An Autonomous Institution Since 2011.
Approved by AICTE / Affiliated to Anna University.
Accredited by NAAC with 'A++' Grade.
Tier-1* - Accredited by NBA.
Part of NIA Educational Institution

Curriculum and Syllabi

B.E. Computer Science and Engineering

Semesters I to VIII

Regulations 2019

(2021 Batch Onwards)

Dr. Mahalingam College of Engineering and Technology
Department of Computer Science and Engineering

Vision

To develop engineers with global employability, entrepreneurship capability, research focus and social responsibility

Mission

- To develop internationally competent engineers in dynamic IT field by providing state-of-art academic environment and industry driven curriculum
- To motivate and guide students to take up higher studies and establish entrepreneurial ventures
- To enrich the department through committed and technically sound faculty team with research focus in thrust areas
- To undertake societal problems and provide solutions through technical innovations and projects in association with the industry, society and professional bodies

Programme: B.E. Computer Science and Engineering

Programme Educational Objectives (PEOs) - Regulations 2019

B.E. Computer Science and Engineering graduates will:

PEO1.Domain expertise: Possess expertise and emerge as key players in IT integrated domains.

PEO2.Computing skills and ethics: Employ computing skills to solve societal and environmental issues in an ethical manner.

PEO3.Lifelong learning and research: Involve in lifelong learning and research to meet the demands of global technology.

Programme Outcomes (POs) - Regulations 2019

On successful completion of B.E. Computer Science and Engineering programme, graduating students/graduates will be able to:

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

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

PO3. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions for complex problems.

PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes (PSOs) - Regulations 2019

On successful completion of B.E. Computer Science and Engineering programme, graduating students/graduates will be able to:

PSO1. Systems engineering: Employ software engineering principles in the design and development of efficient systems

PSO2. Knowledge engineering: Apply data analytics techniques for solving real world problems

Programme: B.E Computer Science and Engineering
2019 Regulations
Curriculum for Semesters I to VIII

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

Semester I

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19MABC1102	Linear Algebra and Infinite Series	3	1	0	4	100	AD,AM CS,IT & SC
19ENHG2101	Communication Skills – I	2	0	2	3	100	All
19EESC2101	Introduction to Electrical and Electronics Engineering	3	0	2	4	100	AD,AM CS,IT & SC
19CSSN2101	Fundamentals of Programming	3	0	2	4	100	-
19CSSC4001	IT Practices Lab	1	0	4	3	100	AD,AM CS,IT & SC
19PSHG6001	Wellness for Students*	0	0	2	-	-	All
Total		**12**	**1**	**12**	**18**	**500**	

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	AD,AM CS,IT & SC
19ENHG2201	Communication Skills – II	2	0	2	3	100	All
19PHBC2002	Physics for Information Sciences	3	0	2	4	100	AD,AM CS,IT & SC
19ECSC2201	Digital System Design	2	0	2	3	100	AD,AM CS,IT & SC
19CSSN2201	Programming with C	3	0	3	4.5	100	-
19MESC4001	Engineering Drawing	1	0	3	2.5	100	AD,AU,CS,EC, EI,IT,ME, &MC
19PSHG6001	Wellness for Students*	0	0	2	1	100	All
19CHMG6201	Environmental Sciences	1	0	0	-	100	All
19PSHG6003	தமிழர்மரபு /Heritage of Tamils**	1	0	0	1	100	All
Total		**16**	**1**	**14**	**23**	**900**	

* Annual Pattern

** Applicable only for 2022 Batch

Semester III

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19MABC1303	Discrete Mathematics	3	1	0	4	100	CS & IT
19CSCN1301	Data Structures and Algorithm Analysis – I	3	0	0	3	100	CS & AD
19CSCN1302	Computer Architecture	3	0	0	3	100	CS & AD
19ECSN1301	Principles of Communication Engineering	3	0	0	3	100	-
19CSCN2301	Database Systems	3	0	2	4	100	CS & AD
19CSCN3301	Data Structures and Algorithm Analysis Laboratory	0	0	3	1.5	100	CS & AD
19CSCN4301	Java Programming 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**	1	0	0	1	100	All
Total		**19**	**2**	**10**	**26**	**1000**	

Semester IV

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19MABG1401	Probability and Statistics	3	1	0	4	100	All
19CSCN1401	Data Structures and Algorithm Analysis – II	3	1	0	4	100	CS & AD
19CSCN2401	Operating Systems	3	0	2	4	100	-
19EESN2401	Microcontrollers and IoT	3	0	2	4	100	-
19CSCN3401	Python Programming Laboratory	0	0	4	2	100	-
19CSPN6401	Mini – Project	0	0	4	2	100	-
XXXXXXXXXX	One Credit Course	0	0	2	1	100	-
Total		**12**	**2**	**14**	**21**	**700**	

Course Code	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			
19CSCN1501	Formal Languages and Automata Theory	3	1	0	4	100	-
19CSCN1502	Object Oriented Software Engineering	3	0	0	3	100	-
19CSCN2501	Computer Network Technology	3	0	2	4	100	-
XXXXXXXXXX	Professional Elective –I	3	0	2	4	100	-
XXXXXXXXXX	Professional Elective –II	3	0	0	3	100	-
XXXXXXXXXX	Open Elective – I	3	0	0	3	100	-
19CSCN3501	Object Oriented Software Engineering Laboratory	0	0	3	1.5	100	-
19CSCN4501	Internet Programming Laboratory	1	0	3	2.5	100	-
19PSHG6501	Employability Skills 1 : Teamness and Interpersonal Skills	0	0	2	1	100	All
Total		**19**	**1**	**12**	**26**	**900**	

Semester VI

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19CSCN1601	Compiler Design	3	1	0	4	100	-
19CSCN1602	Machine Intelligence	3	0	0	3	100	-
XXXXXXXXXX	Professional Elective –III	3	0	2	4	100	-
XXXXXXXXXX	Professional Elective –IV	3	0	0	3	100	-
XXXXXXXXXX	Open Elective –II	3	0	0	3	100	-
19CSCN3601	Machine Intelligence Laboratory	0	0	4	2	100	-
19CSPN6601	Innovative and Creative Project	0	0	4	2	100	-
19PSHG6601	Employability Skills 2: Campus to Corporate	0	0	2	1	100	All
Total		**15**	**1**	**12**	**22**	**800**	

Course Code	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			
19CSCN1701	Cyber Security	3	0	0	3	100	-
19CSCN1702	Software Project Management	3	0	0	3	100	-
XXXXXXXXXX	Professional Elective –V	3	0	2	4	100	
XXXXXXXXXX	Professional Elective –VI	3	0	0	3	100	-
XXXXXXXXXX	Open Elective - III	3	0	0	3	100	
19CSCN4701	Cloud Technology Laboratory	1	0	3	2.5	100	-
19CSCN4702	Open Source Software Development Laboratory	1	0	3	2.5	100	-
Total		**17**	**0**	**8**	**21**	**700**	

Semester VIII

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19SHVG6001/ 19SHVG6002	Entrepreneurship Development / தமிழர் மரபும் பண்பாடும்/ Culture and Heritage of Tamils	1	0	0	1	100	All
19CSPN6801	Project	0	0	16	8	200	-
Total		**1**	**0**	**16**	**9**	**300**	

Course Code	Course Title	Duration	Credits	Marks
XXXXXXXXXX	Internship or Skill Development*	8 or 16 weeks	4	100

*Refer to clause: 4.8 in UG academic regulations 2019

Total Credits (2021 Batch): 170

Total Credits (2022 Batch): 172

Vertical wise Electives

Vertical I Data Science Electives							
Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19CSEN2003	Information Retrieval Techniques	3	0	2	4	100	-
19CSEN2004	Big Data Analytics	3	0	2	4	100	-
19CSEN2013	Social Network Analytics	3	0	2	4	100	-
19CSEN2022	Visualization Techniques	3	0	2	4	100	-
19CSEN2029	Exploratory Data Analytic Techniques	3	0	2	4	100	-
19CSEN1016	Business Intelligence and Management	3	0	0	3	100	-
19CSEN1009	Text and Web Mining	3	0	0	3	100	-
19CSEN1017	Data Warehousing and Mining	3	0	0	3	100	-
19ITIC1001	Integrated Big Data Solutions	3	0	0	3	100	AD,AM CS,IT &SC

Vertical II Artificial Intelligence & Machine Learning							
Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19CSEN2012	Soft Computing Techniques	3	0	2	4	100	-
19CSEN2030	Digital Image Processing Techniques	3	0	2	4	100	-
19CSEN2031	Classical and Evolutionary Optimization Techniques	3	0	2	4	100	-
19CSEN2035	Deep Learning Methods	3	0	2	4	100	-
19CSEN1010	Speech Processing	3	0	0	3	100	-
19CSEN1012	Bio Inspired Computing	3	0	0	3	100	-
19CSEN1018	Knowledge Engineering	3	0	0	3	100	-
19CSEN1019	Reinforcement Learning Techniques	3	0	0	3	100	-

Vertical III Networks & Security							
Course Code	**Course Title**	**Hours/Week**			**Credits**	**Marks**	**Common to Programmes**
		L	**T**	**P**			
19CSEN2005	Multi-Core Architecture	3	0	2	4	100	-
19CSEN2014	Cryptographic Techniques	3	0	2	4	100	-
19CSEN2024	Network and Internet Security	3	0	2	4	100	-
19CSEN2025	Embedded Systems	3	0	2	4	100	-
19CSEN2032	Digital and Mobile Forensics	3	0	2	4	100	-
19CSEN1005	Distributed Systems	3	0	0	3	100	-
19CSEN1008	Wireless Sensor Networks	3	0	0	3	100	-
19CSEN1013	Block Chain Technology	3	0	0	3	100	-
19CSEN1014	Information Security	3	0	0	3	100	-
19EEIC1001	Embedded System Design and Development	3	0	0	3	100	CS,EC,EE,MC & ME

Vertical IV Software Development							
Course Code	**Course Title**	**Hours/Week**			**Credits**	**Marks**	**Common to Programmes**
		L	**T**	**P**			
19CSEN2015	Web Technologies	3	0	2	4	100	-
19CSEN2016	Software Quality Assurance and Testing	3	0	2	4	100	-
19CSEN2026	Design Patterns	3	0	2	4	100	-
19CSEN2027	Foundation Skills in Integrated Product Development	3	0	2	4	100	-
19CSEN2028	Advanced Data Structures and Algorithms	3	0	2	4	100	-
19CSEN2033	Robotic Process Automation Design	3	0	2	4	100	-
19CSEN1020	Agile Methodologies	3	0	0	3	100	-
19CSEN1007	Reliability Engineering	3	0	0	3	100	-
19CSIC1001	Prototype Development	3	0	0	3	100	CS,EC,EE,MC & ME
19CSIC2001	AWS & DevOps	3	0	2	4	100	AD,AM CS,IT &SC

Vertical V Human Computer Interaction							
Course Code	**Course Title**	**Hours/Week**			**Credits**	**Marks**	**Common to Programmes**
		L	**T**	**P**			
19CSEN2001	User Interface Design	3	0	2	4	100	-
19CSEN2021	Game Design	3	0	2	4	100	-
19CSEN2002	Graphics and Visualization	3	0	2	4	100	-
19CSEN2034	Virtual Reality and Augmented Reality	3	0	2	4	100	-
19CSEN1002	Multimedia Systems	3	0	0	3	100	-
19CSEN1003	Interaction Design	3	0	0	3	100	-
19CSEN1021	Human Computer Interaction	3	0	0	3	100	-
19CSEN1022	Wearable Technology	3	0	0	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	-
19MEEC1025	Fundamentals of Entrepreneurship	3	0	0	3	100	-
19MEEC1026	Design Thinking and Innovation	3	0	0	3	100	-
19CSEN1015	Information Storage Systems	3	0	0	3	100	-
19CSEC6701	Professional Readiness for Innovation, Employability and Entrepreneurship	0	0	6	3	100	-
19MEEC1001	Product Life cycle Management	3	0	0	3	100	AD,AU,CS,EC ,EE,EI, IT & ME
19MEEC2002	PLM For Engineers	2	0	2	3	100	AD,AM,AU, CS,EC,EE,EI, IT, ME & SC

Open Electives

(Offered to other Programmes)

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
19CSOC1001	Data Structures	3	0	0	3	100
19CSOC1002	Relational Database Management System	3	0	0	3	100
19CSOC1003	Java Programming	3	0	0	3	100
19CSOC1004	Principles of Operating System	3	0	0	3	100
19CSOC1005	Object Oriented System Design	3	0	0	3	100
19CSOC1006	Management Information Systems	3	0	0	3	100
19CSOC1007	Computer Forensics	3	0	0	3	100
19CSOC1008	Augmented Reality and Virtual Reality	3	0	0	3	100
19CSOC1009	Human Computer Interface Design	3	0	0	3	100
19CSOC1010	Bio Informatics	3	0	0	3	100
19CSOC1011	Geographic Information System	3	0	0	3	100
19CSOC1012	Green Computing	3	0	0	3	100
19CSOC1013	Advanced Algorithms	3	0	0	3	100

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 At the end of this course, students will be able to:	Cognitive Level
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 At the end of this course, students will be able to:	Cognitive Level
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,

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

<table>
<tr><td>Course Code:19ENHG2101</td><td colspan="3">Course Title: Communication Skills – I
(Common to all B.E/B.Tech Programmes)</td></tr>
<tr><td colspan="2">Course Category: Humanities</td><td colspan="2">Course Level: Introductory</td></tr>
<tr><td>L:T:P(Hours/Week)
2: 0: 2</td><td>Credits:3</td><td>Total Contact Hours:60</td><td>Max. Marks:100</td></tr>
</table>

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", 2nd Edition, Cengage Learning, 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”, 2^{nd} 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: 19CSSN2101	**Course Title: Fundamentals of 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. Develop solutions using problem solving techniques
2. Design pseudo code using suitable selection and repetition structures
3. Choose appropriate data types, variables and I/O statements
4. Develop programs using selection and iteration statements
5. Construct programs using arrays

Unit I Introduction to Programming 9 Hours

General Problem Solving Strategy – Program Development Cycle – Basic Programming Concepts: A Simple Program, Data Input, Program Variables and Constants – Data Types – Data Processing and Output – Problem solving techniques: Algorithm, flowchart, pseudocode.– Case study: RAPTOR

Unit II Program Development and Control Structures 9 Hours

Program Development: Program Design, Coding, Documenting and Testing a Program – Control Structures: Sequential Structure – Decision structure: single-alternative, dual-alternative, multiple-alternative structure – Loop structure: repeat-until, while, do-while, for.

Unit III Data Types and Operators In C 9 Hours

Overview of C – Structure of C program – Executing a C program – C Character set – keywords- Identifier – Variables and Constants – Data types – Type conversion – Operators and Expressions – Managing formatted and unformatted Input & Output operation.

Unit IV Control Structures 9 Hours

Statements: Selection statements: if, if-else, nested if-else, if-else-if ladder, switch – Jump statements: break, continue, goto, return – Iteration statements: for, nested for, while, do-while – exit – Storage classes.

Unit V Arrays 9 Hours

Declaration – Initialization – Characteristics of Array – One-dimensional array – Two-dimensional array – Array Operations – Applications: Linear search, Binary search, Selection sort, Bubble sort, Matrix Operations.

List of Exercises 30 Hours

1. Solve simple problems using RAPTOR
2. Generate flowchart using control structures using RAPTOR
3. Create C Program to process data types, operators and expression evaluation
4. Develop C Program using formatted and unformatted I/O operations
5. Construct C Program using selection and iteration statements
6. Develop C Program using arrays and array applications such as searching, sorting and matrix operations

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO 1: Develop solutions using problem solving techniques	Apply
CO 2: Write pseudo code using suitable selection and repetition structures for a real time application	Apply
CO 3: Choose appropriate data types, variables and I/O statements for solving problems	Apply
CO 4: Develop programs using selection and iteration statements for a given scenario	Apply
CO 5: Construct programs using arrays for various real time applications	Apply

Text Book(s):

T1. Venit S, and Drake E, "Prelude to Programming Concepts and Design", 6^{th} Edition, Pearson Education, 2015.

T2. Ajay Mittal, "Programming in C – A Practical Approach", Pearson Education, 2010.

Reference Book(s):

R1.R.G.Dromey, “How to Solve it by Computer”, 2nd Edition, Pearson Education, India, 2008.

R2.Yashavant. P. Kanetkar “Let Us C”, 16th Edition, BPB Publications, 2018.

R3.PradipDey, ManasGhosh, “Computer Fundamentals and Programming in C”, 2nd Edition, Oxford University Press, 2013.

Web References:

1. http://raptor.martincarlisle.com/
2. http://www.cprogramming.com/
3. http://www.c4learn.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	1	1	2	3	2	-	2	3	-
CO2	3	2	2	2	2	1	1	2	3	2	-	2	3	-
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
CO5	3	2	2	2	2	1	1	2	3	2	-	2	3	1

High-3; Medium-2;Low-1

<table>
<tr><td colspan="2">Course Code:19CSSC4001</td><td colspan="2">Course Title: IT Practices Lab
(common to CS, IT, AD, AM & SC)</td></tr>
<tr><td colspan="3">Course Category: Engineering Science</td><td>Course Level: Introductory</td></tr>
<tr><td>L:T:P(Hours/Week)
1: 0: 4</td><td>Credits: 3</td><td>Total Contact Hours: 75</td><td>Max Marks:100</td></tr>
</table>

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”, 4^{th} 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

<table>
<tr><td colspan="2">Course Code: 19PSHG6001</td><td colspan="3">Course Title: Wellness for Students
(Common to all B.E/B.Tech Programmes)</td></tr>
<tr><td colspan="3">Course Category: Humanities</td><td colspan="2">Course Level: Introductory</td></tr>
<tr><td>L:T:P(Hours/Week)
0: 0: 2</td><td colspan="2">Credits:1</td><td>Total Contact Hours:30</td><td>Max. Marks:100</td></tr>
</table>

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 Ed. (2010).
R4. Dr. R. Nagarathna, Dr.H.R. Nagendra, "Integrated approach of yoga therapy for positive health", Swami Vivekananda Yoga Prakashana, Bangalore, 2008 Ed.
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

<table>
<tr><td colspan="2">Course Code:19MABC1202</td><td colspan="2">Course Title: Calculus and Transforms
(common to CS, IT, AD, AM & SC)</td></tr>
<tr><td colspan="2">Course Category: Basic Science</td><td colspan="2">Course Level: Introductory</td></tr>
<tr><td>L:T:P (Hours/Week)
3: 1: 0</td><td>Credits:4</td><td>Total Contact Hours:60</td><td>Max. Marks:100</td></tr>
</table>

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 evolutes 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", 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

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

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”, 2nd Edition, CUP Publications, 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”, 3rd Edition, CUP, 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 Physics Laboratory Manual”, Pearson Publishers, New Delhi, 2014

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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	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	PO 1	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	-	-	-	-	-	2	3	2	-	-	-	-
CO5	2	1	-	-	-	-	-	1	-	1	-	-	-	-

High-3; Medium-2; Low-1

Course Code:19CSSN2201	Course Title: Programming with C		
Course Category: Engineering Science		Course Level: Introductory	
L:T:P (Hours/Week) 3: 0: 3	Credits:4.5	Total Contact Hours:90	Max. Marks:100

Pre-requisites

- Fundamentals of Programming

Course Objectives

The course is intended to:

1. Write programs using control structures, arrays and functions
2. Construct programs using pointers
3. Choose appropriate string manipulation and graphics functions
4. Construct appropriate structure and union representations
5. Develop programs using preprocessor directives and files

Unit I C Basics and Functions 10 Hours

Program using Control structures and Arrays – Function Declaration & Definition – Return statement – Classification of functions – Parameter passing methods: call by value – call by reference – Passing Array to a Function– Returning Array from a function– Recursion.

10 Hours

Unit II Pointers

Features of Pointer – Pointer Declaration – void Pointer– Null Pointer – Operations on Pointers – Pointers and Arrays – Array of Pointers – Pointer to a Pointer– Pointer to an Array – Pointer to a function – Dynamic memory allocation.

7 Hours

Unit III Strings and Graphics

Strings: Declaration and Initialization of string – Display of strings with different formats – String standard Functions – String conversion functions – Graphics: Initialization of Graphics – Graphics functions – Programs Using Library Functions.

9 Hours

Unit IV Structures and Union

Declaration & Initialization of Structures – Structure within Structure – Array of Structures – Pointer to Structures – Structure and Functions – type def – Declaration & Initialization of Union – Operations on Union – Enumerated data type – Bit Fields.

9 Hours

Unit V Preprocessor Directives and Files

Preprocessor Directives: Types – Macros – File inclusion – Conditional compilation directives Files: Streams – File access: Sequential access, Random access – File type – File operations (open, close, read, write) – Command line arguments.

List of Exercises **45 Hours**

1. Construct programs using control structures and arrays
2. Develop programs using functions and pointers
3. Design programs for string manipulation
4. Construct programs using graphics functions
5. Develop programs using structures and union
6. Create programs using preprocessor directives and files

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Write programs using control structures, arrays and functions for a given scenario	Apply
CO2: Construct programs using pointers for a given problem	Apply
CO3: Choose appropriate string manipulation and graphics functions for a Given application	Apply
CO4: Construct appropriate structure and union representations for handling compound data	Apply
CO5: Develop programs using preprocessor directives and files for a given scenario	Apply

Text Book(s):

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

T2. Ajay Mittal, "Programming in C – A Practical Approach", Pearson Education, 2010.

Reference Book(s):

R1.Yashavant. P. Kanetkar “Let Us C”,16th edition, BPB Publications, 2018.

R2.PradipDey, ManasGhosh, “Computer Fundamentals and Programming in C”, 2nd Edition, Oxford University Press, 2013.

R3.Byron S Gottfried, “Programming with C”, Schaum’s Outlines, 2nd Edition, Tata McGraw-Hill, 2006.

Web References:

1. https://electronicsforu.com/resources/15-free-c-programming-ebooks
2. https://www.fromdev.com/2013/10/c-programming-tutorials.html
3. https://books.goalkicker.com/CBook/

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	2
CO4	3	2	2	2	2	1	1	2	3	2	-	2	3	2
CO5	3	2	2	2	2	1	1	2	3	2	-	2	3	1

High-3; Medium-2;Low-1

Course Code: 19MESC4001	Course Title: Engineering Drawing (Common to AU, CS, EC, EI, IT, ME, AD, 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, 48th Edition, 2018.

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.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

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:50

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

<table>
<tr><td colspan="2">Course Code: 19PSHG6003</td><td colspan="3">Course Title:HERITAGE OF TAMILS
(Common to all B.E/B.TechProgrammes)</td></tr>
<tr><td colspan="3">Course Category: Humanities</td><td colspan="2">Course Level: Introductory</td></tr>
<tr><td>L:T:P (Hours/Week)
1: 0 :0</td><td colspan="2">Credit: 1</td><td>Total Contact Hours: 15</td><td>Max Marks:50</td></tr>
</table>

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 At the end of this course, students will be able to:	**Cognitive Level**
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: 19MABC1303	Course Title:Discrete Mathematics (common to CS, IT, 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

- 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 Euclidean algorithm to compute gcd and congruence equations

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 Divisibility and Congruence 9+3 Hours

Division Algorithm – Prime and Composite Numbers – Fundamental theorem of Arithmetic – Euclidean algorithm – GCD and LCM – Congruence – Linear congruence – Chinese Remainder Theorem.

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: Compute GCD using Euclidean algorithm and solve system of linear congruence equations	Apply

Text Book(s):

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

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

Reference Book(s):

R1. Kennth H. Rosen, "Discrete Mathematics and Its Applications", 7th Edition, Tata McGraw-Hill Pub. Co. Ltd., New Delhi, July 2017.

R2. Ralph P Grimaldi, Ramana. B. V, " Discrete and Combinatorial Mathematics", 5th Edition, Pearson Education India, 2011.

R3. Tom M.Apostol,"Introduction to Analytic Number Theory", Springer Science+ Business Media, Newyork, 1976.

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: 19CSCN1301	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

- Programming with C

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

Reference Book(s):

R1.SartajSahni, "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/ DataStructures 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

<table>
<tr><td colspan="2">Course Code: 19CSCN1302</td><td colspan="3">Course Title: Computer Architecture
(common to CS & AD)</td></tr>
<tr><td colspan="3">Course Category: Professional Core</td><td colspan="2">Course Level: Practice</td></tr>
<tr><td>L:T:P (Hours/Week)
3: 0: 0</td><td colspan="2">Credits:3</td><td>Total Contact Hours:45</td><td>Max. Marks:100</td></tr>
</table>

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 At the end of this course, students will be able to:	Cognitive Level
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

<table>
<tr><td colspan="2">Course Code: 19ECSN1301</td><td colspan="3">Course Title: Principles of Communication Engineering</td></tr>
<tr><td colspan="3">Course Category: Engineering Science</td><td colspan="2">Course Level: Introductory</td></tr>
<tr><td>L:T:P (Hours/Week)
3: 0: 0</td><td colspan="2">Credits:3</td><td>Total Contact Hours:45</td><td>Max. Marks:100</td></tr>
</table>

Pre-requisites

- Introduction to Electrical and Electronics Engineering

Course Objectives

The course is intended to:

1. Determine the performance of various modulation and demodulation techniques of analog communication
2. Identify the digital modulation schemes for transmission and reception
3. Describe the characteristics of pulse modulation
4. Explain the basic principle of satellite and optical communication
5. Explain basic concepts of cellular communication

Unit I Analog Communication 9

Basic schemes of modern communication system – Need for modulation – Types: Amplitude modulation and Frequency Modulation, Phase Modulation in time and frequency domain, Comparison of AM and FM, PM signals.

Unit II Digital Communication 9

Introduction, Shannon limit for information capacity, bits, bit rate, baud – ASK and FSK Transmitter and Receiver, phase shift keying – binary phase shift keying – QPSK– Quadrature Amplitude modulation: Principle, transmitter and Receiver.

Unit III Digital Transmission 9

Introduction– Pulse modulation – Pulse Code Modulation: PCM sampling, Quantization, Sampling rate, signal to quantization noise ratio – delta modulation – adaptive delta modulation – differential pulse code modulation – ISI – Eye pattern.

Unit IV Satellite and Optical Communication 9

Satellite communication systems: Kepler’s law, LEO, MEO and GEO orbits, Footprint, Link model – GPS System – Optical communication systems: Elements of optical fiber transmission link, Types of Losses.

Unit V Mobile Communication 9

Multiple access techniques: TDMA, FDMA, CDMA – Cellular Concept and Frequency Reuse: Channel Assignment and Hand off, call processing in cellular phone – GPRS –Global System for Mobile Communications (GSM): 2G, 3G, 4G, 5G systems.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1:Determine the performance in time and frequency domain of different modulation and demodulation techniques used in analog communication	Apply
CO2:Identify the digital modulation schemes used for transmission and reception of digital communication systems	Apply
CO3:Describe the characteristics of pulse modulation techniques used for reliable data transmission	Understand
CO4:Explain the basic principle of operation used in satellite and optical communication for data transmission	Understand
CO5:Explain the basic concepts used in cellular communication for multiuser systems	Understand

Text Book(s):

T1. Wayne Tomasi, "Advanced Electronic Communication Systems", 6th Edition, Pearson Education, 2014.

T2. Rappaport T.S, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education, 2014.

Reference Book(s):

R1. Simon Haykin, "Communication Systems", 5th Edition, John Wiley & Sons. 2017.

R2.Lathi. B.P., "Modern Analog and Digital Communication systems", 4thEdition, Oxford University Press, 2017.

R3.Jochen Schiller,"Mobile Communications" 2nd Edition, Pearson Education, 2014.

R4.B.Sklar, "Digital Communication Fundamentals and Applications", 2nd Edition, Pearson Education, 2009.

Web References:

1. Basic schemes of modern communication URL: http://www.nptel.ac.in /course.php?disciplined =106
2. Multiple Access URL: http://ocw.mit.edu/courses/electrical-engineering-and-computerscience/6-450-principles-of-digital-communications-i-fall-2006

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	-	-	-	-
CO2	3	2	1	1	-	-	-	1	-	1	-	-	-	-
CO3	2	1	-	-	-	-	-	1	-	1	-	-	-	-
CO4	2	1	-	-	-	-	-	1	-	1	-	-	-	-
CO5	2	1	-	-	-	-	-	1	-	1	-	-	-	-

High-3; Medium-2;Low-1

<table>
<tr><td>Course Code: 19CSCN2301</td><td colspan="3">Course Title: Database Systems
(common to CS & AD)</td></tr>
<tr><td colspan="2">Course Category: Professional Core</td><td colspan="2">Course Level: Practice</td></tr>
<tr><td>L:T:P (Hours/Week)
3: 0: 2</td><td>Credits:4</td><td>Total Contact Hours:75</td><td>Max Marks:100</td></tr>
</table>

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 At the end of this course, students will be able to:	**Cognitive Level**
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”, 7thEdition, 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

<table>
<tr><td colspan="2">Course Code: 19CSCN3301</td><td colspan="2">Course Title:Data Structures and Algorithm Analysis Laboratory (common to CS & AD)</td></tr>
<tr><td colspan="2">Course Category: Professional Core</td><td colspan="2">Course Level: Practice</td></tr>
<tr><td>L:T:P (Hours/Week)
0: 0: 3</td><td>Credits:1.5</td><td>Total Contact Hours:45</td><td>Max Marks:100</td></tr>
</table>

Pre-requisites

- Programming with C

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 At the end of this course, students will be able to:	Cognitive Level
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, 3rd Edition, 2011.

Reference Book(s):

R1. SartajSahni, "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 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: 19CSCN4301	Course Title: Java Programming 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

- Programming with C

Course Objectives

The course is intended to:

1. Use the concepts of control structures and arrays in developing java programs
2. Apply the concept of classes, objects and suitable modifiers in developing java programs
3. Develop code using java utilities, Inheritance and Polymorphism
4. Design an application using Swing that handles run-time exceptions

Unit I Java Introduction 4 Hours

Overview of Java – Data types – Operators – Control flows – Arrays & Iterators – Classes & Objects – Modifiers: Access, Non- Access Modifiers.

Unit II Object orientation in Java 4 Hours

Constructors & Destructors – Inheritance & types – Polymorphism: Method overloading, Method overriding.

Unit III Interfaces and Java Utilities 4 Hours

Abstract classes and Abstract Methods – Interfaces – String handling functions – String tokenizer – Regex – Date – Array List – Linked List – Stack .

Unit IV Exceptions & Java Swing 3 Hours

Exceptions: Built-in & User defined Exceptions – Introduction to Java Swing – Swing API – Introduction to IO Streams.

List of Exercises **45 Hours**

1. Implement Java programs using user Inputs and control structures
2. Implement Java programs using Arrays and Iterators
3. Implement programs using Classes, Objects with suitable Modifiers
4. Implement programs using Constructors, Destructors & Inheritance
5. Implement programs using Method Overloading & Overriding
6. Implement programs using Abstract class and Interfaces
7. Implement programs using Java Utilities (String, Regex, Date)
8. Implement programs using Collections in Java
9. Implement program to handle run-time Exceptions & files
10. Develop a simple application using Java Swing

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Implement simple java programs using control structures and Arrays	Apply
CO2: Implement java programs using classes, objects and suitable modifiers	Apply
CO3: Develop code for real world problems using java Utilities, Inheritance and Polymorphism.	Apply
CO4: Design an application using Swing that handles run-time exceptions for a given scenario	Apply

Text Book(s):

T1. Herbert Schildt, "Java the Complete Reference", McGraw-Hill Education, 10th Edition, October 2017.

Reference Book(s):

R1. Bart Baesens, Aimee Backiel, Seppe Vanden Brocke, "Beginning Java Programming: The Object Oriented Approach" , John Wiley & Sons, 2015.

R2. Daniel Liang, "Introduction to Java Programming, Comprehensive Version", Pearson Education, 9th Edition, 2014.

Web References:

1. Oracle, Java tutorials, URL: https://docs.oracle.com/javase/tutorial/java/
2. NPTEL, Course on Programming in Java, URL: https://nptel.ac.in/courses/106105191/
3. Java tutorials, URL: https://www.geeksforgeeks.org/java-tutorials/

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	-	-	2	3	2	-	1	3	-
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: 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. R R Gaur, R Sangal, G P Bagaria, “Human Values and Professional Ethics”, Excel Books, New Delhi, 2010.

Reference Book(s):

R1. Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, “Jeevan Vidya”, 1999.
R2. A.N. Tripathi, “Human Values”, New Age Intl. Publishers, New Delhi, 2004.
R3. Annie Leonard, “The story of stuff”, 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:50**

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 அம்மன் 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 மற்றும் 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

<table>
<tr><td colspan="2">Course Code: 19PSHG6004</td><td colspan="2">Course Title:TAMILS AND TECHNOLOGY
(Common to all B.E/B.TechProgrammes)</td></tr>
<tr><td colspan="2">Course Category: Humanities</td><td colspan="2">Course Level: Introductory</td></tr>
<tr><td>L:T:P (Hours/Week)
1: 0 :0</td><td>Credit: 1</td><td>Total Contact Hours: 15</td><td>Max Marks:50</td></tr>
</table>

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 At the end of this course, students will be able to:	**Cognitive Level**
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

<table>
<tr><td colspan="2">Course Code: 19MABG1401</td><td colspan="3">Course Title:Probability and Statistics
(common to all B.E/B.Tech programmes)</td></tr>
<tr><td colspan="3">CourseCategory: Basic Science</td><td colspan="2">CourseLevel: Introductory</td></tr>
<tr><td>L:T:P(Hours/Week)
3: 1: 0</td><td colspan="2">Credits:4</td><td>Total Contact Hours:60</td><td>Max Marks:100</td></tr>
</table>

Pre-requisites

- NIL

Course Objectives

The course is intended to:

1. Calculate expectations and variances of random variables
2. Apply the concepts of standard distributions to solve practical problems
3. Calculate the correlation and regression for two variables
4. Test the samples based on hypothesis
5. Apply the samples based on variance

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.

Unit II Standard Distributions 9+3Hours

Binomial – Poisson – Uniform – Exponential – Normal Distributions and their properties – Functions of a random variable.

Unit III Two Dimensional Random Variables 9+3Hours

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and regression – Transformation of random variables.

Unit IV Testing of Hypotheses 9+3 Hours

Sampling Distributions – 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 V 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.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Calculate expectations and variances of random variables	Apply
CO2: Apply the concepts of standard distributions to solve practical problems	Apply
CO3: Calculate the correlation and regression for two variables	Apply
CO4: Test the samples based on hypothesis	Apply
CO5: Apply the samples based on variance	Apply

Text Book(s):

T1. Dr.J.Ravichandran, “Probability and Statistics for Engineers”, Wiley India Pvt.Ltd.,2010.

T2. Douglas C.Montgomery and George C. Runger, “Applied Statistics and Probability for Engineers”, 6th Edition, Wiley India Pvt.Ltd.,2017.

T3. Veerarajan T, “Probability, Statistics and Random process”, 4th Edition, Tata McGraw-Hill, New Delhi, 2013.

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, 2016.

R2. M.R. Spiegel,J. Schiller and R.A. Srinivasan, “Schaum's Outlines Probability and Statistics”, 3rd Edition,Tata McGraw Hill edition, 2009.

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

R4. Johnson and C.B. Gupta,“Probability and Statistics for Engineers”, 9th Edition,Pearson Education, Asia, 2016.

Web References:

1. Probability,Random Variables,Standard Distributions,Two dimentional random variables,Testing of Hypotheses: https://onlinecourses.nptel.ac.in/111105041/
2. Probability,Random Variables,Standard Distributions,Two dimentional random variables,Testing of Hypotheseshttps://nptel.ac.in/courses/111105090/
3. Design of Experiments : https://nptel.ac.in/courses/111104075/

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	-	1
CO2	3	2	1	1	-	1	-	1	1	1	1	2	-	1
CO3	3	2	1	1	-	1	-	1	1	1	1	2	-	1
CO4	3	2	1	1	-	1	-	1	1	1	1	2	-	1
CO5	3	2	1	1	-	1	-	1	1	1	1	2	-	1

High-3; Medium-2;Low-1

<table>
<tr><td>Course Code: 19CSCN1401</td><td colspan="3">Course Title: Data Structures and Algorithm Analysis – II (common to CS & AD)</td></tr>
<tr><td colspan="2">Course Category: Professional Core</td><td colspan="2">Course Level: Practice</td></tr>
<tr><td>L:T:P (Hours/Week)
3: 1: 0</td><td>Credits:4</td><td>Total Contact Hours:60</td><td>Max. Marks:100</td></tr>
</table>

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”, 2ndEdition, Pearson Education, 2011.

T2. Anany Levitin, “Introduction to the Design & Analysis of Algorithms”, 3rdEdition, 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++”, 4thEdition, Cengage Learning, 2013.

R3.Cormen.T.H.,Leiserson.C.E., Rivest R.L and Stein C, “Introduction to Algorithms”, PHIPvt 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: 19CSCN2401	Course Title:Operating Systems		
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 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.

List of Exercises 30 Hours

1. Implementation of Process and I/O System calls
2. Implementation of CPU Scheduling Algorithms
3. Implementation of Classical Synchronization problems using semaphores
4. Implementation of Memory Allocation Strategies
5. Implementation of Page Replacement Algorithms
6. Implementation of Disk Scheduling Algorithms

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”, 10thEdition, 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

<table>
<tr><td colspan="2">Course Code: 19EESN2401</td><td colspan="3">Course Title: Microcontrollers and IoT</td></tr>
<tr><td colspan="3">Course Category: Engineering Science</td><td colspan="2">Course Level: Introductory</td></tr>
<tr><td>L:T:P (Hours/Week)
3: 0: 2</td><td colspan="2">Credits:4</td><td>Total Contact Hours:75</td><td>Max Marks:100</td></tr>
</table>

Pre-requisites

- Programming with C
- Digital System Design

Course Objectives

The course is intended to:

1. Write PIC18/PIC16 microcontroller basedI/O programs using EmbeddedC
2. Write programs for interfacing peripheral devices and sensors
3. Use IoT Connectivity technologies
4. Implement IoT protocols and architecture
5. Implement simple IoT applications in various domains

Unit I PIC Microcontroller 9 Hours

PIC18FX Pin connection – File register – I/O programming: Data type and Time delay, Logical operations, Timer and Counter: Timer0 – Serial port– Analog to digital converter.

Unit II IoT Sensors and Peripheral interfacing 9 Hours

IoT – Major Components – Challenges, Advantages and Disadvantages – LED interfacing - LCD interfacing – Keyboard interfacing – Relay and Opto-isolator – Sensor interfacing- Temperature sensor, IR sensor, Ultrasonic Sensor

Unit III IoT Connectivity Technologies and Board Interfacing 9 Hours

IoT networking - local network- Bluetooth, LPWAN, XBEE- IOT gateway - Raspberry pi board and Arduino Board details- Python programming- GPIO, UART – Interfacing multiple nodes with gateway.

Unit IV IoT Architecture and Implementation of IoT 9 Hours

IOT Architecture – Networking Protocols:MQTT -CoAP – Implementation of IoT- Collect data from the devices in the local network, Send the data to a server, control the device from the server- Applications: remote data logging system – remote Lamp control.

Unit V Applications 9 Hours

Patient Monitoring in Health Care– Home Automation– Smart Irrigation in Agriculture Monitoring – Smart parking – Factory Automation

List of Exercises 30 Hours

1. Control the LED using switch(PIC microcontroller)
2. Control the lamp using Relay interfacing (PIC microcontroller)
3. Interface IR sensor and control the FAN(ARDUINO)
4. Interfacing temperature sensor and ultrasonic sensor.(ARDUINO)
5. Multi node connection to GATEWAY using local network.
   (Sensors, Arduino and Raspberry pi)
6. Send the data to the server from GATEWAY.
   (Sensors ,ARDUINO, Raspberry pi and web server)
7. Control the home appliances(lamp, fan) from server.
   (Lamp,fan,arduino, Raspberry pi and web server)

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Write PIC18/PIC16 microcontroller based I/O programs using Embedded C for control applications	Apply
CO2: Write programs for interfacing peripheral devices and sensors with PIC Microcontroller	Apply
CO3: Use Connectivity technologies for data transfer in IoT	Apply
CO4: Implement protocols and architecture for data processing in IoT	Apply
CO5: Implement simple applications in Agriculture, Health Care & Automation using IoT	Apply

Text Book(s):

T1.Muhammad Ali Mazidi, RolinD.Mckinlay, Danny Causery,"PIC Microcontroller and Embedded systems using assembly and C PIC18", 2nd Edition, Micro Digital Ed, 2016.

T2. Charalampos Doukas , "Building Internet of Things with the Arduino", volume 1,Create space publishers , April 2012.

Reference Book(s):

R1. ArshdeepBahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015.

R2. Marco Schwartz, "Internet of Things with the Arduino Yun", Packt Publishing, 2014.

R3.Pedro Larrañaga, David Atienza, Javier Diaz-Rozo, Alberto Ogbechie, Carlos Esteban Puerto-Santana, Concha Bielza"Industrial Applications of Machine Learning", CRC Press, 2018.

Web Reference(s):

1. Introduction to IoT NPTEL Video: https://www.youtube.com/watch?v=WUYAjxnwjU4
2. Sensing NPTEL Video : https://www.youtube.com/watch?v=z3VEZPwl5gA&list=PLE7VH8RC_N3bpVn-e8QzOAHziEgmjQ2qE&index=3
3. Connectivity Technologies NPTEL Video: https://www.youtube.com/watch?v=GHUR_GfQQsQ&list=PLE7VH8RC_N3bpVn-e8QzOAHziEgmjQ2qE&index=9

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	-	-	3	-
CO2	3	2	2	2	2	-	-	2	3	2	-	-	3	-
CO3	3	2	2	2	2	-	-	2	3	2	-	-	3	1
CO4	3	2	2	2	2	-	-	2	3	2	-	-	3	1
CO5	3	2	2	2	2	1	1	2	3	2	1	-	3	-

High-3; Medium-2; Low-1

<table>
<tr><td colspan="2">Course Code: 19CSCN3401</td><td colspan="3">Course Title: Python Programming Laboratory</td></tr>
<tr><td colspan="3">Course Category: Professional Core</td><td colspan="2">Course Level: Practice</td></tr>
<tr><td>L:T:P (Hours/Week)
0: 0: 4</td><td colspan="2">Credits:2</td><td>Total Contact Hours:60</td><td>Max Marks:100</td></tr>
</table>

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Implement basic programming constructs and functions in python
2. Implement file and object oriented concepts in python
3. Implement collection objects and file handling in python
4. Develop Python program with Database Connectivity

List of Exercises **60 Hours**

1. Implement data types, operators and expressions
2. Implementation of branching statements and looping constructs
3. Implementation of Recursive and Non Recursive functions
4. Implementation of class and objects
5. Implementation of Inheritance and polymorphism
6. Implementation of Exception handling
7. Implementation of list, tuple and dictionary
8. Implementation of file handling techniques
9. Implementation of pickle and shelve objects
10. Implement Database Connectivity with SQL Server

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Implement basic programming constructs and functions in python for simple problems	Apply
CO 2: Implement Object oriented concepts python for solving real world problems	Apply
CO 3: Implement python program with collection objects and file for simple problems	Apply
CO 4: Develop python program with Database Connectivity for real world problems	Apply

Text Book(s):

T1.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.

T2. Mark Lutz, "Powerful Object Oriented Programming Python", 4th Edition, O'Reilly, 2012.

Reference Book(s):

R1.Mark Lutz, "Learning Python, Powerful OOPs", 5th Edition, O'Reilly, 2013.

R2.Zelle, John M, "Python Programming: An Introduction to Computer Science", Franklin Beedle& Associates, 2003.

Web References:

1. Official documentation of python 3.10: https://docs.python.org/3/tutorial/
2. Beginner to Advanced Python developer guide: https://www.learnpython.org/
3. Python quick reference guide: 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	2	1	1	2	3	2	1	1	3	-
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	1
CO4	3	2	2	2	2	1	1	2	3	2	1	1	3	-

High-3; Medium-2;Low-1

Course Code: 19CSPN6401	Course Title: Mini – 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 simple engineering problems.
2. Use the knowledge of Science, engineering & 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 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 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: Demonstrate the use of prior knowledge of science and engineering and engineering tools to formulate, analyze and investigate problems systematically.	Apply
CO4: Communicate the process, methods and materials, findings, results and solutions through reports and presentations in appropriate 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	-	-	3	-	-	-	-

High– 3; Medium– 2; Low– 1

Semester V

Course Code:19CSCN1501	Course Title: Formal Languages and Automata Theory		
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. Impart the concept of NFA and DFA
2. Construct Finite Automata from regular expressions
3. Understand Context free languages and Pushdown Automata
4. Construct a Turing Machine
5. Explain decidable and undecidable languages

Unit I Finite Automata **8+3 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+3 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 **10+3 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 **10+3 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 8+3 Hours

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

Course Outcomes At the end of this course, students will be able to:	Cognitive Level
CO 1: Choose the suitable technique for constructing NFA and DFA	Apply
CO 2: Construct Finite Automata from regular expressions for identifying regular languages	Apply
CO 3: Develop Pushdown Automata for accepting context free languages	Apply
CO 4: Construct a Turing Machine for recognizing recursive languages	Apply
CO 5: Explain decidable and undecidable languages by using reducibility	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.

T2. Michael Sipser, "Introduction to the Theory of Computation", 3rd Edition, Cengage Learning, 2013.

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. Course Material URL: http://www.ics.uci.edu/~goodrich/ teach/cs162/notes/
2. NPTEL Course Content URL: http://nptel.ac.in/courses/106106049/
3. 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	1	-	1	2	-
CO2	3	2	1	1	-	-	-	1	1	1	-	1	2	-
CO3	3	2	1	1	-	-	-	1	1	1	1	1	2	1
CO4	3	2	1	1	-	-	-	1	1	1	1	1	2	-
CO5	2	1	-	-	-	-	-	1	1	1	-	1	-	-

High– 3; Medium– 2; Low– 1

<table>
<tr><td>Course Code: 19CSCN1502</td><td colspan="3">Course Title: Object Oriented Software Engineering</td></tr>
<tr><td colspan="2">Course Category: Professional Core</td><td colspan="2">Course Level: Practice</td></tr>
<tr><td>L:T:P (Hours/Week)
3: 0: 0</td><td>Credits:3</td><td>Total Contact Hours:45</td><td>Max Marks:100</td></tr>
</table>

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 At the end of this course, students will be able to:	Cognitive Level
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:19CSCN2501	**Course Title: Computer Network Technology**		
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

- Principles of Communication Engineering

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 10 Hours

Internet Protocol (IP) – Service Model – Global Addresses – Datagram Forwarding in IP – Subnetting and Classless Addressing – ARP – DHCP – ICMP – Routing protocols: RIP and OSPF – 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 Reference(s):

1. MIT Open course ware - Data Communication Networks: http://ocw.mit.edu/courses/electrical– engineering– and– computer– science/6– 829– computer– networks– fall– 2002/
2. NPTEL - Introduction on Computer Networks: http://nptel.ac.in/courses/106105080/
3. NPTEL - Computer Networks: http://nptel.ac.in/courses/106105081/
4. NPTEL - Emergence of Networks & Reference Models: 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	2	1	-	-	-	-	-	1	-	1	-	1	-	-
CO2	2	1	-	-	-	-	-	1	-	1	-	1	-	1
CO3	3	2	2	2	2	-	-	2	3	2	-	1	3	-
CO4	3	2	2	2	2	-	-	2	3	2	-	1	2	-
CO5	3	2	2	2	2	-	-	2	3	2	-	1	2	-

High– 3; Medium– 2; Low– 1

<table>
<tr><td colspan="2">Course Code: 19CSCN3501</td><td colspan="2">Course Title: Object Oriented Software Engineering Laboratory</td></tr>
<tr><td colspan="2">Course Category: Professional Core</td><td colspan="2">Course Level: Practice</td></tr>
<tr><td>L:T:P (Hours/Week)
0: 0: 3</td><td>Credits:1.5</td><td>Total Contact Hours:45</td><td>Max Marks:100</td></tr>
</table>

Pre– requisites

- Fundamentals of Programming

Course Objectives

The course is intended to:

1. Identify the requirements for a Software system
2. Derive classes with appropriate relationships in problem statement
3. Design classes, interface and subsystem
4. Develop functional object– oriented software

List of Exercises

1. Develop requirement specification using object oriented concepts and validate it.
2. Apply Usecase modeling for the given requirement specification.
3. Identify the conceptual classes with its relationships and develop a domain model with UML class diagram.
4. Using the identified scenarios, draw relevant activity diagram.
5. Using the identified scenarios, find the interaction between objects and represent using UML sequence diagrams.
6. Using the identified scenarios, draw relevant state diagram.
7. Develop and validate the user interface.
8. Generate a functional code using UML design.
9. Implement the application with data base connectivity
10. Deploy and test the functional software.

The above List of exercises can be completed for a common application. Some areas for the application are suggested below.

Suggested Areas for Application:

Passport Automation System, Book Bank, Exam Registration, Stock Maintenance System, Online Course Reservation System, E– ticketing, Credit Card Processing, E– book Management System, Recruitment System, Library Management System, Student Information System, etc.

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

Text Books:

T1. Roger. S. Pressman and Bruce R. Maxim, "Software Engineering – A Practitioner's Approach", 7th 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", Pearson Education Asia, 9th Edition, 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	3	2	2	2	2	3	3	2	3	3	3	3	3	1
CO2	3	2	2	2	2	3	3	2	3	3	3	3	3	1
CO3	3	2	2	2	2	3	3	2	3	3	3	3	3	1
CO4	3	2	2	2	2	3	3	2	3	3	3	3	3	1

High– 3; Medium– 2;Low– 1

Course Code: 19CSCN4501	**Course Title: Internet Programming 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:

- IT Practices Lab

Course Objectives

The course is intended to:

1. Build a static web page
2. Develop a real time web page

Unit I Client Side Scripting 7 Hours

HTML5 – Tables – Form Input Types – CSS3 – Gradients –Text Stroke – JavaScript – Control Statements – Selection Statements – Repetition Statements – Functions – Events – Arrays – Objects – XML – Schema – DTD – XSLT.

Unit II Server Side Scripting 8 Hours

HTTP Servlet – JSP – Objects – Scripting – ASP – Page and File System Objects – Web Services – Service side – Client Side – PHP.

List of Exercises 45 Hours

1. Create a webpage using HTML5 Elements.
2. Create a webpage using CSS3.
3. Develop a webpage using the features of JavaScript.
4. Develop a web form application using JavaScript and validate it.
5. Convert a XML page into HTML page using XSLT.
6. Develop a Server side application using HTTP Servlets.
7. Develop a web application using JSP.
8. Develop a web application using ASP.
9. Build sample web services using .Net / Java technology.
10. Create a web application using PHP.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Build a static web page using Client Side scripting Languages	Apply
CO 2: Develop a real time webpage using Server Side scripting Languages	Apply

Reference Book(s):

R1. Harvey Deitel, Paul Deitel, Abbey Deitel "Internet and World Wide Web How To Program", 5th Edition, Pearson Education Asia, 2019.

R2. DT Editorial Services, "HTML 5 Black Book, Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP, jQuery", 2nd Edition, Wiley, 2018.

R3. Robin Nixon, "Learning PhP, MySQL & JavaScript with jQuery, CSS & HTML5", 5th Edition, O'Reilly, 2018.

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	1	1	3	-
CO2	3	2	2	2	2	1	1	2	3	2	1	1	3	1

High– 3; Medium– 2;Low– 1

<table>
<tr><td>Course Code:19PSHG6501</td><td colspan="3">Course Title: Employability Skills 1: Teamness and Interpersonal Skills</td></tr>
<tr><td colspan="2">Course Category: Humanities</td><td colspan="2">Course Level: Introductory</td></tr>
<tr><td>L:T:P (Hours/Week)
0: 0: 2</td><td>Credits: 1</td><td>Total Contact Hours: 30</td><td>Max Marks: 100</td></tr>
</table>

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

Life skills – Core IP Skills – Importance of IP Skills – Tips to improve IP Skills– Necessity of IP Skills.

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 Leadership Fable" Jossey Bass Publishers, 2006.

R2. Malcolm Gladwell, "Talking to Strangers: What We Should Know about the People We Don’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:19CSCN1601	Course Title: Compiler Design		
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

- Formal Languages and Automata Theory

Course Objectives

The course is intended to:

1. Explain the building blocks of System software
2. Describe the phases of a compiler and the role of Lexical analyzer
3. Design and implement different types of parsers
4. Generate intermediate code for the given source code
5. Produce efficient target code.

Unit I System Software 9+3 Hours

System Software – Overview of Language Processors – Program Generation – Program Execution – Assemblers – Elements of Assembly Language Programming – Pass Structure of Assembler – Macro Definition and Call – Macro Expansion – Program Relocation – Linking – Loaders.

Unit II Compiler Phases and Lexical Analysis 9+3 Hours

Compilers – Phases of a compiler – Analysis of the Source Program – Grouping of Phases – Compiler construction tools.

Lexical Analysis – Role of Lexical Analyzer – Input Buffering – Specification of Tokens – Recognition of Tokens – LEX – Implementation of Lexical Analyzer using LEX.

Unit III Syntax Analysis 10+3 Hours

The Role of a Parser – Context Free Grammar – Top Down Parsing – Predictive Parser – Bottom up Parsing – LR Parsers – Construction of SLR, CLR and LALR Parsing Table – Parser Generators: YACC.

Unit IV Intermediate Code Generation 8+3 Hours

Intermediate languages – Declarations – Assignment Statements – Boolean Expressions – Case Statements – Back Patching – Procedure Calls.

Unit V Code Generation and Optimization 9+3 Hours

Code Generation: Issues in the Design of Code Generator – Target Machine – Runtime Storage Management – Basic Blocks and Flow Graphs – DAG Representation of Basic Blocks – Generating Code from DAGs – A Simple Code Generator.

Code Optimization: Principal Sources of Optimization – Optimization of Basic Blocks – Peephole Optimization – Loops in Flow Graphs.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO 1: Explain the building blocks of System software involved in program translation and execution	Understand
CO 2: Describe the phases of a compiler and the role of Lexical analyzer in program compilation	Understand
CO 3: Design and implement different types of parsers for syntax analysis	Apply
CO 4: Generate intermediate code for the given source code using Syntax Directed Translation and Back Patching	Apply
CO 5: Produce efficient target code using code generation and optimization techniques	Apply

Text Book(s):

T1. Dhamdhere D.M., "Systems Programming", Tata McGraw Hill Education Pvt. Ltd., 2011.

T2. Alfred V. Aho, Monica S.Lam, Ravi Sethi, Jeffrey D. Ullman, "Compilers Principles,Techniques, and Tools", 2nd Edition, Pearson Education, 2014.

Reference Book(s):

R1. Leland L. Beck, "System Software – An Introduction to Systems Programming", 3rd Edition, Addison– Wesley, 2007.

R2. Steven S. Muchnick, "Advanced Compiler Design & Implementation", Morgan Kaufmann Publishers, 2000.

R3. C. N. Fisher and R. J. LeBlanc, "Crafting a Compiler with C", Pearson Education, 2000.

Web References:

1. Introduction to Machine Independent Optimization URL: http://nptel.ac.in/courses/106108052/17
2. Static Single Assignment Form URL: http://nptel.ac.in/courses/106108052/31.
3. Compiler Design Course Material URL: https://www.cs.cmu.edu/~fp/courses/15411–f08/

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	-	-
CO2	2	1	-	-	-	-	-	1	1	1	-	1	-	-
CO3	3	2	1	1	-	-	-	1	1	1	-	1	2	-
CO4	3	2	1	1	-	-	-	1	1	1	-	1	2	1
CO5	3	2	1	1	-	-	-	1	1	1	-	1	2	1

High– 3; Medium– 2; Low– 1

<table>
<tr><td colspan="2">Course Code: 19CSCN1602</td><td colspan="3">Course Title: Machine Intelligence</td></tr>
<tr><td colspan="3">Course Category: Professional Core</td><td colspan="2">Course Level: Practice</td></tr>
<tr><td>L:T:P (Hours/Week)
3: 0: 0</td><td colspan="2">Credits:3</td><td>Total Contact Hours:45</td><td>Max Marks:100</td></tr>
</table>

Pre– requisites

- Calculus and Transforms
- Probability and Statistics
- Data Structures and Algorithm Analysis – II

Course Objectives

The course is intended to:

1. Understand the various searching techniques in solving a problem
2. Understand different ways to represent knowledge base
3. Utilize regression and classification algorithms
4. Model data classification using tree based methods and support vector machines
5. Develop resampling and model selection methods to construct optimal models

Unit I Problem Solving Agents **10 Hours**

Foundation – Agents and Environments – Nature of Environments – Structure of agents – Problem solving agents– Measuring problem solving performance – Informed search strategies – Greedy BFS, A* search – Local search algorithms. Constraint satisfaction problem – Inference in CSP – Backtracking search for CSP.

Unit II Logical Agents **9 Hours**

Logical agents – 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 III Regression and Classification **9 Hours**

Supervised and Unsupervised learning – Classification and Regression – Assessing model accuracy – Simple Linear regression – Multiple linear regression – Qualitative predictors – Extensions of the linear Model – Logistic regression – Naïve Bayes classifier.

Unit IV Tree Based Methods and Support Vector Machines **9 Hours**

Decision Tree – Random Forest – Maximal margin classifier – Support vector classifiers – Support Vector Machines (SVM) – SVMs with more than two classes – Relationship to logistic regression.

Unit V Resampling and Model Selection **8 Hours**

Resampling: Cross Validation, Bootstrapping – Linear Model Selection: Subset selection, Shrinkage methods, Dimension reduction methods – High Dimensional data.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Compare the efficiency of various searching techniques in solving a problem	Understand
CO2: Apply inference rules to the given knowledge base for theorem proving	Apply
CO3: Utilize regression and classification algorithms for data modeling and prediction	Apply
CO4: Model data classification using tree based methods and support vector machines for solving multi class problems	Apply
CO5: Develop resampling and model selection methods to construct optimal models for high dimensional data spaces	Apply

Text Book(s):

T1. Stuart Russell, Peter Norvig, "Artificial Intelligence– A modern Approach", 3rd Edition, Pearson Education,2014.

T2. James G, Witten D, Hastie T and Tibshirani R, "An Introduction to Statistical Learning with Applications in R", Springer,2013.

Reference Book(s):

R1. Ethem Alpaydin, "Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)", 3rd Edition, MIT Press, 2014.

R2. Jason Bell, "Machine learning - Hands on for Developers and Technical Professionals", Wiley, 2014.

R3. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", Cambridge University Press, 2012.

Web References:

1. Machine Learning Tutorial URL: https://www.kaggle.com/kanncaa1/machine– learning– tutorial– for– beginners
2. NPTEL Course Content URL: https://nptel.ac.in/courses/106/106/106106139/
3. Dataset for machine Learning URL: https://archive.ics.uci.edu/ml/datasets.php

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	2	1	2	3
CO3	3	2	1	1	1	1	-	1	-	1	2	1	2	3
CO4	3	2	1	1	1	1	1	1	-	1	2	1	2	3
CO5	3	2	1	1	1	1	1	1	-	1	2	1	2	3

High– 3; Medium– 2;Low– 1

Course Code: 19CSCN3601	Course Title: Machine Intelligence 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 Laboratory

Course Objectives

The course is intended to:

1. Implement various searching techniques
2. Use FOL to construct knowledge base
3. Develop supervised learning models
4. Understand about choosing the appropriate model for solving the problem

List of Exercises

1. Implement A* search algorithm for shortest path problem.
2. Implement local search algorithm for given scenario.
3. Construction of knowledge base and inferring using Unification algorithm.
4. Develop a simple AI application(Build a chatbot, spam filtering in email, speech recognition).
5. Develop Linear regression model in order to fit data points. Select appropriate data set and draw graphs.
6. Develop Logistic regression model in order to fit data points. Select appropriate data set and draw graphs.
7. Design a Naïve Bayes classifier to classify the given dataset.
8. Design SVM classifier to classify the dataset. Print both correct and wrong predictions.
9. Construct a Decision Tree classifier for appropriate data set and apply it to classify new sample.
10. Mini project.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Implement various searching techniques for solving the given problem	Apply
CO 2: Implement a knowledge base using FOL and infer facts	Apply
CO 3: Develop supervised learning model to solve the problem	Apply
CO 4: Choose and implement appropriate model for solving the given real world problem	Apply

Reference Book(s):

R1. Andreas C. Müller, Sarah Guido , "Introduction to Machine Learning with Python: A Guide for Data Scientists", O'Reilly, 2017.

R2. Aurélien Géron, "Hands– On Machine Learning with Scikit– Learn, Keras, and TensorFlow Concepts, Tools, and Techniques to Build Intelligent Systems", O'Reilly Media, 2017.

Web References:

1. NPTEL Course content URL: https://nptel.ac.in/courses/106/106/106106139/
2. Dataset for machine Learning URL: https://archive.ics.uci.edu/ml/datasets.php

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	3	2	3	3	3	3	3	3
CO2	3	2	2	2	2	3	3	2	3	3	3	3	3	3
CO3	3	2	2	2	2	3	3	2	3	3	3	3	3	3
CO4	3	2	2	2	2	3	3	2	3	3	3	3	3	3

High– 3; Medium– 2;Low– 1

Course Code: 19CSPN6601	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 solve complex 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 in appropriate 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

<table>
<tr><td>Course Code:19PSHG6601</td><td colspan="3">Course Title: Employability Skills 2: Campus to Corporate</td></tr>
<tr><td colspan="2">Course Category: Humanities</td><td colspan="2">Course Level: Introductory</td></tr>
<tr><td>L:T:P (Hours/Week)
0: 0: 2</td><td>Credits: 1</td><td>Total Contact Hours: 30</td><td>Max Marks: 100</td></tr>
</table>

Pre– requisites

- Nil

Course Objectives

The course is intended to:

1. Understand emotions and necessity to handle it to evolve as an effective social animal
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 of EI 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 in GD– 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 a leader **–** 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 healthy agreements 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

<table>
<tr><td colspan="2">Course Code: 19CSCN1701</td><td colspan="3">Course Title: Cyber Security</td></tr>
<tr><td colspan="3">Course Category: Professional Core</td><td colspan="2">Course Level: Practice</td></tr>
<tr><td>L:T:P (Hours/Week)
3: 0: 0</td><td colspan="2">Credits: 3</td><td>Total Contact Hours: 45</td><td>Max Marks: 100</td></tr>
</table>

Pre-requisites

- Computer Network Technology

Course Objectives

The course is intended to:

1. Outline the Cyber Security metrics and frameworks.
2. Examine the cyber governance and user issues.
3. Discuss Cyber Safety for students and scope & laws of Computer Forensics.
4. Inspect Network Forensic Techniques, Malware Analysis and Threat Intelligence.
5. Inspect Mobile Forensic Techniques.

Unit I — Cyber Security Objectives and Guidance — 8 Hours

Cyber Security Metrics – Security Management Goals – Counting Vulnerabilities – Security Frameworks: E-Commerce Systems, Industrial Control Systems, Personal Mobile Devices – Security Policy Objectives – Guidance for Decision Makers - Cyber Security Management – Catalog Approach.

Unit II — Cyber Security Issues — 9 Hours

Cyber Governance Issues: Net Neutrality, Internet Names and Numbers, Copyright and Trademarks, Email and Messaging - Cyber User Issues: Malvertising, Impersonation, Appropriate Use, Cyber Crime, Geolocation, Privacy - Cyber Conflict Issues: Intellectual, property Theft, Cyber Espionage, Cyber Sabotage, Cyber Warfare.

Unit III — Cyber Safety and Scope of Computer Forensics — 9 Hours

Cyber Crimes - Cyber Bullying - Cyber Grooming - Online Gaming- Email Fraud - Online Transaction Fraud – Safeguards for Social Networking Profiles - Scope of Computer Forensics: Introduction, Types of Evidence, Investigator skills, Importance - History of Computer Forensics - Law Enforcement Training.

Unit IV **Network Forensics, Malware Analysis and Threat Intelligence** **10 Hours**

Network Forensics: Tools, Networking Devices, Understanding the OSI Model, Advanced Persistent Threats, Investigating a Network Attack - Static Malware Analysis: Pestudio, Remux- Dynamic Malware Analysis: Process Explorer, Cuckoo Sandbox- Threat Intelligence: MISP Threat Sharing, Proactive threat Intelligence, Reactive threat Intelligence

Unit V **Mobile Forensics** **9 Hours**

Cellular Network - Handset Specifications - Mobile Operating Systems - Standard Operating Procedures for Handling Handset Evidence - Handset Forensics - Case studies

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Outline the Cyber Security metrics and frameworks for cyber decision making	Understand
CO2: Examine the cyber governance and user issues faced by decision makers	Apply
CO3: Discuss Cyber Safety for students and scope & laws of Computer Forensics for Cyber Security Professionals.	Understand
CO4: Inspect Network Forensic Techniques, Malware Analysis and Threat Intelligence for Cyber Crime investigation.	Apply
CO5: Inspect Mobile Forensic Techniques for Cyber Crime investigation.	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.

T2. Gerard Johansen, “Digital Forensics and Incident Response”, Packt Publishing Ltd, 2017.

T3. Darren R. Hayes, “A Practical Guide to Computer Forensics Investigations”, Pearson, 2014.

Reference Book(s):

R1. Ministry of Home Affairs, Govt. of India, “A Handbook for Adolescents/Students on Cyber Safety”, 2018.

R2. James Graham, Ryan Olson, Rick Howard, “Cyber Security Essentials”, Auerbach Publications, 2017.

R3. Bill Nelson, Amelia Phillips, Christopher Steuart, “Guide to Computer Forensics and Investigations”, 6th Edition, Cengage learning, 2018.

Web References:

1. Cyber Security, URL: https://www.sans.org/course/introduction-cyber-security
2. Fundamentals of cyber security, URL: http://www.cyberaces.org/courses/
3. A Guide to Computer Forensics, URL: https://forensiccontrol.com/resources/beginners -guide-computer-forensics/

Course Articulation Matrix

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

High– 3; Medium– 2; Low– 1

<table>
<tr><td colspan="2">Course Code: 19CSCN1702</td><td colspan="3">Course Title: Software Project Management</td></tr>
<tr><td colspan="3">Course Category: Professional Core</td><td colspan="2">Course Level: Practice</td></tr>
<tr><td>L:T:P (Hours/Week)
3: 0: 0</td><td colspan="2">Credits:3</td><td>Total Contact Hours:45</td><td>Max Marks:100</td></tr>
</table>

Pre– requisites

- Object Oriented Software Engineering

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 8 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 10 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:	
CO 1: Describe the activities of Project Management by classifying projects	Understand
CO 2: Choose the appropriate process model for a project.	Apply
CO 3: Estimate the software development effort using various models.	Apply
CO 4: Evaluate the overall duration of the project by categorizing and Prioritizing risks.	Apply
CO 5: Discuss the work plan, schedule and state of a project for resource allocation	Apply

Text Book:

T1.Bob Hughes, Mike Cotterell, Rajib Mall, “Software Project Management”, 6th Edition, Tata McGraw Hill Publishers, 2017.

Reference Books:

R1. Gopalswamy Ramesh, "Managing Global Software Projects", Tata McGraw Hill Publishers, 2005.

R2 Watts S Humphery, "Managing Software Process", Addison–Wesley Pearson Education, 2010.

R3 Walker Royce, "Software Project Management, A Unified framework", Pearson Education, 2006.

R4 Pankaj Jalote, "Software Project Management in Practice", Addison-Wesley Professional, 2002.

Web References:

1. Project Management URL: http://www.inf.ed.ac.uk/teaching/courses/seoc/ 2006_2007/ notes/LectureNote07_ProjectManagement.pdf
2. Software Project Management URL: https://www.classle.net/#!/classle/large-content/software-project-managment-lecture-slides/
3. Project Risk Management URL: http://nptel.ac.in/courses/106101061/38/

Course Articulation Matrix

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

High– 3; Medium– 2; Low– 1

Course Code: 19CSCN4701	Course Title: Cloud Technology 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

- Computer Network Technology

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 **45 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

Reference Book(s):

R1. Dr. Rajkumar Buyya, Dr. Christian Vecchiola, Dr. S Thamarai Selvi, “Mastering Cloud Computing”, Tata McGraw Hill Education Private Limited, 2013.

R2. Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra, “Cloud Computing – From Parallel processing to the Internet of Things”, Morgan Kaufmann Publishers, 2012

R3. Ronald L. Krutz, Russell Dean Vines, “Cloud Security A comprehensive guide to secure Cloud Computing”, Wiley India Pvt. Ltd, Reprint 2016.

R4. 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-3.4.2.pdf

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	1	1	3	-
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	-
CO4	3	2	2	2	2	1	1	2	3	2	1	1	3	1

High– 3; Medium– 2; Low– 1

Course Code: 19CSCN4702	**Course Title: Open Source Software Development 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

- Python Programming Laboratory
- Internet Programming Laboratory

Course Objectives

The course is intended to:

1. Design a database using SQL database.
2. Design a database using NoSQL database.
3. Create web services using Django.
4. Develop a web application using Angular 2

Unit I Working with SQL database 2 Hours

PostgreSQL: Managing Roles – Creating and managing databases – Managing tables – Advanced statements

Unit II Working with NoSQL database 3 Hours

MongoDB: Collections – Documents – Data type – CRUD operations

Unit III Django 4 Hours

Model – View – Template – Forms – Database Connectivity

Unit IV Angular 2 6 Hours

Components – Directives – Data binding – CRUD operations – Forms

List of Exercises 45 Hours

1. Create a database using PostgreSQL
2. Create a database using Mongo DB
3. Implement Django MVT
4. Implement forms using Django
5. Perform database connectivity using Django
6. Develop a web service using Django

7. Implement directives in Angular 2
8. Implement data binding using Angular 2
9. Design forms using Angular 2
10. Perform CRUD operations using Angular 2

The above List of exercises can be completed for a common application. Some areas for the application are suggested below.

Suggested Areas for Application:

Passport Automation System, Book Bank, Exam Registration, Stock Maintenance System, Online Course Reservation System, E– ticketing, Credit Card Processing, E– book Management System, Recruitment System, Library Management System, Student Information System, etc.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Design a database for any application using PostgreSQL.	Apply
CO2: Design a database for any application using Mongodb.	Apply
CO3: Create web services for any application using Django.	Apply
CO4: Develop a web application using Angular 2 for a chosen scenario.	Apply

Reference Books:

R1. Luca Ferrari, Enrico Pirozzi, “Learn PostgreSQL: Build and Manage High-performance Database Solutions Using PostgreSQL 12 and 13”, Packt Publishing, 2020.

R2. Shannon Bradshaw, Kristina Chodorow, Eoin Brazil, “MongoDB: The Definitive Guide Powerful and Scalable Data Storage”, 3^{rd} Edition, O’Reilly Media, 2019.

R3. Daniel Rubio, “Beginning Django: Web Application Development and Deployment with Python”, Apress, 2017

R4. Brad Green, Shyam Seshadri, “AngularJS”, O'Reilly Media, 2013

Web References:

1. PostgreSQL: https://www.postgresqltutorial.com/
2. MongoDB: https://docs.mongodb.com/manual/tutorial/
3. Django: https://www.djangoproject.com/start/
4. Angular: https://angular.io/

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	1	1	3	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	-
CO4	3	2	2	2	2	1	-	2	3	2	-	1	-	-

High– 3; Medium– 2; Low– 1

Semester VIII

Course Code: 19SHVG6001		**Course Title: Entrepreneurship Development**	
Course Category:		**Course Level:** Basic	
L:T:P **1:0:0 (Hours/Week)**	**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

Assessment Plan:

Internal Component:

Idea Pitching Presentation- 75 Marks

End Semester Assessment: 1.

25 Multiple Choice Questions- 25 Marks

Course Code: 19SHVG6002	Course Title: தமிழர் மரபும் பண்பாடும்		
Course Category: Humanities		Course Level: Introductory	
L:T:P (Hours/Week) 1: 0: 0	Credits:1	Total Contact Hours:15	Max Marks:100

Course Objectives

மாணவர்கள் இப்பாடத்தை கற்பதன் மூலம்:
இந்திய தேசிய இயக்கத்திற்கும் இந்திய கலாச்சாரத்திற்கும் தமிழர்களின் பங்களிப்பை அறிந்து கொள்ள இயலும்.

அலகு 1 - **தமிழ் மொழி மற்றும் இலக்கியம்** **5 Hours**

தமிழ் ஒரு செம்மொழி - சங்க இலக்கியங்கள் - திருக்குறள் - தமிழ்க் காப்பியங்கள் - தமிழகத்தில் சமண, பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம் - ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு

அலகு **2 -** தமிழர் கலைகள் மற்றும் விளையாட்டுகள் **5 Hours**

நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - நாட்டுப்புறத் தெய்வங்கள் - குமரி முனையில் திருவள்ளுவர் சிலை - இசைக்கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்

அலகு **3 -** இந்தியாவின் பண்பாடு மற்றும் வளர்ச்சியில் தமிழர்களின் பங்கு **5 Hours**

சங்ககால நகரங்களும், துறைமுகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி. இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில் சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 இந்திய தேசிய இயக்கத்திற்கும் இந்திய கலாச்சாரத்திற்கும் தமிழர்களின் பங்களிப்பை அறிந்து கொள் வார்கள்.	அறிதல் (Understand)

Text Book(s):

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
3. பொருநை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
5. 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)
6. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

Course Code: 19SHVG6002		Course Title: CULTURE AND HERITAGE OF TAMILS	
Course Category: Humanities		Course Level: Introductory	
L:T:P (Hours/Week) 1: 0: 0	Credits:1	Total Contact Hours:15	Max Marks:100

Course Objectives

The course is intended to:

- Understand the Contribution of Tamils to Indian National Movement and Indian Culture.

UNIT I – TAMIL LANGUAGE AND LITERATURE **5 Hours**

Tamil as a Classical Language - Sangam Literature – Thirukural - Tamil Epics - Impact of Buddhism and Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

UNIT II – FINE ARTS AND MARTIAL ARTS OF TAMILS **5 Hours**

Hero stone to modern sculpture - Bronze icons - Village deities, Thiruvalluvar Statue at Kanyakumari, Musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils - Folk and martial arts.

UNIT III – CONTRIBUTION OF TAMILS TO INDIAN CULTURE AND GROWTH **5 Hours**

Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas. Contribution of Tamils to Indian Freedom Struggle - Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions and Manuscripts – Print History of Tamil Books.

Course Outcomes At the end of this course, students will be able to:		Cognitive Level
CO.1	Understand the Contribution of Tamils to Indian National Movement and Indian Culture.	Understand

Text Book(s):

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
3. பொருநை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
5. 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)
6. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

Course Code: 19CSPN6801	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. Identify solutions to complex interdisciplinary engineering problems.
2. Use the knowledge of Science, engineering & engineering tools to solve complex interdisciplinary 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. Publication of work/findings in standard Journal/Conference.

5. Final Presentation before an expert committee.

Course Outcomes At the end of this course, students will able to:	Cognitive Level
CO1: Design, develop and implement solutions to complex interdisciplinary engineering problems that are socially relevant, economically viable and environment friendly 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 in appropriate 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

Professional Elective Courses: Verticals
Vertical I - Data Science

<table>
<tr><td colspan="2">Course Code: 19CSEN2003</td><td colspan="2">Course Title: Information Retrieval Techniques</td></tr>
<tr><td colspan="2">Course Category: Professional Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P (Hours/Week)
3: 0: 2</td><td>Credits:4</td><td>Total Contact Hours:75</td><td>Max Marks:100</td></tr>
</table>

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 for 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 – Opinion summarization – Social Network.

List of Exercises 30 Hours

1. Implement an algorithm that retrieves relevant documents based on Boolean retrieval model.
2. Implement Blocked sort-based indexing algorithm.
3. Implement an algorithm that retrieves relevant documents based on vector space model.
4. Implementation of query reformulation methods.
5. Design and development of Question/Answering System.
6. Implementation of IR from blog contents.

Course Outcomes At the end of this course, students will be able to:	**Cognitive Level**
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 suitable 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 Reference(s):

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	3	2	2	2	2	-	-	2	3	2	-	1	3	2
CO2	3	2	2	2	2	-	-	2	3	2	-	1	3	2
CO3	3	2	2	2	2	-	-	2	3	2	-	1	3	2
CO4	3	2	2	2	2	-	-	2	3	2	-	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: 19CSEN2004	Course Title: Big Data Analytics		
Course Category: Professional Elective		Course Level: Mastery	
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 – Naïve Bayes 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 MapReduce 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.

T2.Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012.

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.

R4.Jiawei Han, Micheline Kamber and Jian Pei, "Data mining concepts and Techniques",3rd Edition, Elsevier, 2012.

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: 19CSEN2013	Course Title: Social Network Analytics		
Course Category: Professional Elective	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. 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 9 Hours

Social Media Mining – Challenges – Graph Essentials – Representations – Types of Graphs – Connectivity – Special Graphs – Graph Algorithms.

Unit II Measures & Models 9 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 Mining Twitter 9 Hours

Analyzing tweets and finding trends using Data mining process: Data quality – Preprocessing – Supervised Learning – Algorithms and Evaluation – Unsupervised Learning – Clustering algorithms – Evaluation.

Unit IV Communities and Interactions 9 Hours

Community Analysis – Community Detection – Evolution – Evaluation – Information Diffusion in Social Media – Herd Behavior – Information Cascades – Diffusion of Innovations.

Unit V Applications 9 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 given graph.
3. Apply decision tree learning to classify the given dataset samples into relevant groups.
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.

T2. Lam Thuy Vo, “Mining Social Media: Finding Stories in Internet Data”, No Starch Press, 2020.

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 Reference(s):

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

<table>
<tr><td colspan="2">Course Code: 19CSEN2022</td><td colspan="3">Course Title: Visualization Techniques</td></tr>
<tr><td colspan="3">Course Category: Professional Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P (Hours/Week)
3: 0: 2</td><td colspan="2">Credits:4</td><td>Total Contact Hours:75</td><td>Max Marks:100</td></tr>
</table>

Pre– requisites

- Probability and Statistics

Course Objectives

The course is intended to:

1. Illustrate types of data.
2. Construct visualization plots with various metrics.
3. Visualize spatial data and Text Documents.
4. Choose appropriate Visualization Techniques.
5. Design a visualization system.

Unit I Data Visualization Process 9 Hours

Data Visualization Process - Scatter plot - Role of the User - Data Foundations: Types of Data - Data Preprocessing - Data Sets.

Unit II Information Processing and Visualization 9 Hours

Perception - Physiology - Perceptual Processing - Perception in Visualization - Metrics - Cognition - Visualization Foundations: Visualization Process - Visual Variables – Taxonomies.

Unit III Spatial Data and Text and Document Visualization 9 Hours

Spatial Data: One Dimensional Data – Two Dimensional Data- Three Dimensional Data - Dynamic Data - Visualizing Spatial Data - Point Data - Line Data - Area Data - Geospatial Data - Text and Document Visualization.

Unit IV Time-Oriented Data and Multivariate Data 9 Hours

Definitions: Characterizing Time-Oriented Data - Visualizing Time-Oriented Data - Point-Based Techniques - Line-Based Techniques - Region-Based Techniques - Visualization Techniques for Trees, Graphs, and Networks.

Unit V Visualization System 9 Hours

Designing Effective Visualizations – Steps- Problems - Comparing and Evaluating Visualization Techniques - Visualization Systems: Based on Data Type - Analysis Type - Modern Integrated Visualization Systems.

List of Exercises **30 Hours**

1. Develop different types of charts from numerical data.
2. Plot the data using visual variables.
3. Visualize Spatial Data.
4. Visualize Time Oriented Data.
5. Visualize multivariate Data.
6. Visualize Text and Documents.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Illustrate types of data using various kinds of Charts.	Apply
CO2: Construct visualization plots with various metrics using information processing techniques	Apply
CO3: Visualize spatial data and Text Document using suitable tools.	Apply
CO4: Choose appropriate Visualization Techniques for Time-Oriented Data and Multivariate Data	Apply
CO5: Design a visualization system based on various kinds of Data.	Apply

Text Book:

T1. Matthew Ward, Georges Grinstein and Daniel Keim, "Interactive Data Visualization Foundations, Techniques, and Applications", 2nd Edition, CRC Press, 2015.

Reference Books:

R1. Ben Fry, "VisualizingData", O'Reilly, 2008.

R2. Stephen Few,"Now you see it: Simple Visualization techniques for quantitative analysis",Analytics Press, 2009.

R3.Scott Murray,"Interactive Data Visualization for the Web-An Introduction to Designing with D3", O'Reilly, 2013.

Web References:

1. Visualization Process Introduction: https://www.sciencedirect.com/topics/computer-science/visualization-process
2. Data Visualization - Examples Learning Resources using Tableau https://www.tableau.com/learn/articles/data-visualization /
3. Tableau Tutorials: https://www.tableau.com/
4. Various Data Visualization Techniques: https://www.mygreatlearning.com/blog/understanding-data-visualization-techniques/

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	1	1	3	3
CO2	3	2	2	2	2	1	1	2	3	2	1	1	3	3
CO3	3	2	2	2	2	1	1	2	3	2	1	1	3	3
CO4	3	2	2	2	2	1	1	2	3	2	1	1	3	3
CO5	3	2	2	2	2	1	1	2	3	2	1	1	3	3

High– 3; Medium– 2; Low– 1

Course Code: 19CSEN2029	**Course Title: Exploratory Data Analytic Techniques**		
Course Category: Professional Elective		**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. 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 datasets
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 - Data aggregation – 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 10 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 8 Hours

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

List of Exercises 30 Hours

1. Perform exploratory data analysis (EDA) on email data set. Export all your emails as a dataset, import them inside a pandas data frame, visualize them and get different insights from the data.

2. Working with Numpy arrays, pandas data frames and basic plots using Matplotlib
3. Explore various variables 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.

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	Understand
CO2: Identify appropriate methods for data and information visualization using Matplotlib	Apply
CO3: Make use of time series dataset to analyze univariate data	Apply
CO4: Apply bivariate data analysis on various datasets	Apply
CO5: Utilize visualization techniques for 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.
T2. Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data", Oreilly, 2016.
T3. Catherine Marsh, Jane Elliott, “Exploring Data: An Introduction to Data Analysis for Social Scientists”, Wiley Publications, 2nd Edition, 2008.

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 Reference(s):

1. https://www.coursera.org/learn/exploratory-data-analysis
2. https://nptel.ac.in/courses/110106064
3. https://analyticsindiamag.com/8-online-courses-for-exploratory-data-analysis/.
4. https://onlinecourses.nptel.ac.in/noc22_cs32/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
CO2	3	2	2	2	2	-	-	2	3	2	-	-	3	3
CO3	3	2	2	2	2	-	-	2	3	2	-	-	3	3
CO4	3	2	2	2	2	-	-	2	3	2	-	-	3	3
CO5	3	2	2	2	2	-	-	2	3	2	-	-	3	3

High– 3; Medium– 2; Low– 1

Course Code: 19CSEN1016	Course Title: Business Intelligence and 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 10 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, Introduction to common data integration approaches – Introduction to data quality, data profiling concepts and applications – Tools – Case Study: Pentaho.

Unit II Decision Support Systems 8 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 Scorecards – 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 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	Apply
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.

T2. Ramesh Sharda, Dursun Delen, Efraim Turban, “Business Intelligence and Analytics, Systems for Decision Support”, 10th Edition, Pearson Education Inc, 2015.

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 Reference(s):

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
3. MIS - Business Intelligence System Business Intelligence as a Career Option URL:https://www.tutorialspoint.com/business-intelligence-as-a-career-option
4. Decision Support System Java Netbeans Project URL: https://www.freeprojectz.com/java-jsp-netbeans-project/decision-support-system

5. 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	-	-	-	-
CO2	3	2	1	1	-	-	-	1	-	1	-	1	-	1
CO3	3	2	1	1	-	-	-	1	-	1	-	1	-	1
CO4	3	2	1	1	-	-	-	1	-	1	-	1	-	1
CO5	3	2	1	1	-	-	-	1	-	1	-	-	-	-

High– 3; Medium– 2; Low– 1

<table>
<tr><td colspan="2">Course Code: 19CSEN1009</td><td colspan="3">Course Title: Text and Web Mining</td></tr>
<tr><td colspan="3">Course Category: Professional Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P (Hours/Week)
3: 0: 0</td><td colspan="2">Credits:3</td><td>Total Contact Hours:45</td><td>Max Marks:100</td></tr>
</table>

Pre– requisites

- NIL

Course Objectives

The course is intended to:

1. Apply text mining tasks
2. Differentiate text classification and clustering techniques
3. Illustrate the various stages in web content mining process
4. Demonstrate the working of web link mining approaches
5. Apply text and web mining principles

Unit I Text Mining 9 Hours

Text Mining Tasks – Converting Text to Numerical Vectors: Document standardization – Tokenization –Lemmatization – Vector Generation – POS Tagging – Word Sense Disambiguation – Phrase and named entity recognition – Parsing – Feature generation.

Unit II Categorization and Clustering 9 Hours

Text Categorization: Document Classification – Learning to Predict from Text – Performance Evaluation and Applications. Clustering: Document Similarity – Clustering Techniques – Applications and Performance Evaluation.

Unit III Web Content Mining 9 Hours

Information Retrieval Models – Relevance Feedback and Evaluation – Web Page Preprocessing – Inverted Index – Latent Semantic Indexing – Web Search – Meta Search – Spamming.

Unit IV Web Link Mining 9 Hours

Social Networks Analysis – Co-Citation and Bibliographic Coupling – Page Rank – HITS Algorithm – Community Discovery. Web Crawlers: Crawling Algorithm – Implementation Issues – Universal and Focused Crawlers – Evaluation and Ethics.

Unit V Usage Mining and Applications 9 Hours

Data Collection and Preprocessing – Data Modeling – Discovery and Analysis of Web Usage Patterns – Recommender Systems. Case Studies: E-mail Filtering – Search Engines – Mining Social Media – Customized Newspapers

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1. Apply text mining tasks to convert text to numerical vectors.	Apply
CO2. Differentiate text classification and clustering techniques using applications.	Apply
CO3. Illustrate the various stages in web content mining process.	Apply
CO4. Demonstrate the working of web link mining approaches in social media.	Apply
CO5. Apply text and web mining principles in real time applications.	Apply

Text Books:

T1. Sholom M. Weiss, Nitin Indurkhya, Tong Zhang, "Fundamentals of Predictive Text Mining", 2nd Edition, Springer-Verlag London Limited, 2015.

T2. Bing Liu, "Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data", 2nd Edition, Springer, 2013.

Reference Books:

R1. Charu C. Aggarwal, "Machine Learning for Text", 2nd Edition, Springer, 2019.

R2. Dipanjan Sarkar, "Text Analytics with Python: A Practitioner's Guide to Natural Language Processing", 2nd Edition, Apress, 2019

R3. Priti Srinivas Sajja, Rajendra Akerkar, "Intelligent Technologies for Web Applications", Chapman and Hall: CRC, 2019

Web References:

1. NPTEL, Natural Language Processing, IIT Kharagpur URL: https://nptel.ac.in/courses/106105158
2. NPTEL, Applied Natural Language Processing, IIT Madras, URL: https://nptel.ac.in/courses/106106211
3. Coursera, Social Media Data Analytics, URL: https://www.coursera.org/learn/social-media-data-analytics.

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	2	2
CO2	3	2	1	1	-	1	-	1	-	1	-	1	2	2
CO3	3	2	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	1	2	-

High– 3; Medium– 2; Low– 1

Course Code: 19CSEN1017	Course Title: Data Warehousing and Mining		
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 about data preprocessing techniques in detail
2. Describe about data warehousing architecture & schemas for multidimensional data model
3. Outline on design, implementation and generalization of a data warehouse
4. Discuss on association rule mining process for a given dataset
5. Summarize on various classification and clustering methods

Unit I Data Preprocessing and Architecture 9 Hours

KDD Process – Data – Patterns – Technologies – Applications – Issues in data mining – Data Objects and Attribute Types. Date Preprocessing: Cleaning – Integration – Reduction – Transformation – Discretization.

Unit II Data Warehouse Modeling 9 Hours

Data warehouse & Operational database Systems – Multitiered Architecture – Data warehouse Models: Enterprise Warehouse, Data Mart, Virtual Warehouse – Extraction, Transformation and Loading – Metadata Repository – Data cube – Schemas for Multidimensional Data Models – Dimensions – Measures – OLAP Operations.

Unit III Data Warehouse Design, Implementation and Generalization 9 Hours

Data Warehouse Design: Business Analysis Framework for Data Warehouse Design – Data Warehouse Design Process – Data Warehouse Usage for Information Processing – From Online Analytical Processing to Multidimensional Data Mining. Data Warehouse Implementation: Efficient Data Cube Computation – Indexing OLAP Data – Efficient Processing of OLAP Queries – Data OLAP Server Architectures. Data Generalization: Attribute-Oriented Induction for Data Characterization – Efficient Implementation of Attribute-Oriented Induction.

Unit IV Association Rule Mining 9 Hours

Market basket analysis – Frequent itemsets – Closed itemsets & Association Rules – Frequent Itemset Mining Methods: Apriori Algorithm – FP growth Algorithm – Vertical Data Format – Pattern Mining in Multilevel, Multi-Dimensional Space – Constraint-based Frequent Pattern Mining.

9 Hours

Unit V Classification and Clustering

General Approach to classification – Decision Tree Induction – Bayes Classification – Rule Based Classification: Using IF-THEN Rules for Classification – Rule Extraction from a Decision Tree – Rule Induction Using a Sequential Covering Algorithm – Genetic Algorithm – Rough Set Approach – Fuzzy set approach – Cluster Analysis – Partitioning methods – Hierarchical methods – Types of Outliers – Outlier Detection Methods.

Course Outcomes	**Cognitive Level**
At the end of this course – students will be able to:	
CO1: Perform data preprocessing using various techniques for any given dataset.	Apply
CO2: Develop various schemas for any given multidimensional data model.	Apply
CO3: Demonstrate design, implementation and generalization of a data warehouse for any given instance.	Apply
CO4: Generate association rules using different types of rule mining process for obtaining interesting relations.	Apply
CO5: Perform classification and clustering on the given dataset using Various methods.	Apply

Text Book(s):

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

Reference Book(s):

R1. Alex Berson and Stephen J. Smith "Data Warehousing – Data Mining & OLAP", Tata McGraw-Hill Edition, 13th Reprint 2008

R2. K.P. Soman, ShyamDiwakar and V. Ajay "Insight into Data mining Theory and Practice", Easter Economy Edition, Prentice Hall of India, 2006.

R3.Parteek Bhatia, "Data Mining and Data Warehousing: Principles and Practical Techniques", Cambridge University Press, 2019

Web Reference(s):

1. Data Preprocessing: https://www.v7labs.com/blog/data-preprocessing-guide#h1

2. Data Warehouse: https://www.educba.com/data-warehouse-implementation/

3. Classification & Clustering: https://www.geeksforgeeks.org/ml-classification-vs clustering/

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	-	-	-	-
CO2	3	2	1	1	-	-	-	1	-	1	-	-	1	-
CO3	3	2	1	1	-	-	-	1	-	1	-	-	1	-
CO4	3	2	1	1	-	-	-	1	-	1	-	1	1	-
CO5	3	2	1	1	1	-	-	1	-	1	-	1	1	-

High– 3; Medium– 2; Low– 1

Course Code: 19ITIC1001	**Course Title: Integrated Big Data Solutions (Common to AD,AM CS,IT &SC)**		
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

Vertical II – Artificial Intelligence and Machine Learning

<table>
<tr><td colspan="2">Course Code: 19CSEN2012</td><td colspan="3">Course Title: Soft Computing Techniques</td></tr>
<tr><td colspan="3">Course Category: Professional Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P (Hours/Week)
3:0:2</td><td colspan="2">Credits:4</td><td>Total Contact Hours: 75</td><td>Max Marks:100</td></tr>
</table>

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 8 Hours

Associative memories – Auto associative memory network – Hetero associative memory network – Bi-directional associative memory – Discrete Hopfield network.

Unit III Unsupervised Learning Networks 8 Hours

Neural network based on competition – Maxnet – Hamming network – Self-Organizing feature maps – Learning vector quantization.

Unit IV Fuzzy Systems 10 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 10 Hours

Introduction – Traditional optimization and search techniques – Genetic algorithm and search space – Simple genetic algorithm – Operators in genetic algorithm – Solving Travelling Salesman Problem.

List of Exercises **30 Hours**

1. Implement AND function using ADALINE with bipolar inputs and outputs.
2. Implement back propagation network for XOR function using bipolar Inputs and binary targets.
3. Develop a hetero associative memory network using Hebb rule to set the weights. Use suitable input patterns and target output.
4. Implement Kohonen self-organizing map for a suitable application.
5. Implement the various primitive operations of classical sets using fuzzy relations.
6. Solve travelling salesman problem using genetic algorithm.

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/noc22 _ee21/preview

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	2	3	2	-	1	3	-
CO2	3	2	2	2	2	-	1	2	3	2	-	1	3	2
CO3	3	2	2	2	2	-	1	2	3	2	-	1	3	2
CO4	3	2	2	2	2	-	1	2	3	2	-	1	3	2
CO5	3	2	2	2	2	1	2	2	3	2	1	1	3	2

High– 3; Medium– 2; Low– 1

Course Code: 19CSEN2030	Course Title: Digital Image Processing Techniques		
Course Category: Professional Elective	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 theoretical foundation for image processing methods.
2. Implement various categories of filters to enhance and restore images.
3. Discuss various color transformation models for different processing techniques.
4. Analyse an image by detecting the isolated points, edge and boundary parameters.
5. Demonstrate feature extraction of images and pattern classification.

Unit I Image Processing Methods 8 Hours

Steps in Digital Image processing - Elements of visual perception - Image Sensing and Acquisition - Image Sampling and Quantization - Basic relationships between pixels: Neighbors of a pixel, Adjacency, Connectivity, Region, Boundaries and Distance measures - Image Transforms: DFT, DCT, Hadamard, Haar.

Unit II Image Enhancement and Restoration 10 Hours

Gray level transformations - Histogram equalization and specifications - Smoothing Spatial filters - Pixel- domain sharpening filters: first and second order derivative - Frequency domain filters: Low-pass and High-pass - Model of Image Degradation/Restoration.

Unit III Color Image Processing 8 Hours

Color fundamentals - Color models: RGB, CMY/CMYK, and HSI - Color transformation: formulation, Color complements, Color slicing, Tone and Color corrections - Color image smoothing and sharpening - Color image Segmentation - Wavelet Transform.

Unit IV Image Compression and Segmentation 10 Hours

Image Compression: Redundancies, Image Compression standards, Lossy and Loss-less predictive coding - Image Segmentation: Detection of isolated points, Line, edge detection models - Thresholding: global and adaptive – Region based segmentation.

Unit V Feature Extraction and Image Pattern Classification 9 Hours

Boundary feature descriptors - Region feature descriptors - Principal Component as feature descriptors - Whole image features: Harris-Stephens Corner detector - Scale Invariant Feature Transform (SIFT) – Pattern and Pattern classes - Pattern Classification using prototype matching

Course Outcomes At the end of this course, students will be able to:	Cognitive Level
CO1: Describe the theoretical foundation for image processing methods using various image transforms.	Understand
CO2: Implement various categories of filters to enhance and restore images in various applications.	Apply
CO3: Discuss various color transformation models for different processing techniques on color images.	Understand
CO4: Analyse an image by detecting the isolated points, edge and boundary parameters for segmenting images.	Apply
CO5: Demonstrate feature extraction of images and pattern classification using boundary, Region and Principal Component descriptors.	Apply

List of Exercises **30 Hours**

1. Display the image and histogram of grayscale and color images.
2. Perform Image Enhancement using spatial filters.
3. Eliminate the high frequency components of an image by smoothing filters.
4. Demonstrate the conversion between color space models.
5. Implement the line and edge detection methods of an image.
6. Demonstrate image segmentation methods.

Text Books:

T1. R.C. Gonzalez, R.E. Woods, “Digital Image Processing”, 4th Edition, Pearson Education, 2018.

T2. Anil K Jain, “Fundamentals of Digital Image Processing”, 2nd Edition, Pearson India, 2015.

Reference Books:

R1. Rafael Gonzalez, Richard Woods, Stevens Eddins, "Digital Image Processing using MATLAB", 3rd Edition, Gatesmark publishing, 2020.

R2. Rohit M. Thanki, Ashish M. Kothari, “Digital Image Processing using SCILAB”, Springer International Publishing, 2019.

R3. Sandipan Dey, “Image Processing Masterclass with Python”, BPB Publications, India, 2021.

Web References:

1. Coursera, Introduction to Image Processing URL: https://www.coursera.org/learn/introduction-image-processing
2. Wavelet transform: http://www.wavelet.org/
3. NPTEL Course Content:https://nptel.ac.in/courses/117105135

Course Articulation Matrix

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

High– 3; Medium– 2; Low– 1

<table>
<tr><td colspan="2">Course Code: 19CSEN2031</td><td colspan="2">Course Title: Classical and Evolutionary Optimization Techniques</td></tr>
<tr><td colspan="2">Course Category: Professional Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P (Hours/Week)
3: 0: 2</td><td>Credits:4</td><td>Total Contact Hours:75</td><td>Max Marks:100</td></tr>
</table>

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

9 Hours

Unit II Network Models

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

Unit IV Evolutionary Optimization 9 Hours

Fuzzy optimization Problem – Multiobjective Reliability Design Problem – Combinatorial Optimization Problem – Scheduling Problems – Transportation Problems – Network Design and Routing Problems

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

List of Exercises **30 Hours**

1. Apply linear programming algorithm for minimum cost flow problem
2. Solve maximum profit detection problem using non-linear programming algorithm
3. Solve Activity Network Modelsss using CPM/PERT
4. Implement genetic algorithm for real time applications
5. Solve transportation problem using Vogel and Least cost optimization algorithm
6. Apply nature inspired optimization techniques to solve travelling salesman problem

Course Outcomes At the end of this course, students will be able to:	**Cognitive Level**
CO 1: Solve optimization problems using Linear and Non-linear Programming	Apply
CO 2: Compute critical path for Activity Network Models using CPM/PERT	Apply
CO 3: Apply Genetic algorithm for any real time application.	Apply
CO 4: Solve real world problems using Evolutionary optimization techniques	Apply
CO 5: Implement Swarm Intelligence approaches for optimizing practical applications	Apply

Text Book(s):

T1. Taha H.A., "Operations and Research – An Introduction", Pearson Education, 11th Edition, 2022.

T2. Sivanandam S.N., Deepa S. N., "Introduction to Genetic Algorithms", Springer, 2013.

T3. A.Vasuki., "Nature-Inspired Optimization Algorithms", CRC Press, 2020.

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 Reference(s):

1. NPTEL: https://onlinecourses.nptel.ac.in/noc23_ma29
2. NPTEL: https://onlinecourses.nptel.ac.in/noc23_me40
3. Udemy: https://www.udemy.com/course/geneticalgorithm/
4. Coursera: 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	3	2	2	2	2	-	1	2	3	2	-	-	3	-
CO2	3	2	2	2	2	-	1	2	3	2	-	-	3	-
CO3	3	2	2	2	2	1	1	2	3	2	-	-	3	-
CO4	3	2	2	2	2	1	1	2	3	2	-	-	3	-
CO5	3	2	2	2	2	1	1	2	3	2	1	-	3	-

High– 3; Medium– 2; Low– 1

Course Code: 19CSEN2035	Course Title: Deep Learning Methods		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 2	Credits: 4	Total Contact Hours: 75	Max Marks: 100

Pre-requisites

- Machine Intelligence

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 **Applications** **9 Hours**

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	Understand
CO3: Design a Convolutional Neural Network for solving real time problems	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 TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems", O'Reilly Media, 2017.

R2. Francois Chollet, "Deep Learning with Python", Manning Publications, 2017.

R3. Michael Nielsen, "Neural Networks and Deep Learning", Determination Press, 2015.

Web References:

1. NPTEL Course content URL: https://nptel.ac.in/courses/106/106/106106184/
2. Deep Learning models URL: https://in.mathworks.com/discovery/deep-learning.html
3. Deep Learning Tutorial URL: https://www.kaggle.com/kanncaa1/deep-learning-tutorial-for-beginners

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	2	3	2	-	1	3	2
CO2	2	1	-	-	-	-	1	2	3	1	-	1	-	-
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: 19CSEN1010	Course Title: Speech Processing		
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

- Formal Languages and Automata Theory

Course Objectives

The course is intended to:

1. Describe the fundamentals of speech processing.
2. Explain about speech modeling techniques.
3. Explain about the phonetics and pronunciation processing.
4. Develop a speech synthesis system.
5. Develop a speech recognition system.

Unit I Communication and Language 8 Hours

Introduction - Types of Communication – Human Communication: Verbal communication - Linguistic levels - Affective Prosody - Augmentative Prosody - Communication processes: Communication factors – Generation – Encoding – Decoding - Understanding

Unit II Speech Modelling 10 Hours

Text Normalization - Minimum Edit Distance - N-gram Language Models - N Grams - Evaluating Language Models - Smoothing - Word Classes and Part Of Speech Tagging - Named Entities and Named Entity Tagging

Unit III Speech Pronunciation and Signal Processing 9 Hours

Phonetics – Speech Sounds and Phonetic Trasnscription – Articulatory Phonetics: Vocal Organs - Place of Articulation - Manner of Articulation. Prosody - Acoustic Phonetics and Signals: Speech Sound Waves - Frequency and Amplitude - Pitch and Loudness - Interpretation of Phones – Phonetic Resources

Unit IV Speech Synthesis 9 Hours

Introduction - System Organization – TTS Systems - Key Problems in TTS – TTS Architectures - Non-Natural Language Text - Natural Language Text – Natural Language Parsing - Prosody Prediction From Text

Unit V Speech recognition 9 Hours

Automatic Speech Recognition – Feature Extraction: Sampling and Quantization – Windowing - Discrete Fourier Transform - Mel Filter Bank and Log . Architecture – CTC - ASR Evaluation

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Describe the fundamental elements namely Communication and Language in speech processing.	Understand
CO2: Explain the various components of speech processing using different speech modeling techniques.	Understand
CO3: Explain about phonetics and pronunciation using Phoneme and signal processing techniques.	Understand
CO4: Develop a speech synthesis system for a specific corpus following the steps in TTS architecture.	Apply
CO5: Develop a speech recognition system for a real time application using ASR architecture.	Apply

Text Book(s):

T1. Daniel Jurafsky, James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Pearson education, 2020.

T2. Paul Taylor, "Text-to-Speech Synthesis", Cambridge University Press, 2009.

Reference Book(s):

R1. Himanshu Chaurasiya, "Soft Computing Implementation of Automatic Speech Recognition", LAP Lambert Academic Publishing, 2010.

R2. Claudio Becchetti, Klucio Prina Ricotti, "Speech Recognition: Theory and C++ implementation", Wiley publications, 2008.

Web References:

1. Speech Processing – URL: https://speech.zone/courses/speech-processing/

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	-	1
CO3	2	1	-	-	-	-	-	1	-	1	-	1	-	1
CO4	3	2	1	1	1	1	-	1	-	1	1	1	2	1
CO5	3	2	1	1	1	1	-	1	-	1	1	1	2	1

High– 3; Medium– 2; Low– 1

<table>
<tr><td colspan="2">Course Code: 19CSEN1012</td><td colspan="3">Course Title: Bio Inspired Computing</td></tr>
<tr><td colspan="3">Course Category: Professional Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P (Hours/Week)
3: 0: 0</td><td colspan="2">Credits: 3</td><td>Total Contact Hours: 45</td><td>Max Marks: 100</td></tr>
</table>

Pre-requisites

- Data Structures and Algorithm Analysis - II

Course Objectives

The course is intended to:

1. Explain the philosophy of natural computing
2. Apply optimization methods
3. Explore Swarm Intelligence and Immuno-Computing algorithms
4. Formulate solutions for Metaheuristic problems
5. Apply Bioinspired algorithms

Unit I Natural Computing 9 Hours

Introduction – General Concepts – Problem Solving as a Search Task – Hill Climbing and Simulated Annealing – Evolutionary Biology – Evolutionary Computing.

Unit II Optimization methods 9 Hours

Geometric programming – Dynamic programming – Multi-objective optimization – Nature-inspired algorithms for optimization – Algorithms and self-organization.

Unit III Swarm Intelligence and Immuno-Computing 9 Hours

Ant Colonies: Ant Colony Optimization – Ant Clustering Algorithm – Swarm Robotics – Artificial Immune Systems – Bone Marrow Models – Negative Selection Algorithms – Clonal Selection and Affinity Maturation.

Unit IV Advanced Algorithms 9 Hours

Bat algorithm – Cuckoo search algorithm – Firefly algorithm – Flower pollination algorithm - Bio-inspired algorithms: Differential evolution – Particle swarm Optimization – Bacterial foraging optimization.

Unit V Applications **9 Hours**

Traveling salesman problem using bio-inspired metaheuristics – Clustering with nature-inspired metaheuristics – Bat-inspired algorithm for feature selection and white blood cell classification – Swarm robotics

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1. Explain the philosophy of natural computing to solve computational problems	Understand
CO2. Apply optimization methods to provide enhanced solutions for Multi-objective problems	Apply
CO3. Explore Swarm Intelligence and Immuno-Computing algorithms for optimization, design and learning problems	Apply
CO4. Formulate solutions for Metaheuristic problems using advanced algorithms	Apply
CO5. Apply Bioinspired algorithms to provide optimal solutions for real world problems	Apply

Text Book(s):

T1. Leandro Nunes de Castro, "Fundamentals of Natural Computing: Basic Concepts, Algorithms, and Applications", Chapman & Hall: CRC, 2007

T2. Xin-She Yang, "Nature-Inspired Computation and Swarm Intelligence Algorithms, Theory and Applications", Elsevier Academic Press, 2020

Reference Book(s):

R1. Sukanta Nayak, "Fundamentals of Optimization Techniques with Algorithms", Elsevier Academic Press, 2020

R2. George Lindfield and John Penny, "Introduction to Nature – Inspired Optimization", Academic Press, Elsevier, 2017.

R3. Xin-She Yang, "Nature-Inspired Optimization Algorithms", Elsevier Inc., 2014.

Web References:

1. NPTEL SWAYAM, Evolutionary Computation for Single and Multi-Objective Optimization, URL: https://onlinecourses.nptel.ac.in/noc21_me43/preview

2. Newfoundland University, Introduction to Nature-Inspired Computing, URL: https://www.mun.ca/computerscience/undergraduates/courses/comp-3201-introduction-to-nature-inspired-computi/

3. Magdeburg University, Swarm Intelligence, URL:https://www.is.ovgu.de/Teaching/WS+2020_2021/SwarmIntelligence.html

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	-	-
CO2	3	2	1	1	-	1	1	1	-	1	-	1	2	1
CO3	3	2	1	1	1	1	1	1	-	1	1	1	2	1
CO4	3	2	1	1	1	1	1	1	-	1	1	1	2	-
CO5	3	2	1	1	1	1	1	1	-	1	1	1	2	-

High– 3; Medium– 2; Low– 1

Course Code: 19CSEN1018	**Course Title: Knowledge Engineering**		
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 various types of reasoning
2. Design Knowledge based agents
3. Design reusable ontologies
4. Generate rules
5. Perform rule refinement

Unit I Evidence-based Reasoning 9 Hours

Evidence and Knowledge – Abductive reasoning – Probabilistic reasoning - Evidence-based reasoning – Intelligent Agent – Mixed-Initiative Reasoning – Knowledge Engineering.

Unit II Agent design and problem solving 9 Hours

Conventional Design and Development – Development tools and Reusable Ontologies – Using Learning Technology – Problem Solving – Inquiry-driven Analysis and Synthesis – Evidence-based Assessment – Believability Assessment –Assumption-based Reasoning

Unit III Ontologies 9 Hours

Concepts and Instances – Generalization Hierarchies – Features – Ontology Matching. Ontology Design and Development – Domain Understanding and Concept Elicitation – Modelling-based Ontology Specification – Reasoning with Ontologies and Rules.

Unit IV Rule Learning 10 Hours

Learning for Knowledge based agents – Generalization and Specialization Rules – Types – Formal definition. Modelling, Learning and Problem Solving – Rule learning and Refinement – Rule Generation and Analysis – Hypothesis Learning.

Unit V Rule Refinement and Reasoning Abstraction 8 Hours

Incremental Rule Refinement – Rule regeneration – Hypothesis Refinement – Characterization of Rule Learning and Refinement – Abstraction of Reasoning: Statement Abstraction – Reasoning Tree.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Describe various types of evidence-based reasoning used in Knowledge Engineering	Understand
CO2: Apply methodologies and modelling for Agent Design and Development.	Apply
CO3: Design reusable ontologies to support effective reasoning	Apply
CO4: Generate rules using generalization and specialization	Apply
CO5: Perform rule refinement using incremental approach	Apply

Text Book(s):

T1. Gheorghe Tecuci, Dorin Marcu, Mihai Boicu, David A. Schum, "Knowledge Engineering Building Cognitive Assistants for Evidence-based Reasoning", Cambridge University Press, 2016.

Reference Book(s):

R1. Simon Kendal and Malcolm Creen, "An Introduction to Knowledge Engineering", Springer, 2007.

R2. Ela Kumar, "Knowledge Engineering", I K International Publisher House, 2018.

Web Reference(s):

1. http://kremer.cpsc.ucalgary.ca/courses/CG/
2. https://web.stanford.edu/class/cs227/

Course Articulation Matrix

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

High– 3; Medium– 2; Low– 1

<table>
<tr><td>Course Code: 19CSEN1019</td><td colspan="3">Course Title: Reinforcement Learning Techniques</td></tr>
<tr><td colspan="2">Course Category: Professional Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P (Hours/Week)
3: 0: 0</td><td>Credits: 3</td><td>Total Contact Hours: 45</td><td>Max
Marks: 100</td></tr>
</table>

Pre-requisites

- NIL

Course Objectives

The course is intended to:

1. Gain knowledge on the Markov Decision Process.
2. Illustrate dynamic programming and Monte Carlo methods of Reinforcement Learning
3. Know about Time Difference Learning and Bootstrapping
4. Describe about planning and learning techniques
5. Gain knowledge on Function Approximation methods and various applications.

Unit I Introduction to Reinforcement Learning and Markov Decision Process **9 Hours**

Introduction to Reinforcement Learning – Elements of Reinforcement Learning – Limitations and Scope – Tic-Tac-Toe example – History of Reinforcement Learning- A K-Armed Bandit Problem –Action-Value Methods-Incremental Implementation-Markov Decision Process: The Agent-Environment Interface – Goals and Rewards-Returns and Episodes-Policies and Value Function-Optimal Policies and Optimal Value Functions- Optimality and Approximation

Unit II Dynamic Programming and Monte Carlo Methods **9 Hours**

Policy Evaluation-Policy Improvement-Policy Iteration-Value Iteration-Asynchronous Dynamic Programming-Generalized Policy Iteration-Efficiency of Dynamic Programming

Monte Carlo Methods: Prediction- Estimation of Action Values – Monte Carlo Control – Monte Carlo Control without Exploring Starts-Off-policy Prediction via Importance Sampling – Incremental Implementation – Off-Policy Monte Carlo Control.

Unit III Temporal Difference Learning and Bootsrapping **9 Hours**

Temporal-Difference Learning: TD Prediction – Advantages of TD Prediction Methods – Optimality of TD (0) – SARSA: On-Policy TD Control – Q-Learning: OffPolicy TD Control
n-step Bootstrapping: n-step TD prediction-n step Sarsa- n step Off policy Learning- n-step tree Backup Algorithm-Unifying Algorithm.

Unit IV Planning and Learning **9 Hours**

Models and Planning-Prioritized Sweeping-Trajectory Sampling-Planning at Decision Time-Rollout Algorithms-Monte Carlo Tree Search.

Unit V Solution Methods and Applications **9 Hours**

On-policy Prediction with Approximation: Value function approximation-Gradients Descent methods-Linear methods-On-policy control with Approximation - Applications: TD Gammon-Samuels Checkers player-Watsons Daily Double Wagering-Optimizing Memory control-Video Game play.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Illustrate Markov Decision Process for learning.	Understand
CO2: Apply dynamic programming techniques on Markov decision process and Monte Carlo methods	Apply
CO3:Describe planning and learning techniques in reinforcement learning	Understand
CO4: Implement Time difference learning for real world problems	Apply
CO5: Apply Approximation methods of learning.	Apply

Text Book(s):

T1. Richard S. Sutton and Andrew G. Barto, Reinforcement learning: An introduction, Second Edition, MIT Press, 2019.

T2. Csaba Szepesvari, Algorithms for Reinforcement Learning (Synthesis Lectures on Artificial Intelligence & Machine Learning), Morgan & Claypool Publishers, 2010.

Reference Book(s):

R1. Laura Graesser and Wah Loon Keng, Foundations of Deep Reinforcement learning: theory and Practice in Python, Pearson India, New Delhi, 2022.

R2.Phil Winder," Reinforcement learning Industrial Applications of Intelligent Agents",O'reilly,2020

Web References:

1.https://www.javatpoint.com/reinforcement-learning
2.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	-	-	-	-
CO2	3	2	1	1	-	1	-	1	-	1	-	-	2	-
CO3	2	1	-	-	-	-	-	1	-	1	-	-	-	-
CO4	3	2	1	1	-	1	-	1	-	1	-	-	2	-
CO5	3	2	1	1	-	-	-	1	-	1	-	-	2	-

High– 3; Medium– 2; Low– 1

Vertical III – Networks & Security

Course Code: 19CSEN2005	**Course Title: Multi-Core Architecture**		
Course Category: Professional Elective		**Course Level: Mastery**	
L:T:P (Hours/Week) **3: 0: 2**	**Credits: 4**	**Total Contact Hours: 75**	**Max. Marks:100**

Pre-requisites

- Computer Architecture
- Operating Systems

Course Objectives

The course is intended to:

1. Explain about Multi-Core Processors
2. Implement parallel programs using communication primitives
3. Develop parallel programs using OpenMP directives
4. Construct parallel programs using MPI program execution model
5. Deploy an application with MPI

Unit I Multi-Core Processors 9 Hours

Single core to Multi-core architectures – SIMD and MIMD systems – Interconnection networks – Symmetric and Distributed Shared Memory Architectures – Cache coherence – Performance evaluation – Parallel program design.

Unit II Parallel Program Features 9 Hours

Parallelization Patterns – Synchronization and data sharing: Data races – Synchronization primitives (mutexes, locks, semaphores, barriers) – Deadlocks and Livelocks – communication between threads (condition variables, signals, message queues and pipes).

Unit III Shared Memory Programming with OpenMP 9 Hours

OpenMP Execution Model – Memory Model – OpenMP Directives – Handling Data and Functional Parallelism: Handling Loops- Scheduling Loops- Types – Performance Considerations.

Unit IV Distributed Memory Programming with MPI 9 Hours

MPI program execution – MPI constructs – libraries – MPI send and receive – Point-to-point and Collective communication – MPI derived data types – Performance evaluation.

Unit V Parallel Program Applications **9 Hours**

Case studies – n-Body solvers – Tree Search – OpenMP and MPI implementations and comparison.

List of Exercises **30 Hours**

1. Implement a serial program to partition the variables based on the bins given.
2. Implement Conditional wait and signal using threads.
3. Implement bubble sorting using OpenMP.
4. Implement Matrix Multiplication using MPI.
5. Implement tree search using MPI & static partitioning.
6. Implement tree search using MPI & dynamic partitioning.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain the need for shared memory architectures and cache coherence mechanisms	Understand
CO2: Implement parallel programs using communication primitives between threads	Apply
CO3: Develop parallel programs using OpenMP directives for an application	Apply
CO4: Construct parallel programs using MPI program execution model for an application	Apply
CO5: Deploy an application with MPI using various partitioning techniques	Apply

Text Book(s):

T1. Peter S. Pacheco, “An Introduction to Parallel Programming”, Morgan-Kauffman/Elsevier, 2011.

T2. Darryl Gove, “Multicore Application Programming for Windows, Linux, and Oracle Solaris”, Pearson, 2011.

Reference Book(s):

R1. Michael J Quinn, “Parallel programming in C with MPI and OpenMP”, Tata McGraw Hill, 2003.

R2. Shameem Akhter and Jason Roberts, “Multi-core Programming”, Intel Press, 2006.

Web Reference(s):

1. NPTEL Course : https://nptel.ac.in/courses/106/103/106103183/
2. MITOpen courseware: https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-172-performance-engineering-of-software-systems-fall-2018/lecture-videos/lecture-6-multicore-programming/

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	-	-	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
CO5	3	2	2	2	2	1	1	2	3	2	1	1	3	1

High– 3; Medium– 2; Low– 1

Course Code: 19CSEN2014	Course Title: Cryptographic Techniques		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 2	Credits:4	Total Contact Hours:75	Max Marks:100

Pre-requisites

- Calculus and Transforms
- Discrete Mathematics

Course Objectives

The course is intended to:

1. Employ classical encryption techniques
2. Implement symmetric key algorithms
3. Apply number theory concepts
4. Apply hash functions and digital signature
5. Describe key management and authentication protocols

Unit I Classical Encryption 8 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 10 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 9 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 10 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 **8 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: Employ classical encryption techniques for providing confidentiality service	Apply
CO2: Implement symmetric key algorithms for encrypting text and multimedia data	Apply
CO3: Apply number theory concepts to design asymmetric key algorithms for providing confidentiality and key exchange services	Apply
CO4: Apply hash function and digital signature for protecting digital documents	Apply
CO5: Describe key management and user authentication protocols for providing key sharing and authentication services	Understand

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 Reference(s):

1. NPTEL Course contents on Cryptography and Network Security URL:http://nptel.ac.in/courses/106105162/
2. Learn Internet Security at Tutorial point https://www.tutorialspoint.com/cryptography/index.htm

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	1	2	3	2	1	1	3	2
CO2	3	2	2	2	2	2	1	2	3	2	1	1	3	2
CO3	3	2	2	2	2	2	1	2	3	2	1	1	3	2
CO4	3	2	2	2	2	2	1	2	3	2	1	1	3	2
CO5	2	1	-	-	-	2	1	2	3	1	-	1	-	-

High– 3; Medium– 2; Low– 1

Course Code: 19CSEN2024	Course Title: Network and Internet Security		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3:0:2	Credits:4	Total Contact Hours: 75	Max Marks:100

Pre-requisites

- Computer Network Technology

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 9 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 9 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 8 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 8 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 11 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”, 7^{th} Edition, Pearson Education, 2017.

T2: Ronald L Krutz and Russell Dean Vines, “Cloud Security- A Comprehensive Guide to Secure Cloud Computing”, Wiley, 2016.

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	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	3	2	1	1	3	2

High– 3; Medium– 2; Low– 1

Course Code: 19CSEN2025	Course Title: Embedded Systems		
Course Category: Professional Elective		**Course Level: Practice**	
L:T:P (Hours/Week) **3: 0: 2**	**Credits:4**	**Total Contact Hours:75**	**Max Marks:100**

Pre– requisites

- Operating Systems
- Microcontroller & IoT

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 Introduction to Embedded system and Arm Processor 9 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 8 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 10 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 9 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 9 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

5. Blinking two different LEDs
6. Reading temperature from LM 35 interface and plot the temperature Vs Time graph using Graphics LCD – Study Experiment

Course Outcomes At the end of this course, students will be able to:	**Cognitive Level**
CO1: Describe the programming concept involved in ARM Processor Architecture	Understand
CO2: Design ARM processor Peripherals using Embedded 'C' for any given problem scenario	Apply
CO3: Examine the significance of operating systems in embedded system design for Real Time operating Systems	Apply
CO4: Select the suitable communication technique to interface peripheral and sensors for Real Time operating Systems	Apply
CO5: Explain the system architecture using existing product design for any real time applications	Understand

Text Books:

T1. Rajkamal, “Embedded Systems Architecture, Programming and Design”, 3rd Edition, Tata McGraw-Hill, 2017.

T2. Wayne Wolf, “Computers as Components: Principles of Embedded Computing System Design”, Morgan Kaufman Publishers, 2016.

Reference Books:

R1. David E. Simon," An Embedded Software Primer", First Indian Reprint, Pearson Education Asia, 2002.

R2. K.V.K.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.

R4. Dave, "Embedded Systems: Concepts Design and Programming", Pearson Education, 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	2	1	-	-	-	-	-	2	3	1	-	1	-	-
CO2	3	2	2	2	2	1	1	2	3	2	-	1	3	-
CO3	3	2	2	2	2	1	1	2	3	2	-	1	3	-
CO4	3	2	2	2	2	1	1	2	3	2	1	1	3	-
CO5	2	1	-	-	-	1	1	2	3	1	-	1	-	-

High– 3; Medium– 2; Low– 1

<table>
<tr><td colspan="2">Course Code: 19CSEN2032</td><td colspan="2">Course Title: Digital and Mobile Forensics</td></tr>
<tr><td colspan="2">Course Category: Professional Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P (Hours/Week)
3: 0: 2</td><td>Credits:4</td><td>Total Contact Hours:75</td><td>Max Marks:100</td></tr>
</table>

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Explain digital forensic basic concepts
2. Demonstrate the processes of digital forensics
3. Illustrate forensic tools for investigation
4. Identify suitable tool for image file forensics
5. Explain mobile forensic tools

Unit I Introduction **9 Hours**

An Overview of Digital Forensics - Digital Investigations - Digital Forensics Investigation-Conducting an Investigation - Forensics Lab Accreditation Requirements - Physical Requirements for a Digital Forensics Lab - Basic Forensic Workstation - Business Case for Developing a Forensics Lab.

Unit II Digital Forensics Process **8 Hours**

Data Acquisition- Storage Formats for Digital Evidence - Acquisition Method - Acquisition Tools - Validating Data Acquisitions - Remote Network Acquisition Tools - Other Forensics Acquisition Tools

Unit III Digital Forensics Tools **9 Hours**

Evaluating Digital Forensics Tool Needs - Digital Forensics Software Tools - Digital Forensics Hardware Tools - Validating and Testing Forensics Software - E-mail and Social Media Investigations: E-mail Crimes and Violations- E-mail Forensics Tools - Digital Forensics Methods for Social Media Communications

Unit IV Image File Forensics **9 Hours**

Introduction to Image Files - Data Compression in Image Files - Lossless Compression Algorithms - Steganography in Image Files – Steganography, Cryptography, Watermarking - Tools – S-Tools – StegHide – Snow – Camera/Shy

Unit V Mobile Forensics **10 Hours**

Mobile phone evidence extraction process - Mobile operating systems overview - The Android model – security - File system - Forensic Setup and Pre Data Extraction Techniques - Data extraction techniques

List of Exercises **30 Hours**

1. Study of different tools used for computer forensic investigation.
2. Perform live Forensics Case Investigation using Autopsy tool.
3. Verify Evidence files with Encase tool.
4. Recover Deleted Files using Forensics Tools.
5. Create a Forensic Image using FTK imager.
6. Extract installed applications and diagnostic information from Android devices using ADB protocol.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain basics of digital forensics and requirements for digital forensics lab setup	Understand
CO2: Demonstrate the processes of digital forensics in electronic media	Apply
CO3: Perform forensic related activates using forensic tools for a given scenario	Apply
CO4: Create forensic images for investigation using image file forensic tools	Apply
CO5: Explain fundamental concepts of mobile forensics	Understand

Text Book(s):

T1. Bill Nelson, Amelia Phillips, Christopher Steuart, "Guide to Computer Forensics and Investigations", 6th Edition, Cengage Learning, 2019.

T2. EC-Council, "Computer Forensics investigating data and Image Files ", Cengage Learning, 2nd Edition, 2016.

T3. Satish Bommisetty, Rohit Tamma, Heather Mahalik, "Practical Mobile Forensics", Fourth Edition, Packt publishing, 2020.

Reference Book(s):

R1. Cory Altheide, "Harlan Carvey Digital Forensics with Open Source Tools", Syngress, 2011.

R2. Vacca, J, "Computer Forensics", Computer Crime Scene Investigation, 2nd Edition, Charles River Media, 2005.

R3. Chuck Easttom, "An In-Depth Guide to Mobile Device Forensics" CRC Press, 2022.

Web Reference(s):

1. https://in.coursera.org/learn/digital-forensics-concepts
2. https://onlinecourses.swayam2.ac.in/cec20_lb06/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
CO2	3	2	1	1	-	1	1	-	-	-	-	-	-	1
CO3	3	2	1	1	-	1	1	-	-	-	-	-	-	1
CO4	3	2	1	1	-	1	1	-	-	-	-	-	-	1
CO5	3	2	1	1	-	1	1	-	-	-	-	-	-	1

High– 3; Medium– 2; Low– 1

<table>
<tr><td colspan="2">Course Code: 19CSEN1005</td><td colspan="2">Course Title: Distributed Systems</td></tr>
<tr><td colspan="2">Course Category: Professional Elective</td><td colspan="2">Course Level: Practice</td></tr>
<tr><td>L:T:P (Hours/Week)
3: 0: 0</td><td>Credits:3</td><td>Total Contact Hours:45</td><td>Max Marks:100</td></tr>
</table>

Pre– requisites

- Operating Systems
- Computer Network Technology

Course Objectives

The course is intended to:

1. Describe the characteristics of distributed systems.
2. Explain various architectural models of a Distributed System.
3. Use Communication protocols to coordinate distributed activities.
4. Solve the naming and synchronization issues.
5. Apply distributed multimedia systems in real time.

Unit I **Introduction** **9 Hours**

Definition - Characterization of Distributed Systems: Collection of autonomous computing, Single Coherent System – Middleware and Distributed Systems - Types of Distributed Systems: High performance distributed computing, Distributed information systems, pervasive systems.

Unit II **Architecture** **9 Hours**

Architectural styles: Layered architecture, Object based and service oriented architecture, Resource based architecture, Publish-subscribe architecture – Middleware organization– System Architecture-Example Architecture: The Network File System, The web

Unit III **Communication of Distributed System** **9 Hours**

Interprocess Communication : API for the Internet protocols – External data representation and marshalling – Multicast communication –Remote Invocation: Remote Procedure Call-Remote Method Invocation– case study : Java RMI

Unit IV Naming and Synchronization in Distributed Systems 9 Hours

Naming : Names-identifiers-address- Flat Naming- Structured Naming- Attribute based naming - Synchronization : Clock synchronization – Logical clock – Mutual Exclusion — Election Algorithms– The bully algorithm- Example: DNS name space

Unit V Distributed Multimedia Systems 9 Hours

Introduction – Characteristics of Multimedia data – Quality of service management – Resource management –Stream adaptation – Case studies: Tiger, BitTorrent and End System Multicast.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Describe the characteristics of Distributed systems and its types.	Understand
CO2: Explain various architectural models of a Distributed System for different scenarios.	Understand
CO3: Use Communication protocols to coordinate distributed activities between processes	Apply
CO4: Solve the naming and synchronization issues arising in distributed system using different algorithms.	Apply
CO5: Apply distributed multimedia applications for continuous streams of data in real time.	Apply

Text Book(s):

T1.Andrew S. Tanenbaum, Maarten Van Steen, "Distributed Systems", 3rd Edition, Pearson Education, 2017.

T2.George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair,"Distributed Systems : Concepts and Design", 5th Edition, Pearson Education,2017.

Reference Book(s):

R1.Andrew S. Tanenbaum, Maarten Van Steen, "Distributed Systems: Principles and Paradigms", 2nd Edition, Pearson Education, 2015.

R2.Pradeep K Sinha, "Distributed Operating System: Concepts and Design", Wiley Publications, 2008.

R3.Ajay D. Kshemkalyani, Mukesh Singhal "Distributed Computing Principles, Algorithms, and Systems", Cambridge University Press, 2010.

Web Reference(s):

1. Coursera course on Distributed Programming in Java
   URL:https://www.coursera.org/learn/distributed-programming-in-java.
2. Journals in ScienceDirect
   URL: https://www.sciencedirect.com/topics/computer-science/distributed-computing

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	2	-
CO4	3	2	1	1	-	-	-	1	-	1	-	1	2	-
CO5	3	2	1	1	1	1	1	1	-	1	1	1	2	1

High– 3; Medium– 2; Low– 1

Course Code: 19CSEN1008	Course Title: Wireless Sensor Networks		
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

- Computer Network Technology

Course Objectives

The course is intended to:

1. Explain the concepts of sensor network
2. Use the functionalities of MAC in WSN
3. Understand the functionalities of routing algorithms.
4. Choose appropriate solutions for network management and Middleware services.
5. Explain about the various applications of WSN

Unit I WSN Architectures 9 Hours

Single-node architecture - Hardware components- Energy consumption of sensor nodes- Operating systems and execution environments- Sensor network scenarios- Optimization goals- Design principles for WSNs- Service interfaces of WSNs- Gateway concepts

Unit II Medium Access Control Protocols 9 Hours

Wireless channel and communication fundamentals- Physical layer and transceiver design considerations in WSNs- Fundamentals of wireless MAC protocols- Low duty cycle protocols and wakeup concepts- Contention-based protocols- Schedule-based protocols- Random Access-Based Protocols-Case study : sensor-MAC IEEE 802.15.4 LR-WPANs Standard.

Unit III Routing and Data Gathering Protocols for WSN 9 Hours

Routing Challenges and Design Issues in Wireless Sensor Networks- Routing Strategies in Wireless Sensor Networks- Data-centric networking- Data-centric routing- Data aggregation- Data-centric storage

Unit IV Network Management for WSN **10 Hours**

WSN Middleware Principle, Middleware Architecture-Existing Middleware-Network Management Requirements, Traditional Network Management Models- Network Management Design Issues, Operating System Design Issues -WSN Design Issues- Performance Modeling of WSN, Case Study: Simple Computation of the System Life Span

Unit V Applications of WSN **9 Hours**

Home Control - Building Automation - Industrial Automation - Medical Applications - Reconfigurable Sensor Networks - Highway Monitoring - Military Applications - Civil and Environmental Engineering Applications - Wildfire Instrumentation - Habitat Monitoring - Nanoscopic Sensor Applications – Case Study: Target detection and tracking - Contour/edge detection - Field sampling

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1:Explain the concepts of sensor network using WSN architecture	Understand
CO2:Identify appropriate physical and MAC layer protocols for WSN	Apply
CO3:Compare the functionalities of routing algorithms in Sensor networks.	Apply
CO4:Use appropriate solutions for network management and Middleware services in WAN.	Apply
CO5:Demonstrate various applications in wireless sensor networks	Apply

Text Book(s):

T1. Kazem Sohraby, Daniel Minoli and Taieb Znati, " Wireless Sensor Networks Technology, Protocols, and Applications", John Wiley & Sons, 2010

T2. Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, Ltd, 2005.

Reference Book(s):

R1. C.Siva Ram Murthy, B.S.Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols", Prentice Hall Professional Technical Reference, 2008.

R2. Carlos De Morais Cordeiro, Dharma Prakash Agrawal, "Ad Hoc & Sensor Networks:Theory and Applications", World Scientific Publishing Company, 2011.

Web References:

1. NPTEL Course- Wireless Ad Hoc and Sensor Networks, IIT Kharagpur https://nptel.ac.in/courses/106105160
2. Open Access Peer-Reviewed Chapter “Overview of Wireless Sensor Network” M.A. Matin M.M. Islam: https://www.electronics-notes.com/articles/connectivity/

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	-	-	-	1	-	1	-	1	-	-
CO4	3	2	1	1	-	1	1	1	-	1	1	1	2	-
CO5	3	2	1	1	1	1	1	1	-	1	1	1	2	-

High– 3; Medium– 2; Low– 1

Course Code: 19CSEN1013	**Course Title: Block Chain Technology**		
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

- Web Technologies

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 hyperledger fabric.
5. Explore the challenges and trends using various blockchain projects.

Unit I Fundamentals of Block chain 8 Hours

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

Unit II Crypto Currency And Smart Contracts 9 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 10 Hours

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

Unit IV **WEB3 and Hyperledger** **10 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** **8 Hours**

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

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 Reference(s):

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

<table>
<tr><td colspan="2">Course Code: 19CSEN1014</td><td colspan="2">Course Title: Information Security</td></tr>
<tr><td colspan="2">Course Category: Professional Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P (Hours/Week)
3: 0: 0</td><td>Credits: 3</td><td>Total Contact Hours: 45</td><td>Max Marks: 100</td></tr>
</table>

Pre-requisites

- NIL

Course Objectives

The course is intended to:

1. Describe the need for Information security.
2. Apply various Information security policies.
3. Identify suitable risk management and access control mechanisms.
4. Choose appropriate security policy and practice.
5. Apply the Intrusion Detection System and tools.

Unit I Introduction to Information Security 9 Hours

Security – Key concepts - Critical Characteristics of Information – CNSS Security Model - Components of an Information System - Security and the Organization – Need for Information Security – Threats and Attacks – Categories of Threats.

Unit II Security Foundations 9 Hours

Security policy and Mechanism – Operational and Human issues - Protection State - Access Control Matrix – Policy - Security policies - Confidentiality policies - Integrity policies - Hybrid policies.

Unit III Security Analysis 9 Hours

Risk Management - Identifying and Assessing Risk, Assessing and Controlling Risk. Systems: Access Control Mechanisms - Information Flow and Confinement Problem.

Unit IV Logical Design 9 Hours

Blueprint for Security - Information Security Policy - Standards and Practices - ISO 27001, NIST Models - VISA International Security Model - Design of Security Architecture - Planning for Continuity.

Unit V Physical Design 9 Hours

Security Technology – IDS - Scanning and Analysis Tools – Cryptography - Access Control Devices - Physical Security - Security and Personnel.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Describe the need for Information security to prevent threats and attacks.	Understand
CO2: Apply various Information security policies to protect data and information.	Apply
CO3: Identify suitable risk management and access control mechanisms to manage an organization.	Apply
CO4: Choose appropriate security policy and practice for ensuring Information security.	Apply
CO5: Apply the Intrusion Detection System and tools to provide physical security.	Apply

Text Book(s):

T1. Michael E Whitman, Herbert J Mattord, "Principles of Information Security", Cengage Learning, 2021.

T2. Matt Bishop, "Computer Security Art and Science", Pearson/PHI, 2019.

Reference Book(s):

R1. Charles Pfleeger, Shari Lawrence Pfleeger, Devin N Paul, "Security in Computing", Pearson, 2007.

R2. William Stallings, "Cryptography and Network Security – Principles and Practices", 7th Edition, Pearson Education, 2017.

R3. Micki Krause, Harold F. Tipton, "Handbook of Information Security Management", Vol 4 CRC Press LLC, 2019.

Web References:

1. NPTEL SWAYAM, Cryptography and Network Security, IIT Kharagpur, URL: https://onlinecourses.nptel.ac.in/noc21_cs16/preview
2. COURSERA, Introduction to Cyber Security Tools & Cyber Attacks, URL: https://www.coursera.org/learn/introduction-cybersecurity-cyber-attacks?trk_location=query-summary-list-link
3. SIMPLILEARN, An Ultimate Guide to Cyber Security for Beginners URL: https://www.simplilearn.com/tutorials/cyber-security-tutorial/cyber-security-for-beginners
4. ISO 27001 & ISO 22301 Academy – Advisera URL: https://advisera.com/27001academy/what-is-iso-27001/

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	1	1	-	2	2	1	-	1	-	1	2	-
CO3	3	2	1	1	-	2	2	1	-	1	-	1	2	-
CO4	3	2	1	1	-	2	2	1	-	1	1	1	2	-
CO5	3	2	1	1	1	2	2	1	-	1	1	1	2	2

High– 3; Medium– 2; Low– 1

Course Code: 19EEIC1001	Course Title: Embedded System Design and Development (Common to CS,EC,EE,MC & ME)		
Course Category: Industry Offered 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. Understand and implement the functions & Capabilities of embedded platforms for easy prototyping
2. Identify the type of sensors and actuators for required applications
3. Able to communicate the data between devices using different protocols
4. Develop IoT based systems with wireless network connections and accessing devices over cloud

Unit I Embedded Platforms 10 Hours

Embedded Platform Architecture and working - Factors for Microcontroller/Microprocessor selection - Arduino - Boards and schematics – Tool chain - Setup and Configuration - Input/ Output Configurations and Access - Libraries - Analog and Digital Inputs - Pulse Width Modulation – Interrupts
Raspberry Pi - Boards and schematics – Tool chain - cross compilation - Setup and Configuration - Input/output Configurations and Accessing - A/D converters - Pulse Width Modulation – Interrupts

Unit II Sensors and Actuators 10 Hours

Interfacing of Sensors and actuators:
Sensors - Introduction, Characteristics - Analog: Potentiometer, Temperature sensor, Tactile Pressure sensor, LDR - Digital sensors: Accelerometer, Gyroscope, Humidity, Passive Infrared Sensor.
Actuators - Introduction, Characteristics and working with Relay, DC motors, Servo motor, Stepper motor and its drivers

Unit III Communication Protocols 10 Hours

Protocols:
Wired: RS232 Standard - UART, I2C - Comparative study of wired protocols - Demonstration of applications in wired Serial Communication protocols Wireless: Standards - Bluetooth, RF - Comparative study of wireless protocols - Demonstration of applications in wireless Serial Communication protocols

Unit IV Internet of Things 15 Hours

Definition and Architecture of IoT, Building blocks of IoT, Programming with IoT protocols - MQTT, CoAP - Connecting embedded target board to Web, Basics networking in IoT: creating a web page - Creating a server on target board - Controlling I/O peripherals from webpage, Building Mobile Application and Controlling I/O peripherals from mobile application and over the internet, Creating communication between different nodes - Cloud platforms for IoT, Cloud data logging and monitoring, Interfacing with web services.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Model the functions & Capabilities of embedded platforms for easy prototyping	Apply
CO2: Choose the type of sensors and actuators for required applications	Apply
CO3: Plan to communicate the data between devices using different protocols	Apply
CO4: Build IoT based systems with wireless network connections and accessing devices over cloud	Apply

Reference Book(s):

R1. Simon Monk, “Programming Arduino: Getting started with sketches”, 2nd edition, McGraw-Hill Education, 2016.

R2. Gareth Halfacree, “The Official Raspberry Pi Beginner’s Guide” Raspberry Pi Press.

R3. Macro Schwartz, “Internet of Things with ESP8266”, Packt Publishing.

Course Articulation Matrix

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

High-3; Medium-2; Low-1

Vertical IV – Software Development

Course Code: 19CSEN2015	Course Title: Web Technologies		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 2	Credits: 4	Total Contact Hours: 75	Max Marks: 100

Pre-requisites

- IT Practices Lab
- Internet Programming Laboratory

Course Objectives

The course is intended to:

1. Design a responsive web page
2. Develop interactive web pages using open source JavaScript Libraries
3. Construct complex user interfaces having a unidirectional data flow
4. Develop a back end solution for a given scenario
5. Build a Web Content Management System

Unit I Bootstrap 10 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 8 Hours

Selecting and Filtering – Events – Manipulating Content and Attributes – Iteration of Arrays and Objects – Working with CSS Properties – AJAX.

Unit III React JS 8 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 10 Hours

Node.js Capabilities – Setting up Node.js – Modules –NPM – Event Emitters – Sending and receiving events with Event Emitters – HTTP server applications – HTTP Sniffer – Listening to the HTTP conversation– Express JS – Making HTTP Client requests – Calling a REST backend service – Mobile First Paradigm.

Unit V Web Content Management 9 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 Libraries like JQuery and AJAX	Apply
CO3: Construct complex user interfaces having a unidirectional data flow using 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 of the Most Popular CSS Frameworks", APress, 2020.

T2. Richard York, "Web Development with jQuery", Wiley India, 2015.

T3. Alex Banks, Eve Porcello, "Learning React, Modern Patterns for Developing React Apps", 2nd Edition, O'Reilly Publications, 2020.

T4. David Herron, "Node.js Web Development, Server-side development with Node 10 made easy", 4th Edition, Packt Publishing, 2018.

T5. Deane Barker, "Web Content Management - Systems, Features, and Best Practices ", O'Reilly Publications, 2016.

Reference Book(s):

R1. C Xavier, "Web Technology and Design", 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. Web Technologies Tutorials: https://www.w3schools.com/
2. Bootstrap Tutorials: https://getbootstrap.com/docs/5.0/getting-started/introduction/
3. ReactJS Tutorials: https://reactjs.org/tutorial/tutorial.html
4. NodeJS Tutorials: https://nodejs.org/en/
5. Joomla Documentation: https://docs.joomla.org/

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	1	1	3	-
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	-
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: 19CSEN2016	**Course Title: Software Quality Assurance and Testing**		
Course Category: Professional Elective		**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. 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 8 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 8 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 10 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 10 Hours

Need for Levels of Testing – Unit Test: Need, Plan & Design – Integration Test – System Test: Functional Testing – Performance Testing – Stress Testing – Configuration Testing – Security Testing – 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 – Test Metrics and Measurements: Project, Progress and Productivity Metrics.

List of Exercises 30 Hours

1. Demonstrate code quality control in software development process using SonarQube.
2. Identify the code vulnerabilities like SQL Injection attacks using SonarQube.
3. Design test case using any test case design approach in MS-Excel.
4. Create test plan for any given scenario using Jmeter.
5. Perform various system tests for any given application using Jmeter.
6. Perform test automation using Selenium for any given application.

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	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.

T2. Ilene Burnstein, “Practical Software Testing - A Process Oriented Approach”, Springer, 2010.

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 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 Testing - NPTEL Course Content NPTEL Course Content URL: https://nptel.ac.in/courses/106/105/106105150/
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

<table>
<tr><td>Course Code: 19CSEN2026</td><td colspan="3">Course Title: Design Patterns</td></tr>
<tr><td colspan="2">Course Category: Professional Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P (Hours/Week)
3: 0: 2</td><td>Credits: 4</td><td>Total Contact Hours: 75</td><td>Max Marks: 100</td></tr>
</table>

Pre-requisites

- Object Oriented Software Engineering

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 iimplement the system
5. Describe the behavioral patterns & designing with distributed objects

Unit I Design Pattern Concepts 9 Hours

Design pattern – Describing design patterns – The catalog & organizing the catalog –Solve design problems with Design patterns –Selecting & using a design pattern –Object–oriented development – Key concepts and related concepts – Benefits and drawbacks– Basics of OOP.

Unit II System Analysis, Design and Implementation 9 Hours

Overview of the analysis phase– Gathering the requirements – Functional requirements specification – Defining conceptual classes and relationships – Using the knowledge of the domain – Design and Implementation: Design – Implementing our Design.

Unit III Design Pattern Catalog 9 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 9 Hours

Introduction – The 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 9 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 based application.
4. Implement the Flyweight Design pattern for an appropriate Scenario in suitable Java based 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	Apply

Text Book(s):

T1. Brahma Dathan, Sarnath Ramnath, “Object-Oriented Analysis, Design and Implementation: An Integrated Approach”, 2nd Edition, Universities Press, 2015

T2. Erich Gamma, Richard Helan, Ralph Johman , John Vlissides, “Design patterns”, Pearson Publication, 2015.

Reference Book(s):

R1. Mainak Biswas,“Design Patterns: A Domain Agnostic Approach”, Createspace 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:

R2. Software Architecture & Design Patterns: https://hemanthrajhemu.github.io/CSE6/17SCHEME/PE/52_SADP/T2_M3.html

R3. 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	-	-	-	-	-	2	3	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	1
CO4	3	2	2	2	2	1	1	2	3	2	1	1	3	-
CO5	3	2	2	2	2	1	1	2	3	2	1	1	3	-

High– 3; Medium– 2; Low– 1

Course Code: 19CSEN2027	Course Title: Foundation Skills in Integrated Product Development		
Course Category: Professional Elective		Course Level: Practice	
L:T:P (Hours/Week) 3: 0: 2	Credits:4	Total Contact Hours:75	Max Marks:100

Pre-requisites

- Object Oriented Software Engineering

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. Implement sustenance engineering and End of Life support activities.
5. Develop product management plan for a new product.

Unit I Fundamentals of Product Development 9 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 9 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 9 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 9 Hours

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - Sustenance -Maintenance and Repair – Enhancements - Product EoL - Obsolescence Management – Configuration Management - EoL Disposal

Unit V Business Dynamics – Engineering Services Industry 9 Hours

The Industry - Engineering Services Industry - Product Development in Industry versus Academia –The IPD Essentials - Introduction to 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.

The above list of exercises can be completed for any product by forming a group of 3 to 4 students.

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 by considering various global trends.	Understand
CO2: Develop design specification for new product development based 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 on the type of the new product and development methodology.	Apply

Text Book(s):

T1. NASSCOM student Handbook "Foundation Skills in Integrated Product Development".

T2. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", 6^{th} Edition, Tata McGraw Hill, 2016.

T3. John W Newstrom and Keith Davis, "Organizational Behavior", 11^{th} Edition, Tata McGraw Hill, 2014.

Reference Book(s):

R1. Hiriyappa B, “Corporate Strategy – Managing the Business”, Author House, 2013.

R2. Peter F Drucker, “People and Performance”, Oxford, 2007.

R3. Vinod Kumar Garg and Venkita Krishnan N K, “Enterprise Resource Planning – Concepts”, 2^{nd} Edition Reprint, Prentice Hall, 2011.

R4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", 7^{th} Edition, McGraw Hill Education, 2013.

Web References:

1. NPTEL Course Product Design and Development URL: https://onlinecourses.nptel.ac.in/noc21_me83/preview
2. MIT Open Courseware Product Design and Development URL: https://ocw.mit.edu/courses/sloan-school-of-management/15-783j-product-design-and-
3. NPTEL Course Introduction to Strategic Management URL: 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	1	3	2
CO5	3	2	2	2	2	1	1	2	3	2	3	1	3	2

High– 3; Medium– 2; Low– 1

Course Code: 19CSEN2028	Course Title: Advanced Data Structures and Algorithms		
Course Category: Professional Elective		Course Level: Mastery	
L:T:P (Hours/Week) 3: 0: 2	Credits: 4	Total Contact Hours: 75	Max Marks: 100

Pre-requisites

- Data Structures and Algorithm Analysis – II

Course Objectives

The course is intended to:

1. Develop algorithms for efficient search
2. Construct range trees and Voronoi diagrams
3. Construct geometric data structures
4. Solve problems using Randomized and Approximation algorithms
5. Apply Parallel and Online algorithms for solving problem

Unit I **Search Data Structures** **9 Hours**

Splay trees-Red Black trees-Treaps-Suffix arrays and Trees

Unit II **Range Search** **9 Hours**

1-Dimensional Range Searching-Range Trees-Higher Dimensional Range Trees-Voronoi diagram

Unit III **Geometric Data Structures** **9 Hours**

Interval trees-Priority search trees-Segment trees-Quad trees

Unit IV **Randomized and Approximation Algorithms** **9 Hours**

Randomized Algorithms: Random Number Generators-Skip Lists- Primality Testing
Approximation Algorithms: Node cover problem-Euclidean Traveling Salesperson Problem-Bin packing polynomial time approximation schemes:0/1 Knapsack problem

Unit V **Parallel and online Algorithms** **9 Hours**

Parallel Algorithms: Parallelism-PRAM-Handling Write conflicts- Merging and Sorting. Online algorithms: Euclidean spanning tree- Bipartite matching-Convex hull problem.

List of Exercises **30 Hours**

1. Construct Treaps and perform insert, delete operations on it.
2. Construct Range trees and perform range search on it.
3. Construct Interval trees and perform insert, delete and search operations.
4. Construct Skip Lists and insert elements in to it.
5. Solve 0/1 Knapsack problem using Approximation algorithm.
6. Solve convex hull problem using online algorithm.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1:Develop algorithms for efficient search using Tree data structures	Apply
CO2:Construct range trees and Voronoi diagrams for spatial search	Apply
CO3:Construct geometric data structures and perform spatial search operations	Apply
CO4: Solve Problems using Randomized and Approximation algorithms to achieve better efficiency in real time applications	Apply
CO5: Apply Parallel and Online algorithms for solving various problems	Apply

Text Book(s):

T1.Mark Allen Weiss,"Data Structures & Algorithms in Java", 3rd Edition, Pearson Education, 2012.

T2.R.C.T. Lee, S.S.Tseng, R.C.Chang, Y.T.Tsai, "Introduction to the Design and Analysis of Algorithms A strategic Approach", Tata McGraw Hill, 2012.

T3.Charles E.Leiserson, Ronald L Rivest, Thomas H.Cormen, Clifford Stein, "Introduction to Algorithms", 3rd Edition, Prentice Hall India, 2012.

T4.Ellis Horowitz, Sartaj Sahni, S.Rajasekaran, "Fundamentals of Computer Algorithms" 2nd Edition, Galgotia Publications, 2010.

Reference Book(s):

R1.Peter Brass, “Advanced Data Structures”, Cambridge University Press, 2008.

R2.Dinesh P. Mehta, Sartaj Sahni, “Handbook of Data Structures and Applications”, Chapman& Hall/CRC, 2005.

R3.Sara Base Allen Van Gelder, “Computer Algorithms Introduction to Design and Analysis”, 3rd Edition, Pearson Education, 2003.

Web Reference(s):

1. Applications of Computational Geometry-Geometry in Action.
   URL:https//www.ics.uci.edu/eppstein/geom.html
2. MIT Course Content URL: https://courses.csail.mit.edu/6.854/21/

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	-	1	3	1
CO2	3	2	2	2	2	1	1	2	3	2	-	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	3	2	2	2	2	1	1	2	3	2	1	1	3	1

High– 3; Medium– 2; Low– 1

Course Code: 19CSEN2033	Course Title: Robotic Process Automation Design		
Course Category: Professional Elective		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. Describe the RPA Environment.
2. Develop RPA programs using various workflows.
3. Construct RPA programs using File operations and controls.
4. Perform automation using plugins and extensions.
5. Apply exception handling techniques for automation activity.

Unit I RPA Environment 9 Hours

Benefits of RPA – Components of RPA – RPA Platforms – RPA Stack - Studio – Types of Robot – RPA Orchestrator - Learning RPA Studio - User Interface – Task recorder

Unit II Programming Workflow 8 Hours

Sequencing the workflow - Activities – Control flow – Various types of loops and decision making – Assign activity – Delay activity – Break activity – While activity – Do While activity – For Each activity- If activity – Switch activity – Sequence and Flowchart examples

Unit III Data Manipulation and Controls 10 Hours

Variables and scope – Collections – Arguments – Data table usage – Clipboard management – File operations - Finding the Control – Techniques for waiting for a control – Controls – Mouse and Keyboard Activities – UiExplorer – Handling events

Unit IV Plugins, Extensions & Handling User Events 9 Hours

Terminal plugin - SAP Automation – Java plugin – Citrix automation – Mail plugin - PDF plugin – Web integration – Excel and word plugin – Credential management.- System event triggers monitoring –Image and element triggers monitoring.

Unit V Exception Handling & Maintaining the Code 9 Hours

Exception handling - Common exceptions – Logging and taking screenshots – Debugging techniques – Collecting crash dumps – Error reporting –Project organization - Layout for each workflow – Nesting workflows – Reusability of workflows.

List of Exercises **30 Hours**

1. Generate recording of a web-based application and windows-based application using RPA recorder.
2. Create an automation using if and switch activity.
3. Create an automation using While, Do While and for activity.
4. Build a data table using data scrapping (dynamically).
5. Implement data extraction from an Excel file into a data table and vice versa.
6. Create an automation using Exception Handling for any activity.

Course Outcomes At the end of this course, students will be able to:	**Cognitive Level**
CO 1: Describe the RPA Environment for implementing process automation.	Understand
CO 2: Develop RPA programs using various workflows for any given activity.	Apply
CO 3: Construct RPA programs using File operations and controls by mouse and keyboard activities.	Apply
CO 4: Perform automation using plugins and extensions through assistant bots and event triggers.	Apply
CO 5: Apply exception handling techniques for automation activity to handle real time scenarios.	Apply

Text Book(s):

T1. Alok Mani Tripathi, “Learning Robotic Process Automation”, Packt Publishing, 2018.

Reference Book(s):

R1. Husan Mahey, “Robotic Process Automation with Automation Anywhere”, Packt Publishing Ltd, 2020

R2. Richard Murdoch, “Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant”, RPA Ultra, 2018.

Web Reference(s):

1. https://www.uipath.com/rpa/robotic-process-automation
2. https://onlinecourses.nptel.ac.in/Introduction to robotics

Course Articulation Matrix

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

High– 3; Medium– 2; Low– 1

Course Code: 19CSEN1020	Course Title: Agile Methodologies		
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 Engineering

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 9 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 9 Hours

Introduction to Scrum – Adapting to Scrum – Patterns for adopting Scrum – Product Backlog – Sprints – Planning – Progressively Refine Requirements – Iceberg – Refining User Stories.

Unit III Scrum Roles 9 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 9 Hours

Test-Driven Development (TDD) Cycle – Acceptance tests – Continuous planning – Agile Test Automation: Agile Testing Quadrant, Test Automation Backlog and Pyramid – Unit Test Characteristics – xUnit frameworks – Multidimensional Testing Coverage Matrix.

Unit V Agile Software Design and Development 9 Hours

Agile Design: Design Smells – Agile Design Principles: Single Responsibility Principle, Open Closed Principle, Liskov Substitution Principle, Dependency Inversion Principle, Interface Segregation Principle.

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	Apply
CO2: Demonstrate the User stories in agile software development using sprint 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	Apply

Text Book(s):

T1. Roger S. Pressman and Bruce R Maxim, “Software Engineering - A Practitioner’s Approach”, 9th Edition, McGraw-Hill International Edition, 2020.

T2. Mike Cohn, “Succeeding with Agile: Software Development Using Scrum”, Addison- Wesley, 2013.

T3. Robert C. Martin and Micah Martin, “Agile Principles, Patterns and Practices in C#”, Prentice Hall, 2013.

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 Reference(s):

1. Agile Methodology Tutorial : https://www.tutorialspoint.com/agile/index.htm
2. Scrum: https://www.scrum.org/
3. Agile Software Development: https://www.qafox.com/agile-software-development-guide/

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	-
CO2	3	2	1	1	-	1	-	1	-	1	2	-	2	-
CO3	3	2	1	1	-	1	-	1	-	1	2	-	2	-
CO4	3	2	1	1	1	1	-	1	-	1	2	-	2	-
CO5	3	2	1	1	-	1	-	1	-	1	2	-	2	-

High– 3; Medium– 2; Low– 1

Course Code: 19CSEN1007	Course Title: Reliability Engineering		
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 Engineering

Course Objectives

The course is intended to:

1. Stress the importance of the concepts of reliability, system using various models.
2. Use the static and dynamic model systems for reliability design.
3. Design for maintainability with various maintenance models.
4. Understand the analysis of Failure Data and Reliability Testing.
5. Understand 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 10 Hours

Data collection and empirical methods – Reliability testing – Reliability Growth testing – Identifying failure and repair distributions.

Unit V Applications – Case Studies 8 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 At the end of this course, students will be able to:	**Cognitive Level**
CO 1: Explain the concepts of reliability, system using various models	Understand
CO 2: Design the reliability for a system using static and dynamic models	Apply
CO 3: Develop the design for Maintainability with various maintenance concepts	Apply
CO 4: Identify the Failure data using Reliability testing methods	Apply
CO 5: 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-Verlag London Limited, 2011.

Web Reference(s):

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

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	-	-
CO2	3	2	1	1	-	-	-	1	-	1	1	1	2	-
CO3	3	2	1	1	-	-	-	1	-	1	1	1	2	-
CO4	3	2	1	1	-	-	-	1	-	1	1	1	2	1
CO5	3	2	1	1	-	1	1	1	-	1	1	1	2	-

High– 3; Medium– 2; Low– 1

Course Code: 19CSIC1001	Course Title: Prototype Development (Common to CS,EC,EE,MC & ME)		
Course Category: Industry Offered 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. Create quick UI/UX prototypes for customer needs
2. Develop web application to test product traction/product feature
3. Develop 3D models for prototyping various product ideas
4. Tools and Techniques to create prototypes in a quick iterative methodology

Unit I UI/UX 10 Hours

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

Unit II App Development 12 Hours

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

Unit III Industrial Design 11 Hours

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

Unit IV Rapid Prototyping 12 Hours

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

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Create quick UI/UX prototypes for customer needs	Apply
CO2: Develop web application to test product traction/product feature	Apply
CO3: Develop 3D models for prototyping various product ideas	Apply
CO4: Tools and Techniques to create prototypes in a quick iterative methodology	Apply

Reference Book(s):

R1. Peter Fiell, Charlotte Fiell , “Industrial Design A-Z”, Taschen AmericaLlc, 2016

R2. Steve Krug, “Don’t Make Me Think, Revisited”, 3rd edition, Pearson, 2014

R3. Josef Prusa, “Basics of 3D Printing”, Prusa Research, 2020

Web References:

1. www.developer.mozilla.org/en-US/docs/Learn

Course Articulation Matrix

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

High-3; Medium-2; Low-1

<table>
<tr><td colspan="2">Course Code: 19CSIC2001</td><td colspan="2">Course Title: AWS & DevOps
(common to AD,AM CS , IT & SC)</td></tr>
<tr><td colspan="2">Course Category: Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P(Hours/Week)
3: 0: 2</td><td>Credits: 4</td><td>Total Contact Hours: 75</td><td>Max Marks: 100</td></tr>
</table>

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 **10 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 **11 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 **9 Hours**

PowerShell Introduction-Data Structures-Objects-Conditional-Loops-Functions and Pipelines- Script Execution-Error Handling-Input / Output

UNIT V POWERSHELL ADVANCED FEATURES **9 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

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 At the end of the course the student will be able to:	Cognitive Level
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

<u>**Vertical V – Human Computer Interaction**</u>

<table>
<tr><td colspan="2">Course Code: 19CSEN2001</td><td colspan="2">Course Title: User Interface Design</td></tr>
<tr><td colspan="2">Course Category: Professional Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P (Hours/Week)
3: 0: 2</td><td>Credits:4</td><td>Total Contact Hours:75</td><td>Max Marks:100</td></tr>
</table>

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 – Web Site 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: Justinmind Prototyper.

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.

List of Exercises 30 Hours

1. Design simple user interface with various interaction styles.
2. Design registration window using various windows components.
3. Develop prototype for adding products to the cart on an online shopping site.
4. Create a mobile application interface using mobile design patterns.
5. Simulate drag and drop and direct selection web interfaces.
6. Simulate inlays and overlays web interfaces.

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: Design User Interfaces using appropriate Windows and Menu controls for any given application	Apply
CO3: Develop Interaction design, Evaluation and Testing process to solve real world problems	Apply
CO4: Design mobile applications by choosing appropriate Mobile Design elements for a given scenario	Apply
CO5: Design the webpages by selecting appropriate Interaction methods for building an application	Apply

Text Book(s):

T1.Wilbert O.Galitz, “The Essential Guide to User Interface Design”, 3rd Edition, John Wiley & Sons, 2007.

T2.Yvonne Rogers , Helen Sharp, Jenny Preece, “Interaction Design: Beyond Human – Computer Interaction”, 5th Edition, John Wiley & Sons, 2019.

T3.Brian Fling, “Mobile Design and Development”, O’Reilly Media Inc., 2009.

T4.Bill Scott and Theresa Neil, “Designing Web Interfaces”, O’Reilly, 2009.

Reference Book(s):

R1. Jenifer Tidwell, “Designing Interfaces”, 2nd Edition, O’Reilly Publications, 2011.

R2. Marc Silver, “Exploring Interface Design”, Delmar Cengage Learning, 2013.

Web Reference(s):

1. NPTEL Course: 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/
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	3	2	2	2	2	1	1	2	3	2	1	1	3	-
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	-
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	-

High– 3; Medium– 2; Low– 1

<table>
<tr><td>Course Code: 19CSEN2021</td><td colspan="3">Course Title: Game Design</td></tr>
<tr><td colspan="2">Course Category: Professional Elective</td><td colspan="2">Course Level: Practice</td></tr>
<tr><td>L:T:P (Hours/Week)
3: 0: 2</td><td>Credits: 4</td><td>Total Contact Hours: 75</td><td>Max Marks: 100</td></tr>
</table>

Pre-requisites

- Machine Intelligence

Course Objectives

The course is intended to:

1. Explain the theory of game elements.
2. Develop varied gaming experience.
3. Design a dynamic gaming system.
4. Apply various dynamic aspects of gameplay.
5. Build prototype of game design.

Unit I Elements & Player Experience 9 Hours

Design Process - Model Description – Practice of game design - Player Experience – Player theories – User Personas – Empirical models – Experience design

Unit II Game Mechanics 9 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 9 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 9 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 & Prototype 9 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 At the end of this course, students will be able to:	**Cognitive Level**
CO1: Explain the elements of games by preparing a design document for a real game	Understand
CO2: Develop gaming experience by applying various game mechanics	Apply
CO3: Design a dynamic gaming system by integration a variety of mechanics and their interactions.	Apply
CO4: Apply various dynamic aspects of gameplay to maximize the player's interaction and participation in game experience.	Apply
CO5: Build prototype of game design by iterative and incremental model.	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", Mercury Learning And Information LLC, 2015

R3.Ernest Adams and Andrew Rollings, "Fundamentals of Game Design", Pearson Education, 3rd Edition, 2014

R4. Casey Reas, Ben Fry, “Processing : A programming handbook for visual designers and artists”, MIT Press, 2007

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	3	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	1	3	1
CO4	3	3	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

<table>
<tr><td colspan="2">Course Code: 19CSEN2002</td><td colspan="3">Course Title: Graphics and Visualization</td></tr>
<tr><td colspan="3">Course Category: Professional Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P (Hours/Week)
3: 0: 2</td><td colspan="2">Credits:4</td><td>Total Contact Hours:75</td><td>Max Marks:100</td></tr>
</table>

Pre-requisites

- Engineering Drawing

Course Objectives

The course is intended to:

1. Create interactive computer graphics
2. Demonstrate the basic principles of implementing graphical output primitives and their 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 – 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 – 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 Tree Method – Comparison.
Illumination and Surface Rendering: Light Sources – Surface Lighting Effects – Surface Rendering–OpenGL Functions.

List of Exercises **30 Hours**

1. Implementation of graphics built-in functions.
2. Implementation of Circle Drawing Algorithms.
3. Implementation of 2D and 3D Transformation.
4. Implementation of 2D clipping.
5. Visualizing 3D objects.
6. Design a gaming animation using built in 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", 4^{th} 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. F. S. Hill Jr., “Computer Graphics using OpenGL”,3rd Edition, Pearson International Edition, 2008.
R3. Edward Angel, “Interactive Computer Graphics A Top-Down Approach with OpenGL”, 5th Edition, Addison-Wesley, 2012.
R4. Mason Woo, Jackie Neider, Tom Davis, Dave Shreiner , “OpenGL Programming Guide: The Official Guide to Learning OpenGL”, Version 1. 2, Open GL Architecture Review Board, Pearson Education, 1st Indian Reprint 2007.
R5. Shalini Govil Pai, “Principles of Computer Graphics Theory and Practice Using OpenGL and Maya”, Springer, 2010.

Web Reference(s):

1. NPTEL: https://nptel.ac.in/noc/courses/noc21/SEM2/noc21-cs97/
2. OpenGL Programming Guide: http://www.glprogramming.com/red/
3. OpenGL Reference Manual: http://www.glprogramming.com/blue/
4. OpenGL Game Tutorial: http://nehe.gamedev.net/
5. OpenGL Tutorial: http://www.opengl.org/

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	2
CO4	3	2	2	2	2	1	1	2	3	2	-	2	3	2
CO5	3	2	2	2	2	1	1	2	3	2	-	2	3	1

High– 3; Medium– 2; Low– 1

<table>
<tr><td colspan="2">Course Code: 19CSEN2034</td><td colspan="3">Course Title: Virtual Reality and Augmented Reality</td></tr>
<tr><td colspan="3">Course Category: Professional Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P (Hours/Week)
3: 0: 2</td><td colspan="2">Credits:4</td><td>Total Contact Hours:75</td><td>Max Marks:100</td></tr>
</table>

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Describe the fundamentals of VR
2. Explain the concept of VR modeling
3. Develop programs supporting virtual reality
4. Develop the virtual reality applications
5. Apply the design principles and practices of augmented reality

Unit I VR Overview 9 Hours

Introduction to Virtual Reality - Three I's of Virtual Reality - Components of VR System – Input Devices: Trackers - Navigation – Gesture and Interfaces; Output devices: Graphics display – Sound display – Haptic feedback

Unit II VR Modeling 9 Hours

Modeling – Geometric Modeling – Kinematics Modeling: Transformation Matrices – Object Position – Transformation Invariants – Object Hierarchies – Viewing the 3D World; Physical Modeling: Collision Detection – Surface Deformation – Force Computation – Force Smoothing and Mapping; Behavior Modeling – Model Management

Unit III VR Programming 9 Hours

VR Programming – Toolkits and Scene Graphs – World ToolKit: Model geometry and Appearance – WTK Scene graph – Sensors – WTK Networking; Java 3D: 3D Scene graph – 3D Networking; Comparison of World ToolKit and Java 3D - Human Factors in VR – Methodology and Terminology – VR Health and Safety Issues – VR and Society

Unit IV Applications 9 Hours

Medical Applications of VR – Education, Arts and Entertainment - Military VR Applications – VR Applications in Manufacturing – Applications of VR in Robotics – Information Visualization – VR in Business

Unit V Augmented Reality 9 Hours

Introduction to Augmented Reality - Computer vision for AR: Marker tracking – Incremental tracking – Outdoor tracking; Interaction: Haptic Interaction – Multimodal Interaction; Modelling and Annotation- Navigation

List of Exercises **30 Hours**

1. Study of Unity and Vuforia tools.
2. Use the primitive objects and apply various projection types by handling camera.
3. Apply various lighting and shading effects on objects from asset store.
4. Perform various modeling on three dimensional objects and apply textures over them.
5. Develop simple virtual reality enabled mobile applications with limited interactivity.
6. Develop AR enabled Invitation Card using Vuforia.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Describe the fundamentals of VR with suitable devices required.	Understand
CO2: Explain the concept of VR modeling with real time examples.	Understand
CO3: Develop virtual reality programs using the different VR Architecture.	Apply
CO4: Develop the virtual reality applications for real time scenarios.	Apply
CO5: Apply the design principles and practices of augmented reality apps for Industrial sectors.	Apply

Text Book(s):

T1. Grigore C. Burdea, Philippe Coiffet, "Virtual Reality Technology", John Wiley & Sons, Inc., 2nd Edition,2009.

T2. Dieter Schmalstieg, Tobias Hollerer, "Augmented Reality: Principles and Practice", Pearson Education (US), Addison-Wesley Educational Publishers Inc, 2019.

Reference Book(s):

R1. Steve Aukstakalnis, "Practical Augmented Reality: A Guide to the Technology Applications, and Human Factors for AR and VR", Addison-Wesley Professional, 2016.

R2. Robert Scoble, Shel Israel, "The Fourth Transformation: How Augmented Reality & Artificial Intelligence Will Change Everything", Patrick Brewster Press, 2016.

R3. Tony Parisi, "Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile", O'Reilly Media, 2015.

Web Reference(s):

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. Quick Start for Unity Android URL: https://developers.google.com/ar/develop/unity /quickstart-android.
4. 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	2	1	-	-	-	-	-	1	-	1	-	-	-	-
CO2	2	1	-	-	-	-	-	1	-	1	-	-	-	-
CO3	3	2	2	2	2	-	-	2	3	2	-	-	3	-
CO4	3	2	2	2	2	1	-	2	3	2	1	-	3	-
CO5	3	2	2	2	2	1	-	2	3	2	-	-	3	-

High– 3; Medium– 2; Low– 1

<table>
<tr><td colspan="2">Course Code: 19CSEN1002</td><td colspan="3">Course Title: Multimedia Systems</td></tr>
<tr><td colspan="3">Course Category: Professional Elective</td><td colspan="2">Course Level: Practice</td></tr>
<tr><td>L:T:P (Hours/Week)
3: 0: 0</td><td colspan="2">Credits: 3</td><td>Total Contact Hours: 45</td><td>Max Marks: 100</td></tr>
</table>

Pre-requisites

- Data Structures and Algorithm Analysis – I, Database Systems

Course Objectives

The course is intended to:

1. Describe various multimedia components and authoring tools.
2. Implement various data Compression algorithms.
3. Apply steps involved in video and audio compression techniques.
4. Justify the significance of databases and OO Framework.
5. Use Multimedia Application Design for developing applications.

Unit I Multimedia Authoring and Data Representation 8 Hours

Components of Multimedia - Multimedia and Hypermedia – HTML- XML - WWW - Multimedia Software Tools - Multimedia Authoring – Editing and Authoring Tools –VRML - Graphics and Data Representations - Image Data Types - File Formats.

Unit II Multimedia Data Compression 10 Hours

Information Theory - Lossless Compression Algorithms - Run Length Encoding - Variable Length Encoding - Dictionary Based Coding - Arithmetic Coding - Lossy Compression Algorithms - Distortion Measure - Rate Distortion theory – Quantization - Transform coding - Image Compression standards.

Unit III Video and Audio Compression Techniques 9 Hours

Video Compression Techniques - Video Compression based on Motion Compensation - Search for Motion Vectors - H.261 - MPEG Video Coding - MPEG-1 and 2. Audio Compression Techniques - MPEG Audio.

Unit IV Multimedia DBMS and Programming

8 Hours

MDBMS -Characteristics of MDBMS- Data Analysis- Data Structure- Operations on Data- Multimedia specific properties of MMDBMS - Data Modeling in MMDBMS – Integration in a Database Model- Implementation - Abstraction levels - Requirement for Programming Languages - Object Oriented Application development - Object Oriented Frameworks and Class Libraries- Distribution of Objects.

Unit V Multimedia Application Design **10 Hours**

Design specific properties of Images - Visualization - Symbols - Illustrations - Image Production Techniques - User Interfaces - Multimedia Learning - Applications: Media Preparation - Editing - Integration - Transmission – Usage - Electronic Books and Magazines - Kiosks - Tele shopping - Entertainment.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1:Describe the multimedia components, authoring tools and various forms of representing the data in multimedia systems	Understand
CO2:Implement the various Data Compression algorithms using different compression techniques	Apply
CO3:Apply the steps involved in video and audio compression techniques for the given scenario	Apply
CO4:Justify the significance of databases and OO Framework in multimedia systems	Understand
CO5:Demonstrate the components in designing interactive multimedia applications	Apply

Text Book(s):

T1. Ze-Nian Li, Mark S. Drew, “Fundamentals of Multimedia”, Springer, 2021.

T2. Ralf Steinmetz, KlaraNahrstedt, “Multimedia Applications”, Springer, 2013.

Reference Book(s):

R1.John. F. Koegel Buford, “Multimedia Systems “, Pearson Education, 2010.

R2.TayVaughon, “Multimedia: Making It Work”, 9th Edition, McGraw-Hill Education, 2017.

R3.Ralf Steinmetz and Klara Nahrstedt, “Multimedia: Computing, Communications and Applications”, Pearson Education, 2017.

Web Reference(s):

1. NPTEL:https://nptel.ac.in/content/storage2/courses/117105083/pdf/ssg_m1l1.pdf
2. Web Tutorials: http://insy.ewi.tudelft.nl/content/image-and-video-compression-learning-tool-vcdemo
3. W3C Tutorials: https://www.w3.org/standards/agents/authoring

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	2	1
CO3	3	2	1	1	1	1	1	1	-	1	1	1	2	1
CO4	2	1	-	-	-	-	-	1	-	1	-	1	-	-
CO5	3	2	1	1	-	1	1	1	-	1	1	1	2	-

High– 3; Medium– 2; Low– 1

Course Code: 19CSEN1003	Course Title: Interaction Design		
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. Illustrate the interaction design process.
2. Identify the type of interactions.
3. Design a goal directed user interface for various level of users.
4. Construct a workflow for users.
5. Develop an interface design for products.

Unit I Introduction to Interaction Design 9 Hours

Introduction – Good and Poor Design – Interaction Design – Process – Interaction Design and User Experience – Problem Space and Conceptualizing Design – Conceptual Model – Interface Metaphors – Interaction Types – Paradigms , Theories, Models and Frameworks.

Unit II Social and Emotional Interactions 9 Hours

Cognition - Social Interactions – Being Social – Conversations – Telepresence – Co-Presence – Emergent Social Phenomena – Emotional Interaction –User Experience – Interfaces – Persuasive Technologies– Anthropomorphism and Zoomorphism – Models of Emotions.

Unit III Goal Directed Design 9 Hours

Introduction to Goal Directed Design - Evolution of Design - Planning and Designing Behavior - Recognizing User Goals - Goal - Directed Design Process - Implementation Models and Mental Models - Beginners, Experts, and Intermediates. Understanding Users: Qualitative Research.

Unit IV Modeling Users **9 Hours**

Personas - Goals - Constructing Personas – Other Models –Foundations of Design: Scenarios – User Experience (UX) and UX Design - UX Processes, Lifecycles, methods and Techniques.

Unit V Usability Design **10 Hours**

Designing Good Behavior - Designing Considerate Products - Designing Smart Products - Metaphors, Idioms, and Affordances - Visual Interface Design: Building Blocks of Visual Interface Design - Principles of Visual Interface Design - Principles of Visual Information Design - Consistency and Standards.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Illustrate the Interaction Design Process by using various Theories, Models and Frameworks.	Understand
CO2: Identify the type of interactions based on the various conversations and emotions.	Apply
CO3: Design a goal directed user interface for various level of users using various implementation models.	Apply
CO4: Construct a workflow for users using design foundations.	Apply
CO5: Develop an interface design for products using metaphors, idioms and affordances.	Apply

Text Book(s):

T1. Rogers, Sharp, Preece, "Interaction Design", 3rd Edition, Wiley, 2014 Reprint.

T2. Alan Cooper, Robert Reimann, David Cronin. Christopher Nooessel, "About Face: The Essentials of Interaction Design" 4th Edition, Wiley, 2014.

T3. Rex Hartson, Pardha Pyla, "The UX Book - Agile UX Design for a Quality User Experience", 2nd Edition, Morgan Kaufmann Publishers, 2018.

Reference Book(s):

R1.Helen Sharp, JennyPreece, Yvonne Rogers" Interaction Design - Beyond Human - Computer Interaction”, 4th Edition, Wiley. 2019.

R2.Rex Hartson, Pardha S. Pyla, "The UX Book: Agile UX Design for a Quality User Experience" 2nd Edition, Morgan Kaufmann, 2019.

R3. Jon Kolko, "Thoughts on Interaction Design", 2nd Edition, Morgan Kaufmann, 2011.

Web Reference(s):

1. Usability Engineering Literatures:
   https://www.interaction-design.org/literature/topics/usability-engineering
2. Usability Engineering Reference:
   https://www.sciencedirect.com/topics/computer-science/usability-engineering
3. Meanings of Usability:
   https://www.wqusability.com/articles/more-than-ease-of-use.html

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	2	-
CO3	3	2	1	1	-	-	-	1	-	1	-	1	2	-
CO4	3	2	1	1	-	-	-	1	-	1	-	1	2	-
CO5	3	2	1	1	1	1	1	1	-	1	1	1	2	1

High– 3; Medium– 2; Low– 1

Course Code: 19CSEN1021	Course Title: Human Computer Interaction		
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. Elaborate the design principles and guidelines of HCI.
2. Apply universal design standards.
3. Explain the concepts of mobile information architecture and User Interface.
4. Describe the various multi modes of 3D interaction techniques.
5. Develop 3D User Interfaces.

Unit I Foundations 9 Hours

Interaction: Models – Frameworks – Ergonomics – Styles – Elements – Interactivity – Paradigms. Interaction design: Process – User focus – Navigation design – Screen Design and Layout – Interaction and Prototyping.

Unit II Design Process 9 Hours

HCI in software process – Software life cycle – Usability engineering – Iterative Design – Design Rationale – Design rules – Evaluation Techniques. Universal Design: Principles – Multi-modal Interaction – Design for Diversity.

Unit III Mobile HCI 9 Hours

Mobile Ecosystem – Developing a Mobile Strategy – Types of Mobile Applications – Mobile Information Architecture – Mobile Design.

Unit IV 3D Interaction 9 Hours

Introduction to 3D User Interfaces – Selection and Manipulation – Manipulation Tasks – Input Devices – Interaction Techniques. System Control – Classification – Graphical Menus – Voice, Gestural Commands and Tools – Multimodal System Control – Symbolic Input Tasks and Techniques.

Unit V 3D UI Development 9 Hours

Strategies for Designing and Developing 3D User Interfaces: Designing for Humans – Inventing 3D UI – Evaluation of 3D UI – Purpose and Tools – Evaluation metrics – Characteristics of Evaluation and Approaches – Guidelines – 3D User Interfaces for the Real World.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Elaborate the design principles and guidelines of HCI for effective user interaction.	Understand
CO2: Apply universal design standards to develop efficient user Interface.	Apply
CO3: Explain the concepts of Information architecture and User Interface for Mobile UI.	Understand
CO4: Describe the various multi modes of interaction techniques to develop 3D user interface.	Understand
CO5: Develop 3D User Interfaces for real time applications.	Apply

Text Book(s):

T1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human Computer Interaction", 3rd Edition, Pearson Education, 2008.

T2. Brian Fling, "Mobile Design and Development", O'Reilly Media Inc., 2009

Reference Book(s):

R1. Gerard Jounghyun Kim, "Human Computer Interaction: Fundamentals and Practice", CRC Press, 2015.

R2. Julie A.Jacko, "The Human Computer Interaction Handbook: Fundamentals, Evolving Technologies and Emerging Applications", 3rd Edition, CRC Press, 2012.

R3. Francisco R. Ortega, Fatemeh Abyarjoo, Armando Barreto, Naphtali Rishe, Malek Adjouadi, "Interaction Design for 3D User Interfaces", CRC Press, 2016

Web Reference(s):

1. NPTEL Course, Human Computer Interaction, URL: https://nptel.ac.in/courses/ 106103115
2. NPTEL Swayam course, Human Computer Interactions, URL: https://onlinecourses.nptel. ac.in/noc19_cs86/preview
3. Coursera course on Human-Centered Design: an Introduction, URL: https://www. coursera.org/learn/human-computer-interaction

Course Articulation Matrix

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

High– 3; Medium– 2; Low– 1

<table>
<tr><td>Course Code: 19CSEN1022</td><td colspan="3">Course Title: Wearable Technology</td></tr>
<tr><td colspan="2">Course Category: Professional Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P (Hours/Week)
3: 0: 0</td><td>Credits: 3</td><td>Total Contact Hours: 45</td><td>Max Marks: 100</td></tr>
</table>

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Describe Wearable Technology and its applications
2. Explain various architecture in Wearable Technology
3. Outline the Product development process in Wearable product design & development
4. Explain various Wearable monitoring devices in health care application
5. Describe the usage of wearable devices in electronic textile industry.

Unit I Introduction to Wearable Technology 9 Hours

Introduction - History of Wearable Technology – Challenges - Sensing and Sensor Fundamentals-Sensor Characteristic - Applications

9 Hours

Unit II Wearable Technology Architecture

Hardware - Architecture - IOT Architecture - Wearable architecture - Operating system - Communication protocols and Technologies - Cloud - Virtual and augment reality - Voice Recognition.

9 Hours

Unit III Product Development and design consideration

Product development process - Wearable product requirements - Design consideration – Security issues and privacy concerns - Psychological and social impacts

9 Hours

Unit IV Wearable Technology in Health care application

Body-Worn, Ambient, and Consumer Sensing for Health Applications- -Environmental Monitoring for Health and Wellness

Unit V Wearable Technology in Electronic Textile 9 Hours

Design and manufacture of textile-based sensors - Electronic textiles for military personnel- - Wearable sensors for athletes

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1:Describe the characteristics, challenges and various applications of wearable technology	Understand
CO2:Explain the different architectural models of wearable devices used in various applications.	Understand
CO3: Develop wearable products using product development process and design considerations for real time scenarios.	Apply
CO4: Demonstrate various wearable monitoring devices in health care applications.	Apply
CO5: Demonstrate the usage of wearable devices in electronic textile industry.	Apply

Text Book(s):

T1. Haider Raad,” The Wearable Technology Handbook”, Ohio Publishing & Academic Services 2022.

T2. Michael J. McGrath, Cliodhna Ni Scanaill, Dawn Nafus, “Sensor Technologies: Healthcare, Wellness and Environmental Applications”, Apress Media,2011

T3.Tilak Dias,” Electronic Textiles : Smart Fabrics and Wearable Technology”, Woodhead Publishing – Elsevier, 2015.

Reference Book(s):

R1. Raymond Kai-Yu Tong, “Wearable Technology in Medicine and Health Care”, academic Press -2018.

R2.OmeshTickoo, Ravi Iyer “Making Sense of Sensors: End-to-End Algorithms and Infrastructure Design” Apress Media, 2016

Web Reference(s):

1. IoT Applications: https://nptel.ac.in/courses/108108123
2. wearable computing: https://bradleyrhodes.com/Papers/brief-history-of-wearable-computing.html
3. Wearable Technology: https://www.coursera.org/lecture/wearable-technologies/introduction-to-wearable-technology-e0kP5

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	1	-	-	-	1	1	-	-	-	-	-		-
CO3	3	2	1	1	-	1	1	-	-	-	-	1	2	-
CO4	3	2	1	1	-	1	1	-	-	-	-	1	2	-
CO5	3	2	1	1	-	1	1	-	-	-	-	1	2	-

High– 3; Medium– 2; Low– 1

Diversified Electives

<table>
<tr><td colspan="2">Course Code: 19ITEN1029</td><td colspan="3">Course Title: Intellectual Property Rights
(common to all B.E/B.Tech programmes)</td></tr>
<tr><td colspan="3">Course Category: Professional Elective</td><td colspan="2">Course Level : Introductory</td></tr>
<tr><td>L: T: P(Hours/Week)
3: 0: 0</td><td colspan="2">Credits:3</td><td>Total Contact Hours:45</td><td>Max. Marks:100</td></tr>
</table>

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	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”, Cengage learning, 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:

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
CO1	-	-	-	-	-	2	-	-	-	-	-	2
CO2	2	-	-	2	-	-	-	-	-	-	-	-
CO3	-	3	3	-	-	-	-	-	-	-	2	-
CO4	-	-	-	-	-	-	-	2	2	-	-	-
CO5	-	-	-	-	2	-	2	-	-	-	-	2

High-3; Medium-2; Low-1

<table>
<tr><td colspan="1">Course Code: 19MEEC1025</td><td colspan="3">Course Title: Fundamentals of Entrepreneurship (common to all B.E/B.Tech programmes)</td></tr>
<tr><td colspan="2">Course Category: Professional Elective</td><td colspan="2">Course Level : Introductory</td></tr>
<tr><td>L: T: P(Hours/Week)
3: 0: 0</td><td>Credits:3</td><td>Total Contact Hours:45</td><td>Max. Marks:100</td></tr>
</table>

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Describe the types, characteristics of entrepreneurship and its role in economic development.
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 enterprise.
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 New Delhi, 2020.

Reference Book(s):

R1. Charantimath, P. M., “Entrepreneurship Development and Small Business Enterprises”, Pearson, 2006.

R1. Mathew J Manimala,” Entrepreneurship theory at cross roads: paradigms and praxis” Dream tech, 2nd edition 2006.

R2. Rabindra N. Kanungo, “Entrepreneurship and innovation”, Sage Publications, New Delhi, 2003.

R3. Singh, A. K., “Entrepreneurship Development and Management”, University Science Press, 2009.

Web References:

1. https://nptel.ac.in/courses/127105007
2. 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 Action Guide for Educators", ASCD Book, 2020

R3. Brown.T, "Change by design: How design thinking transforms organizations and inspires innovation", HarperCollins, 2009.

Web References:

1. https://www.open.edu/openlearn/science-maths-technology/design-innovation/design-thinking/content-section-6
2. https://www.interaction-design.org/literature/topics/design-thinking
3. 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

<table>
<tr><td colspan="2">Course Code: 19CSEN1015</td><td colspan="3">Course Title: Information Storage Systems</td></tr>
<tr><td colspan="3">Course Category: Professional Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P (Hours/Week)
3: 0: 0</td><td colspan="2">Credits: 3</td><td>Total Contact Hours: 45</td><td>Max Marks: 100</td></tr>
</table>

Pre-requisites

- Database Systems

Course Objectives

The course is intended to:

1. Describe the various kinds of Storage Systems.
2. Explain the Storage Area Network Technologies.
3. Develop the data archiving strategies for business continuity process.
4. Demonstrate the different kinds of Replication Technologies.
5. Implement the Security mechanisms for various kinds of environment.

Unit I Storage Systems 9 Hours

Information Storage, Evolution of Storage Architecture, Data Center Infrastructure, Data Center Environment: Database Management System (DBMS), Host, Connectivity, Storage, Disk Drive Components, Disk Drive Performance. RAID: Implementation of RAID, RAID Array Components, RAID Levels, RAID Comparison, RAID Impact on Disk Performance, Intelligent Storage System: Components, Intelligent Storage Array.

Unit II Storage Networking Technologies 9 Hours

Fibre Channel Storage Area Networks : Components, FC Connectivity, Switched Fabric Ports, Fibre Channel Architecture, FC SAN Topologies, IP SAN and FCoE: iSCSI Protocol-FCIP, FCoE, Network-Attached Storage, Object-Based and Unified Storage.

Unit III Data Archiving 9 Hours

Business Continuity: Information Availability, Terminologies, Planning Life Cycle, Failure Analysis, Backup and Archive: Purpose, Granularity, Methods, Architecture, Restore, Topologies, Targets, Data Deduplication, Data Archive, Archiving Solution Architecture.

Unit IV Replication **9 Hours**

Local Replication: Replication Terminology - Local Replicas - Replica Consistency - Local Replication Technologies- Multiple Replicas, Local Replication in a Virtualized Environment, Remote Replication: Modes, Remote Replication Technologies, Three-Site Replication, Data Migration Solutions, Remote Replication and Migration in a Virtualized Environment.

Unit V Securing and Managing Storage Infrastructure **9 Hours**

Securing the Storage Infrastructure: Information Security Framework - Storage Security Domains- Security Implementations in Storage Networking - Securing Storage Infrastructure in Virtualized and Cloud Environments- Concepts in Practice: RSA and VMware Security Products - Managing the Storage Infrastructure: Monitoring the Storage Infrastructure, Storage Infrastructure Management Activities, Storage Infrastructure Management Challenges, Information Lifecycle Management, Storage Tiering.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Describe the various kinds of Storage Systems for different applications.	Understand
CO2: Explain the Storage Area Network Technologies based on End User Perspective.	Understand
CO3: Develop the data archiving strategies for Data backup and Recovery in business continuity process.	Apply
CO4: Demonstrate the different kinds of Replication Technologies for Data Backup in Virtualized Environment.	Apply
CO5: Implement the Security mechanisms for classic, virtualized and cloud environments	Apply

Text Book(s):

T1. EMC Corporation, "Information Storage and Management: Storing, Managing, and Protecting Digital Information in Classic, Virtualized, and Cloud Environments", 2nd Edition, Wiley, India,2012

Reference Book(s):

R1. Robert Spalding, "Storage Networks: The Complete Reference", Tata McGraw Hill, Osborne, 2003.

R2. Marc Farley, "Building Storage Networks", Tata McGraw Hill, Osborne, 2001.

R3. Meeta Gupta, "Storage Area Networks Fundamentals", Pearson Education Limited, 2002.

Web References:

1. NPTEL Course – Storage Systems: https://nptel.ac.in/courses/106108058

2. ICTACADEMY Course – Information Storage and Management: http://www.ictacademy.in/pages/Information-Storage-and-Management.aspx

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	-	-
CO2	2	1	-	-	-	1	-	1	-	1	-	1	-	-
CO3	3	2	1	1	1	1	1	1	-	1	1	1	2	1
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

<table>
<tr><td colspan="2">Course Code: 19CSEC6701</td><td colspan="3">Course Title: Professional Readiness for Innovation, Employability and Entrepreneurship
(common to CS, IT & EC)</td></tr>
<tr><td colspan="3">Course Category: Professional Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P(Hours/Week)
0: 0: 6</td><td colspan="2">Credits:3</td><td>Total Contact Hours: 96</td><td>Max. Marks:100</td></tr>
</table>

OBJECTIVES:

- To empower students with overall Professional and Technical skills required to solve a real world problem.
- To mentor the students to approach a solution through various stages of Ideation, Research, Design Thinking, workflows, architecture and building a prototype in keeping with the end-user and client needs.
- To provide experiential learning to enhance the Entrepreneurship and employability skillsof the students.

This course is a four months immersive program to keep up with the industry demand and to havecritical thinking, team based project experience and timely delivery of modules in a project that solves world problems using emerging technologies.

To prepare the students with digital skills for the future, the Experiential Project Based Learning is introduced to give them hands-on experience using digital technologies on open-source platforms with an end-to-end journey to solve a problem. By the end of this course, the student understands the approach to solve a problem with team collaboration with mentoring from Industry and faculties. **This is an EEC category course offered as an elective, under the type,"Experiential Project Based Learning".**

Highlights of this course:

- Students undergo training on emerging technologies
- Students develop solutions for real-world use cases
- Students work with mentors to learn and use industry best practices
- Students access and use Self-Learning courses on various technologies, approachesand methodologies.
- Collaborate in teams with other students working on the same topic
- Have a dedicated mentor to guide

OUTCOMES:

On completion of the course, the students will be able to:

- Upskill in emerging technologies and apply to real industry-level use cases
- Understand agile development process
- Develop career readiness competencies, Team Skills / Leadership qualities

- Develop Time management, Project management skills and Communication Skills
- Use Critical Thinking for Innovative Problem Solving
- Develop entrepreneurship skills to independently work on products

The course will involve 40-50 hours of technical training, and 40-50 hours of project development.The activities involved in the project along with duration are given in Table 1.

TABLE 1: ACTIVITIES

Activity Name	Activity Description	Time (weeks)
Choosing a Project	Selecting a project from the list of projects categorized various technologies & businessdomains	2
Team Formation	Students shall form a team of 4 Members before enrolling to a project. Team members shall distribute the project activities among themselves.	1
Hands on Training	Students will be provided with hands-on training on selected technology in which they are going to develop the project.	2
Project Development	Project shall be developed in agile mode. The status of the project shall be updated to the mentors via appropriate platform	6
Code submission, Project Doc and Demo	Project deliverables must include the working code, project document and demonstration video. All the project deliverables are to be uploaded to cloud based repository such as GitHub.	3
Mentor Review and Approval	Mentor will be reviewing the project deliverables as per the milestone schedule and the feedback will be provided to the team.	1
Evaluation and scoring	Evaluators will be assigned to the team to evaluate the project deliverables, and the scoring will be provided based on the evaluationmetrics	1
	TOTAL	**16 WEEKS**

Essentially, it involves 15 weeks of learning and doing, and one week for evaluation. The evaluation will be carried out to assess technical and soft skills as given in Table 2.

TABLE 2: EVALUATION SCHEMA

PROFESSIONAL READINESS FOR INNOVATION, EMPLOYABILITY ANDENTREPRENEURSHIP			
Technical Skills		**Soft Skills**	
Criteria	**Weightage**	**Criteria**	**Weightage**
Project Design using DesignThinking	10	Teamwork	5
Innovation & Problem Solving	10	Time Management	10
Requirements Analysis usingCritical Thinking	10	Attendance and Punctuality	5
Project Planning using AgileMethodologies	5	Project Documentation	5
Technology Stack (APIs, tools,Platforms)	5	Project Demonstration	5
Coding & Solutioning	15		
User Acceptance Testing	5		
Performance of Product /Application	5		
Technical Training & Assignments	5		
Total	70	Total	30
Total Weightage			100
Passing Requirement			50
Continuous Assessment Only			

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	2	3	3	3	3	3	3	3	3	3
CO2	1	1	1	1	1	3	3	3	3	3	3	3	3	3
CO3	2	2	2	2	2	3	3	3	3	3	3	3	3	3
CO4	2	2	2	2	2	3	3	3	3	3	3	3	3	3
CO5	2	2	2	2	2	3	3	3	3	3	3	3	3	3
CO6	2	2	2	2	2	3	3	3	3	3	3	3	3	3

High-3; Medium-2; Low-1

Course Code:19MEEC1001	Course Title: Product Life Cycle Management (Common to AD,AU,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. 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 9

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.

UNITII BUSINESS PROCESSES IN THE PLM 9

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

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

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

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

<table>
<tr><td>Course Code:19MEEC2002</td><td colspan="3">Course Title: PLM FOR ENGINEERS
(All branches)</td></tr>
<tr><td colspan="2">Course Category: Professional Elective</td><td colspan="2">Course Level: Mastery</td></tr>
<tr><td>L:T:P (Hours/Week) 2: 0: 2</td><td>Credits:3</td><td>Total Contact Hours:60</td><td>Max. Marks:100</td></tr>
</table>

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 **At the end of this course, students will be able to:**	**Cognitive Level**
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

Open Electives

Course Code: 19CSOC1001	Course Title: Data Structures		
Course Category: Open 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. Demonstrate abstract data types with suitable implementations
2. Illustrate various operations on trees
3. Apply suitable graph algorithms
4. Apply suitable methods for efficient data access
5. Illustrate various sorting and searching techniques

Unit I Linear Structures 9 Hours

Classification of Data Structures - Algorithm Analysis & Asymptotic Notations - Abstract Data Types (ADT) - List ADT - Array-Based Implementation - Linked List Implementation: Singly Linked List - Stack ADT (Array Implementation) - Queue ADT (Array Implementation).

Unit II Tree Structures 9 Hours

Tree ADT- Preliminaries - Binary Tree ADT- Tree Traversals - Expression Trees - Binary Search Tree ADT - 2-3 Trees.

Unit III Graphs 9 Hours

Definitions - Topological Sort - Breadth First Traversal - Depth First Traversal - Shortest Path Algorithms: Dijkstra's Algorithm - Minimum Spanning Tree: Prim's and Kruskal's Algorithms.

Unit IV Heaps and Hashing 9 Hours

Heaps: Binary Heaps - Applications of Binary Heaps.

Hashing: General Idea - Hash Function - Separate Chaining - Open Addressing -Rehashing - Double Hashing.

Unit V Searching and Sorting 9 Hours

Searching :Linear search - Binary Search - Sorting : Preliminaries - Insertion Sort - Shell Sort - Heap Sort - Merge Sort - Quick Sort.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Demonstrate abstract data types with suitable implementations for linear data structures	Apply
CO 2: Illustrate various operations on trees for real world applications	Apply
CO 3: Apply suitable graph algorithms for solving real world problems	Apply
CO 4: Apply suitable methods for efficient data access using hashing and heaps	Apply
CO 5: Illustrate various sorting and searching techniques for real world applications	Apply

Text Book(s):

T1. Mark Allen Weiss, “Data Structures and Algorithm Analysis in Java”, 3rd Edition, Pearson Education, 2014.

Reference Book(s):

R1. Sartaj Sahni, “Data Structures, algorithms and applications in Java”, 2nd Edition, Silicon Press, 2005.

R2. Yedidyah Langsam, Moshe Augenstein, Aaron M.Tenenbaum, “Data Structures using Java”, 4th Edition, Pearson Education, 2009.

Web Reference(s):

1. NPTEL “Data Structures and Algorithms” Course Content: URL:https://nptel.ac.in/courses/106/102/106102064/
2. Lecture Notes based on Mark Allen Weiss book. URL: http://faculty.simpson.edu/lydia.sinapova/www/cmsc250/LN250_Weiss/Contents.htm
3. Data Structures and Algorithm Visualizations. URL: http://visualgo.net/

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	-	1
CO2	3	2	1	1	1	1	1	1	-	1	-	1
CO3	3	2	1	1	1	1	1	1	-	1	1	1
CO4	3	2	1	1	1	1	1	1	-	1	1	1
CO5	3	2	1	1	1	1	1	1	-	1	1	1

High-3; Medium-2; Low-1

<table>
<tr><td colspan="2">Course Code: 19CSOC1002</td><td colspan="3">Course Title: Relational Database Management System</td></tr>
<tr><td colspan="3">Course Category: Open Elective</td><td colspan="2">Course Level: Practice</td></tr>
<tr><td>L:T:P (Hours/Week)
3: 0: 0</td><td colspan="2">Credits:3</td><td>Total Contact Hours:45</td><td>Max Marks:100</td></tr>
</table>

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 connectivity through 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.

Course Outcomes At the end of this course, students will be able to:	Cognitive Level
CO 1: Describe the functions and architecture of database management system using its components	Understand
CO 2: Design relational databases using ER model and normalization concepts for real world scenarios	Apply
CO 3: Construct SQL queries using DDL, DML and DCL commands for effective retrieval of data from database	Apply
CO 4: Develop applications using database connectivity through advanced SQL Concepts for solving real world problems	Apply
CO 5: 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”, 7th Edition, 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 Reference(s):

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

High-3; Medium-2; Low-1

Course Code: 19CSOC1003	Course Title: Java programming		
Course Category: Open 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 the distinct properties and features of Java
2. Apply inheritance and packages concepts
3. Apply standard library functions and exception conditions
4. Employ the concepts of I/O Streams and Collections
5. Develop Java based applications using the features of Swing and Event Handling

Unit I Introduction 9 Hours

Overview of Java: Data types – Operators - Control Structures and Arrays- Class Fundamentals- Objects- Methods – Constructors- Argument Passing.

Unit II Inheritance and Packages 9 Hours

Inheritance-Method overloading and Overriding- Dynamic Method dispatch-Abstract class - Interfaces -Packages and Access Protection.

Unit III Exceptions and Standard Library 9 Hours

Exception fundamentals and types: try – catch – throw - throws - finally-User Defined Exceptions- Standard Library: String – String Buffer– String Tokenizer – Math.

Unit IV Collections and I/O Streams 9 Hours

Collections -Classes and Interfaces- Iterators and User Defined Collections- Java I/O classes and Interfaces - Streams – Byte Streams - Character Streams –File concepts

Unit V Thread, Swing and Event Handling 9 Hours

Thread: Thread Model, Creating Threads and Thread Priorities- Inter Thread Communication- Java Swing - Components and Containers-Event Handling.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain the distinct properties and features of Java using Object oriented concepts.	Understand
CO2: Apply inheritance and packages concepts for solving real time applications.	Apply
CO3: Apply standard library functions and exceptional conditions for solving complex problems.	Apply
CO4: Employ the concepts of I/O Streams and Collections in application programs.	Apply
CO5: Develop Java based applications using the features of Swing and Event Handling for given scenario.	Apply

Text Book(s):

T1. Herbert Schildt, "Java the Complete Reference", Mcgraw Hill Education, 10th Edition, 2018.

Reference Book(s):

R1. Bart Baesens, Aimee Backiel, SeppeVandenBrocke, "Beginning Java Programming: The Object Oriented Approach", John Wiley & Sons, 2015.

R2. Daniel Liang, "Introduction to Java Programming, Comprehensive Version", Pearson Education, 9th Edition, 2014.

Web Reference(s):

1. Oracle Java Tutorials: https://docs.oracle.com/javase/tutorial/java/index.html
2. Core Java Tutorials: http://javabeginnerstutorial.com/core-java/
3. Java Tutorials: http://www.w3schools.in/java/

Course Articulation Matrix

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

High-3; Medium-2;Low-1

<table>
<tr><td colspan="2">Course Code: 19CSOC1004</td><td colspan="2">Course Title: Principles of Operating System</td></tr>
<tr><td colspan="2">Course Category: Open Elective</td><td colspan="2">Course Level: Practice</td></tr>
<tr><td>L:T:P (Hours/Week)
3: 0: 0</td><td>Credits:3</td><td>Total Contact Hours:45</td><td>Max Marks:100</td></tr>
</table>

Pre-requisites

- NIL

Course Objectives

The course is intended to:

1. Describe the essential components of operating systems
2. Apply appropriate process and disk scheduling algorithms
3. Develop solutions for various synchronization problems
4. Apply different memory management techniques
5. Implement various file system structures

Unit I Operating System – Components and Services 9 Hours

Operating systems - Definition - Views of OS - Main frame Systems, Desktop Systems – Multiprocessor Systems -Distributed Systems – Clustered Systems – Real Time systems – Hand held Systems. Functionalities of operating system - OS Services – System Calls – System Utilities.

Unit II Process Scheduling and Disk Scheduling 9 Hours

Process concepts - Process scheduling - Short term, long term and medium term scheduling -Preemptive and non-preemptive algorithms - CPU scheduling algorithms - Basic disk structure and operation - Disk scheduling algorithms - Selection of the best disk scheduling algorithm.

Unit III Process Synchronization 10 Hours

Inter-process communication techniques – Synchronization - Critical section problem-Peterson's solution, Synchronization hardware, Synchronization tool- Semaphores, Classic Problems of Synchronization - Deadlock-characteristics, Deadlock handling methods –Deadlock Prevention, Avoidance, Detection and Recovery.

Unit IV Memory Management 10 Hours

Memory concept- Swapping, Contiguous memory allocation, Fragmentation, Paging – Hierarchical Paging, Hashed Page Tables, Inverted Page Tables, Segmentation-Paging with Segmentation, Virtual memory - Demand paging, Page-replacement algorithms-FIFO, Optimal Page Replacement, LRU, LFU, MFU.

Unit V File Management 7 Hours

File structures: File concept, File Type, Access methods, Directory structure -Single level directory, two level and Tree structure. File system implementation-FCB, Virtual File system, Directory System Implementation- linear list, hash table implementation.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Describe the essential components of operating systems and its services based on system calls	Understand
CO2: Apply appropriate process and disk scheduling algorithm for various scenarios	Apply
CO3: Develop solutions for various synchronization and deadlock problems in cooperating process	Apply
CO4: Apply different memory management techniques in operating systems	Apply
CO5: Implement various file system structures for storage systems	Apply

Text Book(s):

T1.Avi Silberschatz, 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 Reference(s):

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

High-3; Medium-2; Low-1

Course Code: 19CSOC1005	**Course Title: Object Oriented System Design**		
Course Category: Open 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. 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, IlaNeustadt, "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", Pearson Education Asia, 9th edition, 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
CO1	2	1	-	-	-	1	-	1	-	1	3	1
CO2	3	2	1	1	1	2	2	1	-	1	3	1
CO3	3	2	1	1	1	2	2	1	-	1	3	1
CO4	3	2	1	1	1	2	2	1	-	1	3	1
CO5	3	2	1	1	1	2	2	1	-	1	3	1

High-3; Medium-2;Low-1

Course Code: 19CSOC1006	**Course Title: Management Information System**		
Course Category: Open 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. Describe the role of Management Information System.
2. Choose appropriate MIS model in Business.
3. Develop Decision Making systems with Information Systems support.
4. Explain the impact of Information system on organizations.
5. Apply suitable emerging system for improving Business.

Unit I Introduction 9 Hours

Management Information system(MIS) concept – Role of MIS – Impact – MIS and the User – Management as a control system – Effectiveness – Strategic management of Business performance – Creating model of Organization Excellence – Case Study – SAP ERP system.

Unit II Design and Development of MIS 9 Hours

Strategic management of Business – Strategic design – Balance scorecard – Dash board – Business strategy determination and implementation – Long range plans of MIS – Information requirement – Information quality in MIS – MIS development process model – Case Study – EFQM model for organization excellence.

Unit III Information System in Business 9 Hours

Organizational and Information System Structure - Data and Information - Management and Decision Making - Classification of Information Systems - Information Support for Functional Areas of Management - Impact of Business - Ingredients of Success - MIS in Organizations – Case Study – Office Automation System.

Unit IV Organizational Systems: Analysis and Design 9 Hours

Nature and Characteristics of Organizations - Social Goals - Legal Framework – Professionalism - Organizational Context of Systems Analysis – SDLC - Feasibility Analysis - Computers and Information Systems – Case Study – Basic Library Information System.

Unit V Key System Applications 9 Hours

Enterprise Management Systems - ERP, SCM, CRM, EMS and MIS – Decision Support System and Knowledge Management – Group DSS – Artificial Intelligence system – Expert system – Benefits of MIS – Business Intelligence for MIS – Case Study – Post ERP implementation benefits.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Describe the role of Management Information System for achieving organizational excellence.	Understand
CO2: Choose appropriate MIS Business model for strategic management and process improvement.	Apply
CO3: Develop Decision Making systems with Information Systems support to excel in functional areas of Management.	Apply
CO4: Explain the impact of Information system on organizations in solving societal problems.	Understand
CO5: Apply suitable emerging system for improving Business in key performance areas.	Apply

Text Book(s):

T1. Waman S Jawadekar, Sanjiva Shankar Dubey, “Management Information System: Text and Cases”, Tata McGraw Hill, 2020.

T2. S.Sadagopan, “Management Information Systems”, PHI Learning Private Limited, PHI, Asia, 2014.

Reference Book(s):

R1. Robert Schultheis and Mary Summer, “Management Information Systems – The Managers View”, Tata McGraw Hill, 2018.

R2. Gordon Davis, “Management Information System: Conceptual Foundations, Structure and Development”, Tata McGraw Hill, 2017.

R3. Stephen Haag, Maeve Cummings, “Management Information Systems for the Information Age”, Tata McGraw Hill, 2012.

Web References:

1. Management Information System https://pdfcoffee.com/management-information-systems-pdf-free.html
2. NOC: Management Information System, IIT Kharagpur URL: https://nptel.ac.in/courses/110/105/110105148/
3. Personal Knowledge Management for Development URL: https://www.researchgate.net/publication/256039738_Management_Information_System_ for_Effective_and_Efficient_Decision_Making_A_Case_Study
4. Review on Management Information Systems (MIS) and its Role in Decision Making http://www.ijsrp.org/research-paper-1015/ijsrp-p4671.pdf

5. The Role of Management Information System: Review on the Importance of Data and Implementation in Organizational Process URL: https://papers.ssrn.com/sol3/papers.cfm? abstract_id=3558441

Course Articulation Matrix

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

High-3; Medium-2; Low-1

<table>
<tr><td colspan="2">Course Code: 19CSOC1007</td><td colspan="3">Course Title: Computer Forensics</td></tr>
<tr><td colspan="3">Course Category: Open Elective</td><td colspan="2">Course Level: Introductory</td></tr>
<tr><td>L:T:P (Hours/Week)
3: 0: 0</td><td colspan="2">Credits:3</td><td>Total Contact Hours:45</td><td>Max Marks:100</td></tr>
</table>

Prerequisites

- 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 Evidence.
4. Describe the steps involved in investigating Network Forensics.
5. Comprehend the steps involved in investigating Mobile Forensics.

Unit I Cyber Security **9 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 **9 Hours**

Scope of Computer Forensics: Introduction, Types of Evidence, Investigator skills, Importance - History of Computer Forensics, Law Enforcement Training- Operating Systems and File Systems.

Unit III Acquiring Evidence and Documentation **10 Hours**

Lab requirements - Private sector computer forensics laboratories- Computer Forensics laboratory requirements- Extracting evidence from a device- Documenting the Investigation.

Unit IV Network Forensics **8 Hours**

Tools- Networking devices- Network forensics- OSI Model- Advanced Persistent Threat **-** Investigating a Network Attack.

Unit V Mobile Forensics **9 Hours**

Cellular Network - Handset Specifications - Mobile Operating Systems - Standard Operating Procedures for Handling Handset Evidence - Handset Forensics – Case Studies.

Course Outcomes At the end of this course, students will be able to:	Cognitive Level
CO1:Discuss the cybersecurity policy and its evolution for the purpose of Computer forensics.	Understand
CO2: Summarize the scope and laws of Computer Forensics for Cyber Security Professionals.	Understand
CO3:Explain the process of acquiring and documenting Computer Forensic Evidence for investigation.	Understand
CO4:Describe the steps involved in investigating Network Forensics for attacks.	Understand
CO5:Comprehend the steps involved in investigating Mobile Forensics with Case Studies.	Understand

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.

T2. Darren R. Hayes, “A Practical Guide to Computer Forensics Investigations”, Pearson, 2014.

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
CO1	2	1	-	-	-	2	2	1	-	1	-	1
CO2	2	1	-	-	-	2	2	1	-	1	-	1
CO3	2	1	-	-	-	2	2	1	-	1	-	1
CO4	2	1	-	-	-	2	2	1	-	1	-	1
CO5	2	1	-	-	-	2	2	1	-	1	-	1

High– 3; Medium– 2; Low– 1

<table>
<tr><td colspan="2">Course Code: 19CSOC1008</td><td colspan="3">Course Title: Augmented Reality and Virtual Reality</td></tr>
<tr><td colspan="3">Course Category: Open Elective</td><td colspan="2">Course Level: Introductory</td></tr>
<tr><td>L:T:P (Hours/Week)
3: 0: 0</td><td colspan="2">Credits:3</td><td>Total Contact Hours:45</td><td>Max Marks:100</td></tr>
</table>

Pre-requisites

- NIL

Course Objectives

The course is intended to:

1. Describe the fundamentals of XR.
2. Outline the Virtual Reality Architecture and Modeling.
3. Develop Virtual Reality applications.
4. Explain the basics of Augmented Reality.
5. Apply the design principles of Augmented Reality apps.

Unit I XR Overview 9 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, Modeling 9 Hours

VR Definition, Input Devices: Trackers, Navigation and Gesture Interfaces, Output Devices: Graphics, Three Dimensional Sound and Haptic Displays, Computer Architecture for VR, Modeling.

Unit III VR Application Development 9 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 9 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 9 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

Course Outcomes At the end of this course, students will be able to:	Cognitive Level
CO1: Describe the fundamentals of XR with example applications.	Understand
CO2: Outline the Virtual Reality Architecture and Modeling for real time applications.	Understand
CO3: Develop the virtual reality applications by choosing appropriate tools.	Apply
CO4: Explain the basics of augmented reality with real time examples	Understand
CO5: Apply the design principles and practices of augmented reality apps for Industrial sectors.	Apply

Text Book(s):

T1. Berbard Marr, "Extended Reality in Practice", Wiley, 2021.

T2. Grigore C. Burdea, Philippe Coiffet, “Virtual Reality Technology”, 2nd Edition, John Wiley & Sons Inc., 2014.

T3. Dieter Schmalstieg, Tobias Hollerer, “Augmented Reality: Principles and Practice”, Pearson Education (US), 2017.

T4. Jesse Glover, Jonathan Linowes, "Complete Virtual Reality and Augmented Reality Development with Unity", Packt Publishing Ltd, 2019.

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. Quick Start for Unity Android
   URL:https://developers.google.com/ar/develop/unity/quickstart-android.
4. 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
CO1	2	1	-	-	-	1	-	1	-	1	-	1
CO2	2	1	-	-	-	1	-	1	-	1	-	1
CO3	3	2	1	1	1	1	-	1	-	1	-	1
CO4	2	1	-	-	-	1	-	1	-	1	-	1
CO5	3	2	1	1	1	1	-	1	-	1	-	1

High-3; Medium-2; Low-1

<table>
<tr><td colspan="2">Course Code: 19CSOC1009</td><td colspan="2">Course Title: Human Computer Interface Design</td></tr>
<tr><td colspan="2">Course Category: Open Elective</td><td colspan="2">Course Level: Introductory</td></tr>
<tr><td>L:T:P (Hours/Week)
3: 0: 0</td><td>Credits:3</td><td>Total Contact Hours:45</td><td>Max Marks:100</td></tr>
</table>

Pre-requisites

- **NIL**

Course Objectives

The course is intended to:

1. Describe the fundamental Human Computer Interaction concepts.
2. Discuss various modes of user interactions.
3. Illustrate the user interface prototype.
4. Apply the standards and principles of User Interface.
5. Implement universal design principles.

UNIT I HCI Foundations 9 Hours

Human: Input - Output Channel - Human Memory - Thinking: Reasoning and Problem Solving - Emotion - Psychology - Computer: Text Entry devices-Display Devices-Pointing Devices-Memory-Processing and Networks.

UNIT II Interaction and Paradigms 9 Hours

Interaction : Modes of Interaction – Frameworks and HCI – Ergonomics – Interaction Styles – Windows Icon Pointer and Menus Interfaces – Interactivity – Context – Paradigms.

UNIT III Design Process 9 Hours

Process of Design - User Focus – Scenarios – Navigation Design – Screen design and Layout – Prototyping – HCI Software Life Cycle – Usability Engineering – Iterative Design and Prototyping – Design Rationale.

UNIT IV Implementation 9 Hours

Principles – Standards – Guidelines – Golden Rules – Patterns – Implementation elements – Programming – Toolkits – UI Management Systems – Evaluation Techniques.

UNIT V Universal Design and User Support 9 Hours

Universal design Principles – Multimodal Interaction – Designing for Diversity – Requirements and approaches for User Support – Help Systems – Designing user Support systems.

Course Outcomes At the end of this course, students will be able to:	Cognitive Level
CO1: Describe fundamental HCI concepts for interface design	Understand
CO2: Discuss various modes of user interactions suitable for the given context	Understand
CO3: Illustrate the user interface prototype with appropriate life cycle model	Understand
CO4: Apply the standards and principles for effective implementation of user interface	Apply
CO5: Implement universal design principles to support effective user experience	Apply

Text Book(s):

T1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human Computer Interaction", 3rd Edition, Pearson Education, 2004.

Reference Book(s):

R1. Gerard Jounghyun Kim, "Human Computer Interaction: Fundamentals and Practice", CRC Press, 2015.

R2. Julie A.Jacko, "The Human Computer Interaction Handbook: Fundamentals, Evolving Technologies and Emerging Applications", 3rd Edition, CRC Press, 2012.

Web References:

1. NPTEL Videos: Human Computer Interaction. URL: http://nptel.ac.in/courses/106103115/
2. MIT OpenCourseWare: User Interface Design and Implementation. URL: https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-831-user-interface-design-and-implementation-spring-2011/

Course Articulation Matrix

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

High– 3; Medium– 2; Low– 1

Course Code: 19CSOC1010	Course Title: Bio Informatics		
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 various DNA sequencing methods in Bioinformatics.
2. Explain the different types of Bioinformatics Resources and Databases.
3. Describe the various types of Sequence databases and file formats.
4. Explain about the Sequence Analysis and Scoring matrices in Bioinformatics.
5. Develop applications using Sequence and pairwise sequence alignment.

Unit I Basics of bioinformatics and Gene expression data 9 Hours

Aim and branches of Bioinformatics - Application of Bioinformatics - Basic biomolecular concepts: Protein and amino acid - DNA & RNA Sequence - structure and function. Forms of biological information - Types of Nucleotide Sequence: Genomic DNA - Complementary DNA (cDNA) - Recombinant DNA (rDNA) - Expressed sequence tags (ESTs) - Genomic survey sequences (GSSs). DNA sequencing methods - Gene expression data.

Unit II Bioinformatics Resources and Databases 9 Hours

Bioinformatics Resources – NCBI – EBI – ExPASy – RCSB - DDBJ: Databases and bioinformatics tools - Organization of databases: data contents - purpose and utility. Open access bibliographic resources and literature databases: PubMed - BioMed Central - Public Library of Sciences (PloS) - CiteXplore.

Unit III Sequence databases and file formats 9 Hours

Sequence databases – Nucleic acid sequence databases - Protein sequence databases - Structure Databases - Sequence file formats - Various file formats for bio-molecular sequences - Protein and nucleic acid properties: Proteomics tools - GCG utilities and EMBOSS - Computation of various parameters.

Unit IV Sequence Analysis and Scoring matrices 9 Hours

Sequence Analysis – Basic concepts of sequence similarity - identity and homology - definitions of homologues – orthologues - paralogues and xenologues, Scoring matrices: basic concept of a scoring matrix - Matrices for nucleic acid and protein sequences - PAM and BLOSUM series - matrix derivation methods and principles.

Unit V Sequence and pairwise sequence alignment 9 Hours

Sequence alignment – Measurement of sequence similarity; Similarity and homology. Pairwise sequence alignment: Basic concepts of sequence alignment - Needleman and Wunsch - Smith and Waterman algorithms for pairwise alignments - gap penalties - use of pairwise alignments for analysis of Nucleic acid and protein sequences.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Describe the various components of DNA sequencing methods in Bioinformatics	Understand
CO2: Explain the different types of Bioinformatics Resources and Databases used in real world applications.	Understand
CO3: Describe the various types of Sequence databases and file formats in Bioinformatics.	Understand
CO4: Explain about the Sequence Analysis and Scoring matrices in Bioinformatics for solving the real world problems.	Understand
CO5: Develop applications using Sequence and pairwise sequence alignment methods for solving real world problems.	Apply

Text Book(s):

T1. David W. Mount, “Bioinformatics: Sequence and Genome Analysis”, Cold Spring Harbor Laboratory, 2004.

T2. Baxevanis, A.D. and Francis Ouellellette, B.F, “Bioinformatics - a Practical Guide to the Analysis of Genes and Proteins”, Wiley India Pvt Ltd., 2009.

Reference Book(s):

R1.C.Siva Ram Murthy, B.S.Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols", Prentice Hall Professional Technical Reference, 2008.

R2. Carlos De Morais Cordeiro, Dharma Prakash Agrawal, "Ad Hoc & Sensor Networks: Theory and Applications", World Scientific Publishing Company, 2011.

R3.Durbin, S.Eddy, A.Krogh, G.Mitchison, "Biological Sequence Analysis Probabilistic Models of proteins and nucleic acids", Cambridge University Press, 2002.

R4.Teresa K. Attwood and David J. Parry-Smith, "Introduction to bioinformatics" Pearson Education, 2007.

Web References:

1. Fundamentals of Bioinformatics URL
   https://onlinecourses.swayam2.ac.in/cec21_bt04/preview
2. Bioinformatics: Algorithms and Applications URL
   https://onlinecourses.nptel.ac.in/noc21_bt06/preview

Course Articulation Matrix

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

High– 3; Medium– 2; Low– 1

Course Code: 19CSOC1011	Course Title: Geographic Information System		
Course Category: Open Electives		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. Explain the fundamental principles of GIS.
2. Describe the manipulation of spatial data.
3. Explain the transformation of spatial data.
4. Sketch the representation of Geographic information.
5. Illustrate the display of Geographic information.

Unit I Fundamentals of GIS **9 Hours**

Introduction to GIS – Components of GIS – History of GIS – Elements of GIS – Application of GIS - Integration of GIS – Geographic coordinate systems – Map Projections - Commonly used map projections.

Unit II Spatial Data Models **9 Hours**

Vector data model - Representation of spatial features – Topology - Geo Relational Data model - Object based data model - Representation of composite feature - Raster data model - Elements of Raster data model - Digital Elevation model - Types of Raster data - Raster data structure and compression.

Unit III Data Acquisition and Transformation **9 Hours**

Data acquisition-Existing GIS data -.Metadata – Conversion of Existing data – Creation of new data – Geometric transformation - Root Mean Square – Resampling of Pixel values.

Unit IV Data Quality and Management **9 Hours**

Location errors – Spatial data accuracy standards - Topological errors – Topological and non-topological Editing - Attribute data management – Attribute data in GIS – Relational Model – Joins, Relates, Relationship classes - Spatial join - Attribute data entry - Manipulation of fields.

Unit V Data Display and Cartography 9 Hours

Cartographic representation – Types of quantitative maps – Typography – Map Design – Map Production – Data Exploration – Map Based Data Manipulation - Attribute data and Spatial Data query.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Explain the fundamental principles of GIS using various components and methods.	Understand
CO2: Describe the manipulation of spatial data using GIS Data models.	Understand
CO3: Explain the transformation of spatial data using data acquisition and transformation techniques.	Understand
CO4: Sketch the representation of Geographic information using various data management techniques.	Apply
CO5: Illustrate the display of Geographic information using various data Cartography Methods.	Apply

Text Book(s):

T1. Kang – Tsung Chang, "Introduction to Geographic Information Systems", McGraw Hill Publishing, 9th Edition, 2019.

Reference Books:

R1. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, "An Introduction to Geographical Information Systems", Pearson Education, 2nd Edition, 2007.

R2. Lo.C.P., Albert K.W. Yeung, "Concepts and Techniques of Geographic Information Systems", Prentice-Hall India Publishers, 2006

Web Reference:

1. Introduction to Geographic Information Systems: https://nptel.ac.in/courses/106105184

Course Articulation Matrix

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

High– 3; Medium– 2; Low– 1

<table>
<tr><td>Course Code: 19CSOC1012</td><td colspan="3">Course Title: Green Computing</td></tr>
<tr><td colspan="2">Course Category: Open Elective</td><td colspan="2">Course Level: Introductory</td></tr>
<tr><td>L:T:P (Hours/Week)
3: 0: 0</td><td>Credits: 3</td><td>Total Contact Hours: 45</td><td>Max Marks: 100</td></tr>
</table>

Pre-requisites

- Nil

Course Objectives

The course is intended to:

1. Describe the significance of green computing.
2. Explain about green assets and business process management
3. Describe the energy management and recycling methods.
4. Explain virtualization concepts and their evaluation metrics.
5. Explore various environmental aspects.

Unit I - Green IT **9 Hours**

Green IT Fundamentals: Business, IT, and the Environment – Green vision –Green value Green IT Strategies: Drivers, Dimensions, and Goals – Environmentally Responsible Business: Policies, Practices, and Metrics.

Unit II - Green Assets and Modeling **10 Hours**

Green Assets: Buildings, Data Centers, Networks, and Devices – Green Business Process Management: Modeling, Optimization, and Collaboration – Green Enterprise Architecture – Green Enterprise Transformation Roadmap.

Unit III - Energy Management and Recycling **9 Hours**

Process Reengineering - Teleworkers and Outsourcing - Paperless Office - Intranets - Electronic Data Interchange - Recycling: Problems - Means of Disposal, Life Cycle, Recycling Companies, Hard Drive Recycling, CDs and DVDs - Hardware Considerations: Energy Star, Servers and Remote Desktop.

Unit IV - Virtualizing IT Systems and Metrics **8 Hours**

Consolidation and Virtualization - Server Virtualization - Storage Virtualization - Client Virtualization - Creating Virtual Servers - Blade Servers and Virtualization - Impacts of Server Virtualization on Data Storage –Metrics: SPEC, EPA and LEED Green Building Rating System.

Unit V - Case Studies **9 Hours**

Environmentally Responsible Business Strategies (ERBS) – Case Study Scenarios for Trial Runs – Case Studies: Applying Green IT Strategies and Applications to a Home, Hospital, Packaging Industry and Telecom Sector.

Course Outcomes At the end of this course, students will be able to:	**Cognitive Level**
CO1: Describe the significance of green computing with strategies and policies.	Understand
CO2: Explain about green assets and business process management using enterprise architecture.	Understand
CO3: Describe the energy management and recycling methods for process reengineering	Understand
CO4: Explain virtualization concepts in greening IT systems and their evaluation metrics with examples.	Understand
CO5: Explore various environmental aspects by applying business strategies for various scenarios.	Apply

Text Book(s):

T1. Bhuvan Unhelkar, "Green IT Strategies and Applications-Using Environmental Intelligence", CRC Press, April 2016.

T2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Green IT", Tata McGraw Hill, 2008.

Reference Book(s):

R1. Alvin Galea, Michael Schaefer, Mike Ebbers, "Green Data Center: steps for the Journey", Shoff/IBM redbook, 2011.

R2. Carl Speshock, "Empowering Green Initiatives with IT", John Wiley & Sons, 2010.

R3. John Lamb, "The Greening of IT", Pearson Education, 2009.

Web Reference(s):

1. Course Material URL:https://www.techopedia.com/definition/14753/green-computing
2. NPTEL course content URL:http://nptel.ac.in/courses/110108056/module5/Lecture28.pdf
3. Projects and Major research output developed by C-DAC URL:http://meity.gov.in/content/green-computing.

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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	1
CO4	2	1	-	-	-	3	3	1	-	1	1	1
CO5	3	2	1	1	-	3	3	1	-	1	1	1

High– 3; Medium– 2; Low– 1

<table>
<tr><td colspan="2">Course Code: 19CSOC1013</td><td colspan="3">Course Title: Advanced Algorithms</td></tr>
<tr><td colspan="3">Course Category: Open Elective</td><td colspan="2">Course Level: Practice</td></tr>
<tr><td>L:T:P(Hours/Week)
3: 0: 0</td><td colspan="2">Credits:3</td><td>Total Contact Hours:45</td><td>Max Marks:100</td></tr>
</table>

Pre-requisites

- C programming

Course Objectives

The course is intended to:

1. Develop algorithms for efficient search
2. Construct range trees and Voronoi diagrams
3. Construct geometric data structures
4. Solve problems using Randomized and Approximation algorithms
5. Apply Parallel and Online algorithms for solving problem.

Unit I Search Data Structures 9 Hours

Splay trees-Red Black trees-Treaps-Suffix arrays and Trees

Unit II Range Search 9 Hours

1-Dimensional Range Searching-Range Trees-Higher Dimensional Range Trees-Voronoi diagram

9 Hours

Unit III Geometric Data Structures

Interval trees-Priority search trees-Segment trees-Quad trees

9 Hours

Unit IV Randomized and Approximation Algorithms

Randomized Algorithms: Random Number Generators-Skip Lists- Primality Testing Approximation Algorithms: Node cover problem-Euclidean Traveling Salesperson Problemˇ Bin packing polynomial time approximation schemes:0/1 Knapsack problem

Unit V Parallel and online Algorithms 9 Hours

Parallel Algorithms: Parallelism-PRAM-Handling Write conflicts- Merging and Sorting. Online algorithms: Euclidean spanning tree- Bipartite matching-Convex hull problem.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1:Develop algorithms for efficient search using Tree data structures	Apply
CO2:Construct range trees and Voronoi diagrams for spatial search	Apply
CO3:Construct geometric data structures and perform spatial search operations	Apply
CO4:Solve Problems using Randomized and Approximation algorithms to achieve better efficiency in real time applications	Apply
CO5: Apply Parallel and Online algorithms for solving various problems	Apply

Text Book(s)

T1. Mark Allen Weiss,"Data Structures & Algorithms in Java", 3rd Edition, Pearson Education, 2012.

T2. R.C.T. Lee, S.S.Tseng, R.C.Chang, Y.T.Tsai, "Introduction to the Design and Analysis of Algorithms A strategic Approach", Tata McGraw Hill, 2012.

T3. Charles E.Leiserson, Ronald L Rivest, Thomas H.Cormen, Clifford Stein, "Introduction to Algorithms", 3rd Edition, Prentice Hall India, 2012.

T4. Ellis Horowitz, Sartaj Sahni, S.Rajasekaran, "Fundamentals of Computer Algorithms" 2nd Edition, Galgotia Publications, 2010

Reference Book(s)

R1. Peter Brass, "Advanced Data Structures", Cambridge University Press, 2008.

R2. Dinesh P. Mehta, Sartaj Sahni, "Handbook of Data Structures and Applications", Chapman& Hall/CRC, 2005.

R3. Sara Base Allen Van Gelder, "Computer Algorithms Introduction to Design and Analysis", 3rd Edition, Pearson Education, 2003.

Web References

1. Applications of Computational Geometry-Geometry in Action.
   URL:https//www.ics.uci.edu/eppstein/geom.html
2. MIT Course Content URL: https://courses.csail.mit.edu/6.854/21/

Course Articulation Matrix

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

High-3; Medium-2; Low-1