Robot Operating System **3**

Introduction to open-source meta operating system for robot-Working with ROS System-Programs for publishing and subscribing messages-Log messages. Graph resource names-Launch files-Parameters and Services. Installing ROS on an ARM based Board.

Unit IV ROS Advanced Concepts **3**

ROS file system-Understanding the Parameter server and Dynamic parameters-actionlib-Pluginlib-PCL Library-OpenGL Library-Selenium Library for Robot Framework--toolchains-nodelets-Gazebo Framework and Plugin-ROS transform frames-ROS visualization and Debugging Tools.

Unit V Interfacing sensors and actuators through ROS **3**

Arduino-ROS Interface-Interfacing 9DoF Razor IMU with Arduino-ROS-Interfacing a GPS system-Interfacing Servomotors-Interfacing with Laser Rangefinder-Kinect sensor to view objects in 3D-Collision Avoidance Algorithms for Navigation-Gazebo architecture and interface with ROS.

TOTAL LECTURE PERIODS: 15

LAB COMPONENT **TOTAL PERIODS: 60**

LIST OF EXPERIMENTS:

1. Study of different components used in robot.
2. Study of different functions used to perform different types of movement in robot.
3. Study of Robot Operating System.
4.Study of visualization in ROS.
5. Installing ROS in Arduino based board.
6. Program to access the different sensors and actuators through ROS.
7. Study of Navigation stack in ROS.
8. Implementation of localization using Navigation stack in ROS.
9. Program to perform visualization.
10. Program to control the robots in simulation.
11. Study of Mobile Autonomous robot.
12. Program to implement collision avoidance

Projects that map to sustainable development goals such as 9, 11, 14, 15 (9: Industry, innovation and infrastructure, 11: Sustainable cities and communities, 14: Life below water, 15: Life on land)

TEXTBOOKS:

1. Programming Robots with Robotic Operating System-A practical introduction to the Robot Operating System, Morgan Quigley, Brian Gerkey & William D. Smart, O'REILLY.

2. Robot Operating Systems for Absolute Beginers- Robotic Programming made easy, Lentin Joseph, Apress,
3. ROS Robot Operating System From the basic concepts to Practical Programming and Robot Applications, YoonSeokPyo, HanCheol Cho, RyuWoon Jung &TaeHoon Lim
4. Robot Operating System - The Complete Reference (Volume 4) ,Janusz Kacprzyk, Polish Academy of Sciences, Warsaw, Poland, Springer

REFERENCES:

1. Robot Operating System(ROS) The complete Reference(Volume 1) , Anis Kouba, Springer, Artificial Intelligence Studies.
2. Robot Operating System(ROS) The complete Reference(Volume 2) , Anis Kouba, Springer, Artificial Intelligence Studies.
3. Robot Operating System(ROS) The complete Reference(Volume 3) , Anis Kouba, Springer, Artificial Intelligence Studies

OUTCOMES:

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

CO1: Perform hands-on introduction to the many engineering principles involved for Robotics.
CO2: Design systems with various flexures, actuators and sensor systems for Robots
CO3: Implement various control function for mobility of Robot.
CO4: Analyze the manipulation and navigation problems using knowledge of coordinate frames, kinematics, optimization, control, and uncertainty.

COs	POs					PSO
	1	2	3	4	5	
1	3	1	2	1	3	3
2	3	1	2	1	3	3
3	3	1	2	1	3	3
4	3	1	2	1	3	3

COURSE CODE	COURSE TITLE	L	T	P	C
	SOFTWARE ARCHITECTURES AND DESIGN	3	0	0	3

OBJECTIVES

- To understand the role of architecture and the architect in the software development cycle.
- To learn the design, development, and assessment activities.
- To introduce architectural patterns and tactics, architecture assessment techniques, architecture driven design, and techniques for documenting architectures.
- To provide a basis for understanding cutting-edge techniques and concepts, using open-source projects as case studies.

UNIT I SOFTWARE ARCHITECTURE & DESIGN 9

The role of the software architect- Evolving role and responsibilities- Business implications of architecture solution: Licensing, deployment, and billing - Defining architecture -Different types of architecture – application architecture, enterprise architecture - Evolutionary Architecture - Architecture design, design process and the pattern decision relationship - Architecture principles - Internet Architecture and its impact- Quality Assurance - Quality Attribute Workshops (QAWs).

UNIT II SOFTWARE ARCHITECTURE PATTERNS 9

Purpose of architecture patterns - Using patterns practical considerations – Benefits & Limitation of patterns - Types of architecture patterns: Layered architecture, Event Driven Architecture, Microkernel, Microservices, Blackboard, Nano Services, Space-based architecture, Model View Controller- Pattern analysis: agility, deployment, testability, performance, scalability, ease of deployment - Considerations when choosing an architectural pattern.

UNIT III SOFTWARE DESIGN PATTERNS – I 9

Purpose - Iterators –Comprehensions –generators –Coroutines –case study. Decorator pattern – observer pattern –strategy pattern –state pattern –singleton pattern –template pattern

UNIT IV SOFTWARE DESIGN PATTERNS – II 9

Adaptor pattern –facade pattern –flyweight pattern –command pattern –abstract factory pattern – composite pattern - Patterns for Agile Development- Restful Service Pattern -Concurrency –threads –multi-processing – async i/o.

UNIT V ARCHITECTURE AS A SERVICE 9

Serverless architectures: Serverless benefits and drawbacks - Future of Serverless - Examples of serverless architecture systems - Reference architecture: mobile backend, real time processing, web applications, IoT backend, real time stream processing - Functions as a service (FaaS) and Platform as a Service (PaaS) – comparison and opportunities - FaaS: state, execution duration, startup latency, gateway- FaaS providers: IBM OpenWhisk, AWS Lambda, Google Cloud Functions, Microsoft Azure Functions, Iron.io and Web task- Frameworks: Serverless, Nano services – Case Studies.

TOTAL PERIODS: 45

TEXT BOOKS

1. R. N. Taylor, N. Medvidovic and E. M. Dashofy 2009, Software Architecture: Foundations, Theory, and Practice, Wiley [ISBN: 9780470167748]
2. Len Bass 2012, Software Architecture in Practice, 3rd Ed., Addison-Wesley Professional [ISBN: 9780321815736]
3. Dusty Phillips, “Python 3 Object-Oriented Programming: Build robust and maintainable software with object-oriented design patterns in Python 3.8”, Third Edition, Packt Publishing, 2018.
4. Mark Richards 2015, Software Architecture Patterns, O' Reilly [ISBN: 9781491924242]
5. Gregor Hohpe 2016, 37 Things One Architect Knows About IT Transformation: A Chief Architect's Journey, CreateSpace Independent Publishing Platform [ISBN: 9781537082981]

REFERENCES

1. Stephen F. Lott, “Mastering Object-oriented Python”, Second Edition, Packt Publishing, 2019.
2. Mark Lutz, “Programming Python: Powerful Object-Oriented Programming”, Fourth Edition, O’Reilly Media, 2011.

WEB REFERENCES

1. http://www.oodesign.com/
2. http://ui-patterns.com/patterns/

3. http://sourcemaking.com/design_petterns
4. http://www.dmoz.org/computers/programming/methodologies/patterns_and_anti- patterns/
5. Serverless: https://serverless.com/
6. Serverless Google Cloud Platform: https://cloud.google.com/functions/
7. Serverless Reference Architectures with AWS Lambda: http://www.allthingsdistributed.com/2016 /06/aws-lambda-serverless-reference-arch itectures.html
8. The Open Group Architecture Framework: http://www.opengroup.org/subjectareas/en terprise/togaf

OUTCOMES

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

CO 1: Discuss the evolving role of a software architect in the digital age.
CO 2: Appraise the different approaches to software design and patterns that can be applied to solve a problem in a variety of contexts.
CO 3: Examine how architecture patterns capture structural and behavioural information of a system.
CO 4: Design a software architecture solution from a presented case study.
CO 5: Evaluate how Architecture as a Service (AaaS), serverless architecture systems and other emerging trends are impacting the field of software design and architecture.

COs	**POs**					**PSO**
	1	**2**	**3**	**4**	**5**	
1	1					
2	1	1	1	1		
3	1	1	1	1		
4	3	3	3	3	3	3
5	3	3	2	3	3	3

COURSE CODE	**COURSE TITLE**	**L**	**T**	**P**	**C**
	HEALTH, SPORTS, AND FINANCIAL ANALYTICS	**3**	**0**	**0**	**3**

OBJECTIVES:

- To explore the various forms of electronic health care information.
- To learn the techniques adopted to analyze healthcare data.
- To understand the predictive models for clinical and sports data
- To understand the importance of sports & financial analytics.
- To use analytics, improvise financial situations.

UNIT I HEALTHCARE ANALYTICS I **9**

Introduction to Healthcare Data Analytics- Electronic Health Records– Components of EHR- Coding Systems- Benefits of EHR- Barrier to Adopting HER Challenges- Phenotyping Algorithms- Health Informatics on FHIR.

UNIT II HEALTHCARE ANALYTICS II **9**

Natural Language Processing and Data Mining for Clinical Text- Mining the Biomedical-Visual Analytics for Healthcare - Social Media Analytics for Healthcare - Case Study :COVID19 Pandemic Data.

UNIT III SPORTS ANALYTICS & APPLICATIONS **9**

Understanding sports data - Creating performance metrics for players and teams - Forecasting and prediction - Machine learning in sports- Sports data visualization-Sports Analytics algorithms for performance prediction.

Data Analytics Tools: Rating Sports Teams - The Ratings Percentage Index (RPI) - From Point Ratings to Probabilities - Ranking Great Sports Collapses – Case studies: Comparing Players from Different Eras

UNIT IV FINANCIAL DATA ANALYTICS & RISK MODELING **9**

Definition, relevance and scope financial Analytics, Components of Financial Analytics, Features of Financial Analytics recent trends in financial analytics, building models using accounting and financial data. Measuring and modeling risk, Modeling Credit Risk.

UNIT V BUSINESS VALUATION ANALYTICS **9**

Cash Flow statement – prepare and analyze, model and forecast financial statement & business valuation. Capital budgeting – application and issues

Case studies that map sustainable development goals such as 3, 6, 7, 8 (3: Good health and wellbeing, 6: Clean water and sanitation, 7: Affordable and clean energy, 8: Decent work and economic growth)

TOTAL PERIODS: 45

REFERENCES

1.Chandan K. Reddy and Charu C Aggarwal, “Healthcare data analytics”, Taylor & Francis, 2015.

2. FHIR - https://dl.acm.org/doi/book/10.5555/3281321

3. Massaad, Elie, and Patrick Cherfan. “Social Media Data Analytics on Telehealth During the COVID-19 Pandemic.” Cureus vol. 12,4 e7838. 26 Apr. 2020, doi:10.7759/cureus.7838

4. Wayne L. Winston, “Mathletics: How Gamblers, Managers, and Sports Enthusiasts Use Mathematics in Baseball, Basketball, and Football”, Pearson, 2012. (Part IV).

5.https://www.mentionlytics.com/blog/social-media-monitoring-analytics-healthcare-systems

6. K. Apostolou and C. Tjortjis, "Sports Analytics algorithms for performance prediction," 2019 10th International Conference on Information, Intelligence, Systems and Applications (IISA), 2019, pp. 1-4, doi: 10.1109/IISA.2019.8900754.

7. https://www.hindawi.com/journals/sp/2022/3547703/

8. Singh, Nitin. "Sport analytics: a review." learning 9 (2020): 11.

9. Dixon, Mathew F., Halperin, Igor, Bilokon, Paul, “Machine Learning in Finance”, O’Reilly, 2019

Course Outcomes:

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

CO1: Apply analytics for decision making in healthcare services.
CO2: Apply data mining to develop efficient clinical decision support systems.
CO3: Recognize, formulate, and analyze decision-making in sports
CO4: Explain various concepts and applications of analytics in Finance
CO5: Use business value analytics in improving financial outcomes.

COs	POs					PSO
	1	2	3	4	5	
1	2	2	2	1		2
2	2	2	2	1		2
3	2	2	2	1		2
4	2	2	2	1		2
5	2	2	2	1		2

COURSE CODE	COURSE TITLE	L	T	P	C
	SOCIAL NETWORKS AND OPEN-SOURCE INTELLIGENCE	2	0	2	3

OBJECTIVES

- To learn and understand the structure of social networks using graph theory
- To understand the fundamental network model related to links and communities
- To learn and understand the intelligence produced from publicly available information
- To understand the application of social network models in game theory and epidemic networks

UNIT I GRAPH THEORY AND SOCIAL NETWORKS 6

Introduction to graphs, Strong and Weak Ties, Networks in real-time context, Positive and negative relationships

UNIT II INFORMATION NETWORKS AND WORLD WIDE WEB 6

Structure of web: web as directed graph, Bow-Tie structure of the web, Link analysis and web search: Searching the web, link analysis using Hub and Authority model, Page rank

UNIT III NETWORK DYNAMICS: POPULATION MODELS 6

Information cascades: Herding experiment, Bayes' rule for Herding, General cascades, sequential decision making, Power laws and Rich-Get-Richer Phenomena, Long tail

UNIT IV NETWORK DYNAMICS: STRUCTURAL MODELS 6

Cascading behaviour in networks: Modeling Diffusion through a Network, Cascades and Clusters, Diffusion, Thresholds, and the Role of Weak Ties, The Small-World Phenomenon: Six degrees of separation, Decentralized Search and Modelling the process

UNIT V APPLICATIONS OF GAME THEORY FOR SOCIAL NETWORKS 6

Game theory: Introduction to game strategies, Evolutionary game theory, Modelling network traffic using game theory, Network dynamics in epidemics: SIR, SIS models

TOTAL LECTURE PERIODS: 30

LAB COMPONENT **TOTAL LAB PERIODS: 30**

LIST OF EXPERIMENTS:

1. OSINT preparation
2. Google dorks
3. Reverse searches
4. OSINT on a person
5. OSINT on social media
6. OSINT Documentation and reporting

Tools: OSINT framework, Maltego

TEXT BOOK

1. Networks, Crowds and Markets by David Easley and Jon Kleinberg, Cambridge University Press, 2010
2. Michael Bazzell, Open-Source Intelligence Techniques: Resources for Searching and Analyzing Online Information, 7th Edition, 2019, IntelTechniques.com

REFERENCES

1. Stanley Wasserman, Katherine Faust Social Network Analysis: Methods and Applications Volume 8 of Structural Analysis in the Social Sciences, ISSN 0954- 366X, Cambridge University Press, 1994
2. John Scott, Social Network Analysis, 3rd Edition, SAGE, 2012
3. Borko Furht, Handbook of Social Network Technologies and Applications, 1st Edition, Springer, 2010.
4. Peter Mika, Social Networks and the Semantic Web, First Edition, Springer 2007.
5. GuandongXu ,Yanchun Zhang and Lin Li, Web Mining and Social Networking – Techniques and applications, First Edition Springer, 2011.

OUTCOMES

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

CO1: Explain and analyze the structure and evolution of social networks
CO2: Explain the framework of network analysis
CO3: Analyze the network dynamics using population and structural models
CO4: Apply models for real-time applications like network traffic and epidemic network
CO5: Demonstrate various OSINT techniques using appropriate tools

COs	POs					PSO
	1	2	3	4	5	
1	1		1			1
2			1			1
3	1		1			1
4	1		1			1
5	1	3		2	3	1

COURSE CODE	COURSE TITLE	L	T	P	C
	IoT PROJECTS	**1**	**0**	**4**	**3**

COURSE OBJECTIVES:

- To understand how to Independently Design, Code and Build IOT products.
- To learn to work with Microprocessors and Micro controllers (Arduino Uno, Raspberry PI, NodeMCU), Sensors, Relays, Displays, and more
- To develop code using Arduino IDE
- To establish communication using Ethernet and Wifi shields
- To build connectivity to cloud IOT Platforms, Persist Data, Program Triggers

UNIT 1 - Working with Electronics **3**

Electronic boards and its working – Arduino, Raspberry, ESP32, Node MCU, Sensors – Temperature, photo resistor, motion detector, sound sensors, Working with relays – Switches, buzzer, LED display.

UNIT 2 - Working with Arduino IDE, Raspberry, and Python **3**

Communication – Ethernet, Bluetooth, WiFi, NFC and Zigbee, Arduino IDE – Variables, keywords, Control structures, Functions Raspberry and Python – Python libraries for board interfacing.

UNIT 3 - Industry approach to Edge computing and Data analytics in IoT **3**

Blending data analytics and IoT, Python for Data analytics, Machine learning, Data visualization, Industrial challenges with respect to IoT.

UNIT 4 - Working with Cloud DB, Platforms and services **3**

Cloud platform for IoT, Carriots/Spark/Thinkspeak/AWS and services. IoT communication models – Request/Response, Publish/Subscribe, Push/Pull, Exclusive Pair

UNIT 5 - IoT Computing model implementation **3**

Construction of IoT application based on computing models: Cloud computing, Fog Computing, Edge computing, MIST computing with mobile interfacing through Android application.

TOTAL LECTURE PERIODS: 15

LAB COMPONENT **TOTAL LAB PERIODS: 60**

LIST OF EXPERIMENTS:

Each student will be given an IoT project as a context of the following:

Smart Cities- Smart Waste Management, Smart Street Lights, Smart Street Parking, Security without Surveillance, Connected Vehicles. Healthcare- Baby Monitoring, Elderly Monitoring, Mood Enhancing, Disease Treatment and Progression Monitoring, Enhance Adherence, Challenges. Agriculture- Precision Agriculture, Connected Livestock, Food Safety. Manufacturing and Logistics- Smart Manufacturing- Smart Packaging, Smart Label. Smart Electricity Grid- Managing Supply and Demand. Home Automation

Projects that map to sustainable development goals 2, 3, 6, 7, 9, 11, 13 (2: Zero hunger, 3: Good health and well being, 6: Clean water and sanitation, 7: Affordable and clean energy, 9: Industry, innovation and infrastructure, 11: Sustainable cities and communities, 13: Climate action)

1. Processes: PSP, Scrum, DevOps: 15%
2. Management: Estimation, WBS, Planning, Tracking: 10%
3. Risk Management: 15%
4. Coding Standards and Configuration Management: 15%
5. Automation of routine tasks: 15%
6. Meetings: “Customer” meetings, review meetings, brainstorming: 10%
7. Presentations: 10%
8. Documentations: 10%

COURSE OUTCOMES:

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

CO1: Develop an individual IoT project associated with Industry 4.0

CO2: Understand the connectivity to cloud IOT Platforms, Persist Data, Program Triggers through IoT devices.
CO3: Develop mobile application to interface with IoT devices.
CO4: Communicate efficiently in presentations and prepare project report.

COs	POs					PSO
	1	**2**	**3**	**4**	**5**	
1	3	1	3	3		3
2	3	1	3	3		3
3	3	1	3	3		3
4		3		1	3	2

COURSE CODE	COURSE TITLE	L	T	P	C
	AGILE SOFTWARE DEVELOPMENT	**2**	**0**	**2**	**3**

OBJECTIVES:

- To provide students with understanding of agile software development to create high quality software
- To provide a good understanding of Agile scrum framework.
- To do a detailed examination of Agile testing techniques.
- To provide a good understanding Agile design practices
- To understand the benefits of Agile and its current trend in the industry.

UNIT I: FUNDAMENTALS OF AGILE 12

The Genesis of Agile, Introduction and background, Agile Manifesto and Principles, Overview of Agile methodologies: Scrum,Kanban, Extreme Programming, Pair Programming, Feature Driven development, Lean Software Development, Agile project management, Design and development practices in Agile projects, Test Driven Development, Pair Programming.

Use Case: Any business Scenario.

UNIT II: AGILE SCRUM FRAMEWORK 12

Introduction to Scrum, Project phases, Agile Estimation, Product backlog, Sprint backlog, Iteration planning, User story definition, Characteristics and content of user stories, Acceptance tests and Verifying stories, Project velocity, Burn down chart, Sprint planning and retrospective, Daily scrum, Scrum roles – Product Owner, Scrum Master, Scrum Team.

Use Case: Identify Product backlog, user stories, Sprint tasks. Usage of Agile tool such as AgileFant or Jira.

UNIT III: AGILE TESTING 12

The Agile lifecycle and its impact on testing, Test-Driven Development (TDD), xUnit framework and tools for TDD, Testing user stories - acceptance tests and scenarios, Planning and managing testing cycle, Exploratory testing, Risk based testing, Regression tests, Test Automation, Tools to support the Agile tester.

Use Case: Design Test Cases aligned to xUnit framework for TDD.

UNIT IV: AGILE SOFTWARE DESIGN AND DEVELOPMENT 12

Agile design practices, Role of design Principles including Single Responsibility Principle, Open Closed Principle, Liskov Substitution Principle, Dependency Inversion Principle in Agile Design, Need and significance of Refactoring, Refactoring Techniques, Continuous Integration, Automated build tools, Version control.

Use Case: Refactor a given design for next sprint requirements.

UNIT V: INDUSTRY TRENDS 12

Market scenario and adoption of Agile, Continuous Integration, Roles in an Agile project, Agile in Distributed teams, Business benefits, Challenges in Agile, Risks and Mitigation, Agile projects on Cloud, Balancing Agility with Discipline.

Use Case: Execute Continuous integration using a tool such as Jenkins.

TOTAL PERIODS: 60

TEXT BOOKS:

1. Agile Software Development, Principles, Patterns and Practices, Robert C. Martin, Publisher: Prentice Hall
2. Agile Testing: A Practical Guide for Testers and Agile Teams, Lisa Crispin, Janet Gregory, Publisher: Addison Wesley

REFERENCES:

1. Agile Software Development with Scrum, Ken Schawber, Mike Beedle, Publisher: Pearson.
2. Agile Software Development: The Cooperative Game, By Alistair Cockburn Publisher: Addison Wesley
3. Craig Larman, ―Agile and Iterative Development: A Manager's Guide, Addison-Wesley, 2004.

Other Online Courses

1. www.it-ebooks.info/tag/agile
2. http://martinfowler.com/agile.html

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

CO1: Point out the impact of social aspects on software development success.
CO2: Realize the importance of iterative software development processes: how to plan them, how to execute them.
CO3: Realize the impact of Agile design and its testing
CO4: Show how agile approaches can be scaled up to the enterprise level.

COs	POs					PSO
	1	2	3	4	5	
1	1		1	1	1	1
2	1	1	1	1	1	1
3	1	2	1	1	1	1
4	1	1	1	2	1	1

OPEN ELECTIVES

COURSE CODE	COURSE TITLE	L	T	P	C
OE5091	BUSINESS DATA ANALYTICS	3	0	0	3

OBJECTIVES

- To understand the basics of business analytics and its life cycle.
- To gain knowledge about fundamental business analytics.
- To learn modeling for uncertainty and statistical inference.
- To understand analytics using Hadoop and Map Reduce frameworks.
- To acquire insight on other analytical frameworks.

UNIT I OVERVIEW OF BUSINESS ANALYTICS 9

Introduction – Drivers for Business Analytics – Applications of Business Analytics: Marketing and Sales, Human Resource, Healthcare, Product Design, Service Design, Customer Service and Support – Skills Required for a Business Analyst – Framework for Business Analytics Life Cycle for Business Analytics Process – Converting real time decision making problems into hypothesis.

UNIT II ESSENTIALS OF BUSINESS ANALYTICS 9

Descriptive Statistics – Using Data – Types of Data – Data Distribution Metrics: Frequency, Mean, Median, Mode, Range, Variance, Standard Deviation, Percentile, Quartile, z-Score, Covariance, Correlation – Data Visualization: Tables, Charts, Line Charts, Bar and Column Chart, Bubble Chart, Heat Map – Data Dashboards – Solve numerical problems on basic statistics.

UNIT III MODELING UNCERTAINTY AND STATISTICAL INFERENCE 9

Modeling Uncertainty: Events and Probabilities – Conditional Probability – Random Variables – Discrete Probability Distributions – Continuous Probability Distribution – Statistical Inference: Data Sampling – Selecting a Sample – Point Estimation – Sampling Distributions – Interval Estimation – Hypothesis Testing – Real time applications.

UNIT IV ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK 9

Introducing Hadoop – RDBMS versus Hadoop – Hadoop Overview – HDFS (Hadoop Distributed File System) – Processing Data with Hadoop – Introduction to MapReduce – Features of MapReduce – Algorithms Using Map-Reduce: Matrix-Vector Multiplication, Relational Algebra Operations, Grouping and Aggregation – Extensions to MapReduce.

UNIT V OTHER DATA ANALYTICAL FRAMEWORKS 9

Overview of Application development Languages for Hadoop – PigLatin – Hive – Hive Query Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – Hbase and MongoDB.

TOTAL PERIODS: 45

OUTCOMES

On successful completion of this course, the student will be able to

CO1: Identify the real world business problems and model with analytical solutions.

CO2: Solve analytical problem with relevant mathematics background knowledge.
CO3: Convert any real world decision making problem to hypothesis and apply suitable statistical testing.
CO4: Solve simple applications involving analytics using Hadoop and MapReduce.
CO: Summarize open source frameworks for modeling and storing data.

REFERENCE BOOKS

1. Vignesh Prajapati, "Big Data Analytics with R and Hadoop", Packt Publishing, 2013.
2. Umesh R Hodeghatta, Umesha Nayak, "Business Analytics Using R – A Practical Approach", Apress, 2017.
3. Anand Rajaraman, Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012.
4. Jeffrey D. Camm, James J. Cochran, Michael J. Fry, Jeffrey W. Ohlmann, David R. Anderson, "Essentials of Business Analytics", Cengage Learning, second Edition, 2016.
5. U. Dinesh Kumar, "Business Analytics: The Science of Data-Driven Decision Making", Wiley, 2017.
6. A. Ohri, "R for Business Analytics", Springer, 2012
7. Rui Miguel Forte, "Mastering Predictive Analytics with R", Packt Publication, 2015.

COURSE CODE	COURSE TITLE	L	T	P	C
OE5092	INDUSTRIAL SAFETY	3	0	0	3

OBJECTIVES

- Summarize basics of industrial safety
- Describe fundamentals of maintenance engineering
- Explain wear and corrosion
- Illustrate fault tracing
- Identify preventive and periodic maintenance

UNIT I INTRODUCTION 9

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II FUNDAMENTALS OF MAINTENANCE ENGINEERING 9

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.
.

UNIT III WEAR AND CORROSION AND THEIR PREVENTION 9

Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease

gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

.

UNIT IV FAULT TRACING 9

Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault-finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, i. Any one machine tool, Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler,vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT V PERIODIC AND PREVENTIVE MAINTENANCE 9

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TOTAL PERIODS: 45

OUTCOMES

On successful completion of this course, the student will be able to

CO1: Ability to summarize basics of industrial safety

CO2: Ability to describe fundamentals of maintenance engineering

CO3: Ability to explain wear and corrosion

CO4: Ability to illustrate fault tracing

CO5: Ability to identify preventive and periodic maintenance

REFERENCE BOOKS

1. Audels, Pump-hydraulic Compressors, Mcgrew Hill Publication, 1978.
2. Garg H P,Maintenance Engineering, S. Chand and Company,1987.
3. Hans F. Winterkorn, Foundation Engineering Handbook, Chapman & Hall London, 2013.
4. Higgins & Morrow, Maintenance Engineering Handbook, Eighth Edition,2008

COURSE CODE	COURSE TITLE	L	T	P	C
OE5093	OPERATIONS RESEARCH	3	0	0	3

OBJECTIVES

- Solve linear programming problem and solve using graphical method.
- Solve LPP using simplex method
- Solve transportation, assignment problems
- Solve project management problems
- Solve scheduling problems

UNIT I LINEAR PROGRAMMING 9

Introduction to Operations Research – assumptions of linear programming problems - Formulations of linear programming problem – Graphical method

UNIT II ADVANCES IN LINEAR PROGRAMMING 9

Solutions to LPP using simplex algorithm- Revised simplex method - primal dual relationships – Dual simplex algorithm - Sensitivity analysis.

UNIT III NETWORK ANALYSIS – I 9

Transportation problems -Northwest corner rule, least cost method, Voges's approximation method - Assignment problem -Hungarian algorithm

UNIT IV NETWORK ANALYSIS – II 9

Shortest path problem: Dijkstra's algorithms, Floyds algorithm, systematic method -CPM/PERT

UNIT V NETWORK ANALYSIS – III 9

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models

TOTAL PERIODS: 45

OUTCOMES

On successful completion of this course, the student will be able to

CO1: To formulate linear programming problem and solve using graphical method.

CO2: To solve LPP using simplex method

CO3: To formulate and solve transportation, assignment problems

CO4: To solve project management problems

CO5: To solve scheduling problems

REFERENCES

1. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010
2. Hitler Libermann, Operations Research: McGraw Hill Pub. 2009
3. Pant J C, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Pannerselvam, Operations Research: Prentice Hall of India 2010
5. Taha H A, Operations Research, An Introduction, PHI, 2008

COURSE CODE	COURSE TITLE	L	T	P	C
OE5094	COST MANAGEMENT OF ENGINEERING PROJECTS	3	0	0	3

OBJECTIVES

- Summarize the costing concepts and their role in decision making
- Infer the project management concepts and their various aspects in selection
- Interpret costing concepts with project execution
- Develop knowledge of costing techniques in service sector and various budgetary control techniques
- Illustrate with quantitative techniques in cost management

UNIT I INTRODUCTION TO COSTING CONCEPTS 9

Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost, and Opportunity cost; Creation of a Database for operational control.

UNIT II INTRODUCTION TO PROJECT MANAGEMENT 9

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contracts.

.

UNIT III PROJECT EXECUTION AND COSTING CONCEPTS 9

Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing.

.

UNIT IV COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL 9

Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT V QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT 9

Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

TOTAL PERIODS: 45

OUTCOMES

On successful completion of this course, the student will be able to

CO1: Understand the costing concepts and their role in decision making

CO2: Understand the project management concepts and their various aspects in selection

CO3: Interpret costing concepts with project execution

CO4: Gain knowledge of costing techniques in service sector and various budgetary control techniques

CO5: Become familiar with quantitative techniques in cost management

REFERENCE BOOKS

1. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher, 1991
2. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988
3. Charles T. Horngren et al Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi, 2011
4. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting, 2003

COURSE CODE	COURSE TITLE	L	T	P	C
OE5095	COMPOSITE MATERIALS	3	0	0	3

OBJECTIVES

- Summarize the characteristics of composite materials and effect of reinforcement in composite materials.
- Identify the various reinforcements used in composite materials.
- Compare the manufacturing process of metal matrix composites.
- Understand the manufacturing processes of polymer matrix composites.
- Analyze the strength of composite materials.

UNIT I INTRODUCTION 9

Definition – Classification and characteristics of Composite materials - Advantages and application of composites - Functional requirements of reinforcement and matrix - Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT II REINFORCEMENTS 9

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers - Properties and applications of whiskers, particle reinforcements - Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures - Isostrain and Isostress conditions.

UNIT III MANUFACTURING OF METAL MATRIX COMPOSITES 9

Casting – Solid State diffusion technique - Cladding – Hot isostatic pressing - Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving - Properties and applications.

UNIT IV MANUFACTURING OF POLYMER MATRIX COMPOSITES 9

Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding - Properties and applications.

UNIT V STRENGTH 9

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TOTAL PERIODS: 45

OUTCOMES

On successful completion of this course, the student will be able to

CO1: Know the characteristics of composite materials and effect of reinforcement in composite materials.

CO2: Know the various reinforcements used in composite materials.

CO3: Understand the manufacturing processes of metal matrix composites.

CO4: Understand the manufacturing processes of polymer matrix composites.

CO5: Analyze the strength of composite materials.

REFERENCE BOOKS

1. Cahn R.W. - Material Science and Technology – Vol 13 – Composites, VCH, West Germany.
2. Callister, W.D Jr., Adapted by Balasubramaniam R, Materials Science and Engineering, An introduction, John Wiley & Sons, NY, Indian edition, 2007.
3. Chawla K.K., Composite Materials, 2013.
4. Lubin.G, Hand Book of Composite Materials, 2013.

COURSE CODE	COURSE TITLE	L	T	P	C
OE5096	WASTE TO ENERGY	3	0	0	3

OBJECTIVES

- Interpret the various types of wastes from which energy can be generated
- Develop knowledge on biomass pyrolysis process and its applications
- Develop knowledge on various types of biomass gasifiers and their operations
- Invent knowledge on biomass combustors and its applications on generating energy
- Summarize the principles of bio-energy systems and their features

UNIT I INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE 9

Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT II BIOMASS PYROLYSIS 9

Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

.

UNIT III BIOMASS GASIFICATION 9

Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

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UNIT IV BIOMASS COMBUSTION 9

Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT V BIO ENERGY 9

Properties of biogas (Calorific value and composition), Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production -Urban waste to energy conversion - Biomass energy programme in India.

TOTAL PERIODS: 45

OUTCOMES

On successful completion of this course, the student will be able to

CO1: Understand the various types of wastes from which energy can be generated

CO2: Knowledge on biomass pyrolysis process and its applications

CO3: Develop knowledge on various types of biomass gasifiers and their operations

CO4: Gain knowledge on biomass combustors and its applications on generating energy

CO5: Understand the principles of bio-energy systems and their features

REFERENCE BOOKS

1. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 19

AUDIT COURSES

COURSE CODE	COURSE TITLE	L	T	P	C
AC1	ENGLISH FOR RESEARCH PAPER WRITING	2	0	0	0

OBJECTIVES

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING 6

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II PRESENTATION SKILLS 6

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

.

UNIT III TITLE WRITING SKILLS 6

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT IV RESULT WRITING SKILLS 6

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V VERIFICATION SKILLS 6

Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first- time submission

TOTAL PERIODS: 30

OUTCOMES

On successful completion of this course, the student will be able to

CO1: Understand that how to improve your writing skills and level of readability
CO2: Learn about what to write in each section
CO3: Understand the skills needed when writing a Title
CO4: Understand the skills needed when writing the Conclusion
CO5: Ensure the good quality of paper at very first-time submission

REFERENCE BOOKS

1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006
3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006
4. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.

COURSE CODE	COURSE TITLE	L	T	P	C
AC2	**நற்றமிழ்இலக்கியம்**	2	0	0	0

UNIT I சங்கஇலக்கியம் 6

1. தமிழின் துவக்கநூல் தொல்கொப்பியம்
   – எழுத்து, சொல், பொருள்
2. அகநானூறு (82)
   - இயற்கை இன்னிசை அரங்கம்
3. குறிஞ்சிப்பாட்டின் மலர்க்காட்சி
4. புறநானூறு (95,195)

- போரை நிறுத்திய ஔவையார்

UNIT II **அறநெறித் தமிழ்** **6**

1. அறநெறி வகுத்த திருவள்ளுவர்
   - அறம் வலியுறுத்தல், அன்புடைமை, ஒப்புறவு அறிதல், ஈகை, புகழ்
2. பிற அறநூல்கள் – இலக்கிய மருந்து
   - ஏலாதி, சிறுபஞ்சமூலம், திரிகடுகம், ஆசாரக்கோவை (தூய்மையை வலியுறுத்தும் நூல்)

UNIT III **இரட்டைக்காப்பியங்கள்** **6**

1. கண்ணகியின் புரட்சி
   - சிலப்பதிகார வழக்குரை காதை
2. சமூகசேவை இலக்கியம் மணிமேகலை
   - சிறைக்கொட்டம் அறக்கோட்டமொகிய காதை

UNIT IV **அருள்நெறித்தமிழ்** **6**

1. சிறுபாணாற்றுப்படை
   - பாரி முல்லைக்குத் தேர் கொடுத்தது, பேகன் மயிலுக்கு ப் போர்வை கொடுத்தது, அதியமான் ஔவைக்கு நெல் லிக்கனி கொடுத்தது, அரசர் பண்புகள்.
2. நற்றிணை
   - அன்னைக்கிரிய புன்னை சிறப்பு
3. திருமந்திரம் (617, 618)
   - இயமம் நியமம் விதிகள்
4. தர்மச்சாலையை நிறுவிய வள்ளலார்
5. புறநானூறு
   - சிறுவனே வள்ளலானாள்
6. அகநானாறு (4) - வண்டு
   நற்றிணை (11) - நண்டு
   கலித்தொகை (11) - யானை, புறா
   ஐந்தினை 50 (27) – மான்
   ஆகியவை பற்றிய செய்திகள்

UNIT V **நவீனதமிழ்இலக்கியம்** **6**

1. உரைநடைத்தமிழ்,
   - தமிழின்முதல்புதினம்,
   - தமிழின்முதல்சிறுகதை,
   - கட்டுரைஇலக்கியம்,
   - பயணஇலக்கியம்,
   - நாடகம்,
2. நாட்டு விடுதலை போராட்டமும்தமிழ்இலக்கியமும்,
3. சமுதாய விடுதலையும்தமிழ்இலக்கியமும்,
4. பெண் விடுதலையும் விளிம்பு நிலையினரின் மேம்பாட்டில் தமிழ்இலக்கியமும்,

5. அறிவியல்தமிழ்,
6. இணையத்தில்தமிழ்,
7. சுற்றுச்சூழல் மேம்பாட்டில்தமிழ்இலக்கியம்.

TOTAL PERIODS: 30

தமிழ்இலக்கியவெளியீடுகள் / புத்தகங்கள்

1. தமிழ்இணையகல்விக்கழகம் (Tamil Virtual University)
   - www.tamilvu.org
2. தமிழ்விக்கிப்பீடியா (Tamil Wikipedia)
   - https://ta.wikipedia.org
3. தர்மபுரஆதினவெளியீடு
4. வாழ்வியல்களஞ்சியம்
   - தமிழ்ப்பல்கலைக்கழகம், தஞ்சாவூர்
5. தமிழ்ககலக்களஞ்சியம்
   - தமிழ்வளர்ச்சித்துறை (thamilvalarchithurai.com)
6. அறிவியல்களஞ்சியம்
   - தமிழ்ப்பல்கலைக்கழகம், தஞ்சாவூர்

COURSE CODE	COURSE TITLE	L	T	P	C
AC3	DISASTER MANAGEMENT	2	0	0	0

OBJECTIVES

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION 6

Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS 6

Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III DISASTER PRONE AREAS IN INDIA 6

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas

Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT 6

Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT 6

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival

TOTAL PERIODS: 30

OUTCOMES

On successful completion of this course, the student will be able to

CO1: Ability to summarize basics of disaster
CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5: Ability to develop the strengths and weaknesses of disaster management approaches

REFERENCE BOOKS

1. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep& Deep Publication Pvt. Ltd., New Delhi,2009.
2. NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'NewRoyal book Company,2007.
3. Sahni, PardeepEt.Al. ," Disaster Mitigation Experiences And Reflections", Prentice Hall OfIndia, New Delhi,2001.

COURSE CODE	COURSE TITLE	L	T	P	C
AC4	SANSKRIT FOR TECHNICAL KNOWLEDGE	2	0	0	0

OBJECTIVES

- Illustrate the basic sanskrit language.
- Recognize sanskrit, the scientific language in the world.
- Appraise learning of sanskrit to improve brain functioning.
- Relate sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- Extract huge knowledge from ancient literature.

UNIT I ALPHABETS **6**

Alphabets in Sanskrit

UNIT II TENSES AND SENTENCES **6**

Past/Present/Future Tense - Simple Sentences

UNIT III ORDER AND ROOTS **6**

Order - Introduction of roots

UNIT IV SANSKRIT LITERATURE **6**

Technical information about Sanskrit Literature

UNIT V TECHNICAL CONCEPTS OF ENGINEERING **6**

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TOTAL PERIODS: 30

OUTCOMES

On successful completion of this course, the student will be able to

CO1: Understanding basic Sanskrit language.

CO2: Write sentences.

CO3: the order and roots of Sanskrit.

CO4: Know about technical information about Sanskrit literature.

CO5: Understand the technical concepts of Engineering.

REFERENCE BOOKS

1. "Abhyaspustakam" – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi, 2017.

COURSE CODE	COURSE TITLE	L	T	P	C
AC5	VALUE EDUCATION	2	0	0	0

OBJECTIVES

- Understand value of education and self-development
- Imbibe good values in students
- Let the should know about the importance of character

UNIT I

Values and self-development–Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements

UNIT II

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

.

UNIT III

Personality and Behavior Development-Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour.Universal brother hood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT IV

Character and Competence–Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.

TOTAL PERIODS: 30

OUTCOMES

On successful completion of this course, the student will be able to

CO1: Knowledge of self-development.

CO2: Learn the importance of Human values.

CO3: Developing the overall personality.

REFERENCE BOOKS

1. Chakroborty, S.K."Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

COURSE CODE	COURSE TITLE	L	T	P	C
AC6	CONSTITUTION OF INDIA	2	0	0	0

OBJECTIVES

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION

History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION

Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT IV ORGANS OF GOVERNANCE

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V LOCAL ADMINISTRATION

District's Administration head: Role and Importance Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy(Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT VI ELECTION COMMISSION

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL PERIODS: 30

OUTCOMES

On successful completion of this course, the student will be able to

CO1: Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

CO2: Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

CO3: the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.

CO4: Discuss the passage of the Hindu Code Bill of 1956.

REFERENCE BOOKS

1. The Constitution of India,1950(Bare Act),Government Publication.
2. Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition, 2015.
3. M.P. Jain, Indian Constitution Law, 7thEdn., Lexis Nexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

COURSE CODE	COURSE TITLE	L	T	P	C
AC7	PEDAGOGY STUDIES	2	0	0	0

OBJECTIVES

- Review existing evidence on there view topic to inform programme design and policy
- Making under taken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

UNIT I INTRODUCTION AND METHODOLOGY

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.

UNIT II THEMATIC OVERVIEW

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT III EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES

Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV PROFESSIONAL DEVELOPMENT

Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes

UNIT V RESEARCH GAPS AND FUTURE DIRECTIONS

Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact

TOTAL PERIODS: 30

OUTCOMES

On successful completion of this course, the student will be able to

CO1: What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?

CO2: What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?

CO3: How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

REFERENCE BOOKS

1. Ackers J, HardmanF (2001) Classroom interaction in Kenyan primary schools, Compare, 31(2): 245-261.
2. Agrawal M (2004)Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36(3):361-379.
3. Akyeampong K (2003) Teacher training in Ghana-does it count? Multi-site teacher education research project (MUSTER) country report 1.London:DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33(3): 272–282.
5. Alexander RJ(2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M(2003) Read India: Amass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf

COURSE CODE	COURSE TITLE	L	T	P	C
AC8	STRESS MANAGEMENT BY YOGA	2	0	0	0

OBJECTIVES

- To achieve overall health of body and mind
- To overcome stress

UNIT I

Definitions of Eight parts of yoga.(Ashtanga)

UNIT II

Yam and Niyam - Do`s and Don't's in life - i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.

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UNIT III

Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathing techniques and its effects-Types of pranayama

TOTAL PERIODS: 30

OUTCOMES

On successful completion of this course, the student will be able to

CO1: Develop healthy mind in a healthy body thus improving social health also

CO2: Improve efficiency

REFERENCE BOOKS

1. 'Yogic Asanas for Group Tarining-Part-I":Janardan Swami Yoga bhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

COURSE CODE	COURSE TITLE	L	T	P	C
AC9	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	2	0	0	0

OBJECTIVES

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

UNIT I

Neetisatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (dont's) - Verses- 71,73,75,78 (do's)

UNIT II

Approach to day to day work and duties - Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.

UNIT III

Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 - Verses 13, 14, 15, 16,17, 18 - Personality of role model - shrimadbhagwadgeeta - Chapter2- Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL PERIODS: 30

OUTCOMES

On successful completion of this course, the student will be able to

CO1: Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life

CO2: person who has studied Geeta will lead the nation and mankind to peace and prosperity

CO3: Study of Neet is hatakam will help in developing versatile personality of students.

REFERENCE BOOKS

1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari's Three Satakam, Niti-sringar-vairagya, New Delhi,2010
2. Swami Swarupananda, Srimad Bhagavad Gita, Advaita Ashram, Publication Department, Kolkata, 2016.