B.Tech - Artificial Intelligence and Data Science

[Offered by KCT | Affiliated to Anna University, Chennai | Approved by AICTE, Govt. of India]

Awarded by

Curriculum & Syllabi

R2018 (Batch 2022 onwards)

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Course Content for B.Tech AI & DS Program

Table of Contents

PROGRAM EDUCATIONAL OBJECTIVES:

The graduates of this program shall have:

1. A successful professional career in industry, government, and academia with capabilities to build innovative solutions using technology as a tool to solve real-world problems.
2. Research capabilities in advanced technologies and shall contribute to a new body of knowledge.
3. A learning mindset to continuously improve their knowledge, through on the job, formal and informal learning opportunities
4. An ethical attitude and shall exhibit effective skills in communication, management, teamwork and leadership.
5. Engineering, problem-solving and critical thinking skills to create social, economical and sustainable impact.

PROGRAM SPECIFIC OUTCOMES:

After completing their graduation, students of AI & DS will be able to:

1. Apply the principles of artificial intelligence and data science that require problem-solving, inference, perception, knowledge representation, and learning.
2. Demonstrate the ability to create innovative solutions from idea to product, applying scientific methods and tools
3. Exhibit strong professional skills to function effectively in multi-disciplinary and heterogeneous teams with a growth mindset.

PROGRAM OBJECTIVES:

Graduates of AI & DS programme will have the following abilities:

PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis:** Identity, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society:** Apply to reason informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Curriculum of B.Tech AI & DS Program

Knowledge Disciplines	I - Year		II – Year		III - Year		IV - Year	
	Bridge	Introduction	Foundation	Concentration	Specialization	ProtoSem	Fellowship	Fellowship
	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Sem VII	Sem VIII
Fundamental Science	Engineering Physics (Physics Practicum) (4)	Advanced Physics (3)		Random Process and Optimization (4)		ProtoSem [Core] (12) [Advanced Technology Electives] (6) [Open Elective-II] (3) [Minimum Usable Prototype] (3)	Fellowship (10) [Certification Courses] (4)	Fellowship (9) [Certification Courses] (4I
Math and Statistics	Linear Algebra and Calculus (MATLAB Practicum) (4)	Discrete Mathematics (3) Probability and Statistics (R Practicum) (4)	Multivariate Calculus and Forecasting (4)					
Computer Science	Introduction to Python (Python Practicum) (3) Introduction to Computational Machines (HW Practicum) (3)	Object-Oriented Programming and Data Structures (Python Practicum) (3)	Algorithms and Optimization of Programs (Python Practicum) (4) Operating System (3)	Computer Networks (3)	Cloud Architecture (AWS Practicum) (4)			
Artificial Intelligence		Introduction to AI & ML (Python Practicum) (3)	Applied Machine Learning(PyTorch/ Tensorflow)(4)	Neural Networks and Deep Learnings (Keras and MXnet Practicum) (4)	Reinforcement Learning (4)			
Data Science		Introduction to Data Science (Sheets Practicum) (3)	Data Collection & Data Management (Oracle and SQL Practicum) (3)	Data Mining & Modeling (Rapid Miner Practicum) (3)	Exploratory Data Analysis and Visualization (4)			
Advanced Technology					Advanced Technology Electives -1 (3)			
Arts and Humanities	Fundamentals of Communication I (English Practicum) (3)	Growth Lab I (NC)	Growth Lab II (NC)	Growth Lab III (NC)	Open Elective - I (3)			
	Introduction to Indic Culture and Sciences (1)	Externship I (NC)	Tools and Technologies for Wellness (1)	Externship II (NC)	Philosophy of Wellness (1)		Externship III (NC)	
Business & Entrepreneurship			Principles of Economics (2)	Finance for Engineers (3)	Marketing Fundamentals (3)			

Innovation and Design	Engineering Sprints (3)	Innovation Sprints (3)	Design Sprints (3)	Ideation Sprints (3)				
	Credits: 21	**Credits: 22**	**Credits: 24**	**Credits: 20**	**Credits: 22**	**Credits: 24**	**Credits: 14**	**Credits: 13**

Total Credits: 160

Consolidated Course Information

Course Type : *Professional Core (PC), Professional Elective (PE), Humanities and Social Science (HS), Basic Science(BS), Engineering Science(ES), Open Elective(OE), Project Work(PW)*

	Semester I									
S.No	**Course Title**	**Course Code**	**Course Mode**	**Course Type**	**L**	**T**	**P**	**J**	**C**	**Prerequisite**
1	Engineering Physics	U18PHI1202	Embedded - Theory & Lab	BS	3	0	2	0	4	
2	Linear Algebra and Calculus	U18MAI1203	Embedded - Theory & Lab	BS	3	0	2	0	4	
3	Introduction to Computational Machines	U18AII1204	Embedded - Theory & Lab	ES	2	0	2	0	3	
4	Introduction to Python	U18AII1205	Embedded - Theory & Lab	ES	2	0	2	0	3	
5	Fundamentals of Communication I	U18ENI1202	Embedded - Theory & Lab	HS	2	0	2	0	3	
6	Introduction to Indic Culture and Technologies	U18AIC1006	One Credit Course	HS	1	0	0	0	1	
7	Engineering Sprints	U18AII1607	Embedded - Project & Lab	ES	0	0	4	2	3	
8	Heritage of Tamils	U18TLR1001	Theory	Mandatory (non CGPA)	1	0	0	0	1	
	Total Credits				**21**					

	Semester II									
S.No	**Course Title**	**Course Code**	**Course Mode**	**Course Type**	**L**	**T**	**P**	**J**	**C**	**Prerequisite**
1	Advanced Physics	U18PHT2203	Theory	BS	3	0	0	0	3	U18PHI1202
2	Discrete Mathematics	U18MAT2001	Theory	BS	3	0	0	0	3	
3	Probability and Statistics	U18MAI2203	Embedded - Theory & Lab	BS	3	0	2	0	4	
4	Object-Oriented Programming and Data Structures	U18AII2204	Embedded - Theory & Lab	PC	2	0	2	0	3	U18AII1205
5	Introduction to AI & ML	U18AII2205	Embedded - Theory & Lab	PC	2	0	2	0	3	U18AII1205
6	Introduction to Data Science	U18AII2206	Embedded - Theory & Lab	PC	2	0	2	0	3	
7	Growth Lab I	U18AIP2607	Embedded - Project & Lab	HS	-	-	-	-	-	
8	Externship I	U18AIP2708	Project	HS	-	-	-	-	-	
9	Innovation Sprints	U18AII2609	Embedded - Project & Lab	ES	0	0	4	2	3	
10	Tamils and Technology	U18TLR2001	Theory	Mandatory (non CGPA)	1	0	0	0	1	
	Total Credits				**22**					

Course Type : *Professional Core (PC), Professional Elective (PE), Humanities and Social Science (HS), Basic Science(BS), Engineering Science(ES), Open Elective(OE), Project Work(PW)*

	Semester III									
S.No	**Course Title**	**Course Code**	**Course Mode**	**Course Type**	**L**	**T**	**P**	**J**	**C**	**Prerequisite**
1	Multivariate Calculus and Forecasting	U18MAI3201	Embedded - Theory & Lab	BS	3	0	2	0	4	U18MAI1203
2	Algorithms and Optimization of Programs	U18AII3202	Embedded - Theory & Lab	PC	3	0	2	0	4	U18AII2204
3	Operating System	U18AII3203	Embedded - Theory & Lab	PC	2	0	2	0	3	---
4	Applied Machine Learning	U18AII3204	Embedded - Theory & Lab	PC	3	0	2	0	4	U18AII2205
5	Data Collection & Data Management	U18AII3205	Embedded - Theory & Lab	PC	2	0	2	0	3	---
6	Tools and Technologies for Wellness	U18AIC3006	One Credit	HS	1	0	0	0	1	---
7	Growth lab II	U18AIP3607	Embedded - Project & Lab	HS		-	-	-	-	---
8	Principles of Economics	U18AIT3008	Theory	ES	2	0	0	0	2	---
9	Design Sprints	U18AII3609	Embedded - Project & Lab	ES	0	0	4	2	3	---
	Total Credits				**24**					

	Semester IV									
S.No	**Course Title**	**Course Code**	**Course Type**	**Course Type**	**L**	**T**	**P**	**J**	**C**	**Prerequisite**
1	Random Process and Optimization	U18MAT4105	Theory	BS	3	1	0	0	4	---
2	Computer Networks	U18AII4201	Embedded - Theory & Lab	PC	2	0	2	0	3	---
3	Neural Networks and Deep Learning	U18AII4202	Embedded - Theory & Lab	PC	3	0	2	0	4	U18AII2205
4	Data Mining & Modeling	U18AII4203	Embedded - Theory & Lab	PC	2	0	2	0	3	U18MAI2203
5	Growth Lab III	U18AIP4604	Embedded - Project & Lab	HS	-	-	-	-	-	---
6	Externship II	U18AIP4705	Project	HS	-	-	-	-	-	---
7	Finance for Engineers	U18AIT4006	Theory	ES	3	0	0	0	3	---
8	Ideation Sprints	U18AII4607	Embedded - Project & Lab	ES	0	0	4	2	3	---
9	Environmental Science and Engineering	U18CHT4000	Theory	BS	3	0	0	0	0	
	Total Credits				**20**					

Course Type : *Professional Core (PC), Professional Elective (PE), Humanities and Social Science (HS), Basic Science(BS), Engineering Science(ES), Open Elective(OE), Project Work(PW)*

	Semester V									
S.No	**Course Title**	**Course Code**	**Course Mode**	**Course Type**	**L**	**T**	**P**	**J**	**C**	**Pre-requisite**
1	Cloud Architecture	U18AII5201	Embedded - Theory & Lab	PC	3	0	2	0	4	---
2	Exploratory Data Analysis and Visualization	U18AII5202	Embedded - Theory & Lab	PC	3	0	2	0	4	U18MAI2203
3	Reinforcement Learning	U18AII5203	Embedded - Theory & Lab	PC	3	0	2	0	4	U18AII4202
4	Advanced Technology Elective 1	U18AIE520X	Theory	PE	3	0	0	0	3	---
5	Elective 1	U18XXE5XXX	Theory	OE	3	0	0	0	3	---
6	Marketing Fundamentals	U18AIT5004	Theory	ES	3	0	0	0	3	---
7	Philosophy of Wellness	U18AIC5005	One Credit	HS	1	0	0	0	1	---
8	Constitution of India	U18INT5000	Theory	Mandatory	1	0	0	0	0	
	Total Credits				**22**					

	Semester VI									
S.No	**Course Title**	**Course Code**	**Course Mode**	**Course Type**	**L**	**T**	**P**	**J**	**C**	**Pre-requisite**
1	Applied Design Thinking	U18AII6201	Embedded - Theory & Lab	PC	3	0	2	0	4	---
1	Prototype Development	U18AII6202	Embedded - Theory & Lab	PC	3	0	2	0	4	---
2	Industrial IoT	U18AII6203	Embedded - Theory & Lab	PC	3	0	2	0	4	---
3	Advanced Technology Elective 2	U18AIE6XXX	Theory	PE	3	0	0	0	3	---
4	Advanced Technology Elective 3	U18AIE6XXX	Theory	PE	3	0	0	0	3	---
5	Elective 2	U18XXEXXXX	Theory	OE	3	0	0	0	3	---
6	Minimum Usage Prototype	U18AIP6604	Project	PW	0	0	0	6	3	---
	Total Credits								**24**	

Course Type : *Professional Core (PC), Professional Elective (PE), Humanities and Social Science (HS), Basic Science(BS), Engineering Science(ES), Open Elective(OE), Project Work(PW)*

	Semester VII									
S.No	**Course Title**	**Course Code**	**Course Mode**	**Course Type**	**L**	**T**	**P**	**J**	**C**	**Pre-requisite**
1	Fellowship I	U18AIP7701	Project	PW	0	0	0	20	10	
2	Advanced Technology Certification I	U18AIR7102	eRIDE	PC	0	0	0	8	4	
3	Externship III	U18AIP7703	Project	HS	-	-	-	-	-	
	Total Credits								**14**	

	Semester VIII									
S.No	**Course Title**	**Course Code**	**Course Mode**	**Course Type**	**L**	**T**	**P**	**J**	**C**	**Pre-requisite**
1	Fellowship II	U18AIP8701	Project	PW	0	0	0	18	9	
2	Advanced Technology Certification II	U18AIR8102	eRIDE	PC	0	0	0	8	4	
	Total Credits								**13**	

Total: 160 credits

List of Electives and Certification Courses

Advanced Technology Electives

Sl. No	Specialization Track	Course code	Course title	L	T	P	J	C
1	**General Electives**	U18AIE0001	Natural Language Processing	3	0	0	0	3
2		U18AIE0002	Introduction to Spatial Computing	3	0	0	0	3
3		U18AIE0003	Computer Vision Techniques	3	0	0	0	3
4		U18AIE0004	Recommendation system for e-commerce	3	0	0	0	3
5		U18AIE5005	Mining BigData	3	0	0	0	3
6		U18AIE0006	Neural Computation	3	0	0	0	3
7		U18AIE0007	Human-Centered Systems	3	0	0	0	3
8		U18AIE0008	Speech Processing	3	0	0	0	3
9		U18AIE0009	Startup Fundamentals	2	0	2	0	3
10	**Automation and Artificial Intelligence**	U18AIE0012	Intelligent Automation systems	2	0	2	0	3
11		U18AIE0014	Generative AI	2	0	2	0	3
12		U18AIE0015	Responsible AI	3	0	0	0	3
13	**Data Science, Analytics and Visualization Cohort**	U18AIE0016	Principles of Data science	2	0	2	0	3
14		U18AIE0017	Data Processing Techniques	2	0	2	0	3
15		U18AIE0018	Data Modelling	2	0	2	0	3
16		U18AIE0020	Business Intelligence for Decision Making	2	0	2	0	3
17		U18AIE0021	Data Ethics and Privacy	3	0	0	0	3
18	**Network and Distributed Computing**	U18ITE0018	Smart Contract Development	2	0	2	0	3
19		U18ITE0019	Decentralized Finance	3	0	0	0	3
20	**Cloud Computing**	U18ITE0020	Virtualization and Resource Management	2	0	2	0	3
21		U18ITE0021	Cloud Infrastructure and Architecture	2	0	2	0	3

22		U18ITE0022	Cloud Storage Management	2	0	2	0	3
23		U18ITE0023	Cloud Application Development	2	0	0	2	3
24		U18ITE0024	Cloud security	2	0	2	0	3
25		U18ITE0025	Cloud Automation	2	0	0	2	3
26	**Web and Software Development**	U18ITE0026	Full Stack Software Development	2	0	2	0	3
27	**Extended Reality**	U18CSE0014	3D Modeling and Game Design	2	0	0	2	3
28		U18CSE0015	Augmented Reality and Virtual Reality application development	2	0	0	2	3
29		U18CSE0016	Advanced Metaverse Technologies	3	0	0	0	3
29	**IoT, Edge, UAV**	U18CSE0017	Embedded systems for IoT	2	0	2	0	3
30		U18CSE0018	IoT Systems Design	2	0	0	2	3
31		U18CSE0019	IoT Application Development	2	0	2	0	3
32		U18CSE0020	3D Printing	2	0	2	0	3
33		U18CSE0021	Robotic Operating Systems	2	0	2	0	3
34		U18CSE0022	Software Defined Vehicle	3	0	0	0	3
35	**Cyber Security**	U18CSE0023	Ethical Hacking and Network Defence	2	0	2	0	3
36		U18CSE0024	Cyber Ethics and Laws	3	0	0	0	3
37		U18CSE0025	Secure Software Development	2	0	2	0	3
38		U18CSE0026	Network Security Administration	2	0	2	0	3
39		U18CSE0027	Digital Forensics	2	0	2	0	3

Certification Courses

1. IBM Cyber Security Analyst Professional Certificate
2. Deeplearning.ai TensorFlow Developer Professional Certification
3. Google IT Automation with Python Professional Certification
4. Cloud Architecture with Google Cloud Professional Certification
5. IBM AI Engineering Professional Certification

6. IBM Applied AI Professional Certification
7. Data Engineering with Google Cloud Professional Certification
8. SAS Programmer Professional Certification
9. Cloud Engineering with Google Cloud Professional Certification
10. SAS Visual Business Analytics Professional Certificate
11. Professional Certificate program in Digital Transformation
12. Professional Certificate Program in Innovation & Technology
13. Professional Certificate Program in Legal Tech in the Digital Era
14. AWS Certified Cloud Practitioner
15. AWS Certified Solution Architect (Associate)
16. AWS Certified Developer (Associate)
17. AWS Certified Data Analytics (Speciality)
18. AWS Certified Database (Specialty)
19. AWS Certified Machine Learning (Specialty)
20. Tensorflow Certification (TF)

Syllabi - 1st Year
Semester I

U18PHI1202	ENGINEERING PHYSICS	L	T	P	J	C
		3	0	2	0	4

Course Objectives:

- To explain principles of optics.
- To make students understand the basic concepts of Principles of Physics in a broader sense
- To enable a view to lay the foundation for the various engineering courses
- To demonstrate competency and understanding of the concepts found in quantum mechanism, laser, Optical fiber, Waves in one dimension, Wave Optics, Lasers, Fiber Optics and a broad base of knowledge in physics.

Course Outcomes:

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

CO 1:	Enhance the fundamental knowledge in properties of matter and its applications relevant to various applications of Engineering
CO 2:	Understanding the phenomenon of heat transfer mechanisms in engineering systems.
CO 3:	Acquire knowledge in the basic concepts of quantum mechanics and electron microscopy.
CO 4:	Imbibe the concept of lasers, optical fibers and their applications in engineering.
CO 5:	Introduce and provide a broad view of acoustics.
CO 6:	Apply the NDT techniques and modern engineering tools necessary for Engineering practice.

Pre-requisite courses: Not applicable

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	M									M
CO2	S	M	M									M
CO3	S	M		M								M
CO4	S	M		M								M
CO5	S	M										M

CO6	S	M	M									M

Course Assessment Methods:

DIRECT

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

INDIRECT

1. Course-end survey

Topics covered:

PROPERTIES OF MATTER **9 Hours**

Hooke's Law - Elastic moduli - Relation between elastic constants - Poisson's Ratio – Stress - Strain Diagram and its uses – factors affecting elastic modulus – Bending of beams – Expression for bending moment and depression - Cantilever - Depression of a cantilever - experimental determination of Young's modulus by Non uniform bending – I shape girders

THERMAL PHYSICS **9 Hours**

Transfer of heat energy – conduction, convection and radiation – thermal expansion of solids and liquids – expansion joints – bimetallic strips – theory of heat conduction in solids – rectilinear flow of heat – determination of thermal conductivity of a bad conductor - Lee's & Charlton's disc method - Thermal Insulation – classification and properties – heat exchangers - applications – domestic refrigerator – microwave oven.

MODERN PHYSICS **9 Hours**

Planck's concept (hypothesis) - Compton effect - Expression for Compton shift - Concept of matter waves - Physical significance of wave function - Schrödinger's wave equation - Time independent and time dependent equation - Eigenvalues and Eigenfunction - Particle in a box (one dimension)- Scanning electron microscope (SEM)- Transmission electron microscope (TEM).

APPLIED OPTICS **9 Hours**

LASERS: Absorption and emission - Spontaneous emission - Stimulated emission - Population inversion - Sources of excitation - Active medium - Resonant cavity - Einstein's theory of stimulated emission - Nd-YAG laser - CO_2 laser - Semiconductor lasers - Applications – holography, cutting welding , drilling.
Fibre optics: Structure of optical fiber -principle and propagation of light in optical fibers - Numerical aperture and acceptance angle - - Types of optical fibers - Applications - Fiber optic communication system, Fiber endoscope.

ACOUSTICS AND ULTRASONICS	9 Hours

Acoustics: Sound basic definitions - Reverberation - Reverberation time - Sabine's formula - Absorption coefficient and its determination - Factors affecting the acoustics of the buildings and their remedies.
Ultrasonics: Production of ultrasonic waves- Magneto-striction and Piezoelectric methods - Properties -Detection - Thermal and Knut's methods, Determination of velocity of ultrasonic waves in liquids using acoustic grating – applications - A, B, C scan.

Theory: 30 Hrs	Tutorial: 0	Total Hours: 45 Hrs

Lab component Contents:

LIST OF EXPERIMENTS

1. Non-uniform bending – Determination of Young's modulus
2. Compound Pendulum – Determination of acceleration due to gravity
3. Spectrometer – Determination of wavelength of mercury source using grating
4. Air wedge - Determination of thickness of thin sheet
5. Semiconductor Laser:
    a. Determination of wavelength of laser
    b. Determination acceptance angle and numerical aperture of an optical fibre.
    c. Determination of particle size
6. Melde's string – Determination of frequency of a tuning fork
7. Determination of band gap of a semiconductor
8. Luxmeter – Determination of efficiency of solar cell
9. Lee's disc – Determination of thermal conductivity of a bad conductor
10. B-H Curve apparatus – Determination of magnetic susceptibility of a solid material.

Experiments for Demonstration:

1. Hall effect
2. Hardness Test
3. Four probe experiment
4. Ultrasonic interferometer

Practical: 30 hrs	**Tutorial: 0**	**Total Hours : 30 Hrs**

Textbooks:

1. Kumar Senthil G, Revised Edition 2020-21, Engineering Physics, VRB Publishers Pvt Ltd., Chennai.
2. Arthur Besier, Shobhit Mahajan, S. Rai Choudhury, 7th Edition, 2015, Concepts of Modern Physics, Mcgraw Hill Education, New Delhi.

Reference Books:

1. Avadhanulu M N , 1992, A textbook of Engineering Physics, S. Chand Publishing
2. Dr. Aparna Y & Dr. Venkateswara Rao K, Laboratory Manual of Engineering Physics, V.G.S Publishers.
3. Brijlal and Subharamaniam, 2004, Properties of matter, S. Chand & Co Ltd., New Delhi.
4. Prakash Satya , 2015, Quantum Mechanics, Pragati Prakashan Publishers.
5. Thyagarajan K, Ghatak Ajoy, 2010, Lasers: Fundamentals and Applications, Springer Science & Business Media.
6. Introduction to Fiber Optics, K. Thyagarajan, Ajoy Ghatak, Second Edition, Springer New York Dordrecht Heidelberg London, 2010.
7. Dale Ensminger and Leonard J. Bond, Ultrasonics: Fundamentals, Technology, Applications, Second Edition, 1988, Marcel Dekker, New York.
8. C. C. Ouseph, U. J. Rao, V. VijayendranS, Practical Physics and Electronics, Viswanathan (Printers & Publishers), Pvt., Ltd.

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U18MAI1203	LINEAR ALGEBRA AND CALCULUS	L	T	P	J	C
		3	0	2	0	4

Course Objectives:

- To explain the main concepts of linear algebra that are used in data analysis and machine learning.
- To improve the student's practical skills of using linear algebra methods in machine learning and data analysis.
- To learn the fundamentals of working with data in vector and matrix form, acquire skills for solving systems of linear algebraic equations and finding the basic matrix decompositions and general understanding of their applicability.

Course Outcomes:

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

CO 1:	Identify eigenvalues and eigenvectors, apply Cayley Hamilton theorem to Matrix Manipulation and apply orthogonal diagonalization to convert quadratic form to canonical form which will form the basis for Principal Component Analysis.
CO 2:	Understand the concept of vector spaces and perform LU Decomposition and Singular Value Decomposition, that are essential for dimensionality reduction.
CO 3:	Apply suitable techniques of differentiation and integration to various functions and identify the maxima and minima of functions of one variable.
CO 4:	Solve first order ordinary differential equations and apply them to certain physical situations.
CO 5:	Solve higher order ordinary differential equations arising in real world situations.
CO 6:	Determine Rank, Inverse, Eigenvalues, Eigenvectors of the given matrix, solve Differential equations and locate Maxima-Minima of the function using MATLAB

Pre-requisite courses:Nil

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S										M
CO2	M	M										
CO3	W	W										
CO4	W	W										
CO5	W	W										

CO6					S							S

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

b)Indirect

1. Course-end survey

Topics covered:

MATRICES	**12 Hours**

Rank of a matrix – Consistency of a system of linear equations - Rouche's theorem -Solution of a system of linear equations - Linearly dependent and independent vectors–Eigenvalues and Eigenvectors of a real matrix – Properties of eigenvalues and eigenvectors – Cayley Hamilton theorem (excluding proof) - Orthogonal matrices – Orthogonal transformation of a symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation.

VECTOR SPACES	**12 Hours**

Vector spaces and subspaces – Linear independence and dependence – Basis and Dimension - Null spaces, column spaces and Linear transformations - LU decomposition method - Singular Value Decomposition method.

DIFFERENTIAL AND INTEGRAL CALCULUS	**9 Hours**

Representation of functions -Limit of a function-Continuity -Derivatives -Differentiation rules - Maxima and Minima of functions of one variable - Definite and Indefinite integrals - Techniques of Integration: Substitution rule, Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions bypartial fraction.

FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS	**3 Hours**

Linear differential equations (Leibnitz equation and Bernoulli's equation)

HIGHER ORDER ORDINARY DIFFERENTIAL EQUATIONS	**9 Hours**

Linear, homogeneous and non- homogeneous differential equations of second and higher order with constant coefficients - Non-homogeneous term of the type e^{ax}, sin ax, cos ax, and x^n, e^{ax} V(x)

Theory: 45 Hrs	**Tutorial: 0 Hrs**	**Total Hours: 45 Hrs**

Lab component Contents:

List of MATLAB Programmes:

1. Introduction to MATLAB.
2. Matrix Operations - Addition, Multiplication, Transpose, Inverse
3. Rank of a matrix and solution of a system of linear equations
4. Characteristic equation of a Matrix and Cayley-Hamilton Theorem.
5. Eigenvalues and Eigenvectors of Higher Order Matrices
6. Curve tracing
7. Differentiation and Integration
8. Solving first and second order ordinary differential equations.
9. Determining Maxima and Minima of a function of one variable.

Practical: 30 Hrs	**Tutorial: 0**	**Total Hours : 30 Hrs**

Textbooks:

1. Grewal B.S., , 41st Edition, 2011, "Higher Engineering Mathematics", Khanna Publishers, New Delhi.
2. Ramana B.V., 11th Reprint, 2010, "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., New Delhi
3. David C. Lay, "Linear Algebra and its Applications", Pearson Education Asia, New Delhi, 5 th Edition, 2016.

Reference Materials:

1. Kreyzig E., "Advanced Engineering Mathematics", 10th Edition, John Wiley and sons, 2011
2. Venkataraman M.K., "Engineering Mathematics", The National Publishing Co., Chennai, 2003
3. Weir, MD, Hass J, Giordano FR, 12th Edition, 2015, Thomas' Calculus, Pearson education.
4. Thomas G.B. and Finney R.L., "Calculus and Analytic Geometry", 11th Edition, Pearson Education, 2006.
5. Seymour Lipschutz , Marc Lipson, "Schaum Outline of Linear Algebra", McGraw Hill Trade; New Delhi, 6th Edition, 2017

Crafted By : Dr. Vijeta Iyer, M.Sc., PhD., Department of Mathematics, KCT & Gokul Kumar M.Sc (BITS Pilani),

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U18AII1204	INTRODUCTION TO COMPUTATIONAL MACHINES	L	T	P	J	C
		2	0	2	0	3

Course Objectives:

- To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits
- To prepare students to perform the analysis and design of various digital electronic circuits
- To introduce students to the design issues of embedded systems.
- To provide experience to integrate hardware and software for an embedded system

Course Outcomes:

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

CO 1:	Understand the basics of combinational and sequential circuits
CO 2:	Explain the hardware and software architecture of embedded systems
CO 3:	Understand the network operations and the transport protocols
CO 4:	Demonstrate the I/O operations from the basic embedded systems hardware

Pre-requisite courses:

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S									M	M
CO2	S	M	S	M	M	M					M	M
CO3	S		S	S	S	M					M	M
CO4	S		M	S	S	M					M	M

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

b)Indirect

1. Course-end survey

Topics covered:

BASICS OF DIGITAL ELECTRONICS	**7 Hours**

Introduction to logic gates: Boolean Algebra Theorems - De Morgan's theorem - Logic Gates-Design procedure of Combinational circuits: Adders- Subtractors - Design of sequential circuits, Asynchronous/Ripple counters- Shift registers

EMBEDDED SYSTEM AND ITS ARCHITECTURE	**8 Hours**

Introduction to Embedded Systems- Architecture of Embedded Systems- Programming for Embedded Systems- The Process of Embedded System Development - Hardware Platforms- Communication Interfaces- Future Trends

RASPBERRY PI	**7 Hours**

Hardware aspects- Board details - Operating systems - Programming the Pi : Compilers - Python programming for Pi - Hardware interfacing: GPIO interfacing through Python - LED, buzzer, switch and Sensors Interfacing: Pressure, Temperature, Speed

NETWORKS AND PROTOCOL	**8 Hours**

Introduction to Networks –Components, Categories and Types of Connections – Topologies- ISO/OSI model- Comparison of the OSI and TCP/IP Reference Model- Protocol- Internet Transport (IP)- IP addressing- Transport layer protocols : TCP and UDP-Duties of TCP & UDP-TCP Connection Management-Congestion Control- Quality of Services- Real Time Transport Protocols - Raspberry Pi Interface: Ethernet.

Theory: 30 Hrs	**Tutorial: 0**	**Total Hours: 30 Hrs**

Lab Component:

List of Experiments:

1. Realization of logical expression using gates
2. Verification of Half adder and Full adder
3. Verification of Half Subtractor and Full Subtractor
4. Asynchronous Decade Counter
5. Interfacing Input & Output devices with RPi
6. Interfacing sensors with RPi
7. Serial Communication using RPi
8. Ethernet Communication using RPis
9. Network Protocol packet Analysis

Practical: 30 Hrs	**Tutorial: 0**	**Total Hours : 30 Hrs**

Textbooks:

1. Mano Morris M, 2008, "Digital Design", 4th Edition, Pearson Education.
2. Dr. K.V.K.K. Prasad, 2003, “Embedded/Real Time Systems Programming Black Book”Behrouz A. Forouzan, 2013, "Data Communications and Networking", 5th Edition, TMH.

Reference Materials:

1. Andrew S Tanenbaum, 4th Edition, 2003, "Computer Networks" Pearson Education.
2. Wolfram Donat, , 2014, "Learn Raspberry Pi Programming with Python", Technology in Action Publications.
3. Alex Bradbury and Ben Everard, 2014, "Learning Python with Raspberry Pi",Wiley Publications Pvt., Ltd..

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U18AII1205	INTRODUCTION TO PYTHON	L	T	P	J	C
		2	0	2	0	3

Course Objectives:

- To learn core Python scripting elements such as variables and flow control structures
- To learn how to use lists, tuples, and dictionaries in Python programs.
- To learn how to identify Python object types.
- To learn how to use indexing and slicing to access data in Python programs.

Course Outcomes:

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

CO 1:	Understand the basics of algorithm building for computing and programming
CO 2:	Understand the basics of python programming language
CO 3:	Apply modularization techniques for problem solving through python
CO 4:	Outline the concepts of Lists, Dictionaries and Files

Pre-requisite courses:

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	M									
CO2	S	S	S		S	M			M		M	S
CO3	S	S	S	S	S	M			M		S	S
CO4	S	S	S	S	S						S	S

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

b)Indirect

1. Course-end survey

Topics covered:

INTRODUCTION TO COMPUTING	6 Hours

Algorithms, Building blocks of algorithms (Instructions/statements, state, control flow, functions), Notation (pseudo code, flow chart, programming language), Algorithmic problem solving.

INTRODUCTION TO PYTHON	8 Hours

Python programming language - Debugging - Variables, expressions and statements - Input/Output Statements - Conditional operators and statements - Looping statements - for - while- break and continue statement - Iterations - Strings - String manipulations: subscript operator, indexing, slicing a string

MODULAR PROGRAMMING	8 Hours

Functions- function call- Flow of execution- Parameters and Arguments- Return values - Incremental development - Composition - Recursion - Boolean functions - Checking types - Case study-Interface Designing -Word Play.

LISTS, DICTIONARIES AND FILES	8 Hours

Lists - Basic list operators- Replacing- inserting- removing an element- searching and sorting lists- Dictionaries dictionary literals- adding and removing keys- accessing and replacing values - traversing dictionaries - Tuples - tuples as lists and dictionaries - Comparing tuples - Files - Reading and Writing - Format operator - Filenames and Paths - Catching Exceptions

Theory : 30 Hrs	Tutorial: 0	Total Hours: 30 Hrs

Lab Component:

List of Experiments:

1. Introduction to Algorithms, flowcharts and pseudocode
2. Programs for variables and expressions
3. Programs using conditional statements and iterations
4. Programs using string operations
5. Programs using functions with parameters
6. Programs using recursion and Boolean functions
7. Programs using list operations
8. Programs using dictionaries & tuples
9. Programs using files
10. Programs using exceptions

Practical: 30 Hrs	Tutorial: 0 Hrs	Total Hours : 30 Hrs

Textbooks:

1. Downey Allen , 2002, ”Think Python- How to think like a Computer Scientist”, O'Reilly Media Inc.
2. Dusty Phillips, 2015, "Python 3 - Object Oriented Programming", 2nd Edition, Packet Publishing Ltd.

Reference Materials:

1. Ashok Namdev Kamthane, Amit Ashok Kamthane, 2018, “Programming and Problem Solving with Python” , Mc-Graw Hill Education.
2. T Jeyapoovan, 2015, “Fundamentals of computing and programming in C”, Vikas Publishing.

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U18AIC1006	INTRODUCTION TO INDIC CULTURE AND TECHNOLOGIES	L	T	P	J	C
		1	0	0	0	1

Course Objectives:

- To develop a broad understanding of Indian society and intercultural literacy through cultural immersion.
- To deepen knowledge on Indian development, environmental, and cultural issues through coursework, local engagement, and independent projects.

Course Outcomes:

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

CO 1:	Understand the various dimensions of Indian Culture and Philosophy
CO 2:	Develop appreciation for the contribution of Indians to various science and technologies

Pre-requisite courses: Nil

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							M	M	M			
CO2							M	M	M			

Course Assessment methods:

a) Direct

1. Continuous Assessment Test
2. Quiz

b)Indirect

1. Course-end survey

Topics covered:

Foundations of Indic Knowledge	3 Hours

Branches of Indian Knowledge - Six Foundational Philosophies of Indian Sciences - Indian Big History: Cosmology - Evolutionary Life Sciences

Indic Perspective on Health and Well-being	3 Hours

Body-Mind-Cognition according to Indian health systems - Technologies used by ancient Indians for

well-being of people

Indic Ecology and Sustainability	**3 Hours**

Purpose of life and sustainable development - Traditional Indian tools and practices for sustainability: agriculture, energy, waste management, construction

Indic Values and Modern Technology	**3 Hours**

Value frameworks from the Indian tradition - evaluating modern technology through Indic frameworks - Digital dharma: ethics and responsibility in technology age

Ancient Indian Technologies	**3 Hours**

Technologies used in Ancient India: Computation, Astronomy, Architecture

Theory: 15 Hrs	**Tutorial: 0**	**Total Hours: 15 Hrs**

Textbooks:

1. Excel Health Journals, First edition, 2016, Certification of yoga professionals official guidebook, Excel books Pvt Ltd.
2. Vasant Lad, UK ed. edition, 2002, Textbook of Ayurveda: Volume 1 - Fundamental Principles of Ayurveda, Ayurvedic Press.

Reference Books:

1. Neeltje Huppes, 2017, Indian Psychology - an experiential approach, Indian Psychology Institute, Puducherry, India.
2. S Balachandar rao, 1999, Indian Astronomy: An Introduction, Universities Press.
3. Swami Harshananda, The Six Systems of Hindu Philosophy, (http://rkmathbangalore.org/Books/TheSixSystemsofHinduPhilosophy.pdf)

Crafted By : Smrithi Rekha Adinarayanan, MS (State University of New York), co-founder of Anaadi Foundation, Palani

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U18ENI1202	FUNDAMENTALS OF COMMUNICATION I	L	T	P	J	C
		2	0	2	0	3

Course Objectives:

- To understand and evaluate key theoretical approaches used in the interdisciplinary field of communication
- To communicate effectively orally and in writing
- To understand and apply knowledge of human communication and language processes as they occur across various contexts, e.g., interpersonal, intrapersonal, small group, organizational, media, gender, family, intercultural communication, technologically mediated communication, etc. from multiple perspectives.
- To understand the research methods associated with the study of human communication, and apply at least one of those approaches to the analysis and evaluation of human communication.

Course Outcomes:

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

CO 1:	Demonstrate their ability to write effectively with the optimum use of formats and writing strategies of appropriate grammar and vocabulary.
CO 2:	Develop active listening strategies to enhance language skills.
CO 3:	Speak fluently with effective delivery strategies.

Pre-requisite courses: Nil

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									**S**	**S**		**S**
CO2									**S**	**S**		**S**
CO 3									**S**	**S**		**S**

Course Assessment methods:

Direct

1. Continuous Assessment of Skills
2. Assignment
3. Written Test
4. End Semester Examination

Topics covered:

UNIT 1	**12 Hours**

Glimpses of Essential English for Engineers (General Overview) - Word Classification - Articles - Word Formation (Prefixes & Suffixes) – Different grammatical forms of the same word – Phrasal Verbs – Nominal Compounds

Listening: Listening to Weather Forecast - Listening for Specific Information, Numbers, Time, Duration

Speaking: Self-Introduction with goal setting and SWOT

UNIT 2	**12 Hours**

Sentences and its kinds (Framing Questions) - Cause and Effect Expressions - Purpose and Function Expressions - Subject Verb Agreement - Writing Instructions - Mother Tongue Influence in relation to Pronunciation and Redundancy

Listening: Listening to Social & Cultural Contexts - Listening to Facts & Opinions

Speaking: Proverbs with prompts and cues

UNIT 3	**12 Hours**

Skimming & Scanning - Reading Passages, Newspaper articles, blogs - Reading Comprehension - Cloze test, Note-making - Summary Writing - Formal Letter writing (Enquiry, Complaint & Clarification, Invitation, Acceptance, Rejecting)

Listening: Listening to Scientific Inventions

Speaking: Pair Activity (Negotiation / Pitching opinion)

UNIT 4	**12 Hours**

Tenses – Voice - Reading Advertisement & Graphical representation - Creating Advertisements - Email Etiquettes, Structure, Writing and Responding to Emails
Listening: Listening to News Story

Speaking: Formal Presentation

UNIT 5	**12 Hours**

Discourse Markers - Preparing Checklist and Itinerary - Paragraph Writing (Descriptive, Compare & Contrast, Narrative) - Blog Writing - Proof Reading (Spelling, punctuation, grammar)

Listening: Listening to Documentary

Speaking: Integrated Speaking (Listening, Video & Reading)

Theory: 30 Hrs	**Practical: 30 Hrs**	**Total Hours: 60 Hrs**

Text Books:

1. Basic Communication Skills for Technology, by Andrea J Rutherfoord, Pearson Publishers.
2. English Language Skills by Aruna Koneru, Tata Mc Graw Hills Publications.

Reference Materials:

1. Word Power Made Easy, by Norman Lewis, Simon and Schuster.
2. Effective Technical Communication, by Ashraf Rizvi, Tata Mc Graw Hills Publications.
3. English Grammar in Use, by Murphy, Raymond Ernst Klett Sprachen,
4. Oxford Guide to Effective Writing & Speaking by John Seely, Oxford University Press
5. British Council LearnEnglish Teens Website https://learnenglishteens.britishcouncil.org/

U18TLR1001- HERITAGE OF TAMILS

L	T	P	J	C
1	0	0	0	1

Course Outcomes

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

CO1: Enhance the fundamental knowledge of tamil language and literature

CO2: Understand the heritage ,rock art paintings to modern art sculpture

CO3: Acquire essential knowledge in the folk and martial arts

CO4: Understand the importance of role thinai concept of tamils.

CO5: Gain the knowledge of contribution by tamils to indian national movement and indian culture

UNIT I LANGUAGE AND LITERATURE

Language Families in India - Dravidian Languages – Tamil as aClassical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

UNIT III FOLK AND MARTIAL ARTS

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT IV THINAI CONCEPT OF TAMILS

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
3. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
5. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
8. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book

Semester II

U18PHT2203	ADVANCED PHYSICS	L	T	P	J	C
		3	0	0	0	3

Course Objectives:

- To impart knowledge on the concepts of Faraday‘s law, induced emf and Maxwell‘s equations
- To discuss and explain the key concepts and principles of quantum physics
- To impart knowledge on the concepts of magnetostatics, magnetic flux density, scalar and vector potential and its applications.

Course Outcomes:

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

CO 1:	Impart knowledge on the concepts of electrodynamics for various conditions and its applications
CO 2:	Understand the behaviour of magnetostatics conditions, materials and its applications
CO 3:	Study the importance of various operators and its application in quantum computing
CO 4:	Infer the nuclear reactions and its impact in energy models for data processing
CO 5:	Explore the types of high energy particles and its characteristic effects
CO 6:	Understand the various materials aspects for identify modelling using various tools

Pre-requisite courses: U18PHI1202

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	M									M
CO2	S	M	M									M
CO3	S	M		M								M
CO4	S									M		M
CO5	S	M								M		M
CO6	S	M	M		M							M

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory components)

b)Indirect

1. Course-end survey

Topics covered:

ELECTRODYNAMICS	**9 Hours**

Poisson's and Laplace's Equations – Electric Polarization – Nature of Dielectric Materials- Maxwell's displacement current – Maxwell's equations – vector and scalar potentials – Gauge invariant – wave equation andplane wave solutions

MAGNETODYNAMICS	**9 Hours**

Energy Density in Magnetic Fields – Types of Magnetic Materials - Magnetization and Permeability – Magnetic boundary conditions. Hysteresis – Soft and Hard Magnetic Materials – Ferrites-Storage of Magnetic Data, Floppy, tapes and Magnetic Disc Drives

QUANTUM PHYSICS	**9 Hours**

Introduction to Quantum States - Observables and Operators- Herminian operators-Hamiltonian operators Angular momentum-Spin-orbit coupling- Simon's Algorithm - Grover Search Algorithm

NUCLEAR AND PARTICLE PHYSICS	**9 Hours**

Nuclear Mass and Binding energy- Stability of the nucleus- Mass defect and packing factor-Introduction to Particle physics- particle accelerators and detectors-Antiparticles properties- Symmetry Functions-Quark model-

MATERIALS MODELLING	**9 Hours**

Crystal systems-Symmetry in crystals-Plane and Space groups- Types and effects of defects and imperfections-Bonding and Chemical interactions-Reciprocal lattice-Brillioun zone

Theory: 45 Hrs	**Tutorial: 0 Hrs**	**Total Hours: 45 Hrs**

Textbooks:

1. D.J. Griffiths, 2016, Introduction to Electromagnetic Theory, Prentice Hall, USA.
2. N. Zettili, 2009, Quantum Mechanics Concepts and Applications, Wiley, USA.
3. P M Mathews and K Venkatesan, A Textbook of Quantum Mechanics (2016), Tata McGraw-Hill, India

Reference Books:

1. B. B. Cohen, 2014, "Concepts of Nuclear Physics", TMGH , India
2. C. Kittel, 7th Edn, 1995, Introduction to Solid state Physics. John Wiley & Sons
3. D. Griffiths, 2nd Ed., 2008, "Introduction to Elementary Particles", Wiley-Vch
4. Neil W. Ashcroft, N.David Mermin, 1st Ed., 2003, Solid State Physics, Cengage Learning.

Crafted By : Dr Arul H, M.Sc., PhD., Department of Physics, KCT

U18MAT2001	DISCRETE MATHEMATICS	L	T	P	J	C
		3	0	0	0	3

Course Objectives:

- To introduce concepts of mathematical logic for analyzing propositions and proving theorems.
- To use sets for solving applied problems, and use the properties of set operations algebraically.
- To work with relations and investigate their properties.
- To investigate functions as relations and their properties.
- To introduce basic concepts of graphs, digraphs and trees

Course Outcomes:

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

CO 1:	Understand the concepts of set theory and apply them to situations involving inclusion and exclusion.
CO 2:	Acquire the knowledge of relations, and analyse equivalence relations and their properties.
CO 3:	Understand and analyse the properties of different kinds of functions and solve recurrence relations.
CO 4:	Evaluate the validity of logical arguments and construct simple mathematical proofs.
CO 5:	Determine whether given graphs are isomorphic and apply Dijkstra's algorithm to find the shortest path.

Pre-requisite courses:Nil

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M										
CO2	M											
CO3	M	M										
CO4	S	S										S
CO5	S	S										S

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory components)

b)Indirect

1. Course-end survey

Topics covered:

SET THEORY	**5 Hours**
Algebra of sets – The power set – Ordered pairs and Cartesian product – principle of inclusion and exclusion.	
RELATIONS	**6 Hours**
Relations on sets –Types of relations and their properties - Equivalence relations –Relational matrix and the graph of relation – Operations on relations.	
FUNCTIONS AND RECURRENCE RELATIONS	**11 Hours**
Functions –Type of functions – Injective, surjective and bijective functions –Composition of functions – Inverse functions –Permutation functions - Recurrence relations-Solving linear recurrence relations.	
LOGIC	**12 Hours**
Propositions- Logical operators- Normal forms –Rules of inference-Consistency and inconsistency-Propositional logic- Proofs-Predicates- Quantifiers- Universe of discourse – Logical equivalences and implications for quantified statements-Rules of specification and generalization – Validity of arguments.	
GRAPH THEORY	**11 Hours**
Graphs- Types of graphs- Matrix representation of graphs- Graph isomorphism- Walk – Path - Cycles- Eulerian graphs -Hamiltonian graphs- Planar graphs- Euler formula- Shortest path algorithm: Dijkstra's algorithm	

Theory: 45 Hrs	**Tutorial: 0**	**Total Hours: 45 Hrs**

Textbooks:

1. Kenneth H. Rosen, “Discrete Mathematics and its applications: With Combinatorics and Graph Theory (7th Edition)”, Tata McGraw-Hill, 2015.
2. Tremblay J.P., Manohar R., “Discrete Mathematical Structures with applications to Computer Science”, Tata McGraw-Hill, International Edition, 2017

Reference Books:

1. Liu C.L, “Elements of Discrete Mathematics”, 4th Edition, McGraw Hill, 2017.
2. Grimaldi, R.P. “Discrete and Combinatorial Mathematics: An Applied Introduction”, 5 th Edition, Pearson Education Asia, Delhi, 2016.
3. Mott J.L, Kandel A. and Baker T.P., “Discrete Mathematics for Computer Scientists and Mathematicians”, 2nd Edition, Prentice Hall India, 2015.
4. Narsingh Deo, “Graph Theory with Applications to Engineering and Computer Science”, Courier Dover Publications, 2017.

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U18MAI2203	PROBABILITY AND STATISTICS	L	T	P	J	C
		3	0	2	0	4

Course Objective:

- To introduce the basic concepts of probability and random variables
- To introduce the basic concepts of two dimensional random variables
- To acquire the knowledge of testing hypotheses for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of engineering and statistical quality control.

Course Outcomes:

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

CO 1:	Understand and apply the concept of probability and random variables and predict probabilities of events in models following normal distribution.
CO 2:	Apply the concepts of two dimensional random variables, central limit theorem and estimation, which lay the foundation for Machine Learning and Data Science.
CO 3:	Perform hypothesis testing and interpret the results which will form the basis for Data Analysis
CO 4:	Understand the principles of design of experiments and perform analysis of variance which will help in Data Analysis.
CO 5:	Learn and apply multivariate analysis necessary for Principal Component Analysis.
CO 6:	Use R software to solve problems in the above topics

Pre-requisite courses:Nil

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S										
CO2	S	S										
CO3	S	M										W
CO4	S	S										M
CO5	M	S										M
CO6					S							S

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

b)Indirect

1. Course-end survey

Topics covered:

PROBABILITY AND RANDOM VARIABLES	**13 Hours**

Axioms of probability - Conditional probability – Total probability – Bayes' theorem Random variable – Distribution function – properties – Probability mass function – Probability density function – moments - Standard Distributions - Binomial, Poisson and Normal distributions

TWO DIMENSIONAL RANDOM VARIABLES AND ESTIMATION	**9 Hours**

Joint distributions – Marginal and conditional distributions – Expected values of functions of two variables– Correlation and regression (for discrete data only) - Central limit theorem – Statement

TESTING OF HYPOTHESIS	**10 Hours**

Large sample tests for single mean and difference of means-Small samples tests based on t and F distributions (single mean, difference of means, paired t- test and variance ratio test) – Chisquare test for independence of attributes and goodness of fit.

DESIGN OF EXPERIMENTS	**5 Hours**

Analysis of Variance (ANOVA) – Completely Randomized Design (CRD) – Randomized Block Design (RBD)

MULTIVARIATE ANALYSIS	**8 Hours**

Random vectors and matrices – Mean vectors and covariance matrices –Principal components – Population principal components – Principal components from standardized variables.

Theory: 45 Hrs	**Tutorial: 0**	**Total : 45 Hrs**

Lab component Contents:

List of R Programmes:

1. Introduction to R programming
2. Application of descriptive statistics – Mean, Median, Mode and standard deviation, Skewness and Kurtosis
3. Applications of Correlation and Regression
4. Application of Normal distribution
5. Application of Student – t test

6. Application of F test
7. Application of Chi-square test
8. ANOVA – one way classification
9. ANOVA - two way classification
10. Box Plots

Practical: 30 Hrs	Tutorial: 0	Total Hours : 30 Hrs

Text Books:

1. Johnson R. A., Miller & Freund's, Sixth Edition, 2000, "Probability and Statistics for Engineers", Pearson Education, Delhi.
2. Gupta.S.C and Kapoor.V.K, 11th extensively revised edition, 2007 Fundamentals of Mathematical Statistics,, Sultan Chand & Sons.

Reference Books:

1. Walpole R. E., Myers S.L. & Keying Ye, 9th edition, 2012, "Probability and Statistics for Engineers and Scientists", Pearson Education Inc.
2. Gupta S.C, and KapurV.K, 4th Edition, 2014, "Fundamentals of Applied Statistics", Sultan Chand, New Delhi.
3. Charles Henry Brase and Corrinne Pellillo Brase , 9th edition, 2007, "Understandable Statistics", D.C. Heath and Company, Toronto.
4. Gareth M. James, Daniela Witten, Trevor Hastie, Robert Tibshirani, 7th edition, "An Introduction to Statistical Learning: With Applications in R".
5. Richard A. Johnson and Dean W. Wichern, 5th Edition, 2012, Applied Multivariate Statistical Analysis, Pearson Education, Asia.
6. Anderson, T. W , 2003, An Introduction to Multivariate Statistical Analysis, John Wiley and Sons

Crafted By : Dr. Vijeta Iyer, M.Sc., PhD., Department of Mathematics, KCT & Gokul Kumar M.Sc (BITS Pilani), MBA, Co-Founder & CTO, Vusar - AR 3D Design Visualization

U18AII2204	OBJECT-ORIENTED PROGRAMMING AND DATA STRUCTURES	L	T	P	J	C
		2	0	2	0	3

Course Objectives:

- To understand the importance of Classes & objects along with constructors
- To discuss the principles of inheritance and Class and interface and demonstrate though problem analysis
- assignments how they relate to the design of methods, abstract classes and interfaces and packages
- To introduce the fundamental concept of data structures and to emphasize the importance of data structures in developing and implementing efficient algorithms
- Understand and remember algorithms and its analysis procedure.
- To introduce the concept of data structures through ADT including List, Stack, Queues

Course Outcomes:

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

CO 1:	Understand the object oriented programming concepts and GUI
CO 2:	Apply Overloading and concept of handling exceptions
CO 3:	Demonstrate the concepts of data structures using python
CO 4:	Develop the graph, sorting and search techniques of data structures

Pre-requisite courses: U18AII1205 Introduction to Python

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	S	M	S						S	S
CO2	S	S	S	S	S						S	S
CO3	S	S	S	M	S						S	S
CO4	S	S	S	S	S						S	S

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)

4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

b)Indirect

1. Course-end survey

Topics covered:

OBJECT ORIENTED CONCEPTS IN PYTHON	8 Hours

Introduction - Classes and Objects - Creating Python Classes - Classes and Functions - Pure Functions- Classes and Methods - Inheritance: Basic Inheritance, Multiple Inheritance - Polymorphism - Class Diagrams - Data Encapsulation - GUI - Event-driven programming paradigm; tkinter module, creating simple GUI; buttons, labels, entry fields, dialogs; widget attributes - sizes, fonts, colors layouts, nested frames.

EXCEPTIONS	7 Hours

Operator Overloading - The Basics- Indexing and Slicing- Index Iteration-Iterable Objects- Membership- Attribute AccessObject Destruction- Exceptions - Exception Basics-Catching Exceptions- Raising Exceptions- UserDefined ExceptionsThe try/except/else Statement- The try/finally Statement- Unified try/except/finally- The Raise Statement- Exception Objects- Nesting Exception.

DATA STRUCTURES	7 Hours

Abstract Data Types (ADT) - Linked List Implementation - Doubly-Linked Lists - Circularly Linked Lists - Applications of Lists - Stack ADT - Implementation of Stack and its Applications - Queue ADT - Implementation of Queue and its Applications - Tree ADT - Tree Traversals - Binary Tree ADT - Expression Trees - Applications of Trees - Binary Search tree ADT .

GRAPHS, SORTING AND SEARCHING TECHNIQUES	8 Hours

Graph and its Representations - Graph Traversals - Heap - Binary Heap - Applications of Priority Queues, Preliminaries - Insertion Sort - Shell sort - Heap sort - Merge sort - Quick sort - Linear Search - Binary Search

Theory: 30 Hrs	Tutorial: 0	Total: 30 Hrs

Lab Component:

List of Experiments:

1. Class & Object
2. Inheritance
3. Access Specifier and Abstract Class
4. Exception
5. Constructor Overloading, Operator Overloading
6. Implementation of Stack and Queue
7. Implementation Linked list, Circular Linked List, Double Linked

8. Implementation of Binary Search Tree
9. Implementation of Sorting Algorithms

Practical: 30 Hrs	Tutorial: 0	Total Hours : 30 Hrs

Textbooks:

1. Allen Downey , 2002, ”Think Python- How to think like a Computer Scientist”, O'Reilly Media, Inc.
2. Dusty Phillips, 2nd Edition, 2015, "Python 3 - Object Oriented Programming", Packet Publishing Ltd.

Reference Books:

1. Kenneth Lambert, 2nd Edition, 2018, “Fundamentals of Python: Data Structures” .
2. Thomas H. Cormen, Charles E. Leiserson, 3rd Edition, 2009, “ Introduction to Algorithms”.
3. Eric Matthes, 2nd Edition, 2019, “Python Crash Course: A Hands-On, Project-Based Introduction to Programming”.

Crafted By : Dorai Thodla, B.E (CEG, Guindy), Founder & CTO, iMORPH, California and
Gokul Kumar, M.Sc (BITS Pilani), MBA, Co-Founder & CTO, Vusar - AR 3D Design Visualization, California

U18AII2205	INTRODUCTION TO AI & ML	L	T	P	J	C
		2	0	2	0	3

Course Objective:

- To introduce the basic concepts, theories and state-of-the-art techniques of artificial intelligence.
- To introduce basic concepts and applications of machine learning.
- To learn the application of machine learning /A.I algorithms in the different fields of engineering, science, medicine, finance etc.

Course Outcomes:

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

CO 1:	Understand the basic concepts of machine learning and some typical applications
CO 2:	Understanding how to build and validate models and improve them iteratively
CO 3:	Understand the core concepts of Artificial Intelligence and Applications
CO 4:	Apply knowledge representation with artificial intelligence using FOL and Predicate logic

Pre-requisite courses: U18AII1205 Introduction to Python

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	S	M	S						S	S
CO2	S	S	S	S	S						S	S
CO3	S	S									M	S
CO4	S	S	S	M							S	S

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

b)Indirect

1. Course-end survey

Topics covered:

INTRODUCTION TO MACHINE LEARNING	8 Hours

Introduction - Machine Learning Process - Supervised Learning - Regression - Linear Regression - Predicting - Polynomial Regression - Classification - Feature Engineering - Logistic Regression - kNN classification - SVM - Naive bayes - Decision tree and Random forest classifier - Unsupervised Learning - Clustering techniques.

ANALYSIS OF MODELS	8 Hours

Model representation, decision boundary, cost function, gradient descent, regularization, evaluating a hypothesis (Model selection), training/validation/testing procedures, bias/variance, learning curves, Accuracy and Error measures, evaluating the accuracy of a classifier or predictor, Confusion metric, precision, recall, ROC curve and AUC score, Parameter Tuning.

ARTIFICIAL INTELLIGENCE : PROBLEM SOLVING	6 Hours

Introduction to AI, Control strategies, Search strategies, Production system characteristics - Specialized production system- Problem solving methods - Problem graphs, Matching, Indexing and Heuristic functions -Hill Climbing-Depth first and Breadth first, Constraints satisfaction Problem.

KNOWLEDGE REPRESENTATION AND REASONING	8 Hours

Game playing - Knowledge representation, Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other logic-Structured representation of knowledge.- First order logic – Syntax and Semantics – Knowledge Engineering in First Order Logic – Inference in First Order Logic.

Theory: 30 Hrs	Tutorial: 0 Hrs	Total Hours: 30 Hrs

Lab Component:

List of Experiments:

1. Implement python program to perform operations like mean, median, mode, standard deviation, percentile and various data distributions
2. Try to open a csv file and sort the content with respect to one column using python
3. Implement a python program to perform linear regressions for a dataset that prevails in csv format
4. Implement a python program to perform logistic regression
5. Write a program to implement k-Nearest Neighbour algorithm to classify any dataset. Print both correct and wrong predictions. Python ML library classes can be used for this problem.
6. Assume that K=3
7. Write a program to construct a Support Vector Machine considering medical data. Use this model to demonstrate the diagnosis of heart patients using the standard Heart Disease Data Set. You can use Python ML library classes/API.
8. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.
9. Assuming a set of data that need to be classified, use a decision tree model to perform this task. Preferably use any dataset like medical, titanic dataset or others to evaluate the accuracy
10. Implement a python program to perform Hill climbing algorithm

Practical: 30 Hrs	Tutorial: 0	Total: 30 Hrs

Textbooks:

1. Alexey Grigorev, 2020, “Machine Learning Bookcamp”, MEAP.
2. Shai Shalev-Shwartz, Shai Ben-David, 2014, “Understanding Machine Learning From Theory to Algorithms”, Cambridge University Press

Reference Book:

1. Kevin Night and Elaine Rich, Nair B., 2008, “Artificial Intelligence (SIE)”, McGraw Hill.

Crafted By : Dorai Thodla, B.E (CEG, Guindy), Founder & CTO, iMORPH, California and Gokul Kumar, M.Sc (BITS Pilani), MBA, Co-Founder & CTO, Vusar - AR 3D Design Visualization, California

Reviewed By : Derrick Jose, B.E (BITS Pilani), CEO & Founder, Flutura, Texas

U18AII2206	INTRODUCTION TO DATA SCIENCE	L	T	P	J	C
		2	0	2	0	3

Course Objective:

- To introduce the basic concepts of data science
- To enable students to handle various dataset
- To train the applications of data science and perform data transformations

Course Outcomes:

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

CO 1:	Understand the various aspects of data science and the skill sets necessary for a data scientist
CO 2:	Explain the concepts of data storage and Big Data
CO 3:	Illustrate the different types of process and tools used in data science
CO 4:	Apply the principles of Data Science for analysis using Google Sheets and Excel

Pre-requisite courses:Nil

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											M
CO2	S	S		M							S	S
CO3	S	S	S	M	S						S	S
CO4	S	S	S		S						S	S

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

b)Indirect

1. Course-end survey

Topics covered:

BASICS OF DATA SCIENCE	10 Hours

Data Science: Steps in doing Data Science - Data Science relation to other fields- Data Science and Information Science- Computational Thinking - Skills and tools needed to do Data Science - Storing data - Combining bytes into larger structures - Creating data sets - Identifying data problem - Understanding data sources - Exploring data models- Introduction to Big Data

DATA HANDLING	**10 Hours**

Structured and unstructured data - Challenges with unstructured data - Data collection: Open data - multimodal data - Data Preprocessing: Data Cleaning - Data Integration, Data Transformation - Data Reduction - Data Discretization

EXCEL FOR DATA SCIENCE	**10 Hours**

Elementary data handling: Types - Data Transformation - Filtering -Pivot tables - Graphical Methods - Descriptive statistics - Random sampling - Probability distributions using functions- Binomial - poisson - Normal - Geometric - Negative binomial - exponential - gamma - beta- lognormal - pmf and cmd- Hypothesis testing using Data Analysis Pack - Z test and t-test.

Theory: 30 Hrs	**Tutorial: 0 Hrs**	**Total Hours: 30 Hrs**

Lab Component:

List of Experiments:

1. Basic Statistics and Visualization
2. Data distribution
3. Reading and Writing different types of dataset
4. Correlation and Covariance
5. Regression Model
6. Implementation of Pivot table
7. Implementation of Probability Distribution using Function
8. Implementation of Hypothesis

Textbooks:

1. Jeffrey S. Saltz, Jeffrey M. Stanton, 2018, An Introduction to Data Science, SAGE Publications
2. Chirag Shah, 2020, A Hands-On Introduction to Data Science, Cambridge University Press

Reference Books:

1. Ash Narayan Sah, 2009, Data Analysis Using Microsoft Excel, Excel books
2. Joel Grus, 2015, “Data Science from Scratch”.

Crafted By : Gokul Kumar, M.Sc (BITS Pilani), MBA, Co-Founder & CTO, Vusar - AR 3D Design Visualization, California
Reviewed By : Adarsh Natarajan, MBA (IIM B), CEO & Founder, AIndra Systems

L	T	P	J	C
1	0	0	0	1

U18TLR2001 - TAMILS AND TECHNOLOGY

Course Outcomes

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

CO1: Enhance the fundamental knowledge of weaving and ceramic Technology

CO2: Understand the heritage ,rock art paintings to modern art sculpture

CO3: Acquire essential knowledge in the folk and martial arts

CO4: Understand the importance of role thinai concept of tamils.

CO5: Gain the knowledge of contribution by tamils to indian national movement and indian culture

Assessment methods Direct

1.Continuous Assessment Test I, II

2.Two Assignments

3.End Semester Examination

UNIT I WEAVING AND CERAMIC TECHNOLOGY

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

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

UNIT III MANUFACTURING TECHNOLOGY

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

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING

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

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
3. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
5. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu) 12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Syllabi - 2nd Year
Semester III

U18MAI3201	MULTIVARIATE CALCULUS AND FORECASTING	L	T	P	J	C
		3	0	2	0	4

Course Objectives:

- To enable learning of Multivariate calculus as it's one of the most important data science skills and multivariate calculus is used everywhere in Machine Learning Projects.
- To demonstrate an understanding of Calculus beyond the manipulation of symbols,
- To enable classification or regression when operations are related with multiple variables
- To understand the theory and methods of Calculus to solve a variety of problems in terms of multivariate dataset

Course Outcomes:

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

CO 1:	Evaluate the total derivative of a function, expand the given function as a series and locate the maximum and minimum for multivariate functions which is an important part of data science.
CO 2:	Solve higher order partial differential equations arising in real world situations.
CO 3:	Evaluate double and triple integrals in Cartesian coordinates and apply them to calculate area and volume.
CO 4:	Evaluate gradient, divergence and curl which form the basis of gradient descent and apply them to real life problems.
CO 5:	Analyze and apply the knowledge of time series and interpolation to predict the future values.
CO 6:	Determine multiple integrals, vector differentials, vector integrals using MATLAB.

Pre-requisite courses: U18MAI1203

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S										M
CO2	W											
CO3	W	W										W
CO4	M	M										
CO5	M											M

CO6					S							S

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

b)Indirect

1. Course-end survey

Topics covered:

FUNCTIONS OF SEVERAL VARIABLES	**9 Hours**

Partial derivatives – Homogeneous functions and Euler's theorem –Total derivative – Taylor's series expansion – Maxima and minima of functions of two variables – Constrained maxima and minima: Lagrange's multiplier method with single constraints – Jacobians.

PARTIAL DIFFERENTIAL EQUATIONS	**5 Hours**

Linear Homogeneous partial differential equations of second and higher order with constant coefficients

MULTIPLE INTEGRALS	**9 Hours**

Double integration – Cartesian coordinates – Change of order of integration – Triple integration in Cartesian coordinates – Applications: Area as double integral and Volume as triple integral.

VECTOR CALCULUS	**10 Hours**

Gradient, divergence and curl – Directional derivative – Irrotational and Solenoidal vector fields - Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (Only statements excluding proofs)

TIME SERIES AND INTERPOLATION	**12 Hours**

Time series - components - Trend-Determination of trend by moving averages – Least square method-Seasonal Variations-Ratio to moving average method.

Interpolation – Newton's forward and backward interpolation – Newton's divided difference interpolation – Lagrange's interpolation.

Theory : 45 Hrs	**Tutorial : 0**	**Total Hours: 45 Hrs**

Lab component Contents:

List of MATLAB Programmes:

1. Determining Maxima and Minima of a function of two variables.

2. Evaluating double integral with constant and variable limits.
3. Area as double integral
4. Evaluating triple integral with constant and variable limits
5. Volume as triple integral
6. Evaluating gradient, divergence and curl
7. Evaluating line integrals and work done
8. Verifying Green's theorem in the plane

Practical : 30 Hrs	Tutorial : 0	Total Hours: 30 Hrs

Textbooks:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2014.
2. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., New Delhi, 11th Reprint, 2010.
3. Grewal B.S. and Grewal J.S., "Numerical methods in Engineering and Science", 9th Edition, Khanna Publishers, New Delhi, 2007.
4. Montgomery D.C., Johnson. L.A., Gardiner J.S., "Forecasting and Time series Analysis", McGraw Hill, 1990.

Reference Books:

1. Kreyzig E., "Advanced Engineering Mathematics", 10th Edition, John Wiley and sons, 2011.
2. Venkataraman M.K., "Engineering Mathematics", The National Publishing Co., Chennai,2003
3. Weir, MD, Hass J, Giordano FR: Thomas' "Calculus", Pearson education 12th Edition, 2015.
4. Thomas G.B. and Finney R.L., "Calculus and Analytic Geometry", 11th Edition, Pearson Education, 2006.
5. Gerald, C. F. and Wheatley, P. O.,"Applied Numerical Analysis", 7th Edition, Pearson Education Asia, New Delhi, 20073.
6. Grewal B.S. and Grewal J.S., "Numerical methods in Engineering and Science", 9th Edition, Khanna Publishers, New Delhi, 2007.
7. Montgomery D.C., Johnson. L.A., Gardiner J.S., "Forecasting and Time series Analysis", McGraw Hill, 1990..

Crafted By : Dr. K. Maheswari, M.Sc., PhD., Department of Mathematics, KCT

U18AII3202	ALGORITHMS AND OPTIMIZATION OF PROGRAMS	L	T	P	J	C
		3	0	2	0	4

Course Objectives:

- To teach paradigms and approaches used to analyze and design algorithms and to appreciate the impact of algorithm design in practice.
- To make students understand how the worst-case time complexity of an algorithm is defined, how asymptotic notation is used to provide a rough classification of algorithms.
- To explain different computational models (e.g., divide-and-conquer), order notation and various complexity measures (e.g., running time, disk space) to analyze the complexity/performance of different algorithms.
- To teach various advanced design and analysis techniques such as greedy algorithms, dynamic programming & Know the concepts of tractable and intractable problems and the classes P, NP and NP-complete problem

Course Outcomes:	
After successful completion of this course, the students should able to	
CO 1:	Understand techniques for effective problem solving in computing
CO 2:	Design different paradigms of problem solving to illustrate clever and efficient ways to solve a given problem.
CO 3:	Identify and apply for rigorously proving correctness of the algorithm for a variety of problems.
CO 4:	Implement to show the efficiency of the algorithm over the naive techniques

Pre-requisite courses: U18AII2204

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											M
CO2	S	S		M							S	S
CO3	S	S	S	M	S						S	S
CO4	S	S	S		S						S	S

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

b)Indirect

1. Course-end survey

Topics covered:

ANALYSIS OF ALGORITHMS	**7 Hours**

Introduction Role of Algorithms in computing, Analyzing algorithms and Designing algorithms, Algorithm Design techniques: Divide and Conquer – Merge Sort and Quicksort. **Time complexity:** Growth of Function: Asymptotic notation, Standard notations and common functions Complexity analysis-Time and space tradeoffs in algorithms, Using recurrence relations to analyze recursive algorithms, Master Theorem(Without Proof).

ADVANCED DESIGN AND OPTIMIZATION	**8 Hours**

Algorithm design techniques - Brute-force – Sequential search, Dynamic Programming – Rod cutting problem, Greedy algorithms – Activity Selection Problem; Divide-and-conquer – Strassen's Matrix Multiplication; Backtracking – 8 queens problem; Branch and- bound – Traveling Salesman Problem, 0/1 Knapsack Problem- String Matching Algorithms - Geometric algorithms - Approximation algorithms.

TREES, GRAPHS AND HASHING	**8 Hours**

Non-Linear Data Structures: General Tree; Binary trees, Binary Search Tree: Traversals Graphs: Introduction, Representations of graphs (adjacency list, adjacency matrix)
Hashing: Hash tables, including collision-avoidance strategies, MD5 Hashing, Hashing in SSH. DFS and BFS, Shortest-path algorithms (Single source shortest path. Dijkstra's and Floyd's algorithms); Minimum spanning tree (Prim's and Kruskal's algorithms)

COMPLEXITY CLASS	**7 Hours**

COMPLEXITY CLASS: P, NP and NP -Completeness Problems (without proofs). **Case Study**: Implement a program that resolves any real time problem and optimize the same script in which its time and space complexity is reduced linearly or exponentially.

Theory : 30 Hrs	**Tutorial : 0**	**Total Hours: 30 Hrs**

Lab component Contents:

List of Experiments:

1. Implementation of Sorting algorithms
2. Implementation of Warshall's algorithm
3. Designing Knapsack problem

4. Shortest paths Algorithm
5. Minimum cost spanning tree
6. Implementation of travelling salesman problem
7. Implement N Queens problem using Backtracking

Practical : 30 Hrs	Tutorial : 0	Total Hours: 30 Hrs

Textbooks:

1. Design and Analysis of Algorithms by Sartaj Sahni and Ellis Horwitz, Galgotia Publications 2015.
2. Anany Levitin, Introduction to the Design and Analysis of Algorithms, Pearson Education , 2012
3. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein, Introduction to Algorithms, Third Edition, Prentice Hall of India,New Delhi, 2010

Reference Books:

1. J. Klienberg and E. Tardos, Algorithm Design, Pearson Education Limited , 2014
2. Algorithms, by Dasgupta, Papadimitrou and Vazirani, McGraw-Hill Education, 2006.
3. Computer Algorithms, by Horowitz, Sahni, and Rajasekaran, Silicon Press, 2007.

U18AII3203	OPERATING SYSTEM	L	T	P	J	C
		2	0	2	0	3

Course Objective

- To learn the mechanisms of OS to handle processes and threads and their Communication
- To learn the mechanisms involved in memory management in contemporary OS
- To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols
- To know concept and working principle of open-source OS

Course Outcomes:

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

CO 1:	Apply the concepts of CPU scheduling and Process synchronization
CO 2:	Experiment creation of different virtual machines in a hypervisor
CO 3:	Simulate the principles of memory management
CO 4:	Examine the features of various open source operating systems

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

b)Indirect

1. Course-end survey

Pre-requisite courses:Nil

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											M
CO2	S	S			M			S			S	S
CO3	S	S		S	M	S					S	S
CO4	S	S		S		S					S	S

Topics covered:

INTRODUCTION AND PROCESS CONCEPT	7 Hours

Operating System Structure - Operating System Operations - Process Management - Memory Management - Storage Management - Protection and Security - System Structures: Operating System Services - User and Operating System Interface - System Calls - Types of System Calls - Process Scheduling - Operations on Processes - Inter-process Communication.

MULTITHREADED PROGRAMMING AND PROCESS SCHEDULING	8 Hours

Overview of threads - Multicore programming - Multithreading Models - Threading Issues - Basic Concepts of process scheduling - Scheduling Criteria - Scheduling Algorithms - Multiple Processor Scheduling - Synchronization - The Critical-Section Problem - Peterson's Solution Synchronization Hardware - Semaphores - Classic problems of Synchronization - Monitors

DEADLOCK AND MEMORY MANAGEMENT STRATEGIES	7 Hours

System Model - Deadlock Characterization - Methods for Handling Deadlock - Deadlock Prevention - Deadlock Avoidance - Deadlock Detection - Recovery from Deadlock. Swapping - Contiguous Memory Allocation - Paging - Structure of the Page Table- Segmentation.

OPEN SOURCE SOFTWARE SYSTEMS	8 Hours

Basic UNIX Commands - File Filters: File Related Commands - Piping -Joining - awk and backup Commands - Processes in Linux: User Process and Terminal Handling. Users and Account Management: Configuration - Creating - Testing - Removing - Allocating - System Logging: Logging – Accounting. Compiling and Debugging: Compiling C and C++ Programs under Linux - GNU Debugger: Debugger using GDB - Make: Syntax of makefiles - Automake and Autoconf.

Theory : 30 Hrs	Tutorial : 0	Total Hours: 30 Hrs

Lab component Contents:

List of Experiments:

1. Develop programs for process creation and communication.
2. To Creation of process and child process
3. Demonstration of inter-process communication Creation of Zombie and Orphan process Creation of threads
4. Demonstration of shared memory concept
5. Simulation of the CPU scheduling algorithms
6. Demonstration of Semaphores
7. Implementation of Producer-Consumer problem
8. Simulation of Bankers algorithm for deadlock avoidance
9. Creation of virtual machine in a hypervisor

Practical : 30 Hrs	Tutorial : 0	Total Hours: 30 Hrs

Textbooks:

1. William Stallings, “Operating Systems – Internals and Design Principles”, 7th Edition, Prentice Hall, 2011.
2. Andrew S. Tanenbaum, “Modern Operating Systems”, Second Edition, Addison Wesley, 2001.

Reference Books:

1. Charles Crowley, “Operating Systems: A Design-Oriented Approach”, Tata Mc Graw Hill Education”, 1996.
2. D M Dhamdhere, “Operating Systems: A Concept-Based Approach”, Second Edition, Tata Mc Graw-Hill Education, 2007.

U18AII3204	APPLIED MACHINE LEARNING	L	T	P	J	C
		3	0	2	0	4

Course Objectives:

· To train in terms of Machine Learning Problems and its forms

· To make students understand statistical analysis for classification

· To explain different fuzzy inference systems

· To teach various advanced techniques in business intelligent systems

Course Outcomes:

After successful completion of this course, the students should able to

CO 1:	Understand different methodologies to create application using statistical models
CO 2:	Design the test procedures to assess the efficacy of the developed model.
CO 3:	Identify and apply appropriate machine learning models for analyzing the data for a variety of problems.
CO 4:	Implement different algorithms for business intelligence

Pre-requisite courses: U18AII2205

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S				M		M					M
CO2	S	S		M				S			S	S
CO3	S	S	S	M	S			S		M	S	S
CO4	S	S	S		S						S	S

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

b) Indirect

1. Course-end survey

Topics covered:

INTRODUCTION	**8 Hours**
Real-world use cases of Machine Learning. Introduction to SciKit-Learn. Machine learning LifeCycle an implement a multi-variable regression problem with the scikit-learn library	
LINEAR REGRESSION AND LOGISTIC REGRESSION	**18 Hours**
Understanding cost function and gradient descent. Overfitting and Underfitting K-Nearest Neighbours Classification and Regression Linear Regression: Least Squares, Ridge, Lasso and Polynominal Regression Logistic Regression: SVM and Hyperparameter tuning and Implementing SVM using scikit-learn	
MODEL EVALUATION	**7 Hours**
How and why should we evaluate models? Model Evaluation and Selection methods, Precision-Recall and ROC Curves Confusion Matrices, Regression Evaluation, Optimizing Classifiers for Different Evaluation Metrics	
NAIVE BAYES, DECISION TREES AND RANDOM FOREST	**12 Hours**
Naive Bayes Classifiers, Decision Tree, Training and Visualizing a Decision Tree, Entropy and The CART Training Algorithm, Random Forests, Implement Random forest with a real-world use case and understand th basics of random forest, Boosting - AdaBoost and Gradient Boosting, Capstone Project	

Theory: 45 Hrs	**Tutorial : 0**	**Total Hours: 45 Hrs**

Lab component Contents:

List of Experiments:

1. Implementing multi variable regression problem
2. Evaluating cost function and gradient descent
3. Implementing K NN
4. Implementing SVM
5. Evaluating Precision, Recall
6. Implementing Decision Tree
7. Implementing Random forest
8. Implementing Adaboost
9. Implementing Gradient boosting

Practical : 30 Hrs	**Tutorial : 0**	**Total Hours: 30 Hrs**

Textbooks:

1. 1.Aurélien Géron "Hands-On Machine Learning with Scikit-Learn and TensorFlow" Publisher(s): O'Reilly Media, Inc 2017.

Reference Books:

1. M.Gopal, “Applied Machine Learning”, McGraw Hill Education (15 May 2018).
2. David Forsyth “Applied Machine Learning” Springer; 1st edition (12 July 2019).
3. Mohd. Shafi Pathan, Nilanjan Dey, Parikshit N. Mahalle, Sanjeev Wagh, "Applied Machine Learning for Smart Data Analysis", CRC Press, 2019.

U18AII3205	DATA COLLECTION AND DATA MANAGEMENT	L	T	P	J	C
		2	0	2	0	3

Course Objectives:

- To learn and practice data modelling using the entity relationship and developing database designs.
- To understand the concept of non structured data handling in data science
- To introduce the tools required to manage and analyze big data like Hadoop, NoSql MapReduce
- To enable students to have skills that will help them to solve complex real-world problems in for decision support

Course Outcomes:

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

CO 1:	Explain basic database concepts, applications, data models, schemas and instances
CO 2:	Understand the concept of handling unstructured data
CO 3:	Explain the various data collection methodologies such as map ,filter and List comprehension
CO 4:	Apply mapreduce in real world applications

Pre-requisite courses: Nil

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											M
CO2	S	S			M			S			S	S
CO3	S	S		S	M	S						
CO4	S	S		S		S			M			S

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

b) Indirect

1. Course-end survey

Topics covered:

INTRODUCTION TO DATABASE AND RELATIONAL DATABASE	9 Hours

Introduction - Purpose of database systems - Views of data - Database Development Life cycle - Architecture of DBMS - Key Principles of RDBMS- Database Design and Relational Database- ETL Concepts - ER Model - Constraints - ER-Diagrams - Design Issues - Weak Entity Sets - UML - Converting ER Model to Relational Database Design - Normalization - NF - 2NF - 3NF - multivalued dependency and 4 NF

UNSTRUCTURED DATA HANDLING	7 Hours

Introduction to unstructured data - XML and JSON - NoSQL databases - MongoDB - Web crawling and web APIs - Regular expressions- Information retrieval - Scoring - weighting - vector space

DATA COLLECTION AND PROCESSING	7 Hours

Map - Filter - List manipulations - List Comprehensions - Nested Data and Nested Iterations- Structuring Nested Data - Shallow Copies - Deep Copies - Extracting from Nested Data - Example of Nested Iteration

INTRODUCTION TO MAPREDUCE	7 Hours

Cloud computing and data centers - Hadoop API - Mapreduce programming model- Algorithms Using MapReduce - Extensions to MapReduce - The Communication Cost Model - Complexity Theory for MapReduce

Theory: 30 Hrs	Tutorial : 0	Total Hours: 30 Hrs

Lab component Contents:

List of Experiments:

1. Processing CSV Data using python(Kaggle data)
2. Processing JSON Data using python
3. Processing XLS Data using python
4. Implementation of MongoClient using python
5. Implementation of Map & Filter
6. Implementation of List Comprehension
7. File Management tasks in Hadoop
8. Analyse time-temperature statistics and generate report with max/min temperature in Hadoop

Practical : 30 Hrs	Tutorial : 0	Total Hours: 30 Hrs

Textbooks:

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts , McGraw -Hill, 2015
2. C.J.Date, A.Kannan and S.Swamynathan, “An Introduction to Database Systems”, Eighth Edition, Pearson Education, 2006.

Reference Books:

1. Atul Kahate, “Introduction to Database Management Systems”, Pearson Education, New Delhi, 2006.
2. Alexis Leon and Mathews Leon, “Database Management Systems”, Vikas Publishing House Private Limited, New Delhi,
3. Raghu Ramakrishnan, “Database Management Systems”, Fourth Edition, Tata McGraw Hill, 2010.
4. G.K.Gupta,”Database Management Systems”, Tata McGraw Hill, 2011.
5. Rob Cornell, “Database Systems Design and Implementation”, Cengage Learning, 2011.

U18AIC3006	TOOLS AND TECHNOLOGIES FOR WELLNESS	L	T	P	J	C
		1	0	0	0	1

Course Objectives:

- To understand the concept of ayurveda
- To explain how Asana, Pranayama, Ayurvedic knowledge and Mindfulness for well-being is useful in day to day life

Course Outcomes:	
After successful completion of this course, the students should be able to	
CO 1:	Understand the various tools like Asana, Pranayama, Ayurvedic knowledge and Mindfulness for well-being
CO 2:	Develop a practical understanding of the various tools

Pre-requisite courses: Nil

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							M	M	M			
CO2							M	M	M			

Course Assessment methods:

a) Direct

1. Continuous Assessment Test
2. Quiz

b)Indirect

1. Course-end survey

Topics covered:

FOUNDATIONS OF WELLNESS	3 Hours

What is wellness- Looking at wellness from various viewpoints of Body - Emotions and Cognition and across cultures- Introduction to tools: Yogic practices - Mindfulness and other contemplative practices

PHYSICAL DIMENSION	3 Hours

Understanding the various aspects of the physical body - problems and issues and tools for physical well-being

EMOTIONAL DIMENSION	**3 Hours**
Understanding emotions - stress - mental health - Tools for emotional well-being	
ENERGY AND COGNITIVE DIMENSION	**3 Hours**
Understanding Cognitive executive functions, cognitive biases and challenges and tools for enhanced cognitive capabilities	
TRANSCENDENTAL DIMENSION	**3 Hours**
Understanding the science of happiness and transcending the limitations of the physical, emotional and cognitive dimensions.	

Theory: 15 Hrs	**Tutorial: 0**	**Total Hours: 15 Hrs**

Text Books:

1. Certification of yoga professionals official guidebook- First edition, Excel books Pvt Ltd., 2016
2. Harvard Medical School Guide to Yoga, Marlynn Wei, James E. Groves

Crafted By : Smrithi Rekha Adinarayanan, MS (State University of New York), co-founder of Anaadi Foundation, Palani

U18AIT3008	PRINCIPLES OF ECONOMICS	L	T	P	J	C
		2	0	0	0	2

Course Objectives:

- To familiarize the students with the basic concept of microeconomics
- To make student understand the demand and supply analysis in business applications
- To familiarise students with the production and cost structure under different stages of production
- To understand the pricing and output decisions under various market structure
- To help students understand and apply the various decision tools to understand the market structure

Course Outcomes:

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

CO 1:	Understand the conceptual foundations and analytical methods used in micro economics
CO 2:	Explain the basics of consumer behavior, behavior of firms and market equilibrium
CO 3:	Understand the market structures of perfect competition, oligopoly and monopolies

Pre-requisite courses: Nil

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							M	M	M			
CO2							M	M	M			
CO3							M	M	M			

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory)

b)Indirect

1. Course-end survey

Topics covered:

INTRODUCTION OF ECONOMICS	**4 hours**
Scope - Relationship with other Disciplines	
MICROECONOMICS	**7 hours**
Firms and Managerial Objectives - Demand - Law of Demand - Determinants of demand - Elasticity of demand - Law of diminishing marginal utility - Exceptions of Demand - Demand forecasting techniques (only theory) - Supply - Law of Supply - Elasticity of Supply	
PRODUCTION FUNCTIONS	**6 hours**
Short and long run laws of production - law of returns 6 to scale - Cost - types of cost - Short and long run cost output relationship - Economies and diseconomies of Scale	
MARKET STRUCTURE	**6 hours**
Perfect Competition- monopoly- duopoly - oligopoly - 6 Monopolistic market structures - characteristics & Price - Output determination- Pricing Methods	
MACROECONOMICS	**7 hours**
Nature & importance. National Income - concepts - GNP - GDP - NNP - Business cycle - Phases of Business Cycle - Controlling Trade Cycle - Inflation - Indian Financial System - Fiscal Policy - Monetary Policy	

Theory: 30 Hrs	**Tutorial: 0**	**Total Hours: 30 Hrs**

Textbooks:

1. Piyali Ghosh Geetika, Purba Roy Chowdhury (2017),Managerial Economics, 3 e, McGraw- Hill Education D N Diwedi (2009). Managerial Economics. Seventh Edition, Vikas Publication

Reference Books:

1. D. N. Gujarati and D.C. Porter, Essentials of Econometrics, McGraw Hill, 4th edition, International Edition, 2009.
2. Christopher Dougherty, Introduction to Econometrics, Oxford University Press, 3rd edition, Indian edition, 2007.
3. Jan Kmenta, Elements of Econometrics, Indian Reprint, Khosla Publishing House,2nd edition, 2008.

Semester 4

U18MAT4105	RANDOM PROCESS AND OPTIMIZATION	L	T	P	J	C
		3	1	0	0	4

Course Objectives:

- To make students understand Discrete and Continuous Random
- variables, Random Processes and their applications in data science
- To Understand about the correlation Functions
- To understand the functional relationship between random inputs and outputs with the use of Random Process Techniques

Course Outcomes:

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

CO 1:	Analyze various random processes with practical applications
CO 2:	Analyze correlation related to various random processes and establish the properties of spectral densities
CO 3:	Analyze and apply appropriate queuing models in domain specific situations
CO 4:	Apply linear programming models to domain specific situations.
CO 5:	Determine the extreme values of functions without constraint and with equality constraints

Pre-requisite courses:Nil

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M										
CO2	S	S										S
CO3	M	M										M
CO4	S	M										
CO5	M	M										

Topics covered:

RANDOM PROCESSES	9+3 Hours

Random Process – Stationary Process – Wide sense stationary and Ergodic processes– Gaussian Random Process – Markov process–Markov chain–Poisson process

CORRELATION AND SPECTRAL DENSITIES	9+3 Hours

Auto correlation - Cross correlation - Properties – Power spectral density – Cross spectral density - Properties – Wiener-Khinchine relation – Relationship between cross power spectrum and cross correlation function

QUEUEING MODELS	**9+3 Hours**

Markovian Queues – Single and Multi-server Models – Little's formula – Machine Interference Model – Self Service Queue.

LINEAR PROGRAMMING	**9+3 Hours**

The phases of OR study – formation of an L.P model – graphical solution – simplex algorithm – artificial variables technique -Big M method

CLASSICAL OPTIMIZATION THEORY	**9+3 Hours**

Unconstrained extremal problems – Equality constraints – Lagrange's method – Inequality constraints - Kuhn -Tucker conditions – Quadratic programming – Simple problems.

Theory: 45 Hrs	**Tutorials: 15 Hrs**	**Total Hours: 60 Hrs**

Text Book:

1. Taha H.A., "Operations Research: An Introduction", 10th Edition, Pearson Education, 2017.
2. Peebles. P.Z., "Probability, Random Variables and Random Signal Principles", Tata McGraw Hill, 4th Edition, New Delhi, 2002.

Reference Books:

1. Cooper. G.R., Mc Gillem. C.D., "Probabilistic Methods of Signal and System Analysis", 3 rd Indian Edition, Oxford University Press, New Delhi, 2012.
2. Miller S.L. and Childers D.G., "Probability and Random Processes with Applications to Signal Processing and Communications", 2nd Edition, Academic Press, 2012.
3. Stark H, and Woods J.W., "Probability and Random Processes with Applications to Signal Processing", 3rd Edition, Pearson Education, Asia, 2002.
4. Wagner H.M., "Operations Research", Prentice Hall of India, 2011.
5. Bhaskar S., "Operations Research", Anuradha Agencies, 2 nd Edition, 2014.

U18AII4201	COMPUTER NETWORKS	L	T	P	J	C
		2	0	2	0	3

Course Objectives:

- To study the basic taxonomy and terminology of the computer networking and enumerate the layers of OSI model and TCP/IP model.
- To acquire knowledge of Application layer and Presentation layer paradigms and protocols
- To study Session layer design issues, Transport layer services, and protocols
- To gain core knowledge of Network layer routing protocols and IP addressing.
- To study data link layer concepts, design issues, and protocols
- To study the fundamentals and basics of Physical layer, and will apply them in real time applications.

Course Outcomes:

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

CO 1:	Understand the functionality and protocols operating in each layer of OSI reference model
CO 2:	Design error control, flow control and routing protocols
CO 3:	Construct network traffic characteristics and congestion control mechanism
CO 4:	Apply terror control, flow control and routing protocols

Pre-requisite courses:Nil

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											M
CO2	S	S			M			S		S		S
CO3	S	S		S	M	S				S		
CO4	S			S		S						S

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

b)Indirect

1. Course-end survey

Topics covered:

DATA COMMUNICATIONS AND DATA LINK LAYER	8 Hours

Data Communication – The OSI Model – TCP/IP Protocol Suite – Addressing – Transmission Media – Networking devices – Network Topologies. Encoding - Error Detection – Reliable Transmission – MAC protocols – CSMA/CD – CSMA/CA

NETWORK LAYER	8 Hours

Circuit Switching – Packet Switching – Bridges and LAN Switches: Spanning Tree algorithm – Internetworking – IPv4 - Subnetting – IPv6 – Routing Techniques: Distance vector (RIP) – Link state (OSPF) — Interdomain Routing (BGP).

TRANSPORT LAYER	8 Hours

UDP – TCP – Congestion Control and Resource Allocation: TCP Congestion Control – Congestion Avoidance Mechanisms – Quality of Service: Integrated Services – Differentiated Services – Network Traffic Analysis Bidirectional Protocols: Piggybacking - User Datagram Protocol - Transmission Control Protocol - Congestion Control

APPLICATION LAYER	6 Hours

Domain Name System – Electronic Mail (SMTP, MIME, IMAP) – File Transfer (FTP) – WWW (HTTP) -TLS/SSL -IP Security

Theory: 30 Hrs	Tutorial : 0	Total Hours: 30 Hrs

Lab component Contents:

List of Experiments:

1. Develop client server based TCP applications using UNIX socket programming functions.
2. Develop client server based UDP applications using UNIX socket programming functions.
3. Simulation of data link and network layer protocols.
4. Performance analysis of TCP and UDP protocol using simulation tool.
5. Performance analysis of routing protocols using simulation tool.
6. Demonstrate the working of network tools such as Ping, TCPDump, Traceroute, Netstat, IPconfig.
7. Analyze the network traffic using Wireshark tool/Packet tracer tool.

Practical : 30 Hrs	Tutorial : 0	Total Hours: 30 Hrs

Textbooks:

1. Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Fifth edition, Morgan Kaufmann Publishers Inc., 2011.
2. William Stallings, “Data and Computer Communications”, Tenth edition, Pearson Education, 2013.

Reference Books:

1. Behrouz A Forouzan, “Data Communications and Networking”, Fifth edition, Tata McGraw–Hill, New Delhi, 2013.
2. James F. Kurose, Keith W. Ross, “Computer Networking, A Top–Down Approach Featuring the Internet”, Sixth edition, Pearson Education, 2012.

U18AII4202	Neural Networks and Deep Learning	L	T	P	J	C
		3	0	2	0	4

Course Objectives:

· To teach paradigms and approaches representations and classifications

· To make students understand architectural designs and propagation algorithms

· To explain different belief networks and convolution neural networks

· To teach various advanced techniques in Recurrent Neural Networks, BPTT, Natural language Processing, Regression and deep networks

Course Outcomes:

After successful completion of this course, the students should able to

CO 1:	Understand different methodologies to create application using deep nets
CO 2:	Design the test procedures to assess the efficacy of the developed model.
CO 3:	Identify and apply appropriate deep learning models for analyzing the data for a variety of problems.
CO 4:	Implement different deep learning algorithms

Pre-requisite courses:U18AII2205

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S								M			M
CO2	S	S		M							S	S
CO3	S	S	S	M	S		M		M		S	S
CO4	S	S	S		S						S	S

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

b)Indirect

1. Course-end survey

Topics covered:

CONVOLUTIONAL NEURAL NETWORKS	10 Hours

Architectural Overview, Motivation, Layers, Filters, Parameter sharing, Regularization, Popular CNN Architectures: ResNet, AlexNet – Applications

RECURRENT AND RECURSIVE NETS	12 Hours

Recurrent Neural Networks, Bidirectional RNNs, Encoder-decoder sequence to sequence architectures - BPTT for training RNN, Long Short Term Memory Networks, Computer Vision - Speech Recognition - Natural language Processing, Case studies in classification, Regression and deep networks.

DEEP LEARNING ARCHITECTURES	12 Hours

Machine Learning and Deep Learning, Representation Learning, Width and Depth of Neural Networks, Learning Algorithms: Capacity - Overfitting - Underfitting - Bayesian Classification - Activation Functions: RELU, LRELU, ERELU, Unsupervised Training of Neural Networks, Restricted and Deep Boltzmann Machines , Auto Encoders

ADVANCED NEURAL NETWORKS	11 Hours

Deep Feedforward Networks : Gradient based learning - Hidden Units - Architectural design – Back Propagation algorithms - Regularization for deep learning: Dataset Augmentation - Noise Robustes –Semi supervised learning -Multitask learning - Deep Belief networks -Generative Adversial Networks by Keras MXnet

Theory : 45 Hrs	Tutorial: 0	Total Hours: 45 Hrs

Lab component Contents:

List of Experiments:

1. Develop programs for data representation.
2. Estimating depth and width of Neural Networks
3. Training of Unsupervised Neural Networks
4. Implementing Gradient based learning
5. Implementing Backpropagation algorithms
6. Implementing Deep Belief networks
7. Visualize data by Computer Vision
8. Implementing RNN

Practical : 45 Hrs	Tutorial : 0	Total Hours: 30 Hrs

Text Books:

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, “Deep Learning”, First Edition, MIT Press, 2016.
2. Nikhil Buduma and Nicholas Lacascio, “Fundamentals of Deep Learning”, First Edition, O.Reilly, 2017

Reference Books:

1. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017
2. Laura Graesser, Wah Loon Keng "Foundations of Deep Reinforcement Learning: Theory and Practice in Python" Addison-Wesley Professional -2020
3. Jon Krohn, Grant Beyleveld, Aglaé Bassens "Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence", 1st edition Addison-Wesley Professional 2019

U18AII4203	DATA MINING AND MODELING	L	T	P	J	C
		2	0	2	0	3

Course Objectives:

· To train the basic concepts and techniques of Data Mining.

· To introduce mathematical statistics foundations of the Data Mining Algorithms.

· To include a wide range of clustering, estimation, prediction, and classification algorithms.

· To experiment basic principles, concepts and applications of cluster analysis

Course Outcomes:

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

CO 1:	Understand about data mining basics,issues and the working principle of classification technique.
CO 2:	Explain the basic concepts of Association Rule Mining and evaluate the working of various Association Rule Mining algorithms
CO 3:	Implement classification and prediction techniques
CO 4:	Analyze the working of different clustering algorithms

Pre-requisite courses:U18MAI2203

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											M
CO2	S	S			M			S			S	S
CO3	S	S		S	M	S					S	S
CO4	S	S		S		S					S	S

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

b)Indirect

1. Course-end survey

Topics covered:

INTRODUCTION TO DATA MINING	7 Hours

Data Mining Goals Stages of the Data Mining Process - Data Mining Techniques - Knowledge Representation Methods Applications Data preprocessing: Data cleaning - Data transformation - Data reduction - Discretization and generating concept hierarchies - Real time data processing in Kaggle - OLAP - OLTP.

MINING FREQUENT PATTERNS, ASSOCIATION AND CORRELATIONS	8 Hours

Mining Frequent Patterns - Associations and Correlations - Mining Methods - Mining various Kinds of Association Rules - Correlation Analysis - Constraint Based Association Mining

CLASSIFICATION	7 Hours

Classification and Prediction - Basic Concepts - Decision Tree Induction - Bayesian Classification - Rule Based Classification - Classification by Backpropagation - Associative Classification - Lazy Learners - Other Classification Methods - Prediction CaseStudies: Implementation in Rapidminer, Weka

CLUSTER ANALYSIS	8 Hours

Cluster Analysis - Types of Data - Categorization of Major Clustering Methods - K-means - Partitioning Metho Hierarchical Methods - Density-Based Methods - Grid Based Methods - Model-Based Clustering Methods - Cluste High Dimensional Data - Constraint - Based Cluster Analysis - Outlier Analysis and Data Mining Applications.

Theory : 30 Hrs	Tutorial : 0	Total Hours: 30 Hrs

Lab component Contents:

List of Experiments:

1. Demonstration of preprocessing on different dataset
2. Demonstration of preprocessing on different dataset
3. Demonstration of Association rule process using apriori algorithm
4. Demonstration of classification rule process using decision tree algorithm
5. Demonstration of classification rule process using naïve bayes algorithm
6. Demonstrate performing Regression on data sets
7. Demonstration of clustering rule process using simple k-means

Practical : 30 Hrs	Tutorial : 0	Total Hours: 30 Hrs

Text Books:

1. Pang-Ning Tan, Michael Steinbach, Vipin Kumar: Introduction to Data Mining, Pearson, F impression,2014
2. Jiawei Han, Micheline Kamber, Jian Pei: Data Mining -Concepts and Techniques, 3rd Edition, Mor Kaufmann Publisher, 2012

Reference Books:

1. Sam Anahory, Dennis Murray: Data Warehousing in the Real World, Pearson, Tenth Impression, 2012.
2. Michael.J.Berry, Gordon.S.Linoff: Mastering Data Mining, Wiley Edition, second edtion, 2012.
3. Hand, Mannila, and Smyth,Principles of Data Mining, MIT Press, 2001.
4. Hastie,Tibshirani, and Friedman, Springer,The Elements of Statistical Learning- Data Mining, Infere and Prediction, 2001.
5. Chakrabarti, Morgan Kaufmann, Mining the Web - Discovering Knowledge from Hypertext Data, 2003
6. I. H. Witten and E. Frank, Data Mining: Practical Machine Learning Tools and Techniques with J Implementations,2005.

U18AIT4006	FINANCE FOR ENGINEERS	L	T	P	J	C
		3	0	0	0	3

Course Objectives:

- To acquire knowledge of economics to facilitate the process of economic decision making
- To acquire knowledge on basic financial management aspects
- To develop the skills to analyze financial statements

Course Outcomes:

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

CO 1:	Understand key accounting concepts, terms, and principles.
CO 2:	Learn complex accounting transactions and how they relate to accounting principles.
CO 3:	Implement software development budgeting

Pre-requisite courses: Nil

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							M	M	M			
CO2							M	M	M			
CO3							M	M	M			

Topics covered:

BASICS OF ACCOUNTING	9 hours

Introduction to basic accounting concepts. Accounting terminologies, Accounting fundamentals, debits & credits Accounts payable & Receivables, Accounting cycle,Inventory accounting & Cost accounting

FINANCIAL REPORTS	9 hours

Overview of financial reporting. Types of financial reports. The balance sheet equation - Assets, Liabilities, and Stockholders' Equity. Bookkeeping and managing transactions into book entry.

CLASSIFICATION	8 hours

Classification of cash flows into operating, investing, and financing activities. Preparing and

analyzing the Statement of Cash Flows. Earnings, Cash from Operations, EBITDA,and Free Cash Flow.

ACCOUNTING VERTICALS	**9 hours**

Links between accounting, measurement, and financial statements.Key business ratios that can be calculated using your Income Statement and Balance Sheet. Interpret two key financial statements (Income Statement and Balance Sheet) that drive business decisions.

AGILE S/W DEVELOPMENT BUDGETING	**10 hours**

Types of budget estimate, Requirements definition and analysis, Recommended technological stack, Functional and nonfunctional requirements, Project plan, Cost estimation, dos and don'ts of software development budgeting

Theory : 45 Hrs	**Tutorial : 0**	**Total Hours: 45 Hrs**

Textbooks:

1. “An Easy Introduction to Financial Accounting: A Self-study Guide” by V.G. Narayanan

Reference Books:

1. Christopher Dougherty, Introduction to Econometrics, Oxford University Press, 3rd edition, Indian edition, 2007.
2. Jan Kmenta, Elements of Econometrics, Indian Reprint, Khosla Publishing House,2nd edition, 2008.

U18CHT4000 **Environmental Science and Engineering**
(Common to All branches)

L	T	P	C
3	0	0	0

COURSE OUTCOMES

After successful completion of this course, the students would be able to

CO 1: Analyze the impact of engineering solutions in a global and societal context.
CO 2: Discuss contemporary issues that results in environmental degradation and would attempt to provide solutions to overcome those problems.
CO 3: Highlight the importance of ecosystem and biodiversity.
CO 4: Consider issues of environment and sustainable development in his/her personal and professional undertakings.
CO 5: Paraphrase the importance of conservation of resources.
CO 6: Play an important role in transferring a healthy environment for future generations.

PRE -REQUISITE: NIL

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1		M					S		M			
CO 2						M				M		
CO 3							M					
CO 4						M	S					
CO 5							S					
CO 6			W				S					M

COURSE ASSESSMENT METHODS

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4. Group presentation 5. End Semester Exam	Course end survey

INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES **14 Hours**

Definition, scope and importance – Need for public awareness – Forest resources: Use and over-exploitation, deforestation, case studies – Timber extraction, mining, dams and their effects on forests and tribal people.

Water resources: Use and overutilization of surface and ground water, conflicts over water, dams – benefits and problems – Water conservation, rain water harvesting, watershed management.

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, case studies.

Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of

alternate energy sources, case studies.
Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification, Wasteland reclamation – Role of an individual in conservation of natural resources.

ECOSYSTEMS AND BIODIVERSITY **9 Hours**

ECOSYSTEM: Concept of an ecosystem – Structure and function of an ecosystem: Producers, consumers and decomposers, Food chain, Food web, Energy flow in the ecosystem and Ecological pyramids – Ecological succession – Introduction, types, characteristic features, structure and function of the (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

BIODIVERSITY: Introduction to Biodiversity – Definition: genetic, species and ecosystem diversity – Bio geographical classification of India – Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic values – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

ENVIRONMENTAL POLLUTION **8 Hours**

Definition – Causes, effects and control measures of: (a) Air pollution – Organic and inorganic pollution – cyclone separator, electrostatic precipitator (b) Water pollution (c) Heavy metal pollution (d) Noise pollution (e) Thermal pollution (f) Nuclear hazards – Role of an individual in prevention of pollution – Pollution case studies – Solid waste and hazardous Management: Causes, effects and control measures from factories, small scale and large scale industries – Waste minimization – Disaster management: floods, earthquake, cyclone and landslides.

SOCIAL ISSUES AND THE ENVIRONMENT **7 Hours**

From Unsustainable to Sustainable development – Urban problems related to energy – Resettlement and rehabilitation of people; its problems and concerns, case studies – Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion – Environment Production Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Human Rights.

HUMAN POPULATION AND THE ENVIRONMENT **7 Hours**

Population growth and explosion – Welfare Program – Environment and human health – Communicable disease – Role of Information Technology in Environment and human health – Case studies.

Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Hours

REFERENCES

1. G. Tyler Miller and Scott Spoolman, 'Environmental Science', Fourteenth Edition, Brooks Cole, 2012.
2. Gilbert M. Masters and Wendell P. Ela, 'Introduction to Environmental Engineering and Science', Third Edition, Pearson Education, 2013.
3. BharuchaErach, 'The Biodiversity of India', Mapin Publishing Pvt. Ltd., Ahmedabad, 2002.
4. Trivedi R.K and P.K.Goel, 'Introduction to Air Pollution', Techno-Science Publications, 2003.
5. Trivedi R.K., 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media, 1996.

6. Cunningham, W.P.Cooper and T.H.Gorhani, ‘Environmental Encyclopedia’, Jaico Publication House, Mumbai, 2001.
7. Wager K.D., ‘Environmental Management’, W.B. Saunders Co., Philadelphia, USA, 1998.
8. Colin R. Townsend, Michael Begon and John L. Harper, ‘Essentials of Ecology’, Third Edition, Blackwell Publishing, 2008.

SEMESTER 5

U18AII5201	CLOUD ARCHITECTURE	L	T	P	J	C
		3	0	2	0	4

Course Objectives:

- To make students understand the concept of cloud computing.
- To have knowledge on the various issues in cloud computing
- To understand the functional relationship between cloud computing and stakeholders
- To appreciate the emergence of cloud as the next generation computing paradigm.

Course Outcomes:

After successful completion of this course, the students should able to

CO1:	Analyze the main concepts, key technologies, strengths and limitations of cloud
CO2:	Analyze and understand various queuing models
CO3:	To understand and use the architecture of compute and storage cloud, service and delivery models.
CO4:	Apply the core issues of cloud computing such as resource management and security.

Pre-requisite courses: Nil

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcome (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M			M								
CO2	S			S		S						S
CO3	M	S		M								M
CO4	S			M							M	

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation,Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory component)

b) Indirect

1. Course-end survey

Topics covered:

INTRODUCTION	**10 Hrs**

Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning.

CLOUD ENABLING TECHNOLOGIES	**10 Hrs**

Service Oriented Architecture – REST and Systems of Systems – Web Services – Publish- Subscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices –Virtualization Support and Disaster Recovery.

QUEUEING MODELS	**12 Hrs**

Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds - laaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3.

CLOUD ARCHITECTURE, SERVICES AND STORAGE	**13 Hrs**

Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods – Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges – Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM – Security Standards. Hadoop – MapReduce – Virtual Box - Google App Engine – Programming Environment for Google App Engine — Open Stack- Federation Services

Theory: 45 Hrs	**Tutorial: 0**	**Total Hours: 45 Hrs**

Lab Experiments:

1. Install Virtualbox/VMware Workstation with different flavours of linux or windows OS on top of windows7 or 8.
2. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs
3. Install Google App Engine. Create hello world app and other simple web applications using python/java.
4. Use GAE launcher to launch the web applications.
5. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
6. Find a procedure to transfer the files from one virtual machine to another virtual machine.
7. Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)
   Install Hadoop single node cluster and run simple applications like wordcount

Practical: 30 Hrs	**Tutorial: 0**	**Total Hours: 30 Hrs**

Text Books:

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2. Rittinghouse, John W., and James F. Ransome, ―Cloud Computing: Implementation, Management and Security‖, CRC Press, 2017

Reference Books:

1. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, ―Mastering Cloud Computing‖, Tata Mcgraw Hill, 2013.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical Approach‖, Tata Mcgraw Hill, 2009.
3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice), O'Reilly, 2009.

U18AII5202	EXPLORATORY DATA ANALYSIS AND VISUALIZATION	L	T	P	J	C
		3	0	2	0	4

Course Objectives:

- To teach paradigms and approaches used to analyze data
- To make students understand how the analysis is applied
- To explain different visualization techniques
- To implement and experiment various analytic models for visualization

Course Outcomes:

After successful completion of this course, the students should able to

CO1:	Understand the main principles of visual perception
CO2:	Design core skills for visual analysis
CO3:	Identify and apply visualization techniques for various data analysis tasks
CO4:	Apply and implement the visualization concepts in various streams

Pre-requisite courses: U18MAI2203 – Probability and Statistics

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcome (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S			M						M		
CO2	S			S		S						S
CO3	M	S	M				S		M			M
CO4	S			M							M	

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation,Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory component)

b) Indirect

1. Course-end survey

Topics covered:

ANALYSIS TECHNIQUES	**10 Hrs**

Elements, Variables, and Data categorization- Levels of Measurement- Data management and indexing- Introduction to statistical learning and R-Programming- Measures of central tendency- Measures of location of dispersions- Practice and analysis with R- Basic Analysis Techniques

SKILLS FOR VISUAL ANALYSIS	**13 Hrs**

Information visualization – effective data analysis – traits of meaningful data – visual perception – making abstract data visible – building blocks of information visualization – analytical interaction – analytical navigation – optimal quantitative scales – reference lines and regions – trellises and crosstabs – multiple concurrent views – focus and context – details on demand – over-plotting reduction – analytical patterns – pattern examples.

TIME-SERIES, RANKING, AND DEVIATION ANALYSIS	**10 Hrs**

Time-series analysis – time-series patterns – time-series displays – time-series best practices – part-to-whole and ranking patterns – part-to-whole and ranking displays – best practices – deviation analysis – deviation analysis displays – deviation analysis best practices

DISTRIBUTION, CORRELATION, AND MULTIVARIATE ANALYSIS	**12 Hrs**

Distribution analysis – describing distributions – distribution patterns – distribution displays –distribution analysis best practices – correlation analysis – describing correlations – correlation patterns – correlation displays – correlation analysis techniques and best practices – multivariate analysis – multivariate patterns – multivariate displays – multivariate analysis techniques and best practices

Theory: 45 Hrs	**Tutorial: 0**	**Total Hours: 45 Hrs**

Lab Experiments:

1. Implementation of data charts
2. Implementation of data visualization techniques
3. Designing multivariate patterns
4. Visual encoding of data
5. Dashboard designing
6. Implementation of multivariate displays
7. Implement over plotting

Practical: 30 Hrs	**Tutorial: 0**	**Total Hours: 30 Hrs**

Text Books:

1. Stephen Few, "Now you see it: Simple Visualization techniques for quantitative analysis",Analytics Press, 2019.
2. Stephen Few, "Information dashboard design: The effective visual communication of data",O'Reilly, 2016.
3. Edward R. Tufte, "The visual display of quantitative information", Second Edition, GraphicsPress, 2019

Reference Books:

1. Nathan Yau, "Data Points: Visualization that means something", Wiley, 2013.
2. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment",O'Reilly, 2008.
3. Gert H. N. Laursen and Jesper Thorlund, "Business Analytics for Managers: Taking business intelligence beyond reporting", Wiley, 2010.
4. Evan Stubbs, "The value of business analytics: Identifying the path to profitability", Wiley, 2019

U18AII5203	REINFORCEMENT LEARNING	L	T	P	J	C
		3	0	2	0	4

Course Objectives:

- To teach basics purpose and concepts of Reinforcement Learning
- To make students understand the nature of the problems and solve it through Reinforcement Learning
- To make students to utilize Reinforcement Learning Algorithms for solving Uncertainty problems
- To teach the techniques to build system of agents applying deep learning architectures

Course Outcomes:

After successful completion of this course, the students should able to

CO1:	Understand the underpinnings to structure classical solutions for Reinforcement Learning problem
CO2:	Apply deep learning architectures to train agents navigating from virtual world from sensory data.
CO3:	Analyze basic Reinforcement Learning algorithms for simple sequential decision making and control problems in uncertain conditions
CO4:	Build system of agents to demonstrate collaboration or cooperation

Pre-requisite courses: U18AII4202 – Neural Networks and Deep Learning

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcome (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S			M								S
CO2	S			M								S
CO3	S	S	M		S							S
CO4	S	S	S	S	S	S						S

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation,Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory component)

b) Indirect

1. Course-end survey

Topics covered:

FOUNDATIONS OFREINFORCEMENT LEARNING	**11 Hrs**

Reinforcement Learning - A Preamble - Reinforcement Learning Frameworks: Problems and Solutions -Dynamic Programming - Monte Carlo Methods - Temporal-Difference Methods - Reinforcement Learning in Continuous Space. Case Study: Classic Problem of Gym's Taxi using openAI & V2 Task

VALUE-BASED METHODS	**10 Hrs**

Build and Train Neural Networks, Convolutional Neural Networks - Bandit Algorithms - Deep Q-Learning – Deep Q-Network - Double Deep Q-Network - Dueling-DQN - Prioritized Replay. Case Study: Leveraging Neural Networks to predict machine failures that learns intelligent behaviors from sensory data.

POLICY-BASED METHODS	**13 Hrs**

Theory behind Evolutionary Algorithms, Stochastic Policy Search, REINFORCE Algorithms - Improving Policy Gradient Methods - Generalised Advantage Estimation - Policy Optimization methods: Trust Region Policy Optimization (TRPO), Proximal Policy Optimization (PPO) - Actor-Critic Methods: Deep Deterministic Policy Gradient (DDPG) Case Study: Deep Reinforcement Learning for Robotics (Robotic arm/ four legged creaturewalk)

MULTI-AGENT REINFORCEMENT LEARNING	**11 Hrs**

Hierarchical Reinforcement Learning - Markov Games for Multiplayer Games -Agent training in Collaborative and Competitive Setting Case Study: Intuition behind DeepMind's Alphazero

Theory: 45 Hrs	**Tutorial: 0**	**Total Hours: 45 Hrs**

Lab Experiments:

1. Implementation of Markov Decision Process
2. Implementation of Temporal Difference Algorithm for estimating values
3. Implementation of Q-Learning
4. Implementation of Model- Based approach (DYNA)
5. Implementation of Policy-Based approach (actor-critic)
6. Capstone Project

Practical: 30 Hrs	**Tutorial: 0**	**Total Hours: 30 Hrs**

Text Books:

1. Richard S Sutton and Andrew G Barto,"Reinforcement Learning- An Introduction", 2nd Edition, MIT Press, 2018.
2. Laura Graesser, "Foundations of Deep Reinforcement Learning: Theory and Practice in Python", Addison Wesley Data &Analytics series, 2020

Reference Books:

1. Csaba Szepesvári, Morgan & Claypool, "Algorithms for Reinforcement Learning", Morgan & Claypool Publishers, 2010
2. Dimitri Bertsikas and John G. Tsitsiklis , "Neuro Dynamic Programming".Athena Scientific. 1996

U18AIT5004	MARKETING FUNDAMENTALS	L	T	P	J	C
		3	0	0	0	3

Course Objectives:

- To familiarize the students with the basic concept of marketing
- To familiarize with the basic techniques of marketing management
- To help students understand and apply the various digital marketing tools.

Course Outcomes:

After successful completion of this course, the students should able to

CO1:	Understand the basic concepts, and techniques of marketing management
CO2:	Explain the basics of marketing mix elements
CO3:	Understand and solve marketing problems in the complex and fast changing business environment.

Pre-requisite courses: Nil

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcome (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S		M						M			
CO2		S	M						M			
CO3			M						M			

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation,Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory component)

b) Indirect

1. Course-end survey

Topics covered:

INTRODUCTION TO MARKETING	**10 Hrs**
Introduction to Marketing and Marketing Management, Difference between Marketing & Selling, Customer Value, Customer satisfaction & Delight, Value Chain.	
MARKET OPPORTUNITIES	**12 Hrs**
Marketing Plan, Demand Forecasting – Techniques, 7P's of Marketing, MIS, Environmental Scanning, Market Segmenting-Targeting-Positioning, Target Marketing.	
PRODUCT CONCEPTS	**10 Hrs**
Product Decisions - concept of a Product - Product mix decisions – Product Line- Width-Depth, Differentiation Strategies, Integrated Marketing Communication, CRM	
DIGITAL MARKETING	**13 Hrs**
SEO, SEM, Social Media and Content Marketing, Branding, Marketing Analytics	
Theory: 45 Hrs	**Tutorial: 0** **Total Hours: 45 Hrs**

Text Book:

1. Marketing Management Text and Cases, Tapan K Panda, Excel Books, 2020.

Reference Books:

1. Philip Kotler, marketing management- analysis planning and control, Prentice Hall of India, New Delhi, 2018.
2. Ramaswamy. V S & Namakumari. S, marketing management-planning implementation and control, Macmillan Business Books, New Delhi, 2012.

U18AIC5005	PHILOSOPHY OF WELLNESS	L	T	P	J	C
		1	0	0	0	1

Course Objectives:

- Understand the underlying Philosophy of Wellness
- Look at connections between Modern science and Yogic Sciences

Course Outcomes:

After successful completion of this course, the students should able to

CO1:	Understand the fundamental concepts of physical education, health and fitness
CO2:	Analyze and provide a general understanding on nutrition, first aid and stress management.
CO3:	Understand the awareness regarding hypo-kinetic diseases, and various measures of mental fitness and health assessment.

Pre-requisite courses: Nil

CO/PO Mapping
(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcome (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S			S					M			
CO2		S							M			
CO3						M			M			

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I
2. Open Book Test; Cooperative Learning Report, Assignment;
3. Demonstration etc (as applicable) (Theory component)

b) Indirect

1. Course-end survey
2.

Topics covered:

COGNITION & LEARNING AND YOGIC PSYCHOLOGY - MODERN TOOLS FOR YOGIC RESEARCH **8 Hrs**

Introduction to Wellness Management- Dimensions of Wellness-Healthy People- Introduction to Fitness Management Muscular Fitness for Body and Mind- Getting the Jump on Nutrition-Maintaining a Healthy Emotional

UNDERLYING PHILOSOPHICAL CONTEXT & ANALYSING YOGIC DATA **7 Hrs**

Aging and Longivity- Live in the Present - Think About Tomorrow- Personal Motivation- Goal Setting- happiness- Analysis of yogic data.

Theory: 15 Hrs **Tutorial: 0** **Total Hours: 15 Hrs**

Text Book:

1. Cognitive Psychology: theory, process and methodology, Dawn McBride and Cooper Cutting, Second Edition, Neuroscience by Dale Purves, 2018.

U18INT5000 **CONSTITUTION OF INDIA**

L	T	P	J	C
1	0	0	0	0

COURSE OUTCOMES:

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

CO 1: Gain Knowledge about the Constitutional Law of India
CO 2: Understand the Fundamental Rights and Duties of a citizen
CO 3: Apply the concept of Federal structure of Indian Government
CO 4: Analyze the Amendments and Emergency provisions in the Constitution
CO 5: Develop a holistic approach in their life as a Citizen of India

Pre-requisites :NIL

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	ProgrammeOutcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						M			W			S
CO2						S		S				M
CO3									M	S		W
CO4								W	M			M
CO5						M		M				S
CO6												

COURSE ASSESSMENT METHODS

Direct
1. Group Activity / Quiz/ Debate / Case studies 2. Class test / Assignment
Indirect
Surveys

THEORY COMPONENT:

Module.1: Introduction to Indian Constitution **4 hours**

Meaning of the constitution law and constitutionalism - Historical perspective of the Constitution - Salient features and characteristics of the Constitution of India

Module.2:Fundamental Rights **8 hours**

Scheme of the fundamental rights - Right to Equality - Fundamental Right under Article 19 - Scope of the Right to Life and Liberty - Fundamental Duties and its legal status - Directive Principles of State Policy – Its importance and implementation

Module.3:Federal Structure **8 hours**

Federal structure and distribution of legislative and financial powers between the Union and the States - Parliamentary Form of Government in India - The constitutional powers and status of the President of India

Module.4:Amendment to Constitution **6 hours**

Amendment of the Constitutional Powers and Procedure - The historical perspectives of the constitutional amendments in India

Module.5:Emergency Provisions **4 hours**

National Emergency, President Rule, Financial Emergency
Local Self Government – Constitutional Scheme in India

Theory: 30 Tutorial: 0 Practical: 0 Project: 0 Total: 30 hours

REFERENCES

1.Constitution of India - Ministry of Law & Justice – PDF format
awmin.nic.in/coi/coiason29july08.pdf
2. Introduction to the Constitution of India by DurgadasBasu
3. The Constitution of India – Google free material - www.constitution.org/cons/india/const.html
4. Parliament of India – PDF format
download.nos.org/srsec317newE/317EL11.pdf
5. The Role of the President of India – By Prof.Balkrishna
6. Local Government in India – E Book - Pradeep Sachdeva
https://books.google.com/books/.../Local_Government_in_In...

SEMESTER 6

U18AII6201	APPLIED DESIGN THINKING	L	T	P	J	C
		3	0	2	0	4

Course Objectives:

- To apply a scientific method to define & test various hypotheses to mitigate the inherent risks in product innovations.
- To design the solution concept based on the proposed value defined for the target customer exploring various alternate solutions to achieve value-price fit.
- To develop skills in empathizing, critical thinking, analysing, storytelling & pitching.
- To apply system thinking to reverse engineer a product/prototype and understand its internal components and their correlations

Course Outcomes:

After successful completion of this course, the students should able to

CO1:	Apply and define hypotheses to mitigate the risks in product innovations
CO2:	Design proposed value for the target customer exploring various alternate solutions to achieve value-price fit.
CO3:	Develop skills in empathizing, critical thinking, analysing, storytelling & pitching.
CO4:	Apply system thinking to reverse engineer a product/prototype and understand its internal components and their correlations

Pre-requisite courses: Nil

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcome (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M			M								W
CO2		S	S	M								W
CO3		S		M					M			W
CO4	S		S	M	M				M			W

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory component)

b) Indirect

1. Course-end survey

Topics covered:

DESIGN THINKING PRINCIPLES	**10 Hrs**

Exploring Human centered Design - Understanding the Innovation process, Discovering areas of opportunity, Interviewing & empathy building techniques, Mitigate validation risk - Case studies

CUSTOMER CENTRIC INNOVATION	**12 Hrs**

Importance of customer centric innovation - Problem Validation and Customer Discovery - Understanding problem significance and problem incidence - Customer Validation. Target user, User persona & user stories. Activity: Customer development process - Customer interviews and field visits

APPLIED DESIGN THINKING TOOLS	**10 Hrs**

Concept of Minimum Usable Prototype [MUP] - MUP challenge brief - Designing & Crafting the value proposition - Deriving the Solution concept [MUP] iteratively - Activity: Ideate, Prototype and Test

SYSTEM THINKING & REVERSE ENGINEERING	**13 Hrs**

System Thinking, Understanding Systems, Examples and Understandings, Complex Systems, Reverse Engineering Methodology, Identify building blocks/Components - Re-Engineering a complex system

Theory: 45 Hrs	**Tutorial: 0**	**Total Hours: 45 Hrs**

Lab Component:

Choose any real time use case, apply and experiment the following:

1. Develop empathy with target users
2. Define the problem statement
3. Ideate through brain storming and reverse engineering
4. Create prototype
5. Test the model

Practical : 30 Hrs	**Tutorial: 0**	**Total Hours: 30 Hrs**

Text Books:

1. Daren J. Eich, “Innovation Step-by-Step How to create & develop ideas for your challenge”, Amazon Asia-Pacific Holdings Private Limited, 2014.

Reference Books:

1. Roger Martin , “The Design of Business- Why design thinking is the next competitive advantage”, Harvard Business Review Press, 2009.

U18AII6202	PROTOTYPE DEVELOPMENT	L	T	P	J	C
		3	0	2	0	4

Course Objectives:

- Create quick UI/UX prototypes for customer needs
- Develop web application to test product traction / product feature
- Develop 3D models for prototyping various product ideas
- Tools and Techniques to create prototypes in a quick iterative methodology

Course Outcomes:

After successful completion of this course, the students should able to

CO1:	Create quick UI/UX prototypes for customer needs
CO2:	Develop web application to test product traction / product feature
CO3:	Develop 3D models for prototyping various product ideas
CO4:	Tools and Techniques to create prototypes in a quick iterative methodology

Pre-requisite courses: Nil

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcome (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M			S								W
CO2	M	S	S	S								W
CO3	M	S		S					W			W
CO4	M		S	S	S				W			W

Course Assessment methods:

a) Direct

a. Continuous Assessment Test I, II (Theory component)
b. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
c. Demonstration etc (as applicable) (Theory component)
d. End Semester Examination (Theory component)

b) Indirect

e. Course-end survey

Topics covered:

UI/UX	**12 Hrs**

Fundamental concepts in UI & UX - Tools - Fundamentals of design principles - Psychology and Human factors for User Interface Design - Layout and composition for Web, Mobile and Devices - Typography - Information architecture - Colour theory - Design process flow, wireframes, best practices in industry - User engagement ethics - Design alternatives

APP DEVELOPMENT	**12 Hrs**

SDLC - Introduction to App Development - Types of Apps - web Development - understanding Stack - Frontend - backend - Working with Databases - Introduction to API - Introduction to Cloud services - Cloud environment Setup- Reading and writing data to cloud - Embedding ML models to Apps - Deploying application.

INDUSTRIAL DESIGN	**11 Hrs**

Introduction to Industrial Design - Points, lines and planes - Sketching and concept generation - Sketch to CAD - Introduction to CAD tools - Types of 3D modeling - Basic 3D Modeling Tools - Part creation - Assembly - Product design and rendering basics - Dimensioning & Tolerancing

RAPID PROTOTYPING	**10 Hrs**

Need for prototyping - Domains in prototyping - Difference between actual manufacturing and prototyping - Rapid prototyping methods - Tools used in different domains - Mechanical Prototyping: 3D Printing and classification - Laser Cutting and engraving - RD Works - Additive manufacturing - Electronic Prototyping: Basics of electronic circuit design - lumped circuits - Electronic Prototyping - Working with simulation tool - simple PCB design with EDA

Theory: 45 Hrs	**Tutorial: 0**	**Total Hours: 45 Hrs**

Lab Component:

1. Prepare SRS report
2. Prepare SAR report
3. Create sketches and diagrams for UseCase
4. Design a prototype for the UseCase
5. Building proof of concept
6. Create test cases

Practical : 30 Hrs	**Tutorial: 0**	**Total Hours: 30 Hrs**

Text Book:

1. Peter Fiell, Charlotte Fiell , “Industrial Design A-Z”, TASCHEN America Llc, 2006.

Reference Book:

1. Steve Krug, “Don’t Make Me Think”, Revisited, Third edition, Pearson, 2015.

U18AII6203	INDUSTRIAL IoT	L	T	P	J	C
		3	0	2	0	4

Course Objectives:

· To teach basics purpose and the evolution and types of Autonomous Vehicles

· To enable students to understand the characteristics of technology involved in building Autonomous vehicles

· To make the students to analyze various automation levels

Course Outcomes:

After successful completion of this course, the students should able to

CO1:	Identify appropriate AI techniques to solve industrial automation problems through sensors and actuators.
CO2:	Understand the Industrial IoT Architecture.
CO3:	Understand the idea of business transformation using connected cars.
CO4:	Demonstrate and explore the concepts behind Connected Motions.

Pre-requisite courses: Nil

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S		M								S
CO2	S	S		M								S
CO3	S	S	S	M					W			S
CO4	S	S	S									S

Course Assessment methods:

a) Direct

f. Continuous Assessment Test I, II (Theory component)

g. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation,Project Report, Poster Preparation, Prototype or Product

h. Demonstration etc (as applicable) (Theory component)

i. End Semester Examination (Theory component)

b) Indirect

j. Course-end survey

Topics covered:

INDUSTRY 4.0	**10 Hrs**

Automation- Principles and Strategies of Automation - Basic Elements- Levels of Automation- Smart Automation- introduction to Industry 4.0- Reason for Adopting Industry 4.0 - Definition -Main Concepts and Components of Industry 4.0-Technologies of Industry 4.0 - Big Data - Artificial Intelligence (AI) - Industrial Internet of Things - Cyber Security - Cloud -Augmented Reality-Robotics

INTRODUCTION TO INDUSTRIAL IoT	**12 Hrs**

Basics of Industrial IoT - IIoT Architecture Layers - Introduction to IIoT End Point Gateway, Fog Layer and iSMAC Layers - Difference between traditional SCADA/DCS architectures and IIoT architectures - Business Transformation Potential – Case Study: Connected Cars.

COMPONENTS OF IoT	**10 Hrs**

Control Units - Sensors - Basics of Sensors and actuators - Examples and working principles of sensors and actuators - Communication modules - Power Sources - Communication Technologies - RFID - Bluetooth - Zigbee - Wifi - Rflinks - Mobile Internet - Wired Communication - Locomotion - key issues for locomotion, leg configurations and stability, wheeled mobile robots, wheeled locomotion-the design space.

ROBOTICS AND VISION SYSTEMS	**13 Hrs**

Introduction - Transformations - Forward Kinematics - Inverse Kinematics - Design considerations: Motor sizing, selection of motors based on torque and speed characteristics - Hardware Interface & Assembly - Introduction to ROS framework and prerequisites - ROS Tools and Utilities - Simulation - ROS Motion - Image basics - Image Processing - Histograms - Smoothing and blurring/filtering - Thresholding - Gradients and Edge detection - Contours - Camera calibration - Integration of image processing tool with ROS - Applications.

Theory: 45 Hrs	**Tutorial: 0**	**Total Hours: 45 Hrs**

Lab Experiments:

1. Usage of Sensors and Actuators
2. Lane Detection
3. Gesture Controlled Robots
4. Smart Home Automation
5. Fruit Detection

Practical : 30 Hrs	**Tutorial: 0**	**Total Hours: 30 Hrs**

Text Books:

1. Michael J. Hamill, "Industrial Communications and Control Protocols", PDH center, 2011.
2. Charalampos Doukas , "Building Internet of Things with the Arduino", Create space, 2012.
3. Qusay F.Hassan, Atta ur Rehman Khan and Sajjid A. Madani, "Internet of things - Challenges, Advances and Applications", CRC Press, 2018.

Reference Books:

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, David Boyle, "From Machine-to-Machine to the Internet of Things", Academic Press, 2014.
2. Marco Schwartz, "Internet of Things with Arduino Cookbook", Packt Publishing, 2016.
3. James Anderson, Kalra Nidhi, Karlyn Stanly, "Autonomous Vehicle Technology: A Guide for Policymakers", Rand Co, 2014.
4. Lawrence. D. Burns, Christopher Shulgan, "Autonomy - The quest to build the driverless car and how it will reshape our world", Harper Collins Publishers, 2018.

Advanced Technology Electives

Sl. No	Specialization Track	Course code	Course title	L	T	P	J	C
1	**General Electives**	U18AIE0001	Natural Language Processing	3	0	0	0	3
2		U18AIE0002	Introduction to Spatial Computing	3	0	0	0	3
3		U18AIE0003	Computer Vision Techniques	3	0	0	0	3
4		U18AIE0004	Recommendation system for e-commerce	3	0	0	0	3
5		U18AIE5005	Mining BigData	3	0	0	0	3
6		U18AIE0006	Neural Computation	3	0	0	0	3
7		U18AIE0007	Human-Centered Systems	3	0	0	0	3
8		U18AIE0008	Speech Processing	3	0	0	0	3
9		U18AIE0009	Startup Fundamentals	2	0	2	0	3
10	**Automation and Artificial Intelligence**	U18AIE0012	Intelligent Automation systems	2	0	2	0	3
11		U18AIE0014	Generative AI	2	0	2	0	3
12		U18AIE0015	Responsible AI	3	0	0	0	3
13	**Data Science, Analytics and Visualization Cohort**	U18AIE0016	Principles of Data science	2	0	2	0	3
14		U18AIE0017	Data Processing Techniques	2	0	2	0	3
15		U18AIE0018	Data Modelling	2	0	2	0	3
16		U18AIE0020	Business Intelligence for Decision Making	2	0	2	0	3
17		U18AIE0021	Data Ethics and Privacy	3	0	0	0	3
18	**Network and Distributed Computing**	U18ITE0018	Smart Contract Development	2	0	2	0	3
19		U18ITE0019	Decentralized Finance	3	0	0	0	3
20	**Cloud Computing**	U18ITE0020	Virtualization and Resource Management	2	0	2	0	3

21		U18ITE0021	Cloud Infrastructure and Architecture	2	0	2	0	3
22		U18ITE0022	Cloud Storage Management	2	0	2	0	3
23		U18ITE0023	Cloud Application Development	2	0	0	2	3
24		U18ITE0024	Cloud security	2	0	2	0	3
25		U18ITE0025	Cloud Automation	2	0	0	2	3
26	**Web and Software Development**	U18ITE0026	Full Stack Software Development	2	0	2	0	3
27	**Extended Reality**	U18CSE0014	3D Modeling and Game Design	2	0	0	2	3
28		U18CSE0015	Augmented Reality and Virtual Reality application development	2	0	0	2	3
29		U18CSE0016	Advanced Metaverse Technologies	3	0	0	0	3
29	**IoT, Edge, UAV**	U18CSE0017	Embedded systems for IoT	2	0	2	0	3
30		U18CSE0018	IoT Systems Design	2	0	0	2	3
31		U18CSE0019	IoT Application Development	2	0	2	0	3
32		U18CSE0020	3D Printing	2	0	2	0	3
33		U18CSE0021	Robotic Operating Systems	2	0	2	0	3
34		U18CSE0022	Software Defined Vehicle	3	0	0	0	3
35	**Cyber Security**	U18CSE0023	Ethical Hacking and Network Defence	2	0	2	0	3
36		U18CSE0024	Cyber Ethics and Laws	3	0	0	0	3
37		U18CSE0025	Secure Software Development	2	0	2	0	3
38		U18CSE0026	Network Security Administration	2	0	2	0	3
39		U18CSE0027	Digital Forensics	2	0	2	0	3

U18AIE0001	NATURAL LANGUAGE PROCESSING	L	T	P	J	C
		3	0	0	0	3

Course Objectives:

· To teach basics of natural language processing

· To make students understand Convolutional Neural Net architecture

· To make students understand architectural designs of Recurrent Neural Networks

· To teach various advanced techniques Generative Adversarial Nets, Deep Generative models

Pre-requisite courses: U18AII4202 Neural Networks and Deep Learning

Course Outcomes:

After successful completion of this course, the students should able to

CO1 :	Understand the basics of natural language processing using statistical approach
CO2 :	Understand to use neural networks in natural language processing
CO3 :	Apply appropriate deep learning models for text analytics
CO4 :	Understand advanced neural networks in language analytics

CO/PO Mapping
(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcome (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S		M								S
CO2	S	S		M								S
CO3	S	S	S	M					W			S
CO4	S	S	S									S

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation,Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory component)

b) Indirect

1. Course-end survey

Topics covered:

NATURAL LANGUAGE PROCESSING	10 Hours
Natural Language Processing Basics: Syntax – Semantics – Introduction to Statistical NLP, Operations on a corpus, word vector, word embeddings, Glove, Probability and NLP, Vector Space models, Sequence learning, Machine translation, Preprocessing, Statistical properties of words- deep learning for NLP- Applications of deep learning to NLP.	
CONVOLUTIONAL NEURAL NETWORKS	**12 Hours**
Classification tasks in NLP-Window-based Approach for language modelling -Window-based Approach for NER, POS tagging, and Chunking- Convolutional Neural Net for NLP- Max-margin Training- Scaling Softmax - Adaptive input and output.	
RECURRENT NEURAL NETWORK ARCHITECTURES	**10 Hours**
Basic RNN structures- Language modeling with RNNs- Backpropagation through time- Text generation with RNN LM- Issues with Vanilla RNNs- Exploding gradient- Gated Recurrent Units (GRUs) and LSTMs- Bidirectional RNNs- Multi-layer RNNs- Sequence labeling with RNNs- Sequence classification with RNNs- Attention, Variants	
GANS, ADVERSARIAL NLP AND DEEP GENERATIVE MODELS	**13 Hours**
Generative adversarial nets (GANs)- Domain adversarial nets (DANs)- Adversarial attacks in NLP- Defense: Training with adversarial examples- Consistency regularization- Cross-view consistency, Variational inference, Autoencoders, Variational autoencoders, Conditional VAEs, Vector Quantized VAEs, Variational Generative adversarial nets- Multi-task Learning for NLP	
Theory: 45 Hrs	**Tutorial: 0** **Total Hours: 45 Hrs**

Text Books:

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, “Deep Learning”, First Edition, MIT Press, 2016.
2. Sunil Patel, “Deep Learning for Natural Language Processing”, BPB Publications, 2021.

Reference Books:

1. Goldberg Yoav, “Neural Network Methods in Natural Language Processing”, Morgan and Claypool publishers.
2. Karthiek Reddy Bokka; Shubhangi Hora; Tanuj Jain; Monicah Wambugu, " Deep Learning for Natural Language Processing", Packt Publishing.

U18AIE0002	INTRODUCTION TO SPATIAL COMPUTING	L	T	P	J	C
		3	0	0	0	3

Course Objectives:

· To distinguish traditional relational data and spatial data.
· To understand spatial design issues and data models.
· To make use of technologies to build applications combined with geographical data.
· To understand spatial information services and XR.

Pre-requisite courses: U18AII4202 Neural Networks and Deep Learning

Course Outcomes:

After successful completion of this course, the students should able to

CO1 : Understand the foundations of spatial data and its storage.

CO2 : Identify the spatial design issues and data models for real world problems

CO3 : Use advanced technologies to build applications combined with geographical data

CO4 : Extend knowledge on spatial information services and XR

CO/PO Mapping
(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S										M
CO2	S	S		M								M
CO3	S	S	S	S	M							M
CO4	S	S	S	S	S							M

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation,Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory component)

b) Indirect

1. Course-end survey

Topics covered:

INTRODUCTION	**10 Hours**

Geo-spatial science, systems and services, spatial concepts and data models: field vs object based, spatial query languages. Fundamental spatial algorithms: space filling curves, voronoi diagrams. Spatial storage and indexing: Grid files, Quadtrees and R-trees, query processing, join strategies, and optimization.

SPATIAL MODELING	**12 Hours**

Conceptual, logical and physical level design issues, spatial data models, Sequenced semantics, Spatial databases, Query processing in spatial network databases, spatial data mining: classification, association and clustering.

SPATIAL STATISTICS	**13 Hours**

Hot-spot and distributions using Arc. Conceptualization of spatial relationships: spatial autocorrelation by distance, autocorrelation, nearest neighbor, hot-spot analysis. Exploratory regression, OLS, Geographically weighted regression, Spatial computing systems: Geographic Information Systems: Open Source GRASS GIS, ESRI ArcGIS family

APPLICATION SERVICES AND XR	**10 Hours**

Virtual globes, location-based services, enterprise consulting. Application programming interfaces: HTML5 - Geolocation API, Google Maps API, Bing Maps API, Flickr location API, Twitter location API, Extending reality with spatial computing- audio visual technology, interaction technology, virtual prototypes.

Theory: 45 Hrs	**Tutorial: 0**	**Total Hours: 45 Hrs**

Text Books:

1. Paul Longley and Michael Batty, “Spatial Analysis: Modeling in a GIS Environment”, Wiley, 1994
2. Shashi Shekhar and Sanjay Chawla, “Spatial Databases: A Tour”, Pearson, 2002

Reference Books:

1. Shaowen Wang, Michael F. Goodchild, “Cyber GIS for Geospatial Discovery and Innovation”, Springer, 2019.
2. Shashi Shekhar, Pamela Vold, “Spatial Computing”, The MIT press, 2020

Signature of BOS chairman, CSE

U18AIE0003	COMPUTER VISION TECHNIQUES	L	T	P	J	C
		3	0	0	0	3

Course Objectives:

· To teach basics concepts of computer vision

· To provides a pathway for students to gain the knowledge and skills to apply machine learning to students work

· To teach the capabilities, challenges, and consequences of deep learning

Pre-requisite courses: Nil

Course Outcomes:

After successful completion of this course, the students should able to

CO1 :	Understand how computer vision has evolved and become familiar with its exciting applications
CO2 :	Build a convolutional neural network, including recent variations such as residual networks
CO3 :	Apply convolutional networks to visual detection and recognition tasks and use neural style transfer to generate art
CO4 :	Apply these techniques to a variety of image, video, and other 2D or 3D data

CO/PO Mapping
(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S		M								S
CO2	S	S		M								S
CO3	S	S	S	M					W	M		S
CO4	S	S	S								M	S

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory component)

b) Indirect

1. Course-end survey

Signature of BOS chairman, CSE

Topics covered:

INTRODUCTION AND OVERVIEW	**10 Hours**

Introduction to Image Formation- Capture and Representation- Linear Filtering- Correlation Edge- Blobs- Corner Detection- Scale Space and Scale Selection

FOUNDATIONS OF CONVOLUTIONAL NEURAL NETWORKS	**12 Hours**

Computer Vision- Edge Detection- Padding- Strided Convolutions- Convolutions Over Volume- One Layer of a Convolutional Network- Simple Convolutional Network- Pooling Layers

OBJECT DETECTION	**10 Hours**

Object Localization- Landmark Detection- Object Detection- Convolutional Implementation of Sliding Windows- Bounding Box Predictions- Intersection Over Union- Non-max Suppression- Anchor Boxes- YOLO Algorithm- Semantic Segmentation with U-Net- U-Net Architecture Intuition

SPECIAL APPLICATIONS: FACE RECOGNITION & NEURAL STYLE TRANSFER	**13 Hours**

Face Recognition- One Shot Learning- Siamese Network- Triplet Loss- Face Verification and Binary Classification- Neural Style Transformation- Cost Function- Content Cost Function- Style Cost Function- 1D and 3D Generalizations

Theory: 45 Hrs	**Tutorial: 0**	**Total Hours: 45 Hrs**

Text Books:

1. Vaibhav Verdhan, "Computer Vision Using Deep Learning: Neural Network Architectures with Python, Keras, and TensorFlow: Neural Network Architectures with Python and Keras", Apress; 1st ed. edition, 2021.
2. Salman Khan, Hossein Rahmani, Syed Afaq Ali Shah, Mohammed Bennamoun, “A Guide to Convolutional Neural Networks for Computer Vision”, Morgan & Claypool Publishers, 2018.

Reference Books:

1. Benjamin Planche, Eliot Andres, "Hands-On Computer Vision with TensorFlow 2: Leverage deep learning to create powerful image processing apps with TensorFlow 2.0 and Keras", Packt Publishing Limited, 2019.
2. Rajalingappaa Shanmugamani, "Deep Learning for Computer Vision: Expert techniques to train advanced neural networks using TensorFlow and Keras", Packt Publishing Limited, 2018.

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U18AIE0004	RECOMMENDATION SYSTEM FOR e-COMMERCE	L	T	P	J	C
		3	0	0	0	3

Course Objectives:

- To understand the basic concepts of recommender systems.
- To categorize the types of recommender systems.
- To evaluate the recommender systems based on various metrics.
- To inspect advanced e-commerce applications of recommender systems.

Pre-requisite courses: U18AII2205 Introduction to AI & ML

Course Outcomes:

After successful completion of this course, the students should able to

CO1 :	Understand the basic concepts of recommender systems
CO2 :	Categorize types of recommender systems
CO3 :	Evaluate recommender systems based on various metrics
CO4 :	Analyze advanced e-commerce applications of recommender systems

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M										M
CO2	M	S	S	M								M
CO3	M	S	S	M								M
CO4	M	S	S	S								M

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory component)

b) Indirect

1. Course-end survey

Topics covered:

INTRODUCTION	**8 Hours**

Introduction: Evolution and Basic taxonomy of recommender systems, Recommender system functions, Recommendation Techniques, Recommender Systems and Human Computer Interaction, Applications of recommendation systems, merits and demerits of recommendation systems in e-commerce.

CONTENT-BASED RECOMMENDATION	**13 Hours**

High level architecture of content-based systems, Advantages and drawbacks of content-based filtering, Item representation, methods for learning user profiles. Knowledge based recommendation: Knowledge representation and reasoning, Constraint based recommenders, Case based recommenders.

COLLABORATIVE FILTERING AND MODEL EVALUATION	**14 Hours**

User-based nearest neighbor recommendation, Item-based nearest neighbor recommendation, Model based and pre-processing-based approaches, Matrix factorization models, Neighborhood models. Evaluating Recommender System: Introduction, General properties of evaluation research, Evaluation designs, Evaluation on historical datasets, Error metrics, Decision-Support metrics, User-Centered metrics.

RECOMMENDER SYSTEMS AND COMMUNITIES	**10 Hours**

Communities, collaboration and recommender systems in personalized web search, social tagging recommender systems, Trust and recommendations, Group recommender systems, Context-Aware Recommender Systems, Hybrid approaches, Active learning in recommender systems.
Case study - amazon, Netflix, YouTube.

Theory: 45 Hrs	**Tutorial: 0**	**Total Hours: 45 Hrs**

Text Books:

1. Francesco Ricci, Lior Rokach, Bracha Shapira, Paul B. Kantor, Recommender Systems Handbook, Springer
2. C.C. Aggarwal, Recommender Systems: The Textbook, Springer, 2016.

Reference Books:

1. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press.
2. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, Springer.

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U18AIE5005	MINING BIGDATA	L	T	P	J	C
		3	0	0	0	3

Course Objective

- To develop skills to both design and critique visualizations
- To make students understand and work on Hadoop Framework and Eco systems
- To teach basic concept of mining data streams
- To teach fundamentals of Link Analysis & Mining Social Network Graphs

Pre-requisites: U18AII4203 Data Mining and Modeling

Course Outcomes:

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

CO1:	Choose b tools to carry out exploratory data analysis and produce effective visualization of given data.
CO2:	Perform parallel data processing and duplication with Hadoop and Map-Reduce.
CO3:	Identify suitable data model and algorithms for mining mass data set.
CO4:	Apply link analysis & mining social network graphs in real time problem

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S								M			M
CO2	S	S		M							S	S
CO3	S	S	S	M	S		M		M		S	S
CO4	S	S	S		S						S	S

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product Demonstration etc (as applicable)Pre/Post -
3. End Semester Examination

b)Indirect

1. Course-end survey

Topics covered:

INTRODUCTION TO EDA	**10 Hours**

Mathematics foundations, Statistical inference – Statistical modeling, Probability distributions, Fitting a model, Exploratory Data Analysis(EDA) and data visualization - Basic tools (Plots, Graphs and Summary statistics) of EDA, Data science process, Data visualization – Basic principles, ideas and tools for visualization, Analytic processes and tools - Analysis Vs Reporting

BIG DATA	**12 Hours**

Big data platform – Challenges of conventional systems - Intelligent data analysis - Transition to big data databases- Map reduce - Map Tasks- Grouping by Key - Reduce Tasks- Combiners

MINING DATA STREAMS	**10 Hours**

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 window – Decaying window – Real-time analytics platform (RTAP) applications.

LINK ANALYSIS & MINING SOCIAL NETWORK GRAPHS	**13 Hours**

PageRank- Representing Transition Matrices- PageRank Iteration Using MapReduce- Use of Combiners to Consolidate the Result Vector - Topic-Sensitive PageRank- Biased Random Walk- Inferring Topics from Words - Link Spam - Architecture of a Spam Farm - Analysis of a Spam Farm - Combating Link Spam - TrustRank - Spam Mass

Theory : 45 Hrs	**Tutorial : 0**	**Total Hours: 45 Hrs**

Textbooks:

1. Jure Leskovec, Anand Rajaraman, and Jeffrey David Ullman, "Mining of Massive Datasets", 2nd edition, Cambridge University Press, 2014
2. Scott E, "The Model Thinker- What You Need to Know to Make Data Work for You" First Edition New York: Basic Books, 2018

Reference Books:

1. Cathy O'Neil and Rachel Schutt, “Doing Data Science, Straight Talk From The Frontlin”, O'Reilly. 2014.
2. Foster Provost and Tom Fawcett, “Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking”, ISBN 1449361323, 2013.
3. Kevin P. Murphy,” Machine Learning: A Probabilistic Perspective”, ISBN 0262018020, EMC Education Services, Wiley, 2015

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U18AIE0006	NEURAL COMPUTATION	L	T	P	J	C
		3	0	0	0	3

Course Objectives:

· To enable students to formalize biological facts into mathematical models.
· To provide an introduction to theories of neural computation.
· To enable students to investigate computations by neurons.
· To make students familiar with neural network models.

Course Outcomes:

After successful completion of this course, the students should able to

CO 1:	Understand the basics of neurology and computational neuroscience.
CO 2:	Apply information theory and coding principles to model neurons.
CO 3:	Analyze the working of neurons in various neural network architectures.
CO 4:	Compare and contrast the working of neurons through different types of learning.

Pre-requisite courses: U18AII4202 Neural Network and Deep Learning

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M	M									S
CO2	S	M	M									S
CO3	S	S	M	M								S
CO4	S	S	M	M								S

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation,Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory component)

b) Indirect

1. Course-end survey

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Topics covered:

INTRODUCTION & BASIC NEUROLOGY	**8 Hours**

Overview – Neurons and Membranes – Spikes and Cables – Synapses and Dendrites – Synaptic Plasticity – Computational Neuroscience – Descriptive and Interpretive Models - Hebbian Learning – Neural Code – Neural Encoding & Decoding.

INFORMATION THEORY & NEURAL CODING	**13 Hours**

Information and Entropy – Calculating Information in Spike Trains – Coding Principles - Computation and Logical Units – Biological Visual Systems – Sparse Coding and Predictive Coding – Dynamical Systems Theory: Fixed Points, Nullclines – Computational Maps – Markov Network – Neural Correlations and Synchrony.

NEURAL NETWORK MODELS	**13 Hours**

Attractor Network and Memory - Deep Belief Net – Causal Inference – Neural Network: Perceptron - Deep Network and Brain – Convolutional Neural Networks – Recurrent Neural Networks.

LEARNING FROM SUPERVISION AND REWARDS	**11 Hours**

Biological Plausible Learning – Hierarchical Inference - Attention and Self-Attention – Prediction – Probabilistic Inference – Inference Mechanisms – Reinforcement Learning – Curiosity and Imagination – Emotion and Consciousness.

Theory: 45 Hrs	**Tutorial: 0**	**Total Hours: 45 Hrs**

Text Books:

1. Trappenberg T.P. (TTP), "Fundamentals of computational neuroscience", 2nd edition, Oxford University Press 2009.
2. Dayan, P and Abbott, L (DP), "Theoretical Neuroscience", MIT Press. 2001.
3. Sterling, P. and Laughlin, S., "Principles of Neural Design", MIT Press, 2015.
4. W. Gerstner, W.M. Kistler, R. Naud and L. Paninski, "Neuronal Dynamics - from single neurons to networks and models of cognition", Cambridge Univ. Press. 2014.

Reference Books:

1. Michael. A. Arbib, "The Handbook of Brain Theory and Neural Network", MIT Press, 1995.
2. Hertz J, Krogh A, Palmer RG (HKP), "Introduction to the theory of neural computation", Addison Wesley 1991.
3. Gordon M. Shepherd M.D., "The Synaptic Organization of the Brain", 5th Edition, Oxford University Press, 2004

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U18AIE0007	HUMAN-CENTERED SYSTEMS	L	T	P	J	C
		3	0	0	0	3

Course Objectives:

· To teach basics concepts of human centered systems
· To provides a pathway for students to gain the knowledge and skills to apply human centered systems in students work
· To teach the capabilities, challenges, and consequences of human centered systems
·

Course Outcomes:

After successful completion of this course, the students should able to

CO1:	Understand basic concepts in Human Centered Systems
CO2:	Build user centered system to solve real time problems
CO3:	Demonstrate a broad knowledge of contemporary issues and challenges in HCS
CO4:	Design user interfaces and experiences grounded in known principles of usability and HCS

Pre-requisite courses: Nil

CO/PO Mapping
(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S		M							M	S
CO2	S	S		M								S
CO3	S	S	S	M				M		M		S
CO4	S	S	S					M				S

Course Assessment methods:

a) Direct

a. Continuous Assessment Test I, II (Theory component)
b. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
c. Demonstration etc (as applicable) (Theory component)
d. End Semester Examination (Theory component)

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b) Indirect

a. Course-end survey

Topics covered:

INTRODUCTION TO HUMAN-CENTERED SYSTEMS	**13 Hours**

Introduction- logistics- overview- matrix operations- probability- Different flavors of mathematical models- importance and evolution of Human centered system- software quality and usability- software design and interaction design

MODELS IN HUMAN-CENTERED DESIGN	**10 Hours**

Mentals models- conceptual model and system image- gulf of execution and gulf of evaluation- metaphors- principles- guidelines and rules

UCD	**10 Hours**

Basic elements of User Center Design- models for interaction design- steps for UCD- user and need identification- requirements specifications

PROTOTYPING	**13 Hours**

Characteristics of a prototype- Lo-fi and Hi-fi prototypes- prototyping techniques- prototyping tools- evaluation paradigms and techniques- user observation- interviews and surveys- user modeling- experience designing- affective computing- perceptual systems and ambience intelligence

Theory: 45 Hrs	**Tutorial: 0**	**Total Hours: 45 Hrs**

Text Books:

1. Ideo, "Human Centered Design Toolkit", Authorhouse publisher, 2nd edition, 2011
2. Guy Boy, "Orchestrating Human-Centered Design", Springer, 2012

Reference Books:

1. Ideo, "The Field Guide to Human-Centered Design", IDEO.ORG, 2015.
2. Ethan Beute, "Human-Centered Communication: A Business Case Against Digital Pollution", Fast Company Press, 2021

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U18AIE0008	SPEECH PROCESSING	L	T	P	J	C
		3	0	0	0	3

Course Objectives:

· To teach basics of speech processing and dialog systems

· To make students understand the language modeling

· To make students understand the concepts of Automated Speech Recognition and Speech Conversion

· To make students extract social meaning in the context provided.

Pre-requisite courses: U18AII4202 Neural Networks and Deep Learning

Course Outcomes:

After successful completion of this course, the students should able to

CO1 :	Understand speech production and perception process
CO2 :	Categorize and analyze speech signals in time and frequency domain.
CO3 :	Interpret the idea for building neural chatbots and personal voice assistants.
CO4 :	Explain the process of speech conversions and voice conversions.

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	M	M	M							S
CO2	S	S		S	W							S
CO3	S	S	S	S	M							S
CO4	S	S	S		M							S

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory component)

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b) Indirect

1. Course-end survey

Topics covered:

INTRODUCTION & DIALOG SYSTEMS	**12 Hours**

Acoustics and its types – Phonetics – Audio File Analysis – Digitization and Recording of Speech – Human-Speech Production - Task-oriented Dialogs – Dialog System Design – GUS & Frame based Dialog System – Neural Chatbots – Encoder-Decoder Model – End-to-End Neural Approach.Case Study: GoButler, Alexa Skills Kit

AUTOMATED SPEECH RECOGNITION	**10 Hours**

Audio Signals & its Types – Signal Sampling and Theorem – Acoustic Modeling – Language Modeling – Building a Natural Language Model – Hidden Markov Model in ASR – HMM-DNN Systems – Spectrum Analysis - Case Study: Speech-Brain ASR Toolkit

SPEECH-TO-TEXT & TEXT-TO-SPEECH	**13 Hours**

Speech-to-Text: Modeling – Data Exploration and Data Visualization – Transcription Model using Deep Speech ,Text-to-Speech: Text Analysis and its methods – Stemming and Lemmatization – Stop Words – Phonetic Analysis – Prosodic Analysis – Waveform Synthesis – Wave Analysis of Heart Beat Sound – Voice Builder - Case Study: Voice Building using Text Personal Voice Assistant.

MULTILINGUAL SPEECH PROCESSING & VOICE CONVERSION	**10 Hours**

Multilingual Speech Processing: Understanding Multilingual – Issues in Multilingual – Encoding Characters – Multilingual Speech Models. Voice Conversion: Introduction – Phonetic SID Systems – Speaker Identification & De-Identification

Case Study: Social Meaning Extraction: Interpersonal stance. Flirtation. Intoxication.

Theory: 45 Hrs	**Tutorial: 0**	**Total Hours: 45 Hrs**

Text Books:

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, “Deep Learning”, First Edition, MIT Press, 2016.
2. Sunil Patel, “Deep Learning for Natural Language Processing”, BPB Publications, 2021.

Reference Books:

1. Goldberg Yoav, “Neural Network Methods in Natural Language Processing”, Morgan and Claypool publishers.
2. Karthiek Reddy Bokka; Shubhangi Hora; Tanuj Jain; Monicah Wambugu, " Deep Learning for Natural Language Processing", Packt Publishing

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U18AIE0009	STARTUP FUNDAMENTALS	L	T	P	J	C
		3	0	0	0	3

Course Objectives:

- To develop an entrepreneurial mindset that will help them identify, assess, shape & act on opportunities in a variety of contexts & organization.
- To demonstrate the potential of an innovative idea to create economic value, as a startup.
- To understand the scientific process to explore a viable business model to build a scale business.
- To acquire knowledge on the fundamental concepts of Intellectual Property to Draft the Patent for a product.

Course Outcomes:

After successful completion of this course, the students should able to

CO1:	Identify, assess, shape & act on opportunities in a variety of contexts & organization.
CO2:	Demonstrate the potential of an innovative idea to create economic value, as a startup.
CO3:	Understand the scientific process to explore a viable business model to build a scale business.
CO4:	Acquire knowledge on the fundamental concepts of Intellectual Property to Draft the Patent for a product.

Pre-requisite courses: Nil

CO/PO Mapping

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcome (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M			S								W
CO2		S	S	S								W
CO3	S	S		S					W			W
CO4			S	S					W			W

Course Assessment methods:

a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation,Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory component)

b) Indirect

1. Course-end survey

Topics covered:

ENTREPRENEURIAL MINDSET & METHOD	**11 Hours**

Introduction to Innovation-led, tech-powered entrepreneurship - Understand from research the attributes of an expert entrepreneur - Effectuation principles - Dealing with the unknowns - Case studies of startup failures.

IDEA TO ENTERPRISE	**12 Hours**

Design and Planning of Product Concept - Business Model - Business Planning - Building Proof of Product and Value Testing - Target Market and Revenue Planning

MINIMUM VIABLE BUSINESS	**12 Hours**

Framework for Minimum Viable Business - Disruptive Innovation - Theory of Disruption - Competitive advantage - Building proof of viable business model - Demystifying Scalability - Pitch Clinic

IPR AND PATENT DRAFTING	**10 Hours**

Intellectual Property 101- Introduction and the need for Intellectual Property Rights, Prior Art Search & Case studies of IPR. Fundamentals of Patent Drafting - Invention as a concept - Keywords formation - Structure of patent - Key attributes in patent drafting - Drafting provisional specifications - Drafting complete specifications - Draft claims - Case studies on patent drafting

Theory: 30 Hrs	**Tutorial: 0**	**Total Hours: 30 Hrs**

Text Books:

1. Steven Blank and Bob Dorf, “The Startup Owner’s Manual: The Step-by-Step Guide for Building aGreat Company”, K&S Ranch, 2012.

Reference Books:

1. Dr.Saras Sarasvathy, “Effectuation: Elements of Entrepreneurial Expertise”, New Horizons inEntrepreneurship series, 2008.
2. WIPO Intellectual Property Handbook - https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf

U18AIE0012	INTELLIGENT AUTOMATION SYSTEMS	L	T	P	J	C
		2	0	2	0	3

Course Outcomes:

After successful completion of this course, the students should able to

CO1:	Analyze and articulate the benefits of implementing automation in production systems(K4).
CO2:	Identify industries best-suited for RPA adoption and evaluate case studies showcasing successful RPA implementations (K4).
CO3:	Develop automation solutions with practical examples using Sequence and Flowchart activities (K3).
CO4:	Implement best practices in recording and selector strategies to optimize automation workflows (K3).

Pre–requisite course: U18AII2205 – Introduction to AI and ML

THEORY COMPONENTS: Topics covered:

INTRODUCTION TO AUTOMATION **7 Hours**

Automation in production system-Automation principles and strategies-Basic elements of an automated system-advanced automation Functions-levels of Automation-Hardware components for automation-sensors and actuators-Benefits of Automation -Limitations to Automation.

RPA AND ITS PLATFORMS **7 Hours**

Introduction to Robotic Process Automation- Benefits of RPA- Overview of Industries Best-Suited for RPA-Advancements in RPA and Its Integration with AI. Components of RPA- RPA Platforms-About Ui Path- The future of automation.

WORKFLOW AND CONTROL FLOW **8 Hours**

Sequencing the workflow Activities-Control flow, various types of loops, and decision-making using Sequence and Flowchart-Data Manipulation-Variables and Scope Collections-Arguments -Data table usage with examples -Clipboard Management-File operation mouse and keyboard activities- Working with UiExplorer- Handling events-Screen Scraping.

RECORDERS, SELECTORS **8 Hours**

UiPath Studio Recording -Recorder Overview-Components of Recording Wizard-Comparison of Recording Types-Automatic Recording Activities-Manual Recording activities -Basic Recorder-Desktop Recorder-Web Recorder-Selector-Selector Editor-Selectors with wild cards-UI Explorer in Selector-UI Explorer Window-Full Selectors and Partial Selectors-Errors, Exception and Debugging.

Lab Experiments:

1. Study on UI path Tool
2. Recording Modes
3. Notepad/Word Automation
4. Screen Scrapping Techniques to extract text from Images/Web/Document
5. YouTube Search Engine-BMI Calculator Robot-Excel Automation Basics

6. Fees Concession Robot
7. PDF Automation
8. Invoice Automation Robot
9. Exception Handling / Running Multiple Robots
10. Data Scrapping (Web) with AI Techniques in UiPath
11. Gmail Automation Robot
12. Orchestrator - UiPath Dashboard

Reference Books

1. M.P.Groover, "Automation, Production Systems and Computer Integrated Manufacturing", 4th edition, Pearson Education, 2016.
2. Tom Taulli, The Robotic Process Automation Handbook : A Guide to Implementing RPA Systems,2020, ISBN-13 (electronic): 978-1-4842-5729-6, Publisher : A press,
3. Frank Casale, Rebecca Dilla, Heidi Jaynes ,Lauren Livingston, "Introduction to Robotic Process Automation: a Primer", Institute of Robotic Process Automation.2015.
4. Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant,2018.

Online Learning Materials

1. https://www.coursera.org/specializations/roboticprocessautomation
2. https://www.coursera.org/professional-certificates/google-it-automation.

Theory: 30	**Tutorial:0**	**Practical: 30**	**Project :0**	**Total:60 Hours**

U18AIE0014	GENERATIVE AI	L	T	P	J	C
		3	0	0	0	3

Course Outcomes:

After successful completion of this course, the students should able to

CO1:	Acquire insights into the key technological trends driving generative AI models (K3)
CO2:	Acquire the ability to apply effective prompt engineering techniques to enhance the performance and control the behaviour of generative AI models (K4)
CO3:	Build, train and apply generative models and develop familiarity with platforms (K4)
CO4:	Ability to comprehend ethical issues and limitations of generative AI models(K3)

Pre–requisite course: U18AIE0001 - Natural Language Processing

THEORY COMPONENTS: Topics covered:

INTRODUCTION TO GENERATIVE AI **5 Hours**

Capabilities - History and Evolution -Benefits- Challenges - Applications of Generative AI – Tools for Text, Image Code, Audio and Video generation– Economic Potential of Generative AI - Use cases.

PROMPT ENGINEERING TECHNIQUES AND APPROACHES **6 Hours**

Prompt Creation -Writing effective prompts -Techniques for using text prompts: Zero shot and few-shot prompt techniques – Prompt engineering approaches: Interview pattern, Chain-of Thought, Tree-of Thought - Benefits of using text prompts - Challenges in generating meaningful and coherent prompts.

MODELS FOR GENERATIVE AI **7 Hours**

. Basics of Sequential data processing – Building blocks of Generative AI - Discriminative modelling – Generative modelling –Recurrent Neural Networks – Long Short-Term Memory (LSTM) Networks - Generative Adversarial Networks (GANs) - Variational Autoencoders (VAEs) – Transformer–based Models - Diffusion models- Applications

PLATFORMS FOR GENERATIVE AI **7 Hours**

Introduction to Platforms – Features of platforms – Capabilities -Applications - Pre-trained Models - Challenges – Generation of Text to Text – Generation of Text to Image – Text to Code Generation – Explainable AI – Benefits – Use cases.

ETHICAL ISSUES AND LIMITATIONS OF GENERATIVE AI **5 Hours**

Limitations of Generative AI – Issues and concerns – Considerations for Responsible Generative AI – Economic Implications – Social Implications – Future and professional Growth of Generative AI

Lab Experiments:

1. Generate text using Generative AI
2. Text Generation using ChatGPT and Bard
3. Image Generation using GPT and Stable Diffusion
4. Code Generation
5. Experimenting with Prompts
6. Approaches in Prompt Engineering
    - Chain-of-Thought Approach
    - Interview Pattern Approach
    - Tree-of-Thought Approach
7. Effective Text Prompts for Image Generation
8. Develop AI Applications with the Foundation Models
9. Develop AI Applications for Code Generation

Reference Books

1. Deep Learning: Teaching Machines to Paint, Write, Compose and Play, David Foster, 2023. 2nd edition. O'Reilly Media, Inc.
2. Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press, 2016.
3. Hands-on Generative Adversarial Networks with Keras, Rafael Valle. Packt Publisher, 2019

Online Learning Materials

1. https://www.coursera.org/learn/generative-ai-introduction-and-applications?specialization=generative-ai-for-everyone
2. https://www.coursera.org/learn/generative-ai-prompt-engineering-for-everyone?specialization=generative-ai-for-everyone
3. https://www.coursera.org/learn/generative-ai-foundation-models-and-platforms?specialization=generative-ai-for-everyone
4. https://www.coursera.org/learn/generative-ai-ethical-considerations-and-implications?specialization=generative-ai-for-everyone

Theory: 30	**Tutorial:0**	**Practical: 30**	**Project :0**	**Total:60 Hours**

U18AIE0015	RESPONSIBLE AI	L	T	P	J	C
		3	0	0	0	3

Course Outcomes:

After successful completion of this course, the students should able to

CO1:	Comprehend the fundamental concepts of AI, recognize ethical considerations, and analyze biases and limitations through real-world case studies.(K3)
CO2:	Apply ethical theories and principles to implement responsible AI practices, emphasizing accountability, responsibility, and transparency.(K3)
CO3:	Evaluate the importance of interpretability, categorize methods, and apply them to models, ensuring effective communication of results(K3)
CO4:	Attain a comprehensive understanding of data privacy principles, employ effective privacy-preserving techniques in AI applications, and critically assess real-world instances emphasizing the equilibrium between privacy and utility(K4)
CO5:	Assess ethical reasoning approaches, design moral agents, and implement ethical deliberation, governance, and inclusion for responsible AI practices (K4)

Pre–requisite courses: U18AII3204 – Applied Machine Learning and U18AIE0010 - Deep Learning

THEORY COMPONENTS: Topics covered:

INTRODUCTION **11 Hours**

Autonomy – Adaptability – Interaction – Need for Ethics in AI - Fairness and Bias: Sources of Biases – Exploratory data analysis, limitations of a dataset – Group fairness and individual fairness – Counterfactual fairness ·· AI harms – AI risks : Case Study

ETHICAL DECISION MAKING **8 Hours**

Seven Principles of Responsible AI - Ethical theories – Values - Ethics in practice – Implementing Ethical Reasoning – The ART of AI : Accountability, Responsibility, Transparency

INTERPRETABILITY AND EXPLAINABILITY **10 Hours**

Importance of Interpretability – Taxonomy of Interpretability Methods – Scope of Interpretability – Evaluation of Interpretability – Interpretable Models: Linear Regression – Logistic Regression – Decision Tree.

PRIVACY PRESERVATION **8 Hours**

Introduction to data privacy - Methods of protecting data - Importance of balancing data privacy and utility - Attack model – Privacy Preserving Learning - Differential Privacy – Federated Learning – Case Study

ENSURING RESPONSIBLE AI **8 Hours**

Approaches to Ethical Reasoning by AI – Designing Artificial Moral Agents – Implementing Ethical Deliberation – Levels of Ethical Behaviour – The ethical status of AI system – Governance for Responsible AI – Codes of Conduct – Inclusion and Diversity

Theory: 45	**Tutorial: 0**	**Total Hours: 45 Hours**

Reference Books

1. Virginia Dignum, "Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way" Springer Nature, 2019.
2. Christoph Molnar "Interpretable Machine Learning".Lulu, 1st edition, 2019.
3. Beena Ammanath, " Trustworthy AI", Wiley, 2022.
4. Adnan Masood, Heather Dawe, Dr. Ehsan Adeli, " Responsible AI in the Enterprise", Packt Publishing, 2023.

Online Learning Materials

1. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/introduction-to-responsible-ai?source=search.
2. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/responsible-ai-in-generative-ai?source=search

Data Science, Analytics and Visualization

Dr. Divya Vadlamudi
Associate Director – KSI, HoD – CSE & IT
BoS Chairperson

U18AIE0016 **PRINCIPLES OF DATA SCIENCE**

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES

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

CO1: Analyze the concepts of Data, Data Description, Relationship and Data Wrangling(K4)
CO2: Apply appropriate statistical tests to evaluate hypotheses related to means, proportions, and variances. (K3)
CO3: Apply the knowledge on relationships between data. (K3)
CO4: Apply the advanced Data Wrangling techniques for data(K3).

Pre-requisite: Nil

THEORY COMPONENT CONTENT

INTRODUCTION **(6 Hours)**

Overview Of Data science– Research goals – Building the model– presenting findings and building applications - Data Mining - Data Warehousing -Retrieving data – Data preparation Big Data and Data Science - Big Data Analytics, Business intelligence vs Big data, big data frameworks, Current landscape of analytics.

DATA DESCRIPTION **(6 Hours)**

Exploratory Data Analysis -statistical measures- Representation- Data Analytics Lifecycle- Developing Initial Hypotheses-Identifying Potential Data Sources- testing hypotheses on means, proportions and variances.

DESCRIBING RELATIONSHIPS **(7 Hours)**

Correlation –Scatter plots –correlation coefficient for quantitative data –computational formula for correlation coefficient – Regression –Regression line –least squares regression line – Standard error of estimate – interpretation of r2 –multiple regression equations –Regression towards the mean.

ADVANCED DATA WRANGLING **(8 Hours)**

Strings –Datetimes –Hierachical Indexing –Visualizing data Frames – Pandas Profiling – Data Transformation-handling Null values-categorical values-Data Aggregation-Data Filtering-handling Outliers.

Theory: 30	Tutorial: 0	Practical: 0	Project: 0	Total: 30

REFERENCES

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016.
2. Robert S. Witte and John S. Witte, “Statistics”, Eleventh Edition, Wiley Publications, 2017.
3. Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2016.
4. Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea Press, 2014.

ONLINE LEARNING MATERIALS

1. https://www.coursera.org/specializations/data-science
2. https://www.coursera.org/professional-certificates/fractal-data-science

SAMPLE LAB COMPONENTS

1. Data Retrieval and Preparation (Using Pandas)
2. Perform Exploratory Data Analysis on a dataset, exploring variables and visualizing distributions.
3. Calculate correlation coefficients between variables in a dataset
4. Create scatter plots and correlation matrices using Python
5. Implement simple linear regression on a dataset using Python's scikit-learn
6. Evaluate and interpret regression mode

U18AIE0017 **DATA PROCESSING TECHNIQUES**

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES

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

CO1: Analyze the data processing concepts in data science .(K4)
CO2: Apply the Real time data processing in machine learning model(K3)
CO3: Illustrate the change Data capture Techniques And Strategies in Incremental Processing.(K4)
CO4: Apply the Learning algorithms for incremental processing in data.(K3)
CO5: Correlating the Traditional disk system with In-Memory Database(K4)

Pre-Requisite:Nil

THEORY COMPONENT CONTENT DATA PROCESSING (8 Hours)

Overview of Data processing in Datascience–Importance of Efficiency and Scalability –, challeges in Big Data Processing– Parallel and Distributed Processing – Apache hadoop– Map reduce –Integration of Data mining system with a Data warehouse–Major issues in Data Mining–Data Preprocessing.

REAL TIME DATA PROCESSING (7 Hours)

Streaming Data Architectures–Message Brokers –Pub/Sub Systems– Queues– Apache-kafka for Real Time Data streaming– Producers-consumers-Kafka connect for Data Integration-stream processing-Frame works-Real Time analytics -Machine learning models

INCREMENTAL PROCESSING (7 Hours)

Incremental processing in Data science–Change Data Capture Techniques(CDC)-Strategies-Delta Processing for incremental updates- Incremental Learning algorithms.

IN-MEMORY PROCESSING (8 Hours)

Principles of In-Memory Processing-comparisons Of Traditional Disk based systems -In-Memory database and data structures-In-Memory computing in spark-Resilient Distributed datasets(RDD) And Data frames-In-Memory analytics with SAP HANA-Performance Tuning and optimisation .

REFERENCES

1. Practical Real-time Data Processing and Analytics: Distributed Computing and Event Processing using Apache Spark, Flink, Storm, and Kafka by shilpi Saxena and sharub gupta 1st Edition, Kindle Edition 2017
2. "Data Warehouse ETL Toolkit: Practical Techniques for Extracting, Cleaning, Conforming, and Delivering Data" by Ralph Kimball and Joe Caserta 1st Edition 2004
3. Building a Scalable Data Warehouse with Data Vault 2.0" by Dan Linstedt 2015
4. High Performance Spark: Best Practices for Scaling and Optimizing Apache Spark by Holden karau,Rachel warren 2017 1st edition

ONLINE LEARNING MATERIALS

1. https://www.coursera.org/videos/big-data-integration-processing/zBKt2?query=IN+MEMEORY+DATA+PROCESSING&source=search
2. https://www.coursera.org/videos/machine-learning-accounting-python/j3M5H?source=search&source=search&query=data%20preprocessing

SAMPLE LAB CONTENTS **30 Hours**

1. Implement a program using the environment Apache Flink
2. Implementation of producer and consumer program using kafka
3. Implement a simple flink streaming application.
4. Explore and connect flink application to kafka for Real time data ingestion
5. Design and Deploy simple strom topology
6. Develop a real-time analytics application with a simple machine learning model.
7. Implement mechanisms for model updates in response to streaming data changes.

Theory:30	Tutorial:0	Practical:30	Project:0	Total: 60 Hours

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U18AIE0018 **DATA MODELING**

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES

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

CO1: Apply MySQL Workbench to design database model(K3)
CO2: Apply logical Data model to design Patterns(K3)
CO3: Design Geospatial data models for applications involving location-based analytics(K6)
CO4: Analyze and choose appropriate NoSQL and NewSQL databases for specific modeling requirements.(K4)

Pre-requisite: Nil

THEORY COMPONENT CONTENT

INTRODUCTION TO ADVANCED DATA MODELING (6 Hours)

Overview of Data Modeling in Data science– Importance of Advanced data Modeling – Types of data Model– Dimensional modelling-Design-MySQL Workbench- Build Data model using MySQL workbench– Forward Engineering Feature-Converting Data model into Database schema,MySQL to reverse Engineering schema .

LOGICAL DATA MODEL (6 Hours)

Cross enterprise Analysis- Modern Driven analysis-Baseline data patterns-complex data Patterns-Generation of Entity types-Transition from meta data to data-static vs dynamic Entitytypes-data coupling -cohesion.

ADVANCED DATA PATTERNS (6 Hours)

Advanced subtype variations-Multi recursive networks-conditional Recursions-Rules based entity types-state Transition rules-Meta patterns.

GRAPH AND TEMPORAL DATA MODELING (6 Hours)

Graph Databases – Nodes – Edges – Properties– Graph query Languages – Understanding Temporal Databases – Valid time vs Transition Time– Temporal Datamining Techniques – Temporal query languages; No-SQL-New SQL: CAP theorem – Document-based: MongoDB data model and CRUD operations.

GEOSPATIAL AND METADATA MODELING (6 Hours)

Representing geospatial data in models-Geospatial Query Language-Applications in Mapping and Location-based Analytics-Metadata Definition and Importance-Encryption and Masking in Data Models-Access Controls and Authorization

REFERENCES

1. The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling". Authors: Ralph Kimball and Margy Ross 2013 3rd Edition
2. Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems (Greyscale Indian Edition) 2017.
3. Data Modeling Made Simple: A Practical Guide for Business & IT Professionals Authors:Steve Hoberman: 2nd Edition.2009

ONLINE LEARNING MATERIALS

1. https://www.coursera.org/lecture/advanced-data-modeling/introduction-to-advanced-data-modeling-eqENZ
2. https://www.coursera.org/learn/sql-data-science
3. https://www.coursera.org/learn/advanced-data-modeling
4. https://www.coursera.org/learn/nosql-databases
5. https://www.coursera.org/specializations/databases-for-data-scientists

SAMPLE LAB CONTENTS **30 Hours**

1. Explore a sample dataset and identify dimensions and facts.
2. Design and Implement schema for a dataset using MySQL workbench.
3. Design and implement a graph Data model for any dataset.
4. Implement a temporal data model for historical dataset
5. create Geospatial data models for location analyses

6. Explore the GEOJSON to represent spatial data.
7. create and manage a metadata for given dataset

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Theory: 30	Tutorial: 0	Practical: 30	Project: 0	Total: 60 Hours

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U18AIE0020 BUSINESS INTELLIGENCE FOR DECISION MAKING

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES

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

CO 1: Analyze the real world business problems and model with analytical solutions.(K4)
CO2: Evaluate the business processes for extracting Business Intelligence(K4)
CO3: Apply predictive analytics for business fore-casting.(K3)
CO4: Apply analytics for supply chain and logistics management(K3)
CO5: Use analytics for marketing and sales.(K3)

Pre Requisite: U18AII5202 – Exploratory Data Analysis and Visualization

THEORY COMPONENT

INTRODUCTION TO BUSINESS ANALYTICS (6 Hours)

Analytics and Data Science – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation – Interpretation – Deployment and Iteration

BUSINESS INTELLIGENCE (6 Hours)

Data Warehouses and Data Mart - Knowledge Management –Types of Decisions - Decision Making Process - Decision Support Systems – Business Intelligence –OLAP – Analytic functions.

BUSINESS FORECASTING AND COMPETITIVE ANALYSIS (6 hours)

Introduction to Business Forecasting and Predictive analytics - Logic and Data Driven Models – Data Mining and Predictive Analysis Modelling –Machine Learning for Predictive analytics-Industry analysis- Profit Frontier, Risk vs Return, Competition Positioning- Enterprise Diagnosis

HR ANALYTICS (6 Hours)

Human Resources – Planning and Recruitment – Training and Development - Supply chain network - Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR- Applying HR Analytics to make a prediction of the demand for talent.

MARKETING & SALES ANALYTIC (6 Hours)

Marketing Strategy, Marketing Mix, Customer Behaviour –selling Process – Sales Planning – Analytics applications in Marketing and Sales - predictive analytics for customers' behaviour in marketing and sales.

REFERENCES

1. R. Evans James, Business Analytics, 2nd Edition, Pearson, 2017
2. R N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2nd Edition, Wiley, 2016
3. Philip Kotler and Kevin Keller, Marketing Management, 15th edition, PHI, 2016
4. VSP RAO, Human Resource Management, 3rd Edition, Excel Books, 2010.
5. Mahadevan B, "Operations Management -Theory and Practice",3rd Edition, Pearson Education,2018.

Theory: 30 Tutorial: 0 Practical: 30 Project: 0 Total: 60 Hours

ONLINE LEARNING MATERIALS

1. https://www.coursera.org/learn/data-analytics-business
2. https://www.coursera.org/learn/foundations-of-business-intelligence
3. https://www.coursera.org/specializations/bi-foundations-sql-etl-data- warehouse

SAMPLE LAB CONTENTS 30 Hour

1. Explore the interface and basic features of the BI tool(Qlik)
2. Load and visualize a sample dataset.
3. Import a dataset into the BI tool. And Cleanse data by handling missing values, outliers, and inconsistencies.
4. Transform data to suit BI reporting requirements and Design a dashboard with key performance indicators (KPIs).

5. Develop interactive dashboards for dynamic data exploration.
6. Integrate data from various sources for comprehensive analysis
7. Implement advanced chart types (treemaps, heatmaps, etc.).
8. Apply BI tools for forecasting and predictive analytics.

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U18AIE0021 DATA ETHICS AND PRIVACY

L	T	P	J	C
3	0	0	0	3

COURSE OUTCOMES

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

CO1: Develop an awareness of the impact of data-related decisions on individuals and society (K6)

CO2: Identify the challenges and consequences of Biased datasets. (K4)

CO3: Examine the importance of Data security and Accuracy (K3)

CO4: Apply the aspects of distributed data and associated risks(K3)

CO5: Apply the knowledge of encryption for data(K3)

Pre Requisite: Nil

THEORY COMPONENT CONTENT DATA BIAS (8 Hours)

Introduction,- Data vs Information vs Facts- Algorithmic Bias- Privacy- Biased Datasets- Purpose of Corporation/AI-Fairness, Predictive Analytics & Mistakes- Surveillance & Power- Disparate Treatment/Impact

ETHICS IN DATA SCIENCE (9 Hours)

Ethics in data management- Role of AI Ethics in Corp- Privacy & Shared Responsibility- Surveillance/Power and Shared Responsibility- Disparate Treatment/Impact- Economics of Trust- Transparency vs accountability.

ACCURACY AND PRIVACY (10 Hours)

Creating & Measuring Accuracy- Data Science Ethics- Data Science Hate Privacy- Respecting Data Science-Misconceptions About Data Science Ethics- Accountability and Governance- Data Provenance and Aggregation

PRIVACY ATTACKS (9 Hours)

Defining Differential Privacy- Privacy Loss- Privacy attacks- Types of privacy attacks- Privacy-Aware Machine Learning and Data Science- Architecting Privacy in Data and Machine Learning- Open Source Libraries for PPML Projects- Distributed Data- Federated Learning

DATA ENCRYPTION FOR PRIVACY (9 Hours)

Encrypted Computation- Types of Encrypted Computation- Real-World Encrypted Computation- Navigating the Legal Side of Privacy- GDPR: An Overview- Privacy and Practicality Considerations- Getting Practical: Managing Privacy and Security Risk

Theory: 45	Tutorial: 0	Practical: 0	Project: 0	Total: 45 Hours

REFERENCES

1. Katharine Jarmul, Practical Data Privacy Released April 2023 Publisher(s): O'Reilly Media, Inc. ISBN: 9781098129460
2. Loukides, Mike, Hilary Mason, and DJ Patil. 2018. Ethics and Data Science. Sebastopol, CA: O'Reilly Media.

ONLINE LEARNING MATERIALS

1. https://www.coursera.org/learn/data-science-ethics
2. https://www.coursera.org/learn/northeastern-data-privac

Network and Distributed Computing

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U18ITE0018 SMART CONTRACT DEVELOPMENT

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES

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

CO1: Interpret Ethereum components required to design a smart contract [K3]
CO2: Design and develop smart contracts using Solidity programming. [K3]
CO3: Create and deploy a DApp on a Ethereum test network. [K3]
CO4: Deploy and manage Ethereum blockchain networks using Ganache and Truffle. [K3]

Pre-requisite: U18CSE0012 - Blockchain Technology and Applications

THEORY COMPONENT CONTENT

ETHEREUM FOUNDATIONS 8 Hours

Ethereum Eco System – Components – Ethereum Virtual Machine (EVM) – Ethereum and Turing Completeness – Smart Contract Basics – Smart Contract Lifecycle – Structure of Smart Contract. Ether currency units - Ethereum wallets – Ethereum accounts – Ethereum Tokens – Transactions, Gas and Fees – Ethereum mining - Externally owned accounts and contracts.

SMART CONTRACT DEVELOPMENT 11 Hours

Building a smart contract with Solidity – Ethereum Contract ABI – Programming with Solidity: Data Types & Variables – Operators – Control Structures - Predefined Global variables – Storage & Memory - Contracts – Functions – Function Modifiers - Constructor – Inheritance - Events and logs – Error handling - Inter-contract execution - Libraries and Ethereum package manager – Tokens - Introduction to Ethereum Name Service (ENS) – Designing Smart Contracts.

BUILDING DAPP AND WEB 3 11 Hours

Running an Ethereum Client: Go Ethereum (Geth) - Processing and deploying smart contracts in Remix IDE. Introduction to Web3 - Using the web3.js javascript library - Generating Ethereum accounts.
Truffle Framework & Ganache: Environment Setup for Truffle & Ganache, Truffle Project Creation, – Truffle Compile – Migrate and Create Commands - Decentralized App Creation: Smart Contract Creation, Front-End Creation, Connecting Smart Contract with Front-End Application – Deploying DApp – Validation – Testing of DApp.

REFERENCES

1. Mastering Ethereum: Building Smart Contracts and DApps by Andreas M. Antonopoulos, Gavin Wood, 2018, O'Reilly Media
2. Modi, Ritesh, Solidity Programming Essentials: A beginner's guide to build smart contracts for Ethereum and Blockchain, 2018, Packt Publishing Ltd, United Kingdom
3. Imran. Bashir. Mastering block chain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained. Packt Publishing, 2nd Edition, 2018

ONLINE LEARNING MATERIALS

1. https://www.coursera.org/learn/decentralized-apps-on-blockchain?specialization=blockchain
2. https://www.coursera.org/learn/smarter-contracts#syllabus
3. https://101blockchains.com/course/smart-contracts-development
4. https://www.tcsion.com/courses/industry-honour-course/ethereum-smart-contracts/
5. https://onlinecourses.swayam2.ac.in/aic21_ge01/preview
6. https://trufflesuite.com/docs/truffle/

Sample List of Experiments 30 Hours

1. Getting Started with MetaMask
    a. Creating a Wallet
    b. Interacting with Remix IDE
    c. Switching Networks
    d. Getting some Test Ethers
    e. Sending Ether from MetaMask
    f. Exploring the transaction details of an account
2. Building smart contract using Solidity, compiling and deploying it on Remix IDE
3. Use of setter and getter functions to interact with the contracts.

4. Smart contract to withdraw funds from a contract to a restricted account, preferably the owner's, with different levels of security restrictions.
5. Build a DApp and deploy a smart contract on an external blockchain by using Ganache and Truffle. Interact with a front end developed using Web 3.js.

Theory:30	Tutorial:0	Practical:30	Project:0	Total: 60 Hours

U18ITE0019 DECENTRALIZED FINANCE

L	T	P	J	C
3	0	0	0	3

COURSE OUTCOMES

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

CO1: Interpret the features of decentralized finance required to build its infrastructure. [K3]
CO2: Examine key trends and basic primitives of decentralized finance to design innovative financial solutions. [K3]
CO3: Apply diverse DeFi operations for providing blockchain-based financial solutions. [K3]
CO4: Identify the risks associated with decentralized finance. [K3]
CO5: Analyse ethical and regulatory issues associated with Decentralized Finance. [K4]

Pre-requisite: U18CSE0012 - Blockchain Technology and Applications

THEORY COMPONENT CONTENT

DECENTRALIZED FINANCE(DEFI) INFRASTRUCTURE 8 Hours

Issues in Centralized Finance – History and Overview of Decentralized Finance - Overview of Cryptocurrency – Cryptographic hashing – Proof of work – Smart Contracts – Gas - Stable coins – Tokenomics – Altcoins - Blockchain and DeFi

DEFI PRIMITIVES 8 Hours

Transactions – Fungible tokens – Non Fungible tokens – custody – Supply adjustment – Incentives – Swap – Collateralized loans – Flash loan - Problems solved by DeFi- Ineffeciency – Limited Access – Opacity –

Centralized control and lack of Interoperability

DEFI OPERATIONS **10 Hours**

Credit /Lending and borrowing protocols – Decentralized Exchanges – Derivatives – Tokenization – Hot and cold wallets – Moving centralized exchanges funds to blockchain - Automated market makers – Bridging – Staking - Oracles

DECENTRALIZED IDENTITY AND SECURITY **10 Hours**

Decentralized Identity (DID) – Security risks and measures in DeFi – Smart contract risk - Governance risk – Oracle risk – scaling risk – DEX risk – Custodial risk – Regulatory risk. Smart Contract Auditing – Yield Farming strategies – Liquidity mining

REGULATORY AND ETHICAL CONSIDERATIONS **9 Hours**

Global Regulations – Ethical issues – DAO – Government mechanisms – Crypto hackers – DeFi Usecases -Case study: Crypto Exchange Platforms and Gitcoin

REFERENCES

1. Campbell R. Harvey, Ashwin Ramachandran, Joey Santoro, Vitalik Buterin, "DeFi and the Future of Finance", Wiley 1st Edition.
2. Melanie Swan, Blockchain: Blueprint for a new economy, Shroff Publisher/O'Reilly Publisher.
3. Ron Quaranta, Blockchain in Financial Markets and Beyond: Challenges and Applications, Risk Books Publisher.
4. Richard Hayen, Blockchain & FinTech: A Comprehensive Blueprint to Understanding Blockchain & Financial Technology - Bitcoin, FinTech, Smart Contracts, Cryptocurrency, Risk Books Publisher.

ONLINE LEARNING MATERIALS

1. https://www.udemy.com/course/masteringdefi/
2. https://www.coursera.org/specializations/decentralized-finance-duke
3. https://101blockchains.com/ebooks/decentralized-finance-defi-guide/

Theory:45	Tutorial:0	Practical:0	Project:0	Total: 45 Hours

Cloud Computing

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L	T	P	J	C
2	0	2	0	3

U18ITE0020 VIRTUALIZATION AND RESOURCE MANAGEMENT

COURSE OUTCOMES

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

CO1: Analyze the use of different resource virtualizations used in cloud environment (K4).
CO2: Apply the factors of cloud economics on migration and development (K3).
CO3: Develop applications in different public cloud platform (K3).
CO4: Select appropriate service model for an application(K3).
CO5: Choose a suitable cloud service provider based on application domain(K3).

Prerequisite: Nil

THEORY COMPONENT CONTENTS

VIRTUALIZATION 4 Hours

Roles of Virtualization, Hypervisor, Types of Virtualization – Server virtualization – Storage virtualization – Network virtualization – Desktop virtualization – Application Virtualization.

CLOUD ECONOMICS AND MIGRATION 5 Hours

Cost models and optimization, Economies of Scale, Resource Optimization, Reduced Capital Expenditure - Total Cost of Ownership (TCO), Cost Transparency and Management, Risk Mitigation and Security, Performance vs. Cost Trade-offs.

Cloud Migration Strategies, Iterative Seven-step Model of Migration into the Cloud, Assessment and Planning, Choosing the Right Cloud services and Provider, Change Management and Training, Performance and Monitoring, Testing and Validation, Backups, Post-Migration Optimization.

NFRASTRUCUTURE AS A SERVICE 7 Hours

Compute: AWS EC2, Azure Virtual Machines, Google Compute Engine. Containers – Microservices, Docker, Kubernetes containers. Storage: Amazon EBS, Amazon S3, Azure disk storage, Google cloud storage. Autoscaling – AWS autoscaling, Azure app service, Google compute engine. Load balancing – AWS ELB, Azure traffic manager, Google cloud load balancer. Network: Amazon VPC, Azure virtual network, Google cloud VPN.

PLATFORM AS A SERVICE 7 Hours

PaaS: Serverless computing - AWS Lambda, Azure functions, Google Cloud functions, AWS Apprunner, Elastic beanstalk, Google App engine, Google Cloud Functions, Amazon RDS, DynamoDB, Azure SQL database, Azure CosmosDB, Google cloud SQL, Google cloud database.

SOFTWARE AS A SERVICE 7 Hours

Amazon chime, Workmail, Workdocs, Microsoft 365, Microsoft power platform, Azure active directory, Azure DevOps, Azure IoT central, Azure cost management, Google Maps platform, Google workspace, Google analytics, Google cloud identity, Google Cloud search, Firebase.

REFERENCES:

1. Dr. Rajesh Kumar Pathak , “Cloud Computing Fundamentals, Notion Press, 2023.
2. A. B. Lawal, “Cloud Computing Fundamentals: Learn the Latest Cloud Technology and Architecture with Real-World Examples and Applications”, A. B. Lawal publication, 2020.
3. Rajkumar Buyya, Christian Vecchiola, S.Thamarai Selvi, “Mastering Cloud Computing: Foundations and Applications Programming”, Morgan Kaufmann publications, 2013.
4. Cloudonomics: The Business Value of Cloud Computing" by Joe Weinman, John Wiley & Sons Inc, 2012.
5. Mastering AWS Development" by Uchit Vyas, Ingram short title, 2015.
6. Microsoft Azure Essentials - Fundamentals of Azure, Second Edition" by Michael Collier and Robin Shahan, Microsoft Press, 2015.
7. Google Cloud Platform for Developers: Build highly scalable cloud solutions with the power of Google Cloud Platform" by Ted Hunter and Steven Porter, Packt Publishing Limited, 2018.

ONLINE LEARNING MATERIALS

1. https://www.coursera.org/learn/cloud-computing-basics
2. https://www.coursera.org/learn/meta-cloud-computing

3. https://www.coursera.org/learn/cloud-computing-foundations-duke
4. https://www.coursera.org/browse/information-technology/cloud-computing
5. https://www.mygreatlearning.com/cloud-computing/courses
6. http://www.infocobuild.com/education/audio-video-courses/computer-science/CloudComputing-IIT-Kharagpur/lecture-12.html
7. https://www.coursera.org/specializations/aws-fundamentals
8. https://www.coursera.org/learn/cloud-azure-intro
9. https://www.coursera.org/learn/gcp-infrastructure-foundation

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2	0	2	0	3

LAB CONTENTS:

Few exercise related to AWS, Azure, Google platform services that fall under IaaS, PaaaS and SaaS.
Sample Exercises:

1. Demonstrate the virtualization by enabling the OS virtualization on single machine by creating instances oracle virtual box/VMware.
2. Installation of VM Ware/ virtual box and implement multiple OS.
3. Creating VMs in public cloud.
4. Deploying application in Docker/Kubernetes.
5. Static Web site hosting
6. Dynamic Website hosting
7. Balancing network traffic using load balancer
8. Scale the Compute resource with auto scaling
9. E-mail notification using serverless architecture.
10. Configuring a cloud network

Theory: 30	Tutorial: 0	Practical: 30	Project: 0	Total: 60 Hours

U18ITE0021 CLOUD INFRASTRUCTURE AND ARCHITECTURE

COURSE OUTCOMES

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

CO1: Construct the architecture for a private cloud (K3).
CO2: Develop a cloud environment at small scale (K3).
CO3: Inspect Security of services and applications in private cloud (K4).
CO4: Make use of concepts and features related to Virtualized datacenter to configure cloud storage (K3).
CO5: Build environment to manage IT resources (K3).

Prerequisite: U18ITE0020 - **Virtualization and Resource Management**

THEORY COMPONENT CONTENTS

INTRODUCTION TO CLOUD INFRASTRUCTURE 7 Hours

Introduction to cloud Infrastructure/virtual infrastructure, General Architecture of virtual infrastructure: Architecture of OpenStack, project, services, mode of deployment, workflow, Openstack Components: Nova, Swift, cinder, Nuetron, Glance, Keystone, Horizon. Virtualization environment with KVM. OpenStack API.

CLOUD COMPUTE ARCHITECTURE 7 Hours

Configuring Horizon Dashboard, OpenStack CLI client - Create and manage flavors, compute instances, generate and manage SSH keys, accessing instances, configure an instance with a floating IP address, create instances with security groups, manage Nova host consoles, instance snapshots. Openstack image service: image repository, manage images, metadata, image types, bundling, exporting, migrating images.

CLOUD STORAGE ARCHITECTURE **8 Hours**

Swift: features, architecture of swift, swift installation and configuration, data management lifecycle, backup and archival, media storage with swift. Use the command line client to upload and manage files to Swift containers, manage permissions on a container in object storage,

Cinder: Architecture of cinder clock storage, Volume provisioning and management- create and manage volumes, attach volumes to instances, manage volume quotas, backup and restore volumes, manage volume snapshots.

CLOUD NETWORK ARCHITECTURE **8 Hours**

Software defined networking, Neutron Architecture, Manage network resources, create external/public networks, create project networks, create project routers, attach routers to public and project networks, manage network services for a virtual environment, manage network quotas, manage network interfaces on compute instances, create and manage project security groups and rules, assign security group to instance, create and manage floating IP addresses, assign floating IP address to instance, detach floating IP address from instance. Identity and access management- keystone: users, roles, groups.

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REFERENCES

1. Ben Silverman, Michael Solberg, "OpenStack for Architects :Design Production-ready Private Cloud Infrastructure", 2nd Edition, Packt Publishing, 2018.
2. Michael Solberg, Ben Silverman, "OpenStack for Architects" , Packt Publishing,· 2017
3. Alok Shrivastwa, Sunil Sarat, Kevin Jackson, Cody Bunch, Egle Sigler, Tony Campbell, "OpenStack: Building a Cloud Environment", Packt Publishing, 2016
4. James Denton, "Learning OpenStack Networking (Neutron)", Packt Publishing, 2015.

ONLINE LEARNING MATERIALS

1. **https://www.coursera.org/learn/juniper-openstack-and-kubernetes?**

LAB CONTENTS

Deployment of OpenStack components.

Sample Exercises:

1. Configure NOVA compute Node
2. Configure Swift object storage
3. Construct a cinder block node
4. Build a horizon node – Monitor node
5. Launching an instance- Register an account at openstack, Create SSH Key, validate network.
6. Sharing project environment among multiple users.

Theory: 30	Tutorial: 0	Practical: 30	Project: 0	Total: 60 Hours

U18ITE0022 CLOUD STORAGE MANAGEMENT

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES

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

CO1: Make use of cloud storage technologies in applications (K3).
CO2: Correlate different storage networking technologies (K3).
CO3: Make use of the design principles of virtualization techniques in cloud resource management (K3)
CO4: Analyze different cloud storage life cycle strategies (K4).
CO5: Select appropriate backup and recovery strategies (K3).

Prerequisite: U18ITE0020 - Virtualization and Resource Management

THEORY COMPONENT CONTENTS

INTRODUCTION TO CLOUD STORAGE 7 Hours

Overview of cloud storage concepts - Advantages and challenges of cloud storage - Comparison of traditional storage vs. cloud storage, Evolution of Storage Architecture, Data Center Infrastructure, **Storage Technologies :** Block, file, and object storage - Storage protocols (iSCSI, NFS, SMB, etc.) - Data replication, snapshots, and backups in the cloud.

STORAGE NETWORKING TECHNOLOGIES 8 Hours

Network-Attached Storage: General-Purpose Servers versus NAS Devices, Benefits of NAS, File Systems and Network File Sharing, Components of NAS, NAS I/O Operation, NAS Implementations, NAS File-Sharing Protocols, Factors Affecting NAS Performance , File-Level Virtualization. Fibre Channel Storage Area Networks: Fibre Channel Overview, The SAN and Its Evolution, Components of FC SAN, FC Connectivity, Switched Fabric Ports, Fibre Channel Architecture, Fabric Services, Switched Fabric Login Types, Zoning, FC SAN Topologies, Virtualization in SAN. IP SAN and FCoE: iSCSI, FCIP, FCoE

LIFE CYCLE MANAGEMENT AND SECURITY 8 Hours

Introduction to storage tiers **,** Different Storage Classes Offered by Cloud Providers - Choosing the Right Storage Class for Different Use Cases - Access Control and Security - Identity and Access Management (IAM) - Encryption in Transit and at Rest

BACKUP AND DISASTER RECOVERY 7 Hours

Introduction to Business Continuity: Information Availability, BC Terminology, BC Planning Life Cycle, Failure Analysis, Business Impact Analysis, BC Technology Solutions. Backup and Archive: Backup Purpose, Backup Considerations, Backup Granularity, Recovery Considerations, Backup Methods, Backup Architecture, Backup and Restore Operations, Backup, Backup in NAS Environments, Backup Targets, Data Deduplication for Backup, Backup in Virtualized Environments, Data Archive, Archiving Solution Architecture

REFERENCES

1. Data Intensive Storage Services for Cloud Environments by Athanasios Voulodimos, Dimosthenis P. Kyriazis, Spyridon V. Gogouvitis, Theodora Varvarigou, Business Science Reference, 2013.
2. Cloud Storage Management in Contemporary IT Environments by Michael O'Dell and Michael Corey, Packt Publishing, 2012.
3. Borko Furht, Armando Escalante Handbook of Cloud Computing, Springer Science+Business Media, LLC 2010
4. Information Storage and Management by Emc Education S, John Wiley & Sons, Incorporated, 2012.

ONLINE LEARNING MATERIALS

1. https://www.coursera.org/learn/data-storage-microsoft-azure
2. https://www.udemy.com/course/introduction-to-cloud-storage-apps-a-beginners-course/
3. https://www.coursera.org/learn/cloud-storage-big-data-analysis-sql
4. https://www.classcentral.com/course/linkedin-learning-learning-cloud-computing-cloud-storage-30444

LAB CONTENTS

Attaching volume to instances, Creating snapshots from volumes, Migrating a file among different storage classes, Managing access control over a file/storage, Enabling client and server-side encryption for an object.

Sample Exercise:

1. Attaching volume to instances.
2. Creating snapshots for volumes.
3. Migrating a file among different storage classes.
4. Managing access control over a file/storage.
5. Enabling client and server side encryption for an object.

Theory: 30	Tutorial: 0	Practical: 30	Project: 0	Total: 60 Hours

U18ITE0023 CLOUD APPLICATION DEVELOPMENT

L	T	P	J	C
2	0	0	2	3

COURSE OUTCOMES

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

CO1: Analyse the use cases for cloud application development (K4)
CO2: Compare web and cloud application and analyze appropriate cloud platforms requirements (K3)
CO3: Build applications using APIs and Cloud services (K3)
CO4: Apply agile application development and manage application life cycle using DevOps (K3)

Prerequisite: U18ITE0020 - Virtualization and Resource Management

INTRODUCTION TO APLLICATION DESIGN 6 Hours

Business case for implementing cloud application, Requirements, collection for cloud application development, Cloud service models and deployment models, Open challenges in Cloud Computing: Cloud inter-operability and standards, scalability and fault tolerance, security, trust and privacy.

APPLICATION DEVELOPMENT FRAMEWORK 8 Hours

Accessing the clouds: Web application vs Cloud Application, Frameworks: Model View Controller (MVC), Struts, Spring. Cloud platforms in Industry – Google AppEngine, Microsoft Azure, Openshift, CloudFoundry

CLOUD SERVICE DELIVERY ENVIRONMENT AND API 8 Hours

Storing objects in the Cloud, Session management, Working with third party APIs: Overview of interconnectivity in Cloud ecosystems. Facebook API, Twitter API, Google API. **Architecting for the Cloud :** Best practices Best practices in architecture cloud applications in AWS cloud, Amazon Simple Queue Service (SQS), RabbitMQ, Amazon Simple Notification Service (Amazon SNS), multi-player online game hosting on cloud resources, Building content delivery networks using clouds.

DEVOPS IN CLOUD 8 Hours

Continuous Integration/Continuous Deployment (CI/CD), collaboration among development, operations, and other stakeholders, Agile and lean principles: Embracing agile methodologies and lean practices to enable faster development and delivery cycles. Automating development pipelines, Monitoring and Logging, Implementing monitoring solutions for cloud applications, Containerization: Docker basics and container orchestration with Kubernetes.

REFERENCES

1. Cloud Application Architectures: Building Applications and Infrastructure in the Cloud by George Reese, Oreilly Publication, 2021.
2. Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation by Jez Humble and David Farley, 2020.

ONLINE LEARNING MATERIALS

1. https://www.coursera.org/specializations/ibm-cloud-application-development-foundations
2. https://www.udemy.com/course/cloud-computing-development-essentials/
3. https://www.coursera.org/learn/cloud-native-devops-agile-nosql?specialization=ibm-cloud-application-development-foundations
4. https://www.edx.org/certificates/professional-certificate/ibm-cloud-and-application-development-foundations

PROJECT:

Projects involving Google AppEngine, Microsoft Azure, Openshift, Cloud Foundry services will be done.

Theory: 30	Tutorial: 0	Practical: 0	Project: 30	Total: 60 Hours

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L	T	P	J	C
2	0	2	0	3

U18ITE0024 CLOUD SECURITY

COURSE OUTCOMES

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

CO1: Analyze the security breaches of IaaS, PaaS and SaaS. (K4)
CO2: Apply various data encryption methods and security mechanisms to get the administrative control using IAM service.(K3)
CO3: Inspect compliance, governance and risk management (K4)
CO4: Make use of CI/CD pipeline in application security (K3).
CO5: Analyze security in edge computing (k4)

Pre-requisite: U18ITE0020 - Virtualization and Resource Management

THEORY COMPONENT CONTENTS

INTRODUCTION TO CLOUD SECURITY 6 Hours

Overview of cloud computing and its security challenges - Importance of cloud security for organizations - Shared responsibility model in cloud security. **Cloud Service Models and Security:** Security considerations for IaaS, PaaS, and SaaS, Risks and security measures specific to each service model, Case studies highlighting security vulnerabilities in cloud services.

CLOUD SECURITY ARCHITECTURE AND DATA PROTECTION 6 Hours

Designing secure cloud architectures, Identity and access management (IAM) in the cloud Network security in a cloud environment. Encryption techniques for data at rest and in transit Key management best practices, Data loss prevention (DLP) strategies in the cloud

COMPLIANCE, GOVERNANCE, AND RISK MANAGEMENT 6 Hours

Compliance requirements in the cloud (e.g., GDPR, HIPAA), Risk assessment and management in cloud environments, Implementing governance frameworks for cloud security, Cloud-specific threats and vulnerabilities, Security monitoring and logging in the cloud, Incident response planning and execution in cloud environments.

SECURE DEVELOPMENT AND DEVSECOPS 6 Hours

Security considerations in cloud-native application development, Implementing security in CI/CD pipelines, Best practices for DevSecOps in the cloud.

EMERGING TRENDS AND FUTURE OF CLOUD SECURITY 6 Hours

Edge computing and its security implications, Zero-trust security models in the cloud, Future directions and trends in cloud security

REFERENCES

1. Cloud Security Attacks, Techniques, Tools and Challenges by Preeti Mishra, Emmanuel S Pilli, R C Joshi · 2021
2. Cloud Security: Concepts, Applications and Perspectives by Brij B. Gupta · 2021
3. Securing the Cloud: Cloud Computer Security Techniques and Tactics by Vic (J.R.) Winkler
4. Cloud Security: A Comprehensive Guide to Secure Cloud Computing by Ronald L. Krutz, Russell Dean Vines · 2010
5. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance (Theory in Practice) 1st Edition, by Tim Mather (Author), Subra Kumaraswamy (Author), Shahed Latif (Author) 2009.

ONLINE LEARNING MATERIALS

1. https://www.coursera.org/learn/cloud-security-basics
2. https://www.coursera.org/learn/sscp-4th-ed-course-6
3. https://www.coursera.org/learn/cloud-data-security
4. https://www.checkpoint.com/cyber-hub/cloud-security/what-is-cloud-security/
5. https://www.zscaler.com/resources/security-terms-glossary/what-is-cloud-security
6. https://medium.com/@goodycyb/exploring-cloud-security-in-depth-labs-and-insights-for-aws-and-gcp-50ca038478c4

7. https://goodycyb.hashnode.dev/

LAB CONTENTS

Securing Free tier account, IAM, account bills, instances within Virtual Private Cloud, Role based access control with cloud platform IAM, Instance with firewall rules , Data encryption and decryption using cloud platforms, restricting access to storage, Configuring networking firewall for an application

Sample exercises:

1. Securing free tier account in cloud platform
2. Securing free tier account in cloud platform with IAM user
3. Creating IAM role, Group.
4. Securing free tier account setting billing in cloud platform
5. Securing instances in cloud platform within Virtual Private Cloud
6. Implementing role based access control with cloud platform IAM
7. Securing instances with firewall rules
8. Data encryption and decryption using cloud platforms
9. Securing and restricting access to storage
10. Configuring networking firewall for an application

Theory: 30	Tutorial: 0	Practical: 30	Project: 0	Total: 60 Hours

L	T	P	J	C
2	0	0	2	3

U18ITE0025 CLOUD AUTOMATION

COURSE OUTCOMES

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

CO1: Identify appropriate cloud automation tools for an application (K3).
CO2: Take part in automating DevOps using tools (K4)
CO3: Make use of storage automation in an application (K3).
CO4: Apply automation tools in monitoring services (K3)
CO5: Utilize tools for the cloud resource scaling and management (K3)

Prerequisite: U18ITE0020 - Virtualization and Resource Management

THEORY COMPONENT CONTENTS

INTRODUCTION CLOUD AUTOMATION 7 Hours

Benefits of cloud automation - Types of cloud automation tools - Use cases for cloud automation. Managing and provisioning infrastructure through code (using tools like Terraform, Ansible, Puppet, Chef), Automating code integration and verification through tools like Jenkins, GitLab CI, or CircleCI, Automating the deployment process to push code changes into production environments reliably.

CLOUD RESOURCE SCALLING AND STORAGE AUTOMATION 8 Hours

Automating resource allocation, de-allocation, and right-sizing of resources based on usage. Kubernetes - Salt - CircleCI - Ansible and puppet, AWS DataSync, Azure Data Factory.

CLOUD AUTOMATION TOOLS FOR DEVOPS 7 Hours

DuploCloud - Puppet - Heroku -HashiCorp, Monitoring and Logging Tools – Prometheus, Grafana, Docker, Raygun, Splunk, Git, Ansible, Jenkins, Bamboo.

CLOUD DEPLOYMENT AUTOMATION 8 Hours

NetApp Cloud Volumes ONTAP - CFEngine -VMware vs Realize Automation - Cisco Intelligent - Automation for Cloud - Microsoft Azure Automation - Google Cloud Deployment Manager - AWS CloudFormation - IBM Cloud Schematics

REFERENCES

1. Mikael Krief,, “Learning DevOps: The complete guide to accelerate collaboration with Jenkins, Kubernetes, Terraform and Azure DevOps”, Packt Publishing; 1st edition, 2019.
2. Marcelo Pinheiro, “Mastering DevOps Automation”, Packt Publishing Limited, 2018.
3. Jeff Geerling, “Ansible for DevOps: Server and Configuration Management for Humans”, Midwestern Mac, LLC; 1st edition, 2015.
4. John Rhoton and James Stanger, “Cloud Automation and DevOps: Transforming Your IT Environment, 2015.

ONLINE LEARNING MATERIALS

1. https://www.coursera.org/learn/automation-in-aws
2. https://www.coursera.org/learn/gcp-infrastructure-scaling-automation
3. https://www.udemy.com/course/aws-cloud-security-proactive-way/
4. https://www.edx.org/learn/computer-programming/google-cloud-elastic-google-cloud-infrastructure-scaling-and-automation

PROJECT

Projects involving different cloud platform services like Puppet, Heroku, HashiCorp and monitoring & Logging Tools – Prometheus, Grafana, Docker, Raygun, Splunk, Git, Ansible, Jenkins, Bamboo.

Theory: 30	Tutorial: 0	Practical: 0	Project: 30	Total: 60 Hours

U18ITE0026 FULL STACK SOFTWARE DEVELOPMENT

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES

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

CO1: Create a Web Server with Node.js for a simple application. (K3)
CO2: Develop a Web Application in Express.js Framework. (K3)
CO3: Build an application with Node.js and MongoDB. (K3)
CO4: Deploy the developed application in GitHub repository. (K3)

Prerequisite: NIL

THEORY COMPONENT CONTENT

INTRODUCTION TO FULL STACK DEVELOPMENT & VERSION CONTROL **6 Hours**

Overview of HTML, CSS, JavaScript, and Bootstrap.
Web Development Stack - Full Stack – Introduction – Types: MERN, MEAN, MEVN, LAMP, Ruby on Rails, Django, NET, JAMSTACK
Version Control – Need - Popular version control tools like Git - create a GitHub account - Use the GitHub web interface to create a repository - add a file to Git and commit the changes – Git commands.

INTRODUCTION TO NODE.JS **6 Hours**

Introduction to Node.js - Server-Side JavaScript and Node.js - Creating a Web Server with Node.js - Working with Node.js Modules - Overview of Node Package Manager

SERVER-SIDE JAVASCRIPT **6 Hours**

Asynchronous I/O with Callback Programming - Creating Callback Functions - Using Anonymous Callback Functions in Node.js - Issues with Callbacks - Working with JSON – Handling errors and debugging Node.js applications.

EXPRESS WEB APPLICATION FRAMEWORK **6 Hours**

Extending Node.js - Working with Third Party Node.js Extensions - Introduction to Web Frameworks - Express Web Application Framework - Working with Back-end JavaScript Frameworks and Express - Routing, Middleware, and Templating - Authentication in Node JS - Middleware & Routers - HTTP Methods and Rest APIs.

MONGODB AND DEPLOYMENT OF NODE.JS APPLICATIONS **6 Hours**

NoSQL databases and MongoDB - Setting up a MongoDB development environment - Building MongoDB schema and models with Mongoose – Connecting Node.js application with MongoDB – Testing and Deploying Node.js applications with server configurations.

LAB CONTENTS

Sample List of Lab Experiments:

1. Create your own Node.js module and import and use modules in your web server application.
2. Develop asynchronous functions with callbacks, error handling, and control flow using callbacks.
3. Demonstrate JSON file data read and write using Node.js.
4. Create a RESTful API to serve JSON data.
5. Demonstrate RESTful endpoints using Express and HTTP methods to handle GET, POST, PUT, and DELETE requests.
6. Integrate a template engine (e.g., EJS or Pug) with Express and Render dynamic HTML views using templates.
7. Implement user authentication in your Express application.
8. Explore and integrate third-party Node.js extensions into your Express app and showcase the benefits of using extensions for specific features.
9. Create a multi-page web application with authentication, routing, and RESTful APIs.
10. Create a simple Employee Management Application with MongoDB and Node.js.

Theory: 30	Tutorial: 0	Practical: 30	Project: 0	Total: 60 Hours

REFERENCES

1. “Mastering HTML, CSS & JavaScript Web Publishing” by Laura Lemay, Rafe Colburn, Jennifer Kyrnin, BPB Publications, 2016.
2. "Node.js Web Development: Server-side web development " by David Herron, 5th Edition, 2020
3. "Node.js in Action" by Alex Young, Bradley Meck, Mike Cantelon, Tim Oxley, Marc Harter, T.J. Holowaychuk, and Nathan Rajlich, Manning, 2nd Edition, 2017
4. "Node.js Design Patterns" by Luciano Mammino and Mario Casciaro, 3rd Edition, 2022.
5. “Web Development with MongoDB and Node JS” by Mithun Satheesh, Bruno Joseph D'mello, Jason Krol, Packt Publishing Limited; 2nd edition, 2015.
6. "Web Development with Node and Express" by Ethan Brown, O’Reilly Media, Inc. 2nd Edition, 2019.
7. “Pro Git” by Scott Chacon, Ben Straub, Apress, 2nd edition, 2014.

ONLINE LEARNING MATERIALS

1. Introduction to Web Development with HTML, CSS, JavaScript | Coursera
2. Getting Started with Git and GitHub | Coursera
3. Developing Back-End Apps with Node.js and Express | Coursera
4. Introduction to MongoDB | Coursera
5. [Project] Build a CRUD Node.js and MongoDB employee management web-app | Coursera

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U18CSE0014 3D MODELING AND GAME DESIGN

COURSE OUTCOMES

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

CO1: Understand the foundational knowledge of 3D modeling and apply on a real time scenario in creating object and environment[K3].

CO2: Design and analyse the usage of Game objects and Assets using Physics and Lights[K4].

CO3: Apply Navigations, Particle systems and audio develop simple games[K3].

Prerequisite: Nil

THEORY COMPONENT CONTENT

BUILDING BLOCKS (6 Hours)

3D space- 3D objects- viewports and cPlane basics- selecting objects- solid object creation- outputting images- Boolean modeling and figured space- object snaps and transforms- Boolean modeling- Clipping plane.

OBJECT AND SURFACE MODELING (6 Hours)

Profile modeling – surface- cPlane- revolve- object modeling- project and pull- curves from objects- trimming surfaces- surface modeling – lofting- surface filleting and blending- surface from edge curves- patch surfaces.

GAME OBJECTS AND ASSETS (6 Hours)

Native Game Objects -Manipulating Game Objects - Components in the Game engine – Fundamentals working concept - Materials- Defining the Role of the Prefab - Textures: UV Mapping and Texturing Techniques - Discovering the Standard Shader.

IMPLEMENTATION OF ASSETS WITH PHYSICS AND LIGHTING (6 Hours)

Creating Hierarchies - Using Empty Game Objects as Pivots -Understanding the Physics System – Rigid body Components - Colliders - Scripting Collision Events - Lighting in Games- Analyzing the Different Lights and Properties.

NAVIGATION AND ANIMATIONS (6 Hours)

Animation in Game Development - Creating Animation in the Editor-Refining Animation- NavMesh - NavMesh Agent - NavMesh Obstacle-Creating the Player Controller Game Object- Particles in Video Games-Analyzing Existing Particle Effects-Audio in Game Development - Audio Effects.

REFERENCES

1. "The Ultimate Guide to Game Development with Unity" by Unity Technologies,2023.
2. The Art of Game Design: A Book Of Lenses, THIRD EDITION, Jesse Schell, CRC Press; 3rd edition , 2019.
3. Paris Buttfield-Addison, Jon Manning, Tim Nugent, “Unity Game Development Cookbook”, O'Reilly Media, Inc. 2019.

4. 3D Modeling for Beginners: Learn Everything You Need to Know About 3d Modeling!, Danan Thilakanathan,2016.

ONLINE LEARNING MATERIALS

1. https://www.coursera.org/learn/introduction-to-3d-modeling
2. https://www.coursera.org/specializations/game-design-and-development
3. https://www.coursera.org/learn/game-design
4. Control physics with C# in Unity (coursera.org)
5. Create basic behavior with C# in Unity (coursera.org)
6. The Complete Guide to 3D Modeling with Blender | Udemy

PROJECT:

Projects involving 3D modeling using Blender and design simple games with effective audio, light, animation, and appropriate understanding of physics in Real time environment.

Theory: 30	Tutorial: 0	Practical: 0	Project: 30	Total: 60 Hours

U18CSE0015 AUGMENTED REALITY AND VIRTUAL REALITY APPLICATION DEVELOPMENT

L	T	P	J	C
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COURSE OUTCOMES

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

CO1: Attain a foundational understanding and difference of Augmented and Virtual reality technologies[K3].

CO2: Develop skills in placing assets, managing scale, addressing occlusion, and implementing realistic lighting in AR and VR projects. [K6]

CO3: Apply AR and VR in practical scenarios and conducting AR/VR based visualization case studies for product development. [K3]

Pre–requisite: U18CSE0014 - 3D Modeling and Game Design

THEORY COMPONENT CONTENT

AUGMENTED AND VIRTUAL REALITY BASICS (8 Hours)

Introduction to Augmented Reality -MAR Market, Actors, and Value Chain - Application vs. Browser -MAR System Architecture- Difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, enhancing interactivity in AR environments, evaluating AR systems.

Virtual Reality and Virtual Environment: Introduction, Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark.

AR AND VR TECHNOLOGIES (8 Hours)

Placing and positioning assets - Scale and size of assets - Occlusion -Lighting for increased realism - Solid augmented assets – context awareness - tracking in AR - outside-in tracking - motion tracking - environmental understanding - feature points - plane finding – light estimation - anchors - interface issues and lack of UI metaphors -technical constraints – 3D barriers - computer vision limitations -constraints of occlusion and shading.

Levels of Immersion in VR Systems - Sensorimotor Contingency -Sensorimotor Contingency in VR - Introduction to the Three Illusions: Place Illusion (PI), Plausibility Illusion (Psi) - Necessary Conditions for Psi - Break of Presence - Presence, Immersion, PI, and Psi - The Pinocchio Illusion - The Rubber Hand Illusion - Psychological Effects of Embodiment Illusion - Visual-Tactile and Visual-Motor Synchrony.

AR CORE (7 Hours)

Android OS - limitations of low light conditions on AR on mobile -simple surfaces challenge AR – user flow - working with tech limitations - preparing your tools - design draft. surface detection and creating plane - user interaction - placing with anchor points - occlusion between virtual assets - light estimation - virtual light to real light - multiplane detection and spatial mapping - processing needs in mobile AR - breaking immersion - framing as a creative device.

VR SYSTEMS AND HARDWARES (7 Hours)

The Virtual world space-positioning the virtual observer- perspective projection, human vision, stereo perspective projection, 3D clipping, Colour theory. Illumination models- Reflection models- Shading algorithms, Radiosity, Hidden Surface Removal- Realism - Stereographic image. VR Hardware- sensor hardware, Head-coupled displays, Acoustic

hardware.

REFERENCES

1. Linowes, J., &Babilinski, K. (2017). Augmented Reality for Developers: Build Practical Augmented Reality Applications with Unity, ARCore, ARKit, and Vuforia. Packt Publishing Ltd.
2. XR Development with Unity-A beginner's guide to creating virtual, augmented, and mixed reality experiences using Unity by Anna Braun, Raffael Rizzo(2022).
3. Mastering Augmented Reality: A Comprehensive Guide to Learn Augmented Reality by Cybellium Ltd, Kris Hermans (2023)
4. Peddie, J. (2017). Augmented Reality: where we will all live. Springer.
5. Ong, S. (2017). Beginning windows mixed reality programming. Berkeley, CA: Apress. Doi, 10, 978-1.
6. "The VR Book: Human-Centered Design for Virtual Reality (ACM Books)"by Jason Jerald (2015).

ONLINE LEARNING MATERIALS

1. https://www.coursera.org/learn/ar |Coursera
2. https://www.coursera.org/professional-certificates/meta-ar-developer |Coursera
3. https://www.coursera.org/specializations/extended-reality-for-everybody|Coursera
4. https://www.coursera.org/specializations/virtual-reality
5. https://www.coursera.org/learn/introduction-virtual-reality
6. https://www.coursera.org/learn/making-virtual-reality-game
7. https://www.coursera.org/learn/3d-models-virtual-reality
8. https://www.coursera.org/learn/intro-augmented-virtual-mixed-extended-reality-technologies-applications-issues

PROJECT 30 Hours

To Design and Integration of 3D Spatial audio and sound effects to the objects developed and exploring creative possibilities with AR Core, implement AR/VR navigation system (UX), AR/VR interaction system (UX), Applying AR/VR technologies in real time applications.

Theory: 30	Tutorial: 0	Practical: 0	Project: 30	Total: 60 Hours

U18CSE0016 ADVANCED METAVERSE TECHNOLOGIES

L	T	P	J	C
3	0	0	0	3

COURSE OUTCOMES

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

CO1: Acquire knowledge to differentiate various Extended reality technologies in Metaverse.
CO2: Apply Metaverse Experiences with depth understanding on devices and interoperability.
CO3: Analyze Metaverse in various application domains.
CO4: Develop the Metaverse environment with the integration of other technologies.

Prerequisite: NIL

THEORY COMPONENT CONTENT

THE FOUNDATION OF XR & METAVERSE (7 Hours)

The Brain Science behind VR - Understanding Augmented Reality (AR), Virtual Reality (VR), Mixed Reality (MR), Web XR - Differences & Similarities of VR/AR/MR-XR in Metaverse.

EXPERIENCE WITH METAVERSE (8 Hours)

Metaverse-Experiences in metaverse-Avatars in metaverse-Interoperability in the metaverse-connections and communications-Devices to access the metaverse.

APPLICATIONS OF METAVERSE (8 Hours)

Educational potential in metaverse-Learning in the metaverse-Health and architecture in metaverse-Arts, entertainment, and sports in the metaverse-Building a safe metaverse.

TECHNOLOGIES IN METAVERSE (11 Hours)

Web 3.0-Artificial Intelligence (AI) in Metaverse- Cyber Security aspects / How safe is Metaverse - Blockchain, NFT (non-fungible token) and crypto currency -Metaverse and NFTs - Metaverse Use Cases - Top Metaverse platforms - Current Challenges in Mass adoption of XR - Impact of 5G in XR - Role of Microsoft, Apple and Facebook in Metaverse

INTERACTING IN METAVERSE (11 Hours)

On-premise/Local hosting - Cloud Hosting & Streaming services - Distribution via Application Stores - Understanding UI & UX Design Essentials for AR/VR - Types of Navigation - Types of interaction (Understanding Hand controllers, gesture, gaze and voice controls) - Avatar implementations in VR (Torso/Full body) - AR/VR/Metaverse 3D Assets creation Tools Overview - 3D assets creation for VR/AR (Native polygonal modeling, Converting CAD models, 3D Scanning, Photogrammetry)

Theory:45	Tutorial:0	Practical:0	Project:0	Total: 45 Hours

REFERENCES

1. "The Metaverse: And How it Will Revolutionize Everything" by Matthew Ball. published in 2022.
2. Metaverse for Beginners: The Ultimate Guide to Understanding and Investing in Web 3.0, NFTs, Crypto Gaming, and Virtual Reality by Donn Newman in 2022
3. The Fourth Transformation: How Augmented Reality & Artificial Intelligence Will Change Everything by Robert Scoble, Shel Israel published in 2016

ONLINE LEARNING MATERIALS

1. https://www.coursera.org/learn/what-is-the-metaverse| Coursera
2. Metaverse Web 3.0 and DeFi: A Fintech Masterclass| Udemy

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U18CSE0017 EMBEDDED SYSTEMS FOR IOT

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES

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

- **CO1:** Identify the internal architecture and programming of an embedded processor. [K3]
- **CO2:** Utilize the basic architecture of Internet of Things based Devices [K3]
- **CO3:** Make use of hardware platforms and AI Enabled Boards for application development. [K3]
- **CO4:** Choose the software platforms to process the IoT Data.[K3]
- **CO5:** Build an embedded and IoT Solution for real world scenarios[K5]

Pre-requisite : NIL

THEORY COMPONENT CONTENTS

EMBEDDED AND MICROCONTROLLER CONCEPTS 7 Hours

Introduction to embedded processors-Categories of embedded processors-Architecture-Introduction to PIC microcontrollers, architecture and memory organization, registers, I/O ports, interrupts, timer, instruction sets, Embedded Communication Protocols – UART, USART,I2C, SPI, Modbus-Introduction to Real-Time Operating Systems (RTOS)- RTOS Architecture: Layered Architecture of an RTOS -Kernel Components and Their Functions-Real-Time Operating System Services

INTERNET OF THINGS 5 Hours

Introduction to Internet of Things (IoT), Functional Characteristics, IoT building blocks - Architecture and working - Elements of an IoT ecosystem-IOT Application Development Cycle-Technology drivers, Business drivers, Trends and implications -Recent Trends in the Adoption of IoT, Role of cloud in IoT. IoT Enabling Technologies

HARDWARE PLATFORMS FOR IOT 6 Hours

Development Boards -Arduino, Raspberry Pi, ESP8266, AI Enabled Boards (Jetson Boards for IoT development), Sensors and actuators -Types-Functions, and applications: Gateways-connectivity options for Short range/Long range Communication- IoT device communication protocols Overview.

SOFTWARE DEVELOPMENT FOR IOT 6 Hours

IDEs for IoT prototyping- Arduino Programming - Arduino functions- Interfacing with sensors and actuators-Libraries -Input/Output From Pins - Raspberry Pi platform -Environmental - Programming and interfacing with basic hardware components. Open Platforms- Platforms Overview- IBM Watson IoT—Bluemix, Eclipse IoT, AWS IoT, Microsoft Azure IoT Suite, Google Cloud IoT

APPLICATION DEVELOPMENT 6 Hours

Development of IoT Applications - Cloud platforms for IoT, Cloud data logging and monitoring, Interfacing with web services.
IOT Prototyping - Home Automation –Smart Agriculture – Smart Cities – Smart Healthcare.

LAB CONTENTS: **30 Hours**

To understand the IoT tools and Platforms. Build a basic home automation system. IoT solution for agriculture, IoT-based smart parking system, Smart Cities - Smart Waste Management, Smart Street Lights, Healthcare - Baby Monitoring.

Sample Experiment:

1. Embedded C Programming and Interfacing with various peripherals
2. Integration of Actuators with node MCU (Servo motor/Relay).
3. Capture Image with node MCU.
4. Explore different communication methods with IoT devices (Zigbee, GSM, Bluetooth).
5. Make use of cloud platform to log the data.
6. Build a basic home automation system using IoT devices.
7. Develop an IoT solution for agriculture.
8. Design an IoT-based smart parking system.

Theory: 30 **Tutorial: 0** **Practical: 30** **Project: 0** **Total: 60 Hours**

REFERENCES:

1. Perry Xiao, Designing Embedded Systems and the Internet of Things (IoT) with the ARM mbed, 1119363993,Wiley, First Edition, 2018.
2. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017.
3. Raj Kamal , " Internet of Things: Architecture and Design", McGraw Hill.2nd edition June 2022.
4. Arduino Programming in 24 hours, Richard Blum, 1st Edition, ISBN: 978-0672337123, Sams Tech Yourself Publishing.2014
5. Adrian Mcewen, Hakin Cassimally, "Designing The Internet of Things", First Edition, Wiley, 2014

ONLINE COURSES:

1. https://onlinecourses.nptel.ac.in/noc22_cs53/preview
2. https://www.coursera.org/learn/iot-wireless-cloud-computing
3. https://www.udemy.com/course/complete-guide-to-build-iot-things-from-scratch-to-market/

U18CSE0018 IOT SYSTEMS DESIGN

L	T	P	J	C
2	0	0	2	3

COURSE OUTCOMES

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

- **CO1:** Choose relevant IoT reference architecture for providing a standardized framework for design and implementation of solutions. [K3]
- **CO2:** Design and implement IoT systems by selecting appropriate communication protocols to enable seamless data exchange between devices [K3]
- **CO3:** Demonstrate proficiency in managing and processing IoT data for real time scenarios. [K3]
- **CO4:** Articulate the issues and challenges involved in integration of large scale IoT system. [K3].

Pre-requisite: NIL

THEORY COMPONENT CONTENTS

IOT ARCHITECTURE 6 Hours

Types of IOT Architecture - Three-Tier IoT Architecture, Five-Tier IoT Architecture, Hierarchical IoT Architecture - Mesh IoT Architecture, Microservices IoT Architecture, Serverless IoT Architecture

IOT PROTOCOLS 6 Hours

Application Layer Protocols-MQTT , CoAP , HTTP , AMQP . Network Layer Protocol- IPv6, 6LoWPAN, RPL. Data Link Layer Protocols-ZigBee, BLE. Physical Layer Technologies-RFID-LoRa

DATA MANAGEMENT AND PROCESSING 6 Hours

Data Management -Data Ingestion-Edge and Fog Computing in Large-Scale IoT-Big Data Technologies for IoT-IoT Analytics

INTEGRATION AND STANDARDS 6 Hours

IoT Network Topologies- Scalability, reliability, and latency requirements-IoT Middleware-Interoperability and Standards -API Design for IoT Integration -Case Studies and Industry Practices

INTEGRATING LARGE-SCALE IOT SYSTEMS 6 Hours

Overview of Large-Scale IoT Systems-Challenges and Opportunities, Architectural Considerations-Scalable IoT Architectures-Distributed Systems and Microservices- IoT Security- Case Studies- Use cases in Industrial IoT.

PROJECT COMPONENT: 30 Hours

Design and develop prototypes by applying suitable architecture models and protocols in scenarios like cloud-based smart facility management, healthcare, environment monitoring systems, etc.

Theory: 30 Tutorial: 0 Practical: 0 Project: 30 Total: 60 Hours

REFERENCES :

1. Cirani, S., Ferrari, G., Picone, M., & Veltri, L., “Internet of Things Architectures, Protocols and Standards”, Wiley, 2018.
2. Höller, J., Tsiatsis, V., Mulligan, C., Karnouskos, S., Avesand, S., & Boyle, D., “ From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, Springer, 2019.
3. Gravina, R. (Ed.), Palau, C. E. (Ed.), Manso, M. (Ed.), Liotta, A. (Ed.), Fortino, G. (Ed.), “Integration, Interconnection, and Interoperability of IoT Systems (Internet of Things)”, Springer, 2018.
4. Hanes, D., Salgueiro, G., Grossetete, P., Barton, R., Henry, J., “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, Cisco Press,2017.

ONLINE COURSES :

1. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/m2m-iot-interface-design-embedded-systems?source=search
2. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/iot-networking?source=search
3. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/iot-systems-and-industrial-automation-course-1?source=search
4. https://www.coursera.org/learn/advanced-iot-systems-and-industrial-applications-course-3
5. https://onlinecourses.nptel.ac.in/noc22_cs53/preview

Dr. Divya Vadlamudi
Associate Director – KSI, HoD – CSE & IT
BoS Chairperson

U18CSE0019 IOT APPLICATION DEVELOPMENT

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES

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

- **CO1:** Apply the concept of IoT for application development [K3]
- **CO2:** Build context-aware and gestural interfaces for IoT applications[K3]
- **CO3:** Construct prototype using wireframes for different device interfaces[K3]
- **CO4:** Make use of different testing strategies for IoT applications[K3]
- **CO5:** Develop an appropriate deployment architecture for an IoT project[K3]

Pre-requisite: U18CSE0017 - Embedded systems for IoT

THEORY COMPONENT CONTENTS

INTRODUCTION **5 Hours**

Overview of IOT Application Development - UI/UX Considerations -Feasibility Study- Architecture and Design- **User Interface for Device Management** - Testing and Quality Assurance- Deployment- Monitoring and Optimization- End-of-Life Planning.

USER INTERFACE DESIGN **7 Hours**

User-centred design principles- Device Control Interfaces- Multi-Device Interaction - Responsive Design for Various Screens -Navigation design- Voice and Natural Language Interfaces-Grid systems and layout-Typography in UI design-Color theory and its application-Creating effective user flows- Error Handling and Feedback- Context-Aware Interfaces- Gestural Interfaces.

PROTOTYPING AND WIRE FRAMING **6 Hours**

Prototyping tools-Types of Prototypes- key elements of wireframes-creating basic wireframes-Device Interface Prototyping- Sensor Data Visualization- Interaction Flows- Mobile and Web Application Wire framing- Voice and Gesture Interaction Prototypes- Edge Computing Integration-Error Handling and Feedback Prototypes- Remote Monitoring Interfaces.

IOT TESTING **6 Hours**

Challenges -Unit Testing for IoT Components- Integration Testing for IoT Device -Security Testing for IoT Devices and networks- End to End Testing - Automation Framework and Tools -Metrics of Performance testing- Device and Power Management

APPLICATION DEPLOYMENT **6 Hours**

IoT Deployment Strategies and Project Planning-Deployment Considerations- Challenges and Risks -Deployment Architecture-Configure and set up edge devices - Cloud Platform - Connectivity and Communication-Data Handling and Storage-Deployment Testing-Monitoring and Management.

LAB COMPONENT

Create a real-time IoT application by integrating UI/UX design tools (Sketch, Figma). Utilize wireframing techniques to prototype and visualize the IoT application's layout and operations. Deploy the IoT project to make it operational and accessible by users.

Sample Experiments:

1. Set up a basic IoT ecosystem with microcontrollers and sensors.
2. Simulate a small-scale smart factory using IoT devices
3. Develop prototypes for Smart City applications such as Smart Street Lights or Smart Waste Management.
4. Design a user interface that adjusts to various screen sizes.
5. Implement responsive design using CSS and HTML
6. Use tools like InVision or Marvel to create interactive prototypes for an IoT application
7. Design wireframes for the user interfaces of specific IoT applications (e.g., Smart Home Control).

Theory: 30 Tutorial: 0 Practical: 30 Project: 0 Total: 60 Hours

REFERENCES

1. "Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry" by Maciej Kranz, ISBN: 978-1-119-28568-7, 2016.
2. "Prototyping: A Practitioner's Guide" by Todd Zaki Warfel,2009.
3. Designing in Figma: The Complete Guide to Designing with Reusable Components and Styles in Figma , Eugene Fedorenko, 2020
4. "Designing Connected Products: UX for the Consumer Internet of Things" by Claire Rowland, Elizabeth Goodman, Martin Charlier, and Ann Light, 2015
5. “IOT Deployment Handbook: A practical Guide to Implementing Successful IOT Projects” By Richard G. Brown, 2022

Online Course Links:

1. https://www.coursera.org/programs/coursera-for-campus-faculty-vg1y/learn/iot?source=search
2. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/specializations/interaction-design?source=search
3. https://www.udacity.com/course/ux-design-for-mobile-developers--ud849
4. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/prototyping-design?source=search
5. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/iot-systems-and-industrial-automation-course-1?source=search
6. https://www.udemy.com/course/master-the-secrets-of-figma-a-complete-beginners-course/

U18CSE0020 3D PRINTING

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES

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

- **CO1:** Make use of 3D printing technologies and realize the applications[K3]
- **CO2:** Identify 3D printing process chain in additive manufacturing.[K3].
- **CO3:** Develop proficiency in using 3D modelling software.[K3]
- **CO4:** Identify various issues involves in common 3D printing techniques [K3]
- **CO5:** Apply the concepts of advanced 3D printing techniques to develop applications [K3]

Pre-requisite: Nil

THEORY COMPONENT CONTENTS

INTRODUCTION TO 3D PRINTING 5 Hours

Overview of 3D Printing technology - Historical background and advancements - Applications and real-world examples - Additive manufacturing techniques - Fused Deposition Modeling (FDM) - Stereolithography (SLA) - Digital Light Processing (DLP) -Selective Laser Sintering (SLS) - Direct Metal Laser Sintering (DMLS) - Other Types (MSLA, BJP, EBM, LOM) - Variations of FDM 3D Printing Machines

3D PRINTING PROCESS CHAIN & PHOTOPOLYMERIZATION PROCESSES 7 Hours

Steps in Additive manufacturing - Design for 3D printing - Software in 3D Printing - Materials for 3D Printing - Post-processing and finishing techniques; Introduction to Photopolymerization Processes - Photopolymerization Materials - Reaction Rates - Vector Scan SL - SL Resin Curing Process - SL Scan Patterns - Vector Scan Micro Stereolithography - Mask Projection Photopolymerization Technologies and Processes - Two-Photon SL

3D DESIGNING 6 **Hours**

Introduction to 3D modeling software - Creating 3D Models - Designing basic geometric shapes - CAD software and tools - Parametric modeling - Creating complex structures and assemblies; Preparing Models for 3D Printing - Design considerations for 3D printing - Mesh repair and optimization - File formats for 3D printing - Slicing software and its features - Layer height and resolution settings - Support structures; Print bed adhesion techniques – Orientation – Rafts.

TROUBLESHOOTING AND CALIBRATION 6 Hours

Components of FDM & Stereolithography printers - Identifying and resolving common print issues - Adjusting print settings for optimal results - Materials Handling Issues - Hardware & Software Calibrations.

ADVANCED 3D PRINTING TECHNIQUES 6 Hours

Multi-Material Unit (MMU) and Multi-Color Printing - Overview of 3D scanning technologies - Point cloud data and mesh generation - Reverse engineering and modification of existing models - High-resolution printing - Large-scale printing - Applications - Industrial applications - Medical and healthcare applications - Automotive and aerospace industries - Art, Architecture, Fashion & Food - Education and prototyping.

LAB CONTENTS: **30 Hours**

This lab component focuses on teaching students the fundamentals of 3D printing and design, using various printing techniques, materials, and post-processing methods. Students will engage in hands-on experiments to understand the complete process of 3D printing, from design to troubleshooting.

Sample Experiments:

1. 3D Modeling with Basic Shapes: Introduction to 3D modeling software and creation of basic geometric shapes.
2. FDM Printing Basics and SLA Comparison: Use an FDM printer for a simple model, then print the same model with an SLA printer for comparison.
3. Calibrating and Optimizing 3D Printers: Learn to calibrate FDM printers, including bed leveling and extruder settings. Also, cover basic SLA printer settings.
4. Model Correction and Preparation: Identify and correct common 3D model issues, preparing the model for efficient printing.
5. Orientation and Support Structure Analysis: Experiment with model orientations and support structures for both FDM and SLA printing.
6. Choosing the Best Printing Method: Analyze a 3D model to determine the most suitable printing method, considering the model's geometry and application.
7. Post-Processing Techniques: Learn post-processing techniques for both FDM (like sanding and painting) and SLA prints (including resin curing and support removal).
8. Troubleshooting 3D Printers: Identify and resolve common issues in both FDM and SLA printing.
9. Material Analysis and Application: Study different printing materials for FDM and SLA, understanding their properties, strengths, and use cases.
10. Efficiency and Precision in 3D Printing: Focus on recreating a provided 3D model with precision and optimizing print settings for efficiency within a time limit.

Theory: 30	**Tutorial: 0**	**Practical: 30**	**Project: 0**	**Total: 60 Hour**

REFERENCES

1. "Mastering 3D Printing:A Guide to Modeling,Printing and Prototyoing" by Joan Horvath,Rich Camerona,published in May 2020.
2. 3D Printing Failures: How to Diagnose and Repair ALL Desktop 3D Printing Issues" by Sean Aranda and David Feeney published in January 2020.
3 ."Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing by Ian Gibson, David W Rosen, Brent Stucker published in 2010.
4. "Rapid Prototyping: Principles & Applications" by Chua Chee Kai, Leong Kah Fai published in January 2010

ONLINE COURSES

1. https://www.coursera.org/specializations/rapid-prototyping-using-3d-printing
2. https://www.coursera.org/learn/3d-printing-applications#modules.
3. https://www.coursera.org/specializations/3d-printing-additive-manufacturing
4. https://www.udemy.com/course/3d-printing-for-beginners/
5. https://www.udemy.com/course/3d-printing-from-start-to-finish/
6. https://www.udemy.com/course/learn-3d-printing/

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U18CSE0021 ROBOTIC OPERATING SYSTEMS

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COURSE OUTCOMES

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

- **CO1:** Apply the concepts of ROS to enable the development of robotic system [K3]
- **CO2:** Implement ROS topics and messages for efficient data transfer between nodes. [K3]
- **CO3:** Utilize ROS visualization tools, such as RViz, to analyze and debug ROS applications. [K3]
- **CO4:** Develop ROS perception packages for object detection, recognition, and tracking.[K3]
- **CO5:** Apply ROS drivers for tasks such as sensor data acquisition, robot navigation, and object manipulation [K3]

Pre-requisite: U18AII3203 - Operating System

THEORY COMPONENT CONTENTS

INTRODUCTION 6 Hours

Introduction to ROS-Installation of ROS on different platforms-ROS basic concepts-Components: Nodes, topics, messages, and services- ROS communication architecture-ROS Packages and Ecosystem

ROS TOOLS AND ENVIRONMENT 6 Hours

ROS Tools and Environment- command-line tools- ROSIDEs- ROS Integrated Development Environments (IDEs)- graphical tools for visualization and debugging- Rviz, Rqt, and Gazebo-Creating and managing ROS workspaces-Version control with ROS

ROS COMMUNICATION 6 Hours

ROS nodes and communication - ROS Topics - Publishing and subscribing to topics-Working with ROS topics and messages-ROS services and parameters-ROS launch files for managing multiple nodes-ROS Middleware-ROS Libraries

ADVANCED ROS TOPICS 7 Hours

Perception in ROS- Perception libraries (OpenCV, PCL)- Integration of sensors: Cameras, Lidar, IMU - Basic computer vision techniques in ROS Robot Navigation and Control
- ROS navigation stack-Path planning algorithms-Simulating and executing robot navigation-ROS control stack

ROS AND ROBOT DRIVERS 5 Hours

ROS and Robot Drivers-Writing drivers to interface hardware with ROS-Interfacing Sensors and Actuators-Connecting sensors and actuators to the ROS ecosystem-Integration with Robot Platforms- Working with popular robot platforms.

LAB COMPONENT

Create a simple ROS package with a publisher and a subscriber node-Extend the package to include a service, Expand the package to include an action server that moves a robot forward for a specified duration- Computer Vision with ROS- Integration with Hardware -Use RViz to visualize the movement of a robot as it receives commands from the publisher.

Sample Experiments:

1. Installation and Create a ROS workspace.
2. Create and run a simple ROS node-Publish and subscribe to ROS topics.
3. ROS Tools-Use Rviz for visualization.-Experiment with Rqt tools.
    a. Working with Launch Files:-Create a launch file to start multiple nodes-Pass parameters through launch files.
4. Design a simple robot using URDF
    a. Simulate the robot in Gazebo
    b. ROS Services and Actions:
5. Implement a simple ROS service
    a. Create and use a ROS action server.
    b. Navigation in ROS
    c. Set up the ROS Navigation Stack
    d. Implement basic path planning
6. Computer Vision with ROS
    a. Use OpenCV with ROS for image processing.
7. Integration with Hardware:
    a. Interface with a real-world sensor (e.g., Lidar or IMU) using ROS.
    b. Control actuators or motors using ROS commands.

Theory: 30	**Tutorial: 0**	**Practical: 30**	**Project: 0**	**Total: 60 Hour**

REFERENCES

1. Programming Robots with ROS: A Practical Introduction to the Robot Operating System, O'Reilly Media; by Morgan Quigley , Brian Gerkey , William D. Smart ,1st edition , 2015
2. Robot Operating System (ROS): The Complete Beginner's Guide" - Morgan Quigley, Apress; 1st edition , 2018
3. Robot Operating System (ROS) for Absolute Beginners: Robotics Programming Made Easy,Lentin Joseph,Apress, 1st edition ,2018,
4. ROS Robotics By Example , Carol Fairchild , Dr. Thomas L. Harman, Packt Publishing Limited,2016

ONLINE COURSES:

1. https://www.edx.org/learn/robotics/delft-university-of-technology-hello-real-world-with-ros-robot-operating-system
2. https://www.udemy.com/course/ros-essentials/
3. https://www.udemy.com/course/self-driving-and-ros-learn-by-doing-odometry-control/
4. https://www.udemy.com/course/ros-for-beginners/
5. https://www.coursera.org/learn/intro-self-driving-cars?specialization=self-driving-cars

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U18CSE0022 SOFTWARE DEFINED VEHICLE

COURSE OUTCOMES

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

CO1: Identify the Software Defined Vehicle concepts and realize the paradigm shift from hardware to software centric vehicle design [K3]

CO2: Make use of core principles of SDV architecture, including the separation of hardware and software and the layered software stacks [K3]

CO3: Utilize the Model-Based Development (MBD) and AUTOSAR Standard for automotive software development [K3]

CO4: Apply the key technologies in Self-Driving Vehicles to create a robust and reliable autonomous system [K3]

Pre-requisite: Nil

INTRODUCTION 9 Hours

Overview of software-defined vehicles - Historical perspective and evolution - Essential system basics - Support processes for electronic systems and software development.

IN-VEHICLE SOFTWARE ARCHITECTURE 9 Hours

Software architectures - ECUs (Electronic Control Units) and their functions - Bus systems – CAN: Concepts, Components, Applications – LIN: Concept, Components - Event Triggered and Time Triggered Protocol - TTCAN - FlexRay - Evaluation of Automotive Software Architectures.

AUTOMOTIVE SOFTWARE DEVELOPMENT 9 Hours

Software development life cycle - Automotive Software Development - Core process for electronic systems and software engineering - Methods and tools for development - Model-Based Development (MBD) and AUTOSAR Standard - Detailed Design of Automotive Software.

CONNECTED VEHICLES 9 Hours

Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) communication - Vehicle-to-Everything (V2X) communication - Wireless Communication Technologies (DSRC, LTE, 5G) - Functional Safety of Automotive Software.

SDV ENABLING TECHNOLOGIES 9 Hours

Levels of automation - Sensor technologies (LiDAR, RADAR, cameras) – Perception, Localization, Mapping, Decision Making, Planning and Control Systems - Over-the-Air (OTA) Updates - Regulatory Compliance

Theory: 45	Tutorial: 0	Practical: 0	Project: 0	Total: 45 Hour

REFERENCES:

1. Jörg Schäuffele (Author), Thomas Zurawka,"Automotive Software Engineering: Principles, Processes, Methods, and Tools", Society of Automotive Engineers, 2016

2. Miroslaw Staron, “Automotive Software Architectures An Introduction”, Springer, 2017.
3. Colt Correa, John Simon, Martin Gubow, Samir Bhagwat, “Automotive Ethernet: The Definitive Guide”, Intrepid Control Systems, 2nd edition, 2023.
4. Marco Di Natale, Haibo Zeng, Paolo Giusto, Arkadeb Ghosal, “Understanding and Using the Controller Area Network Communication Protocol Theory and Practice”, Springer New York, NY,2012.
5. Navet, Nicolas, and Françoise Simonot-Lion, eds. “Automotive embedded systems handbook”. CRC press, 2017.
6. Paret, Dominique. “Multiplexed networks for embedded systems: CAN, LIN, flexray, safe-by-wire...”, John Wiley & Sons, 2007.

ONLINE RESOURCES:

1. https://www.coursera.org/learn/intro-self-driving-cars

U18CSE0023 ETHICAL HACKING AND NETWORK DEFENCE

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES

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

CO1: Illustrate the legal and ethical requirements related to ethical hacking (K3)
CO2: Interpret the vulnerabilities, mechanisms to identify vulnerabilities, threats, attacks (K3)
CO3: Perform penetration & security testing to identify the vulnerabilities in the application (K4)
CO4: Examine the different tools and techniques that ethical hackers employ (K4)

Pre-requisite: Nil

ETHICAL HACKING OVERVIEW & VULNERABILITIES (6 Hours)

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

FOOTPRINTING & PORT SCANNING (6 Hours)

Footprinting - 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

SYSTEM HACKING (6 Hours)

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. Side-channel Attacks on Cryptographic Hardware: Basic Idea, Current-measurement based Side-channel Attacks. Hardware Trojans: Hardware Trojan Nomenclature and Operating Modes, Countermeasures Such as Design and Manufacturing Techniques to Prevent/Detect Hardware Trojans.

HACKING WEB SERVICES & SESSION HIJACKING (6 Hours)

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

HACKING WIRELESS NETWORKS (6 Hours)

Introduction to 802.11, Role of WEP, Cracking WEP Keys, Sniffing Traffic, Wireless DOS attacks, WLAN Scanners, WLAN Sniffers, Hacking Tools, Securing Wireless Networks

Theory: 30	Tutorial: 0	Practical: 30	Project: 0	Total: 60 Hours

SAMPLE LAB EXPERIMENTS:

1. Working with Trojans, Backdoors
2. Foot Printing & port scanning

3. Password guessing and Password Cracking.
4. Understanding Data Packet Sniffers
5. Implement the SQL injection attack.
6. Denial of Service and Session Hijacking using Tear Drop, DDOS attack.
7. Wireless and mobile hacking and security

REFERENCES

1. Kimberly Graves, "Certified Ethical Hacker", Wiley India Pvt Ltd, 2013
2. Michael T. Simpson, "Hands-on Ethical Hacking & Network Defense", Course Technology, 2016
3. Rajat Khare, "Network Seuciryt and Ethical Hacking", Luniver Press, 2006
4. Ramachandran V, BackTrack 5 Wireless Penetration Testing Beginner's Guide (3rd ed.). Packt Publishing, 2011
5. Thomas Mathew, "Ethical Hacking", OSB publishers, 2003
6. Debdeep Mukhopadhyay and Rajat Subhra Chakraborty, "Hardware Security: Design, Threats, and Safeguards", CRC Press, 2015

ONLINE LEARNING MATERIALS

1. **https://www.coursera.org/learn/ethical-hacking-essentials-ehe**

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Associate Director – KSI, HoD – CSE & IT
BoS Chairperson

U18CSE0024 **CYBER ETHICS AND LAWS**

L	T	P	J	C
3	0	0	0	3

COURSE OUTCOMES

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

CO1: Demonstrate a comprehensive understanding of electronic business models, including e-commerce, mobile commerce and its legal issues (K3)

CO2: Interpret Cyber Ethics and its significance in the context of technology and information systems. (K3)

CO3: Develop a solid foundation in the principles and concepts of cyber laws (K3)

CO4: Illustrate information Technology act and legislation addressing cybercrime, including laws pertaining to unauthorized access, hacking, identity theft, and online fraud slation. (K3)

Pre-requisite: Nil

ELECTRONIC BUSINESS AND LEGAL ISSUES **9 Hours**

Evolution and developmennt in E-commerce, paper vs paper less contracts E-Commerce models- B2B, B2C, E security. Business, taxation, electronic payments, supply chain, EDI,E-markets, Emerging Trends.

CYBER ETHICS **9 Hours**

The Importance of Cyber Law, Significance of cyber Ethics, Need for Cyber regulations and Ethics. Ethics in Information society, Introduction to Artificial Intelligence Ethics: Ethical Issues in AI and core Principles, Introduction to Block chain Ethics.

INTRODUCTION TO CYBER LAW **9 Hours**

Evolution of computer Technology, emergence of cyber space. Cyber Jurisprudence, Jurisprudence and law, Doctrinal approach, Consensual approach, Real Approach, Cyber Ethics, Cyber Jurisdiction, Hierarchy of courts, Civil and criminal jurisdictions, Cyberspace-Web space, Web hosting and web Development agreement, Legal and Technological Significance of domain Names, Internet as a tool for global access

INFORMATION TECHNOLOGY ACT **9 Hours**

Overview of IT Act, 2000, Amendments and Limitations of IT Act, Digital Signatures, Cryptographic Algorithm, Public Cryptography, Private Cryptography, Electronic Governance, Legal Recognition of Electronic Records, Legal Recognition of Digital Signature, Certifying Authorities, Cyber Crime and Offences, Network Service Providers Liability, Cyber Regulations Appellate Tribunal, Penalties and Adjudication.

CYBER LAW AND RELATED LEGISLATION **9 Hours**

Patent Law, Trademark Law, Copyright, Software – Copyright or Patented, Domain Names and Copyright disputes, Electronic Data Base and its Protection, IT Act and Civil Procedure Code, IT Act and Criminal Procedural Code, Relevant Sections of Indian Evidence Act, Relevant Sections of Bankers Book Evidence Act, Relevant Sections of Indian Penal Code, Relevant Sections of Reserve Bank of India Act, Law Relating To Employees And Internet, Alternative Dispute Resolution , Online Dispute Resolution (ODR).

REFERENCES

1. Cyber Laws: Intellectual property & E Commerce, Security- Kumar K, dominant Publisher, 2011
2. Cyber Ethics 4.0, Christoph Stuckelberger, Pavan Duggal, by Globethics, 2018.
3. Information Security policy & Implementation Issues, PHI, 2003.
4. Legal Dimensions of Cyber Space, Verma S, K, Mittal Raman, Indian Law Institute, New Delhi, 2004.
5. Cyber Law- The law of Internet, Jonthan Rosenoer, Springer, 2011.
6. The right to Information Act 2005, S. R. Bhansali, Sudhir Naib, OUP India, 2011.
7. Cyber Crimes and Law Enforcement, Vasu Deva, Commonwealth Publishers, New Delhi, 2017.

ONLINE LEARNING MATERIALS

1. https://www.coursera.org/videos/business-of-cybersecurity-capstone/ OxfpG?query=CYBER+LAWS+AND+ETHICS
2. https://www.coursera.org/learn/business-of-cybersecurity-capstone/
3. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/-security-principles

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U18CSE0025 SECURE SOFTWARE DEVELOPMENT

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES:

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

CO1: Demonstrate various vulnerabilities related to memory attacks. (K3)
CO2: Apply security principles in software development. (K3)
CO3: Evaluate the extent of risks. (K3)
CO4: Apply security principles in the testing phase of software development. (K3)
CO5: Use tools for securing software. (K3)

Pre-requisite: U18CSE0023 - Ethical Hacking and Network Defence

NEED OF SOFTWARE SECURITY AND LOW-LEVEL ATTACKS (6 Hours)

Introduction - Software Assurance and Software Security –Threats to software security - Sources of software insecurity - Benefits of Detecting Software Security - Properties of Secure Software – Secure SDLC- Memory-Based Attacks: Low-Level Attacks Against Heap and Stack - Defense Against Memory-Based Attacks

SECURE SOFTWARE DESIGN (7 Hours)

Requirements Engineering for secure software - SQUARE process Model – Requirements elicitation and prioritization- Isolating The Effects of Untrusted Executable Content – Stack Inspection – Policy Specification Languages – Vulnerability Trends – Buffer Overflow – Code Injection - Session Hijacking. Secure Design - Threat Modeling and Security Design Principles

SECURITY RISK MANAGEMENT (5 Hours)

Risk Management Life Cycle – Risk Profiling – Risk Exposure Factors – Risk Evaluation and Mitigation – Risk Assessment Techniques – Threat and Vulnerability Management

SECURITY TESTING (8 Hours)

Traditional Software Testing – Comparison - Risk Based Security Testing – Prioritizing Security Testing With Threat Modeling – Penetration Testing – Planning and Scoping - Enumeration – Remote Exploitation – Web Application Exploitation - Exploits and Client Side Attacks – Post Exploitation – Bypassing Firewalls and Avoiding Detection - Tools for Penetration Testing

SECURE PROJECT MANAGEMENT (4 Hours)

Governance and security - Adopting an enterprise software security framework - Security and project management - Maturity of Practice

SAMPLE LAB EXPERIMENTS:

1. Implement the SQL injection attack.
2. Implement the Buffer Overflow attack.
3. Implement Cross Site Scripting and Prevent XSS.
4. Perform Penetration testing on a web application to gather information about the system, then
5. initiate XSS and SQL injection attacks using tools like Kali Linux.
6. Develop and test the secure test cases
7. Penetration test using kali Linux

REFERENCES:

1. Julia H. Allen, “Software Security Engineering”, Pearson Education, 2009
2. Evan Wheeler, “Security Risk Management: Building an Information Security Risk Management Program from the Ground Up”, First edition, Syngress Publishing, 2011
3. Chris Wysopal, Lucas Nelson, Dino Dai Zovi, and Elfriede Dustin, “The Art of Software Security Testing: Identifying Software Security Flaws (Symantec Press)”, Addison-Wesley Professional, 2006
4. Robert C. Seacord, “Secure Coding in C and C++ (SEI Series in Software Engineering)”, Addison-Wesley Professional, 2005.
5. Jon Erickson, “Hacking: The Art of Exploitation”, 2nd Edition, No Starch Press, 2008.
6. Mike Shema, “Hacking Web Apps: Detecting and Preventing Web Application Security Problems”, First edition, Syngress Publishing, 2012
7. Bryan Sullivan and Vincent Liu, “Web Application Security, A Beginner's Guide”, Kindle Edition, McGraw Hill, 2012
8. Lee Allen, “Advanced Penetration Testing for Highly-Secured Environments: The Ultimate Security Guide (Open Source: Community Experience Distilled)”, Kindle Edition, Packt Publishing,2012.

U18CSE0026 NETWORK SECURITY ADMINISTRATION

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES

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

- **CO1:** Identify types of security attacks, services and mechanisms (K3)
- **CO2:** Interpret the implementation of Internetwork security model and its standards (K3)
- **CO3:** Illustrate Email privacy system and compare Pretty Good Privacy (PGP) and S/MIME (K3)
- **CO4:** Interpret the primary components of a Three-Tier Architecture and explain how they work together firewall environment. (K3)
- **CO5:** Explain how communication is secured and how traffic is routed in firewall environment (K3)

Pre-requisite: U18AII4201 - Computer Networks

NETWORD SECURITY BASICS 6 Hours

Security Attacks (Interruption, Interception, Modification and Fabrication), Security Services (Confidentiality, Authentication, Integrity, Non-repudiation, access Control and Availability) and Mechanisms, A model for Internetwork security, Internet Standards and RFCs, Buffer overflow & format string vulnerabilities, TCP session hijacking, ARP attacks, route table modification, UDP hijacking, and man-in-the-middle attacks.

NETWORK SECURITY ALGORITHM 6 Hours

Conventional Encryption Principles, Conventional encryption algorithms, cipher block modes of operation, location of encryption devices, key distribution Approaches of Message Authentication, Secure Hash Functions and HMAC

EMAIL SECURITY 6 Hours

Email privacy: Good Privacy (PGP) and S/MIME.IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations and Key Management.

NETWORK SECURITY MANAGEMENT 6 Hours

Deploying Smart Console - Security Management Server - Security Gateway - Configuring Objects in Smart Console-Establishing Secure Internal Communication - Managing Administrator Access - Managing Licenses - Creating a Security Policy -Configuring Order Layers.

NETWORK SECURITY CONFIGURATION 6 Hours

Configuring a Shared Inline Layer - Configuring NAT - Integrating Security with a Unified Policy - Elevating Security with Autonomous -Threat Prevention - Configuring a Locally Managed Site-to-Site VPN - Elevating Traffic View - Monitoring System States - Maintaining the Security Environment.

Theory: 30	**Tutorial: 0**	**Practical: 30**	**Project: 0**	**Total: 60 Hours**

REFERENCES

1. Network Security Essentials (Applications and Standards) by William Stallings Pearson Education 2018.
2. Hack Proofing your network by Ryan Russell, Dan Kaminsky, Rain Forest Puppy, Joe Grand, David Ahmad, Hal Flynn Ido Dubrawsky, Steve W.Manzuik and Ryan Permeh, Wiley Dreamtech Published by Syngress, 2002
3. Network Security and Cryptography: Bernard Menezes, CENGAGE Learning, 2010
4. Network Security - Private Communication in a Public World by CharlienKaufman, Radia Perlman and Mike Speciner, Pearson/PHI 2002
5. Cryptography and network Security, Third edition, Stallings, PHI/Pearson 4. Principles of Information Security, Whitman, Cengage Learning, 2006

ONLINE LEARNING MATERIALS

1. https://www.checkpoint.com/mind/secureacademy#

SAMPLE LAB EXPERIMENT:

1. Deploying Smart Console
2. Installing a Security Management Server and Security Gateway
3. Managing Administrator Access
4. Configuring Objects in Smart Console
5. Creating a Security Policy
6. Configuring NAT
7. Integrating Security with a Unified Policy
8. Elevating Security with Autonomous Threat Prevention
9. Configuring a Locally Managed Site-to-Site VPN
10. Elevating Traffic View
11. Monitoring System States and Maintaining the Security Environment

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U18CSE0027 DIGITAL FORENSICS

L	T	P	J	C
2	0	2	0	3

COURSE OUTCOMES

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

CO1: Illustrate the digital forensics process and digital evidence acquisition. (K3)
CO2: Explain file systems and data recovery procedures. (K3)
CO3: Demonstrate computer, network and mobile forensics with specialized tools. (K3)
CO4: Analyze malware and report the relevant incident. (K3)
CO5: Utilize the forensics toolkit for efficient investigation and understand the legal aspects of digital forensics. (K3)

Pre-requisite: U18CSE0023 - Ethical Hacking and Network Defence

OVERVIEW OF DIGITAL FORENSICS (6 Hours)

Understanding the role of digital forensics in investigations. Legal and Ethical Considerations: Adhering to legal and ethical standards in digital investigations. Digital Forensics Process: Introduction to the forensic investigation process.

Digital Evidence Acquisition: Types of Digital Evidence: Identifying and classifying digital evidence. Evidence Acquisition Tools: Using tools for acquiring data from different devices. Forensic Imaging: Creating forensic images of storage media

FILE SYSTEMS AND DATA RECOVERY (6 Hours)

File System Analysis: Understanding file systems and their structures. Deleted File Recovery: Techniques for recovering deleted files. File Carving: Extracting files from unallocated space.

COMPUTER, NETWORK AND MOBILE DEVICE FORENSICS (6 Hours)

Computer Forensics: Investigating computers for evidence- Network Forensics: Analysing network traffic and logs- Memory Forensics: Examining volatile memory for evidence.
Mobile Device Investigation: Extracting evidence from smartphones and tablets. App and Cloud Forensics: Investigating applications and cloud-based services. Challenges in Mobile Forensics: Addressing unique challenges in mobile investigations.

MALWARE ANALYSIS (6 Hours)

Introduction to Malware - Understanding different types of malware- Static and Dynamic Analysis: Analysing malware behaviour and code.
Responding to malware incidents- Incident Response and Forensic Tools- Incident Response Planning: Preparing for and responding to security incidents. Introduction to bug bounty – Working of bug bounty - Bug bounty program examples – Setting up bug bounty program.

AUTOMATED FORENSICS (6 Hours)

Introduction to popular forensic tools- Automated Forensics: Leveraging automation for efficient investigations-Automated Forensics: Leveraging automation for efficient investigations.

Legal Aspects of Digital Forensics: Expert Witness Role: Preparing for and testifying in court- Digital Forensics Laws and Regulations: Understanding legal frameworks - Case Studies: Analysing legal cases involving digital forensics.

Theory: 30	Tutorial: 0	Practical: 30	Project: 0	Total: 60 Hours

REFERENCES

1. Digital Forensics by André Årnes, Released July 2017,Publisher(s): Wiley, ISBN: 9781119262381.
2. Digital forensics and cybercrime : 10th International EAI Conference, ICDF2C 2018, New Orleans, LA, USA, September 10-12, 2018, Proceedings.
3. Cybercrime and Digital Forensics : An cybercrime And Digital Forensics : An Introduction, 3rd Edition May 2022 by Adam M. Bossler, Kathryn C. Seigfried-Spellar, Thomas J. Holt.

ONLINE LEARNING MATERIALS

1. https://www.coursera.org/learn/digital-forensics-concepts
2. https://www.udemy.com/course/ifci-expert-cybercrime-investigators-course/?gad_source=1&gclid=CjwKCAiApuCrBhAuEiwA8VJ6JtQFDivymnmlFeE1agIwADZlrJE8xv8piHikMZLKreNBO9e0AlAL-hoCVbsQAvD_BwE&matchtype=b&utm_campaign=LongTail_la.EN_cc.INDIA&utm_content=deal4584&utm_medium=udemyads&utm_source=adwords&utm_term=_._ag_84769189328_._ad_670210149092_._kw_digital+forensics+course_._de_c_._dm__._pl__._ti_kwd-323936302499_._li_9298970_._pd__._
3. https://www.open.edu/openlearn/science-maths-technology/digital-forensics/content-section-0?active-tab=content-tab
4. https://www.edx.org/learn/computer-forensics/rochester-institute-of-technology-computer-forensics
5. What Is a Bug Bounty? [3 Bug Bounty Program Examples] (hackerone.com)

SAMPLE LAB EXPERIMENT:

1. Use Autopsy tools to Identify and classify the digital evidence.
2. Demonstrate the data recovery techniques.
3. Demonstrate the process of analysing the network traffic and logs.
4. Demonstration of extracting the evidence from mobile phone.
5. Analyse the malware behaviour and its code.

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HoD AI & DS **BoS Chairperson**

Signature of BoS Chairman, CS