Dr. MAHALINGAM
COLLEGE OF ENGINEERING AND TECHNOLOGY
Affiliated to Anna University, Chennai; Approved by AICTE ; Accredited by NAAC with Grade 'A++'
Accredited by NBA - Tier1 (Mech, Auto, Civil, EEE, ECE, E&I and CSE)
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Curriculum and Syllabi

B.Tech. Artificial Intelligence and Data Science

Semesters I to VIII

Regulations 2019

(2021 Batch Onwards)

Programme : B.Tech. Artificial Intelligence and Data Science
Curriculum and Syllabi : Semesters I to VIII
Recommended by Board of Studies on 28.12.2023
Approved by Academic Council on

Action	Responsibility	Signature of Authorized Signatory
Designed and Developed by	BoS Artificial Intelligence and Data Science	
Compiled by	Office of the Controller of Examinations	
Approved by	Principal	

Dr. Mahalingam College of Engineering and Technology
Department of Artificial Intelligence and Data Science

Vision:

To build quality engineers with diversified knowledge to compete globally with innovations in the domain of Artificial Intelligence and Data Science

Mission:

- To impart technical content in latest technologies through industry collaborative Curriculum
- To produce young engineers with expert knowledge to hoist industry's growth
- To foster ethical engineers for resolving community issues through automation solutions
- To motivate engineers to employ ethical conduct of research for societal benefits

TL Coordinator **Programme Coordinator** **Head of the Department**

Head – TLC

Programme: B.Tech. Artificial Intelligence and Data Science

Programme Educational Objectives (PEOs) - Regulations 2019

B.Tech. Artificial Intelligence and Data Science graduates will:

PEO1. Domain Knowledge: Possess diversified knowledge and expertise in the domain of Artificial Intelligence and Data Science

PEO2. Problem solving skills and Ethics: Apply computing skills to identify the challenges and to develop creative ethical solutions

PEO3. Lifelong Learning and development: Involve in lifelong learning, research and development to fulfill social needs using latest technology

Programme Outcomes (POs) - Regulations 2019

On successful completion of B.Tech. Artificial Intelligence and Data Science, graduating students/graduates will be able to:

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, concepts of Artificial Intelligence and data science to solve complex engineering problems

PO2. Problem Analysis: Identify, review literature, formulate and analyze complex engineering problems using first principles of mathematics and engineering sciences

PO3. Design and Development of Solutions: Design and develop AI based solutions for complex engineering problems with societal and environmental awareness

PO4. Complex problem Investigation: Investigate complex problems by employing skills pertaining to knowledge acquisition, knowledge representation and knowledge engineering to arrive at valid conclusions

PO5. Modern Tool Usage: Evaluate and use Data analysis tools and AI based techniques for effective decision making in business and engineering domains

PO6. Societal contribution: Follow professional engineering practice by applying contextual knowledge to assess societal and legal issues

PO7. Environment and Sustainability: Understand and provide professional engineering solutions taking into consideration environmental and economic sustainability

PO8. Ethics: Follow ethical principles and norms in engineering practice

PO9. Individual and Team work: Function effectively as an individual, team member or leader in diversified environments

PO10. Communication: Communicate and present the actionable insights of data using reports through various modes for all professional activities

PO11. Project Management and Finance: Apply Engineering knowledge and management principles for effective project management in multi-disciplinary environments

PO12. Life-long Learning: Engage in independent life-long learning and skill development for professional and social well being

Programme Specific Outcomes (PSOs) - Regulations 2019

PSO1. Software Automation: Develop customized automation solutions for Engineering and business problems using intelligent techniques.

PSO2. Data Engineering: Predict significant information and visualize large scale data using latest technologies.

Programme: B.Tech Artificial Intelligence and Data Science2019 Regulations
Curriculum for Semesters I to VIII

CourseCode	Course Title	Duration	Credits	Marks
19SHMG6101	Induction Program	3 Weeks	-	100

Semester I

CourseCode	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19MABC1102	Linear Algebra and Infinite Series	3	1	0	4	100	CS, IT, AD,AM &SC
19ENHG2101	Communication Skills – I	2	0	2	3	100	All
19EESC2101	Introduction to Electrical and Electronics Engineering	3	0	2	4	100	CS, IT, AD,AM &SC
19ADSN2101	Introduction to C Programming	3	0	2	4	100	-
19CSSC4001	IT Practices Lab	1	0	4	3	100	CS, IT, AD,AM &SC
19PSHG6001	Wellness for students	0	0	2	1	100	All
	Total	**12**	**1**	**12**	**19**	**600**	

Semester II

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19MABC1202	Calculus and Transforms	3	1	0	4	100	CS, IT, AD,AM &SC
19ENHG2201	Communication Skills – II	2	0	2	3	100	All
19PHBC2002	Physics for Information Sciences	3	0	2	4	100	CS, IT, AD,AM &SC
19ECSC2201	Digital System Design	2	0	2	3	100	CS, IT, AD,AM &SC
19ADSN2201	Object Oriented Programmingwith Java	3	0	3	4.5	100	-
19MESC4001	Engineering Drawing	1	0	3	2.5	100	AU,CS,EC,EI, IT, ME, AD,AM &SC
19CHMG6201	Environmental Sciences	1	0	0	-	100	All
19PSHG6003	தமிழர்மரபு / Heritage of Tamils**	1	0	0	1	100	All
	Total	**16**	**1**	**12**	**22**	**800**	

** Applicable only for 2022 Batch

Semester III

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19MABN1302	Probability and Statistics forData Science	3	1	0	4	100	-
19ADCN1301	Data Structures and Algorithm Analysis – I	3	0	0	3	100	CS & AD
19ADCN1302	Computer Architecture	3	0	0	3	100	CS & AD
19ADCN1303	Data Mining	3	0	0	3	100	-
19ADCN2301	Database Systems	3	0	2	4	100	CS & AD
19ADCN3301	Data Structures and Algorithm Analysis Laboratory	0	0	3	1.5	100	CS & AD
19ADCN4301	Python Programming for Data Engineers Laboratory	1	0	3	2.5	100	-
19PSHG6002	Universal Human Values 2 : Understanding Harmony	2	1	0	3	100	All
XXXXXXXXXX	One Credit Course	0	0	2	1	100	
19PSHG6004	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology**	2	0	0	1	100	All
	Total	**20**	**2**	**10**	**26**	**1000**	

Semester IV

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19MABN1401	Discrete Mathematics for Artificial Intelligence	3	1	0	4	100	-
19ADCN1401	Data Structures and Algorithm Analysis – II	3	1	0	4	100	CS & AD
19ADCN1402	Artificial Intelligence –I	3	0	0	3	100	-
19ADCN1403	Operating System Principles	3	0	0	3	100	-
19ADCN1404	Object Oriented Software Development	3	0	0	3	100	-
19ADCN3401	Intelligent systems - I Laboratory	0	0	4	2	100	-
19ADPN6401	Mini Project	0	0	4	2	100	-
XXXXXXXXXX	One Credit Course	0	0	2	1	100	-
	Total	**15**	**2**	**10**	**22**	**800**	

CourseCode	Course Title	Duration	Credits	Marks
XXXXXXXXXX	Internship or Skill Development*	2 Weeks	1	100

*Refer to clause: 4.8 in UG academic regulations 2019

** Applicable only for 2022 Batch

Semester V

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19ADCN1501	Exploratory Data Analysis	3	0	0	3	100	-
19ADCN1502	Artificial Intelligence –II	3	0	0	3	100	-
19ADCN2501	Computer Networking	3	0	2	4	100	-
XXXXXXXXXX	Professional Elective – I	3	0	0	3	100	-
XXXXXXXXXX	Professional Elective – II	2	0	2	3	100	-
XXXXXXXXXX	Open Elective – I	3	0	0	3	100	-
19ADCN3501	Exploratory Data Analysis Laboratory	0	0	4	2	100	-
19ADCN3502	Intelligent systems-IILaboratory	0	0	4	2	100	-
19PSHG6501	Employability Skills 1: Teamness and Interpersonal Skills	0	0	2	1	100	All
	Total	**17**	**0**	**14**	**24**	**900**	

Semester VI

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19ADCN2601	Big Data AnalyticsTechniques	3	0	2	4	100	-
19ADCN2602	Deep Learning Techniques	3	0	2	4	100	-
XXXXXXXXXX	Professional Elective – III	3	0	0	3	100	-
XXXXXXXXXX	Professional Elective – IV	2	0	2	3	100	-
XXXXXXXXXX	Open Elective – II	3	0	0	3	100	-
19ADCN3601	Cloud TechnologiesLaboratory	1	0	4	3	100	-
19ADPN6601	Innovative and CreativeProject	0	0	4	2	100	-
19PSHG6601	Employability Skills 2:Campus to Corporate	0	0	2	1	100	All
	Total	**15**	**0**	**16**	**23**	**800**	

CourseCode	Course Title	Duration	Credits	Marks
XXXXXXXXXX	Internship or Skill Development*	2 or 4 Weeks	1	100

*Refer to clause: 4.8 in UG academic regulations 2019

Semester VII

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19ADCN2701	Computational Foundation for Robotics	3	0	2	4	100	-
19ADCN1701	Data security	3	0	0	3	100	-
XXXXXXXXXX	Professional Elective – V	3	0	0	3	100	-
XXXXXXXXXX	Professional Elective – VI	2	0	2	3	100	-
XXXXXXXXXX	Open Elective – III	3	0	0	3	100	-
19ADCN3701	Business Intelligence and Analytics Laboratory	0	0	4	2	100	-
19ADCN3702	Data Security Laboratory	0	0	4	2	100	-
	Total	**14**	**0**	**12**	**20**	**700**	

Semester VIII

CourseCode	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19SHVG6001	Entrepreneurship Development	1	0	0	1	100	All
19ADPN6801	Project	0	0	16	8	200	-
	Total	**1**	**0**	**16**	**9**	**300**	

CourseCode	Course Title	Duration	Credits	Marks
XXXXXXX	Internship or Skill Development*	8 or 16 weeks	4	100

*Refer to clause: 4.8 in UG academic regulations 2019

Total Credits (2021 batch): 169
Total Credits (2022 batch): 171

Vertical wise Electives

Vertical I Security Essentials Electives							
CourseCode	**Course Title**	**Hours/Week**			**Credits**	**Marks**	**Common to Programmes**
		L	**T**	**P**			
19ADEN1001	Ethics in Artificial Intelligence	3	0	0	3	100	-
19ADEN1002	Ethical Hacking	3	0	0	3	100	-
19ADEN1003	Web Application Security	3	0	0	3	100	-
19ADEN1004	Fundamentals of Computation	3	0	0	3	100	-
19ADEN2001	Cryptographic Techniques in Network Security	2	0	2	3	100	-
19ADEN2002	Blockchain Technology	2	0	2	3	100	-
19ADEN2003	Network and Web Security	2	0	2	3	100	-
19ADEN2004	Digital Forensics	2	0	2	3	100	-

Vertical II Full Stack Development Electives							
Course Code	**Course Title**	**Hours/Week**			**Credits**	**Marks**	**Common to Programmes**
		L	**T**	**P**			
19ADEN1005	User Interface Design Principles	3	0	0	3	100	-
19ADEN1006	Visual Data Analysis	3	0	0	3	100	-
19ADEN1007	Computational Vision	3	0	0	3	100	-
19ADEN1008	Cloud Services Management	3	0	0	3	100	-
19ADEN2005	Web Programming	2	0	2	3	100	-
19ADEN2006	Game Designing Techniques	2	0	2	3	100	-
19ADEN2007	Augmented reality for AI	2	0	2	3	100	-
19ADEN2008	Security and Privacy in Cloud	2	0	2	3	100	-

Vertical III Software Project Management Electives							
CourseCode	**Course Title**	**Hours/Week**			**Credits**	**Marks**	**Common to Programmes**
		L	**T**	**P**			
19ADEN1009	Principles of Business Management	3	0	0	3	100	-
19ADEN1010	Software Development Project Management	3	0	0	3	100	-
19ADEN1011	Software Quality Management	3	0	0	3	100	-
19ADEN1012	Reliability Engineering and system safety	3	0	0	3	100	-
19ADEN2009	Agile Software Development Program	2	0	2	3	100	-
19ADEN2010	Basic Skills in Integrated Product Development	2	0	2	3	100	-
19ADEN2011	Design Patterns Concepts	2	0	2	3	100	-
19ADEN2012	Marketing Analytics	2	0	2	3	100	-

Vertical IV Data Analytics Electives							
Course Code	**Course Title**	**Hours/Week**			**Credits**	**Marks**	**Common to Programmes**
		L	**T**	**P**			
19ADEN1013	Data Analytics for Engineers	3	0	0	3	100	-
19ADEN1014	Business Analytics Management	3	0	0	3	100	-
19ADEN1015	Health Care Analytics	3	0	0	3	100	-
19ADEN1016	Graph Analytics and Algorithm	3	0	0	3	100	-
19ADEN2013	Social Graph Analytics	2	0	2	3	100	-
19ADEN2014	Recommendation Systems	2	0	2	3	100	-
19ADEN2015	Text and Speech Analysis	2	0	2	3	100	-
19ADEN2016	Image and Video Analytics	2	0	2	3	100	-

Vertical V Emerging Technologies Electives							
Course Code	**Course Title**	**Hours/Week**			**Credits**	**Marks**	**Common to Programmes**
		L	**T**	**P**			
19ADEN1017	Fuzzy Logic and Neural Computing	3	0	0	3	100	-
19ADEN1018	Optimization Techniques	3	0	0	3	100	-
19ADEN1019	Information Retrieval Methods	3	0	0	3	100	-
19ADEN1020	Reinforcement Learning	3	0	0	3	100	-
19ADEN2017	Fundamentals of Virtualization	2	0	2	3	100	-
19ADEN2019	Natural Language Processing Systems	2	0	2	3	100	-
19ADEN2020	Web Services and DevOps	2	0	2	3	100	-
19ADEN2025	Edge Computing	2	0	2	3	100	-

Vertical VI Applied Robotics Electives							
Course Code	**Course Title**	**Hours/Week**			**Credits**	**Marks**	**Common to Programmes**
		L	**T**	**P**			
19ADEN1021	Drone Technologies	3	0	0	3	100	-
19ADEN1022	Agricultural Robotics	3	0	0	3	100	-
19ADEN1023	Robot Operating Systems	3	0	0	3	100	-
19ADEN1024	Collaborative Robotics	3	0	0	3	100	-
19ADEN2021	Sensors and Instrumentation	2	0	2	3	100	-
19ADEN2022	Embedded Computing Systems	2	0	2	3	100	-
19ADEN2023	Robotic Automation technology	2	0	2	3	100	-
19ADEN2024	Mobile Robotics	2	0	2	3	100	-

Diversified Electives

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19ITEC1001	Intellectual Property Rights	3	0	0	3	100	All
19MEEC1025	Fundamentals of Entrepreneurship	3	0	0	3	100	All
19MEEC1026	Design Thinking and Innovation	3	0	0	3	100	All
19ADEN1025	Business and Sustainable Development	3	0	0	3	100	-
19MEEC1001	Product Life Cycle Management	3	0	0	3	100	AU, AD, CS, EC,EE, EI, IT & ME
19MEEC2002	PLM for Engineers	2	0	2	3	100	AU, AD, CS, EC.EE, EI, IT & ME
19ITIC1001	Integrated Big Data Solutions	3	0	0	3	100	AD, AM, CS,IT & SC

Open Electives (Offered to other Programmes)

CourseCode	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19ADOC1001	Data Mining and Warehousing	3	0	0	3	100	-
19ADOC1002	Data Science for Engineers	3	0	0	3	100	-
19ADOC1003	Business Analytics	3	0	0	3	100	-
19ADOC1004	Cognitive Science	3	0	0	3	100	-
19ADOC1005	Total Quality Management Principles	3	0	0	3	100	-
19ADOC1006	Professional Ethics	3	0	0	3	100	-
19ADOC1007	Ethical Hacking Essentials	3	0	0	3	100	-
19ADOC1008	Data Visual Exploration	3	0	0	3	100	-
19ADOC1009	Foundations of Marketing Analytics	3	0	0	3	100	-
19ADOC1010	Information Extraction and Text Mining	3	0	0	3	100	-
19ADOC1011	Drone Technology	3	0	0	3	100	-
19ADOC1012	Agri-Robotics	3	0	0	3	100	-

Regulations 2019

Detailed Syllabi for Semesters I to VIII

Regulations 2019

Detailed Syllabi for Semesters I to VIII

Course Code: 19SHMG6101	Course Title: Induction Program (common to all B.E/B.Tech programmes)
Course Category: Mandatory Non-Credit Course	Course Level: Introductory
Duration: 3 Weeks	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Explain various sources available to meet the needs of self, such as personal items and learning resources
2. Explain various career opportunities, opportunity for growth of self and avenues available in the campus
3. Explain the opportunity available for professional development
4. Build universal human values and bonding amongst all the inmates of the campus and Society

List of Activities:

1. History of Institution and Management: Overview on NIA Education Institutions-Growth of MCET – Examination Process-OBE Practices – Code of Conduct – Centre of Excellence
2. Lectures by Eminent People, Motivational Talk – Alumni, Employer
3. Familiarization to Dept./Branch: HoD Interaction – Senior Interaction – Department Association
4. Universal Human Value Modules: Module 1, Module 2, Module 3 and Module 4
5. Orientation on Professional Skill Courses
6. Proficiency Modules – Mathematics, English, Physics and Chemistry
7. Introduction to various Chapters, Cell, Clubs and its events
8. Creative Arts: Painting, Music and Dance
9. Physical Activity: Games and Sports, Yoga and Gardening
10. Group Visits: Visit to Local areas and Campus Tour

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain various sources available to meet the needs of self, such as personal items and learning resources through visit to local areas and campus	Understand
CO2: Explain various career opportunities and avenues available in the campus through orientation sessions	Understand
CO3: Explain the opportunity available for professional development through professional skills, curricular, co-curricular and extracurricular activities	Understand
CO4: Build universal human values and bonding amongst all the inmates of the campus and society for having a better life	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	-	-	-	-	2	1	2	-	-	-	-
CO2	1	-	-	-	-	-	-	2	1	2	-	-	-	-
CO3	1	-	-	-	-	-	-	2	1	2	-	-	-	-
CO4	2	-	-	-	-	-	-	2	1	2	-	-	-	-

High-3; Medium-2; Low-1

Semester – I

Course Code:19MABC1102	Course Title: Linear Algebra and Infinite Series (common to CS, IT , AD, AM &SC)		
Course Category: Basic Science		Course Level: Introductory	
L:T:P (Hours/Week) 3: 1: 0	Credits:4	Total Contact Hours:60	Max. Marks:100

Pre-requisites

- NIL

Course Objectives

The course is intended to:

1. Determine the solution of system of equations using echelon forms
2. Apply the properties of vector spaces
3. Use the Gram-Schmidt process to orthogonalize set of vectors
4. Determine the canonical form of a quadratic form using orthogonal transformation
5. Use different testing methods to check the convergence of infinite series

Unit I Matrices 9+3 Hours

System of linear equations – Homogeneous and Non homogeneous forms – row echelon form – row reduced echelon form – rank of a matrix – Crout's method – Applications to linear systems.

Unit II Basis and Dimension of Vector Spaces 9+3 Hours

Vector spaces – Linear dependence of vectors – Basis, dimension, row space, column space, null space, rank nullity theorem – Linear transformations – matrix associated with a linear map, range and kernel of linear map – Inverse of linear transformation.

Unit III Orthogonality and Inner Product Space 9+3 Hours

Inner product space of vectors – Inner product spaces – length of a vector, distance between two vectors, orthogonally of vectors – orthogonal projection of a vector – Gram-Schmidt process – orthonormal basis.

Unit IV Eigen Values and Eigen Vectors 9+3 Hours

Eigen values and vectors – symmetric, skew symmetric and orthogonal matrices – Diagonalization of symmetric matrices through orthogonal transformation – reduction of quadratic forms to canonical form-rank ,index, signature nature of quadratic forms – Singular Value decomposition.

Unit V Sequences and Series 9+3 Hours

Sequences – definitions and examples – Series – Tests for convergence – comparison test, integral test, Cauchy's root test, Alembert's ratio test – Alternating series – Leibnitz's test.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Solve system of equations using echelon forms	Apply
CO2: Apply the properties of vector spaces	Apply
CO3: Determine orthogonal set of vectors using Gram Schmidt orthogonal process	Apply
CO4: Determine the canonical form of a quadratic form using orthogonal transformation	Apply
CO5: Use different testing methods to check the convergence of infinite series	Apply

Text Book(s):

T1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & sons, 2010.

T2. David C Lay, Linear Algebra and its Applications, 3rd Edition, Pearson India, 2011.

T3. Howard Anton, Chris Rorres, Elementary Linear Algebra Applications version,9th Edition, Wiley India edition,2011.

Reference Book(s):

R1. T. Veerarajan, "Engineering Mathematics for first year", Tata McGraw-Hill, New Delhi,2008

R2. V. Krsihnamurthy, V. P. Mainra and J. L. Arora, "An Introduction to Linear Algebra", Affiliated East-West press, Re-print 2005.

Web References:

1. https://nptel.ac.in/downloads/111102011/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	1	-	1	1	1	1	2	-	-
CO2	3	2	1	1	-	1	-	1	1	1	1	2	-	-
CO3	3	2	1	1	-	1	-	1	1	1	1	2	-	-
CO4	3	2	1	1	-	1	-	1	1	1	1	2	-	-
CO5	3	2	1	1	-	1	-	1	1	1	1	2	-	-

High-3; Medium-2; Low-1

Course Code:19ENHG2101	Course Title: Communication Skills – I (common to all B.E/B.Tech Programmes)		
Course Category: Humanities		Course Level: Introductory	
L:T:P(Hours/Week) 2: 0: 2	Credits:3	Total Contact Hours:60	Max. Marks:100

Pre-requisites

- The student should have undergone English as his/her first or second language in school.

Course Objectives

The course is intended to:

1. Listen and understand monologues and dialogues of a native speaker on par with B1 of CEFR level
2. Speak in simple sentences to convey their opinions and ideas on par with B1 of CEFR level
3. Read and infer a given text on par with B1 of CEFR level
4. Draft basic formal written communication on par with B1 of CEFR level

Unit I Listening 15 Hours

Importance of active listening – Physical condition needed for active listening – Identifying relevant points while taking notes – Framing questions at different linguistic contexts – Listening for specific details of concrete monologues and dialogues – Listening to organize ideas – Developing ideas – Listening to compose paragraphs – Paraphrasing the aural input.

Unit II Speaking 15 Hours

Importance of note making to practice speaking – Traditional note making, developing Mind map – Collecting points from various sources – Identifying relevant ideas needed for the speech – Using mind-map to organize thought processing – Prioritizing the ideas – Types of sentences – Frequently used words (Institution, home and leisure) – Mother Tongue Influence – Expressing the thoughts in simple sentences – Tenses & Voices (Active & Passive) – Postures, gestures and eye contact – Intonation and Sentence stress – Express one's thoughts coherently.

Unit III Reading 15 Hours

Reading strategies – Skimming -Scanning - Interpretation of visual data – Factual texts on subjects of relevance – Inferring texts – Reading to write a review – Checking the accuracy of reading while presenting the interpreted data – Reading to comprehend.

Unit IV Writing 15 Hours

WritingSimple and short sentences – Writing E-mail, Memo, Note and Message – Letter Writing – Importance of punctuations – Identifying the main points – Organising the main ideas – Writing a draft.

List of Tasks

1. BEC Preliminary Listening Test – I & Speaking Test – 1
2. BEC Preliminary Listening Test – 2 & Speaking Test – 2
3. BEC Preliminary Listening Test – 3 & Speaking Test – 3
4. BEC Preliminary Listening Test – 4 & Speaking Test – 4
5. BEC Preliminary Listening Test – 5 & Speaking Test – 5
6. BEC Preliminary Listening Test – 6 & Speaking Test – 6

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Listen actively and paraphrase simple messages and specific details of concrete monologues and dialogues	Apply
CO2: Express one's views coherently in a simple manner	Apply
CO3: Read and comprehend factual texts on subjects of relevance	Understand
CO4: Write texts bearing direct meanings for different contexts maintaining an appropriate style	Apply

Text Book(s):

T1. Whitby Norman, Business Benchmark Pre-intermediate to Intermediate Students' Book CUP Publications, 2nd Edition, 2014.

T2. Wood Ian, Williams Anne, Cowper Anna, Pass Cambridge BEC Preliminary, Cengage Learning, 2nd Edition, 2015.

T3. Learners Book prepared by the Faculty members of Department of English.

Reference Book(s):

R1. BEC-Preliminary - Cambridge Handbook for Language Teachers, 2nd Edition, CUP 2000.

R2. Hewings Martin - Advanced Grammar in use - Upper-intermediate Proficiency, CUP, 3rd Edition, 2013.

Web References:

1. http://www.grammarinenglish.com -Jan 23, 2018
2. https://www.northshore.edu/support_centre /pdf/listen-notes.pdf
3. http://www.examenglish.com/BEC/BEC_Vantage.html- Jan 23, 2018

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	2	3	3	-	2	-	-
CO2	-	-	-	-	-	-	-	2	3	3	-	2	-	-
CO3	-	-	-	-	-	-	-	1	-	3	-	2	-	-
CO4	-	-	-	-	-	-	-	1	-	3	-	2	-	-

High-3; Medium-2; Low-1

Course Code:19EESC2101	Course Title: Introduction to Electrical and Electronics Engineering (common to CS, IT , AD,AM & SC)		
Course Category: Engineering Science		Course Level: Introductory	
L:T:P (Hours/Week) 3: 0: 2	Credits:4	Total Contact Hours:75	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Explain basics of DC circuits
2. Explain the fundamentals of AC circuits
3. Describe the basic electrical machines
4. Summarize the semiconductor devices
5. Outline the display devices and transducers
6. Utilize carpentry and piping methods

Unit I Fundamentals of DC Circuits 9 Hours

Definition, symbol and unit of quantities – Active and Passive elements – Ohm's Law: statement, illustration and limitation – Kirchhoff's Laws: statement and illustration – Resistance in series and voltage division rule – Resistance in parallel and current division rule – Method of solving a circuit by Kirchhoff's laws – Star to Delta and Delta to Star transformation.

Unit II AC Fundamentals 9 Hours

Magnetic Circuits: Definition of magnetic quantities – Law of electromagnetic induction – Generation of single phase alternating EMF – Terminology – 3 Phase System: 3-Wire and 4 Wire system – Root Mean Square (RMS) – Average value of AC – Phasor representation of alternating quantities – Pure Resistive, Inductive and Capacitive circuits.

Unit III Electrical Machines 9 Hours

DC Generator and DC Motor: Construction, Working Principle, Characteristics of shunt and series motor – Single phase transformer: Construction, working principle - Three phase and Capacitor start and run single phase induction motor: Construction and Working Principle.

Unit IV Semiconductor Devices 9 Hours

Theory of Semiconductor: PN junction diode, Forward Bias Conduction, Reverse Bias Conduction, V-I Characteristics – Bipolar Junction Transistor: Operation of NPN and PNP

Transistor, Common Emitter Configuration – Field Effect Transistor & MOSFET: construction and working principle.

Unit V Display Devices and Transducers 9 Hours

Opto-Electronic Devices: Working principle of Photoconductive Cell, Photovoltaic Cell-solar cell Display Devices: Light Emitting Diode (LED) – Liquid Crystal Display (LCD) – Transducers: Capacitive and Inductive Transducer, Thermistors, Piezoelectric and Photoelectric Transducer.

List of Experiments 30 Hours

[A] Electrical & Electronics :

1) Identification of resistor and capacitor values
2) Soldering practice of simple circuit and checking the continuity
3) Fluorescent tube, staircase, house wiring and need for earthing

[B] Civil & Mechanical:

1) Make a wooden Tee joint to the required dimension
2) Make a tray in sheet metal to the required dimension
3) Assemble the pipeline connections with different joining components for the given Layout

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain basic laws and simplification techniques in electrical engineering using DC Circuits	Understand
CO2: Explain the fundamentals and basic principles of AC Circuits	Understand
CO3: Describe the principles of basic electrical machines	Understand
CO4: Summarize the working of semiconductor devices	Understand
CO5: Outline the features of display devices and transducers	Understand
CO6: Utilize Carpentry and Piping methods	Apply

Text Book(s):

T1. R.Muthusubramanian and S.Salivahanan, "Basic Electrical and Electronics Engineering", McGraw Hill India Limited, New Delhi, 2014.

Reference Book(s):

R1. B.L Theraja, "Fundamental of Electrical Engineering and Electronics", S.Chand Limited – 2006.

R2. J.B.Gupta, "Basic Electrical and Electronics Engineering", S.K.Kataria & Sons, 2009.

R3. Smarajit Ghosh, "Fundamental of Electrical and Electronics Engineering", 2nd Edition, PHI Learning Private Limited New Delhi, 2010.

R4. S. K. Sadhev, "Basic Electrical Engineering and Electronics ", Tata Mcgraw Hill, 2017.

Web References:

1. https://www.nptel.ac.in/courses/108108076/
2. https://www.oreilly.com/library/view/basic-electrical-and/9789332579170/
3. http://www.ait.ac.jp/en/faculty/lab-enginnering/latter/elec-material/
4. http://www.electrical4u.com
5. http://www.allaboutcircuits.com

Course Articulation Matrix

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	2	3	2	-	-	-	-
CO2	2	1	-	-	-	-	-	2	3	2	-	-	-	-
CO3	2	1	-	-	-	-	-	2	3	2	-	-	-	-
CO4	2	1	-	-	-	-	-	1	-	1	-	-	-	-
CO5	2	1	-	-	-	-	-	1	-	1	-	-	-	-
CO6	3	2	1	1	-	-	-	2	3	2	-	-	-	-

High-3; Medium-2; Low-1

Course Code: 19ADSN2101	Course Title: Introduction to C Programming		
Course Category: Engineering Science		Course Level: Introductory	
L:T:P(Hours/Week) 3: 0: 2	Credits:4	Total Contact Hours:75	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Build solutions using problem solving techniques and appropriate programming constructs
2. Develop programs using control Structures and arrays
3. Write Programs using Functions and Strings
4. Implement programs using pointers and structures
5. Write programs using files, preprocessor directives and graphics functions

Unit I Introduction 9 Hours

General Problem solving strategy – Program development cycle - Problem Solving Techniques : Algorithm, Pseudocode and Flow Chart - Introduction – C Character set - Identifiers – keywords - Data types – Variables and constants –Structure of C Program-Operators and Expressions-Type Conversion-Formatting input and output statements.

Unit II Control Structures and Arrays 9 Hours

Statements: Selection statement-Jumping statement-Iterative statements-Arrays-One dimensional Array-Two-dimensional Array-Applications: Linear search, Binary search, Matrix Operations.

Unit III Functions and Strings 9 Hours

Functions: Declaration & Definition – Return statement – Types of functions –call by value – call by reference –Recursion. Strings: Declaration and Initialization of string –String library Functions-Storage classes.

Unit IV Pointers and Structures 9 Hours

Pointers: Features of Pointers-Declaration of pointer-Operations on Pointers-void pointer-Dynamic memory allocation-Structures: Declaration & Initialization of Structures – Structure within Structure – Array of Structures.

Unit V Files and Preprocessor Directives 9 Hours

Introduction to Files – Streams - File Types – File operations – Command line arguments – Preprocessor Directives: Macros, File Inclusion- Graphics: Initialization -Graphics functions.

List of Exercises 30 Hours

1. Write programs using Operators and Expressions
2. Develop programs using control structures and Arrays
3. Implement programs using Functions and Strings
4. Write programs using Pointers and Structures
5. Implement programs using Files and Preprocessor directives
6. Develop programs using Graphics functions

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Build solutions using problem solving techniques and appropriate programming constructs for a given scenario	Understand
CO2: Develop programs using control Structures and arrays for a given application	Apply
CO3: Write Programs using Functions and Strings for a given scenario	Apply
CO4: Implement programs using pointers and structures for real time applications	Apply
CO5: Write programs using files, preprocessor directives and graphics functions for a given application	Apply

Text Book(s):

T1. Ashok N.Kamthane, Amit.N.Kamthane, "Programming in C", 3rd Edition, Pearson Education, 2015.

Reference Book(s):

R1. Ajay Mittal, "Programming in C - A Practical Approach", 3rd Edition, Pearson Education, 2010.

R2. Yashavant P.Kanetkar, "Let Us C", 16th Edition, BPB Publications, 2017.

R3. Brian W. Kernighan , Dennis Ritchie, "The C Programming Language",2nd Edition, Pearson Education, 2015.

Web References:

1. NPTEL Course Introduction to Programming in C:
   https://onlinecourses.nptel.ac.in/noc19_cs42
2. Learn C: https://www.learn-c.org/
3. C Programming Tutorials: https://www.cprogramming.com/
4. C Programming Exercises: https://codeforwin.org/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	2	3	1	2	3	2	1	2	3	2
CO2	3	2	2	2	2	3	1	2	3	2	1	2	3	2
CO3	3	2	2	2	2	3	1	2	3	2	1	2	3	2
CO4	3	2	2	2	2	3	1	2	3	2	1	2	3	2
CO5	3	2	2	2	2	3	1	2	3	2	1	2	3	2

High-3; Medium-2;Low-1

Course Code:19CSSC4001	Course Title: IT Practices Lab (common to CS, IT , AD,AM & SC) (2020 Batch onwards)		
Course Category: Engineering Science		Course Level: Introductory	
L:T:P(Hours/Week) 1: 0: 4	Credits: 3	Total Contact Hours: 75	Max Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1.Build a web page with all web page elements

2. Develop a web design for any real time application

3. Design a Mobile application with GUI components

4. Build a real time mobile application

Unit I Introduction 7 Hours

Internet and World Wide Web – Web Browser – Web Server – Web Page – URIs and URLs – Client Side Scripting – Server Side Scripting

Study of Open Source Tools: Open Element, MIT App Inventor, any other Open source Tool

Unit II HTML 8 Hours

Structure of HTML -Special Characters and Horizontal rules – Headers - Lists – Tables – Forms – Links – Images - Internal Linking – frameset element - meta Elements.

List of Experiments 60 Hours

Web Applications

1. Develop a web page with image, text, links, tables

2. Build a web page with Menus, Image links and Navigations bars

3. Create a web page with containers and Media

4. Construct a web page to display own resume

5. Construct a web page to display the products of a company

Mobile Applications

6. Design an application with GUI widgets

7. Design an application with Layouts and Media

8. Create an application using Event handlers

9. Develop a calculator application to perform all arithmetic operations

10. Construct an application to calculate BMI

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Build a web page with all web page elements	Apply
CO2: Develop a web design for any real time application	Apply
CO3: Design a Mobile application using mobile development framework involving GUI components	Apply
CO4: Build a real time mobile application to handheld devices	Apply

Reference(s):

R1. Harvey M. Deitel , Paul J. Deitel,"Internet and World Wide Web – How to Program", 4th Edition ,Pearson Education Asia, 2009.

R2. David Wolber , Hal Abelson , Ellen Spertus, Liz Looney, "App Inventor 2: Create Your Own Android Apps", 2nd Edition,O'Reilly Media, 2014.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	1	1	2	3	2	-	2	3	1
CO2	3	2	2	2	2	1	1	2	3	2	-	2	3	1
CO3	3	2	2	2	2	1	1	2	3	2	-	2	3	-
CO4	3	2	2	2	2	1	1	2	3	2	-	2	3	1

High-3; Medium-2;Low-1

Course Code: 19PSHG6001	Course Title: Wellness for Students (Common to all B.E/B.Tech Programmes) (2020 Batch onwards)		
Course Category: Humanities		Course Level: Introductory	
L:T:P(Hours/Week) 0: 0: 2	Credits:1	Total Contact Hours:30	Max. Marks:100

Pre-requisites

- NIL

Course Objectives

The course is intended to:

1. Set SMART goals for academic, career and life
2. Apply time management techniques
3. Articulate the importance of wellness for success in life.
4. Understand the dimensions of wellbeing and relevant practices

Unit I Goal Setting

Understanding Vision and mission statements - Writing personal mission statements – 'Focus' as a way of life of most successful people. Clarifying personal values, interests and orientations – Awareness of opportunities ahead – Personal SWOT analysis - Principles driving goal setting: Principle of response and stimuli, Circle of influence and circle of concern, What you see depends on the role you assume. Potential obstacles to setting and reaching your goals - Five steps to goals setting: SMART goals, Inclusive goals, Positive stretch, Pain vs gain, Gun-point commitment.

Unit II Time Management - Tools and Techniques

Importance of planning and working to time. Pareto 80-20 principle of prioritization – Time quadrants as a way to prioritize weekly tasks – The glass jar principle - Handling time wasters – Assertiveness, the art of saying 'NO' – Managing procrastination.

Unit III Practices for Physical Wellness

Concept of wellness – impact of absence of wellness - Wellness as important component to achieve success. Wellbeing as per WHO - Dimensions of Wellbeing: Physical, Mental, Social, Spiritual – indicators and assessment methods

Simplified Physical Exercises. Fitness as a subset of Wellness – health related physical fitness - skill related physical fitness. Joint movements, Warm up exercises, simple asanas, WCSC simplified exercises.

Unit IV Practices for Mental Wellness

Meditation: Mind and its functions - mind wave frequency – Simple basic meditation – WCSC meditation and introspection tables. Greatness of friendship and social welfare – individual, family and world peace – blessings and benefits.

Food & sleep for wellness: balanced diet - good food habits for better health (anatomic therapy) – hazards of junk food - food and the gunas

Unit V Putting into Practice

Practicals: Using the weekly journal – Executing and achieving short term goals – Periodic reviews.

Course Outcomes	**Cognitive/ Affective**
At the end of this course, students will be able to:	
CO1. Set well-articulated goals for academics, career, and personal aspirations	Apply
CO2. Apply time management techniques to complete planned tasks on time	Apply
CO3. Explain the concept of wellness and its importance to be successful in career and life	Apply
CO4. Explain the dimensions of wellness and practices that can promote wellness	Apply
CO5. Demonstrate the practices that can promote wellness	Valuing

Text book(s):

T1. Reading material, workbook and journal prepared by PS team of the college.

Reference Book(s):

R1. Stephen R Covey, “First things first”, Simon & Schuster UK, Aug 1997.

R2. Sean Covey, “Seven habits of highly effective teenagers”, Simon & Schuster UK, 2004.

R3. Vethathiri Maharishi Institute for Spiritual and Intuitional Education, Aliyar, “Value education for harmonious life (Manavalakalai Yoga)”, Vethathiri Publications, Erode, I Edition (2010).

R4. Dr. R. Nagarathna, Dr.H.R. Nagendra, “Integrated approach of yoga therapy for positive health”, Swami Vivekananda Yoga Prakashana, Bangalore, 2008 Edition.

R5. Tony Buzan, Harper Collins, The Power of Physical Intelligence (English).

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	1	1	-	1	-	-
CO2	-	-	-	-	-	-	-	-	1	-	1	1	-	-
CO3	-	-	-	-	-	-	-	-	1	-	-	1	-	-
CO4	-	-	-	-	-	-	-	-	1	-	-	1	-	-
CO5	-	-	-	-	-	1	1	-	1	-	-	1	-	-

High-3; Medium-2; Low-1

Semester - II

Course Code:19MABC1202	Course Title: Calculus and Transforms (common to CS, IT, AD,AM & SC)		
Course Category: Basic Science		Course Level: Introductory	
L:T:P (Hours/Week) 3: 1: 0	Credits:4	Total Contact Hours:60	Max. Marks:100

Pre-requisites

- NIL

Course Objectives

The course is intended to:

1. Determine the curvature and equation of evolutes of a curve
2. Apply partial derivatives to find extreme values of functions of two variables and to vector fields
3. Determine the solution of first and second order ordinary differential equations
4. Compute the Fourier series expansion for given periodic functions
5. Compute Z transform and inverse transform for discrete time sequences

Unit I Differential Calculus 9+3 Hours

Curvature – Cartesian and Polar coordinates – radius of curvature – center of curvature – circle of curvature – Evolutes and Involutes.

Unit II Multivariable Calculus 9+3 Hours

Partial derivatives – total derivatives – Jacobian – maxima and minima and saddle points – method of lagrange multipliers – Gradient – directional derivative – curl and divergence.

Unit III Ordinary Differential Equations of First and Second Order 9+3 Hours

Solution of differential equations of first order and first degree: homogeneous form – linear form and exact differential equations – Second order linear differential equations with constant coefficients – Solution by variation of parameters.

Unit IV Fourier Series 9+3 Hours

Fourier series – Dirichlet's condition – Half range sine and cosine series – Parseval's identity – Harmonic Analysis – Applications.

Unit V Z Transforms 9+3 Hours

Z transform – region of convergence – properties of z transforms – inverse transform – Solution to homogeneous linear constant difference equations – Interpretation of stability in Z domain.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Determine the curvature and equation of evaluates of a curve using differentiation techniques	Apply
CO2: Apply partial derivatives to find extreme values of functions and to vector fields	Apply
CO3: Solve the various types of first, second and higher order ordinary differential equations using various techniques	Apply
CO4: Compute the Fourier series expansion for given periodic functions	Apply
CO5: Compute Z transform and inverse transform for discrete time sequences	Apply

Text Book(s):

T1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & sons, 2010.

T2. B.S.Grewal, Higher Engineering Mathematics, 43rd Edition, Khanna Publishers, 2014.

Reference Book(s):

R1. Veerarajan Engineering Mathematics (for semester III), 3rd Edition, Tata McGraw-Hill, New Delhi, 2010.

R2. Srimanta Pal &Subodh C. Bhunia. "Engineering Mathematics", Oxford University Press, 2015.

Web References:

1. https://nptel.ac.in/courses/117105134/15
2. https://nptel.ac.in/courses/122101003/44

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	1	-	1	1	1	1	2	-	-
CO2	3	2	1	1	-	1	-	1	1	1	1	2	-	-
CO3	3	2	1	1	-	1	-	1	1	1	1	2	-	-
CO4	3	2	1	1	-	1	-	1	1	1	1	2	-	-
CO5	3	2	1	1	-	1	-	1	1	1	1	2	-	-

High-3; Medium-2; Low-1

Course Code:19ENHG2201	Course Title: Communication Skills – II (Common to all B.E/B.Tech Programmes)		
Course Category: Humanities		Course Level: Introductory	
L:T:P (Hours/Week) 2: 0: 2	Credits:3	Total Contact Hours:60	Max. Marks:100

Pre-requisites

- Communication Skills – I

Course Objectives

The course is intended to:

1. Listen and understand monologues and dialogues of a native speaker on par with B2 of CEFR level
2. Speak in simple sentences to convey their opinion and ideas on par with B2 of CEFR level
3. Read and infer a given text on par with B2 of CEFR level
4. Draft basic formal written communication on par with B2 of CEFR level

Unit I Listening 15 Hours

Importance and purpose of extensive listening and intensive listening – Body Language – Listening tasks on complex and abstract themes – Correlating Ideas related to listening input – importance of empathetic – listening for main ideas – Paraphrasing – Listening to native speakers English – Compound and Complex sentences – Developing ideas – Listening to compose paragraphs.

Unit II Speaking 15 Hours

Jotting down ideas collected from listening to speak – organising the ideas – Expressing one's view coherently – Understanding grammatical elements (Noun – Pronoun Antecedent) – Expressing ideas assertively – Answering questions during presentations – Understanding the use of discourse markers – word stress and sentence stress – voice modulation and pauses – Highlighting significant points – interpretation of visual data – Using verbal cues – Preparing simple hand – outs.

Unit III Reading 15 Hours

Reading strategies – Skimming &Scanning – Inferring meaning- Barriers to reading – sub vocalisation, Eye fixation, Regression – Speed Reading Techniques - Reading different types of texts and their contexts with speed – Note making – Reading a review – Paraphrasing – Reading to comprehend.

Unit IV Writing **15 Hours**

Reported speech & Concord (Subject – verb Agreement) – Report writing – Different kinds of Report – Structure of the report – Writing Proposal – Plagiarism – References – Appendices – Techniques for Report writing – Registers.

List of Tasks

1. BEC Vantage Listening Test – I & Speaking Test – 1
2. BEC Vantage Listening Test – 2 & Speaking Test – 2
3. BEC Vantage Listening Test – 3 & Speaking Test – 3
4. BEC Vantage Listening Test – 4 & Speaking Test – 4
5. BEC Vantage Listening Test – 5 & Speaking Test – 5
6. BEC Vantage Listening Test – 6 & Speaking Test – 6

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Listen actively and empathetically, and paraphrase discussions and presentations on complex and abstract themes and topics	Apply
CO2: Express one's views coherently, fluently and confidently highlighting the significant points with supporting details	Apply
CO3: Read and comprehend different types of texts and their contexts reasonably at moderate speed	Understand
CO4: Write detailed reports on variety of subjects synthesizing information gathered during listening & reading citing appropriate references	Apply

Text Book(s):

T1. Whitby Norman, Business Benchmark Upper Intermediate Students' Book CUP Publications, 2nd Edition, 2014.

T2. Learners Book prepared by the Faculty members of Department of English.

Reference Book(s):

R1. Cambridge BEC Vantage - Practice Tests, Self-study Edition, Cambridge University Press, 2002.

R2. Hewings Martin - Advanced Grammar in use - Upper-intermediate Proficiency, CUP, 3rd Edition, 2013.

Web References:

1. http://www.grammarinenglish.com-Jan 23,2018
2. https://www.northshore.edu/support_centre/pdf/listen-notes.pdf
3. http://www.examenglish.com/BEC/BEC_Vantage.html-Jan 23, 2018

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	2	3	3	-	2	-	-
CO2	-	-	-	-	-	-	-	2	3	3	-	2	-	-
CO3	-	-	-	-	-	-	-	1	-	3	-	2	-	-
CO4	-	-	-	-	-	-	-	1	-	3	-	2	-	-

High-3; Medium-2;Low-1

Course Code: 19PHBC2002		Course Title: Physics for Information Sciences (common to CS, IT , AD,AM & SC)	
Course Category: Basic Science		Course Level: Introductory	
L:T:P (Hours/Week) 3: 0: 2	Credits:4	Total Contact Hours:75	Max. Marks:100

Pre-requisites

- NIL

Course Objectives

The course is intended to:

1. Explain the fundamental concepts of light
2. Illustrate the characteristics, principles and applications of laser
3. Explain the mode of propagation and losses in optical fibers
4. Identify a suitable technique for fabricating integrated circuits
5. Use the concept of luminescence in various electronic display devices

Unit I Wave Optics 9 Hours

Nature of Light – Laws of reflection and refraction – Total internal reflection – Reflectivity and Transmissivity – The electromagnetic spectrum – properties of electromagnetic radiation – Interference of light waves- Young's double slit experiment – Newton's rings : determination of radius of bright and dark rings – Diffraction of light waves – Fresnel and Fraunhofer diffraction at single slit and circular aperture – Diffraction grating and resolving power.

Unit II Laser 9 Hours

Characteristics of laser light- Einstein's theory of matter radiation interaction A& B Coefficients – Stimulated and spontaneous emissions of radiations – Population inversion and pumping methods – Types of laser: Neodymium Yttrium Aluminum (Nd: YAG) laser and Carbon di oxide (CO_2) molecular gas laser – Semiconductor laser (Homo junction and hetro junction) – Applications: Holograms and Holographic data storage (record/read).

Unit III Fiber Optics **9 Hours**

Optical fibers – Principle of light propagation through optical fibers – Expressions for numerical aperture and acceptance angle – Types of optical fibers based on material, refractive index, and mode of propagation – Fabrication of optical fiber: Double crucible method – Dispersion and attenuation in optical fiber – Photo detectors: PN, PIN & Avalanche photo diodes – Fiber optic communication system and its advantages.

Unit IV Integrated Circuits **9 Hours**

Introduction to semiconductors: Intrinsic and extrinsic semiconductors – Advantages of Integrated circuits (ICs) over discrete components – IC classification – Construction of bipolar transistor – Epitaxial growth & Oxidation – Photolithography- Isolation diffusion – Base diffusion – Emitter diffusion – Contact mask – Aluminium metallization – Passivation – Structures of integrated PNP transistor.

Unit V Display Devices **9 Hours**

Human vision – Red, Blue, and Green (RGB) color scheme – Primary and secondary colors – Color addition and subtraction – Optical Emissions: Luminescence, photoluminescence, cathodoluminescence – electroluminescence – Injection electro Luminescence – Displays (Working principles): Plasma display, LED display, Liquid crystal display (LCD) and Numeric display.

List of Experiments **30 Hours**

1. Determination of Laser parameters – Wave length and particle size
2. Determination of Acceptance angle and Numerical aperture of an optical fiber
3. Determination of band gap of semi conducting material – Thermistor
4. Light Illumination characteristics of Light Dependent Resistor
5. Thickness of thin material – Air wedge
6. Determination of wavelength of the given light source using spectrometer

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain the fundamentals of light and properties of electromagnetic spectrum	Understand
CO2: Explain the application of Laser through their properties	Understand
CO3: Differentiate various types of optical fiber and its usefulness towards industrial applications	Understand
CO4: Explain the suitable methodology for fabricating integrated circuits	Understand
CO5: Describe the concept of colors and luminescence in various display devices	Understand

Text Book(s):

T1. M. N. Avadhanulu and P. G. Kshirsagar, "Text Book of Engineering Physics", S. Chand & Company Ltd., New Delhi, 2018.

T2. David Armitage, "Introduction to Micro displays", John Wiley & Ltd, 2006.

T3. D. Roy Choudhry, Shail Jain, "Linear Integrated Circuits", 3rd Edition, New Age International Pvt. Ltd, 2010

Reference Book(s):

R1. D. Halliday., R. Resnick and J. Walker, "Fundamentals of Physics", Wiley Publications, 10th Edition, 2014

R2. Ajoy Ghatak,"Optics",Tata McGraw-Hill Education, New Delhi, 5th Edition, 2012.

R3. A. Marikani,"Engineering Physics", 2nd Edition, PHI Learning, New Delhi, 2014.

R4. Dr. Jayaraman, V.Umadevi, S.Maruthamuthu and B. Saravanakumar, "Engineering

Web References:

1. https://onlinecourses.nptel.ac.in/noc17_cy07/preview
2. https://onlinecourses.nptel.ac.in/noc17_ph01/preview
3. http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	-	-	-	1	2	3	2	-	1	-	-
CO2	2	1	1	-	-	-	1	2	3	2	-	1	-	-
CO3	2	1	1	-	-	-	1	2	3	2	-	1	-	-
CO4	2	1	1	-	-	-	1	2	3	2	-	1	-	-
CO5	2	1	1	-	-	-	1	1	-	1	-	1	-	-

High-3; Medium-2; Low-1

Course Code: 19ECSC2201	Course Title: Digital System Design (common to CS, IT , AD,AM & SC)		
Course Category: Engineering Science		Course Level: Introductory	
L:T:P(Hours/Week) 2: 0: 2	Credits: 3	Total Contact Hours: 60	Max. Marks:100

Pre-requisites

- Introduction to Electrical and Electronics Engineering

Course Objectives

The course is intended to:

1. Identify and explain fundamental concepts of digital logic design
2. Explain logic processes and implement logical operations using combinational logic circuits
3. Understand concepts of synchronous sequential circuits and to analyze synchronous sequential systems
4. Understand concepts of asynchronous sequential circuits and to analyze asynchronous sequential systems
5. Understand the basic computer system and the peripherals

Unit I Digital Fundamentals 6 Hours

Number System Representation and Conversion - Logic Gates, Universal Gates - Boolean Algebra and Simplification Techniques: SOP – POS and Karnaugh Map Methods for Boolean Expression Simplification.

Unit II Combinational Circuits 6 Hours

Implementing Combinational Logic - Arithmetic Circuits: Full Adder – Full Subtractor - Magnitude Comparator – Multiplexer – Demultiplexer – Encoder and Decoder.

Unit III Synchronous Sequential Circuits 6 Hours

Flip-Flop: RS - JK – T and D – Types of Triggering – Analysis of synchronous sequential circuit - Shift Register.

Unit IV Asynchronous Sequential Circuits 6 Hours

Analysis of asynchronous sequential circuit – Hazards – Static, Dynamic and Essential Hazards

Unit V Basic Computer System, Memory and I/O Peripherals 6 Hours

Computer System – Computer Memory - Random Access Memory - Read Only Memory - Expanding Memory Capacity – Input / Output Devices - Secondary Storage.

List of Experiments **30 Hours**

1. Verification of Boolean theorems using digital logic gates
2. Implementation of combinational circuits using basic gates
3. Logic verification of half adder and full adder
4. Logic verification of Multiplexer / Demultiplexer
5. Logic verification of 4 bit shift register
6. Logic verification of 3 bit binary counter

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain fundamental concepts in digital logic design	Understand
CO2: Explain the design of combinational logic circuits	Understand
CO3: Elucidate the analysis of synchronous sequential logic circuits	Understand
CO4: Elucidate the analysis of asynchronous sequential logic circuits	Understand
CO5: Categorize a computer system including Input /Output devices and Memory devices	Understand

Text Book(s):

T1. Anil K. Maini, "Digital Electronics Principles, Devices and Applications", John Wiley & Sons, 2007.

T2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, "Computer Organization and Embedded Systems", 6th Edition, McGraw-Hill, 2011.

Reference Book(s):

R1. Morris Mano, Michael ciletti, "Digital Degin", 5th Edition, Pearson Publication, New Delhi, 2014.

R2. Charles H.Roth, Jr. "Fundamentals of Logic Design", 7th Edition, Jaico publishing House, New Delhi, 2014.

R3. Tokheim, "Digital Electronics Principles and Applications", Tata McGraw Hill, 6th Edition, 2004.

R4. Leach P Donald, Albert Paul Malvino and Goutam Saha, "Digital Principles and Applications", 7th Edition, Mcgraw Hill, 2010.

Web References:

1. http://www.nptel.ac.in/courses/ 108105132
2. https://www.surrey.ac.uk/Projects/Labview/boolalegebra/index.html
3. https://scilab.in/textbook_run/2672/42/5

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	2	3	2	-	-	-	-
CO2	2	1	-	-	-	-	-	2	3	2	-	-	-	-
CO3	2	1	-	-	-	-	-	2	3	2	-	-	-	-
CO4	2	1	-	-	-	-	-	2	3	2	-	-	-	-
CO5	2	1	-	-	-	-	-	1	-	1	-	-	-	-

High-3; Medium-2; Low-1

Course Code: 19ADSN2201	Course Title: Object Oriented Programming with Java		
Course Category: Engineering Science		Course Level: Practice	
L:T:P(Hours/Week) 3: 0: 3	Credits:4.5	Total Contact Hours:90	Max. Marks:100

Pre-requisites

- Introduction to C Programming

Course Objectives

The course is intended to:

1. Develop simple java programs using classes, objects and static methods
2. Utilize the principles of inheritance, interfaces and packages
3. Apply the error handling techniques and multithreading concepts
4. Develop java programs using Collection frameworks and built in classes
5. Design java applications using Streams and Java Swing

Unit I Introduction 9 Hours

Object Oriented Programming Concepts – Java Features – Data Types –Variables – Constants – Operators – Java Virtual Machine – Classes & Methods – Constructors – Constructors overloading – Static Members – Garbage Collection – Command Line Arguments –Arrays – String Class.

Unit II Inheritance, Interfaces and Packages 9 Hours

Class Inheritance: Types – Method Overriding – Super Keyword – Final Variables and Methods – Final Classes – Method Overloading – Abstract Classes and Methods – Interfaces – Packages – Importing Packages – Visibility Control.

Unit III Exception Handling and Thread 9 Hours

Exception: Types – Try – Catch – Multiple Catch – Nested Try – Throw – Throws – Finally – Built in Exceptions – User Defined Exceptions – Thread – Extending the Thread Class – Thread Life Cycle –Multithreading.

Unit IV Java Collections and Built in Classes 9 Hours

Collection Interfaces – Set, List, Queue, Collections Classes – ArrayList, LinkedList, HashSet - Accessing a Collection via an Iterator –Map interfaces – Utility Classes: String Buffer – StringTokenizer - Math.

Unit V Streams and GUI Programming 9 Hours

Streams - Byte Streams - Character Streams – Reading and Writing Files- SWING Basics - Layout Managers -Swing Components: JLabel - JTextField - JButton – JcheckBox – JTextArea – JRadioButton - Event Handling.

List of Exercises 45 Hours

1. Write programs using constructors and static members
2. Write programs using Inheritance, and Interfaces
3. Write programs using Method overriding and Packages
4. Write programs using Exception Handling and Thread
5. Write programs using Java Collections and String Tokenizer
6. Write programs using Streams and Swing components

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Develop simple java programs using classes, objects and static methods for solving real time problems	Understand
CO2: Utilize the principles of inheritance, interfaces and packages for achieving the code reusability	Apply
CO3: Apply the error handling techniques and multithreading concepts to solve the business problems	Apply
CO4: Develop java programs using Collection frameworks and built in classes for efficient programming	Apply
CO5: Design java applications using Streams and Java Swing for the real word scenarios	Apply

Text Book(s):

T1. Schildt. Herbert., "Java - The complete Reference", 11th Edition, McGraw Hill Education, 2019.

Reference Book(s):

R1. Deitel and Deitel, "Java How to Program", Prentice Hall, 11th Edition, 2017.

R2. Allen B. Downey, Chris Mayfield, "Think Java: How to Think Like a Computer Scientist", O'Reilly,2016.

Web References:

1. https://onlinecourses.nptel.ac.in/noc19_cs84/preview
2. https://www.w3schools.com/java/
3. https://www.tutorialspoint.com/java/index.htm
4. http://www.javamex.com

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	2	3	1	2	3	2	1	2	3	3
CO2	3	2	2	2	2	2	1	2	3	2	1	2	3	3
CO3	3	2	2	2	2	3	1	2	3	2	1	2	3	3
CO4	3	2	2	2	2	2	1	2	3	2	1	2	3	3
CO5	3	2	2	2	2	3	1	2	3	2	1	2	3	3

High-3; Medium-2;Low-1

Course Code: 19MESC4001	Course Title: Engineering Drawing (Common to AU, AD, CS, EC, EI, IT, ME, AM & SC)		
Course Category: Engineering Science		Course Level: Introductory	
L:T:P (Hours/Week) 1: 0: 3	Credits: 2.5	Total Contact Hours: 60	Max. Marks:100

Pre-requisites

- NIL

Course Objectives

The course is intended to:

1. Develop skills for communication of concepts and ideas
2. Expose them to existing national standards related to technical drawings

Unit I Orthographic Projection 12 Hours

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning. Projection of points, Projection of straight lines located in the first quadrant. Determination of true lengths and true inclinations. Visualization principles – conversion of pictorial into orthographic views.

Unit II Projection of Solids 12 Hours

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one of the principal planes by rotating object method.

Unit III Projection of Sectioned Solids 12 Hours

Sectioning of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by cutting planes inclined to one reference plane and perpendicular to the other – Orthographic views of sections of simple solids.

Unit IV Development of Surfaces 12 Hours

Development of lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinders and cones.

Unit V Isometric Projection 12 Hours

Principles of isometric projection – Isometric scale – Isometric projections of simple solids and truncated solids.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Sketch the orthographic projections of the given pictorial view of the object using first angle projection	Apply
CO2: Sketch the projections of simple solids such as prism, pyramid, cylinder and cone using rotating object method	Apply
CO3: Sketch the projections of simple sectioned solids with all necessary dimensions meeting the standards	Apply
CO4: Sketch the lateral surface of simple solids using straight line and radial line development methods	Apply
CO5: Sketch the isometric view of simple solids and truncated solids using principles of isometric projection	Apply

Text Book(s):

T1. Cencil Jensen, Jay D.Helsel and Dennis R. Short, " Engineering Drawing and Design", Tata McGraw Hill India, New Delhi, 7th Edition, 2017.

T2. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, Gujarat, 53rd Edition, 2015.

T3. K. V. Natrajan, "A Text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai,

Reference Book(s):

R1. BasantAgarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill India, New Delhi, 2nd Edition, 2013.

R2. John K.C., "Engineering Graphics", PHI Learning, Delhi, 2009.

R3. Dhananjay A. Jolhe, "Engineering Drawing with an introduction to AutoCAD" Tata McGraw India, New Delhi, 3rd Edition, 2008.

Publications of Bureau of Indian Standards

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.

Web References:

1. Engineering Drawing - http://nptel.ac.in/courses/112103019/
2. https://en.wikipedia.org/wiki/Engineering_drawing

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	-	-	-	2	3	2	-	1	-	-
CO2	3	2	2	2	-	-	-	2	3	2	-	1	-	-
CO3	3	2	2	2	-	-	-	2	3	2	-	1	-	-
CO4	3	2	2	2	-	-	-	2	3	2	-	1	-	-
CO5	3	2	2	2	-	-	-	2	3	2	-	1	-	-

High-3; Medium-2; Low-1

Course Code: 19CHMG6201	Course Title: Environmental Sciences (Common to all B.E/B.Tech Programmes)	
Course Category: Mandatory Non-Credit Course	Course Level: Introductory	
L:T:P(Hours/Week) 1: 0: 0	Total Contact Hours:15	Max. Marks: 100

Pre-requisites

- NIL

Course Objectives

The course is intended to:

1. Create awareness for conservation and equitable use of natural resources.
2. Explain the measures of prevention of pollution and disaster management.
3. State the importance of environmental legislation in India.
4. Expose the general environmental issues relevant to human health.
5. Explain the innovative measures for day to day environmental issues.

Unit I Natural Resources 2 Hours

Role of individual in conservation of natural resources; Equitable use of resources for sustainable lifestyles.

Unit II Environmental Pollution and Disaster Management 2 Hours

Role of an individual in prevention of pollution; Disaster management : floods, earthquake, cyclone and landslides.

Unit III Environmental Ethics and Legislations 2 Hours

Environmental ethics : Environment Protection Act; Air Act; Water Act ; Wildlife Protection Act; Forest Conservation Act; Issues involved in enforcement of environmental legislation.

Unit IV Environmental Issues and Public Awarness 2 Hours

Public awareness - Environment and human health

Unit V Environmental Activities 7 Hours

(a) Awareness Activities*:*

i) Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste

ii) Slogan making event

iii) Poster making event

(b) Actual Activities:

i) Plantation

ii) Cleanliness drive

iii) Drive for segregation of waste

iv) To know about the different varieties of plants

v) Shutting down the fans and ACs of the campus for an hour or so

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Describe the measures for conservation and equitable use of natural Resources	Understand
CO2: Describe the measures for pollution prevention and disaster Management	Understand
CO3: Brief the importance of environmental legislation in India	Understand
CO4: Explain the general environmental issues in relevant to human health	Understand
CO5: Demonstrate innovative measures for day to day environmental issues	Understand

Text Book(s):

T1. Benny Joseph, "Environmental Studies", Tata McGraw Hill, New Delhi, 2006.

T2. Mackenzie Davis and Susan Masten, "Principles of environmental engineering and science", Mc-Graw Hill, 3rd Edition, 2014.

Reference Book(s):

R1. Trivedi R.K. "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol.I and II, Enviro Media.

R2. Cunningham, W.P.Cooper,T.H. Gorhani, "Environmental Encyclopedia", Jaico Publishing House, Mumbai, 2001.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	-	-	-	-	2	1	2	-	-	-	-
CO2	1	-	-	-	-	-	-	2	1	2	-	-	-	-
CO3	1	-	-	-	-	-	-	2	1	2	-	-	-	-
CO4	1	-	-	-	-	-	-	2	1	2	-	-	-	-
CO5	1	-	-	-	-	-	-	2	1	2	-	-	-	-

High-3; Medium-2; Low-1

Course Code: 19PSHG6003	Course Title:HERITAGE OF TAMILS (Common to all B.E/B.TechProgrammes)		
Course Category: Humanities		Course Level: Introductory	
L:T:P (Hours/Week) 1: 0 :0	Credit: 1	Total Contact Hours: 15	Max Marks:100

Pre–requisites

- NIL

Course Objectives

மாணவர்கள் இப்பாடத்தை கற்றலின் மூலம்

CO.1 மொழி மற்றும் இலக்கியம், பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை , நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள் , திணைக் கோட்பாடுகள் மூலம் தமிழர் மரபை அறிந்து கொள்ள இயலும்.

CO.2இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பை அறிந்து கொள்ள இயலும்.

தமிழர் மரபு

அலகு 1 – மொழி மற்றும் இலக்கியம் 3

இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் – சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் – தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் – பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி –தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு 2 – மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை 3

நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள் – பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளுவர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு 3 – நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள் 3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு 4 – தமிழர்களின் திணைக் கோட்பாடுகள் 3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக் கோட்பாடு – சங்க காலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறைமுகங்களும் – சங்க காலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு 5 – இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு 3

இந்திய விடுதலைப் போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறபகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுய மரியாதை இயக்கம் – இந்திய மருத்துவத்தில் சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத் துப் படிகள்– தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

TOTAL : 15 PERIODS

Course Outcomes	**Cognitive Level**
மாணவர்கள் இப்பாடத்தை கற்றபின்	
CO.1 மொழி மற்றும் இலக்கியம், பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை , நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள் , திணைக் கோட்பாடுகள் மூலம் தமிழர் மரபை அறிந்து கொள்வார்கள்.	அறிதல் (Understand)
CO.2 இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பை அறிந்து கொள்வார்கள்.	அறிதல் (Understand)

TEXT - CUM REFERENCE BOOKS

1 தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே.பிள்ளை
(வெளியீடு. தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)

2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி – வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by:
   Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	1	-	-

High–3; Medium–2; Low–1

Course Code: 19PSHG6003	Course Title:HERITAGE OF TAMILS (Common to all B.E/B.TechProgrammes)		
Course Category: Humanities		Course Level: Introductory	
L:T:P (Hours/Week) 1: 0 :0	Credit: 1	Total Contact Hours: 15	Max Marks:100

Pre–requisites

- NIL

Course Objectives

The course is intended to:

1. Understand the Heritage of Tamils in terms of Language and Literature, Rock Art Paintings to Modern Art – Sculpture, Folk and Martial Arts, Thinai Concept.
2. Understand the Contribution of Tamils to Indian National Movement and IndianCulture.

HERITAGE OF TAMILS

UNIT I LANGUAGE AND LITERATURE 3

Language Families in India - Dravidian Languages – Tamil as a Classical 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 3

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 **3**

Therukoothu, Karagattam, VilluPattu, KaniyanKoothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT IV THINAI CONCEPT OF TAMILS **3**

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 INDIANCULTURE **3**

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

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO.1 Understand the Heritage of Tamils in terms of Language and Literature, Rock Art Paintings to Modern Art – Sculpture, Folk and Martial Arts, Thinai Concept.	Understand
CO.2 Understand the Contribution of Tamils to Indian National Movement and IndianCulture.	Understand

TEXT - CUM REFERENCE BOOKS

1 தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே.பிள்ளை
(வெளியீடு. தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)

2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி – வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by:
   Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	1	-	-

High–3; Medium–2; Low–1

Semester III

Course Code: 19MABN1302	Course Title: Probability and Statistics for Data Science		
Course Category: Basic Science		Course Level: Introductory	
L:T:P (Hours/Week) 3: 1: 0	Credits:4	Total Contact Hours:60	Max Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Calculate expectations and variances of random variables and solve practical problems using standard distributions
2. Calculate the correlation and regression for two variables
3. Test the samples based on hypothesis
4. Analyze the samples based on variance
5. Acquire the knowledge of control charts

Unit I Probability and Random Variables 9+3 Hours

Axioms of Probability- Conditional Probability- Total Probability -Baye's Theorem- Random Variables- Probability Mass Function- Probability Density Functions- Properties - Moments- Moment generating functions and their properties- Binomial- Poisson- Uniform –Exponential- Normal Distributions and their properties.

Unit II Two Dimensional Random Variables 9+3 Hours

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression using least square method – Transformation of random variables.

Unit III Testing of Hypotheses 9+3 Hours

Sampling Distributions- Estimation of parameters-Testing of hypotheses for mean, variance, proportions and differences using Normal, t, Chi-Square and F distributions – Tests for independence of attributes and Goodness of fit.

UNIT IV Design of Experiments 9+3 Hours

Analysis of Variance (ANOVA)- One way Classification – Completely Randomized Design(CRD) – Two way Classification – Randomized Block Design (RBD) – Latin square.

Unit V Statistical Quality Control 9+3 Hours

Control charts for measurements(X and R Charts)-Control charts for attributes (p,c and np charts –Tolerance limits-Acceptance sampling.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply the concepts of random variables and solve practical problems using standard distributions	Apply
CO2: Calculate the correlation and regression for two variables	Apply
CO3: Test the samples based on hypothesis	Apply
CO4: Analyze the samples based on variance	Apply
CO5: Construct group control chart, draw charts for variables and attributes.	Apply

Text Book(s):

T1. Veerajan T, "Probability, Statistics and Random process", 3rd Edition, Tata McGraw-Hill, New Delhi, 2017.

T2. Dr.J.Ravichandran, "Probability and Statistics for Engineers", 1stEdition, Wiley India Pvt. Ltd., 2010.

Reference Book(s):

R1. R.E. Walpole, R.H. Myers, S.L. Myers, and K Ye, "Probability and Statistics for Engineers and Scientists", 9th Edition Pearson Education, Asia, 2013.

R2. M.R. Spiegel, J. Schiller and R.A. Srinivasan, "Schaum's Outlines Probability and Statistics", 4th Edition Tata McGraw Hill edition, 2012.

R3. Morris DeGroot, Mark Schervish, "Probability and Statistics", Pearson Educational Ltd, 4th Edition, 2014.

R4. M.R. Spiegel , L.J.Stephens," Schaum's Outlines Theory and Problems of Statistics", 3rd Edition, Mcgraw Hill International edition, 1999.

Web References:

1. https://onlinecourses.nptel.ac.in/111105041/
2. https://nptel.ac.in/downloads/111105041/
3. https://nptel.ac.in/courses/111105090/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	1	-	1	1	1	1	2	-	-
CO2	3	2	1	1	-	1	-	1	1	1	1	2	-	-
CO3	3	2	1	1	-	1	-	1	1	1	1	2	-	-
CO4	3	2	1	1	-	1	-	1	1	1	1	2	-	-
CO5	3	2	1	1	-	1	-	1	1	1	1	2	-	-

High-3; Medium-2; Low-1

Course Code: 19ADCN1301	Course Title: Data Structures and Algorithm Analysis – I (common to CS &AD)		
Course Category: Professional Core		Course Level: Practice	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Introduction to C Programming

Course Objectives

The course is intended to:

1. Describe the importance of data structures and asymptotic notations
2. Perform various operations on List data structure
3. Perform various operations on Stack and Queue data structures
4. Apply suitable methods for efficient data access through hashing and determine the complexity of algorithms
5. Compare the efficiency of brute force & divide and conquer techniques

Unit I Basic Concepts of Algorithms 8 Hours

Introduction – Classification of Data Structures – Abstract data type – Algorithm properties – Fundamentals of Algorithmic Problem Solving – Fundamentals of analysis framework – Efficiency classes – Asymptotic notations.

Unit II List 9 Hours

List – Array implementation – Linked List implementation:Singly, Doubly, Circular Linked list – Operations: Insert, Delete and Search- Applications of List.

Unit III Stack and Queue 9 Hours

Stack – Implementation – Applications: Balancing Symbols, Infix to Postfix conversion, Evaluation of Postfix expression and function calls – Queue – Implementation –Circular Queue-Deque – Applications.

Unit IV Hashing and Mathematical Analysis of Algorithms 10 Hours

Hashing – Separate chaining – Open addressing – Double hashing – Rehashing.
Mathematical analysis of non-recursive algorithms: Matrix Multiplication – Mathematical analysis of recursive algorithms: Factorial problem, Towers of Hanoi – Empirical analysis of algorithms.

Unit V Simple Algorithmic Design Techniques 9 Hours

Brute force approach: Exhaustive Search – String matching:Naive approach, Linear search Bubble sort – Divide and Conquer technique: Binary search, Merge sort, Quick sort.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Describe the importance of data structures and the notations used in algorithm analysis	Understand
CO2: Perform operations on List data structures for various applications	Apply
CO3: Perform operations on Stack and Queue data structures for various applications	Apply
CO4: Apply suitable methods for efficient data access through hashing and determine the complexity of algorithms using mathematical analysis	Apply
CO5: Compare the efficiency of brute force & divide and conquer techniques for problem solving	Apply

Text Book(s):

T1. Mark A. Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education, 2011.

T2. Anany Levitin, "Introduction to the Design & Analysis of Algorithms", 3rd Edition, Pearson Education, 2011.

Reference Book(s):

R1. Sartaj Sahni, "Data Structures, Algorithms and Applications in C++", 2nd Edition, Universities Press, 2005..

R2. Michael T. Goodrich, Roberto Tamassia, David M. Mount, "Data Structures and Algorithms in C++", 2nd Edition, John Wiley & Sons, 2010.

R3. Cormen.T.H.,Leiserson.C.E., Rivest. R.L. and Stein.C., "Introduction to Algorithms", PHI Pvt. Ltd., 2001.

Web Reference(s):

1. Animation of Various Data Structures URL:http://visualgo.net/
2. NPTEL Course Content URL: http://nptel.ac.in/courses/106102064/ Data Structures and Algorithms
3. The Animation of Recursion URL: http://www.animatedrecursion.com/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	-	-
CO2	3	2	1	1	1	1	-	1	-	1	1	1	2	-
CO3	3	2	1	1	1	1	-	1	-	1	1	1	2	-
CO4	3	2	1	1	1	1	1	1	-	1	1	1	2	1
CO5	3	2	1	1	1	1	1	1	-	1	1	1	2	1

High-3; Medium-2; Low-1

Course Code: 19ADCN1302		Course Title: Computer Architecture (common to CS &AD)	
Course Category: Professional Core		Course Level: Practice	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Describe the memory organization and various addressing modes
2. Explain the various components of the processing unit and bus organization
3. Design cache memory organization
4. Use various pipeline techniques
5. Describe the various Parallel Processing architectures

Unit I Memory Organization and Addressing 9 Hours

Evolution of Microprocessor – Basic Processor Architecture – Operational concepts – Performance – Memory location – Memory Operations – Instructions and sequencing – Addressing modes – CISC Vs RISC – DMA.

Unit II Input / Output and Basic Processing Unit 9 Hours

Accessing I/O devices – Interrupts – Buses – Instruction Execution – Hardware Components – Instruction Fetch and Execution Steps – Control Signals – Hardwired Control, CISC Style Processors: Micro programmed Control.

Unit III Cache Memory Design 9 Hours

Characteristics of Memory Systems – Cache Memory Principles – Elements of Cache Design – Mapping Function – Example of Mapping Techniques – Replacement Algorithms – Performance Consideration.

Unit IV Pipelining 9 Hours

Pipelining Concept – Pipeline Organization and issues- Data Dependencies – Memory Delays – Branch Delays – Resource Limitations – Performance Evaluation – Superscalar operation– Pipelining in CISC Processors

Unit V Parallelism 9 Hours

Instruction Level Parallelism – Parallel Processing Challenges – Flynn's Classification – Hardware multithreading – Multicore Processors: GPU, Multiprocessor Network Topologies – Case Study: ARM, Intel 32/64.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Describe the memory organization and various addressing modes with example	Understand
CO2: Explain the various components of the processing unit and bus organization for instruction execution	Understand
CO3: Design cache memory organization using various mapping techniques	Apply
CO4: Use various pipeline techniques to improve the performance of processors	Apply
CO5: Describe the various Parallel Processing architectures to implement parallelism	Understand

Text Book(s):

T1. Carl Hamacher, Zvonok Vranesic, Safwat Zaky, NaraigManjikian "Computer Organization and Embedded Systems", 6th Edition, McGraw Hill, 2012. (Unit 1,2,3,4)

T2. David A. Patterson and John L. Hennessey, "Computer Organization and Design: The Hardware/Software Interface", 5th Edition, Morgan Kauffman / Elsevier, 2014.(Unit 5)

Reference Book(s):

R1. William Stallings, "Computer Organization and Architecture: Designing for Performance", 10th Edition, Pearson Education, 2016.

R2. S.S.S.P.Rao, "Basics of Computer Organisation and Architecture: Problems and Solutions", Alpha Science International Ltd, 2014.

R3. John L. Hennessey and David A. Patterson, "Computer Architecture: A Quantitative Approach", Morgan Kauffman / Elsevier, 5th Edition, 2012

Web Reference(s):

1. Computer Architecture – Coursera URL: https://www.coursera.org/lecture/comparch/course-introduction-Ouq7L
2. Computer System Architecture-MIT Open Courseware Notes URL: https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-823-computer-system-architecture-fall-2005/index.htm
3. Computer Architecture: NPTEL Course URL: http://www.nptel.ac.in/courses/106102062/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	-	-
CO2	2	1	-	-	-	-	-	1	-	1	-	1	-	-
CO3	3	2	1	1	-	-	1	1	-	1	-	1	2	-
CO4	3	2	1	1	-	-	1	1	-	1	-	1	2	-
CO5	2	1	-	-	-	-	-	1	-	1	-	1	-	-

High-3; Medium-2; Low-1

Course Code: 19ADCN1303	Course Title: Data Mining		
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- NIL

Course Objectives

The course is intended to:

1. Distinguish the types of data to be pre-processed for the given dataset
2. Describe the basic principles, concepts and applications of data warehousing
3. Categorize the kinds of patterns that are discovered by association rule mining
4. Classify data for the given dataset.
5. Analyze the data mining trends and applications.

Unit I Introduction 10 Hours

Introduction to Data Mining: Kinds of Data – Kinds of Patterns – Technologies - Applications – Issues - Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Data Visualization, Measuring Data Similarity - Preprocessing: Data Quality - Major Tasks in Data Preprocessing - Data Reduction – Data Transformation and Data Discretization - Data Cleaning and Data Integration.

Unit II Data Warehousing 8 Hours

Data Warehousing and Online Analytical Processing: Data Warehouse basic concepts - Data Warehouse Modeling - Data Cube and OLAP - Data Warehouse Design and Usage - Data Warehouse Implementation - Data Generalization by Attribute-Oriented Induction.

Unit III Association 9 Hours

Mining Frequent Patterns - Associations and Correlations: Basic Concepts and Methods: Frequent Item set Mining Methods, Pattern Evaluation Methods, Frequent Pattern and Association Mining: A Road Map, Multidimensional Space, Constraint-Based Frequent Pattern Mining, Applications of frequent pattern Mining.

Unit IV Classification and Clustering 10 Hours

Classification: Basic Concepts - Decision Tree Induction – Bayes Classification Methods – Rule Based Classification – K-Nearest-Neighbor Classifier - Model Evaluation and Selection – Techniques to Improve Classification Accuracy. Cluster Analysis: Basic Concepts and Methods- Cluster Analysis - Partitioning Methods - Hierarchical Methods - Density-Based Methods - Grid-Based Methods.

UNIT V Data Mining Trends 8 Hours

Mining Complex Data Types - Statistical Data Mining - Views on Data Mining Foundations -Visual and Audio Data Mining - Data Mining Applications - Data Mining and Society - Data Mining Trends.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Distinguish the types of data to be pre-processed for the given dataset using the preprocessing technique.	Apply
CO2: Describe the basic principles, concepts and applications of data warehousing in real world scenario.	Apply
CO3: Categorize the kinds of patterns that are discovered by association rule mining for transaction database	Analyze
CO4: Classify data for the given dataset using real world applications	Apply
CO5: Analyze the data mining trends and applications for societal problems	Analyze

Text Book(s):

T1. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", 3rd Edition, Elsevier, 2012.

Reference Book(s):

R1. Jure Leskovec, Anand Rajaraman, Jeffery David Ullman, "Mining of Massive Datasets", 2nd Edition, Cambridge University Press, 2014.

R2. Ian H.Witten, Eibe Frank, Mark A.Hall, "Data Mining: Practical Machine Learning Tools and Techniques", 3rd Edition, Elsevier, 2011.

R3. EMC Education Services, "Data Science and Big Data Analytics Discovering, Analyzing, Visualizing and Presenting Data", Wiley, 2015.

R4. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley & sons 2013.

Web References:

1. http://www.cs.waikato.ac.nz/ml/weka/documentation.html
2. https://cran.r-project.org/manuals.html
3. https://archive.ics.uci.edu/ml/index.html

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	1	1	1	1	1	2	2	1	3
CO2	3	2	1	1	1	2	2	1	1	1	2	2	1	3
CO3	3	3	2	2	1	1	1	1	1	1	2	2	1	3
CO4	3	2	1	1	1	2	2	1	1	1	2	2	1	3
CO5	3	3	2	2	1	3	3	1	1	1	2	2	1	3

High-3; Medium-2; Low-1

Course Code: 19ADCN2301	Course Title: Database Systems (common to CS &AD)		
Course Category: Professional Core		Course Level: Practice	
L:T:P (Hours/Week) 3: 0: 2	Credits:4	Total Contact Hours:75	Max Marks:100

Pre-requisites

- NIL

Course Objectives

The course is intended to:

1. Describe the functions and architecture of database management system
2. Design relational databases using ER model and normalization concepts
3. Construct SQL queries using DDL, DML and DCL commands
4. Develop applications using database connectivitythrough advanced SQL concepts
5. Explain the concurrency control and recovery mechanisms

Unit I Foundations of DBMS 7 Hours

File System – Database System – File System Vs. DBMS – Roles in DBMS Environment – Data Models and Conceptual Modeling – Functions of DBMS – Components of DBMS – Multi user DBMS Architecture.

Unit II Relational Model, ER Model and Normalization 10 Hours

Relational Model: Terminology, Integrity Constraints – Relational Algebra – ER Modeling: Concepts, Relationship Types, Attributes, Structural Constraints – Normalization: Data Redundancy and Update Anomalies, Functional Dependencies,1NF, 2NF, 3NF, BCNF.

Unit III SQL Fundamentals 10 Hours

SQL: Overview of Query Language, Data Types, Data Definition, Views, Access Control – Data Manipulation – Joins – Nested Queries.

Unit IV Advanced SQL and Query Processing 9 Hours

Advanced SQL: Functions and procedures, Cursors, Triggers – Accessing SQL from a Programming Language – Query Processing: Decomposition, Heuristical Approach to Query Optimization, Cost Estimation for Relational Algebra Operations.

Unit V Transaction and Concurrency Control 9 Hours

Transaction: Properties – Concurrency Control: Locking methods, Deadlock, Timestamp Ordering, Multi-version Timestamp Ordering, Optimistic Techniques – Database Recovery: Transaction and Recovery, Recovery facilities, Recovery Techniques.

List of Exercises **30 Hours**

1. Design a database using ER diagrams
2. Create and modify the tables using DDL commands and manipulate the data using DML commands
3. Implement Joins and nested queries
4. Implement Functions and procedures
5. Create Cursors and Triggers
6. Access database through programming language

The suggested applications are (not limited to)

1. Library management system
2. Hotel Management system
3. Student management system
4. Ticket reservation system
5. Hospital management system
6. Employee management system

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Describe the functions and architecture of database management system using its components	Understand
CO2: Design relational databases using ER model and normalization concepts for real world scenarios	Apply
CO3: Construct SQL queries using DDL, DML and DCL commands for effective retrieval of data from database	Apply
CO4: Develop applications using database connectivity through advanced SQL Concepts for solving real world problems	Apply
CO5: Explain the concurrency control and recovery mechanisms to manage multiple transactions in real time application	Understand

Text Book(s):

T1. Thomas Connolly, Carolyn Begg, "Database Systems: A Practical Approach to Design, Implementation and Management", 6th Edition, Pearson Education,2015.

T2. A Silberschatz, H Korth, S Sudarshan, "Database System Concepts", 7thEdition, McGraw-Hill,2019.

Reference Book(s):

R1. RamezElmasri,Shamkant B. Navathe, "Fundamentals of Database Systems", 7th Edition, Pearson Education,2017.

R2. C.J. Date, A. Kannan and S. Swamynathan– "An Introduction to Database Systems", 8th Edition, Pearson Education, 2006.

Web References:

1. Text book handouts: http://www.inf.unibz.it/~nutt/IDBs1011/idbs-slides.html
2. NPTEL lecture videos and notes: https://nptel.ac.in/courses/106106093/
3. SQL practice exercises with solutions: https://www.w3resource.com/sql-exercises/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	-	-
CO2	3	2	2	2	2	1	1	2	3	2	1	1	3	-
CO3	3	2	2	2	2	1	1	2	3	2	1	1	3	2
CO4	3	2	2	2	2	1	1	2	3	2	1	1	3	2
CO5	2	1	-	-	-	1	-	1	-	1	-	1	-	-

High-3; Medium-2;Low-1

Course Code: 19ADCN3301	Course Title:Data Structures and Algorithm Analysis Laboratory (common to CS &AD)		
Course Category: Professional Core		Course Level: Practice	
L:T:P (Hours/Week) 0: 0: 3	Credits:1.5	Total Contact Hours:45	Max Marks:100

Pre-requisites

- Introduction to C Programming

Course Objectives

The course is intended to:

1. Implement list data structures using array and linked list
2. Implement stack data structure for various applications
3. Implement queue data structure and hashing techniques
4. Compare the efficiency of Brute-Force and Divide & Conquer approaches

List of Exercises

1. Implementation of List using array representation
2. Implementation of List using linked list representation
3. Implementation of Doubly linked list
4. Implementation of Stack application: Balancing parenthesis
5. Implementation of Stack application: Evaluation of postfix expression
6. Implementation of Circular Queue using array representation
7. Implementation of Hashing
8. Implementation of String Matching algorithm
9. Implementation of Searching techniques
10. Implementation of Sorting techniques: Bubble and Merge sort

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Implement list data structures and perform various operations using array and linked list representation.	Apply
CO2: Implement stack data structure for various applications using array representation	Apply
CO3: Implement circular queue using array and hashing techniques for efficient data handling in various scenarios	Apply
CO4: Compare the efficiency of Brute-Force and Divide & Conquer approaches for solving problems.	Apply

Text Book(s):

T1. Mark A. Weiss., "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education, 2011.

T2. Anany Levitin, "Introduction to the Design & Analysis of Algorithms", Pearson Education,

Reference Book(s):

R1. Sartaj Sahni, "Data Structures, Algorithms and Applications in C++", 2nd Edition, Universities

R2. Michael T. Goodrich, Roberto Tamassia, David M. Mount, "Data Structures and Algorithms in C++", 2nd Edition, John Wiley & Sons, 2010.

R3. Cormen.T.H.,Leiserson.C.E., Rivest. R.L. and Stein.C., "Introduction to Algorithms", PHI Pvt. Ltd., 2001.

Web References:

1. Animation of Various Data Structures URL:http://visualgo.net/
2. NPTEL Course Content URL: http://nptel.ac.in/courses/106102064/ Data Structures and Algorithms
3. The Animation of Recursion URL: http://www.animatedrecursion.com/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	-	-	2	3	2	-	1	3	1
CO2	3	2	2	2	2	1	-	2	3	2	-	1	3	1
CO3	3	2	2	2	2	1	1	2	3	2	1	1	3	1
CO4	3	2	2	2	2	1	1	2	3	2	1	1	3	1

High-3; Medium-2;Low-1

Course Code: 19ADCN4301	Course Title: Python Programming for Data Engineers Laboratory		
Course Category: Professional Core		Course Level: Practice	
L: T: P (Hours/Week) 1: 0: 3	Credits:2.5	Total Contact Hours: 60	Max Marks:100

Pre-requisites

- Object Oriented Programming with Java

Course Objectives

The course is intended to:

1. Develop Python programs using variables and statements
2. Utilize suitable data structures for a given problem
3. Create classes and objects for given business requirement
4. Create a GUI based application with data persistence

Unit I Introduction to Python and Data Structures 7 Hours

Introduction to Python- Variables, Expressions and Statements – File handling operations- Conditionals - Lists- Tuples- -Dictionaries – Strings –Functions.

Unit II OOPS Concepts and GUI Programming in Python 8 Hours

Classes- Creating Instance Objects- Built-In Class Attributes- Inheritance- TKinter – Widget creation- Database Connection: INSERT - READ - UPDATE - DELETE Operation-GUI application with database connection.

List of Exercises 45 Hours

1. Implement data types, operators and expressions
2. Implementation of branching statements, looping constructs & functions
3. Implementation of list, tuple and dictionary
4. Implementation of file handling techniques
5. Implementation of class and objects with exception handling
6. Implementation of polymorphism
7. Implementation of Inheritance
8. Implementation of pickle and shelve objects
9. Implement Database Connectivity with SQL Server
10. Design a GUI programming with Tkinter for given application

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Develop Python programs using variables and statements for simple business logic	Apply
CO2: Utilize suitable data structures for a given problem and its constraints	Apply
CO3: Create classes and objects for provided business requirement	Apply
CO4: Create a GUI based application with data persistence using databases	Apply

Reference (s):

R1. Peter Wentworth, Jeffrey Elkner, Allen B. Downey, and Chris Meyers, "How to Think Like a Computer Scientist: Learning with Python",3rd Edition, O'Reilly, 2016.

R2. Mark Lutz, "Powerful Object Oriented Programming Python", 4th Edition, O'Reilly, 2012

Web References:

1. https://docs.python.org/3/tutorial/
2. https://www.pyschools.com/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	3	1	1	2	3	2	2	2	3	3
CO2	3	2	2	2	3	1	1	2	3	2	2	2	3	3
CO3	3	2	2	2	3	1	1	2	3	2	2	2	3	3
CO4	3	2	2	2	3	1	1	2	3	2	2	2	3	3

High-3; Medium-2; Low-1

Course Code: 19PSHG6002		Course Title: Universal Human Values 2 :Understanding Harmony (common to all B.E/B.Tech programmes)	
Course Category: Humanities		Course Level: Practice	
L:T:P (Hours/Week) 2:1: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Pre-requisites

- Induction Program (UHV 1)

Course Objectives

The course is intended to:

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. Strengthening of self-reflection
3. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
4. Development of commitment and courage to act

Unit I Introduction to Value Education 6+3 Hours

Need for the Value Education;. Self -exploration as the process for value education ; Continuous Happiness and Prosperity: A look at basic Human Aspirations; Right understanding: Relationship and Physical Facilities ; Happiness and Prosperity: current scenario ; Method to fulfill the Basic human aspirations

Unit II Harmony in Human Being 6+3 Hours

Human being as a co-existence of self ('I') and the material 'Body'; needs of Self ('I') and 'Body'; The Body as an instrument of 'I' ; Harmony in the self('I'); Harmony of the self('I') with body ;Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensure Sanyam and Swasthya.

Unit III Harmony in the Family and Society 6+3 Hours

Harmony in the Family the basic unit of human interaction; Values in human to human relationship; Trust as the foundational values of relationship; Respect as the right evaluation ;Understanding harmony in the society (society being an extension of family); Vision for the universal human order

Unit IV Harmony in the Nature 6+3 Hours

Understanding the harmony in the Nature Interconnectedness, self-regulation and mutual fulfillment among the four orders of nature; Existence as Co-existence at all levels; Holistic perception of harmony in existence.

Unit V Harmony on Professional Ethics 6+3 Hours

Natural acceptance of human values ;Definitiveness of Ethical Human Conduct; Basic for Humanistic Education, Humanistic Constitution and Humanistic Universal Order; Competence in professional ethics ;Case study: holistic technologies, management models and production systems ;Strategy for transition towards value based life and profession

Course Outcomes	**Affective Level**
At the end of this course, students will be able to:	
CO1: Reflect on values, aspiration, relationships and hence identify strengths and weaknesses.	Responding
CO2: Appraise physical, mental and social well being of self and practice techniques to promote well being.	Responding
CO3: Value human relationships in family and society and maintain harmonious relationships.	Valuing
CO4: Respect nature and its existence for survival and sustainable of all life forms and hence practice conservation of nature	Valuing
CO5: Appreciate ethical behaviour as a result of value system in personal and professional situations	Receiving

Text Book(s):

T1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010.

Reference Book(s):

R1.Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.

R2.Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

R3. The story of stuff, Annie Leonard, Free Press, New York 2010.

Web References:

1. https://aktu.ac.in/hvpe/ResourceVideo.aspx
2. http://hvpenotes.blogspot.com/
3. https://nptel.ac.in/courses/109/104/109104068/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	1	2	2	-	-	2	-	-
CO2	-	-	-	-	-	1	2	2	2	1	-	2	-	-
CO3	-	-	-	-	-	2	2	2	2	1	-	2	-	-
CO4	-	-	-	-	-	2	2	2	2	-	-	2	-	-
CO5	-	-	-	-	-	1	2	2	2	-	-	2	-	-

High-3; Medium-2; Low-1

Course Code: 19PSHG6004	Course Title:TAMILS AND TECHNOLOGY (Common to all B.E/B.TechProgrammes)		
Course Category: Humanities		Course Level: Introductory	
L:T:P (Hours/Week) 1: 0 :0	Credit: 1	Total Contact Hours: 15	Max Marks:100

Pre–requisites

- NIL

Course Objectives

மாணவர்கள் இப்பாடத்தை கற்றலின் மூலம்

CO.1 நெசவு மற்றும் பானைத் தொழில்நுட்பம், வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம், உற்பத்தித் தொழில்நுட்பம், வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம் ஆகியன குறித்து அறிந்து கொள்ள இயலும்.

CO.2 அறிவியல் தமிழ் மற்றும் கணினித் தமிழ் குறித்து அறிந்து கொள்ள இயலும்.

தமிழரும் தொழில்நுட்பமும்

அலகு 1 – நெசவு மற்றும் பானைத் தொழில்நுட்பம் 3

சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் – கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்

அலகு 2 – வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம் 3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் ஷ சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு – சங்க காலத்தில் கட்டுமானப் பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் – மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் – மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம் மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள், பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ – சாரோசெனிக் கட்டிடக் கலை.

அலகு 3 – உற்பத்தித் தொழில்நுட்பம் 3

கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத் துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு 4 வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம் 3

அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன் வளம் – முத்து மற்றும் முத்துக் குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.

அலகு 5 – அறிவியல் தமிழ் மற்றும் கணினித் தமிழ் 3

அறிவியல் தமிழின் வளர்ச்சி – கணினித் தமிழ் வளர்ச்சி – தமிழ் நூல்களை மின் பதிப்பு செய்தல் – தமிழ் மென் பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக் கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.

TOTAL : 15 PERIODS

Course Outcomes	**Cognitive Level**
மாணவர்கள் இப்பாடத்தை கற்றபின்	
CO.1 நெசவு மற்றும் பானைத் தொழில்நுட்பம், வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம், உற்பத்தித் தொழில்நுட்பம், வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம் ஆகியன குறித்து அறிந்து கொள்வார்கள்.	அறிதல் (Understand)
CO.2 அறிவியல் தமிழ் மற்றும் கணினித் தமிழ் குறித்து அறிந்து கொள்வார்கள்.	அறிதல் (Understand)

TEXT - CUM REFERENCE BOOKS

1 தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே.பிள்ளை (வெளியீடு. தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி – வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	1	-	-

High–3; Medium–2; Low–1

Course Code: 19PSHG6004	Course Title:TAMILS AND TECHNOLOGY (Common to all B.E/B.TechProgrammes)		
Course Category: Humanities		Course Level: Introductory	
L:T:P (Hours/Week) 1: 0 :0	Credit: 1	Total Contact Hours: 15	Max Marks:100

Pre–requisites

- NIL

Course Objectives

The course is intended to:

1. Understand Weaving and Ceramic Technology, Design and Construction Technology, Manufacturing Technology, Agriculture and Irrigation Technology.
2. Understand the Scientific Tamil & Tamil Computing.

TAMILS AND TECHNOLOGY

UNIT I WEAVING AND CERAMIC TECHNOLOGY **3**

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

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY **3**

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

UNIT III MANUFACTURING TECHNOLOGY **3**

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 **3**

Dam, Tank, ponds, Sluice, Significance of KumizhiThoompu 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 **3**

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

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO.1 Understand Weaving and Ceramic Technology, Designand Construction Technology, Manufacturing Technology, Agriculture and Irrigation Technology.	Understand
CO.2 Understand the Scientific Tamil & Tamil Computing.	Understand

TEXT - CUM REFERENCE BOOKS

1 தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே.பிள்ளை
(வெளியீடு. தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி – வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	1	-	-

High–3; Medium–2; Low–1

Semester IV

Course Code:19MABN1401		Course Title: Discrete Mathematics for Artificial Intelligence	
Course Category: Basic Science		Course Level: Introductory	
L:T:P(Hours/Week) 3: 1: 0	Credits:4	Total Contact Hours:60	Max. Marks:100

Pre-requisites

- Linear Algebra and Infinite Series

Course Objectives

The course is intended to:

1. Use the concepts of propositional logic to test the validity of arguments.
2. Use the concepts of sets, relations and functions in programming.
3. Use combinatorics in counting problems.
4. Use the concepts of groups to study the algebraic structures.
5. Use the fundamental concepts in graph theory in practical problems.

Unit I Logic 9+3 Hours

Propositions- Logical operators – Logical equivalences and implications - Normal forms –Rules of inference-Consistency and inconsistency- Theory of Inference – Proofs – Predicates-Quantifiers- Universe of discourse – Validity of arguments.

Unit II Relations, Lattices and Functions 9+3 Hours

Relations –Types of relations – Properties of relations - Equivalence relations –Relational matrix - Graph of relations – Partial ordering relation - Poset – Hasse Diagram - Lattices – Properties of Lattices. Functions - Type of functions: Injective, surjective and bijective functions –Composition of functions – Inverse functions.

Unit III Combinatorics 9+3 Hours

Mathematical induction- Basics of counting–Pigeon hole principle – Permutations with and without repetition – Circular permutation – Combinations - Recurrence relations-Solution of linear recurrence relations.

Unit IV Algebraic Structures 9+3 Hours

Algebraic Systems – properties – Semi groups and monoids – Homomorphism – Sub semi groups and sub monoids – Groups – Abelian group – Cyclic group – Cosets – Lagrange's theorem – Codes and Group codes.

Unit V Graphs 9+3 Hours

Graphs and graph models – Graph terminology and special types of graphs – Matrix representation of graphs and graph isomorphism – Connectivity – Euler and Hamilton paths.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Apply logic to test the validity of arguments	Apply
CO2: Apply the concepts of sets, relations and functions in discrete structures	Apply
CO3: Solve the counting problems using combinatorics	Apply
CO4: Apply the concepts of groups and its properties to algebraic structures	Apply
CO5: Apply the concepts of graph theory to solve practical problems	Apply

Text Book(s):

T1. J.P.Trembly, R. Manohar, Discrete Mathematical Structures with applications to Computer Science, First edition, TMH International Edition,July 2017.

T2. T.Veerarajan, "Discrete Mathematical Structures with Graph Theory and Combinatorics", First edition, Tata McGraw-Hill Education Private Limited, New Delhi, July 2017.

Reference Book(s):

R1. Kennth H. Rosen, "Discrete Mathematics and Its Applications", Seventh edition, Tata McGraw-Hill Pub. Co. Ltd., New Delhi, July 2017.

R2. Ralph P Grimaldi, Ramana. B. V, " Discrete and Combinatorial Mathematics", Fifth Edition, Pearson Education India, 2011.

Web References:

1. Logic, Relations: http://nptel.ac.in/courses/106106094
2. Combinatorics: https://nptel.ac.in/courses/111/104/111104026/
3. Algebraic Structures: https://nptel.ac.in/courses/106/103/106103205/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	1	-	1	1	1	1	2	-	-
CO2	3	2	1	1	-	1	-	1	1	1	1	2	-	-
CO3	3	2	1	1	-	1	-	1	1	1	1	2	-	-
CO4	3	2	1	1	-	1	-	1	1	1	1	2	-	-
CO5	3	2	1	1	-	1	-	1	1	1	1	2	-	-

High-3; Medium-2; Low-1

Course Code: 19ADCN1401	Course Title: Data Structures and Algorithm Analysis – II (common to CS &AD)		
Course Category: Professional Core		Course Level: Practice	
L:T:P (Hours/Week) 3: 1: 0	Credits:4	Total Contact Hours:60	Max. Marks:100

Pre-requisites

- Data Structures and Algorithm Analysis – I

Course Objectives

The course is intended to:

1. Perform various operations on Binary trees and Heaps
2. Implement operations on Search tree structures
3. Perform various operations on Graphs and Sets
4. Apply Greedy strategy & Dynamic Programming techniques
5. Compare the working of Backtracking & Branch and Bound techniques

Unit I Trees Structures 9+3 Hours

Tree – Preliminaries – Binary trees – Tree traversal – Applications: Expression tree, Decision tree, Game tree – Binary Heap – Heap sort.

Unit II Search Tree Structures 9+3 Hours

Binary search tree – B-Trees – k-d tree – Tries.

Unit III Graph 9+3 Hours

Graph – Definitions – Representations – Topological sort – Breadth first traversal – Depth first traversal – Biconnectivity – Euler circuits – Sets – Representation – Operations.

Unit IV Greedy Method and Dynamic Programming 9+3 Hours

Greedy technique: Dijikstra's algorithm, Prim's and Kruskal's algorithm, Huffman Tree – Dynamic Programming: Binomial Coefficient, Floyd's and Warshall's algorithm, Multistage Graph.

Unit V Backtracking & Branch and Bound 9+3 Hours

Limitations of Algorithm Power: P,NP and NP Complete problems - Backtracking: n-Queens problem, Hamiltonian Circuit, Subset-sum problem - Branch and Bound: Assignment problem, Knapsack problem, Travelling salesman problem.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Perform various operations on Binary trees and Heaps for real world applications	Apply
CO2: Implement operations on Search tree structures for efficient storage and retrieval of data	Apply
CO3: Perform various operations on Graphs and Sets by using suitable storage organizations	Apply
CO4: Apply Greedy strategy & Dynamic Programming techniques for solving optimization problems	Apply
CO5: Compare the working of Backtracking & Branch and Bound techniques and choose the suitable technique for problem solving	Apply

Text Book(s):

T1. Mark A. Weiss., "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education, 2011.

T2. Anany Levitin, "Introduction to the Design & Analysis of Algorithms", 3rd Edition, Pearson Education, 2011.

Reference Book(s):

R1. Ellis Horowitz, Sartaj Sahni, Rajasekaran, "Fundamentals of Computer Algorithms", 2nd Edition, Galgotia Publications, 2010.

R2. Adam Drozdek, "Data Structures and Algorithms in C++", 4th Edition, Cengage Learning, 2013.

R3. Cormen.T.H.,Leiserson.C.E., Rivest R.L and Stein C, "Introduction to Algorithms", PHI Pvt Ltd, 2001.

Web Reference(s):

1. SWAYAM Course Design and Analysis of Algorithms: https://swayam.gov.in/nd1_noc19_cs47/preview
2. Animation Videos: http://www.animatedrecursion.com/
3. Course Material: THE P VERSUS NP PROBLEM https://www.claymath.org/sites/default/files/pvsnp.pdf

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	1	-	1	1	1	1	1	2	-
CO2	3	2	1	1	1	1	1	1	1	1	1	1	2	-
CO3	3	2	1	1	1	1	1	1	1	1	1	1	2	-
CO4	3	2	1	1	1	1	1	1	1	1	1	1	2	1
CO5	3	2	1	1	1	1	1	1	1	1	1	1	2	1

High-3; Medium-2;Low-1

Course Code: 19ADCN1402	Course Title: Artificial Intelligence - I		
Course Category : Professional Core		Course Level: Introductory	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks: 100

Pre-requisites

- Data Structures and Algorithm s

Course Objectives

The course is intended to:

1. Describe agent types and behaviour.
2. Compare the efficiency of various searching techniques.
3. Apply real time searching to the given problem
4. Apply Inference rules to the given Knowledge Base
5. Choose the appropriate planning technique.

Unit I Introduction to Artificial Intelligence 9 Hours

Introduction – Definitions - Foundations - History – State of Art – Intelligent Agents: Agents and Environments – The concept of Rationality - Nature of Environments - Structure of Agents - Problem Solving agents

Unit II Solving Problems by Searching 9 Hours

Searching for Solutions – Uninformed Search Strategies : Breadth First, Uniform Cost, Depth First, Depth Limited, Iterative Deepening, Bidirectional Search – Comparison of Uninformed Search Strategies - Informed Search strategies : Greedy BFS, A* search – Optimality of A* - Memory Bounded Heuristic Search – Heuristic Functions

Unit III Real Time Searching 9 Hours

Local search algorithms and Optimization Problems – Local Search in Continuous Spaces - Online search agents - Adversarial search – Optimal decision in games - Alpha – Beta Pruning – Imperfect Real Time Decisions - Constraint Satisfaction Problem – Inference in CSPs - Backtracking search for CSP.

Unit IV Knowledge and Reasoning 9 Hours

Logical Agents – Knowledge Based Agents - Propositional Logic – Theorem Proving - Resolution - Forward and Backward chaining – Agents Based on Propositional Logic - First Order Logic - Syntax and Semantics of FOL - Using First Order Logic - Knowledge Engineering in FOL - Inference in FOL - Unification and Lifting - Forward and Backward chaining – Resolution.

Unit V Planning 9 Hours

Classical Planning - Planning as State space search - Planning and acting in Real world and Non deterministic domains - Hierarchical planning – Multi-agent planning.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Describe the types and behavior of problem solving agents	Apply
CO2: Compare the efficiency of various searching techniques in solving a problem	Apply
CO3: Apply real time searching technique to solve the given problem	Apply
CO4: Apply Inference rules to the given Knowledge Base for theorem proving	Apply
CO5: Choose the appropriate planning technique to solve the given problem	Apply

Text Book(s):

T1. Stuart J. Russell, Peter Norvig, "Artificial Inteligence – A modern Approach", 3rd Edition, Pearson Education Inc., 2021.

Reference Book(s):

R1. Saroj Kaushik, " Artificial Intelligence", Cengage Learning, 2019.

R2. Lavika Goel, "Artificial Intelligence – Concepts and Applications", Wiley, 2021.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	1	3	1	-	2	3	3
CO2	3	2	2	1	1	-	-	1	3	1	1	2	3	3
CO3	3	2	2	1	1	1	-	1	3	1	1	2	3	3
CO4	3	2	2	1	1	1	-	1	3	1	1	2	3	3
CO5	3	2	2	1	2	1	-	1	3	1	1	2	3	3

High-3; Medium-2; Low-1

Course Code: 19ADCN1403		Course Title: Operating System Principles	
Course Category: Professional Core		Course Level: Practice	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Pre-requisites

- NIL

Course Objectives

The course is intended to:

1. Describe the components of operating systems and its services
2. Solve process scheduling and synchronization problems
3. Compare different memory management techniques
4. Develop solutions for free space management
5. Summarize various administrative tasks in Linux environment

Unit I Introduction 9 Hours

Computer System Organization– Operating System Operations – Kernel Data Structures – Operating Systems Structures: System Components, Operating System Services, System calls, System Programs – Process Concepts: Process Scheduling, Operation on Process, CoOperating process, Inter Process Communication.

Unit II Process Management 10 Hours

CPU scheduling: Scheduling Algorithms – Process Synchronization: The Critical Section Problem, Peterson's Solution, Hardware Support for Synchronization, Mutex Locks, Semaphores, Monitors – Classical problems of Synchronization – Deadlock: Deadlock Characterization – Methods for handling Deadlocks: Deadlock Prevention, Avoidance, Detection and Recovery from Deadlock.

Unit III Memory Management 9 Hours

Main Memory: Contiguous Memory Allocation, Paging, Structure of Page Table, Swapping –Virtual Memory: Demand paging, Copy-on-write, Page Replacement Algorithms, Allocation of Frames, Thrashing.

Unit IV File Systems 9 Hours

Mass Storage System: Disk Structure, Disk Attachment, Disk Scheduling – File System Interface: File Concepts, Access methods, Directory Structure, File Protection – File System Implementation: File System Structure and Operations, Directory Implementation, Allocation methods, Free Space Management.

Unit V Case Study – Linux 8 Hours

Design Principles – Kernel Modules – Process Management – Scheduling – Memory Management – File Systems – Input and Output – Inter-process Communication – Network Structure – Security.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO 1: Describe the components of operating systems and its services based on system calls	Understand
CO 2: Solve process scheduling and synchronization problems using algorithms	Apply
CO 3: Compare different memory management techniques using allocation schemes	Apply
CO 4: Develop solutions for free space management using file systems and disk scheduling concepts.	Apply
CO 5: Summarize various administrative tasks in Linux environment using its components and services	Understand

Text Book(s):

T1. AviSilberschatz, Galvin. P.B. and Gagne. G. "Operating System Concepts", 10th Edition, John Wiley & Sons, 2018.

Reference Book(s):

R1. Andrew S. Tanenbaum, "Modern Operating Systems", 4th Edition, Pearson Education, 2015.

R2. William Stallings, "Operating Systems Internals and Design Principles", 9th Edition, Pearson Education, 2018.

Web References:

1. MIT open course on Operating System Engineering: http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-828-operating-system-engineering-fall-2012/
2. Bell's Course Notes on Operating Systems Processes: https://www2.cs.uic.edu/~jbell/CourseNotes/OperatingSystems/3_Processes.html
3. NPTEL course on Operating System Fundamentals: https://nptel.ac.in/courses/106/105/106105214/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	-	-
CO2	3	2	2	2	2	1	1	2	3	2	1	1	3	1
CO3	3	2	2	2	2	1	1	2	3	2	-	1	3	1
CO4	3	2	2	2	2	1	1	2	3	2	1	1	3	1
CO5	2	1	-	-	-	-	-	1	-	1	-	1	-	-

High-3; Medium-2; Low-1

Course Code: 19ADCN1404	Course Title: Object Oriented Software Development		
Course Category: Professional Core		Course Level: Practice	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Pre– requisites

- Fundamentals of Programming

Course Objectives

The course is intended to:

1. Impart the knowledge on Software Life cycle models.
2. Derive the requirements for a Software system.
3. Analyze classes with appropriate relationships.
4. Design classes, interfaces and subsystems.
5. Develop functional object oriented software.

Unit I Software Process 9 Hours

Software Process Structure – Software Development Process Models – Agile Development – Understanding Requirements.

Unit II Requirements Modeling 8 Hours

Unified Modeling Language – Architecture – Unified Process – Requirements Workflow – Defining Requirements – Use Case Modeling – Actor and Use Case Generalization – Use Case Relationships.

Unit III Analysis Modeling 10 Hours

Analysis Workflow – Classes and Objects – Finding Analysis Classes – Relationships – Inheritance and Polymorphism – Analysis Packages – Use Case Realization – Activity Diagrams.

Unit IV Design Modeling 9 Hours

Design Workflow – Design Classes – Refining Analysis Relationships – Interface and Subsystems – Design Realization – Basic and Advanced State Charts.

Unit V Implementation, Testing & Deployment 9 Hours

Implementation Workflow – Components – Software Testing Strategies – Testing Conventional Applications – Testing Object Oriented Applications – Deployment.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Impart the knowledge on Software Life cycle models for Software development process	Understand
CO 2: Derive the requirements for a Software system through Requirement Engineering process	Apply
CO 3: Analyze classes with appropriate relationships in problem statement using activity diagrams	Apply
CO 4: Design classes, interface and subsystems by using Interaction and State diagrams	Apply
CO 5: Develop functional object oriented software, test it with necessary deployment techniques	Apply

Text Books:

T1. Roger. S. Pressman and Bruce R. Maxim, "Software Engineering – A Practitioner's Approach", 8th Edition, McGraw Hill, 2015.

T2. Jim Arlow, Ila Neustadt, "UML2 and The Unified Process: Practical Object Oriented Analysis and Design", Pearson Education, 2015.

Reference Books:

R1. Craig Larman, "Applying UML and Patterns: An Introduction to Object Oriented Analysis and Design and Iterative Development", 3rd Edition, Addison Wesley Professional, 2015.

R2. Ian Sommerville, "Software Engineering", 9th Edition, Pearson Education Asia, 2011.

Web References:

1. Roger S.Pressman online learning Center URL:http://www.mhhe.com/engcs/compsci /pressman/
2. NPTEL Course on Object Oriented Analysis and Design URL:http:/nptel.ac.in/courses/106105153/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	1	-	1	-	1	2	1	-	-
CO2	3	2	1	1	1	2	2	1	-	1	2	1	3	1
CO3	3	2	1	1	1	2	2	1	-	1	2	1	3	1
CO4	3	2	1	1	1	2	2	1	-	1	2	1	3	1
CO5	3	2	1	1	1	2	2	1	-	1	2	1	3	1

High– 3; Medium– 2; Low– 1

Course Code: 19ADCN3401	Course Title: Intelligent systems - I Laboratory		
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week) 0: 0: 4	Credits:2	Total Contact Hours:60	Max Marks:100

Pre-requisites

- Object Oriented Programming with Java

Course Objectives

The course is intended to:

1. Identify the types of data to be pre-processed
2. Generate association rules and cluster the data
3. Analyze the type of search technique
4. Develop AI application

List of Exercises

1. Identification of characteristic of data and perform data pre-processing techniques for any given dataset.
2. Perform data Classification using Decision Tree on the given data set
3. Identification of frequent item set and generation of association rules using Apriori algorithm
4. Cluster the given data set using K-Means clustering algorithm
5. Visualize and analyze the results for the given dataset using different types of charts.
6. Implementation of Breadth First and Depth First searching techniques
7. Implementing state space search algorithms
   - Hill climbing algorithms
   - A* algorithm
8. Demonstrate the Min-Max algorithm
9. Knowledge representation and inference using first order logic
10. Develop Simple AI applications

Suggested list (not limited to)

Chat bot creation, Smart assistants, Natural language processing tools,

Travel booking agent etc..,

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1 :Identify the types of data to be pre-processed for the given dataset	Apply
CO2: Generate association rules and cluster the data for the given data set	Apply
CO3: Analyze the type of search technique over the given scenario.	Analyze
CO4: Develop AI application to interact with environment	Apply

Reference (s):

R1. Stuart J. Russell, Peter Norvig, "Artificial Intelligence – A modern Approach", 3rd Edition, Pearson Education Inc., 2021.

R2. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", 3rd Edition, Elsevier, 2014.

Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	2	1	2	3	2	1	2	3	3
CO2	3	2	2	2	2	2	2	2	3	2	1	2	3	3
CO3	3	3	2	2	2	2	3	2	3	2	1	2	3	3
CO4	3	2	2	2	2	2	3	2	3	2	1	2	3	3
CO5	3	2	2	2	2	2	1	2	3	2	1	2	3	3

High-3; Medium-2; Low-1

Course Code: 19ADPN6401	Course Title: Mini Project		
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week) 0: 0: 4	Credits:2	Total Contact Hours:60	Max Marks:100

Course Objectives

The course is intended to:

1. Identify solution to simple engineering problems.

2. Use knowledge of science and engineering and engineering tools to solve simple problems relevant to the discipline.

The objective of Project is to enable the student to take up investigative study in the broad field of Artificial Intelligence and Data Science, to solve relevant social/environmental/ethical issues on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment will normally include:

1. Survey and study of published literature on the assigned topic.
2. Working out a preliminary Approach to the Problem relating to the assigned topic
3. Conducting Analysis, Design, Implementation/Modeling /Simulation.
4. Preparing a Written Report of the Study/Work
5. Final Presentation before a departmental committee.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1 : Design, develop and implement solutions using relevant modern tools to simple engineering problems that are relevant to the discipline	Apply
CO2: Work in teams performing different roles for effective accomplishment of project goals following ethical practices.	Apply
CO3: Communicate the process, methods and materials, findings, results and solutions through reports and presentations in appropriate forums.	Apply
CO4: Demonstrate the use of prior knowledge of science and engineering and engineering tools to formulate, analyze and investigate problems systematically.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	3	-	3	3	3	-	-	-	-	3	3	3
CO2	-	-	-	-	-	-	-	3	3	-	3	-	-	-
CO3	3	3	-	3	-	3	3	-	-	-	-	3	3	3
CO4	-	-	-	-	-	-	3	-	-	3	-	-	-	-

High-3; Medium-2; Low-1

Semester V

Course Code: 19ADCN1501		Course Title: Exploratory Data Analysis	
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Data Mining

Course Objectives

The course is intended to:

1. Outline the fundamentals of exploratory data analysis
2. Identify the appropriate method for data and information visualization
3. Make use of time series dataset to analyze univariate data
4. Apply bivariate data analysis for various dataset
5. Utilize visualization techniques for multivariate and time series data

Unit I Exploratory Data Analysis 9 Hours

EDA fundamentals - Visual Aids for EDA - Data transformation techniques-merging database - reshaping and pivoting - transformation techniques - Grouping datasets - Dataaggregation – Pivot tables and cross-tabulations.

Unit II Visualizing using Matplotlib 9 Hours

Importing Matplotlib – Histograms – legends – colors – subplots – text and annotation customization – three dimensional plotting - Geographic data with basemap – Visualization with Seaborn.

Unit III Univariate Analysis 9 Hours

Introduction to Single variable: Distributions and Variables - Numerical Summaries of Level and Spread - Scaling and Standardizing – Inequality - Smoothing Time Series.

Unit IV Bivariate Analysis 9 Hours

Relationships between Two Variables - Percentage Tables - Analyzing Contingency Tables - Handling Several Batches - Scatterplots and Resistant Lines – Transformations.

Unit V Multivariate And Time Series Analysis 9 Hours

Introducing a Third Variable - Causal Explanations - Three-Variable Contingency Tables and Beyond - Longitudinal Data – Fundamentals of TSA – Visualizing – Grouping – Resampling.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Outline the fundamentals of exploratory data analysis using various data transformation techniques	Apply
CO2: Identify the appropriate method for data and information visualization using Matplotlib	Apply
CO3: Experiment with univariate data to analyze time series dataset	Apply
CO4: Make use of appropriate transformation techniques to analysis bivariate dataset	Apply
CO5: Utilize visualization techniques for analyzing multivariate and time series data	Apply

Text Book(s):

T1. Suresh Kumar Mukhiya, Usman Ahmed, "Hands-On Exploratory Data Analysis with Python", Packt Publishing, 2020. (Unit-1)

T2. Jake Vander Plas, "Python Data Science Handbook: Essential Tools for working with Data", Oreilly, 1st Edition, 2016. (Unit-2)

T3. Catherine Marsh, Jane Elliott, "Exploring Data: An Introduction to Data Analysis for Social Scientists", Wiley Publications, 2nd Edition, 2008. (Unit-3,4&5)

Reference Book(s):

R1. Eric Pimpler, Data Visualization and Exploration with R, GeoSpatial Training service, 2017.

R2. Claus O. Wilke, "Fundamentals of Data Visualization", O'reilly publications, 2019.

R3. Matthew O. Ward, Georges Grinstein, Daniel Keim, "Interactive Data Visualization: Foundations, Techniques, and Applications", 2nd Edition, CRC press, 2015.

Web References:

1. Coursera content on Exploratory Data :https://www.coursera.org/learn/exploratory-data-analysis
2. NPTEL course content: https://nptel.ac.in/courses/110106064
3. Online courses for EDA: https://analyticsindiamag.com/8-online-courses-for-exploratory-data-analysis/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	-	1	-	1	1	1	-	2	2	3	1
CO2	2	1	1	-	1	-	1	1	1	-	2	2	3	2
CO3	2	1	1	-	1	-	1	1	1	-	2	2	3	2
CO4	2	1	1	-	1	-	1	1	1	-	2	2	3	2
CO5	2	1	1	-	1	-	1	1	1	-	2	2	3	2

High-3; Medium-2; Low-1

Course Code: 19ADCN1502	Course Title: Artificial Intelligence - II		
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week) 3: 0: 0	Credits: 3	Total Contact Hours:45	Max. Marks: 100

Pre-requisites

- Artificial Intelligence- I

Course Objectives

The course is intended to:

1. Explain probabilistic reasoning foruncertainty factors
2. Apply probabilistic temporal processes on probabilistic reasoning models
3. Discuss utility theory and Sequential decision problems
4. Apply Statistical Learning algorithms on complex probabilistic research areas
5. Examine reinforcement learning model and robotics for real time AI problems

Unit I Probabilistic Reasoning I 9 Hours

Acting under uncertainty – Bayesian inference – naïve Bayes models - Probabilistic reasoning – Bayesian networks – exact inference in BN – approximate inference in BN – causal networks.

Unit II Probabilistic Reasoning II 9 Hours

Probabilistic reasoning over time – time and uncertainty – inference in temporal models – Hidden Markov Models – Kalman filters – Dynamic Bayesian networks, Probabilistic programming.

Unit III Decisions under Uncertainty 9 Hours

Basis of utility theory – utility functions – Multiattribute utility functions – decision networks –value of information – unknown preferences-Sequential decision problems – MDPs – Multiagent environments – non-cooperative game theory – cooperative game theory – making collective decisions.

Unit IV Learning Probabilistic Models 9 Hours

Statistical Learning – Learning with complete data: Maximum likelihood parameter learning with discrete, continuous, Bayesian, naive bayes models – Learning with hidden variables - learning The EM Algorithm.

Unit V Reinforcement Learning and Robotics 9 Hours

Learning from rewards – passive reinforcement learning – active reinforcement learning – generalization in reinforcement learning – inverse reinforcement learning – applications -Robots – robotic perception – planning movements – reinforcement learning in robotics – robotic frameworks - applications of robotics - Philosophy, ethics, and safety of AI – the future of AI.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Outline uncertainty factors with Probabilistic and Bayesian models	Understand
CO2: Apply probabilistic reasoning models on uncertain knowledge with probabilistic temporal processes	Apply
CO3: Make use of utility theory and Sequential decision problems for uncertain environments	Apply
CO4: Illustrate Statistical Learning algorithms on complex probabilistic models for active area of research	Apply
CO5: Examine reinforcement learning model and for real time applications using RIL algorithms	Apply

Text Book(s):

T1. Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", 3rd Edition, Pearson Education, 2021.

Reference Book(s):

R1. Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2007

R2. Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence", McGraw Hil, 2008

R3. Patrick H. Winston, "Artificial Intelligence", 3rd Edition, Pearson Edition, 2006

R4. Deepak Khemani, "Artificial Intelligence", Tata McGraw Hill Education, 2013

Web References:

1. A beginner's guide to artificial intelligence and machine learning: https://developer.ibm.com/articles/cc-beginner-guide-machine-learning-ai-cognitive/
2. NPTEL course content on Applied Accelerated Artificial Intelligence: https://onlinecourses.nptel.ac.in/noc22_cs83

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	1	-	1	1	1	1	2	3	2
CO2	3	2	1	1	-	1	-	1	1	1	1	2	3	2
CO3	3	2	1	1	-	1	-	1	1	1	1	2	3	2
CO4	3	2	1	1	-	1	1	1	1	1	1	2	3	2
CO5	3	2	1	1	-	1	1	1	1	1	1	2	3	2

High-3; Medium-2; Low-1

Course Code: 19ADCN2501	Course Title: Computer Networking		
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week) 3: 0: 2	Credits:4	Total Contact Hours:75	Max. Marks:100

Pre-requisites

- Digital System Design
- Computer Architecture

Course Objectives

The course is intended to:

1. Characterize the functionalities of network layers
2. Differentiate various encoding and medium access coordination services
3. Design a network with appropriate addressing
4. Illustrate the functionalities of transport layer protocols
5. Demonstrate the working principles of application layer protocols.

Unit I Network Components 8 Hours

Network Requirements – Components – Architecture – Socket implementation – Bandwidth and Latency – Delay X Bandwidth product – Application Performance needs.

Unit II Link Layer 9 Hours

Connection Perspectives – Encoding (NRZ, NRZI, Manchester, 4B/5B) – Framing: (PPP, HDLC, SONET) – Error Detection (Parity, Internet Checksum, CRC) – Reliable transmission – Multi Access Networks.

Unit III Network Layer 9 Hours

Internet Protocol (IP) – Service Model – Global Addresses – Datagram Forwarding in IP – Subnetting and Classless Addressing – ARP – DHCP – ICMP – Routing protocols: RIP andOSPF – IPv6 – Mobile IP.

Unit IV Transport Layer 9 Hours

UDP: Segment format, Applications – TCP: Segment Format, Connection Establishment and Termination– TCP Congestion Control – Congestion Avoidance Mechanisms.

Unit V Application Layer 9 Hours

Electronic Mail: SMTP, MIME, IMAP – World Wide Web: HTTP – Web Services – Infrastructure Services: Domain Name System, Simple Network Management Protocol – Firewalls.

List of Exercises **30 Hours**

1. Implementation of TCP/UDP socket programming
2. Implementation of Sliding Window Protocol
3. Simulation of IEEE LAN topologies
4. Implementation of Routing Protocols with Router configuration
5. Implementation of TCP congestion control algorithms
6. Implementation of SNMP

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Characterize the functionalities of various layers in network architecture	Understand
CO2: Differentiate various encoding and medium access coordination services for node– to– node data transmission	Apply
CO3: Design a network with appropriate addressing using subnetting and routing algorithms	Apply
CO4: Illustrate the functionalities of transport layer protocols for reliable data transmission	Apply
CO5: Demonstrate the working principles of application layer protocols for end– to– end communication	Apply

Text Book(s):

T1. Larry L. Peterson and Bruce S. Davie, "Computer Networks – A Systems Approach",6th Edition, Morgan Kaufmann Publishers, 2019.

Reference Book(s):

R1. James F. Kurose, Keith W. Ross, "Computer Networking – A Top Down Approach Featuring the Internet", 7th Edition, Pearson Education, 2017.

R2. William Stallings, "Data and Computer Communication", 10th Edition, Pearson Education, 2013.

Web References:

1. NPTEL Course Content: http://nptel.ac.in/courses/106106091/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	-	1	1	1	-	1	1	1	-	-	2	-
CO2	2	1	-	2	2	2	-	2	3	3	-	2	2	-
CO3	2	1	-	2	2	2	-	2	3	3	-	2	2	-
CO4	2	1	-	2	2	2	-	2	3	3	2	2	2	-
CO5	2	1	-	2	2	2	-	2	3	3	2	2	2	-

High-3; Medium-2; Low-1

Course Code: 19ADCN3501	Course Title: Exploratory Data Analysis Laboratory		
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week) 0: 0: 4	Credits:2	Total Contact Hours:60	Max. Marks:100

Pre-requisites

- Python Programming for Data Engineers Laboratory

Course Objectives

The course is intended to:

1. Utilize the preprocessing techniques for identified datasets
2. Build the appropriate method for data and information visualization
3. Make use of time series dataset to analyze univariate and bivariate data
4. Develop a project for an application using data analysis technique

List of Exercises:

1. Perform exploratory data analysis (EDA) on with datasets like email data set. Export al your emails as a dataset, import them inside a pandas data frame, visualize them and getdifferent insights from the data.
2. Working with Numpy arrays, pandas data frames , basic plots using Matplotlib.
3. Explore various variable and row filters in R for cleaning data. Apply various plot features in R on sample data sets and visualize.
4. Perform Time Series Analysis and apply the various visualization techniques.
5. Perform Data Analysis and representation on a Map using various Map data sets with Mouse Rollover effect, user interaction, etc.
6. Build cartographic visualization for multiple datasets involving various countries of the world;states and districts in India etc
7. Perform EDA on Wine Quality Data Set.
8. Use a case study on a data set and apply the various EDA and visualization techniques andpresent an analysis report.
9. Mini project.
10. Mini project.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Utilize the preprocessing techniques for identified datasets using python library function and R Programming	Understand
CO2: Build the appropriate method for data and information visualization using Matplotlib, seaborn and basemap library function	Apply
CO3: Make use of time series dataset to analyze univariate and bivariate data using scipy	Apply
CO4: Develop a project for an application for data analysis of real time dataset	Apply

Reference Book(s):

R1. Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data", Oreilly, 1st Edition, 2016.

R2. Suresh Kumar Mukhiya, Usman Ahmed, "Hands-On Exploratory Data Analysis with Python", Packt Publishing, 2020.

R3. Catherine Marsh, Jane Elliott, "Exploring Data: An Introduction to Data Analysis for social Scientists", Wiley Publications, 2nd Edition, 2008.

Web References:

1. Coursera content on Exploratory Data : https://www.coursera.org/learn/exploratory-data-analysis
2. NPTEL course content: https://nptel.ac.in/courses/110106064

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	2	2	-	-	2	3	2	-	1	3	1
CO2	3	2	-	2	2	-	-	2	3	2	-	1	3	1
CO3	3	2	2	2	2	-	1	2	3	2	1	1	3	1
CO4	3	2	2	2	2	-	1	2	3	2	1	1	3	1

High-3; Medium-2; Low-1

Course Code: 19ADCN3502	Course Title: Intelligent Systems - II Laboratory		
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week) 0: 0: 4	Credits:2	Total Contact Hours:60	Max. Marks:100

Pre-requisites

- Intelligent systems - I Laboratory

Course Objectives

The course is intended to:

1. Develop the bayesian belief networks and HMM
2. Classify the data using naïve bayes classifier
3. Build the Gaussian mixture model
4. Construct the reinforcement learning model for real time applications

List of Exercises:

1. Implement Bayesian Belief networks
2. Implement Hidden Markov Models
3. Implement EM algorithm for HMM
4. Implement decision problems for various real-world applications
5. Design a Naïve Bayes classifier to classify the given dataset
6. Implement Gaussian mixture models
7. Implement EM algorithm for Gaussian mixture model
8. Implement the Reinforcement learning for various reward based applications
9. Mini project
10. Mini project

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Develop the uncertainty factors using bayesian belief networks and HMM	Apply
CO2: Classify the data using Naïve Bayes classifier for various real-world applications	Apply
CO3: Build the Gaussian mixture model for time series data Modeling	Apply
CO4: Construct the reinforcement learning model for real time AI Problems	Apply

Reference Book(s):

R1. Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach”,3rd Edition, Pearson Education, 2021.

Web References:

1. NPTEL Course Content: http://nptel.ac.in/courses/106106091/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	-	-	2	-	2	-	1	3	1
CO2	3	2	2	2	2	1	-	2	-	2	-	1	3	1
CO3	3	2	2	2	2	1	-	2	3	2	1	1	3	1
CO4	3	2	2	2	2	1	-	2	3	2	1	1	3	1

High-3; Medium-2; Low-1

Course Code: 19PSHG6501		Course Title: Employability Skills 1: Teamness and Interpersonal Skills (common to all B.E/B.Tech programmes)	
Course Category: Humanities		Course Level: Introductory	
L:T:P(Hours/Week) 0: 0: 2	Credits:1	Total Contact Hours:30	Max. Marks:100

Pre-requisites

- NIL

Course Objectives

The course is intended to:

1. Demonstrate effective communicative attributes and facilitate presentation and public speaking skills
2. Identify and explore the true self and handle negatives
3. Develop interpersonal skills and to groom as a professional
4. Educate the importance of Nonverbal skill set to attain perfection
5. Build teamness and its ethics to facilitate corporate working

Unit I Effective Communication & Presentation Skills 6 Hours

Barriers of Communication – Fear of English – Handling Social Factors – Handling Psychological Factors – Handling Practical Problems – Do's & Don'ts– Effective Presentation –Presentation – Importance of Presentation – Slide orientation – Introduction in a presentation– Styles of a slide – Slide Templates – Font, color, Background – Graph Diagrammatic representation – Delivery of presentation – Body Language &Gestures – Verbal Attributes – Communication – Handling stammers and breaks – Handling fear of stage – Maintaining Confidence – Content delivery methods – Do's and Don'ts in a presentation – Tips to handle it – Effective Conclusion.

Unit II Positive Attitude & Handling Rejections 6 Hours

A,B,C's of Attitude – Influencing Factors – Individual Factors – Character Comparison – Strategies to Handle ourselves– Benefits of Positive Attitude – Do's& Don'ts – Handling Rejections – Identifying Negativities – How to handle it ?? – Necessary changes – To do List
– Creating One's self – Self Qualifiers.

Unit III Interpersonal Skills 6 Hours

Introduction to Single variable: Distributions and Variables - Numerical Summaries of Level and Spread - Scaling and Standardizing – Inequality - Smoothing Time Series.

Unit IV Body Language, Dressing &Grooming 6 Hours

Unconscious Physical moments – Metrics of Body Language – Good Posture – Head Motion – Facial Expression – Eye contact – Gestures – Dressing – Grooming & Outlook – Necessity of good Body Language.

Unit V Team Ethics 6 Hours

Team Ethics – Necessity of Team Work – Teams Everywhere – Benefits of team culture – Reason for team failure – Conflicts – Handling Conflicts – Being a team player – Work difference from college.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Demonstrate effective communicative attributes as part of their skills and facilitate presentation & public speaking skills	Apply
CO2: Identify and explore the true self and handle negatives	Apply
CO3: Develop interpersonal skills and to groom as a professional	Apply
CO4: Explain the importance of Nonverbal skill set to attain Perfection	Understand
CO5: Build teamness and its ethics to facilitate corporate working	Apply

Text Book(s):

T1: John C Maxwell, " The 17 Indisputable Laws of Teamwork: Embrace Them and Empower Your Team", Harper Collins Leadership Publishers, 2013.

Reference Book(s):

R1: Patrick Lencioni, " The Five Dysfunctions of a Team: A Leaders Fable" Jossey Bass Publishers, 2006.

R2: Malcolm Gladwell, "Talking to Strangers: What We Should Know about the People WeDon't Know", Penguin Publishers, 2019.

R3: Harvey Segler, "Body Language: Discovering & Understanding the Psychological Secrets behind reading & Benefiting from Body Language" ,Kindle Edition, 2016.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	3	-	1	-	-
CO2	-	-	-	-	-	-	-	-	2	-	-	1	-	-
CO3	-	-	-	-	-	-	-	-	2	-	1	1	-	-
CO4	-	-	-	-	-	-	-	-	-	1	-	1	-	-
CO5	-	-	-	-	-	-	-	2	1	-	-	1	-	-

High-3; Medium-2; Low-1

Semester VI

Course Code: 19ADCN2601	Course Title: Big Data Analytics Techniques		
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week) 3: 0: 2	Credits: 4	Total Contact Hours: 75	Max. Marks:100

Pre-requisites

- Database Systems

Course Objectives

The course is intended to:

1. Illustrate the concepts of big data and analytics
2. Understand about map reduce programming model to run big data applications
3. Explain various operations on NoSQL databases
4. Describe about classification algorithms
5. Demonstrate different clustering algorithms and recommendation systems

Unit I Fundamentals of Big Data **7 Hours**

Database Evolution – Evolution of Big data – Best Practices for Big data Analytics – Big data characteristics – Big data use cases – Characteristics of big data Applications.

Unit II Understanding Big Data Storage **9 Hours**

High Performance Architecture – HDFS – Map reduce and YARN – Map reduce Programming Model.

Unit III NoSQL Data Management for Big Data **9 Hours**

NoSQL Databases: Schema less Models – Increasing Flexibility for Data Manipulation– Key Value Stores – Document Stores – Tabular Stores – Object Data Stores – Graph Databases- Hive – Sharding – Hbase.

Unit IV Classification **10 Hours**

Classification: Decision Trees – The General Algorithm – Decision Tree Algorithms – Evaluating a Decision Tree – Decision Trees in R – Naïve Bayes – Bayes Theorem – NaïveBayes Classifier .

Unit V Clustering and Recommendation System **10 Hours**

Clustering – K-means – Use Cases – Overview of the Method – Determining the Number of Clusters – Diagnostics – Recommendation System: Collaborative Recommendation– Content Based Recommendation – Knowledge Based Recommendation – Hybrid Recommendation Approaches.

List of Exercises **30 Hours**

1. Implementation of commands in HDFS
2. Implement Map Reduce application for word counting on Hadoop cluster
3. Implement simple operations in NoSQL databases
4. Perform advanced analysis using hiveql
5. Implement classification algorithm using map reduce in Hadoop
6. Implement K-means clustering using map reduce in Hadoop

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Describe fundamental concepts of big data and analytics	Understand
CO2: Apply Map reduce programming model to run big data applications	Apply
CO3: Use NoSQL databases for processing large scale data	Apply
CO4: Apply classification algorithms on large scale data	Apply
CO5: Demonstrate different clustering algorithms and recommendation systems using map reduce	Apply

Text Book(s):

T1. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013 (Unit-I, II &III).

T2. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012 (Unit- IV, V).

Reference Book(s):

R1. EMC Education Services, “Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data”, Wiley Publishers,2015.

R2. Tom White, “Hadoop: The Definitive Guide”, O’Reilly Publication and Yahoo! Press, 4th Edition, 2015.

R3. Seema Acharya, Subhashini Chellappan, “Big Data and Analytics”, Wiley Publication, 2015.

Web References:

1. NPTEL Course content URL: https://onlinecourses.nptel.ac.in/noc20_cs92/
2. Hadoop complete reference URL: https://hadoop.apache.org
3. Tutorial on Hive URL:https://data-flair.training/blogs/apache-hive-tutorial/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	2	3	1	-	1	-	-
CO2	3	2	2	2	2	1	1	2	3	2	1	1	3	2
CO3	3	2	2	2	2	1	1	2	3	2	1	1	3	2
CO4	3	2	2	2	2	1	1	2	3	2	1	1	3	2
CO5	3	2	2	2	2	1	1	2	3	2	1	1	3	2

High-3; Medium-2; Low-1

Course Code: 19ADCN2602	Course Title: Deep Learning Techniques		
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week) 3: 0: 2	Credits: 4	Total Contact Hours: 75	Max. Marks:100

Pre-requisites

- NIL

Course Objectives

The course is intended to:

1. Develop feed forward and deep Networks
2. Describe various regularization techniques of deep neural network
3. Design a Convolutional Neural Network
4. Apply Recurrent Neural Network
5. Apply deep learning concepts

Unit I Deep Networks **9 Hours**

Neural Networks-Training Neural Networks-Activation Functions-Loss Functions-Hyper parameters - Deep Networks-Architectural Principles of Deep Networks-Building Blocks of Deep Networks.

Unit II Regularization for Deep Learning **9 Hours**

Parameter Norm Penalties-Norm Penalties as Constrained Optimization-Regularization and Under-Constrained Problems-Dataset Augmentation-Noise Robustness-Semi supervised Learning-Multitask Learning-Early Stopping-Bagging.

Unit III Convolutional Neural Networks **9 Hours**

The convolution operation-Motivation-Pooling-Variants of basic convolution function-Structured outputs-Convolution algorithms-Unsupervised features.

Unit IV Sequence Modeling **9 Hours**

Recurrent Neural Networks-Bidirectional RNNs- Encoder-Decoder Sequence to sequence Architectures-Deep Recurrent Networks-Recursive Neural Networks- The Long Short Term Memory-Explicit Memory.

Unit V **Appli**

Performance Metrics-Large Scale Deep Learning-Computer Vision-Speech Recognition-Natural Language Processing.

List of Exercises **30 Hours**

1. Implement a Feed-Forward Network
2. Implement an Image Classifier using CNN
3. Implement a Simple LSTM
4. Implement an Opinion Mining in Recurrent Neural network
5. Implement an Autoencoder.
6. Implement an Object Detection using CNN

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Develop feed forward and deep Networks for solving simple problems	Apply
CO2: Describe various regularization techniques of deep neural network	Apply
CO3: Design a Convolutional Neural Network for solving real timeproblems	Apply
CO4: Apply Recurrent Neural Network in various real time problems	Apply
CO5: Apply deep learning concepts for any target application	Apply

Text Book(s):

T1. Ian Good Fellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2017.

T2. Josh Patterson, “Deep Learning: A Practitioner's Approach”, O'Reilly Media, 2017.

Reference Book(s):

R1. Aurélien Géron, “Hands-On Machine Learning with Scikit-Learn and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems”, O'Reilly Media, 2017.

R2. Santosh Kumar K, Kogent Solutions, “JDBC Servelts and JSP Includes JSF and Design Patterns Black Book”, Dream Tech Press, 2008.

R3. Sheng Liang,” The Java Native Interface: Programmer's Guide and Specification”, Addison-Wesley, 1999.

Web References:

1. NPTEL course content: https://onlinecourses.nptel.ac.in/noc23_cs112/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	1	1	1	-	-	1	2	3	-	1	2	3
CO2	1	2	1	1	2	2	1	1	2	3	-	1	2	3
CO3	1	2	1	1	2	2	1	1	2	3	1	1	2	3
CO4	2	2	1	1	2	2	1	1	2	3	1	1	2	3
CO5	1	2	1	1	2	2	1	1	-	1	1	1	2	3

High-3; Medium-2; Low-1

Course Code: 19ADCN3601	Course Title: Cloud Technologies Laboratory		
Course Category: Professional Core		Course Level: Practice	
L:T:P(Hours/Week) 1: 0: 4	Credits: 3	Total Contact Hours: 75	Max. Marks:100

Pre-requisites

- Computer Networking

Course Objectives

The course is intended to:

1. Implement the core concept of Cloud Computing
2. Demonstrate the concept of Virtualization Techniques
3. Deploy application in Amazon Web Services
4. Create application using Google App Engine

Unit I Cloud Computing **3 Hours**

Defining a Cloud - Cloud Computing Reference Model - Characteristics and Benefits.

Unit II Virtualization **4 Hours**

Virtualization and Cloud Computing - Types of Virtualization: Full Virtualization and Para Virtualization.

Unit III Amazon Web Services **4 Hours**

Cloud Architectural Model - Types of Clouds - AWS Overview - Application Migration - EC2 Instance - S3 Bucket - Deployment.

Unit IV Google App Engine **4 Hours**

Google App Engine Overview - Web services - Google Big Query - Microsoft Azure.

List of Exercises **60 Hours**

1. Configure a network adapter connection in Oracle Virtual Box.
2. Install Single node / Multi node setup using DevStack.
3. Perform various operations of Cloud using Horizon.
4. Perform application migration using AWS.
5. Deploy Java Web Application using Amazon-EC2.
6. Host a Static Website using Amazon S3.
7. Deploy web application in AWS.
8. Implement database migration in Google App Engine.
9. Store and Query massive Datasets using Google Cloud Big Query.
10. Create a web application using Microsoft Azure.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Implement the Core Concept of Cloud Computing by using Cloud setup software	Apply
CO2: Demonstrate the concept of Virtualization Techniques using Virtualization Software	Apply
CO3: Deploy application in cloud platform using Amazon Web Services	Apply
CO4: Create application in cloud platform using Google App Engine	Apply

Text Book(s):

T1. Dr. Rajkumar Buyya, Dr. Christian Vecchiola, Dr. S Thamarai Selvi, "Mastering Cloud Computing", Tata McGraw Hill Education Private Limited, 2013.

T2. Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra, "Cloud Computing – From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.

Reference Book(s):

R1. Ronald L. Krutz, Russell Dean Vines, "Cloud Security A comprehensive guide to Secure Cloud Computing", Wiley India Pvt. Ltd, Reprint 2016.

R2. Dr. Kris Jamsa, "Cloud Computing: SaaS, PaaS, Iaas, Virtualization, Business Models, Mobile, Security and more", Jones & Bartlett Learning, 2013.

Web References:

1. Virtualization: http://www.ibm.com/developerworks/library/os - Cloud - virtual1/
2. Cloud Architecture: http://docs.hpCloud.com/pdf/static/Eucalyptus_3.4/faststart-guide-

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	1	1	1	1	1	-	-	-	1	1	1
CO2	1	1	1	1	1	1	1	1	2	3	1	1	1	1
CO3	1	1	1	-	-	-	1	1	2	3	1	1	1	1
CO4	2	2	2	2	2	2	2	1	2	3	2	2	2	2

High-3; Medium-2; Low-1

Course Code: 19ADPN6601	Course Title: Innovative and Creative Project		
Course Category: Project		Course Level: Practice	
L:T:P (Hours/Week) 0: 0: 4	Credits: 2	Total Contact Hours: 60	Max Marks: 100

Pre-requisites:

- Nil

Course Objectives

The course is intended to:

1. Identify solutions to complex engineering problems
2. Use the knowledge of Science, engineering & engineering tools to solvecomplex problems relevant to the discipline

The objective of Project is to enable the student to take up investigative study in the broad field of Computer Science and Engineering, to solve relevant social/environmental/ethical issues on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment will normally include:

1. Survey and study of published literature on the assigned topic
2. Working out a preliminary Approach to the Problem relating to the assigned topic
3. Conducting Analysis, Design, Implementation/Modeling /Simulation
4. Preparing a Written Report of the Study/Work
5. Final Presentation before a departmental committee

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Design, develop and implement solutions to complex engineering problems using appropriate tools and techniques	Apply
CO2: Work in teams performing different roles for effective accomplishment of project goals following ethical practices	Apply
CO3: Demonstrate the use of prior knowledge of science and engineering critical reflection and continuous learning to formulate, analyze and investigate problems systematically	Apply
CO4: Communicate the process, methods and materials, findings, Results and solutions through reports, presentations and other media inappropriate forums	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	3	3	3	3	3	-	-	-	3	-	3	3
CO2	-	-	-	-	-	-	-	3	3	-	3	-	-	-
CO3	3	3	-	3	-	3	3	-	-	-	-	3	3	3
CO4	-	-	-	-	-	-	-	-	-	3	-	-	-	-

High– 3; Medium– 2; Low– 1

Course Code: 19PSHG6601	Course Title: Employability Skills 2: Campus to Corporate		
Course Category: Humanities		Course Level: Introductory	
L:T:P (Hours/Week) 0: 0: 2	Credits: 1	Total Contact Hours: 30	Max Marks: 100

Pre– requisites

- Nil

Course Objectives

The course is intended to:

1. Understand emotions and necessity to handle it to evolve as an effective socialanimal
2. Build effective resumes to project the positives to be employable
3. Facilitate working in a collaborative work environment and to engage in healthy agreements for building person's professional facet
4. Formulate the growth attribute to outperform, initiate and grow in professional arena
5. Explain time management and impart leadership skills

Unit I Emotional Intelligence **6 Hours**

Nature of Emotions – Importance of EI – EQ vs IQ – Behavioral difference between EQ &IQ – Acquiring Emotional Intelligence – Benefits of high EI – Steps to develop EI – Role ofEI in Interviews.

Unit II Resume Preparation **6 Hours**

Importance of Resume – Good Resume – Planning Resume – Organizing Resume – Spell check – Benefits of good resume – Resume Writing.

Unit III Group Discussion **6 Hours**

Purpose of GD – Prerequisites of GD– Benefits of GD – Features of GD – Do's &Don'ts inGD – Accept Criticism &Feedback– Accepting Suggestions– GD Phrases – Effective Introduction & Conclusion – Preferred Etiquette of GD.

Unit IV Interview Etiquette (Netiquette) **6 Hours**

Definition of Interview– Types of Interview — Prior interview – Know the Company — Employer's perspective in interview – Non Verbal etiquette – Dressing – Verbal Communication in Interview – Facing Rejection in Interview – Do's & Don'ts in an Interview – Common Interview Questions – Handling Stress Questions – Handling Telephonic Interviews.

Unit V Leadership Skills & Time Management **6 Hours**

Leadership – Leadership Traits – Leadership styles – Types of Leaders – Qualities of aleader — Developing Perspectives.

Time Management – Necessity of Time Management – Types of time – Estimation of time – Process of Time management – Efficient utilization of Time – Time wasting culprits – Tips to manage time – Goal setting in Time Management.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Understand the emotions and necessity to handle them	Apply
CO2: Build effective resumes to project the positives to be employable	Apply
CO3: Facilitate collaborative work environment and to engage in healthyagreements for building person's professional facet	Understand
CO4: Formulate the growth attribute to outperform, initiate and grow in professional arena	Apply
CO5: Explain time management and impart leadership skills	Understand

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	1	-	1	-	1	-	-
CO2	-	-	-	-	-	-	-	-	-	2	-	1	-	-
CO3	-	-	-	-	-	-	-	-	1	1	-	1	-	-
CO4	-	-	-	-	-	-	-	-	1	-	-	1	-	-
CO5	-	-	-	-	-	-	-	1	-	-	1	1	-	-

High– 3; Medium– 2; Low– 1

Semester VII

Course Code: 19ADCN2701	Course Title: Computational Foundation for Robotics		
Course Category: Professional Core		Course Level: Mastery	
L: T: P (Hours/Week) 3: 0: 2	Credits: 4	Total Contact Hours: 75	Max. Marks:100

Pre-requisites

- NIL

Course Objectives

The course is intended to:

1. Understand and discuss the fundamental elementary concepts of Robotics
2. Provide insight into different types of robots
3. Explain intelligent module for robotic motion control
4. Educate on various path planning techniques
5. Illustrate the working of innovative robotic devices

Unit I Robotics and Automation 9 Hours

Robotics and Automation- laws of robot - Brief history of robotics - basic components of robot - robot specifications - safety measures in robotics - safety measures in robotics - advantages and disadvantages of robots.

Unit II Robot Anatomy and Motion Analysis 9 Hours

Anatomy of a Robot - Robot configurations: polar – cylindrical – Cartesian - jointed arm configurations - Degrees of freedom: types of movements – vertical - radial - rotational traverse – Introduction to direct and inverse kinematics.

Unit III Robot Drives and End Effectors 9 Hours

Robot drive systems: Hydraulic - Pneumatic - Electric drive systems - classification of end effectors - gripper force analysis - gripper design - Robot control types: limited sequence control - point-to-point control - playback with continuous path control - intelligent control.

Unit IV Path Planning 9 Hours

Path Planning - Joint space technique - Use of P-degree polynomial - Cartesian space technique - straight line and circular paths - position and orientation planning.

Unit V Robotics Applications 9 Hours

Material Handling: Pick and Place - Medical - Agricultural and Space applications - Case Studies: Applying Green IT Strategies - Applications to a Home – Hospital - Packaging Industry - Telecom Sector.

List of Exercises 30 Hours

1. Experiment with different path planning algorithms within RoboDK to optimize the robot's movement.
2. Create a scenario where the robot needs to navigate through a cluttered environment. Use RoboDK's collision detection features to test and optimize collision avoidance algorithms.
3. Design a simulation where the robot interacts with a dynamic environment.
4. Integrate virtual sensors into the simulation using RoboDK.
5. Set up a scenario involving multiple robots collaborating on a task. Use RoboDK to simulate the coordination and communication between these robots, ensuring they work together efficiently and avoid collisions.
6. Simulate and program complex industrial tasks offline using RoboDK. Experiment with different robot configurations and end-of-arm tooling to optimize the production process without affecting the real manufacturing environment.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Identify the need and importance of robotics and automation in various engineering applications	Apply
CO2: Describe the components and anatomy of robotic system in the automated application system	Apply
CO3: Interpret the various path planning techniques and analyze different motions of robotics system	Analyze
CO4: Compare and Contrast the suitable drives and end-effectors for a given robotics application	Analyze
CO5: Apply robotics concept to automate the monotonous and hazardous tasks and categorize various types of robots based on the design and applications in real world scenarios	Evaluate

Text Book(s):

T1. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education, 2009. (Unit I & II)

T2. Mikell P. Groover et. al., "Industrial Robots - Technology, Programming and Applications", McGraw Hill, Special Edition, (2012). (Unit III & IV).

T3. Ganesh S Hegde, "A textbook on Industrial Robotics", University science press, 3rd edition, 2017. (Unit V)

Reference Book(s):

R1. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India Pvt. Ltd., 2006.

R2. Fu K S, Gonzalez R C, Lee C.S.G, "Robotics: Control, Sensing, Vision and Intelligence", McGraw Hill, 1987.

Web References:

1. NPTEL course content: https://onlinecourses.nptel.ac.in/noc20_de11/
2. Robotics process automation: https://www.edureka.co/blog/what-is-robotic-process-automation/
3. NVIDIA Research Breakthrough Puts New Spin on Robot Learning: https://blogs.nvidia.com/blog/eureka-robotics-research/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	1	1	-	-	-	-	-	-	1	-
CO2	-	3	-	-	1	1	-	-	1	-	-	1	1	-
CO3	3	-	-	-	2	1	-	-	1	-	-	2	2	-
CO4	-	3	-	-	3	2	-	-	2	-	-	2	3	1
CO5	-	-	-	3	3	2	-	-	2	-	-	2	3	1

High-3; Medium-2; Low-1

Course Code: 19ADCN1701	Course Title: Data Security		
Course Category: Professional Core		Course Level: Mastery	
L:T: P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Probability and Statistics for Data Science

Course Objectives

The course is intended to:

1. Develop a comprehensive understanding of data security principles
2. Enhance critical thinking skills for identifying and mitigating data security risks
3. Gain efficiency in applying data security best practices in real-world scenarios

Unit I Cryptosystems 8 Hours

Security Problems in computing – security goals – threats and attacks. – Services and mechanisms - symmetric key cryptography - substitution cipher – transposition cipher - stream ciphers and block ciphers – Beaufort and DES Family – Product ciphers – Lucifer and DES.

Unit II Asymmetric Key Cryptographic Systems 9 Hours

Advanced Encryption Standard (AES) – cryptanalysis of symmetric key cryptosystems - Public key cryptography – RSA cryptosystem - Attacks on RSA – Hellman and ElGamal Elliptical Curve Cryptography.

Unit III Hash Functions and Digital Signature 9 Hours

Cryptographic Hash Functions: Message Authentication-Secure Hash Algorithm (SHA512), Message authentication codes: Authentication requirements - HMAC - CMAC - Digital signatures - Elgamal Digital Signature Scheme - Digital signature standard - Key Management and Distribution: Symmetric Key Distribution Using Symmetric & Asymmetric Encryption-Distribution of Public Keys- Kerberos- X.509 Authentication Service- Public Key Infrastructure.

Unit IV Transport Layer Security 9 Hours

Transport Layer security – SSL - Network layer security – IPSec - Secure Coding – Malicious and non-Malicious program errors - OWASP/SANS Top Vulnerabilities - Malwares – types of Malwares - Buffer Overflows – defense mechanisms- Incomplete mediation - XSS - Redirection - Inference – Application Controls - Evaluation of Security Systems.

Unit V Data Base Security **10 Hours**

Security Requirements – Database Administration Security – SQL Injection And Exploitation And Defense Methods - Database Roles and Permissions – Object Level Security - Sensitive Data – Multilevel Databases- Case Study on Data Security.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Apply various classical encryption techniques in analyzing the real world security breaches	Apply
CO2: Compare and contrast various cryptographic techniques and explain their appropriate use cases for data security	Analyze
CO3: Demonstrate a comprehensive understanding of cryptographic principles and their applications in securing data transmission	Analyze
CO4: Identify and mitigate the data security risks associated with database management systems	Apply
CO5: Develop a strong foundation in data security principles that allows continuously learning and adapting to evolving threats and technologies	Evaluate

Text Book(s):

T1. Stallings William. Cryptography and Network Security: Principles and Practice, 8th Edition, Pearson Education, 2020 (Unit I & II)

T2. Padmanabhan T R, Shyamala C and Harini N, "Cryptography and Security", Wiley Publications 2011. (Unit III & V)

T3. John R. Vacca, "Network and Systems Security" Syngress Imprint of Elsevier, 2014. (Unit IV)

Reference Book(s):

R1. Harold F. Tipton, Micki Krause Nozaki,, "Information Security Management Handbook, Volume 6, 6th Edition, 2016.

R2. Basta, Alfred, and Melissa Zgola. "Database Security". Cengage Learning, 2011.

R3. Stuart McClure, Joel Scrambray, George Kurtz, "Hacking Exposed", McGraw- Hill, 7th Edition, 2012.

R4. Behrouz A Forouzan, Debdeep Mukhopadhyay, Cryptography And network security, 3rd Edition, . McGraw-Hill Education, 2015

Web References:

1. NPTEL course :https://nptel.ac.in/courses/106106129
2. NIST develops cybersecurity standards, guidelines, best practices, and other resources: https://www.nist.gov/topics/cybersecurity.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	1	-	-	-	-	-	-	-	-
CO3	-	3	-	-	-	1	-	-	-	-	-	-	-	-
CO4	2	-	-	-	-	2	-	-	2	2	-	-	2	1
CO5	-	-	-	3	-	2	-	-	3	3	-	3	3	1

High-3; Medium-2; Low-1

Course Code: 19ADCN3701	Course Title: Business Intelligence and Analytics Laboratory		
Course Category: Professional Core		Course Level: Practice	
L:T: P (Hours/Week) 0: 0: 4	Credits: 2	Total Contact Hours: 60	Max. Marks:100

Pre-requisites

- Python Programming for Data Engineers Laboratory

Course Objectives

The course is intended to:

1. Analyse data to generate information and knowledge that lead to informed decisions for businesses
2. Identify distinct customer segments based on purchasing behaviour, demographics, or other relevant factors
3. Analyse sentiment on social media platforms to understand customer opinions
4. Evaluate employee performance and identify factors influencing productivity
5. Optimize the supply chain process to minimize the costs and improve efficiency

List of Exercises:

Introduction to Business Intelligence, Business Modeling and Analytics continues then

1. **Customer Segmentation Analysis:** Identify distinct customer segments based on purchasing behavior, demographics, or other relevant factors. Experiment: Use clustering algorithms (e.g., k-means) to group customers and analyze the characteristics of each segment.

2. **Churn Prediction:** Build a predictive model using machine learning algorithms to forecast customer churn and assess the impact of different variables.

3. **Sales Forecasting:** Utilize time series analysis and forecasting methods (e.g., ARIMA, Exponential Smoothing) to predict future sales trends.

4. **Sentiment Analysis on Social Media Data:** Use natural language processing (NLP) techniques to perform sentiment analysis on social media data related to your business.
5. **Fraud Detection: I**mplement anomaly detection algorithms to flag unusual patterns or transactions that may indicate fraudulent behavior.
6. **A/B Testing for Website Optimization:** Conduct A/B tests by randomly assigning users to different website versions and analyze user engagement metrics.
7. **Employee Performance Analysis:** Analyze employee data to identify correlations between performance metrics and various factors such as training, workload, or job
8. **Supply Chain Optimization:** Use data analytics to identify bottlenecks, optimize inventory levels, and enhance overall supply chain performance.
9. **Customer Lifetime Value Prediction:** Build a predictive model to estimate the future value of customers based on historical data.
10. **Market Basket Analysis:** Apply association rule mining algorithms (e.g., Apriori) to analyse transaction data and discover patterns in customer buying habits.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Apply segmentation techniques to customer data, utilizing factors and Gain proficiency in developing predictive models to forecast customer churn	Apply
CO2: Acquire the skills to build predictive models for sales forecasting using historical data, employing techniques such as time series analysis and to be proficient in leveraging social media analytics tools to analyze sentiments	Analyze
CO3: Develop expertise in implementing fraud detection mechanisms within business transactions, utilizing analytics and algorithms to identify and prevent fraudulent activities	Evaluate
CO4: Gain the ability to assess and evaluate employee performance metrics, and Acquire skills in optimizing supply chain processes, leveraging data analytics to minimize costs	Create

Reference Book(s):

R1. Drew Bentley, "Business Intelligence and Analytics", 2017, Library Press, ISBN: 978-1-9789-2136-8

R2. Ramesh Sharda, Dursun Delen, Efraim "Business Intelligence, Analytics, And Data Science: A Managerial Perspective", 4th Edition ,Global Edition, 2018.

R3. Pradip Kumar Das, Hrudaya Kumar Tripathy, Shafiz Affendi Mohd yusuf, "Privacy and Security Issues in Big Data, An Analytical View on Business Intelligence" Springer 2021.

Web References:

1. Business-Intelligence: https://learn.g2.com/business-intelligence
2. Tutorial Business Intelligence and Analytics : https://www.academia.edu/40285447/Business_Intelligence_and_Analytics
3. DIKW https://www.youtube.com/watch?v=u9DoQ9gY4z4
4. A quick, conceptual, and practical introduction of BI by Jared Hillam (Intricity), from a traditional perspective: https://www.youtube.com/watch?v=LFnewuBsYiY
5. BI intro video by LearnItFirst: https://www.youtube.com/watch?v=LhZX0MAYKp8
6. Data Analytics for Beginners Video Tutorial: https://www.youtube.com/watch?v=mm2A5tKVIpg

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	1	1	-	-	-	-	-	1	2	2
CO2	-	3	-	-	1	1	-	-	-	-	-	1	2	2
CO3	-	-	-	3	1	1	-	-	-	1	-	1	2	2
CO4	-	-	3	-	1	1	-	-	2	1	-	1	2	2

High-3; Medium-2; Low-1

Course Code: 19ADCN3702	Course Title: Data Security Laboratory		
Course Category: Professional Core		Course Level: Practice	
L:T: P (Hours/Week) 0: 0: 4	Credits: 2	Total Contact Hours: 60	Max. Marks: 100

Pre-requisites

- Probability and Statistics for Data Science

Course Objectives

The course is intended to:

1. Understand the knowledge on Substitution and Transposition Techniques
2. Apply symmetric encryption algorithms and asymmetric encryption principles for practical applications, ensuring data confidentiality and integrity
3. Implement the message digest and Digital Signature Standard (DSS) to ensuring data integrity and authenticity
4. Explore automated attack and penetration testing tools for vulnerability assessment, malware detection and removal to enhance system security awareness and defence capabilities

List of Exercises:

1. Perform encryption, decryption using the following substitution Technique:

a) Caesar cipher b) Play Fair cipher c) Hill Cipher d) Vigenere cipher

2. Perform encryption, decryption using the following Transposition Technique:

a) Rail Fence b) Row & Column Transformation

3. Apply DES algorithm for practical applications.
4. Apply AES algorithm for practical applications.
5. Implement RSA algorithm using HTML & Javascript.
6. Implement the Diffie-Hellman key exchange algorithm for a given problem.
7. Calculate the message digest of a text using SHA-1 algorithm.
8. Implement the signature scheme Digital signature standard.
9. Automated Attack and penetration Tools Exploring N-stalker, a vulnerability Assessment Tool.
10. Defeating Malware-Building Trojans and Rootkit Hunter.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply knowledge of encryption and decryption techniques to secure data transmission and storage effectively	Apply
CO2: Analyze security requirements and select appropriate encryption algorithms and techniques to address specific security challenges	Analyze
CO3: Develop critical thinking and analytical skills to resolve data security issues effectively	Evaluate
CO4: Explore automated attack and penetration tools to identify and mitigate security vulnerabilities in systems	Create

Reference Book(s):

R1. Stallings William. Cryptography and Network Security: Principles and Practice, 8th Edition, Pearson Education, 2020

R2. Padmanabhan T R, Shyamala C and Harini N, "Cryptography and Security", Wiley Publications 2011.

R3. John R. Vacca, "Network and Systems Security" Syngress Imprint of Elsevier, 2014.

Web References:

1. NPTEL course :https://nptel.ac.in/courses/106106129
2. NIST develops cybersecurity standards, guidelines, best practices, and other resources: https://www.nist.gov/topics/cybersecurity.
3. Tools link

i) Snort - https://www.snort.org/downloads

ii) N-Stalker - https://www.nstalker.com/products/editions/free/download/

iii) GMER - http://www.gmer.net/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	1	1	-	-	1	-	-	1	-	-
CO2	-	2	-	-	1	1	-	-	1	-	-	1	-	-
CO3	-	-	-	3	3	1	-	-	1	-	-	3	2	-
CO4	-	-	3		3	2	-	-	3	2	-	3	2	-

High-3; Medium-2; Low-1

Course Code: 19SHVG6001		Course Title: Entrepreneurship Development	
Course Category: Minor		Course Level: Basic	
L:T:P 1:0:0	Credits: 1	Total Contact Hours: 15	Max Marks:100

Course Objectives:

The course is intended to equip students with the entrepreneurial mindset, understand market, apply the process of problem solving, and Entrepreneurship ecosystem.

Entrepreneurship **15 Hours**

Entrepreneur- Types of Entrepreneurship-Problem identification-Opportunity Discovery-Explore Market, customer persona-customer segmentation, TAM,SOM,SAM- creating compelling value proposition- competitor analysis. Prototying- Types -Business model canvass-Idea pitching. Entrepreneurial eco system- Startups-Angel Investors, Venture Capitalist, Makers Space, Incubators, Accelerators-Financial models- Equity, Debt, Crowd funding.

Course Outcomes	Cognitive Level
At the end of the course, students will able to	
CO1: Pitch an Idea for a problem with understanding entrepreneurial ecosystem.	Apply

Text Book(s):

1. Robert D.Hisrich, Micheal P. Peters, Dean A. Shepherd, Sabayasachi (2020), Entrepreneurship,McGrawHill, 11th Edition.
2. Donald F Kuratko,Entrepreneurship: Theory, Process, Practice with MindTap, 11th Edition.

Web References:

1. https://wadhwanifoundation.org/our-programs/ignite/
2. https://academy.forge-iv.co/#academia

Course Code: 19ADPN6801		Course Title: Project	
Course Category: Project		Course Level: Practice	
L:T:P(Hours/Week) 0: 0: 16	Credits:8	Total Contact Hours:240	Max Marks: 200

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Propose a sound technical knowledge of their selected project topic.
2. Formulate problem identification, and solution.
3. Combine the knowledge, skills and attitudes of a professional engineer

The objective of Project is to enable the student to take up investigative study in the broad field of Artificial Intelligence and Data Science, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Propose a sound technical knowledge of their selected project topic by formulating proper methodology.	Create
CO2: Formulate problem identification and solution to successful completion the project.	Create
CO3: Combine the knowledge, skills and attitudes of a professional engineer to formulate, analyze and investigate problems systematically.	Create

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

High-3; Medium-2; Low-1

Professional Elective Courses: Verticals

Vertical I - Security Essentials Electives

Course Code: 19ADEN1001	Course Title: Ethics in Artificial Intelligence		
Course Category: Professional Elective		Course Level: Mastery	
L: T :P(Hours/Week) 3: 0 : 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Define and differentiate between morality and ethics in AI
2. Interpret the knowledge on ethical harms and ethical initiatives in AI
3. Evaluate international ethical initiatives in AI and analyze ethical concerns related to specific applications
4. Apply ethical principles to AI standards and regulation
5. Analyse the knowledge of real time application ethics, issues and its challenges

Unit I Morailty ethics and AI **9 Hours**

Definition of morality and ethics in AI - Impact on society - Impact on human psychology Impact on the legal system - Impact on the environment and the planet - Impact on trust.

Unit II Ethical Initiatives in AI **9 Hours**

International ethical initiatives - Ethical harms and concerns - Case study: healthcare robots - Autonomous Vehicles - Warfare and weaponization.

Unit III AI Standards and Regulation **9 Hours**

Model Process for Addressing Ethical Concerns During System Design - Transparency of Autonomous Systems - Data Privacy Process - Algorithmic Bias Considerations - Ontological Standard for Ethically Driven Robotics and Automation Systems.

Unit IV Roboethics: Social and Ethical Implication of Robotics **9 Hours**

Robot - Roboethics - Ethics and Morality - Moral Theories - Ethics in Science and Technology - Ethical Issues in an ICT Society - Harmonization of Principles - Ethics and Professional Responsibility - Roboethics Taxonomy.

Unit V Challenges and Opportunities **9 Hours**

Challenges – Opportunities - ethical issues in artificial intelligence - Societal Issues Concerning the Application of Artificial Intelligence in Medicine – decision - making role in industries - National and International Strategies on AI.

Course Outcomes		Cognitive Level
At the end of this course, students will be able to:		
CO1:	Define key terms related to AI ethics and explain their significance in real-world AI applications	Understand
CO2:	Identify case studies involving AI technologies and potential ethical concerns.	Understand
CO3:	Make use of AI standards and Regulations for design of automation Systems	Apply
CO4:	Identify the social and ethical issues raised by Robot Ethics including the professional responsibilities	Apply
CO5:	Analyze the strengths and weaknesses of national and international strategies for regulating AI	Analyze

Text Book(s):

T1. Y. Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner, Ruth Larbey, Emma Weitk amp and Alan Winfield, "The ethics of artificial intelligence: Issues and initiatives", European Parliamentary Research Service Scientific Foresight Unit, March 2020. (Unit I,II & III)

T2. Patrick Lin, Keith Abney, George A Bekey," Robot Ethics: The Ethical and Social Implications of Robotics", The MIT Press, January 2014. (Unit IV & V)

Reference Book(s):

R1. Towards a Code of Ethics for Artificial Intelligence (Artificial Intelligence: Foundations, Theory, and Algorithms) by Paula Boddington, November 2017.

R2. Mark Coeckelbergh," AI Ethics", The MIT Press Essential Knowledge series, April 2020.

Web References:

1. Artificial Intelligence and Ethics: Sixteen Challenges and Opportunities: https://www.scu.edu/ethics/all-about-ethics/artificial-intelligence- and- ethics- sixteen-challenges- and- opportunities/

2. Ethical issues in artificial intelligence: https://www.weforum.org/agenda/2016/10/top- 10- ethical-issues- in- artificial-intelligence/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	1	-	1	1	1	1	2	2	1
CO2	3	2	1	1	-	1	-	1	1	1	1	2	2	1
CO3	3	-	-	-	-	1	-	1	1	1	1	2	2	1
CO4	3	2	1	1	-	1	-	1	-	-	-	2	2	1
CO5	3	2	1	1	-	1	-	1	1	1	1	2	2	1

High-3; Medium-2; Low-1

Course Code: 19ADEN1002	Course Title: Ethical Hacking		
Course Category: Professional Elective		Course Level: Mastery	
L: T :P(Hours/Week) 3: 0 : 0	Credits:3	Total Contact Hours:45	Max.Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Elucidate the various types of attacks, security threats and vulnerabilities
2. Explain the different foot printing, reconnaissance and scanning methods
3. Demonstrate the enumeration and vulnerability analysis method
4. Understand hacking options available in Web and wireless applications
5. Explore the options for network protection and to practice tools to perform ethical hacking to expose the vulnerabilities

Unit I Security and Penetration Testing **9 Hours**

Ethical Hacking - Role of Security and Penetration Testers - Penetration -Testing Methodologies - Laws of the Land - Overview of TCP/IP - Application Layer - Transport Layer - Internet Layer - Network and Computer Attacks - Malware - Protecting Against Malware Attacks.- Intruder Attacks - Addressing Physical Security.

Unit II Foot Printing, Reconnaissance And Scanning Networks **9 Hours**

Footprinting Concepts - Footprinting through Search Engines - Competitive Intelligence - Footprinting through Social Engineering - Footprinting Tools - Network Scanning Concepts – Port - Scanning Tools - Scanning Techniques - Scanning Beyond IDS and Firewall.

Unit III Enumeration And Vulnerability Analysis **9 Hours**

NetBIOS Enumeration – SNMP, LDAP, NTP, SMTP and DNS Enumeration - Vulnerability Assessment Concepts - Desktop and Server OS Vulnerabilities - Windows OS Vulnerabilities - Tools for Identifying Vulnerabilities in Windows - Linux OS Vulnerabilities- Vulnerabilities of Embedded Oss.

Unit IV System Hacking **9 Hours**

Hacking Web Servers - Web Application Components - Vulnerabilities - Tools for Web Attackers and Security Testers Hacking Wireless Networks - Components of a Wireless Network – Wardriving- Wireless Hacking - Tools of the Trade.

Unit V Network Protection Systems **9 Hours**

Access Control Lists. - Cisco Adaptive Security Appliance Firewall - Configuration and Risk Analysis Tools for Firewalls and Routers - Intrusion Detection and Prevention Systems – Network - Based andHost - Based IDSs and IPSs - Web Filtering - Security Incident Response Teams – Honeypots.

Course Outcomes		Cognitive Level
At the end of this course, students will be able to:		
CO1:	Understand the fundamentals of computer and network security, including common vulnerabilities, threats and attack vectors	Understand
CO2:	Develop knowledge in using ethical hacking tools and techniques to identify, assess, and mitigate security risks within a variety of systems and networks	Apply
CO3:	Demonstrate penetration testing and vulnerability assessments to assess the security posture of an organization's IT infrastructure	Apply
CO4:	Ethically exploit security weaknesses to demonstrate their potential impact and provide recommendations for remediation	Analyze
CO5:	Justify the need of independent learning for finding solutions for the real-world applications	Apply

Text Book(s):

T1. Michael T. Simpson, Kent Backman, and James E. Corley, "Hands-On Ethical Hacking and Network Defense, Course Technology", Delmar Cengage Learning, 2010. (Unit I,II & III)

T2. Patrick Engebretson,"The Basics of Hacking and Penetration Testing SYNGRESS",Elsevier, 2013. (Unit IV & V)

Reference Book(s):

R1. Justin Seitz "Black Hat Python: Python Programming for Hackers and Pentesters", 2014.

R2. Dafydd Stuttard and Marcus Pinto "The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws", second edition, Wiley Publication 2011.

Web References:

1. NPTEL Courses on Ethical Hacking: https://onlinecourses.nptel.ac.in/noc22_cs13/preview
2. COURSERA Courses on Ethical Hacking Esssentials: https://www.coursera.org/learn/ethical-hacking-essentials-ehe

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	1	-	1	1	1	1	2	3	2
CO2	3	2	1	1	-	1	-	1	1	1	1	2	3	2
CO3	-	-	-	-	-	1	-	1	1	1	1	2	3	2
CO4	3	2	1	1	-	1	-	1	-	-	-	2	3	2
CO5	3	2	1	1	-	1	-	1	1	1	1	2	3	2

High-3; Medium-2; Low-1

Course Code: 19ADEN1003	Course Title: Web Application Security		
Course Category: Professional Elective		Course Level: Mastery	
L: T : P(Hours/Week) 3: 0 : 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Understand the fundamental principles and concepts of web application security
2. Explore various security mechanisms and technologies used to protect web applications
3. Analyze real-world case studies and examples of web application security breaches
4. Evaluate different approaches to secure web application development
5. Discuss emerging trends and challenges in web application security for adapting security measures accordingly

Unit I Web Application Reconnaissance 9 Hours

The history of Software Security - Introduction to Web Application Reconnaissance - Recognizing Web Application Security Threats - Web Application Security - Web Servers - Secure Socket layer - Transport layer Security - Session Management - Input Validation.

Unit II Web Application Security Principles 9 Hours

Authentication: Access Control - Authentication Fundamentals - Two factor and three Factor Authentication - Web Application Authentication - Authorization: Access Control - Session Management - Securing Web Application Session Management.

Unit III Secure Development and Deployment 9 Hours

Web Applications Security - Security Testing - Security Incident Response Planning - Microsoft Security Development Lifecycle (SDL) - OWASP Comprehensive Lightweight Application Security Process (CLASP) - Software Assurance Maturity Model (SAMM).

Unit IV Secure API Development 9 Hours

API Security - Elements of API Security, Security mechanism, Natter API – Overview - Implementation - Securing Natter APIs: Addressing threats with Security Controls - Rate Limiting for Availability - Authentication to prevent spoofing – Encryption - Audit logging - Securing Session Cookies - Authentication in Web browsers - Token Based Authentication.

Unit V Hacking Techniques and Tools 9 Hours

Vulnerability Assessment Lifecycle - Vulnerability Assessment Tools: Cloud - based vulnerability scanners - Host - based vulnerability scanners - Network - based vulnerability scanners - Database - based vulnerability scanners - Types of Penetration Tests: External Testing - Web Application Testing - Internal Penetration Testing - SSID or Wireless Testing - Mobile Application Testing.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Identify the most common web application vulnerabilities andexplain the potential impact of these vulnerabilities	Understand
CO2: Demonstrate the ability to evaluate the effectiveness of different web application security mechanisms through real- world case studies	Apply
CO3: Design and implement secure authentication and authorization mechanisms for web applications	Apply
CO4: Demonstrate the ability to synthesize advanced techniques for securing web servers and databases in enterprise environments	Analyze
CO5: Design a secure web application prototype that incorporatesbest security practices throughout the development life cycle	Apply

Text Book(s):

T1. Andrew Hoffman,"Web Application Security: Exploitation and Counter measures for Modern Web Applications", O'Reilly Media, Inc,1st Edition, 2020. (Unit I & II)

T2. Bryan Sullivan, Vincent Liu, "Web Application Security: A Beginners Guide", The McGraw-Hill Companies, 2012. (Unit III & IV)

T3. Neil Madden, "API Security in Action", Manning Publications Co., NY, USA 2020.(Unit V)

Reference Book(s):

R1. Michael Cross, "Developer's Guide to Web Application Security", Syngress Publishing,Inc 2007.

R2. Ravi Das and Greg Johnson, "Testing and Securing Web Applications", Taylor & Francis Group, LLC, 2021.

R3. Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, "Gideon Lenkey, and Terron Williams Grey Hat Hacking: The Ethical Hacker's Handbook", 3rd Edition, The McGraw-Hill Companies, 2011.

Web References:

1. Web Application Security Vulnerabilities and How to prevent them in 2023: https://relevant.software/blog/web-application-security-vulnerabilities/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	1	-	1	1	1	1	2	2	1
CO2	3	2	1	1	-	1	-	1	1	1	-	2	2	1
CO3	3	2	1	1	-	1	-	1	1	1	-	2	2	1
CO4	3	2	1	1	-	1	-	1	1	1	-	2	2	1
CO5	3	2	1	1	-	1	-	1	1	1	1	2	2	1

High-3; Medium-2; Low-1

Course Code: 19ADEN1004	Course Title: Fundamentals of Computation		
Course Category: Professional Elective		Course Level: Mastery	
L: T :P(Hours/Week) 3: 0 : 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Data Structures and Algorithm Analysis –I &II

Course Objectives

The course is intended to:

1. Understand the theoretical foundations of computation in solving problems related to finite-state machines and regular languages
2. Analyze and design finite automata to model and solve problems
3. Explore regular languages and grammars to recognize and generate patterns in strings efficiently
4. Examine context-free languages and grammars for understanding structured data processing
5. Discuss Turing machines and computability theory leading to an understanding of the limits of computation and problem-solving in theoretical computer science

Unit I Finite Automata **9 Hours**

Automata - Computability – Complexity – Chomsky Hierarchy of Languages – Finite Automata – Finite Automata for Vending Machine – Non–determinism – Finite Automata with Epsilon Transitions – Equivalence of NFA and DFA – Minimization of DFA.

Unit II Regular Languages **9 Hours**

Regular Grammars – Regular Languages and Operations – Regular Expressions – Equivalence of Finite Automata and Regular Expressions: Thompson Construction – State Elimination Method – Closure Properties of Regular Languages – Pumping lemma for Regular Languages.

Unit III Context Free Languages **9 Hours**

Context Free Grammars – Derivations - Parse Tree and Ambiguity – Simplification of Grammars – Normal Forms – CNF – GNF – Pushdown Automata – Language Acceptance of PDA – Applications of PDA – Equivalence of Pushdown Automata and CFG – Closure Properties of Context Free Languages.

Unit IV Turing Machine **9 Hours**

Turing Machine – Language Acceptance – Techniques for Turing Machine Construction – Storage in Finite Control – Subroutine – Checking off Symbols – Multiple Tracks – Variants of Turing Machines – Universal Turing Machine.

Unit V Computability Theory **9 Hours**

Decidability: Decidable Languages – Undecidability – Reducibility: Undecidable Problems from Language Theory – Halting Problem – Post Correspondence Problem.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Define the concepts of automata, computability, complexity, and the Chomsky Hierarchy of Languages	Understand
CO2: Design a finite automata model to represent a problem and to analyze the model's behavior and correctness	Analyze
CO3: Compare and contrast different types of formal grammars and their capabilities to convert between regular expressions and finite automata	Apply
CO4: Explain the concept of a Turing Machine and its role in computability theory	Apply
CO5: Identify undecidable problems in language theory and to explain the significance of these problems in the context of computability	Understand

Text Book(s):

T1. John E.Hopcroft, Rajeev Motwani, Jeffrey D.Ullman, "Introduction to Automata Theory, Languages and Computation", 3rd Edition, Pearson Education Publishers, 2012. (Unit I, II & III)

T2. Michael Sipser, "Introduction to the Theory of Computation", 3rd Edition, Cengage Learning, 2013. (Unit IV & V)

Reference Book(s):

R1. Kamala Krithivasan, R. Rama, "Introduction to Formal Languages, Automata Theory and Computation", Pearson Education, 2009.

R2. K. L. P. Mishra, N. Chandrasekaran, "Theory of Computer Science: Automata, Languages and Computation", 3rd Edition, PHI, 2006.

Web References:

1. NPTEL Course Grammars and Natural Language Processing URL: http://nptel.ac.in/courses/106106049/
2. JFLAP tool – Home URL: www.jflap.org/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	1	-	-	-	-	1	2	2	1
CO2	3	2	1	1	-	1	-	1	1	1	1	2	2	1
CO3	3	2	1	1	-	1	-	1	1	1	1	2	2	1
CO4	3	2	1	1	-	1	-	1	1	1	1	2	2	1
CO5	3	2	1	1	-	1	-	1	1	1	1	2	2	1

High-3; Medium-2; Low-1

Course Code: 19ADEN2001	Course Title: Cryptographic Techniques in Network Security		
Course Category: Professional Elective		Course Level: Mastery	
L: T : P(Hours/Week) 2: 0 : 2	Credits:3	Total Contact Hours:60	Max. Marks:100

Pre-requisites

- Calculus and Transforms
- Discrete Mathematics for Artificial Intelligence

Course Objectives

The course is intended to:

1. Employ classical encryption techniques for providing confidentiality Service
2. Implement symmetric key algorithms for encrypting text and multimedia Data
3. Apply number theory concepts to design asymmetric key algorithms for providing confidentiality and key exchange services
4. Apply hash function and digital signature for protecting digital documents
5. Describe key management and user authentication protocols for providing key sharing and authentication services

Unit I Classical Encryption **6 Hours**

Basic concepts – Security attacks – services and mechanisms – Characteristics of good ciphers – Security Standards – Classical encryption techniques: Symmetric cipher– Substitution techniques and Transposition techniques.

Unit II Symmetric Ciphers **6 Hours**

Block cipher design principles – Data Encryption Standard (DES) – Fields and finite field arithmetic – Advanced Encryption Standard (AES) – Block cipher modes of operation. Principles of random number generation – random number generators – Stream ciphers – RC4.

Unit III Asymmetric Ciphers **6 Hours**

Number theory concepts: Euclidean algorithm – Modular arithmetic – Prime numbers – Fermat's and Euler's theorem – Discrete logarithms – Principles of public-key cryptosystems – RSA algorithm – Diffie-Hellman key exchange – ElGamal cryptographic system.

Unit IV Hash Function and Digital Signature **6 Hours**

Hash function: Applications – Requirements – Secure Hash Algorithm (SHA) – Message authentication codes: Requirements – functions – Hash based Message Authentication Codes (HMAC) – Digital signature: Properties – ElGamal digital signature scheme – Schnorr Digital Signature Scheme – Digital Signature Standard (DSS).

Unit V Key Management and Authentication **6 Hours**

Key management and distribution – X.509 certificate – Public key infrastructure – Kerberos protocol.

List of Exercises **30 Hours**

1. Implement various traditional Substitution and Transposition techniques (without using built-in package)
2. Implement DES and AES algorithms using Java built-in packages
3. Implement RSA algorithm using Java built-in packages
4. Develop Diffie-Hellman key exchange algorithm (without using built-in package)
5. Implementation of Hash Function using Java built-in packages
6. Implementation of Digital signature using Java built-in packages

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain the fundamental principles of cryptography for secure network communication	Understand
CO2: Analyze the most appropriate cryptographic techniques to real-world network security problems	Analyze
CO3: Implement and evaluate the basic cryptographic algorithms using a programming language to ensure their robustness	Apply
CO4: Design a secure communication protocol that utilizes appropriate cryptographic techniques	Apply
CO5: Evaluate the security vulnerabilities of existing cryptographic protocols and analyze the potential impact of vulnerabilities	Analyze

Text Book(s):

T1. William Stallings, "Cryptography and Network Security - Principles and Practices", 7th Edition, Pearson Education, 2017.

Reference Book(s):

R1. Behrouz A Forouzan and Debdeep Mukhopadhyay, "Cryptography and Network Security", 3rd Edition, Tata McGraw Hill, New Delhi, 2016.

R2. Atul Kahate, "Cryptography and Network Security", 3rd Edition, Tata Mcgraw Hill, New Delhi, 2017.

R3. Douglas R Stinson, "Cryptography - Theory and Practice", Chapman and Hall / CRC Press, New York, 2013.

Web References:

1. NPTEL Course Cryptography And Network Security URL: https://nptel.ac.in/courses/106/105/106105162/
2. Tutorials point Course Content on cryptography URL : https://www.tutorialspoint.com/cryptography/index.htm
3. Khan Academy Course Content on cryptography URL : https://www.khanacademy.org/computing/computer-science/cryptography

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	1	-	1	-	-	1	2	3	2
CO2	3	2	1	1	-	1	-	1	1	1	1	2	3	2
CO3	3	2	1	1	-	1	-	-	1	1	1	2	3	2
CO4	3	2	1	1	-	1	-	-	1	1	1	2	3	2
CO5	3	2	1	1	-	1	-	1	1	1	1	2	3	2

High-3; Medium-2; Low-1

Course Code: 19ADEN2002	Course Title: Blockchain Technology		
Course Category: Professional Elective		Course Level: Practice	
L:T :P(Hours/Week) 2: 0 : 2	Credits:3	Total Contact Hours:60	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Interpret the significance of decentralization
2. Demonstrate the concept of crypto currency
3. Develop smart contracts in ethereum network
4. Create a distributed ledger using hyper ledger fabric
5. Explore the challenges and trends using various blockchain projects

Unit I Fundamentals of Blockchain **6 Hours**

History of Blockchain – Types of Blockchain – Consensus – Decentralization using Block chain – Methods of Decentralization- Blockchain and Full Ecosystem Decentralization – Platforms for Decentralization-Decentralized Autonomous organization.

Unit II Crypto Currency And Smart Contracts **6 Hours**

Private key vs. Public key-Hash function-Secure Hash algorithms-Bitcoin – Digital Keys and Addresses – Transactions – Mining – Bitcoin Networks and Payments – Wallets – Alternative Coins – Theoretical Limitations – Bitcoin limitations– Smart Contracts – Ricardian Contracts.

Unit III Ethereum **6 Hours**

The Ethereum Network – Components of Ethereum Ecosystem – Ethereum Development tools and frameworks – Solidity Language.

Unit IV WEB3 and Hyperledger **6 Hours**

Introduction to Web3 – Contract Deployment – POST Requests – Development Frameworks – Hyperledger as a Protocol – The Reference Architecture – Hyperledger Fabric – Distributed Ledger.

Unit V Alternative Blockchains and Challenges **6 Hours**

Kadena – Ripple – Rootstock – Quorum – Multichain – Scalability – Privacy – Emerging trends – Other challenges – Blockchain Research – Notable Projects.

List of Exercises **30 Hours**

1. Implement a program to create your own Blockchain and analyse Blockchain security issues.
2. Implement a program to create the Wallets and track process of transactions in Cryptocurrency.
3. Develop smart contract on private Blockchain using Ethereum tools like Ganache and GO.
4. Create and deploy a business network on Hyperledger Composer Playground.
5. Implement a business network in Blockchain using hyperledger Fabric.
6. Develop a Blockchain based solution using Multichain for banking system.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Interpret the significance of decentralization using blockchain	Understand
CO2: Demonstrate the concept of crypto currency using Bitcoin	Apply
CO3: Develop smart contracts in ethereum network using solidity	Apply
CO4: Create a distributed ledger using hyperledger fabric for a web3 application	Apply
CO5: Explore the challenges and trends using various blockchain projects	Apply

Text Book(s):

T1. Kang – Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained", 2nd Edition, Packt Publishing, 2018.

Reference Book(s):

R1. Arshdeep Bahga, Vijay Madisetti, "Blockchain Applications: A Hands On Approach", VPT, 2017.

R2. Andreas Antonopoulos, Satoshi Nakamoto, "Mastering Bitcoin", O'Reilly, 2014.

R3. Roger Wattenhofer, "The Science of the Blockchain", CreateSpace Independent Publishing, 2016.

R4. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press, 2016.

Web References:

1. Blockchain Architecture Design and Use Cases: https://nptel.ac.in/courses/106105184

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	-	-
CO2	3	2	1	1	-	-	-	1	-	1	-	1	-	-
CO3	3	2	1	1	2	-	-	1	-	1	1	1	2	1
CO4	3	2	1	1	2	-	-	1	-	1	1	1	2	1
CO5	3	2	1	1	-	1	-	1	-	1	-	1	-	-

High-3; Medium-2; Low-1

Course Code: 19ADEN2003	Course Title: Network and Web Security		
Course Category: Professional Elective		Course Level: Mastery	
L: T :P(Hours/Week) 2: 0 : 2	Credits:3	Total Contact Hours:60	Max. Marks:100

Pre-requisites

- Computer Networking

Course Objectives

The course is intended to:

1. Describe intrusion detection techniques and firewalls
2. Apply IP security and Web security protocols
3. Identify suitable e-mail security protocols
4. Utilize wireless security protocols
5. Identify security services in cloud environment

Unit I Network Security 6 Hours

Threats in networks - Network security controls – Intruders - Intrusion detection - Password management - Malicious software - Firewalls: Characteristics – Types - Firewall basing - Firewall location and configurations.

Unit II IP and Web Security 6 Hours

IP security: IP security policy - Encapsulating Security Payload - Web security: Secure Socket Layer - Transport Layer Security – HTTPS - Secure Shell (SSH).

Unit III Electronic Mail Security 6 Hours

Store and forward - Security services - Source authentication - Message integrity - Non-Repudiation - Proof of submission and delivery - Pretty Good Privacy (PGP) - Secure/Multipurpose Internet Mail Extension (S/MIME).

Unit IV Wireless Network Security 6 Hours

IEEE 802.11 wireless LAN overview - IEEE 802.11i wireless LAN security - Wireless Application Protocol - Wireless Transport Layer Security - WAP end-to-end security.

Unit V Security In Cloud Computing 6 Hours

Cloud Information Security Objectives - Cloud Security Services - Cloud Security Design Principles - Penetration Testing Tools and Techniques - Cloud Computing Risk Issues: CIA Triad - Privacy and Compliance Risks - Threats to Infrastructure - Data and Access Control - Cloud Service Provider Risks.

List of Exercises 30 Hours

1. Demonstrate Intrusion Detection System using any simulation tool (Example: Snort).
2. Setup a honey pot and monitor it on the available network (Example: KF Sensor).
3. Implement packet filtering firewall. (Example: Using jpcap package)
4. Perform wireless audit on an access point or a router and decrypt WEP and WPA. (Example : Net Stumbler)
5. Implement the encryption and decryption process used in PGP protocol.
6. Study and analyze the various security protocols used to secure the transport layer for a gmail account.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Describe intrusion detection techniques and firewalls for preventing security attacks	Understand
CO2: Apply IP security and web security protocols for providing data security services	Apply
CO3: Identify suitable security protocols for securing e-mail services	Apply
CO4: Utilize wireless security protocols for protecting data in wireless environment	Apply
CO5: Identify security services in cloud environment for secure data sharing	Apply

Text Book(s):

T1. William Stallings, "Cryptography and Network Security – Principles and Practice", 7th Edition, Pearson Education, 2017.(Unit I,II & III)

T2. Ronald L Krutz and Russell Dean Vines, "Cloud Security- A Comprehensive Guide to Secure Cloud Computing", Wiley, 2016. (Unit IV & V)

Reference Book(s):

R1. Bernard Menezes, "Network Security and Cryptography", Cengage Learning, 2014.

R2. Behrouz A Forouzan and Debdeep Mukhopadhyay, "Cryptography and Network Security", 3rd Edition, Tata McGraw Hill, New Delhi, 2016.

R3. Bruce Schneier, "Applied Cryptography: Protocols, Algorithms and Source Code in C", John Wiley and Sons, 2013.

Web References:

1. NPTEL Course contents on Cryptography and Network Security
   URL:http://nptel.ac.in/courses/106105162/
2. Learn Internet Security at Tutorial point
   URL: https://www.tutorialspoint.com/internet_security/index.htm
3. Network Security Tutorial of APNIC.
   URL: https://training.apnic.net/wp-content/uploads/sites/2/2016/12/TSEC01.pdf

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	1	1	2	2	1	1	1	-	-
CO2	3	2	2	2	2	1	1	2	3	2	1	1	3	2
CO3	3	2	2	2	2	1	1	2	3	2	1	1	3	-
CO4	3	2	2	2	2	-	-	-	-	2	1	1	3	2
CO5	3	2	2	2	2	1	1	2	3	2	1	1	3	2

High-3; Medium-2; Low-1

Course Code: 19ADEN2004	Course Title : Digital Forensics		
Course Category: Professional Elective		Course Level: Mastery	
L : T : P(Hours/Week) 2 : 0 : 2	Credits:3	Total Contact Hours:60	Max.Marks:100

Pre-requisites

- NIL

Course Objectives

The course is intended to:

1. Discuss the cybersecurity policy and its evolution
2. Summarize the scope and laws of Computer Forensics
3. Explain the process of acquiring and documenting Computer Forensic Evidenc
4. Describe the steps involved in investigating Network Forensics
5. Comprehend the steps involved in investigating Mobile Forensics

Unit I Cyber Security **6 Hours**

Cyber Security — Cyber Security policy — Domain of Cyber Security Policy: Laws and Regulations - Enterprise Policy - Technology Operations - Technology Configuration - Strategy Versus Policy — Cyber Security Evolution: Productivity – Internet - E-commerce - Counter Measures - Challenges.

Unit II Scope and Laws of Computer Forensics **6 Hours**

Scope of Computer Forensics: Introduction - Types of Evidence - Investigator skills - Importance - History of Computer Forensics - Law Enforcement Training- Operating Systemsand File Systems.

Unit III Acquiring Evidence and Documentation **6 Hours**

Lab requirements - Private sector computer forensics laboratories - Computer Forensics laboratory requirements - Extracting evidence from a device - Documenting the Investigation.

Unit IV Network Forensics **6 Hours**

Tools - Networking devices - Network forensics - OSI Model - Advanced Persistent Threat - Investigating a Network Attack.

Unit V Mobile Forensics **6 Hours**

Cellular Network - Handset Specifications - Mobile Operating Systems - Standard Operating Procedures for Handling Handset Evidence - Handset Forensics – Case Studies.

List of Exercises **30 Hours**

1. Study of Computer Forensics and different tools used for forensic investigation.
2. Live Forensics Case Investigation using Autopsy.
3. How to Recover Deleted Files using Forensics Tools.
4. Find Last Connected USB on your system (USB Forensics).
5. How to Extracting Browser Artifacts
6. Study the steps for hiding and extract any text file behind an image file/ Audio file using Command Prompt.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain the principles and methodologies of digital forensics evidence acquisition	Apply
CO2: Analyze the digital evidence using forensic tools to identify artifacts and reconstruct timelines	Analyze
CO3: Explain the process of acquiring and documenting Computer Forensic Evidence for investigation	Apply
CO4: Recommend appropriate digital forensics techniques for different scenarios	Apply
CO5: Articulate the importance of continuous learning in the evolving field of digital forensics and identify strategies for staying current with advancements	Apply

Text Book(s):

T1. Jennifer L. Bayuk, J. Healey, P. Rohmeyer, Marcus Sachs , Jeffrey Schmidt, Joseph Weiss, "Cyber Security Policy Guidebook", John Wiley & Sons, 2017. (Unit I,II & III)

T2. Darren R. Hayes, "A Practical Guide to Computer Forensics investigations", Pearson,2014. (Unit IV & V)

Reference Book(s):

R1. Bill Nelson, Amelia Phillips, Christopher Steuart, "Computer Forensics and Investigations",6th Edition, Cengage learning, 2018.

R2. James Graham, Ryan Olson, Rick Howard, "Cyber Security Essentials", Auerbach Publications 2017.

R3. Kevin Mandia, Chris Prosise, Matt Pepe, "Incident Response and Computer Forensics",3rd Edition, Tata McGraw -Hill, 2014.

Web References:

1. Basic Research in Cyber Security: http://dst.gov.in/basic-research-cyber-security
2. Developing a Computer Forensics Team: https://www.sans.org/reading-room/whitepapers/incident/developing- computer-forensics-team-628
3. Advanced Executive Program in Cyber Security: https://www.cybrary.it/cyber-security/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	1	1	2	3	1	1	1	-	-
CO2	3	2	2	2	2	1	1	2	3	2	1	1	3	2
CO3	3	2	2	2	2	1	1	2	3	2	1	1	3	-
CO4	3	2	2	2	2	1	1	2	3	2	1	1	3	2
CO5	3	2	2	2	2	1	1	2	2	2	1	1	3	2

High-3; Medium-2; Low-1

Vertical II Full Stack Development Electives

Course Code: 19ADEN1005	Course Title: User Interface Design Principles		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Explain the principles and process of UI design
2. Design User Interfaces using appropriate Windows and Menu controls
3. Develop Interaction design, Evaluation and Testing process
4. Design mobile applications by choosing appropriate Mobile Design elements
5. Design the webpages by selecting appropriate Interaction methods

Unit I Principles and Process 9 Hours

Importance of the User Interface – Interaction Styles – Graphical User Interface – Direct Manipulation – Characteristics – Web User Interface – Principles of User Interface Design – User Interface Design Process – Human Characteristics in Design.

Unit II Windows and Menus 9 Hours

Windows – Characteristics – Components – Presentation Styles – Types – Organizations – Operations – Web Systems – Device Based Controls – Screen Based Controls – Menus–Structures – Functions – Contents – Formatting – Phrasing – Selecting Menu Choices – WebSite Navigation – Graphical Menus. Case Study: Pencil Project tool.

Unit III Design and Testing 9 Hours

Emotions and the User Experience – Expressive Interfaces – Frustrating Interfaces – Models of Emotion – Interfaces – Process of Interaction Design – Requirements Gathering – Analysis – Interpretation – The Evaluation Framework – Usability Testing – Prototypes – Kinds of Test. Case Study: Just in mind Prototype.

Unit IV Mobile HCI 9 Hours

Mobile Ecosystem: Platforms – Application frameworks – Types of Mobile Applications – Mobile Information Architecture – Mobile Design – Elements of Mobile Design – Case study: Mobile 2.0.

Unit V Web HCI 9 Hours

In Page Editing – Drag & Drop – Direct Selection – Contextual Tools – Overlays – Inlays and Virtual Pages – Process Flow – Static Invitations – Dynamic Invitations.

Course Outcomes		Cognitive Level
At the end of this course, students will be able to:		
CO1:	Explain the principles and process of UI design for developing an Interface	Understand
CO2:	Fundamental UI design principles like visual hierarchy, balance, and consistency	Apply
CO3:	Develop Interaction design, Evaluation and Testing process to solvereal world problems	Apply
CO4:	Design mobile applications by choosing appropriate Mobile Designelements for a given scenario	Apply
CO5:	Designing the webpages by selecting appropriate Interaction methodsfor building an application	Apply

Text Book(s):

T1. Wilbert O.Galitz, "The Essential Guide to User Interface Design", 3rd Edition, John Wiley &Sons, 2007. (Unit I,II & III)

T2. Brian Fling, "Mobile Design and Development", O'Reilly Media Inc., 2009. (Unit IV)

T3. Bill Scott and Theresa Neil, "Designing Web Interfaces", O'Reilly, 2009. (Unit V)

Reference Book(s):

R1. Yvonne Rogers , Helen Sharp, Jenny Preece, "Interaction Design: Beyond Human – Computer Interaction", 5th Edition, John Wiley & Sons, 2019.

R2. Jenifer Tidwell, "Designing Interfaces", 2nd Edition, O'Reilly Publications, 2011.

R3. Marc Silver, "Exploring Interface Design", Delmar Cengage Learning, 2013.

Web References:

1. NPTEL Course User Interface Design https://onlinecourses.nptel.ac.in/noc21_ar05/preview
2. User interface design for the mobile web URL:https://www.ibm.com/developerworks/library/wa-interface/
3. Designing web applications URL:http://nathanbarry.com/webapps/of- management-buisness-management/512
4. Ten Great Sites for UI Design Patterns URL:https://www.interaction-design.org/ literature/ article/10-great-sites-for-ui-design-patterns.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	1	1	-	-	1	-	1	-	-	-	-
CO2	2	1	1	1	1	-	-	2	3	3	-	1	1	-
CO3	2	1	1	1	1	-	-	2	3	3	-	1	1	-
CO4	2	1	1	1	1	-	-	2	3	3	-	1	1	-
CO5	2	1	1	1	1	-	-	2	3	3	-	1	1	-

High-3; Medium-2; Low-1

Course Code: 19ADEN1006	Course Title: Visual Data Analysis		
Course Category: Professional Elective		Course Level: Mastery	
L: T : P(Hours/Week) 3: 0 : 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Create interactive computer graphics
2. Demonstrate the basic principles of implementing graphical output primitives andtheir attributes
3. Implement 2D transformation and viewing operations
4. Design a 3D object and perform transformation and viewing operations
5. Identify suitable surface detection, lighting and rendering methods

Unit I Graphics Software Standards and Primitives 9 Hours

Coordinate Representations – Graphics Functions – Software Standards – Introduction to OpenGL – Coordinate reference frame – Specifying 2D using OpenGL – OpenGL Point Functions – OpenGL Line Functions – Fill Area Primitives – Polygon Fill Area – OpenGL polygon Fill Area Functions.

Unit II Output Primitives and Attributes 9 Hours

Line Drawing Algorithms – DDA Line Drawing Algorithm – Bresenhams Line Drawing Algorithm – Circle Drawing Algorithm. Point attributes – Line attributes – Fill Area attributes – Characterattributes – OpenGL Functions.

Unit III 2D Transformation and Viewing 9 Hours

Basic Transformations – Homogeneous Representation – Composite Transformation – Other Transformations – OpenGL functions. Viewing Pipeline – Clipping Window – Window to Viewport transformation – OpenGL 2D viewing Functions – Clipping Algorithms: Point Clipping– Line Clipping – Cohen Sutherland Line Clipping Algorithm – Polygon Clipping – Sutherland Hodgeman and Weiler Atherton Method – Text Clipping.

Unit IV 3D Transformations and Viewing 9 Hours

3D Object Representation – OpenGL Functions– Quadric and Cubic Surfaces–Bezier and Spline Curves– 3D Transformation – OpenGL Functions – 3D Viewing – 3D Viewing Concepts– 3D Viewing Pipeline – Projection Transformations – Orthogonal Projections – Oblique Parallel Projections – Perspective Projections – OpenGL Functions.

Unit V Visualization of 3D Objects 9 Hours

Visible Surface Detection Methods: Classification – Back face detection – Depth Buffer Method– A Buffer Method – Scan Line Method – Depth Sorting Method – BSP Tree Method – Oct TreeMethod – Comparison. Illumination and Surface Rendering: Light Sources – Surface Lighting Effects – Surface Rendering–OpenGL Functions.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Create Interactive Computer Graphics using basic OpenGL functions	Apply
CO2: Demonstrate the basic principles in implementing graphical output primitives and their attributes for the given scenario	Apply
CO3: Implement 2D Transformations and Viewing operations for the given 2D object	Apply
CO4: Design a 3D object and perform Transformation and Viewing operations using OpenGL built-in functions	Apply
CO5: Identify suitable surface detection, lighting and rendering methods for displaying the real-world objects	Apply

Text Book(s):

T1. Donald D. Hearn, M. Pauline Baker, Warren Carithers, "Computer Graphics with OpenGL", 4th Edition, Pearson Education, 2016.

Reference Book(s):

R1. D. F. Rogers and J. A. Adams, "Mathematical Elements for Computer Graphics",2nd Edition, McGraw-Hill International Edition, 2017.

R2. Edward Angel, "Interactive Computer Graphics A Top-Down Approach with OpenGL", 5thEdition, Addison-Wesley, 2012.

R3. Shalini Govil Pai, "Principles of Computer Graphics Theory and Practice usingOpenGLand Maya", Springer, 2010.

Web References:

1. NPTEL Course User Interface Design: https://nptel.ac.in/noc/courses/noc21/SEM2/noc21-cs97/
2. The Official Guide to Learning OpenGL: http://www.glprogramming.com/re
3. OpenGL Reference Manual : http://www.glprogramming.com/blue/
4. OpenGL Latest :http://nehe.gamedev.net/
5. The Official site of OpenGL :http://www.opengl.org/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	1	-	-	2	3	3	-	1	1	-
CO2	2	1	1	1	1	-	-	2	3	3	2	1	1	-
CO3	2	1	1	1	1	2	-	2	3	3	2	1	2	-
CO4	2	1	1	1	1	1	1	2	3	3	-	1	2	-
CO5	2	1	1	1	1	1	1	2	2	2	-	1	2	-

High-3; Medium-2; Low-1

Course Code: 19ADEN1007	Course Title: Computational Vision		
Course Category: Professional Elective		Course Level: Mastery	
L: T : P(Hours/Week) 3: 0 : 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Summarize the fundamental concepts and methods related to Image formation and processing
2. Apply feature detection, matching and detection
3. Make use of feature based alignment and motion estimation
4. Develop skills on 3D reconstruction
5. Select image based rendering and recognition

Unit I Introduction to Image Formation and Processing 9 Hours

Computer Vision - Geometric primitives and transformations - Photometric image formation – The digital camera - Point operators - Linear filtering - More neighborhood operators - Fourier transforms - Pyramids and wavelets - Geometric transformations - Global optimization.

Unit II Feature Detection, Matching and Segmentation 9 Hours

Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Meanshift and mode finding - Normalized cuts - Graph cuts and energy - based methods.

Unit III Feature - Based Alignment and Motion Estimation 9 Hours

2D and 3D feature - based alignment - Pose estimation - Geometric intrinsic calibration - Triangulation – Two - frame structure from motion - Factorization - Bundle adjustment – Constrained structure and motion - Translational alignment - Parametric motion - Spline-basedmotion – Optical flow - Layered motion.

Unit IV 3D Reconstruction 9 Hours

Shape from X - Active range finding - Surface representations - Point-based representations Volumetric representations - Model-based reconstruction - Recovering texture maps and albedosos.

Unit V Image-Based Rendering and Recognition 9 Hours

View interpolation Layered depth images - Light fields and Lumigraphs - Environment mattes - Video-based rendering - Object detection - Face recognition - Instance recognition – Category recognition - Context and scene understanding - Recognition databases and test sets.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply fundamental computer vision principles to analyze real-world problems	Apply
CO2: Analyze the strengths and weaknesses of different computer vision algorithms based on their underlying theoretical principles	Apply
CO3: Make use of feature based recognition and motion estimation for identifying the characteristics of an object	Apply
CO4: Utilize 3D reconstruction for capturing the shape and appearance ofobjects	Apply
CO5: Influence the ongoing theoretical advancements in computer vision and the implications for future applications	Apply

Text Book(s):

T1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer- Texts in Computer Science, Second Edition, 2022. (Unit I, II & III)

T2. D. A. Forsyth, J. Ponce, "Computer Vision: A Modern Approach", Pearson Education, Second Edition, 2015. (Unit IV &V)

Reference Book(s):

R1. Richard Hartley and Andrew Zisserman, "Multiple View Geometry in Computer Vision",Second Edition, Cambridge University Press, 2004.

R2. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.

R3. E. R. Davies, "Computer and Machine Vision", Fourth Edition, Academic Press, 2012.

Web References:

1. NPTEL Course computer Vision and image processor https://onlinecourses.nptel.ac.in/noc19_cs58/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	1	-	-	2	3	3	-	1	1	-
CO2	2	1	1	1	1	-	-	2	3	3	-	1	1	-
CO3	2	1	1	1	1	2	1	2	3	3	2	1	1	2
CO4	2	1	1	1	1	2	1	2	3	3	2	1	1	2
CO5	2	1	1	1	1	-	-	2	3	3	-	1	1	-

High-3; Medium-2; Low-1

Course Code: 19ADEN1008	Course Title: Cloud Services Management		
Course Category: Professional Elective		Course Level: Mastery	
L: T : P(Hours/Week) 3: 0 : 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Understand the Cloud Service Management terminology, definition and concepts
2. Compare cloud service management with traditional IT service management
3. Identify strategies to reduce risk and eliminate issues associated with adoption of cloudservices
4. Select appropriate structures for designing, deploying and running cloud-based servicesin a business environment
5. Illustrate the benefits and drive the adoption of cloud-based services

Unit I Cloud Ecosystem 9 Hours

Cloud Ecosystem - The Essential Characteristics - Basics of Service Management - Service Perspectives - Cloud Service Models - Cloud Service Deployment Models.

Unit II Cloud Services Fundamentals 9 Hours

Cloud Strategy Management Framework- Cloud Policy - Key Driver for Adoption - Risk Management - IT Capacity and Utilization - Demand and Capacity matching - Demand Queuing - Change Management - Cloud Service Architecture.

Unit III Cloud Service Management 9 Hours

Cloud Service Reference Model - Cloud Service Lifecycle - Basics of Cloud Service Design - Dealing with Legacy Systems and Services - Benchmarking of Cloud Services - Cloud Service Capacity Planning - Deployment and Migration - Marketplace - Operations Management.

Unit IV Cloud Service Economics 9 Hours

Pricing models for Cloud Services - Procurement of Cloud-based Services - Capex vs OpexShift - Cloud service Charging - Cloud Cost Models.

Unit V Governance and Values 9 Hours

Cloud Governance Framework & Structure - Cloud Governance Considerations - Cloud Service Model Risk Matrix - Value of Cloud Services - Balanced Scorecard - Total Cost of Ownership.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain core cloud service models and their associated services for appropriate applications	Understand
CO2: Analyze and compare different cloud management platforms and their functionalities of cloud resources	Apply
CO3: Identify strategies to reduce risk and eliminate issues associated with adoption of cloud services	Apply
CO4: Select appropriate structures for designing, deploying and running cloud-based services in a business environment	Apply
CO5: Illustrate the benefits and drive the adoption of cloud-based services to solve real world problems	Apply

Text Book(s):

T1. Thomas Erl, Robert Cope, Amin Naserpour, "Cloud Computing Design Patterns",Pearson Education, 2017. (Unit I, II & III)

T2. Enamul Haque, "Cloud Service Management and Governance: Smart Service Management in Cloud Era", Enel Publications, 2020. (Unit IV & V)

Reference Book(s):

R1. Praveen Ayyappa, "Economics of Cloud Computing", LAP Lambert AcademicPublishing, 2020.

R2. Rajkumar Buyya, Christian Vechhiola, S. Thamarai Selvi , "Mastering Cloud ComputingFoundations and Applications Programming", 2013.

Web References:

1. NPTEL Course Cloud Computing: https://onlinecourses.nptel.ac.in/noc21_cs14/preview

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	1	-	-	2	3	3	-	1	1	-
CO2	2	1	1	1	1	-	-	2	3	3	-	1	1	-
CO3	2	1	1	1	1	1	1	2	3	3	-	1	1	3
CO4	2	1	1	1	1	1	1	2	3	3	2	1	1	3
CO5	2	1	1	1	1	-	-	2	3	3	2	1	1	-

High-3; Medium-2; Low-1

Course Code: 19ADEN2005	Course Title: Web Programming		
Course Category: Professional Elective		Course Level: Mastery	
L: T : P(Hours/Week) 2: 0 : 2	Credits:3	Total Contact Hours:60	Max. Marks:100

Pre-requisites

- IT Practices Lab

Course Objectives

The course is intended to:

1. Understand the core principles of web development, including the roles of HTML, CSS, and JavaScript
2. Develop proficiency in constructing static web pages using HTML for structure and content, and CSS for styling and layout
3. Implement basic interactivity and user input validation using client-side scripting with JavaScript
4. Evaluate and compare different web development tools and frameworks based on project requirements
5. Design and develop a dynamic web application utilizing client-side scripting and server-side functionality

Unit I Bootstrap **6 Hours**

Containers – Grid System – Display Widths – Advanced Grid Techniques: Row Columns – Vertical Alignment – Horizontal Alignment – Nesting – Collapse and Expand – Navigation Bar– Buttons – Tables – Labels and Badges – Tabs – Alerts – Progress Bar – Cards – Carousels Forms.

Unit II JQuery and AJAX **6 Hours**

Selecting and Filtering – Events – Manipulating Content and Attributes – Iteration of Arraysand Objects – Working with CSS Properties – AJAX.

Unit III React JS **6 Hours**

React Elements – React DOM – React Components – React with JSX – React State Management – Building Forms – React Context – Enhancing Components with Hooks – Incorporating Data.

Unit IV Node JS **6 Hours**

Node.js Capabilities – Setting up Node.js – Modules – NPM – Event Emitters – Sending and receiving events with Event Emitters – HTTP server applications – HTTP Sniffer – Listeningto the HTTP conversation – Express JS – Making HTTP Client requests – Calling a REST backend service – Mobile First Paradigm.

Unit V Web Content Management **6 Hours**

Content Management system – Acquiring CMS – Content Management Team – Content Modeling – Content Aggregation – Output and Publication Management – Case Study: Joomla.

List of Exercises **30 Hours**

1. Develop a responsive web page using BootStrap
2. Develop interactive web pages using JQuery and AJAX
3. Create a front-end web page using React JS
4. Implement back-end web system using Node JS
5. Develop a web application using Node JS
6. Create a Web content management system using Joomla tool

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Design a responsive web page using Bootstrap Technology	Apply
CO2: Develop interactive web pages using open source JavaScript Librarieslike JQuery and AJAX	Apply
CO3: Construct complex user interfaces having a unidirectional data flowusing React JS	Apply
CO4: Develop a back end solution for a given scenario using Node JS	Apply
CO5: Build a Web Content Management System using tools like Joomla	Apply

Text Book(s):

T1. Panos Matsinopoulos, "Practical Bootstrap: Learn to Develop Responsively with One ofthe Most Popular CSS Frameworks", APress, 2020.(Unit I ,II& III)

T2. Richard York, "Web Development with jQuery", Wiley India, 2015.(Unit IV,V)

Reference Book(s):

R1. C Xavier, "Web Technology and Design", First edition, New Age International Publishers, 2018.

R2. Porter Scobey, Pawan Lingras, "Web Programming And Internet Technologies: An E-Commerce Approach", 2nd Edition, Jones and Bartlett Publishers, Inc, 2016.

Web References:

1. React JS Tutorial: https://reactjs.org/tutorial/tutorial.html
2. nodejs Tutorial: https://nodejs.org/en/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	1	-	-	2	3	3	-	1	1	-
CO2	2	1	1	1	1	-	-	2	3	3	-	1	1	-
CO3	2	1	1	1	1	3	3	2	3	3	-	1	1	2
CO4	2	1	1	1	1	3	3	2	3	3	3	1	1	2
CO5	2	1	1	1	1	3	3	2	3	3	3	1	1	-

High-3; Medium-2; Low-1

Course Code: 19ADEN2006	Course Title: Game Designing Techniques		
Course Category: Professional Elective		Course Level: Practice	
L: T : P(Hours/Week) 2: 0 : 2	Credits:3	Total Contact Hours:60	Max. Marks:100

Pre-requisites

- Artificial Intelligence-II

Course Objectives

The course is intended to:

1. Understand the fundamental concepts of game design, including core mechanics, player experience, and different game genres
2. Analyze successful game examples to identify core mechanics, player motivations, and design principles
3. Develop engaging game concepts through brainstorming, prototyping, and iterating on mechanics and user experience
4. Apply various dynamic aspects of gameplay
5. Implement basic game mechanics using appropriate game development tools or frameworks

Unit I Elements and Player Experience 6 Hours

Design Process - Model Description – Practice of game design - Player Experience – Player theories – User Personas – Empirical models – Experience design.

Unit II Game Mechanics 6 Hours

Mechanics as Building Blocks - Composition of Mechanics - Games as State Spaces Game State - Explicit and Implicit Mechanics - Families of Mechanics: Control Mechanics - Progression Mechanics - Uncertainty Mechanics - Resource Management Mechanics – Mechanics Design.

Unit III Game System 6 Hours

Game system - Mechanic chains and loops – Feedback loops - Effects of Positive Feedback - Effects of Negative Feedback – Emergence and Chaos – System design – System tuning - Case Study: Diablo.

Unit IV Game Play 6 Hours

Gameplay Loops - Player Motivation: Intrinsic and Extrinsic Motivation - Intrinsic Motivation: Flow and Learning Flow - Extrinsic Motivation: Work and Rewards - Gameplay Loop Design Heuristics – Case Study: The Sims.

Unit V Macrostructure and Prototype 6 Hours

Game Fiction - Macrostructure and Content Arcs – Prototyping: Playable Prototypes - Iterative Process - Playtesting - Documenting Design - Finishing Iteration – Case study: The Witcher - Project Highrise.

List of Exercises **30 Hours**

1. Develop a game design document for a simple game
2. Build a prototype of the game designed in Exercise 1
3. Develop different game mechanics required to provide the expected user experience
4. Integrate the mechanics developed in Exercise 3 to provide a dynamic gaming experience
5. Design a suitable user interface for the game developed
6. Include audio and special effects to the game environment

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain the elements of games by preparing a design document for a real game	Understand
CO2: Analyze existing games to identify their core mechanics, player motivations, and underlying design principles	Apply
CO3: Design engaging game concepts through brainstorming, prototyping, and iterating on mechanics and user experience	Apply
CO4: Implement basic game mechanics using a chosen game development tool or framework	Apply
CO5: Effectively communicate game design ideas through well-structured documentation, clear presentations and informative play testing sessions	Apply

Text Book(s):

T1. Robert Zubek, " Elements of Game Design" , The MIT Press, 2020

Reference Book(s):

R1. Nicolas Alejandro Borromeo, "Hands-on Unity 2020 Game development", Packt Publishing Ltd, 2020.

R2. James R. Parker , "Introduction to game development using Processing", MercuryLearning And Information LLC, 2015.

Web References:

1. Introduction to Game Design URL: https://www.coursera.org/learn/game-design
2. Introduction to Game Design Theory URL: https://www.udemy.com/course/welcome-to-game-design-introduction-to-game-theory/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	2	2	1	-	1	-	1
CO2	3	2	2	2	2	1	1	2	2	2	1	1	3	1
CO3	3	2	2	2	2	1	1	2	-	2	1	1	3	1
CO4	3	2	2	2	2	1	1	2	3	2	1	1	3	1
CO5	3	2	2	2	2	1	1	2	3	2	1	1	3	1

High-3; Medium-2; Low-1

Course Code: 19ADEN2007	Course Title: Augmented Reality for AI		
Course Category: Professional Elective		Course Level: Mastery	
L: T : P(Hours/Week) 2: 0 : 2	Credits:3	Total Contact Hours:60	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Describe the fundamentals of XR with example applications
2. Outline the Augmented Reality Architecture and Modelling for real time applications real time applications
3. Develop the Augmented reality applications by choosing appropriate tools appropriate tools
4. Explain the basics of augmented reality with real time examples
5. Apply the design principles and practices of augmented reality apps for industrial sectors

Unit I XR Overview 6 Hours

Introduction – XR Spectrum – Definitions - Augmented Reality – Virtual Reality – Mixed Reality – History – Challenges – XR and Business – Applications : Retail – Training - Education – Healthcare - Entertainment – Sports – Manufacturing - Military.

Unit II VR IO, Modelling 6 Hours

VR Definition - Input Devices: Trackers - Navigation and Gesture Interfaces - Output Devices: Graphics - Three Dimensional Sound and Haptic Displays - Computer Architecture for VR - Modelling.

Unit III VR Application Development 6 Hours

Enabling VR Environment - Building: Steam VR - Oculus Rift - Windows Gear VR - Oculus Go - Google VR - Setting up for Android Devices - 3D walkthrough - Object Grabbing - Transformation - Hand Avatar manipulation - World space menu creation.

Unit IV AR Principles 6 Hours

AR Definition - Displays: Multimodal Displays - Spatial Display Model - Visual Displays – Tracking - Calibration and Registration - Mobile Sensors - Computer Vision for AR.

Unit V AR Application Development 6 Hours

Mobile Application for Image Tracking - Image Dataset Generation - Setting up AR Environment - Animation and transformation (Scale, Move, Rotate, Transform) - Build Generation for ios and Android. Case Study: Picture Puzzle.

List of Exercises 30 Hours

1. Study of tools like Unity, Maya, 3DS MAX, AR toolkit, Vuforia and Blender
2. Use the primitive objects and apply various projection types by handling camera
3. Download objects from asset store and apply various lighting and shading effects
4. Model three dimensional objects using various modelling techniques and apply textures over them
5. Create three dimensional realistic scenes and develop simple virtual reality enabled mobileapplications which have limited interactivity
6. Add audio and text special effects to the developed application

Course Outcomes		Cognitive Level
At the end of this course, students will be able to:		
CO1:	Explain the fundamental concepts of Augmented Reality and Artificial Intelligence, including their core functionalities and applications	Apply
CO2:	Analyze the integration of AI techniques in AR development, identifying potential use cases for object recognition, image processing, and user interaction	Apply
CO3:	Compare different AR development tools and platforms for building AR experiences that leverage AI functionalities	Apply
CO4:	Design and develop a simple AR prototype using chosen tools that incorporates basic AI features for object recognition or user interaction	Apply
CO5:	Evaluate the new developments and independently seeking relevant information beyond the course confines	Apply

Text Book(s):

T1. Jesse Glover, Jonathan Linowes, "Complete Virtual Reality and Augmented Reality Development with Unity", Packt Publishing Ltd, 2019. (Unit I,II & III)

T2. Dieter Schmalstieg, Tobias Hollerer, "Augmented Reality: Principles and Practice", Pearson Education (US), 2017. (Unit IV &V)

Reference Book(s):

R1. Steve Aukstakalnis, "Practical Augmented Reality: A Guide to the Technology Applications,and Human Factors for AR and VR", Addison-Wesley, 2016.

R2. Robert Scoble, Shel Israel, "The Fourth Transformation: How Augmented Reality & Artificial Intelligence Will Change Everything", Patrick Brewster Press, 2016.

Web References:

1. Build Virtual Worlds URL:https://developers.google.com/vr/
2. Quick Start for unreal URL:https://developers.google.com/ar/develop/unreal/quickstart
3. Unity User Manual URL:https://docs.unity3d.com/Manual/UnityManual.html

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	-	-	-	-	2	3	1	-	1	-	1
CO2	3	2	2	2	2	1	-	2	3	2	1	1	3	1
CO3	3	2	2	2	2	1	-	2	3	2	1	1	3	1
CO4	3	3	2	2	2	1	-	2	3	3	1	1	3	1
CO5	3	2	2	2	2	1	-	2	3	2	1	1	3	1

High-3; Medium-2; Low-1

Course Code: 19ADEN2008	Course Title: Security and Privacy in Cloud		
Course Category: Professional Elective		Course Level: Mastery	
L: T : P(Hours/Week) 2: 0 : 2	Credits:3	Total Contact Hours:60	Max. Marks:100

Pre-requisites

- Computer Networking

Course Objectives

The course is intended to:

1. Describe Cloud Computing terminology, definition and concepts
2. Explain the risks and challenges associated with access control
3. Implement audit and monitoring mechanisms in the cloud
4. Implement the best practices for Cloud security
5. Illustrate the monitoring and administration patterns

Unit I Fundamentals of Cloud Security Concepts **6 Hours**

Evaluation of cloud Computing- Overview of Cloud Computing-Infrastructure Security: Network Level - Host Level - Application Level.

Unit II Access Control, Identity Management and Security Management in cloud **6 Hours**

Trust Boundaries and IAM- IAM Challenges and Definitions- IAM Architecture and Practice- IAM standards and protocols for cloud Services- IAM Practices in the Cloud- Cloud Authorization Management- Security Management Standards- Availability Management of Iaas – Paas - Saas- Access Control-Security vulnerability - Patch and Configuration Management.

Unit III Audit, Privacy and Compliance **6 Hours**

Privacy - Data life cycle - Key Privacy concern in cloud - Internal Privacy compliance -` GRC - Control Objectives for cloud computing - Control consideration for CSP users - Regulatory external Compliance - Other requirements - Examples of cloud service providers.

Unit IV Cloud Security Design Patterns **6 Hours**

Introduction to Design Patterns - Design Patterns notation - Measures of Design Pattern Application - Sharing - Scaling and Elasticity Patterns.

Unit V Monitoring, Provisioning and Administration Patterns **6 Hours**

User Monitoring - Pay as you Go - Real time Resource Availability - Rapid Provisioning - Platform Provisioning - Bare-metal Provisioning - Automated Administration - Centralized remote Administration - resource Management - Self Provisioning - Power Consumption Reduction

List of Exercises **30 Hours**

1. Simulate a cloud scenario using CloudSim and run a scheduling algorithm not present inCloudSim
2. Simulate resource management using CloudSim
3. Simulate a secure file sharing using CloudSim
4. Implement data anonymization techniques over the simple dataset (masking, k-anonymization,etc)
5. Implement any encryption algorithm to protect the images
6. Develop a log monitoring system with incident management in the cloud

Course Outcomes		**Cognitive Level**
At the end of this course, students will be able to:		
CO1:	Explain core security concepts in cloud computing, including access control, data encryption, and threat modeling specific to cloud environments	Apply
CO2:	Analyze security vulnerabilities and privacy concerns associated with cloud storage, deployment models, and service offerings	Apply
CO3:	Implement audit and monitoring mechanisms in the cloud	Apply
CO4:	Utilize security patterns for designing applications to protectfrom various attacks	Apply
CO5:	Develop expertise in emerging security threats and privacy considerations specific to cloud environments	Apply

Text Book(s):

T1. Thomas Erl, Robert Cope, Amin Naserpour , “Cloud Computing Design Patterns”, PearsonEducation, 2015. (Unit I & II)

T2. Tim Mather, Subra Kumaraswamy, Shahed Latif, “Cloud Security and Privacy”, O’ReillyMedia, 2009. (Unit III, IV & V)

Reference Book(s):

R1. Mark C. Chu-Carroll , “Code in the Cloud”, CRC Press, 2011.

R2. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, “Mastering Cloud ComputingFoundations and Applications Programming” , Elsevier,2013.

Web References:

1. Cloud Security and Privacy ebook: https://www.oreilly.com/library/view/cloud-security-0596806453/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	2	-	-	-	-	1	1	3	3	1
CO2	1	3	2	3	2	-	-	-	-	2	3	2	2	1
CO3	3	2	2	2	1	2	3	3	-	1	1	2	2	2
CO4	2	-	3	2	3	2	2	3	2	2	3	2	-	-
CO5	1	3	-	3	1	2	-	-	2	3	3	3	2	3

High-3; Medium-2; Low-1

Vertical III Software Project Management Electives

Course Code: 19ADEN1009	Course Title: Principles of Business Management		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Describe the functions of management in a business organization
2. Analyze different forecasting techniques
3. Identify various types of organizational structures and patterns
4. Describe various leadership funcilors and Motivational Techniques
5. Illustrate the role of Information technology for performance control

Unit I Management and Administration **9 Hours**

Historical developments – management - Management and Administration - Taylor and Fayol's - Functions of Management - Types of Business Organization.

Unit II Managers and Environment **9 Hours**

Social responsibility - Planning - Objectives - Setting Objectives - Process of Managing - Policies and Planning Premises – Forecasting - Decision making.

Unit III Functional Area Organization **9 Hours**

Formal - Informal Organization - Organization Chart Structure - Process Departmentalization - Line and Staff authority - Benefits and Limitations - De-Centralization - Authority Staffing Selection Process - Techniques.

Unit IV Motivation and Directions **9 Hours**

Objectives Human Factors - Harmonizing - Objectives - Leadership Types - Motivation Hierarchy - Motivational Techniques – Communication - Types.

Unit V Controlling Strategies **9 Hours**

System and Process - Requirements - Budget - Information Technology - Computers in handling the information - Control of Overall Performance Direct - Preventive Control - Globalization and Liberalization - International Management - Global theory of Management

Course Outcomes		Cognitive Level
At the end of this course, students will be able to:		
CO1:	Apply time and motion study techniques to analyze and improve specific task within a real-world organization	Apply
CO2:	Analyze different forecasting techniques to set objectives and make decisions	Apply
CO3:	Identify various types of organizational structures and patterns for effective management	Apply
CO4:	Describe various leadership functions and MotivationalTechniques for performance Improvement	Apply
CO5:	Illustrate the role of Information technology for performance control in organizations and impact of globalization	Apply

Text Book(s):

T1. Harold Koontz, Heinz Weinrich, "Essentials of Management", 7th Edition, Tata McGraw-Hill, 2007. (Unit I)

T2. Tripathy PC, Reddy PN, "Principles of Management", Tata McGraw Hill, 1999. (Unit II & III)

T3. Stephen P Robins & Mary Coulter, "Fundamentals of Management", 7th Edition, 2013. (Unit IV & V)

Reference Book(s):

R1. JAF Stoner, Freeman RE and Daniel R Gilbert. "Management, 6th Edition Pearson Education, 2004.

Web References:

1. Management Principles guide: http://www.managementstudyguide.com/managementprinciples.html
2. Principles of Management guide: http://study.com/academy/course/principles-of-management-course.html
3. Functional Areas of management Tutorial:http://www.buisnessmanagementideas.com/management/5-functional-areas-of-agement-buisness-management/512
4. Characteristic of leadership Principles: http://www.leadership-toolbox.com/characteristic-of-leadership.html
5. Bitspilani Principles of Management guide: http://discovery.bitspllani.ac.in/dipd/courses/coursecontent/courseMaterial/mgtszc211 /

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	2	-	-	-	1	1	1	3	3	1
CO2	1	3	2	3	1	-	-	-	2	2	3	2	3	1
CO3	3	2	2	3	2	-	-	-	3	1	1	2	2	3
CO4	2	1	2	3	3	-	-	-	3	2	3	3	1	1
CO5	1	3	3	1	1	-	-	-	2	3	3	2	2	3

High-3; Medium-2; Low-1

Course Code: 19ADEN1010	Course Title: Software Development Project Management		
Course Category: Professional Elective		Course Level: Practice	
L: T : P(Hours/Week) 3: 0 : 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Object Oriented Software Development

Course Objectives

The course is intended to:

1. Describe the activities of Project Management
2. Choose the appropriate process model
3. Estimate the software development effort
4. Evaluate the overall duration of the project
5. Discuss the work plan, schedule and state of a project

Unit I Project Evaluation and Management 9 Hours

Importance of Software Project Management – Types of Project – Contract and Technical Project Management – Activities – Plans, Methods and Methodologies- Categorizing Software Projects – Stakeholders – Setting Objectives - Project Success and Failure – Management Control – Portfolio Management – Evaluation Techniques – Risk Evaluation - Programme Management.

Unit II Project Planning and selection of Approaches 9 Hours

Stepwise Project Planning – Build or Buy- Choosing Methodologies and technologies– Software Process and Models – Prototyping – Categorizing Prototypes – Incremental Delivery – Atern/Dynamic System Development – RAD – Agile Methods –Extreme Programming(XP) - SCRUM – Managing Iterative Process – Selecting Appropriate Process Model.

Unit III Software Effort Estimation 9 Hours

Estimation – Problems in Estimation – Basis for Estimation – Software Effort Estimation Techniques – Bottom-up Estimating – Top-down Approach and Parametric Models – Expert Judgment – Estimating by Analogy – Albercht Function Point Analysis – Function Points Mark II – COSMIC Full Function Points –Parametric Productivity Model – Capers Jones Estimating Rules of Thumb.

Unit IV Activity Planning and Risk Management 9 Hours

Objectives of Activity Planning– Project Schedules – Project and Activities - Sequencing and Scheduling Activities – Network Planning Model – Forward Pass – The Backward Pass – Activity Float – Project Duration – Critical Activities – Activity on Arrow Networks - Risk - Categories of Risk - Identification - Assessment - Planning - Management –Evaluating Risk – Applying PERT – Monte Carlo Simulation –Critical Chain Concepts.

Unit V Resource Allocation, Monitoring And Control 9 Hours

Identifying Resource Requirements – Scheduling Resources – Creating Critical Paths – Counting the Cost – Publishing Resource Schedule – Cost Schedules – Scheduling Sequence – Creating Framework – Collecting Data – Visualizing Progress – Cost Monitoring – Earned Value Analysis–Managing Contracts- Types of Contract - Stages in Contract Placement - Contract Management - Acceptance.

Course Outcomes		Cognitive Level
At the end of this course, students will be able to:		
CO1:	Describe the activities of Project Management by classifying projects	Understand
CO2:	Choose the appropriate process model for a project planning	Apply
CO3:	Estimate the software development effort using various models	Apply
CO4:	Evaluate the overall duration of the project by categorizing and prioritizing risks	Apply
CO5:	Discuss the work plan, schedule and state of a project for resource allocation	Apply

Text Book(s):

T1. Bob Hughes, Mike Cotterell, Rajib Mall, "Software Project Management", 6th Edition, Tata McGraw Hill Publishers, 2017.

Reference Book(s):

R1. Robert K. Wysocki "Effective Software Project Management", Wiley Publication, 2011.

R2. Walker Royce: "Software Project Management", Addison Wesley, 1998.

R3. Gopalaswamy Ramesh, "Managing Global Software Projects" –McGraw HillEducation, 14th Edition, 2013.

Web References:

1. Project Management URL: http://www.inf.ed.ac.uk/teaching/courses/seoc/ 2006_2007/ notes/LectureNote07_ProjectManagement.pdf
2. Software ProjectManagement URL: https://www.classle.net/#!/classle/largecontent/software-project-managment-lecture- s slides/
3. Project Risk Management URL: http://nptel.ac.in/courses/106101061/38/management-buisness-management/512

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	2	-	-	-	1	1	1	3	3	1
CO2	1	3	2	3	1	-	2	3	2	2	3	2	3	1
CO3	-	-	2	3	2	-	-	-	3	1	1	2	2	3
CO4	2	1	2	3	3	2	3	2	3	2	3	3	-	-
CO5	1	3	3	1	1	-	-	-	2	3	3	2	2	3

High-3; Medium-2; Low-1

Course Code: 19ADEN1011	Course Title: Software Quality Management		
Course Category: Professional Elective		Course Level: Practice	
L: T : P(Hours/Week) 3: 0 : 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Explain various factors and components of software quality
2. Demonstrate on integrating software quality assurance components in project life cycle
3. Identify the appropriate software testing strategies for designing test cases
4. Choose a suitable type of software testing at the appropriate stage
5. Illustrate on automatic software testing for projects

Unit I Software Quality and Architecture 9 Hours

Need for Software Quality – Software Quality Assurance (SQA) – Software Quality Factors: McCall's Factor Model – Components of SQA System: SQA System and Architecture – Pre- Project Components – Software Project Life Cycle Components – Infrastructure Component for error prevention and improvement – Management of SQA components – CASE Tools.

Unit II Software Quality Assurance Components 9 Hours

Reviews: Objectives – Formal design Review – Peer Review – Expert Opinions – Supporting Quality devices: Templates – Checklists – Corrective and Preventive Actions process – Documentation Control – SQA Units.

Unit III Test Case Design 9 Hours

Testing as a Process – Test Case Design Strategies – Black Box Approach: Equivalence Class Partitioning, Boundary Value Analysis, Cause-and-Effect Graphing – State Transition Testing – White Box Approach: Test Adequacy Criteria, Coverage and Control Flow Graphs, Covering Code Logic – Data Flow and White Box Test Design – Loop Testing – Mutation Testing.

Unit IV Levels of Testing, Test and Defect Management 9 Hours

Need for Levels of Testing – Unit Test: Need, Plan & Design – Integration Test – System Test:Functional Testing – Performance Testing – Stress Testing – Configuration Testing – SecurityTesting – Recovery Testing – Regression Testing – Alpha, Beta, and Acceptance Tests – Test Planning – Test plan Components – Defect Lifecycle – Fixing / Closing Defects.

Unit V Test Automation 9 Hours

Software Test Automation – Skill Needed for Automation – Scope of Automation – Design and Architecture for Automation – Requirements for a Test Tool – Challenges in Automation – TestMetrics and Measurements: Project, Progress and Productivity Metrics.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain various factors and components of software quality in any software related process and differentiate it with administration.	Understand
CO2: Demonstrate on integrating software quality assurance components in project life cycle for any project	Apply
CO3: Identify the appropriate software testing strategies for designing test cases for any given problem	Apply
CO4: Choose a suitable type of software testing at appropriate stage for any given application	Apply
CO5: Illustrate on automatic software testing for projects using automated testing tools	Apply

Text Book(s):

T1. Daniel Galin, "Software Quality Assurance - From theory to implementation",Pearson Education, 2016. (Unit I & II)

T2. Ilene Burnstein, "Practical Software Testing - A Process Oriented approach", Springer, 2010. (Unit III, IV & V)

Reference Book(s):

R1. Alan Gilles, "Software Quality: Theory and Management", 3rd Edition, Thomson Computer Press, 2011.

R2. Srinivasan Desikan, Gopalaswamy Ramesh, "Software Testing: Principles and practice", Pearson Education, 2008.

R3. Dorothy Graham, Mark Fewster, "Experiences of Test Automation: Case of studies of Software Test Automation", Pearson Education, 2012.

Web References:

1. Software Quality Assurance Tutorial: https://reqtest.com/testing-blog/software-quality-assurance/https://reqtest.com/testing-blog/software-quality-assurance/
2. Software Project Management URL: https://www.classle.net/#!/classle/largecontent/software-project-managment-lecture- s slides/
3. Software Testing: https://www.toolsqa.com/software-testing/defect-life-cycle

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	1	1	2	3	1	3	1	-	-
CO2	3	2	2	2	2	1	1	2	3	2	3	1	3	-
CO3	3	2	2	2	2	1	1	2	3	2	3	1	3	1
CO4	3	2	2	2	2	1	1	2	3	2	3	1	3	1
CO5	3	2	2	2	2	1	1	2	3	2	3	1	3	1

High-3; Medium-2; Low-1

Course Code: 19ADEN1012	Course Title: Reliability Engineering and System safety		
Course Category: Professional Elective		Course Level: Mastery	
L: T : P(Hours/Week) 3: 0 : 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Object Oriented Software Development

Course Objectives

The course is intended to:

1. Understand the importance of the concepts of reliability, system using variousmodels
2. Use the static and dynamic model systems for reliability design
3. Design for maintainability with various maintenance models
4. Apply the analysis of Failure Data and Reliability Testing
5. Build reliability application using various case studies

Unit I Concepts of Reliability, System and Models 9 Hours

The study of reliability and maintainability –Concepts, terms and definitions – Reliability function – MTTF – Hazard rate function – Bathtub curve – Conditional Reliability – Constant failure rate model – Time dependent failure models: Weibull distribution – Normal distribution –The lognormal distribution.

Unit II Design for Reliability 9 Hours

Markov analysis – Load sharing systems – Standby system – Degraded systems, Three state devices – Covariate models – Static models – Dynamic models – Physics of failure models – Reliability Specification and System Measurements – Reliability allocation – Design methods –Failure analysis – System safety and FTA.

Unit III Design for Maintainability 9 Hours

Maintainability - Analysis of downtime – The repair time distribution – Stochastic point processes – System repair time – Reliability under preventive maintenance – State dependent systems with repair – Design for Maintainability – Availability.

Unit IV Analysis of Failure Data and Reliability Testing 9 Hours

Data collection and empirical methods – Reliability testing – Reliability Growth testing – Identifying failure and repair distributions.

Unit V Applications – Case Studies 9 Hours

Goodness of Fit Tests - Applications: Reliability Estimation and Application - Implementation: Objectives, Functions and Processes –Economics of reliability and maintainability – Organizational Considerations – Data Sources and Data Collection methods – Product Liability, Warranties and Related Matters – Software Reliability.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain the concepts of reliability, system using various models	Understand
CO2: Design the reliability for a system using static and dynamic models	Apply
CO3: Develop the design for maintainability with various maintenance concepts	Analyze
CO4: Identify the Failure data using Reliability testing methods	Apply
CO5: Construct reliable system by adapting various test- case applications	Apply

Text Book(s):

T1. Charles E. Ebling, "An Introduction to Reliability and Maintainability Engineering",Tata McGraw-Hill, 2017.

Reference Book(s):

R1. R.Subburaj, "Software Reliability Engineering", McGraw Hill Education, 2015.
R2. P.K.Kapur, H.Pham, A.Gupta,P.C.Jha, "Software Reliability with OR Assessments",Springer,2013.

Web References:

1. Reliability Engineering : Definition, Goals,Techniques: https://limblecmms.com/blog/reliability-engineering
2. Introduction to Reliability Engineering: https://reliabilityweb.com/articles/entry/introduction_to_reliability_engineering Springer-Verlag London Limited, 2011

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	3	1	3	1	-	1	-	-
CO2	3	2	1	1	2	2	3	1	3	1	-	1	2	1
CO3	3	2	1	1	2	2	3	1	3	1	-	1	2	1
CO4	3	2	1	1	2	2	3	1	3	1	1	1	2	1
CO5	3	2	1	1	2	1	3	1	3	1	1	1	2	1

High-3; Medium-2; Low-1

Course Code: 19ADEN2009	Course Title: Agile Software Development Program		
Course Category: Professional Elective		Course Level: Mastery	
L: T : P(Hours/Week) 2: 0 : 2	Credits:3	Total Contact Hours: 60	Max. Marks:100

Pre-requisites

- Object Oriented Software Development

Course Objectives

The course is intended to:

1. Implement the various activities involved in the agile software development process
2. Illustrate the User stories in agile software development
3. Understand scrum roles for agile software development
4. Learn various testing activities within an Agile project
5. Use design principles to achieve Agility

Unit I Agile Development **6 Hours**

Agile Manifesto – Agile Principles – Overview of Extreme Programming: User Stories – Pair Programming – Test Driven Development – Continuous Integration– Simple Design – Refactoring – Metaphor – Agile Process Models: Test Driven development, Lean Software Development.

Unit II Scrum, Sprint and Product Backlog **6 Hours**

Introduction to Scrum – Adapting to Scrum – Patterns for adopting Scrum – ProductBacklog– Sprints –Planning – Progressively Refine Requirements – Iceberg – Refining User stories.

Unit III Scrum Roles **6 Hours**

Individual New Roles: Scrum Master, Product Owner – Changed Roles: Analysts, Project Managers, Functional Managers, Programmers, Database Administrators, Testers, User Experience Designers.

Unit IV Agile Testing **6 Hours**

Test-Driven Development (TDD) Cycle – Acceptance tests – Continuous planning – Agile Test Automation: Agile Testing Quadrant - Test Automation Backlog - Pyramid – Unit Test Characteristics –xUnit frameworks – Multidimensional Testing Coverage Matrix.

Unit V Agile Software Design and Development **6 Hours**

Agile Design: Design Smells – Agile Design Principles: Single Responsibility Principle - Open Closed Principle - Liskov Substitution Principle - Dependency Inversion Principle - Interface Segregation Principle.

List of Exercises **30 Hours**

1. Implement agile software development dashboard using Jira
2. Create scrum using Jira software
3. Apply Jira for assigning scrum roles in an organization
4. Write test cases for Test driven Development using Junit
5. Create user stories in scrum using Jira
6. Create sprint in the backlog using Jira

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Develop the agile software through various methodologies using a dashboard	Understand
CO2: Demonstrate the User stories in agile software development using print and product backlog	Apply
CO3: Create roles in scrum framework for Agile software development	Apply
CO4: Perform testing activities within an Agile project	Apply
CO5: Apply design principles to achieve Agility in software design	Apply

Text Book(s):

T1. Roger S. Pressman and Bruce R Maxim, "Software Engineering - A Practitioner's approach, 7th Edition, 2020. (Unit I)

T2. Mike Cohn, "Succeeding with Agile: Software Development Using Scrum", Addison-Wesley, 2013. (Unit II & III)

T3. Robert C. Martin and Micah Martin, "Agile Principles, Patterns and Practicesin C#", Prentice Hall, 2013. (Unit IV & V)

Reference Book(s):

R1. Ken Schwaber, "Agile Project Management with Scrum Microsoft Professional", Microsoft Press, 2015.

R2. Thomas Stober, Uwe Hansmann, "Agile Software Development - Best Practices for large Software Development Projects", Springer, 2014.

R3. David Harned, "Hands-On Agile Software Development with JIRA", Packt Publishing, 2018.

Web References:

1. Agile Methodology Tutorial : https://www.tutorialspoint.com/agile/index.htm
2. Scrum: https://www.scrum.org/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	1	1	2	-	-	-	1	3	1
CO2	3	2	2	2	2	1	-	2	3	2	3	1	3	1
CO3	3	2	2	2	-	1	-	2	3	2	3	1	3	1
CO4	3	2	2	2	-	1	1	2	3	-	-	1	3	1
CO5	3	2	2	2	2	1	1	2	-	2	3	1	3	1

High-3; Medium-2; Low-1

Course Code: 19ADEN2010	Course Title: Basic Skills in Integrated Product Development		
Course Category: Professional Elective		Course Level: Mastery	
L: T : P(Hours/Week) 2: 0 : 2	Credits:3	Total Contact Hours: 60	Max. Marks:100

Pre-requisites

- Object Oriented Software Development

Course Objectives

The course is intended to:

1. Describe about deciding the scope of a new product
2. Develop design specification for new product development.
3. Perform validation of new product.
4. Develop a basic product development plan outlining key milestones and deliverables.
5. Implement sustenance engineering and End of Life support activities.

Unit I Fundamentals of Product Development 6 Hours

Global Trends Analysis and Product decision - Social Trends - Technical Trends - Economical Trends - Environmental Trends - Political/Policy Trends - Introduction to Product Development Methodologies and Management - Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies - Product Life Cycle –Product Development Planning and Management.

Unit II Requirements and System Design 6 Hours

Requirement Engineering - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management - System Design & Modeling - Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design.

Unit III Design and Testing 6 Hours

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – Challenges - Concept Screening & Evaluation - Detailed Design - Component Design and Verification – Mechanical - Electronics and Software Subsystems - High Level Design-Low Level Design of S/W Program - Types of Prototypes - S/W Testing - System Integration – Testing - Certification and Documentation.

Unit IV Sustenance Engineering and End-of-Life (EoL) Support 6 Hours

Product verification processes - stages - Product Validation processes: stages - Product Testing Standards and Certification - Product Documentation - Sustenance - Maintenance and Repair - Enhancements - Product EoL - ObsolescenceManagement - Configuration Management - EoL Disposal.

Unit V Business Dynamics – Engineering Services Industry 6 Hours

Industry - Engineering Services Industry - Product Development in Industry versus Academia - IPD Essentials - Vertical Specific Product Development processes – Manufacturing - Purchase and Assembly of Systems - Integration of Mechanical - Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

List of Exercises **30 Hours**

1. PESTLE and SWOT Analysis.
2. Traceability Matrix and Analysis.
3. Concept Screening & Evaluation.
4. Product Testing standards and Certification.
5. Product Documentation.
6. Product EoL.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Describe about deciding the scope of a new product byconsidering various global trends	Understand
CO2: Develop design specification for new product developmentbased on the requirements	Apply
CO3: Perform validation of new product based on design specification	Apply
CO4: Implement sustenance engineering and End of Life support activities for engineering customer	Apply
CO5: Develop product management plan for a new product based onthe type of the new product and development methodology	Apply

Text Book(s):

T1. "Foundation Skills in Integrated Product Development", NASSCOM student Handbook, Ist Edition,2013. (Unit- I & II)

T2. Karl T Ulrich , Stephen D Epinger, "Product Design and Development, 6th Edition, Tata McGraw Hill, 2016. (Unit- III & IV)

T3. John W Newstrom and Keith Davis, "Organizational Behavior", 11th Edition, McGraw Hill, 2014. (Unit- V)

Reference Book(s):

R1. Mark S Sanders and Ernest J McCormick, "Human Factors in Engi Design",7th Edition, McGraw Hill Education, 2013.

R2. Vinod Kumar Garg and Venkita Krishnan N K, "Enterprise ResourceConcepts", 2nd Edition Reprint, Prentice Hall, 2011.

Web References:

1. NPTEL Course Product Design and Development: https://onlinecourses.nptel.ac.in/noc21_me83/preview
2. Scrum: https://www.scrum.org/ MIT Open Courseware Product Design and Development: https://ocw.mit.edu/courses/sloan-school-of-management/15-783j and-development-spring-2006/
3. NPTEL Course Introduction to Strategic Management: https://nptel.ac.in/courses/110/108/110108047/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	1	1	2	3	1	3	1	-	2
CO2	3	2	2	2	2	1	1	2	3	2	3	1	3	2
CO3	3	2	2	2	2	1	1	2	3	2	3	1	3	2
CO4	3	2	2	2	2	1	1	2	3	2	-	-	3	2
CO5	3	2	2	-	-	-	1	2	3	2	3	1	3	2

High-3; Medium-2; Low-1

Course Code: 19ADEN2011	Course Title: Design Patterns Concepts		
Course Category: Professional Elective		Course Level: Mastery	
L: T : P(Hours/Week) 2: 0 : 2	Credits:3	Total Contact Hours: 60	Max. Marks:100

Pre-requisites

- Object Oriented Software Development

Course Objectives

The course is intended to:

1. Understand the design pattern concepts
2. Identify the system requirements
3. Prepare a design pattern using the catalog
4. Use MVC architecture to implement the system
5. Describe the behavioral patterns & designing with distributed objects

Unit I Design Pattern Concepts **6 Hours**

Design pattern – Describing design patterns – catalog - organizing the catalog –Solve design problems with Design patterns –Selecting design pattern - Using design pattern –Object – oriented development – Key concepts and related concepts – Benefits and drawbacks– Basics of OOP.

Unit II System Analysis, Design and Implementation **6 Hours**

Overview of the analysis phase – Gathering the requirements – Functional requirements specification – Defining conceptual classes - relationships – Using the knowledge of the domain – Design and Implementation: Design – Implementing Design.

Unit III Design Pattern Catalog **6 Hours**

Structural patterns: Motivation – Applicability - Implementation – Adapter: Motivation – Applicability - Implementation – Bridge: Motivation –Applicability - Implementation – Composite: Motivation – Applicability - Implementation – Decorator– Facade – Flyweight– Proxy.

Unit IV Interactive systems and the MVC architecture **6 Hours**

Introduction – MVC architectural pattern – Analyzing a simple drawing program – Designing the system – Designing of the subsystems – Getting into implementation – Implementing undo operation – Drawing incomplete items – Adding a new feature – Pattern based solutions.

Unit V Behavioral Patterns & Designing with Distributed Objects **6 Hours**

Behavioral Patterns: Chain of Responsibility – Command – Interpreter – Iterator – State- Designing with Distributed Objects: Client server system– Java remote method invocation– Implementing an object oriented system on the web.

List of Exercises **30 Hours**

1. Illustrate an Use case Diagram for a suitable Scenario.
2. Implement the Adapter Design pattern for an appropriate Scenario in suitable Java based application.
3. Implement the MVC Design pattern for an appropriate Scenario in suitable Java basedapplication.
4. Implement the Flyweight Design pattern for an appropriate Scenario in suitable Javabased application.
5. Implement the Decorator Design pattern for a suitable Scenario in Text editor application.
6. Implement the Iterator Design pattern for a suitable Scenario in Text editor application.

Course Outcomes		**Cognitive Level**
At the end of this course, students will be able to:		
CO1:	Explain the design pattern using object–oriented concepts	Understand
CO2:	Identify the system requirements for design and implementation	Apply
CO3:	Develop a Design pattern using the catalog for Structural Patterns	Apply
CO4:	Implement the Interactive system using MVC architecture	Apply
CO5:	Design the behavioral patterns with distributed objects for client server system	Apply

Text Book(s):

T1. Brahma Dathan, Sarnath Ramnath, "Object-Oriented Analysis, Design and implementation: An Integrated Approach", 2nd Edition, Universities Press, 2015. (Unit I & II)

T2. Erich Gamma, Richard Helan, Ralph Johman , John Vlissides, "Design patterns", Pearson Publication, 2015 (Unit III, IV & V)

Reference Book(s):

R1. Mainak Biswas, "Design Patterns: A Domain Agnostic Approach", Create space Independent publication, 2016.

R2. Martin Fowler, Dave Rice, Matthew Foemmel, Edward Hieatt, Robert Mee, and Randy Stafford, "Patterns of Enterprise Application Architecture", Pearson Publication, 2012.

Web References:

1. Software Architecture & Design Patterns: https://hemanthrajhemu.github.io/CSE6/17SCHEME/PE/52_SADP/T2_M3.html
2. Creational, Structural & Behavioral Patterns: https://sourcemaking.com/design_patterns.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	1	1	2	3	1	3	1	-	2
CO2	3	2	2	2	2	1	1	2	3	2	3	1	3	2
CO3	3	2	2	2	2	1	1	2	3	2	3	1	3	2
CO4	3	2	2	2	2	1	1	2	3	2	-	-	3	2
CO5	3	2	2	-	-	-	1	2	3	2	3	1	3	2

High-3; Medium-2; Low-1

Course Code: 19ADEN2012	Course Title: Marketing Analytics		
Course Category: Professional Elective		Course Level: Mastery	
L:T: P(Hours/Week) 2: 0: 2	Credits:3	Total Contact Hours:60	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Understand the role and importance of marketing analytics in decision-making processes within organizations
2. Develop proficiency in data analysis using R
3. Acquire knowledge of various machine learning algorithms and their applications in marketing research
4. Analyze social media data using APIs and other tools

Unit I Introduction to Marketing Analytics **6 Hours**

Introduction - Marketing Research - Marketing Analytics - Marketing Analytics Data - Web Analytics - Online and Offline Data -Type of Media and DataType: Structured – Semi – Structured - Unstructured Data.

Unit II Descriptive Analysis **6 Hours**

Introduction - Key Ideas in the World of R - Taste of R - Summarizing data - Generating an Overall Data Summary - Summarizing Numeric Variables - Summarizing Categorical Variables - Exploring Relationships Between Numeric Variables - Exploring Relationships between Categorical Variables Plotting data.

Unit III Machine Learning **6 Hours**

Introduction - Supervised Learning - Unsupervised Learning - Reinforcement Learning-Key Steps in Building Machine Learning Models - Machine Learning and Marketing Research Models - Correlation – Regression.

Unit IV Advertising Analytics **6 Hours**

Introduction - Media Budget Decisions - Advertising Effectiveness - Consumer Perception and Preference - Cluster Analysis – Multi - Dimensional Scaling - Correspondence Analysis.

Unit V Social Media Data **6 Hours**

Overview of Social Media Platforms - Social Media APIs - Observable aspects of Consumer Behavior on Social Media - Workflow for Social Media Data Collection.

List of Exercises: **30 Hours**

1. Create clutter-free plots that effectively convey insights using facets and advanced plot types in R programming.
2. Analyze a sample web analytics report and identify key insights for improving online marketing strategies.
3. Explore relationships between categorical variables using contingency tables and chi-square tests.
4. Implement a supervised learning algorithm (e.g., linear regression) to predict sales based on marketing expenditures. (ANOVA, ANCOVA, MANOVA, MANCOVA)
5. Implement an unsupervised learning algorithm (e.g., k-means clustering) to segment customers based on their purchasing behaviour.
6. Identify influential users or content on social media using network analysis techniques.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Understand the foundational concepts of marketing research and analytics.	Understand
CO2: Analyze various types of marketing data from online and offline sources.	Analyze
CO3: Apply descriptive analysis techniques to summarize and visualize marketing data effectively.	Apply
CO4: Explore machine learning algorithms for marketing research and decision-making.	Analyze
CO5: Utilize social media data for consumer insights and marketing strategy formulation.	Analyze

Text Book(s):

T1. Moutusy Maity and Pavankumar Gurazada, “Marketing Analytics for Strategic decision making”, Oxford University press, 1st Edition, April 2021. (Unit I to V)

Reference Book(s):

R1. Chuck hemann and Ken Burbary, “Digital marketing analytics: Making Sense of consumer Data in a Digital World”, QUE Publication, 2nd Edition, May 2018.

R2. Wayne L. Winston, “Marketing Analytics: Data-Driven Techniques with Microsoft Excel”, Wiley Publication,1st Edition, January 2014.

Web References:

1. Web analytics: https://www.hotjar.com/web-analytics/
2. R programming: https://www.geeksforgeeks.org/r-tutorial/
3. Advertising analytics: https://www.knorex.com/blog/articles/advertising-analytics
4. Nptel courses Marketing Analytics: https://onlinecourses.nptel.ac.in/noc20_mg30/preview

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	1	-	1	1	1	1	2	2	1
CO2	3	2	1	1	-	1	-	1	1	1	1	2	2	1
CO3	3	-	-	-	-	1	-	1	1	1	1	2	2	1
CO4	3	2	1	1	-	1	-	-	-	-	-	2	2	1
CO5	3	2	1	1	-	1	-	1	1	1	1	2	2	1

High-3; Medium-2; Low-1

Vertical IV-Data Analytics Electives

Course Code: 19ADEN1013	Course Title: Data Analytics for Engineers		
Course Category: Professional Elective		Course Level: Introductory	
L: T : P(Hours/Week) 3: 0 : 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Understand data input and accessing data using R
2. Representation of data in graphical form
3. Analyzing data using probability and statistics
4. Inference of data using correlation and regression analysis

Unit I Introduction to R **9 Hours**

Introduction R as a statistical software and language - R as a calculator - R preliminaries - Methods of data input - Data accessing or indexing. Some useful built-in functions - Graphics with R-Getting help, - saving, storing and retrieving work.

Unit II Descriptive Statistics **9 Hours**

Introduction - Diagrammatic representation of data - Graphical representation of data - Measures of central tendency-dispersion - skewness and kurtosis - Selection of representative samples.

Unit III Probability and probability distributions **9 Hours**

Probability: Definitions and properties - probability distributions - some special discrete distributions - continuous distributions.

Unit IV Statistical Inference **9 Hours**

Sampling distribution of sample mean - Estimation of parameters – Plots to check normality - Hypothesis testing - Goodness of fit tests.

Unit V Correlation and Regression analysis **9 Hours**

Correlation - Inference procedures for correlation coefficient - Linear regression - Inference procedure for simple linear model - validation of linear regression model -Transformation of the variables - Polynomial regression models.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Make use of various data analysis techniques and derive Conclusions	Understand
CO2: Make use of descriptive and inferential statistical techniques for data analysis	Apply
CO3: Perform exploratory data analysis on a given set of data including visualization techniques	Analyze
CO4: Build regression models and use them for prediction	Apply
CO5: Build time series models and use them for prediction	Apply

Text Book(s):

T1. Sudha G. Purohit, Sharad D. Gore and Shailaja R. Deshmukh, “Statistics using R”, Narosa Publications, 2019.

Reference Book(s):

R1. Dan Toomey ,“R for Data Science”, PACKT Publishing, 2014.

R2. Nina Zumel, John Mount ,“Practical Data Science with R”, Manning Publications, 2014.

R3. Eric Mayor ,“Learning Predictive Analytics with R”, PACKT Publishing, 2015.

Web References:

1. NPTEL Course Data Science for Engineers
   : https://onlinecourses.nptel.ac.in/noc21_cs69/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	2	1	3	3	-	-	-	1	2	1
CO2	3	2	1	2	2	1	-	-	-	2	2	1	2	1
CO3	3	2	1	1	2	1	-	1	1	1	2	1	2	1
CO4	3	2	1	3	2	1	-	1	1	3	--	1	2	1
CO5	3	2	1	3	2	1	-	-	-	-		1	2	1

High-3; Medium-2; Low-1

Course Code: 19ADEN1014	Course Title: Business Analytics Management		
Course Category: Professional Elective		Course Level: Mastery	
L: T :P(Hours/Week) 3: 0 : 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Choose appropriate Information Technology applications
2. Develop a Decision-Making Tool
3. Design Dashboard and Scorecard
4. Deploy a Knowledge Management System
5. Apply suitable platform for improving business intelligence

Unit I Introduction to BI **9 Hours**

Business View of IT Applications – Digital Data – Getting started with BI – BI Component Framework – Users – Applications – Roles and Responsibilities – Concepts of data integration – Need - advantages of using data integration - Introduction to common data integration approaches – Introduction to data quality - data profiling concepts - applications – Tools – Case Study: Pentaho.

Unit II Decision Support Systems **9 Hours**

Decision Making: Introduction – Models – Phases – DSS Description – Characteristics – Capabilities – Classifications – Components – Data – Model - User Interface (DIALOG) - Knowledge Based Management Subsystem – DSS User – Case Study: PHP - MySQL implementation of DSS.

Unit III Business Performance Management **9 Hours**

BPM Cycle – Performance Measurement – BPM Methodologies – Architecture - Applications – Introduction to enterprise reporting – Performance Dashboards and Scorecards – Case Study: Freeboard.

Unit IV Knowledge Management **9 Hours**

Introduction – Organizational Learning and Transformation – KM Activities – Approaches – Information Technology - Roles of People in KM – KM System Implementation – Ensuring the Success of KM Efforts – Case Study: Apache Sling CMS.

Unit V Emerging Trends **9 Hours**

Reality Mining – Virtual Worlds – Web 2.0 Revolution – Virtual Communities – Online Social Networking – Cloud Computing and BI – MSS Impacts on Organization - Individual.

Course Outcomes		Cognitive Level
At the end of this course, students will be able to:		
CO1:	Choose appropriate Information Technology applications for Modern Business implementing Business Intelligence components	Understand
CO2:	Develop a Decision-Making Tool for given real time application using Decision Support System components	Apply
CO3:	Design Dashboard and Scorecard for any given application to Analyze its business performance	Apply
CO4:	Deploy a Knowledge Management System for effective functioning of an organization by choosing suitable KMS approach	Analyze
CO5:	Apply suitable platform for improving business intelligence in decision making	Apply

Text Book(s):

T1. R N Prasad, Seema Acharya, "Fundamentals of Business Analytics", 2nd Edition, Wiley,2016. (Unit I & V)

T2. Ramesh Sharda, Dursun Delen, "Business Intelligence and Analytics, Systems for Decision Support", 10th Edition, Pearson Education Inc, 2015. (Unit II, III & IV)

Reference Book(s):

R1. Vicki L. Sauter, "Decision Support Systems for Business Intelligence", Wiley, 2011.

R2. David Loshin, "Business Intelligence: The Savvy Manager's Guide", 2nd Edition, Morgan Kaufman, 2012.

Web References:

1. Mastering Microsoft Power BI URL: https://www.tutorialspoint.com/power_bi/index.htm
2. MIS-Business Intelligence System Business Intelligence as a CareOptionURL:https://www.tutorialspoint.com/business-intelligence-as-a-career-option
3. Decision Support System Java Netbeans Project URL: https://www.freeprojectz.com/java-jsp-netbeans-project/decision-support-system
4. Open source dashboard tools for visualizing data URL:https://opensource.com/business/16/11/open-source-dashboard-tools-visualizing-data

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	-	-
CO2	3	2	2	2	2	1	-	2	-	2	1	1	3	1
CO3	3	2	2	2	2	1	-	2	-	2	1	1	3	1
CO4	3	2	2	2	2	1	-	2	3	2	1	1	3	1
CO5	3	2	2	2	2	1	-	2	3	2	1	1	3	1

High-3; Medium-2; Low-1

Course Code: 19ADEN1015	Course Title: Health Care Analytics		
Course Category: Professional Elective		Course Level: Mastery	
L: T :P(Hours/Week) 3 : 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Understand health data formats, health care policy and standards
2. Learn the significance and need of data analysis and data visualization
3. Understand the health data management frameworks
4. Learn the use of machine learning and deep learning algorithms in healthcare
5. Apply healthcare analytics for critical care applications

Unit I Introduction to Healthcare Analysis 9 Hours

Overview - History of Healthcare Analysis Parameters on medical care systems - Health care policy - Standardized code sets – Data Formats – Machine Learning Foundations: Tree Like reasoning - Probabilistic reasoning - Bayes Theorem - Weighted sum approach.

Unit II Analytics on Machine Learning 9 Hours

Machine Learning Pipeline – Pre - processing –Visualization – Feature Selection – Training model parameter – Evaluation model : Sensitivity - Specificity - PPV – NPV - FPR -Accuracy - ROC - Precision Recall Curves - Valued target variables – Python: Variables and types- Data Structures and containers - Pandas Data Frame :Operations – Scikit –Learn : Pre-processing - Feature Selection.

Unit III Health Care Management 9 Hours

IOT- Smart Sensors – Migration of Healthcare Relational database to NoSQL Cloud database - Decision Support System – Matrix block Cipher System – Semantic Framework Analysis – Histogram bin Shifting and RC6 Encryption – Clinical Prediction Models – Visual Analytics for Healthcare.

Unit IV Healthcare And Deep Learning 9 Hours

Introduction on Deep Learning – DFF network CNN- RNN for Sequences – Biomedical Image and Signal Analysis – Natural Language Processing - Data Mining for Clinical Data – Mobile Imaging and Analytics – Clinical Decision Support System.

Unit V Case Studies 9 Hours

Predicting Mortality for cardiology Practice –Smart Ambulance System using IOT – Hospital Acquired Conditions (HAC) program - Healthcare and Emerging Technologies – ECG Data Analysis.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Use machine learning and deep learning algorithms for health data analysis	Apply
CO2: Apply the data management techniques for healthcare data	Apply
CO3: Evaluate the need of healthcare data analysis in e-healthcare, telemedicine and other critical care applications	Apply
CO4: Implement health data analytics for real time applications	Apply
CO5: Apply Deep learning to health data analytics for emergencycare system	Apply

Text Book(s):

T1. Chandan K.Reddy, Charu C. Aggarwal, "Health Care data Analysis", 1st Edition, CRC, 2015.

Reference Book(s):

R1. Vikas Kumar, "Health Care Analysis Made Simple", Packt Publishing, 2018.

R2. Hui Jang, Eva K.Lee, "HealthCare Analysis : From Data to Knowledge to Healthcare Improvement", 1st Edition, Wiley, 2016.

R3. Kulkarni , Siarry, Singh ,Abraham, Zhang, Zomaya , Baki, "Big Data Analytics in HealthCare", Springer, 2020.

Web References:

1. Data Analytics in Healthcare Blog: https://intellipaat.com/blog/data-analytics-in-healthcare/
2. Watson for healthcare Data Analytics: https://www.ibm.com/watsonhealth/learn/healthcare-data-analytics
3. Article on data analytics in Health-Care :https://www.comptia.org/content/articles/how-is-data-analytics-used-in-health-care

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	1	-	3
CO2	3	2	2	2	-	1	-	2	-	2	1	1	-	3
CO3	3	2	2	2	-	1	-	2	-	2	1	1	-	3
CO4	3	2	2	2	-	1	-	2	3	2	1	1	-	3
CO5	3	2	2	2	-	1	-	2	3	2	1	1	-	3

High-3; Medium-2; Low-1

Course Code: 19ADEN1016	Course Title: Graph Analytics and Algorithms		
Course Category: Professional Elective		Course Level: Mastery	
L: T : P(Hours/Week) 3 : 0 : 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Basics of Data Structures and Algorithm Analysis
- Basics of Artificial Intelligence

Course Objectives

The course is intended to:

1. Paraphrase the Graph Analytics and Algorithms
2. Summarize the Graph Platforms and processing
3. Illustrate the Community Detection Algorithms
4. Develop Graph Algorithm application
5. Relate Graph Algorithms with Machine Learning

Unit I Introduction to Graphs **9 Hours**

Introduction – Graph Analytics and Algorithms - Graph Processing, Databases, Queries, and Algorithms OLTP and OLAP - Graph Analytics Use Cases - Graph Theory & Concepts-Terminology - Graph Types and Structures - Flavors of Graphs - Types of Graph Algorithms.

Unit II Graph Platforms and Processing **9 Hours**

Graph Platform and Processing Considerations- Representative Platforms - Path Finding and Graph Search Algorithms - Example Data: The Transport Graph - Shortest Path & its types.

Unit III Community Detection Algorithms **9 Hours**

Example Graph Data: The Software Dependency Graph - Triangle Count and Clustering Coefficient - Strongly Connected Components - Connected Components - Label Propagation - Louvain Modularity.

Unit IV Graph Algorithms in Practice **9 Hours**

Analyzing Yelp Data with Neo4j - Overview of the Yelp Data - Analyzing Airline Flight Data with Apache Spark.

Unit V Using Graph Algorithms to Enhance Machine Learning **9 Hours**

Machine Learning and the Importance of Context - Connected Feature Extraction and Selection - Graphs and Machine Learning in Practice: Link Prediction.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Identify and differentiate graph structures used in social networks, recommendation systems and knowledge graphs	Understand
CO2: Implement pathfinding algorithms on a chosen graph platform to determine the shortest path within a real-world transportation data	Analyze
CO3: Evaluate the effectiveness of community detection algorithms ona software dependency graph to identify tightly coupled modules	Apply
CO4: Develop recommendations for businesses on Yelp by analyzinguser reviews and network connections	Apply
CO5: Design a machine learning model that leverages graph-based features in a link prediction task	Apply

Text Book(s):

T1. Mark Needham, Amy E. Hodler, “Graph Algorithms: Practical Examples in Apache Spark and Neo4j”, 2019.

Reference Book(s):

R1. R. Ahuja, L. Magnanti, and J. Orlin, “Network Flows: Theory, Algorithms and Applications”, Prentice - Hall, Inc., 1993.

R2. B. Mohar and C. Thomassen, “Graphs on Surfaces”, Johns Hopkins University Press, 2001.

Web References:

1. Graph_Algorithm Tutorial point : https://www.tutorialspoint.com/parallel_algorithm/graph_algorithm.htm
2. Graph-Algorithms real world application: https://www.oracle.com/a/tech/docs/asktom-graph-algorithms.pdf
3. Graph-Analytics Guide: https://www.nvidia.com/en-us/glossary/data-science/graph-analytics/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	1	-	-	1	-	1	-	1	-	3
CO2	3	2	-	-	1	1	-	2	-	2	1	1	-	3
CO3	3	2	2	2	1	1	-	2	-	2	1	1	-	3
CO4	3	2	2	2	1	1	-	2	3	2	1	1	-	3
CO5	3	2	2	2	1	1	-	2	3	2	1	1	-	3

High-3; Medium-2; Low-1

Course Code: 19ADEN2013	Course Title: Social Graph Analytics		
Course Category: Professional Elective		Course Level: Mastery	
L: T :P(Hours/Week) 2: 0 : 2	Credits:3	Total Contact Hours:60	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Describe the graph features
2. Apply network measures and models
3. Implement data mining algorithms
4. Illustrate community mining and interactions
5. Develop social mining applications

Unit I Graph Basics **6 Hours**

Social Media Mining – Challenges – Graph Essentials – Representations – Types of Graphs – Connectivity – Special Graphs – Graph Algorithms.

Unit II Measures & Models **6 Hours**

Network Measures – Centrality – Transitivity and Reciprocity – Similarity. Network Models-Properties of Real-World Networks – Random Graphs – Small-World Model – Preferential Attachment Model.

Unit III Asymmetric Ciphers **6 Hours**

Number theory concepts: Euclidean algorithm – Modular arithmetic – Prime numbers – Fermat's and Euler's theorem – Discrete logarithms – Principles of public-key cryptosystems –RSA algorithm – Diffie-Hellman key exchange – ElGamal cryptographic system.

Unit IV Mining Twitter **6 Hours**

Community Analysis – Community Detection – Evolution – Evaluation – Information Diffusion in social media – Herd Behavior – Information Cascades – Diffusion of Innovations.

Unit V Applications **6 Hours**

Influence and Homophily – Recommendation in Social Media – Classical Recommendation Algorithms – Recommendation Using Social Context – Evaluating Recommendations.

List of Exercises **30 Hours**

1. Implementation of Shortest path and Minimum Spanning Tree algorithms.
2. Develop a program to identify degree centrality and Page rank for the givengraph.
3. Apply decision tree learning to classify the given dataset samples into relevantgroups.
4. Clustering of Twitter dataset using k-means algorithm.
5. Identification of user community using Brute-Force Clique technique.
6. Development of recommendation system using collaborative filtering approach.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Describe the graph features for social media mining	Understand
CO2: Apply network measures and models to visualize social networks	Apply
CO3: Implement data mining algorithms using real time social data	Apply
CO4: Illustrate community mining and interactions in social media	Apply
CO5: Develop social mining applications for real time scenarios	Apply

Text Book(s):

T1. Reza Zafarani, Mohammad Ali Abbasi, Huan Liu, "Social Media Mining: An Introduction",Cambridge University Press, 2014. (Unit I, II & III)

T2. Lam Thuy Vo, "Mining Social Media: Finding Stories in Internet Data", No Starch Press,2020. (Unit IV & V)

Reference Book(s):

R1. Peter Mika, "Social Networks and the Semantic Web", Springer Science, 2007.

R2. Maksim Tsvetovat and Alexander Kouznetsov, "Social Network Analysis for Startups", O'Reilly Media Inc., 2011.

R3. Charu. C.Aggarwal, "Social Network Data Analytics", Springer, 2011.

R4. Matthew A. Russell, "Mining the Social Web", 2nd Edition, O'Reilly Media Inc., 2013.

Web References:

1. NPTEL – Social Networks course. URL: http://nptel.ac.in/courses/106106169

2. MIT Open Courseware.URL: https://ocw.mit.edu/courses/media-arts-and-sciences/mas-961-networks-complexity-and-its-applications-spring-2011/index.htm

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	1	1	2	3	1	-	1	-	-
CO2	3	2	2	2	2	1	1	2	3	2	1	1	3	2
CO3	3	2	2	2	2	1	1	2	3	2	1	1	3	2
CO4	3	2	2	2	2	1	1	2	3	2	1	1	-	1
CO5	3	2	2	2	2	1	1	2	3	2	1	1	3	2

High-3; Medium-2; Low-1

Course Code: 19ADEN2014	Course Title: Recommendation Systems		
Course Category: Professional Elective		Course Level: Mastery	
L: T : P(Hours/Week) 2: 0 : 2	Credits:3	Total Contact Hours:60	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Understand the foundations of the recommender system
2. Learn the significance of machine learning and data mining algorithms for Recommender systems
3. Learn about collaborative filtering
4. Design and implement a recommender system
5. Evaluate & design the recommender systems applications

Unit I Introduction to Recommender Systems **6 Hours**

Introduction and basic taxonomy of recommender systems - Traditional and non-personalized Recommender Systems - Overview of data mining methods for recommender systems - similarity measures - Dimensionality reduction – Singular Value Decomposition (SVD).

Unit II Content-Based Recommendation Systems **6 Hours**

High level architecture of content-based systems - Item profiles - Representing item profiles - Methods for learning user profiles - Similarity-based retrieval - Classification algorithms.

Unit III Collaborative Filtering **6 Hours**

Systematic approach - Nearest neighbor collaborative filtering (CF) - User based and item-based CF - components of neighborhood methods: rating normalization - similarity weight computation - neighborhood selection.

Unit IV Attack-Resistant Recommender Systems **6 Hours**

Introduction – Types of Attacks – Detecting attacks on recommender systems – Individual attack – Group attack – Strategies for robust recommender design - Robust recommendation algorithms.

Unit V Evaluating Recommender Systems **6 Hours**

Evaluating Paradigms – User Studies – Online and Offline evaluation – Goals of evaluation design – Design Issues – Accuracy metrics – Limitations of Evaluation measures.

List of Exercises **30 Hours**

1. Implement Data similarity measures using Python.
2. Implement dimension reduction techniques for recommender systems.
3. Implement user profile learning.
4. Implement content-based recommendation systems.
5. Implement collaborative filter techniques.
6. Create an attack for tampering with recommender systems.
7. Implement accuracy metrics like Receiver Operated Characteristic curves.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Understand the fundamental concepts of recommender systems and their applications	Apply
CO2: Analyze and compare different data mining methods used in recommender systems	Analyze
CO3: Implementation of Collaborative Filtering in carrying out performance evaluation of recommender systems based on various metrics	Apply
CO4: Evaluate the vulnerabilities of recommender systems and propose strategies for robust design	Apply
CO5: Critically assess the effectiveness of recommender systems using different evaluation methods	Apply

Text Book(s):

T1. Charu C. Aggarwal, "Recommender Systems: The Textbook", Springer Publication, 2016.

Reference Book(s):

R1. Dietmar Jannach, Markus Zanker, Alexander Felfernig and Gerhard Friedrich, "Recommender Systems: An Introduction", Cambridge University Press, 1st Edition 2011.

R2. Francesco Ricci, Lior Rokach, Bracha Shapira, "Recommender Systems Handbook", 1st Edition, Springer publication, 2011.

Web References:

1. Coursera Recommender-systems course material: https://www.coursera.org/specializations/recommender-systems.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	1	1	2	3	1	-	1	-	-
CO2	3	2	2	2	2	1	1	2	3	2	1	1	3	2
CO3	3	2	2	2	2	1	1	2	3	2	1	1	3	2
CO4	3	2	2	2	2	1	1	2	3	2	1	1	-	1
CO5	3	2	2	2	2	1	1	2	3	2	1	1	3	2

High-3; Medium-2; Low-1

Course Code: 19ADEN2015	Course Title: Text and Speech Analysis		
Course Category: Professional Elective		Course Level: Mastery	
L: T : P(Hours/Week) 2: 0 : 2	Credits:3	Total Contact Hours:60	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Understand natural language processing basics
2. Apply classification algorithms to text documents
3. Build question-answering and dialogue systems
4. Develop a speech recognition system
5. Develop a speech synthesizer

Unit I Natural Language Basics **6 Hours**

Foundations – Language Syntax and Structure - Text Preprocessing and Wrangling – Text tokenization – Stemming – Lemmatization – Removing stop - words – Feature Engineering forText representation – Bag of Words model- Bag of N - Grams model – TF - IDF model.

Unit II Text Classification **6 Hours**

Vector Semantics and Embeddings - Word Embeddings - Word2Vec model – Glove model – FastText model – Deep Learning models – RNN – Transformers.

Unit III Question Answering And Dialogue Systems **6 Hours**

Information retrieval – IR-based question answering – knowledge-based question answering _ language models for QA – classic QA models – chatbots – Design of dialogue systems –– evaluating dialogue systems.

Unit IV Text-To-Speech Synthesis **6 Hours**

Overview.-Text normalization-Letter-to-sound-Prosody, Evaluation. Signal processing - Concatenative and parametric approaches, WaveNet and other deep learning-based TTS systems.

Unit V Automatic Speech Recognition **6 Hours**

Speech recognition: Acoustic modelling – Feature Extraction - HMM, HMM-DNN systems.

List of Exercises **30 Hours**

1. Create Regular expressions in Python for detecting word patterns and tokenizing
2. Getting started with Python and NLTK - Searching Text, Counting Vocabulary, Frequency Distribution, Collocations, Bigrams
3. Accessing Text Corpora using NLTK in Python
4. Write a function that finds the 50 most frequently occurring words of a text that are not stop words.
5. Implement the Word2Vec model text
6. Use a transformer for implementing classification

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain existing and emerging deep learning architectures for text and speech processing	Apply
CO2: Apply deep learning techniques for NLP tasks, language modeling and machine translation	Apply
CO3: Explain coreference and coherence for text processing	Apply
CO4: Build question-answering systems, chatbots and dialogue systems	Apply
CO5: Apply deep learning models for building speech recognition and text- to-speech systems	Apply

Text Book(s):

T1. Daniel Jurafsky and James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", 3rd Edition, 2022.

Reference Book(s):

R1. Dipanjan Sarkar, "Text Analytics with Python: A Practical Real-World approach to Gaining Actionable insights from your data", APress,2018.

R2. Tanveer Siddiqui, Tiwary U S, "Natural Language Processing and Information Retrieval",Oxford University Press, 2008.

R3. Lawrence Rabiner, Biing-Hwang Juang, B. Yegnanarayana, "Fundamentals of Speech Recognition", 1st Edition, Pearson, 2009.

Web References:

1. Nptel Course Natural Language Processing: https://nptel.ac.in/downloads/111102011/.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	1	1	2	3	1	-	1	-	-
CO2	3	2	2	2	2	1	1	2	3	2	1	1	3	2
CO3	3	2	2	2	2	1	1	2	3	2	1	1	3	2
CO4	3	2	2	2	2	1	1	2	3	2	1	1	-	1
CO5	3	2	2	2	2	1	1	2	3	2	1	1	3	2

High-3; Medium-2; Low-1

Course Code: 19ADEN2016	Course Title: Image and Video Analytics		
Course Category: Professional Elective		Course Level: Mastery	
L: T: P(Hours/Week) 2: 0: 2	Credits:3	Total Contact Hours:60	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Explain fundamental concepts of image representation and analyze image properties
2. Implement image pre-processing techniques for noise reduction and edge detection
3. Evaluate object detection methods and design deep learning architectures for object recognition
4. Analyze facial features and implement face recognition systems
5. Critically evaluate deep learning architectures for video analytics and propose improvement strategies

Unit I Computer Vision **6 Hours**

Computer Vision – Image representation and image analysis tasks - Image representations - digitization – properties – color images – Data structures for Image Analysis - Levels of image data representation - Traditional and Hierarchical image data structures.

Unit II Image Pre-Processing **6 Hours**

Local pre-processing - Image smoothing - Edge detectors – Zero crossings of the second derivative - Scale in image processing - Canny edge detection - Parametric edge models – Edges in multi-speralct images - Local pre-processing in the frequency domain - Line detection by local pre-processing operators - Image restoration.

Unit III Object Detection using Machine Learning **6 Hours**

Object detection – Object detection methods – Deep Learning framework for Object detection – bounding box approach-Intersection over Union (IoU) –Deep Learning Architectures – R - CNN - Faster R – CNN - You Only Look Once(YOLO) - Salient features - Loss Functions - YOLO architectures.

Unit IV Face Recognition and Gesture Recognition **6 Hours**

Face Recognition – Introduction - Applications of Face Recognition - Process of Face Recognition – Deep Face solution by Facebook - FaceNet for Face Recognition - Implementation using FaceNet - Gesture Recognition.

Unit V Video Analytics **6 Hours**

Video Processing – use cases of video analytics - Vanishing Gradient and exploding gradient Problem - RestNet architecture - RestNet and skip connections - Inception Network-Google Net Architecture - Improvement in Inception v2 - Video analytics - RestNet and Inception v3.

List of Exercises **30 Hours**

1. Write a program that computes the T-pyramid of an image.
2. Write a program that derives the quad tree representation of an image using the homogeneity criterion of equal intensity.
3. Develop programs for the following geometric transforms: (a) Rotation (b) Change of scale (c) Skewing (d) Affine transform calculated from three pairs of corresponding points (e) Bilinear transform calculated from four pairs of corresponding points.
4. Develop a program to implement Object Detection and Recognition.
5. Develop a program for Facial Detection and Recognition.
6. Write a program for event detection in video surveillance system.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Infer the fundamentals of image processing techniques for computer vision and video analysis	Understand
CO2: Explain the techniques used for image pre-processing	Understand
CO3: Develop various object detection techniques	Apply
CO4: Recognize the face available in image using various face recognition mechanisms	Apply
CO5: Analyze the video using deep learning techniques	Apply

Text Book(s):

T1. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision", 4th Edition, Thomson Learning, 2013. (Unit I, II & III)

T2. Vaibhav Verdhan," Computer Vision Using Deep Learning Neural Network Architectures with Python and Keras", Apress, 2021. (Unit IV & V)

Reference Book(s):

R1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer Verlag London, Limited,2011.

R2. Caifeng Shan, FatihPorikli, Tao Xiang, Shaogang Gong, "Video Analytics for Business intelligence", Springer, 2012.

R3. D. A. Forsyth, J. Ponce, "Computer Vision: A Modern Approach", Pearson Education,2003.

Web References:

1. Innovating with Video Analytics Technologies and Use Cases: https://wso2.com/whitepapers/innovating-with-video-analytic technologies- use-cases/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	1	1	2	3	1	-	1	-	-
CO2	3	2	2	2	2	1	1	2	3	2	1	1	3	2
CO3	3	2	2	2	2	1	1	2	3	2	1	1	3	-
CO4	3	2	2	2	2	1	1	2	3	2	1	1	-	2
CO5	3	2	2	2	2	1	1	2	3	2	1	1	3	2

High-3; Medium-2; Low-1

Vertical V - Emerging Technologies Electives

Course Code: 19ADEN1017	Course Title: Fuzzy Logic and Neural Computing		
Course Category: Professional Elective		Course Level: Mastery	
L: T :P(Hours/Week) 3: 0 : 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Linear Algebra and Infinite Series

Course Objectives

The course is intended to:

1. Construct feed forward neural networks using supervised learning
2. Develop neural networks based on associative memory
3. Build unsupervised learning networks using competitive strategy
4. Model inference systems using fuzzy rules
5. Develop genetic algorithms

Unit I Supervised Learning Networks 9 Hours

Evolution of computing – soft computing constituents – Biological neural networks – Artificial neurons – Applications. Supervised Learning Networks: Activation functions - Learning rules - Perceptron networks – Adaline – Madaline - Back propagation networks.

Unit II Associative Memory Networks 9 Hours

Associative memories – Auto associative memory network – Hetero associative memory network – Bi-directional associative memory – Discrete Hopfield network.

Unit III Unsupervised Learning Networks 9 Hours

Model Process for Addressing Ethical Concerns During System Design - Transparency of Autonomous Systems - Data Privacy Process - Algorithmic Bias Considerations - Ontological Standard for Ethically Driven Robotics and Automation Systems.

Unit IV Fuzzy Systems 9 Hours

Classical sets – Fuzzy Sets – Classical relations – Fuzzy relations – Membership Functions – Defuzzification – Fuzzy rules – Fuzzy reasoning – Fuzzy inference systems – Neuro-fuzzy systems.

Unit V Genetic Algorithms 9 Hours

Introduction – Traditional optimization and search techniques – Genetic algorithm and search space – Simple genetic algorithm – Operators in genetic algorithm – Solving Travelling Salesman Problem.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Construct feed forward neural networks using supervised learning for solving classification problems	Apply
CO2: Develop neural networks based on associative memory for retrieving patterns	Apply
CO3: Build unsupervised learning networks using competitive strategy for solving clustering problems	Apply
CO4: Model inference systems using fuzzy rules for solving uncertainty problems	Apply
CO5: Develop genetic algorithm for solving optimization problems	Apply

Text Book(s):

T1. S.N. Sivanandam, S.N. Deepa, "Principles of Soft Computing", 3rd Edition, John Wiley & Sons, New Delhi, 2019.

Reference Book(s):

R1. Hitoshi Iba, Nasimul Noman, "Deep Neural Evolution: Deep Learning with Evolutionary Computation", Springer, 2020.

R2. N.P. Padhy, S.P. Simon, "Soft computing with matlab programming", Oxford University Press; 2015.

R3. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Wiley, 2016.

Web References:

1. NPTEL, Introduction to Soft Computing, URL: https://onlinecourses.nptel.ac.in/noc22_cs54/preview
2. Soft Computing IIT Kharagpur: URL: https://cse.iitkgp.ac.in/dsamanta/courses/sca/index.html
3. Fuzzy Sets, Logic and Systems & Applications: URL: https://onlinecourses.nptel.ac.in/noc22ee21/preview

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	1	1	2	3	1	-	1	-	-
CO2	3	2	2	2	2	1	1	2	3	2	1	1	3	2
CO3	-	-	2	2	2	-	-	2	3	2	1	1	3	2
CO4	3	2	2	2	2	1	1	2	3	2	1	1	-	1
CO5	3	2	-	-	2	1	1	2	3	-	-	1	3	2

High-3; Medium-2; Low-1

Course Code: 19ADEN1018	Course Title: Optimization Techniques		
Course Category: Professional Elective		Course Level: Mastery	
L: T : P(Hours/Week) 3: 0 : 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Solve optimization problems using Linear and Non-linear programming
2. Compute critical path for Activity Network models
3. Apply genetic Algorithm using Evolutionary Computation principles
4. Solve real world problems using Evolutionary Optimization techniques
5. Implement Swarm Intelligence approaches for optimizing practical applications

Unit I Classical Optimization Methods 9 Hours

General Linear Programming Model: Two variable LP Model – Graphical LP Solution – Simplex Method – Artificial Starting Solution – Non-linear Programming Algorithms: Unconstrained Algorithms – Constrained Algorithms.

Unit II Software Quality Assurance Components 9 Hours

Scope and Definition of Network Models – Minimum Spanning Tree Algorithm –Maximal flow model – CPM and PERT – Critical path Method (CPM) Computations – Construction of the Time Schedule – Linear Programming formulation of CPM – PERT Networks.

Unit III Evolutionary Computation 9 Hours

Genetic Algorithm – Conventional Optimization and Search Techniques – Comparison between Genetic Algorithm and traditional optimization method – Advantages - Limitations and Applications of Genetic Algorithm – Genetic Programming – Primitives of Genetic Programming – Attributes in Genetic Programming – Steps of Genetic Programming.

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Unit IV Evolutionary Optimization 9 Hours

Fuzzy optimization Problem – Mult objective Reliability Design Problem – Combinatorial Optimization Problem – Scheduling Problems – Transportation Problems – Network Designand Routing Problems.

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Unit V Natured Inspired Optimization 9 Hours

Particle Swarm Optimization – Ant Colony Optimization – Fish School Search Algorithm – Cuckoo Search Algorithm – Bat Algorithm – Applications of Nature Inspired Optimization Algorithms.

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Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply classical optimization methods to solve linear problems	Apply
CO2: Analyze network models and apply algorithms for network optimization	Apply
CO3: Compare and contrast traditional optimization methods with evolutionary computation techniques	Apply
CO4: Formulate and solve optimization problems in differentdomains using appropriate techniques	Apply
CO5: Evaluate the performance of nature-inspired optimizationalgorithms for specific applications	Apply

Text Book(s):

T1. Taha H.A., "Operations and Research – An Introduction", Pearson Education, 11th Edition, 2022. (Unit I & II)

T2. Sivanandam S.N., Deepa S. N., "Introduction to Genetic Algorithms", Springer, 2013. (Unit III & IV)

T3. T.A.Vasuki., "Nature-Inspired Optimization Algorithms", CRC Press, 2020. (Unit V)

Reference Book(s):

R1. Richard Johannes Boucherie, Henk Tijms, Aleida Braaksma, "Operations Research: Introduction To Models And Methods," World Scientific Publishing Company, 2021.

R2. Fouad Bennis, Rajib Kumar Bhattachariya, "Nature-Inspired Methods for Metaheuristics Optimization", Springer, 2020.

R3. Sumathi S., Surekha P., "Computational Intelligence Paradigms Theory and Applications using MATLAB", CRC Press, 2019.

Web References:

1. NPTEL problem-solving techniques : https://onlinecourses.nptel.ac.in/noc23_me40
2. Udemy linear programming: https://www.udemy.com/course/geneticalgorithm/
3. Coursera convex optimization: https://in.coursera.org/learn/operations-research-modeling

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	1	1	2	3	1	-	1	-	-
CO2	3	2	2	2	2	1	1	2	3	2	1	1	3	2
CO3	3	2	2	2	2	1	1	2	3	2	1	1	3	2
CO4	3	2	2	2	2	1	1	2	3	2	1	1	-	1
CO5	3	2	2	2	2	1	1	2	3	2	1	1	3	2

High-3; Medium-2; Low-1

Course Code: 19ADEN1019	Course Title: Information Retrieval Methods		
Course Category: Professional Elective		Course Level: Mastery	
L: T : P(Hours/Week) 3: 0 : 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Implement the text retrieval systems based on Boolean retrieval model
2. Deploy an algorithm for indexing using suitable index construction and compression methods
3. Evaluate the vector space model for any given document
4. Implement the query refinement process to match the semantically similar queries
5. Use web crawling and indexes to develop IR based web applications

Unit I Text Retrieval Systems 9 Hours

Boolean retrieval – The term vocabulary and postings lists: Document delineation – Determining the vocabulary of terms – Faster postings list intersection via skip pointers – Dictionaries and tolerant retrieval.

Unit II Index construction and Compression 9 Hours

Hardware basics – Blocked sort-based indexing – Single pass in-memory indexing – Distributed indexing – Dynamic indexing – Dictionary compression – Postings file compression – Term frequency and weighting.

Unit III Vector Space Models and Evaluation 9 Hours

Vector Space Model – TF–IDF functions – Scoring & Ranking – Evaluation in information retrieval: Information retrieval system evaluation – Standard test collections – Evaluation of unranked retrieval sets – Evaluation of ranked retrieval results – Assessing relevance.

Unit IV Query Expansion 9 Hours

Relevance feedback – Pseudo relevance feedback – Query Reformulation – Review of basic probability theory – Probability ranking principle – Binary independence model – Language models information retrieval.

Unit V Web Search Basics and IR Applications 9 Hours

Web Characteristic – Crawling – Distributing indexes – Connectivity servers – Web as a graph– Page Rank – Hubs and Authorities – Information extraction – Question answering – Opinionsummarization – Social Network.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Implement the text retrieval systems based on Boolean retrieval model by determining the vocabulary of terms	Apply
CO2: Deploy an algorithm for indexing using suitable index construction and compression methods for a given database	Apply
CO3: Evaluate the vector space model for any given document using different evaluation techniques	Apply
CO4: Implement the query refinement process to match the semantically similar queries by Relevance feedback and query expansion methods	Apply
CO5: Develop simple IR based web applications using web crawling and indexes	Apply

Text Book(s):

T1. Christopher D. Manning and Prabhakar Raghavan, "Introduction to Information Retrieval",Cambridge University Press, 2008.

Reference Book(s):

R1. Bruce Croft, Donald Metzler, Trevor Strohman, "Search Engines: Information Retrieval in Practice", Pearson Education, 2015.

R2. Ricardo Baeza-Yates, Berthier Ribeiro-Neto, "Modern Information Retrieval", 2nd Edition, Pearson Education, 2011

Web References:

1. Text Retrieval and Search Engines URL: https://www.coursera.org/learn/text-retrieval?
2. Search Engines: Information Retrieval in Practice URL: https://ciir.cs.umass.edu/irbook/
3. Introduction to Information Retrieval URL: http://nlp.stanford.edu/IR-book /html / htmledition/ irbook.html
4. Modern Information Retrieval URL: http://www.mir2ed.org/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	3	1	3	1	-	1	-	-
CO2	3	2	1	1	2	2	3	1	3	1	-	1	2	1
CO3	3	2	1	1	2	2	3	1	3	1	-	1	2	1
CO4	3	2	1	1	2	2	3	1	3	1	1	1	2	1
CO5	3	2	1	1	2	1	3	1	3	1	1	1	2	1

High-3; Medium-2; Low-1

Course Code: 19ADEN1020	Course Title: Reinforcement Learning		
Course Category: Professional Elective		Course Level: Mastery	
L: T : P(Hours/Week) 3: 0 : 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Utilize Reinforcement Learning tasks and the core principles of Markov Decision process behind the RL
2. Apply Dynamic Programming algorithms and Monte Carlo methods in policies, value functions
3. Develop value function with combined Temporal Difference Learning algorithm
4. Apply Integrating the Planning with RL algorithms
5. Analyze different solution methods for RL

Unit I Introduction to Reinforcement Learning & Problems 9 Hours

Introduction – History of Reinforcement Learning, Elements of Reinforcement Learning - Multi-armed Bandits - Finite Markov Decision Processes.

Unit II Dynamic Programming and Monte Carlo Methods 9 Hours

Policy Prediction & Evaluation - Policy Improvement Iteration - Value Iteration - Asynchronous Dynamic Programming - Efficiency. Monte Carlo Methods: Prediction – Estimation - Controls without Exploring Starts - Off policy Prediction with Importance Sampling - Incremental Implementation - Off policy Monte Carlo Control.

Unit III Temporal Difference Learning 9 Hours

Temporal Difference Learning: Prediction – Optimality – Sarsa - Q-learning – n-step Bootstrapping: n-step TD Prediction - Tree backup algorithm - Off policy learning - Unifying Algorithm.

Unit IV Integrating Planning with Learning 9 Hours

Models and Planning – Dyna – Real time Dynamic Programming - Planning at Decision Time-Heuristic Search - Rollout Algorithms - Monte Carlo Tree Search.

Unit V Solution Methods and Applications 9 Hours

On-policy Prediction with Approximation: Value prediction and control - Gradient Descent methods - Linear methods - On-policy Control with Approximation - Optimizing Memory Control - Video Game Play - Classical Games: Combining Minimax Search and RL.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Utilize Reinforcement Learning tasks and core principles for real time application	Apply
CO2: Apply the Dynamic programming algorithms in policies and Monte carlo methods in value function for solving the problem	Apply
CO3: Develop & estimate value function with combined Temporal difference Learning algorithm for policy prediction and learned estimates	Apply
CO4: Apply integrating planning with Reinforcement learning Algorithms for real time applications	Apply
CO5: Analyze different solution methods for policy prediction, approximation with real time applications	Apply

Text Book(s):

T1. Sutton R. S. and Barto A. G., "Reinforcement Learning: An Introduction", MIT Press, 2020.

Reference Book(s):

R1. Csaba Szepesvári, “Algorithms for Reinforcement Learning”, Morgan & Claypool, 2013.

R2. Kevin Murphy , “Machine Learning - A Probabilistic Perspective” , MIT press, 2012

R3. Christopher Bishop, “Pattern Recognition and Machine Learning”, Springer, 2016.

R4. Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach”, Prentice Hall, 2020.

Web References:

1. Tutorial on RL: https://www.javatpoint.com/reinforcement-learning
2. Introduction to Reinforcement Learning: https://www.geeksforgeeks.org/what-is-reinforcement-learning

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	1	1	2	3	1	-	1	-	-
CO2	3	2	2	2	2	1	1	2	3	2	1	1	3	2
CO3	3	2	2	2	2	1	1	2	3	2	1	1	3	2
CO4	3	2	2	2	2	1	1	2	3	2	1	1	-	1
CO5	3	2	2	2	2	1	1	2	3	2	1	1	3	2

High-3; Medium-2; Low-1

Course Code: 19ADEN2017	Course Title: Fundamentals of Virtualization		
Course Category: Professional Elective		Course Level: Mastery	
L: T : P(Hours/Week) 2: 0 : 2	Credits:3	Total Contact Hours: 60	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Explain the importance of Virtualization
2. Describe the significance of Server and Desktop Virtualization
3. Explore the tools in Network virtualization
4. Experiment the types storage virtualization
5. Use design principles to achieve Agility\\\

Unit I Virtualization and cloud computing 6 Hours

Virtualization and cloud computing - Need of virtualization – cost – administration - fast deployment - reduce infrastructure cost – limitations - Types of hardware virtualization: Full virtualization - partial virtualization – Paravirtualization -Types of Hypervisors.

Unit II Server and Desktop Virtualization 6 Hours

Virtual machine basics - Types of virtual machines- Understanding Server Virtualization - Types of server virtualization - Business Cases for Server Virtualization – Uses of Virtual Server Consolidation – Selecting Server Virtualization Platform - Desktop Virtualization- Types of Desktop Virtualization.

Unit III Network Virtualization 6 Hours

Introduction to Network Virtualization – Advantages – Functions - Tools for Network virtualization - VLAN - WAN Architecture - WAN Virtualization.

Unit IV Storage Virtualization 6 Hours

Memory Virtualization - Types of Storage Virtualization – Block – File - Address space Remapping - Risks of Storage Virtualization – SAN – NAS - RAID.

Unit V Virtualization Tools 6 Hours

VMWare - Amazon AWS - Microsoft HyperV - Oracle VM Virtual Box - IBM PowerVM - Google Virtualization - Case study.

List of Exercises **30 Hours**

1. Create type 2 virtualization in VMWARE or any equivalent Open Source Tool. Allocatememory and storage space as per requirement. Install Guest OS on that VMWARE .
2. Optimizing Storage Utilization: Disk Resizing, Snapshots, and Volume Management
    a. Shrink and extend virtual disk
    b. Create, Manage, Configure and schedule snapshots
    c. Create Spanned, Mirrored and Striped volume
    d. Create RAID 5 Volume
3. Remote Desktop Options: Exploring VNC and Chrome Remote Desktop
    a. Virtualization using VNC
    b. Desktop Virtualization using Chrome Remote Desktop
4. Create type 2 virtualization on ESXI 6.5 server
5. Create a VLAN in CISCO packet tracer
6. Create Nested Virtual Machine(VM under another VM)

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Understand the fundamental concepts of virtualization and cloud computing	Understand
CO2: Analyze and apply server and desktop virtualization techniques	Analyze
CO3: Explain the principles and applications of network virtualization	Apply
CO4: Evaluate and implement storage virtualization solutions	Apply
CO5: Gain hands-on experience with virtualization tools and platforms	Apply

Text Book(s):

T1. Anthony T.Velte , Toby J. Velte Robert Elsenpeter, ”Cloud computing a practical approach”,Tata McGraw- Hill , New Delhi , 2010. (Laboratory exercises)

T2. Rajkumar Buyya, James Broberg, Andrzej Goscinski,”Cloud Computing (Principles and Paradigms)”, John Wiley & Sons Inc. 2011. (Unit I & II)

T3. David Marshall, Wade A. Reynolds, “Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center”, Auer Bach, 2012. (Unit III, IV & V)

Reference Book(s):

R1. Chris Wolf, Erick M. Halter, “Virtualization: From the Desktop to the Enterprise”, APress, 2005.

R2. James E. Smith, Ravi Nair, “Virtual Machines: Versatile Platforms for Systems and Processes”, Elsevier/Morgan Kaufmann, 2005.

R3. David Marshall, Wade A. Reynolds, “Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center”, Auer Bach Publications, 2006.

Web References:

1. virtualization-technology: https://www.sciencedirect.com/topics/computer-science/virtualization-technology

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	1	1	2	3	1	-	1	-	-
CO2	3	2	2	2	2	1	1	2	3	2	1	1	3	2
CO3	3	2	2	2	2	1	1	2	3	2	1	1	3	2
CO4	3	2	2	-	-	1	1	2	3	2	1	1	-	1
CO5	3	2	2	2	2	1	1	-	-	2	1	1	3	2

High-3; Medium-2; Low-1

Course Code: 19ADEN2019	Course Title: Natural Language Processing Systems		
Course Category: Professional Elective		Course Level: Mastery	
L: T : P(Hours/Week) 2: 0 : 2	Credits:3	Total Contact Hours: 60	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Perform word and sentence recognition
2. Identify POS tags for words
3. Perform syntax analysis and construct parse trees
4. Determine word sense, semantic role and similarity
5. Develop NLP applications

Unit I Language Modeling **6 Hours**

Knowledge in Speech and Language Processing – Ambiguity – Regular Expressions Finite State Automata – Morphology – Finite State Transducers Word and Sentence Tokenization – Detecting and Correcting Spelling Errors – Minimum Edit Distance.

Unit II Word Level Analysis **6 Hours**

N-grams – Unsmoothed N - grams – Perplexity – Smoothing –Word Classes – Part of Speech Tagging – Rule-based - Stochastic - Transformation based tagging – Evaluation and issues in PoS tagging – Markov chains – Hidden Markov Model – Forward – Viterbi - Forward- Backward algorithms.

Unit III Syntax Analysis **6 Hours**

Context - Free Grammars – Grammar rules – Treebank - Dependency Grammars – Parsing asSearch – Ambiguity – Dynamic Programming parsing – Partial parsing – Probabilistic CFG – Probabilistic CKY parsing – Probabilistic Lexicalized CFGs.

Unit IV Semantics **6 Hours**

First Order Logic – Description Logics – Syntax-driven semantic analysis – Word Senses – Relations between Senses – Semantic roles – Word Sense Disambiguation: Supervised-Dictionary & Thesaurus methods – Word Similarity: Thesaurus and Distributional methods.

Unit V Pragmatics and Applications **6 Hours**

Discourse segmentation – Text Coherence – Reference, Anaphora and Co-reference resolution – Named Entity Recognition – Relation Detection and Classification – Information Retrieval – Factoid Question Answering – Summarization.

List of Exercises **30 Hours**

1. Download nltk and packages. Use it to print the tokens in a document and the sentences from it. Include custom stop words and remove them and all stop words from a given document using nltk or spaCY package.
2. Implement a stemmer and a lemmatizer program.
3. Implement a simple Part-of-Speech Tagger.
4. Write a program to calculate TFIDF of documents and find the cosine similarity between any two documents.
5. Use nltk to implement a dependency parser.
6. Implement a semantic language processor that uses WordNet for semantic tagging.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Construct Finite state automata and transducers for word recognition	Apply
CO2: Identify n-grams and Parts of Speech tags for sentences	Apply
CO3: Perform syntax analysis using appropriate parsing algorithms	Apply
CO4: Determine word sense and similarity between words usingsuitable methods	Apply
CO5: Implement NLP techniques for Information Extraction and retrieval	Apply

Text Book(s):

T1. Daniel Jurafsky and James H Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Prentice Hall, 2nd Edition, 2008. (Unit I, II & III)

T2. U. S. Tiwary and TanveerSiddiqui, "Natural Language Processing and information Retrieval", Oxford University Press, 2008. (Unit IV & V)

T3. Richard M Reese, "Natural Language Processing with Java", Packt Publishing, 2015. (Laboratory Exercises)

Reference Book(s):

R1. Christopher Manning, "Foundations of Statistical Natural Language Processing", MIT Press, 2009.

R2. Nitin Indurkhya,Fred J. Damerau, "Handbook of Natural Language Processing", 2nd Edition, Chapman & Hall/CRC: Machine Learning & Pattern Recognition, Hardcover, 2010 .

R3. Deepti Chopra, Nisheeth Joshi, "Mastering Natural Language Processing with Python", Packt Publishing Limited, 2016.

Web References:

1. NPTEL Course on Natural Language Processing : https://nptel.ac.in/courses/106101007/
2. NLP software Guide : https://nlp.stanford.edu/software/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	1	1	2	3	1	-	1	-	-
CO2	3	2	2	2	2	1	1	2	3	2	1	1	3	2
CO3	3	2	2	2	2	1	1	2	3	2	1	1	3	2
CO4	3	2	2	2	2	1	1	2	3	2	1	1	-	1
CO5	3	2	2	2	2	1	1	2	3	2	1	1	3	2

High-3; Medium-2; Low-1

Course Code: 19ADEN2020		Course Title: Web services and DevOps	
Course Category: Elective		Course Level: Mastery	
L:T:P(Hours/Week) 2: 0: 2	Credits: 3	Total Contact Hours: 60	Max Marks: 100

Prerequisites: Nil

Course Objectives

The course is intended to:

1. Demonstrate the various Amazon web services
2. Build CI/CD strategy followed in project development
3. Develop python applications using advanced features
4. Demonstrate the PowerShell basic commands
5. Design the PowerShell script for processes, services, management and remote execution

Unit I Amazon Web Services **6 Hours**

AWS Introduction-Identity and Governance-AWS Administration-Networking and Security-Network Connectivity-Network Traffic Management-AWS Storage-EC2-Data Protection-Containers and Serverless Computing-Monitoring

Unit II Devops **6 Hours**

Introduction to DevOps-GIT-Ansible-Jenkins-Dockers-DevOps with Azure and AWS

Unit III Python **6 Hours**

Python Introduction-Data Structures-Functions and Decorators-Modules-Error Handling-Input/ Output-Classes in Python - Regular Expressions-GUI in Python

Unit IV PowerShell Basics **6 Hours**

PowerShell Introduction-Data Structures-Objects-Conditional-Loops-Functions and Pipelines- Script Execution-Error Handling-Input / Output

Unit V PowerShell Advanced Features **6 Hours**

Text Processing and Regular Expressions-Configuration using XML-Windows Registry-Processes, Services and Event Log Management-WMI Management-Remote Execution-Workflow-Desired State Configuration (DSC)

List of Exercises **30 Hours**

1. Deploy a web application in EC2 & Elastic Beanstalk
2. Create Cloud Monitoring and Management Service using AWS CloudWatch
3. Install Git and check-in code into Repository
4. Build Database Schema Deployment Pipeline with Jenkins and Sqitch
5. Deploy Django app & its Content Management Systems in Cloud
6. Create Automated administrative tasks by using PowerShell

Course Outcomes	**Cognitive Level**
At the end of the course the student will be able to:	
CO1: Demonstrate the various Amazon web services for deploying applications and monitoring services	Apply
CO2: Build CI/CD strategy followed in project development using GIT, Docker and AWS	Apply
CO3: Develop python applications using advanced features	Apply
CO4: Demonstrate the powershell basic commands for file management with error handling	Apply
CO5: Design the powershell script for processes, services, management and remote execution	Apply

Web References:

1. https://aws.amazon.com/free/?
2. https://git-scm.com/docs/git#_git_commands
3. Official documentation of python 3.10: https://docs.python.org/3/tutorial/
4. https://www.pdq.com/powershell/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	2	1	1	2	3	2	2	1	1	-
CO2	3	2	1	1	2	1	1	2	3	2	2	1	1	-
CO3	3	2	1	1	2	1	1	2	3	2	2	1	2	-
CO4	3	2	1	1	1	-	-	2	3	2	-	1	-	-
CO5	3	2	1	1	1	-	-	2	3	2	-	1	-	-

High-3; Medium-2;Low-1

Course Code: 19ADEN2025	Course Title: Edge Computing		
Course Category: Professional Elective		Course Level: Mastery	
L:T :P(Hours/Week) 2:0:2	Credits:3	Total Contact Hours: 60	Max. Marks:100

Pre-requisites

- NIL

Course Objectives

The course is intended to:

1. Understand the foundation of cloud computing and its deployment & service models
2. Make use of virtualization concepts, types, hypervisors, and their role in edge computing
3. Explore the role of edge computing platforms, key techniques, and resource management
4. Analyze the potential of edge analytics, its architecture with IoT, and applications in IIoT
5. Evaluate various edge cloud service platforms and their data analytics capabilities

Unit I Cloud Computing Fundamentals with Virtualization 6 Hours

Cloud characteristics - Deployment models - Service models - Types of virtualizations - Types of Hypervisors - VM Migration: Cold and Live - Live Migration Techniques and advantages over WAN - VM Provisioning and manageability - Study on virtualization softwares: XEN – KVM - Hyper-v and Virtual box

Unit II Edge Cloud Platform 6 Hours

Edge computing role - Hierarchy of Edge Computing - Benefits - Key Techniques: Virtual machine and Container - Software Defined Network - Content Delivery Networks - Mobile Data centers

Unit III Edge Resource Management 6 Hours

Resource management: Kubernetes- Containers - Dockers - Edge to Cloud Protocols Edge computing challenges.

Unit IV Edge Analytics 6 Hours

Centralized cloud: Parallel processing - Map Reduce programming paradigm in cloud - Potential of Edge Analytics - IoT and Edge Architecture - Sensors and Endpoints - Edge Servers - Edge Gateways - Edge Devices and Management - Edge computing in IIoT.

Unit V Edge Cloud Services 6 Hours

Amazon AWS - Microsoft Windows Azure - Google App Engine - OpenStack - Azure IoT Edge - iFogSim - Eclipse ioFog - Data analytics on high potential applications.

List of Exercises **30 Hours**

1. Install Oracle Virtual box or Open Stack Virtual box and create two VMs and Install Turbo C in guest OS and execute C program and test the ping command to test the communication between the guest OS and Host OS.
2. Set up a Docker environment and explore container creation, management, and execution of simple applications.
3. Deploy a simple multi-container application using a Kubernetes cluster and explore basic resource management functionalities.
4. Simulate communication protocols used in edge computing environments (e.g., MQTT) using network simulators or emulators.
5. Design and implement a basic data processing pipeline on a chosen edge platform (e.g., Apache Flink) to analyze a simulated real-time data stream.
6. Develop a simple data analytics application on a chosen edge service platform to process sensor data from a simulated IoT device.

Course Outcomes		**Cognitive Level**
At the end of this course, students will be able to:		
CO1:	Deploy a virtual machine using a chosen hypervisor software in a simulated edge computing environment	Apply
CO2:	Explain the benefits of edge analytics compared to cloud analytics for the chosen application	Apply
CO3:	Implement resource management strategies using containers and Kubernetes for edge environments	Apply
CO4:	Evaluate the potential of edge analytics compared to centralized cloud analytics, particularly for real-time data processing and applications like Industrial IoT	Evaluate
CO5:	Explore leading edge cloud service platforms for data analytics on high-potential applications	Apply

Text Book(s):

T1. Rajkumar Buyya, James Broberg and AndrzejGoscinski, "Cloud Computing: Principles and Paradigms", Wiley, USA, 2017. (Unit I)

T2. Jie Cao, Quan Zhang, WeisongShi, “Edge Computing: a Primer”, Springer, Detroit, USA, 2018. (Unit III & IV)

T3. K. Anitha Kumari, G. Sudha Sadasivam, D. Dharani, M. Niranjanamurthy, “Edge Computing: Fundamentals, Advances and Applications”, CRC press, 2021. (Unit V)

Reference Book(s):

R1. Dac-Nhuong Le, Raghvendra Kumar, Gia Nhu Nguyen, Jyotir Moy Chatterjee, “Cloud Computing and Virtualization”, Wiley, USA, 2018.

R2. RajkumarBuyya, SatishNarayanaSrirama, “Fog and Edge Computing: Principles and Paradigms”, Wiley, USA, 2019.

Web References:

1. NPTEL Edge Computing Course: https://onlinecourses.nptel.ac.in/noc24_cs66/preview
2. CISCO guide on Edge Computing: https://www.cisco.com/c/en/us/solutions/enterprise-networks/edge-computing.html
3. IBM - Edge Computing, Concepts and Technologies: https://www.ibm.com/cloud/learn/edge-computing
4. Hewlett Packard Enterprise (HPE) - Edge Computing: The Future of the Internet of Things (IoT): https://www.hpe.com/us/en/what-is/edge-computing.html

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	1	3	-	-	-	1	3	-	2	-	2
CO2	3	1	-	3	3	-	-	-	1	2	-	1	-	2
CO3	3	3	2	3	3	-	-	-	2	3	-	3	-	3
CO4	-	-	3	-	2	-	-	-	1	2	-	3	-	3
CO5	3	-	3	-	3	-	-	-	3	1	-	3	3	2

High-3; Medium-2; Low-1

Vertical VI - Applied Robotics Electives

Course Code: 19ADEN1021	Course Title: Drone Technologies		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Understand the basics of drone concepts
2. Understand the fundaments of design, fabrication and programming of drone
3. Impart the knowledge of an flying and operation of drone
4. Know about the various applications of drone
5. Understand the safety risks and guidelines of fly safely

Unit I Introduction to Drone Technology 9 Hours

Drone Concept - Current Breadth of Drone Use - Future Breadth of Drone Use- Risks of Drone Technology - Concept Design and Design Development- Construction Administration – Time Based Site Comparisons.

Unit II Drone Flying and Operation 9 Hours

Drone Standard Features - Flying Skills - Flight Controller Automations – Support and troubleshooting - Drone Packages - Flight Conditions - Video and Photo Recording - Multimedia and Video Editing - Drone Flying Apps - Simulator Mode - Flight Operations - EmergencyOperations - Pre-flight Planning for Automated Flights.

Unit III Working with 3D Models 9 Hours

Point Cloud versus 3D Mesh - Working with Point Clouds and 3D Meshes - Third-Party Sites. Construction Management Viewing and Sharing Software — Point Cloud to Mesh – MeshDecimation - Mesh Manipulation and Proposed Features.

Unit IV Drones and Photogrammetry 9 Hours

Choosing a drone based on the application - Photogrammetry Accuracy and Precision- Ground Control Points- Collecting Data- RTK Drones, Ground Control Pads - Processing the Data- Photogrammetry Project Comparisons.

Unit V Acquiring and Working with Drone Data 9 Hours

Photo and Video Quality- Using DJI Standard Apps- Litchi Flight Planning Software- Litchi Smart Device App- Virtual Litchi Mission- Annotated Images- Photoshop Photo Matches- 3D Model Photo Matches- Working with Drone Videos.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain the fundamental concepts of drone technology, including its current and future applications	Understand
CO2: Demonstrate safe and proficient drone operation skills for emergency procedures	Apply
CO3: Compare and analyze appropriate sensors and actuators for Drones for specific application	Analyze
CO4: Select appropriate drones and apply photogrammetry techniques to collect and process aerial data	Apply
CO5: Acquire and manage drone data by understanding image/video quality for specific application	Analyze

Text Book(s):

T1. Daniel Tal and John Altschuld, "Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation", John Wiley & Sons Inc., 2021.

Reference Book(s):

R1. John Baichtal, "Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs", Que Publishing, 2016.

R2. Zavrsnik, "Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance", Springer, 2018.

Web References:

1. Drone Technology Future trend and practical application https://onlinelibrary.wiley.com/doi/book/10.1002/9781394168002: Course Articulation Matrix

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	1	1	2	3	1	-	1	2	2
CO2	3	2	2	2	2	1	1	2	3	2	-	1	3	2
CO3	3	-	-	-	2	1	-	2	3	2	-	1	3	2
CO4	3	2	2	2	2	1	-	2	3	2	-	1	2	1
CO5	3	2	2	2	2	1	-	2	3	2	-	1	3	2

High-3; Medium-2; Low-1

Course Code: 19ADEN1022	Course Title: Agricultural Robotics		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Identify the areas in agricultural process
2. Build sensor and system for agricultural applications
3. Implement Mechanics to the design various robot parameters
4. Identify various mechanisms into agricultural robotic
5. Develop suitable robotic system for specific agricultural tasks

Unit I Mechanized Agriculture **9 Hours**

History of Mechanized Agriculture – Farming Operations and Related Machines – Tillage – Planting Cultivation- and Harvesting- Agricultural Automation - Agricultural Vehicle Robot.

Unit II Precision Agriculture **9 Hours**

Sensors – types and agricultural applications - Global Positioning System (GPS) - GPS for civilian use - Differential GPS - Carrier-phase GPS - Real-time kinematic GPS - Military GPS – Geo graphic Information System - Variable Rate Applications and Controller Area Networks.

Unit III Traction and Testing **9 Hours**

Hitching - Principles of hitching - Types of hitches - Hitching and weight transfer - Control of hitches -Tires and Traction models - Traction predictor spread sheet - Soil Compaction - Traction Aids - Tractor Testing.

Unit IV Soil Tillage and Weed Management **9 Hours**

Tillage Methods and Equipment - Mechanics of Tillage Tools - Performance of Tillage Implements - Hitching of Tillage Implements - Weed Management - Conventional Cropping Systems – Tools - Crop Rotation - Mechanical Cultivation.

Unit V Machinery Selection **9 Hours**

Screw Conveyors - Pneumatic Conveyors - Bucket Elevators - Forage Blowers and cellaneous Conveyors - Machinery Selection - Field Capacity And Efficiency - Draft And Power Requirements - Machinery Costs.

Course Outcomes		Cognitive Level
At the end of this course, students will be able to:		
CO1:	Recognize the areas in agricultural process where robotics can be applied	Apply
CO2:	Integrate sensor and system for a required specific process in agricultural applications	Apply
CO3:	Apply mechanics to the design various robot parameters	Apply
CO4:	Convert various mechanisms into robot by providing actuation at specific links and joints of the mechanism	Analyze
CO5:	Develop suitable robotic system for specific agricultural tasks	Apply

Text Book(s):

T1. Ajit K. Srivastava, Carroll E. Goering, Roger P. Rohrbach, Dennis R. buckmaster, "Engineering Principles of Agricultural Machines", ASABE Publication, 2012. (Unit I & II)

T2. Myer Kutz,"Handbook of Farm, Dairy and Food Machinery Engineering", Academic Press, 2019. (Unit III, IV & V)

Reference Book(s):

R1. Qin Zhang, FrancisJ.Pierce, "Agricultural Automation Fundamentals and practices", CRC Press, 2016.

R2. Stephen L Young, Francis J. Pierce, "Automation: The Future of Weed Control in Cropping Systems", Springer, Dordrecht Heidelberg New York London, 2014.

Web References:

1. Agricultural Robotics: https://www.annualreviews.org/doi/10.1146/annurev-control-053018-023617

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	1	1	2	3	1	-	1	-	-
CO2	3	2	2	2	2	1	1	2	3	2	1	1	3	2
CO3	3	2	2	2	2	1	1	2	3	2	1	1	3	2
CO4	3	2	2	2	2	1	1	2	3	2	-	1	-	1
CO5	3	2	2	2	2	1	1	2	3	2	-	1	3	2

High-3; Medium-2; Low-1

Course Code: 19ADEN1023		Course Title: Robot Operating System	
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Explain the basics of Robot Operating Systems and its architecture
2. Illustrate Linux commands on the file system, rights aspects
3. Explain the applications of ROS in real world complex applications
4. Identify navigation through Debugging and Visualization
5. Explain about the hardware interfaces

Unit I Introduction to ROS 9 Hours

Introduction –The ROS Equation - History - distributions -difference from other meta-operating systems–services - ROS framework – operating system – releases.

Unit II Introduction to Linux Commands 9 Hours

UNIX commands - file system – redirection of input and output - File system security - Changing access rights - process commands – compiling, building and running commands – handling variables

Unit III Architecture of Operating System 9 Hours

File system - packages – stacks – messages – services – catkin workspace – working with catkin workspace - working with ROS navigation and listing commands

Unit IV Debugging and Visualization 9 Hours

Navigation through file system -Understanding of Nodes – topics – service – messages – bags – master –parameter server.

Unit V Files and Preprocessor Directives 9 Hours

Debugging of Nodes – topics – services – messages – bags – master – parameter – visualization using Gazebo - Rviz – URDF modeling – Xacro – launch files.

Hardware Interface: Sensor Interfacing – Sensor Drivers for ROS – Actuator Interfacing – Motor Drivers for ROS.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain the need for ROS and its significance	Apply
CO2: Summarize the Linux commands used in robotics	Understand
CO3: Explain the concepts behind navigation through file system	Apply
CO4: Explain the concepts of Node debugging	Apply
CO5: Summarize the issues in hardware interfacing	Understand

Text Book(s):

T1. Lentin Joseph, "Robot Operating Systems (ROS) for Absolute Beginners, Apress, 2018

T2. Aaron Martinez, Enrique Fernández, "Learning ROS for Robotics Programming", Packt Publishing Ltd, 2013.

Reference Book(s):

R1. Jason M O'Kane, "A Gentle Introduction to ROS", CreateSpace, 2013.

R2. Anis Koubaa, "Robot Operating System (ROS) – The Complete Reference (Vol.3), Springer, 2018.

R3. Kumar Bipin, "Robot Operating System Cookbook", Packt Publishing, 2018.

R4. Wyatt Newman, "A Systematic Approach to learning Robot Programming with ROS", CRC Press, 2017.

R5. Patrick Gabriel, "ROS by Example: A do it yourself guide to Robot Operating System", Lulu, 2012.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	1	3	-	-	-	1	3	-	2	-	2
CO2	3	1	-	3	3	-	-	-	1	2	-	1	-	2
CO3	3	3	2	3	3	-	-	-	2	3	-	3	-	3
CO4	-	-	3	-	2	-	-	-	1	2	-	3	-	3
CO5	3	-	3	-	3	-	-	-	3	1	-	3	3	2

High-3; Medium-2; Low-1

Course Code:19ADEN1024	Course Title: Collaborative Robotics		
Course Category: Professional Elective		Course Level: Mastery	
L:T: P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Artificial Intelligence – I & II

Course Objectives

The course is intended to:

1. Understand technology applications, and limitations of Cobots
2. Evaluate the benefits and challenges of COBOT implementation in various situations
3. Propose real-world COBOT applications for specific needs and environments
4. Learn HRI principles for safe and efficient human-robot interaction
5. Explore COBOT trends and research, preparing for their evolving role in society

Unit I Introduction to Cobots **9 Hours**

Definition - Comparison with Traditional Robots - Advantages - Limitations - Cobot Anatomy: Sensors – Actuators - Control Systems - Safety Features - Applications across Industries: Manufacturing, Healthcare, Logistics, Retail - HRI Principles for Cobots: NLP - Gesture Recognition - Shared Workspace Modeling - Case Studies of Successful Cobot Implementations.

Unit II Cobot Programming and Control **9 Hours**

Introduction to Cobot Programming Languages and Environments - Motion Planning and Trajectory Generation for Cobots - Force Control and Sensor - based Interaction - Safety Programming and Error Handling - Interfacing Cobots with Other Systems: PLCs - MES - Cloud Platforms.

Unit III Cobot Applications in AI & Data Science **9 Hours**

Robotics for Data Acquisition and Manipulation - Collaborative Robots for Machine Learning Tasks - Cobots for Anomaly Detection and Predictive Maintenance - Integration with Computer Vision and Deep Learning - Case Studies of Cobot-Driven AI & DS Solutions.

Unit IV Roboethics: Social and Ethical Implication of Robotics **9 Hours**

Risk Assessment and Hazard Identification for HRC - Collaborative Robot Safety Standards Compliance - Design Principles for Safe Human - Robot Workplaces - Human Factors and Ergonomics: Training - User Interfaces - Cognitive Workload - Ethical Considerations for Cobot Deployment.

Unit V Safety and Standards for Cobot Systems **9 Hours**

Advancements in Cobot Technology: Soft Robotics – Bio - inspired Designs - AI-powered Cobots- Integration with IoT and Industry 4.0 - Human-Robot Co-creation and Collaborative Intelligence - Challenges and Opportunities for HRC in the Future - Emerging Research Areas in Cobot Technology and Applications.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Understand the workings of Cobot, their components, and functionalities	Understand
CO2: Analyzing the advantages and disadvantages of Cobot implementation in various contexts	Analyze
CO3: Designing and proposing real-world Cobot solutions tailored to specific needs and environments	Apply
CO4: Determine HRI principles for safe and efficient interactions between humans and Cobots	Apply
CO5: Use emerging trends and research in Cobots, preparing for their evolving impact on society	Apply

Text Book(s):

T1. Edward T. Lyons, Daniel F. Johnson, "Cobots: Design and Application", 2nd Edition, Springer, 2023. (Unit I & II)

T2. Pamela Hinds, Nadine Lampert, Jean-Marc Mirenda, Mehran Moallem, "Robots and Human Interaction: An Introduction" Cambridge University Press, 2016. (Unit III & IV)

T3. John N. Pires, Eduardo I. Garcia, Aitor Moreno Murugarren, "Collaborative Robotics and Intelligent Industrial Systems", Springer, 2014. (Unit V)

Reference Book(s):

R1. Anupam Jena, Amit Kumar Pandey "Human-Robot Interaction" CRC Press, 2023.

R2. Alessandro De Luca, Bruno Siciliano, "Robot Programming: A Guide to Control, Planning, and Self-Motion", Springer, 2018.

R3. Rodney Brooks, Anita K. Goel ,"Introduction to AI Robotics",MIT Press, 2017.

Web References:

1. The Cobot Guide: https://www.universal-robots.com/blog/guide-to-ur-cobot-implementation/
2. Universal Robots Academy: https://academy.universal-robots.com/
3. ABB Robotics Learning Portal: https://new.abb.com/products/robotics/robots/articulated-robots/irb-1200
4. RoboHub: https://robohub.org/category/news/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	3	3	1	-	1	-	1	-	1
CO2	2	1	-	-	-	3	3	1	-	1	-	1	-	1
CO3	2	1	-	-	-	3	3	1	-	1	-	1	2	1
CO4	2	1	-	-	-	3	3	1	-	1	-	1	2	1
CO5	3	2	1	1	1	3	3	1	-	1	-	1	2	1

High-3; Medium-2; Low-1

Course Code: 19ADEN2021	Course Title: Sensors and Instrumentation		
Course Category: Professional Elective		Course Level: Mastery	
L: T : P(Hours/Week) 2: 0 : 2	Credits:3	Total Contact Hours: 60	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Understand the concepts of measurement technology
2. Explain the various sensors used to measure various physical parameters
3. Apply the fundamentals of signal conditioning
4. Demonstrate about the optical, pressure and temperature sensor
5. Apply the signal conditioning and DAQ systems for given application

Unit I Sensor Calibration Techniques 6 Hours

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors Sensor calibration techniques – Sensor Output Signal Types.

Unit II Motion, Proximity and Ranging Sensors 6 Hours

Motion Sensors – Potentiometers – Resolver - Encoders – Optical – Magnetic – Inductive – Capacitive - LVDT – RVDT – Synchro – Microsyn - Accelerometer – GPS – Bluetooth - Range Sensors – RF beacons - Ultrasonic Ranging - Reflective beacons - Laser Range Sensor (LIDAR).

Unit III Force, Magnetic and Heading Sensors 6 Hours

Strain Gage - Load Cell - Magnetic Sensors – types – principle - requirements and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass - Gyroscope - Inclinometers.

Unit IV Optical, Pressure and Temperature Sensors 6 Hours

Photoconductive cell - photo voltaic - Photo resistive - LDR – Fiber optic sensors – Pressure –Diaphragm - Bellows - Piezoelectric – Tactile sensors - Temperature – IC - Thermistor - RTD -Thermocouple. Acoustic Sensors – flow and level measurement - Radiation Sensors – Smart Sensors - Film Sensors - MEMS & Nano Sensors - LASER sensors.

Unit V Signal Conditioning and DAQ Systems 6 Hours

Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel andmultichannel data acquisition – Data logging - applications - Automobile - Aerospace - Home appliances - Manufacturing - Environmental monitoring.

List of Exercises **30 Hours**

1. Determination of Load, Torque and Force using Strain Gauge.
2. Determination of the characteristics of Pressure Sensor and Piezoelectric Force Sensor.
3. Determination of Displacement using LVDT.
4. Determine the Characteristics of Various Temperature Sensors.
5. Determine the Characteristics of Various Light Detectors (Optical Sensors).
6. Distance Measurement using Ultrasonic and Laser Sensor.

Course Outcomes		**Cognitive Level**
At the end of this course, students will be able to:		
CO1:	Recognize various calibration techniques and signal types for sensors	Apply
CO2:	Describe the working principle and characteristics of force, magnetic, heading, pressure and temperature, smart and other sensors and transducer	Apply
CO3:	Apply the various sensors and transducers in various applications	Apply
CO4:	Select the appropriate sensor for different applications	Apply
CO5:	Acquire the signals from different sensors using Data acquisition	Apply

Text Book(s):

T1. Ernest O Doebelin, "Measurement Systems – Applications and Design", Tata McGraw-Hill, 2009. (Unit I & II)

T2. Sawney A K and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", Dhanpat Rai & Co, 12th Edition New Delhi, 2013. (Unit: III, IV & V)

Reference Book(s):

R1. C. Sujatha Dyer, " Survey of Instrumentation and Measurement", John Wiley &sons, Canada, 2001.

R2. Hans Kurt Tönshoff, Ichiro, "Sensors in Manufacturing" Volume 1, Wiley- VCH, April 2001.

Web References:

1. Process Instrumentation and sensors : https://www.controleng.com/process-instrumentation-sensors/:Process Instrumentation and sensors

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	3	-	-	-	1	3	-	2	2	2
CO2	1	1	2	3	3	-	-	-	1	2	-	1	3	2
CO3	2	3	2	1	3	-	-	-	2	3	-	1	3	3
CO4	1	2	1	3	2	-	-	-	1	2	1	3	3	3
CO5	3	3	3	1	3	-	-	-	3	1	3	1	3	2

High-3; Medium-2; Low-1

Course Code: 19ADEN2022	Course Title: Embedded Computing Systems		
Course Category: Professional Elective		Course Level: Practice	
L: T : P(Hours/Week) 2: 0 : 2	Credits:3	Total Contact Hours: 60	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Understand about the types of Embedded System and various devices in Arm Processor
2. Design ARM processor Peripherals using Embedded 'C'
3. Examine the significance of operating systems in embedded system design
4. Select the suitable communication technique to interface peripheral and sensors
5. Explain the system architecture using existing product design

Unit I Embedded system and Arm Processor 6 Hours

Definition of Embedded System — Features of Embedded System — Types of Embedded System – List of Embedded System Devices - LPC 2148 ARM Block diagram – Memory and on chip peripheral devices – ARM 7 TDMI - S - CPU registers – Modes of Operation — PSW — Instruction set.

Unit II ARM Processor Interfacing Techniques 6 Hours

GPIO register map – Pin Connect Block - 8 bit LEDs – 8bit Switches – Buzzer – Relay — Timer/Counter - Vector Interrupt Controller (VIC) — ADC — Temperature sensor interfacing.

Unit III Real Time Operating Systems 6 Hours

Tasks and states - scheduling - Inter Process Communication- Semaphore(s) - Shared data problem - Priority Inversion Problem and Deadlock Situations - Message Queues - Mailboxes - Pipes - Introduction to µC OS II – Porting of µC OS II – RTOS functions.

Unit IV Communication Devices and Bus Standards 6 Hours

I/O Devices: Types and Examples of I/O devices - Synchronous – ISO - synchronous and Asynchronous Communications from Serial Devices - Internal Serial-Communication Devices: SPI - UART — Serial Communication using I^2C.

Unit V System Design Techniques 6 Hours

Design Methodologies - Requirement Analysis - Specification - System Analysis and Architecture Design. Design Examples: Hardware Design and Software Design Telephone PBX - System Architecture - Ink jet printer - Personal Digital Assistants.

List of Exercises **30 Hours**

Write the Programs in Embedded C for the following experiments

1. 8 bit LED and switch Interface
2. Buzzer and Relay Interface
3. Stepper Motor Interface
4. Time delay program using built in Timer / Counter feature

RTOS based experiments

1. Blinking two different LEDs
2. Reading temperature from LM 35 interface and plot the temperature vs Time graph using Graphics LCD — Study Experiment

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Describe the programming concept involved in ARM Processor Architecture	Apply
CO2: Design ARM processor Peripherals using Embedded 'C' for anygiven problem scenario	Apply
CO3: Examine the significance of operating systems in embedded System design for Real Time operating Systems applications	Apply
CO4: Select the suitable communication technique to interface peripheraland sensors for Real Time operating Systems	Apply
CO5: Explain the system architecture using existing product design for any real time applications systems	Apply

Text Book(s):

T1. Rajkamal, "Embedded Systems Architecture, Programming and Design", 3rd Edition, TataMcGraw-Hill, 2017.

T2. UWayne Wolf, "Computers as Components: Principles of Embedded Computing System Design", Morgan Kaufman Publishers, 2016.

Reference Book(s):

R1. David E. Simon," An Embedded Software Primer", 1st Indian Reprint, Pearson Education Asia, 2002.

R2. K.V.K.Prasad "Embedded /Real-Time Systems: Concepts, Design and programming", Dream Tech, Wiley 2013.

R3. Steve Furber, "ARM System on chip Architecture", 2nd Edition, Addision Wesley, 2015.

Web References:

1 LPC214x User manual: http://www.nxp.com/documents/user_manual/UM10139.pdf

2 NPTEL - Embedded Systems : https://nptel.ac.in/courses/106/105/106105193/

3 Coursera -Real-Time Embedded Systems Concepts and Practices: https://www.coursera.org/learn/real-time-embedded-systems-concepts- practices

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	3	-	-	-	1	3	-	2	2	2
CO2	1	1	2	3	3	-	-	-	1	2	-	1	3	2
CO3	2	3	2	-	3	-	-	-	2	3	-	1	3	3
CO4	1	2	1	-	2	-	-	-	1	2	-	3	3	3
CO5	3	3	3	-	3	-	-	-	3	1	-	1	3	2

High-3; Medium-2; Low-1

Course Code: 19ADEN2023	Course Title: Robotic Automation Technology		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 2: 0: 2	Credits:3	Total Contact Hours:60	Max.Marks:100

Pre-requisites

- Artificial Intelligence – I & II

Course Objectives

The course is intended to:

1. Explain RPA, where it can be applied and how it's implemented
2. Explain the different types of variables, control flow and data manipulation techniques
3. Identify and understand image, text and data tables automation
4. Explain how to handle the user events and various types of exceptions and strategies
5. Build the deployment of the robot and to maintain the connection

Unit I Emergence of Robotic Process Automation 6 Hours

Emergence of Robotic Process Automation (RPA) - Evolution of RPA - Differentiating RPA from Automation - Benefits of RPA - Application areas of RPA - Components of RPA - RPA Platforms - Robotic Process Automation Tools - Templates - User Interface - Domains in Activities - Workflow Files.

Unit II Automation Process Activities 6 Hours

Sequence - Flowchart & Control Flow: Sequencing the Workflow - Activities - Flowchart - Control Flow for Decision making - Data Manipulation: Variables - Collection - Arguments - Data Table - Clipboard management - File operations Controls: Finding the control - waiting for a control - Act on a control - UI Explorer - Handling Events.

Unit III App Integration, Recording and Scraping 6 Hours

App Integration - Recording - Scraping - Selector - Workflow Activities - Recording mouse and keyboard actions to perform operation - Scraping data from website and writing to CSV - Process Mining.

Unit IV Exception Handling and Code Management 6 Hours

Exception handling - Common exceptions - Logging- Debugging techniques - Collecting crash dumps - Error reporting - Code management and maintenance: Project organization - Nesting workflows - Reusability - Templates - Commenting techniques - State Machine.

Unit V Deployment and Maintenance 6 Hours

Publishing using publish utility - Orchestration Server - Control bots - Orchestration Server to deploy bots - License management - Publishing and managing updates - RPA Vendors - Open Source RPA - Future of RPA.

List of Exercises **30 Hours**

1. Create a Sequence to obtain user inputs display them using a message box.
2. Create a Flowchart to navigate to a desired page based on a condition.
3. Create a State Machine workflow to compare user input with a random number.
4. Build a process in the RPA platform using UI Automation Activities.
5. Create an automation process using key System Activities, Variables and Arguments.
6. Scraping data from website and writing to CSV.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Build the RPA and the ability to differentiate it from other types of automation	Apply
CO2: Demonstrate to store and manipulate data in a more persistent way using such files as CSV and Excel	Analyze
CO3: Automate tasks using app integration, recording, scraping, and data extraction.	Apply
CO4: Handle exceptions through logging, debugging, and code management	Apply
CO5: Deploy and maintain RPA processes including publishing, orchestration and updates.	Apply

Text Book(s):

T1. Tom Taulli, "The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems", Apress publications, 2020.

T2. Alok Mani Tripathi, "Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool – UiPath", Packt Publishing, 2018.

Reference Book(s):

R1. Frank Casale ,Rebecca Dilla, Heidi Jaynes ,Lauren Livingston, "Introduction to Robotic Process Automation: a Primer" , Institute of Robotic Process Automation, Amazon Asia-Pacific Holdings Private Limited, 2018.

R2. "Robots, Automate Repetitive Tasks & Become An RPA Consultant", AmazonPacific Holdings Private Limited, 2018.

Web References:

1. What is Robotic Process Automation - RPA Software | UiPath [SNIPPET] https://www.uipath.com/rpa/robotic-process-automation
2. AI-powered automation : https://www.academy.uipath.com

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	3	-	-	-	1	3	3	2	2	2
CO2	1	1	2	3	3	-	-	-	1	2	3	1	3	2
CO3	2	3	2	3	3	-	-	-	2	3	1	1	3	3
CO4	1	2	1	2	2	-	-	-	1	2	1	3	3	3
CO5	3	3	3	3	3	-	-	-	3	1	1	1	3	2

High-3; Medium-2; Low-1

Course Code: 19ADEN2024	Course Title: Mobile Robotics		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 2:0:2	Credits:3	Total Contact Hours:60	Max. Marks:100

Pre-requisites

- NIL

Course Objectives

The course is intended to:

1. Introduce mobile robotic technology and its types in detail
2. Learn the kinematics of wheeled and legged robot
3. Familiarize the intelligence into the mobile robots using various sensors
4. Acquaint the localization strategies and mapping technique for mobile robot
5. Aware the collaborative mobile robotics in task planning, navigation and intelligence

Unit I Robot Locomotion **6 Hours**

Introduction – Locomotion of the Robots – Key Issues on Locomotion – Legged Mobile Roots – Configurations and Stability – Wheeled Mobile Robots – Design Space and Mobility Issues – Unmanned Aerial and Underwater Vehicles.

Unit II Robot Kinematics **6 Hours**

Kinematic Models – Representation of Robot – Forward Kinematics – Wheel and Robot Constraints – Degree of Mobility and Steer ability – Manoeuvrability – Workspace – Degrees ofFreedom – Path and Trajectory Considerations – Motion Controls - Holonomic Robots.

Unit III Perception for Mobile Robots **6 Hours**

Sensor for Mobile Robots – Classification and Performance Characterization – Wheel/Motor Sensors – Heading Sensors - Ground-Based Beacons - Active Ranging - Motion/Speed Sensors – Camera - Visual Appearance based Feature Extraction.

Unit IV Localization **6 Hours**

Localization Based Navigation Versus Programmed Solutions - Map Representation - Continuous Representations - Decomposition Strategies - Probabilistic Map-Based Localization- Landmark-Based Navigation - Globally Unique Localization - Positioning Beacon Systems - Route-Based Localization - Autonomous Map Building - Simultaneous Localization and Mapping (SLAM).

Unit V Planning, Navigation and Collaborative Robots **6 Hours**

Introduction - Competences for Navigation: Planning and Reacting - Path Planning - Obstacle Avoidance - Navigation Architectures - Control Localization - Techniques for Decomposition -Case Studies – Collaborative Robots – Swarm Robots.

List of Exercises **30 Hours**

1. Implement the Locomotion of the Robots.
2. Implementation of Kinematic Model Robots.
3. Apply the sensors for Mobile Robots and evaluate the performance.
4. Implementation of different Localization techniques.
5. Apply the SLAM techniques in real-time environment.
6. Develop a Swarm Robot.

Course Outcomes		**Cognitive Level**
At the end of this course, students will be able to:		
CO1:	Evaluate the appropriate mobile robots for the desired application	Apply
CO2:	Create the kinematics for given wheeled and legged robot	Apply
CO3:	Analyze the sensors for the intelligence of mobile robotics	Analyze
CO4:	Build the localization strategies and mapping technique for mobile robot	Apply
CO5:	Create the collaborative mobile robotics for planning, navigation and intelligence for desired applications	Apply

Text Book(s):

T1. Roland Siegwart and Illah R.Nourbakish, “Introduction to Autonomous Mobile Robots” MITPress, Cambridge, 2004.

Reference Book(s):

R1. Dragomir N. Nenchev, Atsushi Konno, TeppeiTsujita, “Humanoid Robots: Modelling and Control”, Butterworth-Heinemann, 2018.

R2. MohantaJagadish Chandra, “Introduction to Mobile Robots Navigation”, LAP Lambert Academic Publishing, 2015.

R3. Xiao Qi Chen, Y.Q. Chen and J.G. Chase, “Mobile Robots - State of the Art in Land, Sea, Air, and Collaborative Missions”, Intec Press, 2009.

Web References:

1. Research Article on Advanced Mobile Robotics: https://www.mdpi.com/books/book/2067-advanced-mobile-robotics-volume-1
2. Research Article on Introduction to Mobile Robot Control: https://www.academia.edu/11985316/Introduction_to_Mobile_Robot_Control

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-		-	1	1	-	-	-	1
CO2	2	-	2	-	-	-		-	1	1	-	-	2	1
CO3	2	3	-	1	-	1		-	1	1	2	-	2	2
CO4	2	-	2	1	-	2		-	1	1	2	-	2	3
CO5	2	-	2	1	-	2		-	1	1	3	-	3	3

High-3; Medium-2; Low-1

Diversified Electives

Course Code: 19ITEC1001	Course Title: Intellectual Property Rights (common to all B.E/B.Tech programmes)		
Course Category: Professional Elective		Course Level: Introductory	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Describe the basic concepts of Intellectual Property Law
2. Explain the classification of Patents and its Rights and Limitations
3. Explain the Patent Searching Process and Application Filling Process
4. Describe the concepts and principles of Trademark
5. Explain the principles of copyright and its sources

Unit I Intellectual Property: An Introduction 9 Hours

Intellectual Property Law: Patent Law-Copyright Law-Trademark Law- Trade secret Law-Right of Publicity-Paralegal tasks in Intellectual Property Law-Ethical obligations of the paralegal in Intellectual Property Law-Trade secrets: Protectible as a trade secret-Maintaining trade secrets- Protecting an Idea .

Unit II Patents: Rights and Limitations 9 Hours

Sources of patent law-Subject matter of Patents: Utility Patents-Plant Patents-Design Patents- Design Patents and copyright-Design Patents and trademarks-Computer Software, Business methods and Patent Protection-Rights under Patent Law-Patent Requirements-Limitations on Patent Rights-Patent Ownership.

Unit III Patents: Research, Applications, Disputes, and International Considerations 9 Hours

Patent Search Process-Patent Application Process-Patent Infringement-Patent Litigation, International Patent laws.

Unit IV Principles of Trademark 9 Hours

Trademarks and Unfair Competition-Acquiring Trademark Rights-Types of Marks, Strong Marks Versus Weak Marks-Selecting and Evaluating a Trademark-International Trademark Laws.

Unit V Principles of Copyrights 9 Hours

Sources of Copyright Law- The Eight Categories of Works of Authorship-Derivative Works and Compilations- Rights and Limitations: Grant of Exclusive Rights–Copyrights Ownership-International Copyright Laws.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Describe the basics of Intellectual Property Law and programming	Apply
CO2: Identify the Rights and Limitations of various patents	Apply
CO3: Apply the process of patent search and application filling process	Apply
CO4: Explain the concept of trademark and its types	Apply
CO5: Classify the concepts of copyrights and its limitations	Apply

Text Book(s):

T1. Richard Stim, “Intellectual Property: Copyrights, Trademark and Patents”, Cengagelearning, 2nd edition 2012.

Reference Book(s):

R1. Deborah E. Bouchoux, “Intellectual Property: The Law of Trademarks, Copyrights,Patents and Trade Secrets”, Cengage Learning, Third Edition, 2013.

R2. Prabuddha Ganguli,”Intellectual Property Rights: Unleashing the Knowledge Economy”,McGraw Hill Education, 2017.

Web References:

1. https://ipindia.gov.in/writereaddata/Portal/ev/sections-index.html

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	2	-	-	-	-	-	2	-	-
CO2	2	-	-	2	-	-	-	-	-	-	-	-	2	-
CO3	-	3	3	-	-	-	-	-	-	-	2	-	-	3
CO4	-	-	-	-	-	-	-	2	2	-	-	-	-	-
CO5	-	-	-	-	2	-	2	-	-	-	-	2	-	-

High-3; Medium-2; Low-1

Course Code: 19MEEC1025	Course Title: Fundamentals of Entrepreneurship (common to all B.E/B.Tech programmes)		
Course Category: Professional Elective		Course Level: Introductory	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Describe the types, characteristics of entrepreneurship and its role in economic
2. Define the types of entrepreneurship
3. Explain the appropriate form of business ownership in setting up an enterprise
4. Disseminate the support and management to entrepreneurs in the growth strategies in
5. Explain the techniques involved in development of industries

Unit I Entrepreneurship **9 Hours**

Entrepreneur – Characteristics – Entrepreneurial Decision Process-Types of Entrepreneurs – Difference between Entrepreneur and a manager-Intrapreneur-Social Entrepreneur – Entrepreneurial Growth- Role of Entrepreneurship in Economic Development.

Unit II Types of Entrepreneurship **9 Hours**

Women Entrepreneurship-Rural Entrepreneurship-Tourism Enterprise, Entrepreneurship-Policy Measure of Tourism Entrepreneurship-Eco-Tourism/Nature Tourism/Rural Tourism-Need, Opportunities, Challenges for Developing Agri-preneurship-Social Entrepreneurship.

Unit III Start-Up **9 Hours**

Small Enterprises-Micro and Macro Units-Essentials, Features and Characteristics-Relationship between Micro and Macro Enterprises-Scope of Micro and Small Enterprises-Enterprise and Society-Package for Promotion of Micro and Small-Scale Enterprises-Problems of Micro and Small Enterprises- Identification of Business Opportunity-Steps in Setting Up of a Small Business Enterprise – Content of Business Plan- Significance of Business Plan, Formulation of Business Plan – Guidelines for Formulating Project Report– Project Appraisal.

Unit IV Support and Management **9 Hours**

Institutional Finance-Types of Lease Agreements-Lease Financing-Concept and Procedure for Hire-Purchase-Institutional Support to Small Entrepreneurs-Tax Benefits- Depreciation, Rehabilitation Allowance- Investment Allowance-Expenditure to Scientific Research-Tax Concession in Rural and Backward Areas-Difference between Management and Administration-Management of Working Capital-Methods of Inventory Management-Production Design-Market Segmentation-Marketing Mix.

Unit V Development **9 Hours**

Accounting for Small Enterprise-Types of Growth Strategies-Signal and Symptoms, Causes and Consequences of Industrial Sickness-Forms of Export Business-Types of Documents-E-Commerce Suitability for Small Enterprises-Types of Franchising-Evaluation of Franchise Arrangement-Corporate Citizenship.

Course Outcomes		Cognitive Level
At the end of this course, students will be able to:		
CO1:	Explain the types, characteristics of entrepreneurship and its Role in economic development.	Apply
CO2:	Classify various types of entrepreneurship and highlight the opportunities to improve the economy of India.	Apply
CO3:	Select the appropriate form of business ownership in setting up An enterprise.	Apply
CO4:	Determine the financial planning to become an Entrepreneur and manage tax benefits that can be provided to the small Entrepreneurs.	Analyze
CO5:	Identify the techniques involved in the development of the small enterprise for the growth of industries.	Apply

Text Book(s):

T1. S.S.Khanka, "Entrepreneurial Development" S.Chand & Co. Ltd. Ram Nagar NewDelhi, 2020.

Reference Book(s):

R1. Charantimath, P. M., "Entrepreneurship Development and Small Business Enterprises", Pearson, 2006.

R2. Mathew J Manimala," Entrepreneurship theory at cross roads: paradigms and praxis" Dream tech, 2nd edition 2006.

R3. Rabindra N. Kanungo, "Entrepreneurship and innovation", Sage Publications, NewDelhi, 2003.

R4. Singh, A. K., "Entrepreneurship Development and Management", University Science Press, 2009.

Web References:

1. NPTEL course on Entrepreneurship Development :https://nptel.ac.in/courses/127105007
2. Tutorial on Entrepreneurship Development: https://ncert.nic.in/ncerts/l/lebs213.pdf

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	3
CO2	-	2	-		-	3	3	-	-	-	-	-
CO3	-	-	-	2	-	-	-	-	-	2	-	-
CO4	-	-	-	-	3	-	-	3	-	-	3	-
CO5	-	-	2	-	-	-	-	-	2	-	-	-

High-3; Medium-2; Low-1

Course Code: 19MEEC1026	Course Title: Design Thinking and Innovation(common to all B.E/B.Tech programmes)		
Course Category: Professional Elective		Course Level: Introductory	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Disseminate the fundamental concepts and principles of design thinking
2. Explain the design thinking methods in each stage of the problem
3. Conceptualize innovative ideas using prototypes
4. Explain the significance of Evaluating and Testing Ideas
5. Describe the design thinking approach to real world problems

Unit I Introduction to Design Thinking **9 Hours**

Design thinking overview - Impact of Design Thinking - Design Process – Principles of Design Thinking – Creating Ideal Conditions – Case Study: Identify problem in AI .

Unit II Understand the Problem **9 Hours**

Information Gathering – Analysis – Storytelling tool- Innovation- Ideation Finding and Evaluating Ideas –Mind Mapping Tool. Case Study: Analysis of the Identified Problem.

Unit III Defining Prototypes **8 Hours**

Tasks in Prototyping – Understanding Different Prototypes - Developing different prototypes – Demonstration – Prototyping Tools. Case Study: Prototype the solution.

Unit IV Evaluating and Testing Ideas **10 Hours**

Finding Ideas – Developing Ideas Intuitively and Creatively - Selecting Evaluation method Evaluating Ideas with checklist –Testing Ideas and Assumptions – Tasks in the Test Phase – Testing with Interviews – Testing with Online Studies – Case Study: Evaluate the solution.

Unit V Applications **9 Hours**

Politics and Society – Business – Strategic technology Plan – Creativity – Visioning, Listening and Diagramming - HealthCare and Science – Approach to treat Cancer – Law Problem Definition – Alternatives.

Course Outcomes		Cognitive Level
At the end of this course, students will be able to:		
CO1:	Apply the key concepts of design thinking	Apply
CO2:	Relate design thinking in all stages of problem solving	Apply
CO3:	Identify the diverse methods employed in design thinking and establish a workable design thinking framework to use in their practices	Analyze
CO4:	Determine the significance of testing and evaluating the solution	Analyze
CO5:	Apply design thinking skills to solve real time user experience problems	Apply

Text Book(s):

T1. Muller-Roterberg "Design thinking for dummies" John Wiley & Sons, 2020. (Unit: I,III & IV)

T2. Andrew Pressman "Design Thinking A Guide to Creative Problem Solving for Everyone", Routledge Publication, 2019.(Unit: II & V)

Reference Book(s):

R1. Robert Curedale, "Design Thinking Process & Methods" Design Community College, 5th Edition, 2019.

R2. Alyssa Gallagher and Kami Thordarson, "Design Thinking in Play: An ActionGuide for Educators", ASCD Book, 2020.

R3. Brown.T, "Change by design: How design thinking transforms organizations and inspires innovation", HarperCollins, 2009.

Web References:

1. Tutorial on Design thinking: https://www.open.edu/openlearn/science- maths-technology/design- innovation/design-thinking/content-section
2. Article on Design thinking: https:www.interaction-design.org/literature/topics/design-thinking
3. Practical exercises on Design thinking:https://venturewell.org/class-exercises/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	3
CO2	-	2	-	-	-	3	3	-	-	-	-	-
CO3	-	-	-	2	-	-	-	-	-	3	-	-
CO4	-	-	-	-	3	-	-	3	-	-	3	-
CO5	-	-	2	-	-	-	-	-	2	-	-	-

High-3; Medium-2; Low-1

Course Code: 19ADEN1025	Course Title: Business and Sustainable Development		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits: 3	Total Contact Hours: 45	Max Marks: 100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Describe significance of Business and Sustainability
2. Provide the Significance of Strategic management issues
3. Explain the Business ethics and Leadership
4. Explore the Concept of External stakeholder Issues

Unit I Business and Sustainability **9 Hours**

Business and Sustainability Overview – Sustainability Challenges Confronting Business– Business in a Resource Constrained World -Stakeholder Approach to Business, Society, and Ethics

Unit II Managing Sustainability **9 Hours**

Leadership, Entrepreneurship, and Change – Strategy and Execution- Innovation, Planning, and Design- Financing Sustainability- Cooperation, Collaboration, and Partnership- Next Generation Competencies

Unit III Business Ethics and Leadership **8 Hours**

Business Ethics Essentials- Managerial and Organizational Ethics - Business Ethics and Technology.- Ethical Issues in the Global Arena

Unit IV External Stake Holders Issues **10 Hours**

Business, Government, and Regulation- Business Influence on Government and Public Policy- Consumer Stakeholders: Information Issues- Consumer Stakeholders: Product and Service Issues - Sustainability and the Natural Environment– Business and Community Stakeholders- Case Studies.

Unit V Internal StakeHolder Issues **9 Hours**

Employee Stakeholders and Workplace Issues– Employee Stakeholders: Privacy, Safety, and Health- Employment Discrimination and Workplace Diversity Cases-Case studies.

Course Outcomes		Cognitive Level
At the end of this course, students will be able to:		
CO1:	Describe the significance of Business and Sustainability with Stackholders	Understand
CO2:	Describe the Significance of Sustainability management issues	Understand
CO3:	Understand the impact of the professional engineering solutions for Ethical Issues in the global arena	Apply
CO4:	Explore the Concept of External stakeholder Issues in real world scenario	Apply
CO5:	Apply functions effectively as an individual for the stakeholder Issues in real world scenario	Apply

Text Book(s):

T1. Michael Blowfield,"Business and Sustainability",South Asian Edition,2019. (Unit I &II)
T2. Archie B. Carroll,Ann K. Buchholtz, "Business & Society Ethics and Stakeholder Management", 7th Edition, South Western, 2009. (Unit III, IV & V)

Reference Book(s):

R1. James E. Post, Lee E. Preston, Sybille Sachs, "Managing the Extended Enterprise: The New Stakeholder View," California Management Review, 2002.

R2. Andrew L. Friedman and Samantha Miles, "Stake-holders: Theory and Practice", Oxford University Press, 2006.

Web Reference(s):

1. Course Material URL: https://courses.lumenlearning.com/suny-wmopen-introbusiness/chapter/business-stakeholders-2/
2. NPTEL course content URL https://onlinecourses.nptel.ac.in/noc21_mg94/preview

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	-	-	-	3	3	1	-	-	1	1
CO2	1	1	-	-	-	3	3	1	-	-	1	1
CO3	2	1	-	-	-	3	3	1	-	-	1	1
CO4	2	1	-	-	-	3	3	1	-	-	1	1
CO5	3	2	1	1	-	3	3	1	-	-	1	1

High– 3; Medium– 2; Low– 1

Course Code:19MEEC1001	Course Title: Product Life Cycle Management (Common to AU, AD, CS, EC,EE, EI, IT, & ME)		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites:

- Nil

Course Objectives:

The course is intended to:

1. Explain the fundamentals of PLM
2. Provide an in-depth understanding of business processes in the PLM.
3. Explain the management concept for product development in PLM.
4. Explain the importance of Digital Manufacturing in PLM.
5. Explain the use case scenarios through various customer case studies.

Unit I Business Strategy in the PLM **9 Hours**

Definition, PLM Lifecycle Model, Threads of PLM, Need for PLM, Opportunities and Benefits of PLM, Views, Components and Phases of PLM, PLM feasibility Study, PLM Visioning, Strategy, Impact of strategy, Implementing a PLM strategy, PLM Initiatives to Support Corporate Objectives, Infrastructure Assessment, Assessment of Current Systems and Applications.

Unit II Business Processes in the PLM **9 Hours**

Characteristics of PLM, Environment Driving PLM, PLM Elements, Drivers of PLM, Conceptualization, Design, Development, Validation, Production, Support of PLM.

Engineering Vaulting, Product Reuse, Smart Parts, Engineering Change Management, Workflow Management.

Unit III Product Development Concepts in the PLM **9 Hours**

Bill of Materials (E-BOM, M-BOM, S-BOM) and Process Consistency, Product Structure, Configuring BOM, Simulation Process Management, Variant Management, Digital Mock-Up and Prototype Development, Design for Environment, Virtual Testing and Validation, Marketing Collateral.

Unit IV Digital Manufacturing in the PLM **9 Hours**

Digital Manufacturing, Benefits of Digital Manufacturing, Manufacturing the First-One, Ramp Up, Virtual Learning Curve, Manufacturing the Rest, Production Planning.

Unit V Customer Use Cases of the PLM **9 Hours**

Impact and Challenges faced while implementing a successful PLM strategy -Rolls Royce, Nissan Motor, Sunseeker International and Xtrac

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Understand PLM strategy based on the business needs	Understand
CO2: Explain various business processes in the PLM	Understand
CO3: Understand the product development concepts involved in the PLM	Understand
CO4: Explain the use of Digital Manufacturing environment in the PLM	Understand
CO5: Understand the various customer use cases of the PLM	Understand

Text Book(s):

T1. John Stark, "Product Lifecycle Management: Volume 1: 21st Century Paradigm for Product Realisation", Springer International Publishing Switzerland, 3rd Edition, 2015.

T2. Grieves Michael, "Product Lifecycle Management- Driving the Next Generation of Lean Thinking", McGraw-Hill, 2010.

T3. Wang, Lihui; Nee, Andrew Y.C. (Eds.) Collaborative Design and Planning for Digital Manufacturing, Springer, 2009.

Reference(s):

R1. Elangovan, U., "Product Lifecycle Management (PLM)". Boca Raton, CRC Press, 2020.

R2. Fabio Giudice, Guido La Rosa, "Product Design for the environment-A life cycle approach", Taylor & Francis 2006.

R3. Antti Saaksvuori, " Product Life Cycle Management" - Anselmi Immonen, Springer, 1st Edition, 2003.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	1	-	-	1	-	1	-	1	2	1
CO2	2	1	-	-	1	-	-	1	-	1	-	1	2	1
CO3	2	1	-	-	1	-	-	1	-	1	-	1	2	1
CO4	2	1	-	-	1	-	-	1	-	1	-	1	2	1
CO5	2	1	-	-	1	-	-	1	-	1	-	1	2	1

High-3; Medium-2; Low-1

Course Code:19MEEC2002	Course Title: PLM FOR ENGINEERS (All branches)		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 2: 0: 2	Credits:3	Total Contact Hours:60	Max. Marks:100

Pre-requisites:

- Nil

Course Objectives:

The course is intended to:

1. To explain the fundamentals of PLM
2. To provide an in-depth understanding of business processes in the PLM.
3. To explain the management concept for product development in PLM.
4. To explain the importance of Digital Manufacturing in PLM.
5. To explain the use case scenarios through various customer case studies.

UNIT I BUSINESS STRATEGY IN THE PLM **6**

Definition, PLM Lifecycle Model, Threads of PLM, Need for PLM, Opportunities and Benefits of PLM, Components and Phases of PLM, PLM feasibility Study, PLM Visioning, Strategy, Impact of strategy, Implementing a PLM strategy, PLM Initiatives to Support Corporate Objectives, Infrastructure Assessment.

UNITII BUSINESS PROCESSES IN THE PLM **6**

Characteristics of PLM, Environment Driving PLM, PLM Elements, Drivers of PLM, Conceptualization, Design, Development, Validation, Production, Support of PLM. Engineering Vaulting, Product Reuse, Smart Parts, Engineering Change Management, Workflow Management.

UNIT III PRODUCT DEVELOPMENT CONCEPTS IN THE PLM **6**

Bill of Materials (E-BOM, M-BOM, S-BOM) and Process Consistency, Product Structure, Configuring BOM, Simulation Process Management, Variant Management, Digital Mock-Up and Prototype Development, Design for Environment, Virtual Testing and Validation, Marketing Collateral.

UNIT IV DIGITAL MANUFACTURING IN THE PLM **6**

Digital Manufacturing, Benefits of Digital Manufacturing, Manufacturing the First-One, Ramp Up, Virtual Learning Curve, Manufacturing the Rest, Production Planning.

UNIT VCUSTOMER USE CASES OF THE PLM **6**

Impact and Challenges faced while implementing a successful PLM strategy -Rolls Royce, Nissan Motor, SunseekerInternational ,Xtrac,Kesslers international and Monier and Weatherford international.

List of Experiments **30**

1. Demonstrate the 2-Tier & 4-Tier Architectures and Basic Teamcenter applications like Organization, Project, and Schedule Manager.

2.Create CAD and Non-CAD datasets (MS Office, Notepad, etc.) by using explicit and implicit Check-In and Check-Out to create multiple iterations.

3. Create the access control (Read, Write, and Delete) for the given dataset and block the access rights to other group members belongs to the same department. Also Perform the Impact Analysis (Where Used and Where Referenced) of a given dataset which is used in multiple assemblies.

4.createthe Product Structure in Structure Manager with 5 components assembled in first level and 3 components Assembled in second, third and fourth level with the sub-assemblies and export the assembly in local drive. Also, demonstrate the Variant Management.

5.Export the CAD dataset as a JT file and perform the various visualization tasks like Measurements, Sectioning, PMI, and Mark-up using JT2GO application.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Understand PLM strategy based on the business needs	Understand
CO2: Explain various business processes in the PLM	Understand
CO3: Understand the product development concepts involved in the PLM	Understand
CO4: Explain the use of Digital Manufacturing environment in the PLM.	Understand
CO5: Understand the various customer use cases of the PLM	Understand

Text Book(s):

T1. John Stark, “Product Lifecycle Management: Volume 1: 21st Century Paradigm for Product Realisation”, Springer International Publishing Switzerland, 3rd edition, 2015.

T2. Grieves Michael, “Product Lifecycle Management- Driving the Next Generation of Lean Thinking”, McGraw-Hill, 2010.

T3. Wang, Lihui; Nee, Andrew Y.C. (Eds.) Collaborative Design and Planning for Digital Manufacturing, Springer, 2009.

Reference(s):

R1. Elangovan, U., “Product Lifecycle Management (PLM)”. Boca Raton, CRC Press, 2020.

R2. Fabio Giudice, Guido La Rosa, Product Design for the environment-A life cycle approach, Taylor & Francis 2006.

R3. AnttiSaaksvuori, “ Product Life Cycle Management” - AnselmiImmonen, Springer, 1st Edition, 2003.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	1	-	-	1	-	1	-	1	2	1
CO2	2	1	-	-	1	-	-	1	-	1	-	1	2	1
CO3	2	1	-	-	1	-	-	1	-	1	-	1	2	1
CO4	2	1	-	-	1	-	-	1	-	1	-	1	2	1
CO5	2	1	-	-	1	-	-	1	-	1	-	1	2	1

High-3; Medium-2; Low-1

Course Code: 19ITIC1001	Course Title: Integrated Big Data Solutions (Common to AD, CS & IT)		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3:0:0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Data Structures, Database Management Systems

Course Objectives

The course is intended to:

1. Apply the principles of distributed computing to analyze and solve complex computing problems.
2. Implement and configure NoSQL databases to handle large-scale data storage and retrieval.
3. Develop and construct a data warehouse system to support data analysis.
4. Utilize the MapReduce programming model for processing large datasets.
5. Design an analytics machine using big data analytic tools.

Unit I Distributed Computing 9 Hours

Introduction – Message Passing – Shared Memory – Consensus algorithms – Distributed Transactions, Mutual exclusions, dead locks – Local & Global time and state – Distributed file systems.

Unit II NoSQL 9 Hours

Introduction to NoSQL Databases – Definition and Purpose – CAP Theorem – Overview of CAP – Consistency and Availability – Type of NoSQL Databases – Key-Value Stores – Document Stores Column – Family Stores – Graph Databases.

Unit III Data Warehouse & Mining 9 Hours

Data Warehouse Basics – Data Warehouse Architecture – Modeling Facts – Modeling Dimensions – Schemas – Data Cleansing Techniques – ETL Process – Data Mining – Introduction to Techniques.

Unit IV Introduction to Big Data computing 9 Hours

Defining Big Data, 3 Vs – Challenges and Opportunities – Role of Computing Frameworks– Hadoop – Introduction to Apache Hadoop – Components of the Hadoop Ecosystem – MapReduce Programming Model – HDFS: Architecture – HDFS Commands –Data Replication and Fault Tolerance.

Unit V Big Data Analytics Tools 9 Hours

Apache Spark – Spark's Role in Big Data Analytics – PySpark – Overview of PySpark – Data Processing with PySpark – Data Processing – Data Lakehouse Concepts – Performance Considerations.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply distributed computing concepts to design and implement solutions for parallel and scalable systems.	Apply
CO2: Implement optimized data storage and retrieval techniques in NoSQL databases for high-performance applications.	Apply
CO3: Utilize data warehousing concepts and data mining techniques to extract insights and inform decision-making in real-world scenarios	Apply
CO4: Apply the MapReduce programming model to develop and execute big data applications efficiently.	Apply
CO5: Implement data visualization techniques to effectively communicate insights from data.	Apply

Text Book(s):

T1. Andrew S. Tanenbaum, Maarten Van Steen, “Distributed Systems”, 3rd Edition, Pearson Education, 2017. (Unit 1)

T2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013. (Unit 2,3,4,5)

Reference Book(s):

R1. Jiawei Han, Micheline Kamber and Jian Pei, “Data mining concepts and Techniques”, 3rd Edition, Elsevier, 2012

R2. Tom White, “Hadoop: The Definitive Guide”, O"Reilly Publication and Yahoo! Press, 4th Edition, 2015.

Web References:

1. https://onlinecourses.nptel.ac.in/noc20_cs92/
2. https://hadoop.apache.org

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	3	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	3
CO3	-	-	-	3	3	-	-	-	-	-	-	-	-	-
CO4	-	-	3		3	-	-	-	3	3	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	3	-

High-3; Medium-2; Low-1

Open Elective

Course Code: 19ADOC1001	Course Title: Data Mining and Warehousing		
Course Category: Open Elective		Course Level: Introductory	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- NIL

Course Objectives

The course is intended to:

1. Identify the types of data to be pre-processed for the given dataset
2. Describe the basic principles, concepts and applications of data warehousing
3. Categorize the kinds of patterns that are discovered by association rule mining
4. Classify and construct a cluster of data for the given dataset
5. Analyze the data mining trends and applications

Unit I An Overview of Database Systems 9 Hours

Introduction – Database system applications - Database versus file systems - View of data - Data models - Database languages - Database users and administrators - Database system structure - Entity – Relationship Model – Basic concepts - Constraints - Keys - Design issues - ER diagram - Weak entity sets - Design of an ER database schema.

Unit II Data Mining Introduction 9 Hours

Introduction to Data Mining: Kinds of Data — Kinds of Patterns — Technologies - Applications – Issues – Data Preprocessing: Data Cleaning – Data Integration – Data Reduction – Data Transformation - Data Discretization - Data Visualization.

Unit III Data Warehousing 9 Hours

Data Warehousing and Online Analytical Processing: Data Warehouse basic concepts - Data Warehouse Modeling - Data Cube and OLAP - Data Warehouse Design and Usage - Data Warehouse Implementation - Data Generalization by Attribute - Oriented Induction.

Unit IV Association 9 Hours

Mining Frequent Patterns - Associations and Correlations: Basic Concepts and Methods: Frequent Item set Mining Method - Pattern Evaluation Methods - Pattern Mining: A Road Map - Multidimensional Space - Constraint - Based Frequent Pattern Mining - Applications pattern Mining.

Unit V Classification and Clustering 9 Hours

Basic Concepts - Decision Tree Induction – Bayes Classification Methods – Rule Based Classification – Model Evaluation and Selection – Techniques to Improve Classification Accuracy. Cluster Analysis - Partitioning Methods - Hierarchical Methods – Density - Based Methods - Grid-Based Methods.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Construct the Entity Relationship Model for obtaining the structure of a database	Apply
CO2: Identify the types of data to be pre-processed for the given	Apply
CO3: Design a data mart or data warehouse for any organization	Analyze
CO4: Categorize the kinds of patterns that are discovered by association rule mining for transaction database	Analyze
CO5: Examine the prediction accuracy using different classification algorithms and construct a cluster of data using different clustering algorithms for the given dataset	Apply

Text Book(s):

T1. Silberschatz, Korth, Sudarshan, "Database System Concepts", 6th Edition, McGraw HillInternational Edition, New Delhi 2010. (Unit I & II)

T2. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", 4th Edition, Elsevier, 2022. (Unit III, IV &V)

Reference Book(s):

R1. Jure Leskovec, Anand Rajaraman, Jeffery David Ullman, "Mining of Massive Datasets", 2nd Edition, Cambridge University Press, 2014.

R2. Ian H.Witten, Eibe Frank, Mark A.Hall, "Data Mining: Practical Machine Learning Tools and Techniques", 3rd Edition, Elsevier, 2011.

R3. EMC Education Services, "Data Science and Big Data Analytics Discovering, Analyzing, Visualizing and Presenting Data", Wiley, 2015.

R4. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley & sons 2013.

Web References:

1. Weka tool documentation: http://www.cs.waikato.ac.nz/ml/weka/documentation.html
2. Cran R-program: https://cran.r-project.org/manuals.html
3. UCI Machine learning repository: https://archive.ics.uci.edu/ml/index.html

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	2	2	2	2	2	2	2
CO2	3	3	2	2	3	2	2	2	2	2	2	2
CO3	3	3	2	2	3	2	2	2	2	2	2	2
CO4	3	2	2	2	2	2	2	2	2	2	2	2
CO5	3	3	2	2	3	2	2	2	2	2	2	2

High-3; Medium-2; Low-1

Course Code: 19ADOC1002	Course Title: Data Science for Engineers		
Course Category: Open Elective		Course Level: Introductory	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Define Data Science and its applications across different fields
2. Understand the different stages involved in a data science project
3. Identify and explain the key characteristics of data
4. Perform Data Preprocessing techniques and their importance in data analysis.
5. Apply exploratory data analysis methods to get initial insights into the data and identify patterns or trends

Unit I Overview of Data Science **9 Hours**

Introduction – benefits and uses – facets of data – data science process: Retrieving data – cleansing – integrating - transforming data – exploratory data analysis – build the models – presenting and building applications.

Unit II Describing Data I **9 Hours**

Frequency distributions – Outliers – Types of frequency distributions – frequency distributions for Qualitative data – Graphs – Averages – Describing variability: Range – variance – standard deviation – interquartile range – variability for qualitative and ranked data.

Unit III Python For Data Handling **9 Hours**

Basics of Numpy arrays – aggregations – computations on arrays – comparisons – masks - boolean logic – fancy indexing – structured arrays – Data manipulation with Pandas – data indexing and selection — operating on data — missing data — hierarchical indexing — combining datasets – aggregation and grouping – pivot tables.

Unit IV Describing Data II **9 Hours**

Normal distributions – z scores – normal curve problems – proportions – scores – correlation: scatterplots – correlation coefficient for quantitative data – Regression.

Unit V Python for Data Visualization **9 Hours**

Visualization with matplotlib – line plots – scatter plots – visualizing errors – density and contour plots – histograms - binnings, and density – three dimensional plotting – geographic data – data analysis using statmodels and seaborn – graph plotting using Plotly – interactive data visualization using Bokeh.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Gain knowledge in the basic concepts of Data Analysis	Apply
CO2: Acquire skills in data preparatory and preprocessing steps	Apply
CO3: Understand the mathematical skills in statistics	Apply
CO4: Learn the tools and packages in Python for data science	Apply
CO5: Gain understanding in classification and Regression Model	Apply

Text Book(s):

T1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016. (Unit I)

T2. Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017. (Unit II and IV)

T3. Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016. (Unit III & V)

Reference Book(s):

R1. Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press, 2014.

Web References:

1. Nptel Course on Introduction to Data Science: https://nptel.ac.in/downloads/111102011/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	3	-	3	-	2	2	2	3	-	2
CO2	2	-	-	2	-	-	2	2	2	3	-	2
CO3	2	3	-	-	3	-	-	2	2	3	-	2
CO4	2	-	2	-	-	3	-	2	2	3	-	2
CO5	2	-	2	2	3	-	2	2	2	3	-	2

High-3; Medium-2; Low-1

Course Code: 19ADOC1003	Course Title: Business Analytics		
Course Category: Open Elective		Course Level: Introductory	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Choose appropriate Information Technology applications
2. Develop a Decision-Making Tool
3. Design Dashboard and Scorecard
4. Deploy a Knowledge Management System
5. Apply suitable platform for improving business intelligence

Unit I Introduction to Business Intelligence 9 Hours

Business View of IT Applications - Digital Data-Getting started with BI-BI Component Framework – Users – Applications - Roles and Responsibilities - Concepts of data integration Need and advantages of using data integration –Tools - Case Study: Pentaho.

Unit II Decision Support Systems 9 Hours

Decision Making: Introduction – Models – Phases - DSS Description – Characteristics – Capabilities – Classifications – Components – Data – Model - User Interface (DIALOG) and Knowledge Based Management Subsystem - DSS User - Case Study: PHP MySQL Implementation of DSS.

Unit III Business Performance Management 9 Hours

BPM Cycle - Performance Measurement - BPM Methodologies - Architecture and Applications - Introduction to enterprise reporting - Performance Dashboards and core cards -Case Study: Freeboard.

Unit IV Knowledge Management 9 Hours

Introduction-Organizational Learning and Transformation - KM Activities – Approaches - Information Technology and Roles of People in KM - KM System Implementation Ensuring the Success of KM Efforts - Case Study: Apache Sling CMS.

Unit V Emerging Trends 9 Hours

Reality Mining - Virtual Worlds - Web 2.0 Revolution - Virtual Communities - Online Social Networking - Cloud Computing and BI - MSS Impacts on Organization & Individual.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Choose appropriate Information Technology applications for modern business implementing business intelligence components	Understand
CO2: Develop a Decision-Making Tool for given real time application using Decision Support System components	Apply
CO3: Design Dashboard and Score card for any given application to analyze its business performance	Apply
CO4: Deploy a Knowledge Management System for effective functioning of an organization by choosing suitable KMS approach	Apply
CO5: Apply suitable platform for improving business intelligence in decision making	Apply

Text Book(s):

T1. RN Prasad, Seema Acharya, "Fundamentals of Business Analytics", 2nd Edition, Wiley, 2016. (Unit I & V)

T2. Ramesh Sharda, Dursun Delen, Efraim Turban, "Business Intelligence and Analytics, Systems for Decision Support", 10th Edition, Pearson Education Inc, 2015. (Unit II, III & V)

Reference Book(s):

R1. Vicki L. Sauter, "Decision Support Systems for Business Intelligence", Wiley, 2011.

R2. David Loshin, "Business Intelligence: The Savvy Manager's Guide", 2nd Edition, Morgan Kaufman, 2012.

R3. Carlo Vercellis, "Business Intelligence: Data Mining and Optimization for Decision Making", Wiley, 2009.

Web References:

1. MIS - Decision Support System Tutorials point URL: https://www.tutorialspoint.com/management_information_system/decision_support system.htm
2. Mastering Microsoft Power BI URL: https://www.tutorialspoint.com/power_bi/index.htm

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	-	2	-	3	-	2	2	3	-	2
CO2	2	3	-	2	-	3	-	2	2	3	-	2
CO3	2	3	-	2	-	3	-	2	2	3	-	2
CO4	2	3	-	2	-	3	-	2	2	3	-	2
CO5	2	3	-	2	-	3	-	2	2	3	-	2

High-3; Medium-2; Low-1

Course Code: 19ADOC1004	Course Title: Cognitive Science		
Course Category: Open Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- NIL

Course Objectives

The course is intended to:

1. Explain the theoretical background of cognition
2. Explain the link between cognition and computational intelligence
3. Infer Deep learning Methods
4. Summarize the computational inference models of cognition
5. Summarize the computational learning Tools

Unit I Introduction of Cognitive Science 9 Hours

Challenge of Cognitive Science - Discipline Matures: Three Milestones - Turn to the Brain - Physical Symbol Systems and the Language of Thought - Neural Networks and Distributed Information Processing

Unit II Neuro Science 9 Hours

Applying Dynamical Systems Theory to Model the Mind - Bayesianism in Cognitive Science - Modules and Architectures - Strategies for Brain Mapping - Models of Language Learning - Object Perception and Folk Physics

Unit III Cognitive Languages 9 Hours

Machine Learning: From Expert Systems to Deep Learning - Exploring Mindreading – Robotics: From GOFAI to Situated Cognition and Behavior - Based Robotics - The Cognitive Science of Consciousness

Unit IV Artificial Intelligence Design Methodology 9 Hours

Emotions: From Cognitive Science to Affective Science - Coauthored with Dong An - Looking Ahead: Challenges and Opportunities - The Neuroscience Approach: Mind As Brain: Perspective - Methodology- Neuron Anatomy- Brain Anatomy- The Neuroscience of Visual Object Recognition

Unit V Cognitive Roboscience 9 Hours

Artificial Intelligence I: Definitional Perspective: Historical and Philosophical Roots- defining - AI Methodologies – tools – Programming - Alan Turing and the Great Debate - Artificial Intelligence II: Operational Perspective: Approaches to the Design of Intelligent Agents - Machine Representation -Reasoning: Machine – Logical – Inductive - Expert Systems - Fuzzy Logic

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply the underlying theory behind cognition.	Understand
CO2: Experiment with the cognition elements computationally.	Apply
CO3: Organize deep learning with behavior.	Apply
CO4: Relate applications using cognitive inference model.	Apply
CO5: Explain applications using tools.	Apply

Text Book(s):

T1. Jose Luis Bermúdez, "Cognitive Science - An Introduction to the Science of the Mind", Cambridge University Press 2020.(Unit I & II)

T2. Jay Friedenberg, Gordon Silverman, " Cognitive Science - An Introduction to the Study of Mind", Sage publication 2006.(Unit III, IV & V)

Reference Book(s):

R1. Noah D. Goodman, Andreas Stuhlmuller, "The Design and Implementation of Probabilistic Programming Languages", Electronic version of book.

R2. Noah D. Goodman, Joshua B. Tenenbaum, ProbMods Contributors, "Probabilistic Models of Cognition", 2nd Edition, 2016.

Web References:

1. Tutorial on Cognitive Science: https://www.problang.org/chapters/app-06-intro-to-webppl.html
2. Article on Cognitive Science: https://www.hindawi.com/journals/aai/2010/918062/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	3	2	2	-	-	-	1	1	2	2
CO2	2	2	1	1	2	-	-	-	3	2	3	1
CO3	1	3	1	3	3	-	-	-	1	3	1	3
CO4	2	1	1	2	3	-	-	-	1	2	3	1
CO5	1	2	3	2	2	-	-	-	1	2	2	2

High-3; Medium-2; Low-1

Course Code: 19ADOC1005		Course Title: Total Quality Management Principles	
Course Category: Open Elective		Course Level: Introductory	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- NIL

Course Objectives

The course is intended to:

1. Describe the fundamentals of total quality management
2. Choose the appropriate TQM methodologies
3. Apply traditional tools and techniques
4. Apply the various performance measures
5. Identify the quality system standards

Unit I Evolution of Quality 9 Hours

Need for Quality - Evolution of Quality - Definition of Quality - Dimensions of Manufacturing and Service Quality - Basic Concepts of TQM - Definition of TQM – TQM Framework - Contributions of Deming - Juran and Crosby – Barriers to TQM.

Unit II TQM Principles 9 Hours

Leadership – Strategic Quality Planning, Quality Statements - Customer Focus – Customer Orientation - Customer Satisfaction - Customer Complaints - Customer Retention - Employee Involvement – Motivation - Empowerment-Team and Teamwork - Recognition and Reward, Performance Appraisal – Continuous Process Improvement – PDSA Cycle - 5s - Kaizen - Supplier Partnership – Partnering - Supplier Selection - Supplier Rating.

Unit III TQM Tools & Techniques I 9 Hours

The Seven Traditional Tools of Quality – New Management Tools – Six-Sigma: Concepts - Methodology - Applications to Manufacturing - Service Sector Including IT – Bench Marking – Reason to Bench Mark - Bench Marking Process – FMEA – Stages – Types.

Unit IV TQM Tools & Techniques II 9 Hours

Quality Circles – Quality Function Deployment (QFD) – Taguchi Quality Loss Function – TPM – Concepts- Improvement Needs – Cost of Quality – Performance Measures.

Unit V Quality Systems 9 Hours

Need for ISO 9000- ISO 9000-2000 Quality System – Elements-Documentation-Quality Auditing- QS9000 – ISO 14000 – Concepts-Requirements and Benefits – Capability Maturity Model for Software Industry.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Describe the fundamentals of total quality management based on the TQM principles for the modern organizations	Apply
CO2: Choose the appropriate methods from the TQM principles for managing the organization	Apply
CO3: Apply traditional tools and techniques for identifying customer needs in the software industry	Apply
CO4: Apply the various performance measures for quality improvement	Apply
CO5: Identify the quality system standards for software industry	Apply

Text Book(s):

T1. Dale H. Besterfield, Carol Besterfield, "Total Quality Management", 3rd Edition, Pearson Education Asia, Indian Reprint, 2011.

Reference Book(s):

R1. James R. Evans, William M. Lindsay, "The Management and Control of Quality", 6th Edition, South-Western (Thomson Learning), 2005.

R2. Oakland J.S., "TQM – Text with Cases", Butterworth – Heinemann Ltd., 3rd Edition, Oxford, 2003.

R3. Suganthi L, Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.

R4. Janakiraman B, Gopal R.K, "Total Quality Management – Text and Cases", Prentice Hall (India)Pvt. Ltd, 2015.

Web References:

1. American Society for Quality (ASQ): https://asq.org/quality-resources/total-quality-management
2. Mind Tools: https://www.mindtools.com/
3. The Chartered Quality Institute (CQI): https://www.quality.org/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	3	2	2	-	-	-	1	1	2	2
CO2	2	2	1	1	2	-	-	-	3	2	3	1
CO3	1	3	1	3	3	-	-	-	1	3	1	3
CO4	2	1	1	2	3	-	-	-	1	2	3	1
CO5	1	2	3	2	2	-	-	-	1	2	2	2

High-3; Medium-2; Low-1

Course Code: 19ADOC1006	Course Title: Professional Ethics		
Course Category: Open Elective		Course Level: Introductory	
L:T :P(Hours/Week) 3:0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Define and Differentiate Moral Values, Ethics, and Integrity
2. Understanding of core human values essential for ethical conduct in the professional lives
3. Apply Ethical Values to Work Ethic and Service Learning
4. understanding of civic virtue and its importance in professional conduct
5. Explore the Role of Self-Awareness and Stress Management in Ethics

Unit I Human Values **9 Hours**

Morals - values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respectfor others — Living peacefully — Caring — Sharing — Honesty — Courage — Valuing time — Cooperation — Commitment — Empathy — Self-confidence — Character — Spirituality — Introduction to Yoga and meditation for professional excellence and stress management.

Unit II Engineering Ethics **9 Hours**

Senses of ‗Engineering Ethics' — Variety of moral issues — Types of inquiry — Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles – Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

Unit III Engineering as Social Experimentation **9 Hours**

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics– A Balanced Outlook on Law.

Unit IV Safety, Responsibilities and Rights **9 Hours**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk Respect for Authority — Collective Bargaining — Confidentiality — Conflicts of Interest Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Right(IPR) — Discrimination.

Unit V Global Issues **9 Hours**

Multinational Corporations — Environmental Ethics — Computer Ethics — Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors — Moral Leadership –Code of Conduct — Corporate Social Responsibility.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply values and ethics in society	Understand
CO2: Discuss the ethical issues related to engineering and realize the responsibilities and rights in the society	Understand
CO3: Apply the Ethics in real world	Understand
CO4: Describe the safety, responsibilities and rights as an engineer	Understand
CO5: Discuss the Global issues around the world as an engineer perspective	Understand

Text Book(s):

T1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.(Unit I & II)

T2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.(Unit III,IV & V)

Reference Book(s):

R1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.

R2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009.

R3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, NewDelhi, 2003.

R4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.

R5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility", McGraw Hill education, India Pvt. Ltd., New Delhi, 2013.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	3	2	2	-	-	-	1	1	2	2
CO2	2	2	1	1	2	-	-	-	3	2	3	1
CO3	1	3	1	3	3	-	-	-	1	3	1	3
CO4	2	1	1	2	3	-	-	-	1	2	3	1
CO5	1	2	3	2	2	-	-	-	1	2	2	2

High-3; Medium-2; Low-1

Course Code: 19ADOC1007	Course Title: Ethical Hacking Essentials		
Course Category: Open Elective		Course Level: Introductory	
L: T :P(Hours/Week) 3: 0 : 0	Credits:3	Total Contact Hours:45	Max.Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Understand the fundamentals of ethical hacking and penetration testing
2. Explain the network scanning techniques and bypassing basic security measures
3. Identify vulnerabilities in different operating systems and network devices
4. Understand hacking options available in Web and wireless applications
5. Explore the options for network protection and to practice tools to perform ethical hacking to expose the vulnerabilities

Unit I Security and Penetration Testing 9 Hours

Ethical Hacking - Role of Security and Penetration Testers- Penetration-Testing Methodologies - Network and Computer Attacks - Malware - Protecting Against Malware Attacks - Intruder Attacks - Addressing Physical Security.

Unit II Foot Printing, Reconnaissance And Scanning Networks 9 Hours

Footprinting Concepts - Footprinting through Search Engines- Footprinting through Social Engineering - Footprinting Tools - Network Scanning Concepts - Port-Scanning Tools - Scanning Techniques - Scanning Beyond IDS and Firewall.

Unit III Vulnerability Analysis 9 Hours

Vulnerability Assessment Concepts - Desktop and Server OS Vulnerabilities - Windows OS Vulnerabilities - Tools for Identifying Vulnerabilities in Windows- Linux OS Vulnerabilities- Vulnerabilities of Embedded Oss.

Unit IV System Hacking 9 Hours

Hacking Web Servers - Web Application Components- Vulnerabilities - Tools for Web Attackers and Security Testers Hacking Wireless Networks - Components of a Wireless Network – Wardriving- Wireless Hacking.

Unit V Network Protection Systems 9 Hours

Configuration and Risk Analysis Tools for Firewalls and Routers - Intrusion Detection and Prevention Systems – Network Based and Host Based IDSs and IPSs - Web Filtering - Security Incident Response Teams – Honeypots.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Identify information about target systems using search engines, social engineering techniques, and dedicated tools	Understand
CO2: Explain vulnerabilities in various operating systems and network devices using vulnerability assessment tools	Apply
CO3: Demonstrate the enumeration and vulnerability analysis method	Apply
CO4: Analyze identified vulnerabilities and propose appropriate security measures to mitigate the risks	Apply
CO5: Apply knowledge of network protection systems for incident response	Apply

Text Book(s):

T1. Michael T. Simpson, Kent Backman, and James E. Corley, "Hands-On Ethical Hacking and Network Defense, Course Technology", Delmar Cengage Learning, 2010. (Unit I & II)

T2. Patrick Engebretson, "The Basics of Hacking and Penetration Testing SYNGRESS", Elsevier, 2013. (Unit III & IV)

T3. Dafydd Stuttard and Marcus Pinto "The Web Application Hacker's Handbook: Finding and Exploiting Security", Flaws 2011. (Unit V)

Reference Book(s):

R1. Justin Seitz "Black Hat Python: Python Programming for Hackers and Pentesters",2014.

Web References:

1. NPTEL Courses on Ethical Hacking: https://onlinecourses.nptel.ac.in/noc22_cs13/preview
2. COURSERA Courses on Ethical Hacking Esssentials: https://www.coursera.org/learn/ethical-hacking-essentials-ehe

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-	1	-	1	1	1	1	2
CO2	3	2	1	1	-	1	-	1	1	1	1	2
CO3	-	-	-	-	-	1	-	1	1	1	1	2
CO4	3	2	1	1	-	1	-	1	-	-	-	2
CO5	3	2	1	1	-	1	-	1	1	1	1	2

High-3; Medium-2; Low-1

Course Code: 19ADOC1008	Course Title: Data Visual Exploration		
Course Category: Open Elective		Course Level: Mastery	
L: T : P(Hours/Week) 3: 0 : 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- NIL

Course Objectives

The course is intended to:

1. Apply graphics software standards and primitive operations in OpenGL.
2. Implement and manipulate basic graphical elements such as lines and circles using algorithms and OpenGL functions.
3. Apply various clipping algorithms, and utilize OpenGL functions for 2D graphics
4. Identify a 3D object transformation and operations.
5. Identify suitable surface detection, lighting and rendering methods

Unit I Graphics Software Standards and Primitives 9 Hours

Coordinate Representations – Graphics Functions – Software Standards – Introduction to OpenGL – Coordinate reference frame – Specifying 2D using OpenGL – OpenGL Point Functions – OpenGL Line Functions – Fill Area Primitives – Polygon Fill Area – OpenGL polygon Fill Area Functions.

Unit II Output Primitives and Attributes 9 Hours

Line Drawing Algorithms – DDA Line Drawing Algorithm – Bresenhams Line Drawing Algorithm – Circle Drawing Algorithm. Point attributes – Line attributes – Fill Area attributes – Character attributes – OpenGL Functions.

Unit III 2D Transformation and Viewing 9 Hours

Basic Transformations – Homogeneous Representation – Composite Transformation – Other Transformations – OpenGL functions. Viewing Pipeline – Clipping Window – Window to Viewport transformation – OpenGL 2D viewing Functions

Unit IV 3D Transformations and Viewing 9 Hours

3D Object Representation – OpenGL Functions– Quadric and Cubic Surfaces – Bezier and Spline Curves– 3D Transformation – OpenGL Functions – 3D Viewing – 3D Viewing Concepts– 3D Viewing Pipeline – Projection Transformations – Orthogonal Projections – Oblique Parallel Projections – Perspective Projections.

Unit V Visualization of 3D Objects 9 Hours

Visible Surface Detection Methods: Classification – Back face detection – Depth Buffer Method– A Buffer Method – Scan Line Method – Depth Sorting Method – BSP Tree Method – Oct Tree Method – Comparison.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Create Interactive Computer Graphics using basic OpenGL functions	Apply
CO2: Demonstrate the basic principles in implementing graphical output primitives and their attributes for the given scenario	Apply
CO3: Implement 2D Transformations and Viewing operations for the given 2D object	Apply
CO4: Design a 3D object and perform Transformation and Viewing operations using OpenGL built-in functions	Apply
CO5: Discuss the work plan, schedule and state of a project for resource allocation	Apply

Text Book(s):

T1. Donald D. Hearn, M. Pauline Baker, Warren Carithers, "Computer Graphics with OpenGL", 4th Edition, Pearson Education,2016.

Reference Book(s):

R1. D. F. Rogers and J. A. Adams, "Mathematical Elements for Computer Graphics", 2nd Edition, McGraw-Hill International Edition, 2017.

R2. Edward Angel, "Interactive Computer Graphics A Top-Down Approach with OpenGL", 5th Edition, Addison-Wesley, 2012.

R3. Shalini Govil Pai, "Principles of Computer Graphics Theory and Practice Using OpenGLand Maya", Springer, 2010.

Web References:

1. NPTEL Course: https://nptel.ac.in/noc/courses/noc21/SEM2/noc21-cs97/
2. The Official Guide to Learning OpenGL: http://www.glprogramming.com/re
3. OpenGL Reference Manual : http://www.glprogramming.com/blue/
4. OpenGL Latest :http://nehe.gamedev.net/
5. The Official site of OpenGL :http://www.opengl.org/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	1	-	-	2	3	3	-	1
CO2	2	1	1	1	1	-	-	2	3	3	2	1
CO3	2	1	1	1	1	-	-	2	3	3	2	1
CO4	2	1	1	1	1	1	1	2	3	3	-	1
CO5	2	1	1	1	1	1	1	2	3	3	-	1

High-3; Medium-2; Low-1

Course Code: 19ADOC1009	Course Title: Foundations of Marketing Analytics		
Course Category: Open Elective		Course Level: Introductory	
L:T: P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Understand the role and importance of marketing analytics in decision-making processes within organizations
2. Develop proficiency in data analysis using R
3. Acquire knowledge of various machine learning algorithms and their applications in marketing research
4. Analyze social media data using APIs and other tools

Unit I Introduction to Marketing Analytics **9 Hours**

Introduction-Marketing Research-Marketing Analytics-Marketing Analytics Data-Web Analytics-Online and Offline Data -Type of Media and DataType: Structured, Semi-Structured, Unstructured Data

Unit II Descriptive Analysis **9 Hours**

Introduction-Key Ideas in the World of R - Taste of R -Summarizing data-Generating an Overall Data Summary-Summarizing Numeric Variables-Summarizing Categorical Variables-Exploring Relationships Between Numeric Variables-Exploring Relationships between Categorical Variables Plotting data

Unit III Machine Learning **9 Hours**

Introduction-Supervised Learning- Unsupervised Learning-Reinforcement Learning-Key Steps in Building Machine Learning Models-Machine Learning and Marketing Research Models-Correlation-Regression

Unit IV Advertising Analytics **9 Hours**

Introduction-Media Budget Decisions-Advertising Effectiveness-Consumer Perception and Preference-Cluster Analysis-Multi-Dimensional Scaling-Correspondence Analysis

Unit V Social Media Data **9 Hours**

Overview of Social Media Platforms- Social Media APIs-Observable aspects of Consumer Behavior on Social Media- Workflow for Social Media Data Collection.

Course Outcomes		Cognitive Level
At the end of this course, students will be able to:		
CO1:	Understand the foundational concepts of marketing research and analytics	Understand
CO2:	Analyze various types of marketing data from online and offline sources	Understand
CO3:	Apply descriptive analysis techniques to summarize and visualize marketing data effectively	Apply
CO4:	Explore machine learning algorithms for marketing research and decision-making	Analyze
CO5:	Utilize social media data for consumer insights and marketing strategy formulation	Analyze

Text Book(s):

T1. Moutusy Maity and Pavankumar Gurazada, "Marketing Analytics for Strategic decision making", Oxford University press, 1st Edition, April 2021. (Unit I to V)

Reference Book(s):

R1. Chuck hemann and Ken Burbary, "Digital marketing analytics: Making Sense of consumer Data in a Digital World", QUE Publication, 2nd Edition, May 2018

R2. Wayne L. Winston, "Marketing Analytics: Data-Driven Techniques with Microsoft Excel", Wiley Publication,1st Edition, January 2014.

Web References:

1. Web analytics: https://www.hotjar.com/web-analytics/
2. R programming: https://www.geeksforgeeks.org/r-tutorial/
3. Advertising analytics: https://www.knorex.com/blog/articles/advertising-analytics
4. Nptel courses: https://onlinecourses.nptel.ac.in/noc20_mg30/preview

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-	1	-	1	1	1	1	2
CO2	3	2	1	1	-	1	-	1	1	1	1	2
CO3	3	-	-	-	-	1	-	1	1	1	1	2
CO4	3	2	1	1	-	1	-	-	-	-	-	2
CO5	3	2	1	1	-	1	-	1	1	1	1	2

High-3; Medium-2; Low-1

Course Code: 19ADOC1010	Course Title: Information Extraction and Text Mining		
Course Category: Open Elective		Course Level: Introductory	
L: T : P(Hours/Week) 3: 0:0	Credits:3	Total Contact Hours: 45	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Perform word and sentence recognition
2. Identify POS tags for words
3. Perform syntax analysis and construct parse trees
4. Determine word sense, semantic role and similarity
5. Develop NLP applications

Unit I Language Modeling **9 Hours**

Knowledge in Speech and Language Processing – Ambiguity – Regular Expressions Finite State Automata – Morphology – Finite State Transducers Word and Sentence Tokenization – Detecting and Correcting Spelling Errors –Minimum Edit Distance.

Unit II Word Level Analysis **9 Hours**

N-grams –Unsmoothed N-grams – Perplexity – Smoothing –Word Classes – Part-of-Speech Tagging – Rule-based, Stochastic and Transformation based tagging – Evaluation and issuesin PoS tagging.

Unit III Syntax Analysis **9 Hours**

Context-Free Grammars –Grammar rules – Treebanks - Dependency Grammars – Parsing as Search – Ambiguity –Dynamic Programming parsing – Partial parsing – Probabilistic CFG.

Unit IV Semantics **9 Hours**

First Order Logic –Description Logics – Syntax-driven semantic analysis – Word Senses – Relations between Senses –Semantic roles – Word Sense Disambiguation: Supervised, Dictionary & Thesaurus methods – Word Similarity: Thesaurus and Distributional methods.

Unit V Pragmatics and Applications **9 Hours**

Discourse segmentation – Text Coherence – Reference, Anaphora and Co-reference resolution –Named Entity Recognition – Relation Detection and Classification – Information Retrieval – Factoid Question Answering – Summarization.

Course Outcomes		Cognitive Level
At the end of this course, students will be able to:		
CO1:	Understand the challenges of language ambiguity, regular expressions, and the basic building blocks of language	Apply
CO2:	Identify n-grams and Parts of Speech tags for sentences	Apply
CO3:	Analyze and understand word-level information for a sentence	Apply
CO4:	Comprehend the role of syntax in language processing which helps computers understand the structure of sentences.	Apply
CO5:	Explain the natural language techniques for real-world applications like Information Extraction and retrieval	Apply

Text Book(s):

T1. Daniel Jurafsky and James H Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition",Prentice Hall, 2nd Edition, 2008.(Unit I,II & III)

T2. U. S. Tiwary and TanveerSiddiqui, "Natural Language Processing and information Retrieval", Oxford University Press, 2008. (Unit IV & V)

Reference Book(s):

R1. Christopher Manning, "Foundations of Statistical Natural Language Processing", MIT Press, 2009.

R2. Nitin Indurkhya, Fred J. Damerau, "Handbook of Natural Language Processing", 2nd Edition, Chapman & Hall/CRC: Machine Learning & Pattern Recognition, Hardcover,2010 .

Web References:

1. NPTEL Course on Natural Language Processing: https://nptel.ac.in/courses/106101007/
2. NLTK tool tutorial: https://nlp.stanford.edu/software/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	-	-	1	1	2	3	1	-	1
CO2	3	2	2	2	2	1	1	2	3	2	1	1
CO3	3	2	2	2	2	1	1	2	3	2	1	1
CO4	3	2	2	2	2	1	1	2	3	2	1	1
CO5	3	2	2	2	2	1	1	2	3	2	1	1

High-3; Medium-2; Low-1

Course Code: 19ADOC1011	Course Title: Drone Technology		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Understand the basics of drone concepts
2. Understand the fundaments of design, fabrication and programming of drone
3. Impart the knowledge of an flying and operation of drone
4. Know about the various applications of drone
5. Understand the safety risks and guidelines of fly safely

Unit I Introduction to Drone Technology 9 Hours

Drone Concept - Current Breadth of Drone Use - Future Breadth of Drone Use- Risks of Drone Technology - Concept Design and Design Development- Construction Administration – Time Based Site Comparisons.

Unit II Drone Flying and Operation 9 Hours

Drone Standard Features - Flying Skills - Flight Controller Automations – Support and troubleshooting - Drone Packages - Flight Conditions - Video and Photo Recording - Multimedia and Video Editing - Drone Flying Apps - Simulator Mode - Flight Operations – Emergency Operations - Pre-flight Planning for Automated Flights.

Unit III Working with 3D Models 9 Hours

Point Cloud versus 3D Mesh - Working with Point Clouds and 3D Meshes - Third-Party Sites. Construction Management Viewing and Sharing Software – Point Cloud to Mesh – Mesh Decimation - Mesh Manipulation and Proposed Features.

Unit IV Drones and Photogrammetry 9 Hours

Choosing a drone based on the application - Photogrammetry Accuracy and Precision- Ground Control Points- Collecting Data- RTK Drones, Ground Control Pads - Processing the Data- Photogrammetry Project Comparisons.

Unit V Acquiring and Working with Drone Data 9 Hours

Photo and Video Quality- Using DJI Standard Apps- Litchi Flight Planning Software- Litchi Smart Device App- Virtual Litchi Mission- Annotated Images- Photoshop Photo Matches- 3D Model Photo Matches- Working with Drone Videos.

Course Outcomes		Cognitive Level
At the end of this course, students will be able to:		
CO1:	Explain the fundamental concepts of drone technology, including its current and future applications	Understand
CO2:	Demonstrate safe and proficient drone operation skills for emergency procedures	Apply
CO3:	Compare and analyze appropriate sensors and actuators for Drones for specific application	Analyze
CO4:	Select appropriate drones and apply photogrammetry techniques to collect and process aerial data	Apply
CO5:	Acquire and manage drone data by understanding image/video quality for specific application	Analyze

Text Book(s):

T1. Daniel Tal and John Altschuld, "Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation", John Wiley & Sons Inc., 2021.

Reference Book(s):

R1. John Baichtal, "Building Your Own Drones: A Beginners' Guide to Drones", UAVs,and ROVs", Que Publishing, 2016.

R2. Zavrsnik, "Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance", Springer, 2018.

Web References:

1. Drone Technology Future trend and practical application https://onlinelibrary.wiley.com/doi/book/10.1002/9781394168002: Course Articulation Matrix

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	-	-	1	1	2	3	1	-	1
CO2	3	2	2	2	2	1	1	2	3	2	-	1
CO3	3	-	-	-	2	1	-	2	3	2	-	1
CO4	3	2	2	2	2	1	-	2	3	2	-	1
CO5	3	2	2	2	2	1	-	2	3	2	-	1

High-3; Medium-2; Low-1

Course Code: 19ADOC1012	Course Title: Agri-Robotics		
Course Category: Open Elective		Course Level: Introductory	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Identify the areas in agricultural process
2. Build sensor and system for agricultural applications
3. Mechanics to the design various robot parameters
4. Identify various mechanisms into agricultural robotic
5. Build suitable robotic system for specific agricultural tasks

Unit I Agricultural Automation **9 Hours**

Mechanized Agriculture – Farming Operations - Related Machines – Tillage - Planting Cultivation – Harvesting - Agricultural Automation - Agricultural Vehicle Robot.

Unit II Precision Agriculture **9 Hours**

Sensors - Types and agricultural applications - Global Positioning System (GPS): GPS for civilian use - Differential GPS - Carrier-phase GPS - Real-time kinematic GPS - Military GPS - Geographic Information System - Variable Rate Applications - Controller Area Networks.

Unit III Traction and Testing **9 Hours**

Hitching- Principles of hitching - Types of hitches - Hitching and weight transfer - Control of hitches - Tires and Traction models - Traction predictor spread sheet - Soil Compaction - Traction Aids - Tractor Testing.

Unit IV Soil Tillage and Weed Management **9 Hours**

Tillage Methods and Equipment - Mechanics of Tillage Tools - Performance of Tillage Implements - Hitching of Tillage Implements - Weed Management - Conventional Cropping Systems - Tools - Crop Rotation - Mechanical Cultivation.

Unit V Machinery Selection **9 Hours**

Screw Conveyors - Pneumatic Conveyors - Bucket Elevators - Forage Blowers and miscellaneous Conveyors - Machinery Selection - Field Capacity And Efficiency - Draft And Power Requirements - Machinery Costs.

Course Outcomes	Cognitive Level
At the end of this course , students will be able to:	
CO1: Recognize the process of planting cultivation where robotics mechanism can be applied.	Apply
CO2: Integrate various communication system required for agricultural applications	Understand
CO3: Apply various robotic technologies in modern agriculture to obtain efficient outcomes	Apply
CO4: Articulate the plant life cycle process with various automated mechanisms to provide effective actuation on specific crops	Analyze
CO5: Develop suitable robotic automated systems for categorical agricultural tasks	Apply

Text Book(s):

T1. Qin Zhang, Francis J. Pierce, “Agricultural Automation Fundamentals and Practices", CRC Press, 2016. (Unit I, II, & III)

T2. Stephen L Young, Francis J. Pierce, “Automation: The Future of Weed Control in Cropping Systems", Springer, Dordrecht Heidelberg New York London, 2014. (Unit IV & V)

Reference Book(s):

R1. Ajit K. Srivastava, Carroll E. Goering, Roger P. Rohrbach, Dennis R. Buck master, “Engineering Principles of Agricultural Machines”, ASABE Publication, 2012.

R2. Myer Kutz, “Handbook of Farm, Dairy and Food Machinery Engineering”, Academic Press, 2019

Web References:

1. Report on Agricultural Robotics annual review: https://www.annualreviews.org/doi/10.1146/annurev-control-053018-023617

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	2	-	2	-	2	-	-	-	-	-
CO2	2	3	2	-	2	-	1	-	-	-	-	-
CO3	3	-	-	-	-	1	1	-	-	-	-	-
CO4	-	3	-	3	-	1	1	-	-	-	1	1
CO5	-	-	2	-	3	1	1	-	-	-	1	1

High-3; Medium-2; Low-1