BCA – DATA SCIENCE

CURRICULUM AND SYLLABUS
2023

Programme Educational Objectives (PEOs)

PEO1	Graduate will strive on a global platform to pursue their career in Computer Applications.
PEO2	Graduate will contribute as entrepreneurs in inter disciplinary areas.
PEO3	Graduate will demonstrate high regard for professionalism, integrity and respect values in diverse culture, and have a concern for society and environment.

Programme Outcomes (POs)

PO1	**Computational knowledge:** Apply knowledge of computing fundamentals, mathematics, and domain knowledge appropriate for developing computing applications.
PO2	**Problem Analysis:** Identify, formulate and solve complex computing problems using fundamental principles of mathematics and computer science.
PO3	**Design/development of solutions:** Design and evaluate solutions for complex problems in societal and environmental domains..
PO4	**Conduct investigations of complex problems:** Use knowledge based computing techniques for the design and analysis of the system to provide optimal solutions.
PO5	**Modern tool usage:** Create, select, adapt and apply appropriate techniques, resources, and modern tools to solve real world problems.
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 teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes (PSOs)

PSO1	The capability to effectively develop applications that can acquire, manage, and analyze large volume of data.
PSO2	Develop big data applications using the defined standards and practices, tools, and technologies.
PSO3	Ability to learn emerging data science paradigms for innovation.

SEMESTER I

Code	Title	L T P	Credit
22AVP103	Mastery Over Mind	1 0 2	2
22ADM101	Foundations of Indian Heritage	2 0 1	2
21ENG101	Communicative English	2 0 2	3
	Language I	2 0 0	2
23MAT108	Discrete Mathematics	3 1 0	4
21ENV200	Environmental Science and Sustainability	3 0 0	3
23CSA102	Computer Essentials	3 0 0	3
23CSA103	Problem Solving and Programming	3 1 0	4
23CSA181	Problem Solving and Programming Lab	0 0 2	1
23CSA183	Computer Essentials Lab	0 0 2	1
	TOTAL		**25**

SEMESTER II

Code	Title	L T P	Credit
22ADM111	Glimpses of Glorious India	2 0 1	2
21ENG111	Professional Communication	1 0 2	2
23MAT118	Probability and Statistics	3 0 2	4
23CSA111	Database Management System	3 1 0	4
23CSA115	Object Oriented Programming using Java	3 1 0	4
23CSA116	Operating System	3 1 0	4
23CSA184	Object Oriented Programming using Java Lab	0 0 2	1
23CSA185	Database Management System Lab	0 0 2	1
	TOTAL		**22**

SEMESTER III

Code	Title	L T P	Credit
	Amrita Value Programme I	1 0 0	1
21SSK201	Life Skills I	1 0 2	2
23MAT207	Linear Algebra	3 0 2	4
23CSA202	Exploratory Data Analysis using Python	3 0 2	4
23CSA203	Data Structures and Algorithms	3 1 0	4
23CSA204	Computer Networks	3 1 0	4
23CSA205	Software Engineering	2 1 0	3
23CSA281	Data Structures and Algorithms Lab	0 0 2	1
23CSA282	Spreadsheet Modelling Lab	0 0 2	1
	TOTAL		**24**

SEMESTER IV

Code	Title	L T P	Credit
	Amrita Value Programme II	1 0 0	1
21SSK211	Life Skills II	1 0 2	2
23CSA213	Data Mining	3 0 0	3
23CSA214	Optimization Techniques	3 0 0	3
23CSA215	Artificial Intelligence	3 1 0	4
23CSA216	Web Technologies	2 0 2	3
	Elective A	3 0 0	3
	Elective B	3 0 0	3
23CSA283	Data Mining Lab	0 0 2	1
23CSA290	Case Study Based Seminar	1 0 0	1
	TOTAL		**24**

SEMESTER V

Code	Title	L T P	Credit
21SSK301	Life Skills III	1 0 2	2
	Elective C	3 0 0 / 2 0 2	3
23CSA302	Machine Learning	3 1 0	4
23CSA390*/21 OELXXX	Live-in-Labs / Open Elective	3 0 0	3
23CSA303	Cloud Computing	3 0 2	4
23CSA386	Machine Learning Lab	0 0 2	1
23CSA398	Minor Project		4
	TOTAL		**21**

SEMESTER VI

Code	Title	L T P	Credit
23CSA313	Big Data Analytics and Visualization	3 0 0	3
23CSA314	Data Governance	3 0 0	3
23CSA387	Big Data Analytics and Visualization Lab	0 0 2	1
23CSA399	Major Project		10
	TOTAL		**17**
	TOTAL CREDITS		**133**

LANGUAGES

Paper I			
Code	**Title**	**L T P**	**Credit**
21HIN101	**Hindi I**	**2 0 0**	**2**
21KAN101	**Kannada I**	**2 0 0**	**2**
21MAL101	**Malayalam I**	**2 0 0**	**2**
21SAN101	**Sanskrit I**	**2 0 0**	**2**
21TAM101	**Tamil I**	**2 0 0**	**2**
18ENG103	**Additional English I**	**2 0 0**	**2**

ELECTIVE A, B, C

Code	Title	L T P	Credit
23CSA341	Time Series Analysis	3 0 0	3
23CSA342	Introduction to IoT	3 0 0	3
23CSA343	Embedded Systems	3 0 0	3
23CSA344	Non-Relational Databases	3 0 0	3
23CSA345	Pattern Recognition	3 0 0	3
23CSA346	Digital Image Processing	3 0 0	3
23CSA347	Wireless Networks and Communications	3 0 0	3
23CSA348	Multimedia and Graphics	3 0 0	3
23CSA349	Bioinformatics	3 0 0	3
23CSA350	Soft Computing	3 0 0	3
23CSA351	Advanced Operating Systems and Distributed Computing	3 0 0	3
23CSA352	Natural Language Processing	3 0 0	3
23CSA353	Text Mining and Analytics	3 0 0	3
23CSA354	Secure Data Analytics	3 0 0	3
23CSA355	Business Intelligence	3 0 0	3
23CSA356	Quantum Computing	2 0 2	3
23CSA357	Visual Programming using C#	2 0 2	3
23CSA358	Design Patterns	3 0 0	3
23CSA359	Block chain Technologies	3 0 0	3
23CSA360	Graph Analytics and Algorithms	2 0 2	3

OPEN ELECTIVE

Course Code	Course Title	L T P	Cr.	ES
21OEL231	A Journey towards Free India	3 0 0	3	J
21OEL232	Political Leadership	3 0 0	3	J
21OEL233	Social issues in Contemporary India	3 0 0	3	J
21OEL234	The Story of Indian Business	3 0 0	3	J
21OEL235	Industrial Psychology	3 0 0	3	J
21OEL236	Advertising	3 0 0	3	J
21OEL237	Basic Statistics	3 0 0	3	J
21OEL238	Citizen Journalism	3 0 0	3	J
21OEL239	Creative Writing for Beginners	3 0 0	3	J
21OEL240	Desktop Support and Services	3 0 0	3	J
21OEL241	Development Journalism	3 0 0	3	J
21OEL242	Digital Photography	3 0 0	3	J
21OEL243	Emotional Intelligence	3 0 0	3	J
21OEL244	Essence of Spiritual Literature	3 0 0	3	J
21OEL245	Film Theory	3 0 0	3	J
21OEL246	Fundamentals of Network Administration	3 0 0	3	J
21OEL247	Gender Studies	3 0 0	3	J
21OEL248	Glimpses of Indian Economy and Polity	3 0 0	3	J
21OEL249	Graphics and Web-designing Tools	3 0 0	3	J
21OEL250	Green Marketing	3 0 0	3	J
21OEL251	Healthcare and Technology	3 0 0	3	J
21OEL252	History of English Literature	3 0 0	3	J
21OEL253	Indian Writing in English	3 0 0	3	J
21OEL254	Industrial Relations and Labor Welfare	3 0 0	3	J
21OEL255	Introduction to Ancient Indian Yogic and Vedic Wisdom	3 0 0	3	J
21OEL256	Introduction to Computer Hardware	3 0 0	3	J
21OEL257	Introduction to Event Management	3 0 0	3	J
21OEL258	Introduction to Media	3 0 0	3	J
21OEL259	Introduction to Right to Information Act	3 0 0	3	J
21OEL260	Introduction to Translation	3 0 0	3	J
21OEL261	Linguistic Abilities	3 0 0	3	J
21OEL262	Literary Criticism and Theory	3 0 0	3	J
21OEL263	Macro Economics	3 0 0	3	J
21OEL264	Managing Failure	3 0 0	3	J
21OEL265	Media Management	3 0 0	3	J
21OEL266	Micro Economics	3 0 0	3	J
21OEL267	Micro Finance, Small Group Management and Cooperatives	3 0 0	3	J
21OEL268	Negotiation and Counselling	3 0 0	3	J
21OEL269	New Literatures	3 0 0	3	J
21OEL270	Non-Profit Organization	3 0 0	3	J
21OEL271	Personal Effectiveness	3 0 0	3	J
21OEL272	Perspectives in Astrophysics and Cosmology	3 0 0	3	J
21OEL273	Principles of Marketing	3 0 0	3	J
21OEL274	Principles of Public Relations	3 0 0	3	J
21OEL275	Science, Society and Culture	3 0 0	3	J
21OEL276	Statistical Analysis	3 0 0	3	J
21OEL277	Teamwork and Collaboration	3 0 0	3	J
21OEL278	The Message of Bhagwad Gita	3 0 0	3	J
21OEL279	Understanding Travel and Tourism	3 0 0	3	J
21OEL280	Videography	3 0 0	3	J

21OEL281	Vistas of English Literature	3 0 0	3	J
21OEL282	Web-Designing Techniques	3 0 0	3	J
21OEL283	Organic Farming	3 0 0	3	J
21OEL284	Basic Legal Awareness on Protection of Women and Rights	3 0 0	3	J
21OEL285	Ritual Performances of Kerala	3 0 0	3	J
21OEL286	Documenting Social Issues	3 0 0	3	J
21OEL287	Fabrication of Advanced Solar Cell	3 0 0	3	J
21OEL288	Basic Concepts of X-ray Diffraction	3 0 0	3	J
21OEL289	Introduction to FORTRAN and GNUPLOT	3 0 0	3	J
21OEL290	Introduction to Porous Materials	3 0 0	3	J
21OEL291	Forensic Science	3 0 0	3	J
21OEL292	Introduction to solar Physics	3 0 0	3	J
21OEL293	Recycling Recovery and Treatment Methods for Wastes	3 0 0	3	J
21OEL294	Acting and Dramatic Presentation	2 0 2	3	J
21OEL295	Computerized Accounting	2 0 2	3	J
21OEL296	Kerala Mural Art and Painting	2 0 2	3	J
21OEL297	Painting	2 0 2	3	J
21OEL298	Reporting Rural Issues	3 0 0	3	J

Amrita Value Programmes I & II for UG programmes			
Course Code	Title	L-T-P	Credits
22ADM201	Strategic Lessons from Mahabharatha	1-0-0	1
22ADM211	Leadership from Ramayana	1-0-0	1
22AVP210	Kerala Mural Art and Painting	1-0-0	1
22AVP218	Yoga Therapy and Lessons	1-0-0	1
22AVP212	Introduction to Traditional Indian Systems of Medicine	1-0-0	1
22AVP201	Amma's Life and Message to the modern world	1-0-0	1
22AVP204	Lessons from the Upanishads	1-0-0	1
22AVP205	Message of the Bhagavad Gita	1-0-0	1
22AVP206	Life and Message of Swami Vivekananda	1-0-0	1
22AVP207	Life and Teachings of Spiritual Masters of India	1-0-0	1
22AVP208	Insights into Indian Arts and Literature	1-0-0	1
22AVP213	Traditional Fine Arts of India	1-0-0	1
22AVP214	Principles of Worship in India	1-0-0	1
22AVP215	Temple Mural Arts in Kerala	1-0-0	1
22AVP218	Insights into Indian Classical Music	1-0-0	1
22AVP219	Insights into Traditional Indian Painting	1-0-0	1
22AVP220	Insights into Indian Classical Dance	1-0-0	1
22AVP221	Indian Martial Arts and Self Defense	1-0-0	1
22AVP209	Yoga and Meditation	1-0-0	1

SYLLABUS

SEMESTER I

22AVP103	MASTERY OVER MIND (MAOM)	L-T-P-C: 1-0-2-2

Course Objective(s)

- Mastery Over Mind (MaOM) is an Amrita initiative to implement schemes and organize university-wide programs to enhance health and wellbeing of all faculty, staff, and students (UN SDG -3).
- It gives an introduction to immediate and long-term benefits of MA OM meditation and equips every attendee to manage stressful emotions and anxiety, in turn facilitating inner peace and harmony.
- This course will enhance the understanding of experiential learning based on the University's mission: "Education for Life along with Education for Living" and is aimed to allow learners to realize and re-discover the infinite potential of one's true Being and the fulfilment of life's goals.

Course Outcomes

COs	Description
CO1	To be able to describe what meditation is and to understand its health benefits.
CO2	To understand the causes of stress and how meditation improves well-being.
CO3	To understand the science of meditation.
CO4	To learn and practice MAOM meditation in daily life.
CO5	To understand the application of meditation to improve communication and relationships.
CO6	To be able to understand the power of meditation in compassion-driven action.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	1	2	2	-	2	-	-	-
CO2	-	-	2	2	-	-	-	-	2	2	-	2	-	-	-
CO3	-	-	-	2	-	2	-	2	2	2	-	2	-	-	-
CO4	-	-	3	3	-	-	2	3	3	3	-	3	-	-	-
CO5	-	-	2	2	-	-	-	2	2	3	-	3	-	-	-
CO6	-	-	2	-	-	-	-	2	2	2	-	2	-	-	-

Syllabus

Unit I

Describe Meditation and Understand its Benefits (CO1)

A: Importance of meditation. How does meditation help to overcome obstacles in life (Pre- recorded video with Swami Shubhamritananda Puri)

Reading 1: Why Meditate? (Swami Shubamritananda ji)

Reading 2: 'Stillness of the Mind' Chapter 17 in Amritam Gamaya (2022). Mata Amritanandamayi Mission Trust.

Additional Reading: Abhyasa Yoga: The Yoga of Practice. (Br. Achyutamrita Chaitanya)

B: Understand how meditation works. Understand how meditation helps in improving physical and mental health. Understand how meditation helps in the development of personality (Pre-recorded video with Dr. Ram Manohar)

Reading 1: Allen, Cynthia (2020) The Potential Health Benefits of Meditation

Additional Reading: Sharma, Hari (2022) Meditation: Process and Effects

Unit II

Causes of Stress and How Meditation Improves Well-being (CO2)

A: Learn how to prepare for meditation. Understand the aids that can help in effectively practicing meditation. Understand the role of sleep, physical activity, and a balanced diet in supporting meditation. (Pre-recorded video with Dr. Ram Manohar)

B: Causes of Stress. The problem of not being relaxed. Effects of stress on health. How meditation helps to relieve stress. Basics of stress management at home and the workplace. (Pre-recorded video with Prof Udhaykumar)

Reading 1: Mayo Clinic Staff (2022, April 29). Meditation: A Simple, Fast Way to Reduce Stress. Mayo Clinic. https://www.mayoclinic.org/tests-procedures/meditation/in- depth/meditation/art-20045858 (PDF provided)

Reading 2: 'Efficient Action.' Chapter 28 in Amritam Gamaya (2022). Mata Amritanandamayi Mission Trust.

Unit III

The Science of Meditation (CO3)

A: A preliminary understanding of the Science of meditation. What can modern science tell us about this tradition-based method? (Pre-recorded video with Dr. Shyam Diwakar)

B: How meditation helps humanity according to what we know from scientific research (Pre-recorded video with Dr. Shyam Diwakar)

Reading 1: Does Meditation Aid Brain and Mental Health (Dr Shyam Diwakar)

Reading 2: 'Science and Spirituality.' Chapter 85 in Amritam Gamaya (2022). Mata Amritanandamayi Mission Trust.

Unit IV

Practicing MA OM Meditation in Daily Life (CO4)

Guided Meditation Sessions following scripts provided (Level One to Level Five)

Reading 1: MA OM and White Flower Meditation: A Brief Note (Swami Atmananda Puri)

Reading 2: 'Live in the Present Moment.' Chapter 71 in Amritam Gamaya (2022). Mata Amritanandamayi Mission Trust.

Unit V

Improving Communication and Relationships (CO5)

How meditation and mindfulness influence interpersonal communication. The role of meditation in improving relationship quality in the family, at the university and in the workplace. (Pre-recorded video with Dr Shobhana Madhavan)

Reading 1: Seppala E (2022, June 30th) 5 Unexpected Ways Meditation Improves Relationships a Lot. Psychology Today. https://www.psychologytoday.com/intl/blog/feeling-it/202206/5-unexpected-ways- meditation-improves-relationships-lot

Reading 2: 'Attitude.' Chapter 53 in Amritam Gamaya (2022). Mata Amritanandamayi Mission Trust.

Unit VI

Meditation and Compassion-driven Action (CO6)

Understand how meditation can help to motivate compassion-driven action. (Pre- recorded video with Dr Shobhana Madhavan)

Reading 1: Schindler, S., & Friese, M. (2022). The relation of mindfulness and prosocial behavior: What do we (not) know?. Current Opinion in Psychology, 44, 151-156.

Reading 2: 'Sympathy and Compassion.' Chapter 100 in Amritam Gamaya (2022). Mata Amritanandamyi Mission Trust.

Textbooks/References

1. Meditation and Spiritual Life-Swami Yatiswarananda, Ramakrishna Math
2. The Complete Works of Swami Vivekananda Vol Vii by Advaita Ashram Mayavati Almora Himalayas
3. Dhyana Yoga-Holy Gita Swami Chinmayanda
4. Voice of God, Chandrasekharendra Saraswati, 68th Acharya of Sri Kanchi Kamakoti Peetam,
5. Hindu Dharma-Chandrasekharendra Saraswati, 68th Acharya of Sri Kanchi Kamakoti Peetam,
6. Mind: It's Mysteries and control-Swami Sivananda Saraswati
7. Amritam Gamaya (2022). Mata Amritanandamayi Mission Trust.
8. Books on Amma's teachings like Awaken children, From Amma's Heart etc.
9. The Science of Meditation: How to Change Your Brain, Mind and Body by Daniel Goleman and Richard. J. Davidson.

10. Allen, Cynthia (2020) The Potential Health Benefits of Meditation
11. Seppala E (2022, June 30th Unexpected Ways Meditation Improves Relationships a Lot.Psychology Today
12. Sharma, Hari (2022) Meditation: Process and Effects
13. Mayo Clinic Staff (2022, April 29). Meditation: A Simple, Fast Way to Reduce Stress.
14. Schindler, S., & Friese, M. (2022). The relation of mindfulness and prosocial behavior: What do we (not) know? Current Opinion in Psychology, 44, 151-156

Evaluation Pattern

Assessment	Weightage (%)
Reflective Journal	20
Group Activities	20
Class Participation	40
Written Examination	20
Total Marks	100

22ADM101	FOUNDATIONS OF INDIAN HERITAGE	L-T-P-C:2-0-1-2

Course Objective(s)

To introduce students to the depths and richness of the Indian culture and knowledge traditions, and to enable them to obtain a synoptic view of the grandiose achievements of India in diverse fields. To equip students with a knowledge of their country and its eternal values.

Course Outcomes

COs	Description
CO1	Increase student understanding of true essence of India's cultural and spiritual heritage.
CO2	Emancipating Indian histories and practices from manipulation, misunderstandings and other ideological baggage thus, shows its contemporary relevance.
CO3	Understand the ethical and political strategic concepts to induce critical approach to various theories about India.
CO4	Familiarize students with the multi dimension of man's interaction with nature, fellow beings and society in general.
CO5	Appreciate the socio-political and strategic innovations based on Indian knowledge systems. Gives an understanding of bringing Indian teaching into practical life.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	2	2	-	-	-	3	-	-	-
CO2	-	-	-	-	-	-	1	2	-	-	-	3	-	-	-
CO3	2	-	-	-	-	2	3	3	-	-	-	-	-	-	-
CO4	-	-	3	-	3	2	3	-	-	-	-	3	-	-	-
CO5	2	-	1	2	-	1	3	1	-	-	-	2	-	-	-

Syllabus

1. Chapter 1 - Educational Heritage of Ancient India
2. Chapter 2 - Life and Happiness
3. Chapter 3 - Impact of Colonialism and Decolonization
4. Chapter 4- A timeline of Early Indian Subcontinent
5. Chapter 5 - Indian approach towards life
6. Chapter 6 - Circle of Life
7. Chapter 7- Pinnacle of Selflessness and ultimate freedom
8. Chapter 8- Ocean of love; Indian Mahatmas.
9. Chapter 9 - Become A Strategic Thinker (Games / Indic activity)
10. Chapter 10 - Man's association with Nature
11. Chapter 11 - Celebrating life 24/7
12. Chapter 12 - Metaphors and Tropes
13. Chapter 13 - India: In the Views of foreign Scholars and Travellers.

Self-Study/ Self-reading

14. Chapter 14 - Personality Development Through Yoga.
15. Chapter 15 - Hallmark ofIndian Traditions: Advaita Vedanta, Theory of oneness
16. Chapter 16 - Conversations on Compassion with Amma

Textbooks/References

1. Foundations of Indian Heritage

Evaluation Pattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

21ENG101	COMMUNICATIVE ENGLISH	L-T-P-C: 2-0-2-3

Course Objective(s)

To help students obtain an ability to communicate fluently in English; to enable and enhance the students' skills in reading, writing, listening, and speaking; to impart an aesthetic sense and enhance creativity.

Course Outcomes

COs	Description
CO1	Recall fundamental concepts of the four linguistic skills, viz. listening, speaking, reading and writing.
CO2	Apply different styles of communication in professional context.
CO3	Participate in different planned & extempore communicative activities.
CO4	Interpret and discuss facts and information in each context.
CO5	Critique literary texts that develop an appreciation for human values.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	1	3	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-

Syllabus

Unit I
Kinds of sentences, Word Order,usage of preposition, use of adjectives, adverbs for description, Determiners-Agreement (Subject – Verb, Pronoun- Antecedent) collocation

Unit II
Tenses
Reported speech
Active and passive Voice
Phrasal Verbs, Linkers/ Discourse Markers, Question Tags

Unit III
Paragraph writing – Cohesion - Development: definition, comparison, classification, contrast, cause and effect - Essay writing: Descriptive and Narrative

Unit IV
Reading Comprehension – Skimming and scanning- inference and deduction – Reading various kinds of material –Speaking: Narration of incidents / stories/ anecdotes- Current News Awareness.

Unit V
Nirad C Chaudhuri “Indian Crowds” [Non-Detailed]
Dr S Radhakrishnan “The Shaping of my Character” [Detailed]
Charles Lamb” Dream Children” [Detailed]
Ruskin Bond “Night Train at Deoli” [Non-Detailed]
Rabindranath Tagore “Subha” [Non-Detailed]
Agra Gra “And you call me coloured” [Detailed]
Alfred Lord Tennyson “Ulysses” [Detailed]

Textbooks

1. Ruskin Bond, Time Stops at Shamli and Other Stories, Penguin Books India Pvt Ltd, 1989
2. Syamala, V. Speak English in Four Easy Steps, Improve English Foundation Thiruvananthapuram: 2006
3. Online sources
4. M Nagarajan, T Sashisekaran, S Ramamurthy Indian Prose for Effective Communication: A Practical Programme for Colleges Trinity Press (An imprint of Laxmi Publications Pvt. Ltd.

References

1. Martinet, Thomson, A Practical English Grammar, IV Ed. OUP, 1986.
2. Murphy, Raymond, Murphy's English Grammar, CUP, 2004

Evaluation Pattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

23MAT108	DISCRETE MATHEMATICS	L-T-P-C: 3-1-0-4

Course Objective(s)

- Understand the logic and various functions.
- Understand the basic concept of combinatorics.
- Understand the concepts of recurrence relations and its applications.
- Understand the concepts of equivalence and partial order relations.
- To familiarize various definitions and theorems on graph theory.

Course Outcomes

COs	Description
CO1	To understand the basic concepts of Mathematical reasoning and basic counting techniques.
CO2	To understand the recursive functions and apply the concepts of generating functions to solve the recurrence relations.
CO3	Apply the concepts of divide and conquer method, principle of inclusion and exclusion to solve some simple algorithms in discrete mathematics.
CO4	To understand the concepts of various types of relations, partial ordering and equivalence relations.
CO5	To understand the basic concepts of graph theory and apply it to shortest path problems.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	1	-	-	1
CO2	3	2	-	-	-	-	-	-	-	-	-	1	-	-	2
CO3	3	2	-	-	-	-	-	-	-	-	-	1	-	-	3
CO4	3	2	-	-	-	-	-	-	-	-	-	1	-	-	2
CO5	3	2	-	-	-	-	-	-	-	-	-	1	-	-	3

Syllabus

Unit I
Logic, Mathematical Reasoning and Counting: Logic, Prepositional Equivalence, Predicate and Quantifiers, Theorem Proving. Recursive Definitions, Recursive Algorithms, Basics of Counting, Pigeonhole Principle, Permutation and Combinations.

Unit II
Relations and Their Properties: Representing Relations, Closure of Relations, Partial Ordering, Equivalence Relations and partitions.
Advanced Counting Techniques and Relations: Recurrence Relations, Solving Recurrence Relations, Generating Functions, Solutions of Homogeneous Recurrence Relations, Divide and Conquer Relations, Inclusion-Exclusion.

Unit III
Graph Theory: Graphs and subgraphs, isomorphism, matrices associated with graphs, degrees, walks, connected graphs, shortest path algorithm. Euler and Hamilton Graphs: Euler graphs, Euler's theorem. Fleury's algorithm for Eulerian trails. Hamilton cycles, Chinese-postman problem, approximate solutions of travelling salesman problem. Closest neighbour algorithm.

Textbooks

1. Kenneth H. Rosen, “Discrete Mathematics and its Applications”, Tata McGraw- Hill Publishing Company Limited, New Delhi, Sixth Edition, 2007.
2. James Strayer, Elementary Number Theory, Waveland Press, 2002.

References

1. R.P. Grimaldi, “Discrete and Combinatorial Mathematics”, Pearson Education, Fifth Edition, 2007.
2. Thomas Koshy, “Discrete Mathematics with Applications”, Academic Press, 2005.
3. Liu, “Elements of Discrete Mathematics”, Tata McGraw- Hill Publishing Company Limited, 2004.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

21ENV200	ENVIRONMENTAL SCIENCE AND SUSTAINABILITY	L-T-P-C: 3-0-0-3

Course Objective(s)

To provide a general understanding of our environment, exploitation of natural resources, importance of biodiversity, pollution and its impacts and some environment-friendly concepts.

Course Outcomes

COs	Description
CO1	Understanding the over exploitation of our natural resources and the need for sustainable development.
CO2	Understanding the concept of ecosystem, its structure and function and threats to ecosystems.
CO3	Study of biodiversity, its importance and conservation.
CO4	Understanding the impacts of different types of pollution.
CO5	Understanding Environment friendly concepts and management plans.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	2	-	-	-	3	1	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
CO3	-	-	1	-	-	-	2	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
CO5	-	-	1	-	-	-	3	1	-	-	-	-	-	-	-

Syllabus

Unit I

Multidisciplinary nature of environmental studies. Renewable and non-renewable Natural resources. Over exploitation and conservation of the following natural resources -- forest, water, food, energy, mineral and land resources. Concept of sustainability, sustainable development. Concept of zero waste. Concept of three R's (Reduce, Reuse and Recycle). Need for environmental education.

Unit II

Concept of ecosystem. Components, structure and function of an ecosystem. A brief description of forest ecosystem and desert ecosystem. Food chain and food web, ecological pyramids. Biogeochemical cycles examples (nitrogen, phosphorous and carbon). Ecosystem services (example forest). Threats to ecosystems.

Unit III

Biodiversity, hot spots of biodiversity, India as a mega diversity nation, Threats to biodiversity, Value of biodiversity, Brief description of economic valuation of biodiversity, Conservation of biodiversity, Role of individuals in the up keeping of environment.

Unit IV

Pollution of air, acid rain, global warming and climate change, ozone layer depletion, Water pollution, Soil pollution. Industrial and urban solid wastes, Hospital wastes, Collection, segregation and disposal of solid wastes, Hazardous waste, Plastic pollution, E-waste.

Unit V

Ecological Foot Prints -brief description of carbon footprint and water footprint, Linear and Circular resource management, System thinking, Industrial ecosystems, EIA, EMP, Green technology, Green business, Green accounting, Green buildings, Eco-labelling, Sustainable (Green) cities.

Textbooks/References

1. Harikumar P.N., Susha D. And Manoj Narayanan K. S. – Environment management and human rights. Himalaya Publishing House.
2. Bala Krishnamoorthy – Environmental management: Text and Cases.PHI LearningPrivate Limited.
3. Jacob Thomas – Environmental management: Text and Cases. Pearson.
4. Rajagopaln R. – Environmental Studies: From crisis to cure. Oxford University Press.
5. Palanisamy P. N., Manikandan P., Geetha A., Manjula Ran -- Environmental Science, Pearson Education.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

23CSA102	COMPUTER ESSENTIALS	L-T-P-C: 3-0-0-3

Course Objective(s)

- To provide an understanding of computers' various components and functional units, their design and working.
- To provide insight into digital systems and logic circuit design.

Course Outcomes

COs	Description
CO1	Identify and describe basic components of computer systems and its functionality.
CO2	Explain number systems and representations.
CO3	Design and implement various logic circuits.
CO4	Analyze various types of combinational and sequential circuits and their functions.
CO5	Describe the basic organization of a computer.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		-	-	-	1	1	-	-	-	1	1	-	-	1
CO2	3	1	1	-	-	1	-	-	-	-	-	-	-	-	-
CO3	3	1	2	-	1	1	1	-	-	-	-	-	-	-	-
CO4	3	2	2	-	1	1	1	1	-	-	-	-	-	-	1
CO5	3	-	1	-	1	1	1	-	-	-	-	-	-	-	-

Syllabus

Unit 1

Computer Fundamentals: Brief history of Computer, Classification of Computers, Functions & Components of a Computer, Central Processing Unit, Storage units, Bus, Input and output Devices. Types of memory, Memory hierarchy - RAM, ROM, Variants of ROM, Secondary storage devices- hard disk-disk components and geometry. Other Secondary Storage devices, Operating systems, Bootstrapping. Program execution with illustrative examples.

Unit II

Number Systems: Decimal, Binary, Octal, Hexadecimal conversion from one to another- Binary arithmetic, representation of signed numbers, 1‘s and 2‘s Complement Arithmetic.

Unit III

Logic Gates and Boolean Algebra. Logic Gate: Basic logic gates- AND, OR, NOT, NAND, NOR, Exclusive OR, Exclusive NOR gates- Logic symbols, truth table and timing diagrams. Boolean algebra - Basic laws and theorems, Boolean functions, truth table, minimization of Boolean function using K map method, Realization using logic gates and universal gates.

Unit IV

Logic Circuits: Combinational logic circuits: Half adder, Full adder, Parallel binary adder, Subtractor, Decoders, Encoders, Multiplexers, De-multiplexers. Sequential logic circuits- Flip Flops – RS, JK, T and D Flip Flops, Edge triggered Flip Flops, Master slave Flip Flops.

Unit V

Basic Computer Organization: Registers, Instruction Formats, Types of instructions, Execution of a Complete Instruction, Bus Organization, Control Unit Organizations-Hard-wired Control, Micro programmed Control. – Input Out organizations Central processing units and different CPU organizations

Textbooks/References

1. J. Glenn Brookshear,"Computer Science: An Overview", Addision-Wesley, Twelfth Edition, 2014.
2. Computer Organization – Carl Hamacher, ZvonksVranesic, SafeaZaky, Vth Edition, McGraw Hill.
3. Computer Systems Architecture – M.Moris Mano, IIIrd Edition, Pearson/PHI

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous assessment	25
End Semester Exam	50
Total Marks	100

23CSA103	PROBLEM SOLVING AND PROGRAMMING	L-T-P-C: 3-1-0-4

Course Objective(s)

- This course provides the foundations of computational problem solving.
- The course focuses on principles and methods thereby providing transferable skills to any other domain.
- The course also provides a foundation for developing computational perspectives of one's discipline.

Course Outcomes

COs	Description
CO1	Apply algorithmic thinking to understand, define and solve problems.
CO2	Design and implement algorithm(s) for a given problem.
CO3	Apply the basic programming constructs for problem-solving.
CO4	Understand an algorithm by tracing its computational states, identifying bugs and correcting them.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	3	2	3	-	3	-	-	-	2	2	-	-	2	-	-
CO3	2	1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO4	1	1	2	-	2	-	-	-	-	-	-	-	-	-	-

Syllabus

Unit I
Introduction to computer science – algorithms, hardware, software, computational problem-solving process, programming, input, output, Data and expressions – literals, variables, identifiers, operators, expressions, data types, problem solving exercises,

Unit II
Algorithmic thinking – Constituents of algorithms – Sequence, Selection and Repetition, input-output; Computation – expressions, logic; algorithms vs programs, Problem Understanding and Analysis – problem definition, input[1]output, variables, name binding, data organization: lists, arrays etc. algorithms to programs.

Unit III
Problem solving with algorithms – Searching and Sorting, Evaluating algorithms, modularization, recursion. C for problem-solving – Introduction, structure of C programs, data types, data input, output statements, control structures.

Textbooks

1. Riley DD, Hunt KA. Computational Thinking for the Modern Problem Solver. CRC Press; 2014 Mar 27.

References

1. Ferragina P, Luccio F. Computational Thinking: First Algorithms, Then Code. Springer; 2018.
2. Beecher K. Computational Thinking: A beginner's guide to Problem-solving and Programming. BCS Learning & Development Limited; 2017.
3. Curzon P, McOwan PW. The Power of Computational Thinking: Games, Magic and Puzzles to help you become a computational thinker. World Scientific Publishing Company; 2017

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous assessment	25
End Semester Exam	50
Total Marks	100

23CSA181	PROBLEM SOLVING AND PROGRAMMING LAB	L-T-P-C: 0-0-2-1

Course Objective(s)

- This course provides the foundations of computational problem solving.
- The course focuses on principles and methods thereby providing transferable skills to any other domain.
- The course also provides a foundation for developing computational perspectives of one's discipline.

Course Outcomes

COs	Description
CO1	Apply algorithmic thinking to understand, define and solve problems.
CO2	Design and implement algorithm(s) for a given problem.
CO3	Apply the basic programming constructs for problem-solving.
CO4	Understand an algorithm by tracing its computational states, identifying bugs and correcting them.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	3	2	3	-	3	-	-	-	2	2	-	-	2	-	-
CO3	2	1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO4	1	1	2	-	2	-	-	-	-	-	-	-	-	-	-

Syllabus

Unit I
Graphical Authoring Tool (eg: Flowgorithm) Variables, Operators- Arithmetic, Relational, assignment, logical, increment and decrement, Bitwise-Modularisation, Selection statements, Repetition statements, Data organization-Arrays.

Unit II
Introduction to Programming Language and implementation of algorithms, Operators- Arithmetic, Relational, Ternary, Logical, Bitwise**.** Control Statements-if, if-else, nested if, if-else if, Looping Control-while, for, do-while**.**

Unit III
Recursion, Introduction to arrays, Searching and Sorting

Textbooks/References

1. Ferragina P, Luccio F. Computational Thinking: First Algorithms, Then Code. Springer; 2018.
2. Beecher K. Computational Thinking: A beginner's guide to Problem-solving and Programming. BCS Learning & Development Limited; 2017.
3. Curzon P, McOwan PW. The Power of Computational Thinking: Games, Magic and Puzzles to help you.

Evaluation Pattern

Assessment	Weightage (%)
Continuous assessment	70
End Semester Exam	30
Total Marks	100

23CSA183	COMPUTER ESSENTIALS LAB	L-T-P-C: 0-0-2-1

Course Objective(s)

To impart the skills needed to assemble a PC, PC troubleshooting, and installation of system/application software.

Course Outcomes

COs	Description
CO1	Students will be able to Identify components and assemble a PC
CO2	Familiarize with disk formatting and partitioning tools
CO3	Learn to use and install operating systems and system administration tools
CO4	They will be able to use basic Linux command and familiarize with Linux Environment

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	-	-	-	-	-	-	1	-	-	1	-	-	-
CO2	1	1	-	-	1	-	-	-	1	-	-	1	-	-	-
CO3	1	1	-	-	2	-	-	-	-	-	-	-	-	-	-
CO4	1	1	-	-	2	-	-	-	-	-	-	-	-	-	-

Syllabus

Unit I

Lab: PC assembling, identification of components, bus subsystems, main chipsets on the motherboard (north bridge, south bridge), Disk formatting, Understanding disk partitions and obtaining partition information using system tools. Operating system installation, Using package manager or system tools to install/update software. Obtaining essential system resource utilization and information using system tools, troubleshooting.

Basic Linux commands, Searching the file system using find and grep with simple regular expressions. Basic process control using signals: pausing and resuming process from a Linux terminal, terminating a process. Adding/removing from search path using PATH variable. Compressing/uncompressing using tar/gzip and zip tools. Using man pages to understand tool documentation.

Textbooks/References

1. Mastering Pc Hardware And Networking Paperback – Big Book, 1 January 2014. Ajit Mittal, Ajay Rana.
2. The Complete Reference PC Hardware – Craig Zacker, John Rourke, Tata McGraw-Hill, 2004.
3. All about Hard Disk- Manohar Lotia, BPB Publications.
4. P K Sinha & Priti Sinha, “Computer Fundamentals”, Fourth Edition, BPB Publications, (2004).
5. Halsey M. Windows 10 Troubleshooting. Apress; 2016.
6. Soyinka W. Linux Administration: A Beginner’s Guide. Fifth Edition, Mc Graw Hill Professional;2008.

Evaluation Pattern

Assessment	Weightage (%)
Continuous assessment	70
End Semester Exam	30
Total Marks	100

SEMESTER II

22ADM111	GLIMPSES OF GLORIOUS INDIA	L-T-P-C:2-0-1-2

Course Objective(s)

To introduce students to the depths and richness of the Indian culture and knowledge traditions, and to enable them to obtain a synoptic view of the grandiose achievements of India in diverse fields. To equip students with a knowledge of their country and its eternal values.

Course Outcomes

COs	Description
CO1	This part deals with two topics: The Need to Become Fearless in Life and the Role or Status of Women in India.
CO2	This part deals with three topics: Teachings and Principles of Chanakya, Difference between the terms God and Iswara and Contribution of Bhagavad Gita
CO3	This area handles two important concepts: Indian Soft powers and A portrayal of how nature was preserved through the medium of Faith. Inner power is about never giving up on your dreams. To manifest more of what you desire in life, you must be prepared to embrace your inner power. You must be persistent if you wantto succeed. Maintain your modesty and never stop learning. Inner strength is an attitude to life. Faiths shape and direct how we think, act, and live our lives. However, faith's power is not solely spiritual. To preserve nature, our forefathers established systems and traditions based on faith. Our culture and faith are intricately bound to nature.
CO4	Two important topics are discussed here: A Brief history of Ancient Indian Cultures and a Discussion on Practical Vedanta. Indian culture is the legacy of the ethno-linguistically diverse country's social norms, moral principles, traditional practices, belief systems, political systems, artefacts, and technologies. Following every invasion or change of political control, new kingdoms carried their respective cultures with them, adding to the Indian culture. Vedanta is the philosophy of the Upanishads. Every soul possesses the potential to be divine. The objective is to manipulate this inner divinity by invoking both internal and external natural forces.
CO5	From this part, a student gets an insight into the contribution that India has made to the world. Moreover, foreign powers have been trying to humiliate and degrade India in front of the world for so long. However, it should be recognized that many inventions that are considered beneficial to the world today have been contributed by the great men of India.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	3	2	2	-	-	-	3	-	-	3	-	-	-
CO2	-	-	2	-	-	-	-	2	2	-	-	2	-	-	-
CO3	-	-	3	-	2	-	3	2	2	-	-	3	-	-	-
CO4	-	-	1	-	-	-	1	1	-	-	1	-	-	-	-
CO5	2	-	-	1	1	-	2	-	-	-	3	3	-	-	-

Syllabus

1. Chapter 1 - Face the Brutes
2. Chapter 2 - Role of Women in India
3. Chapter 3 - Acharya Chanakya
4. Chapter 4 - God and Iswara
5. Chapter 5 - Bhagavad Gita: From Soldier to Samsarin to Sadhaka

6. Chapter 6 - Lessons of Yoga from Bhagavad Gita
7. Chapter 7 - Indian Soft Powers: A Solution For Many Global Challenges
8. Chapter 8 - Nature Preservation through faith
9. Chapter 9 - Ancient Cultures what happened to them.
10. Chapter 10 - Practical Vedanta
11. Chapter 11 - To the World from India
12. Chapter 12 - IndianApproach to Science

Textbooks/References

1. Glimpses Of Glorious India

Evaluation Pattern

Assessment	Weightage (%)
Midterm	30
Continuous Assessment	20
End Semester Exam	50
Total Marks	100

21ENG111	PROFESSIONAL COMMUNICATION	L-T-P-C: 1-0-2-2

Course Objective(s)

To convey and document information in a formal environment; to acquire the skill of self-projection in professional circles; to inculcate critical and analytical thinking.

Course Outcomes

COs	Description
CO1	Recall the fundamentals of linguistic features in communication.
CO2	Apply different styles of communication in professional context.
CO3	Demonstrate competence in different planned & extempore communicative activities.
CO4	Interpret and discuss facts and information in each context.
CO5	Write a mini project exercising critical and analytical thinking.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-

Syllabus

Unit I
Vocabulary Building: Prefixes and Suffixes; One-word substitutes, Modal auxiliaries, Error Analysis: Position of Adverbs, Redundancy, modifiers (displaced, dangling etc.).

Unit II
Instruction, Suggestion & Recommendation - Sounds of English: Stress, Intonation
- Essay writing: Analytical and Argumentative.

Unit III
Circulars, Memos, Business Letters, E-mails.

Unit IV
Reports: Trip report, incident report, event report - Situational Dialogue - Group Discussion.

Unit V
Mini Project and Presentation

Textbooks/References

1. Felix Eskey. Tech Talk, University of Michigan. 2005
2. Michael Swan. Practical English Usage, Oxford University Press. 2005
3. Anderson, Paul. Technical Communication: A Reader Centred Approach, V Edition, Harcourt, 2003.

4. Raymond V. Lesikar and Marie E. Flatley. Basic Business Communication, Tata McGraw Hill Pub. Co. New Delhi. 2005. Tenth Edition.
5. Thampi, G. Balamohan. Meeting the World: Writings on Contemporary Issues. Pearson, 2013.
6. Lynch, Tony. Study Listening. New Delhi: CUP, 2008.
7. Kenneth, Anderson, Tony Lynch, Joan Mac Lean. Study Speaking. New Delhi: CUP, 2008.
8. Marks, Jonathan. English Pronunciation in Use. New Delhi: CUP, 2007.
9. Syamala, V. Effective English Communication for You (Functional Grammar, Oral and Written Communication): Emerald, 2002.

Evaluation Pattern

Assessment	Weightage (%)
Internal Assessment	80
External Assessment	20
Total Marks	100

23MAT118	PROBABILITY AND STATISTICS	L-T-P-C: 3-0-2-4

Course Objective(s)

- To understand the measures of central tendencies.
- To understand the concepts of basic probability and random variables.
- To understand some standard distributions and apply to some problems.
- To understand the correlation and regressions for given set of data.

Course Outcomes

COs	Description
CO1	Understand and apply different measures of central tendency with some discrete data.
CO2	Understand the basic concepts of probability and probability modeling.
CO3	Gain knowledge about statistical distributions of one and two dimensional random variables and correlations.
CO4	Gain knowledge about correlation and regression analysis.
CO5	Understand the hypothetical testing for small and large samples.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	1	2	-	2
CO2	3	-	-	-	-	-	-	-	-	-	-	1	2	-	2
CO3	3	-	-	-	-	-	-	-	-	-	-	1	2	-	2
CO4	3	-	-	-	-	-	-	-	-	-	-	1	2	-	2
CO5	3	-	-	-	-	-	-	-	-	-	-	1	2	-	2

Syllabus

Unit I
Measures of Central Tendency (Mean, Median, Mode), Measures of Dispersion (Range, Inter quartile range, Standard deviation,), skewness and kurtosis. Introduction to Probability: Probability, Conditional Probability, Multiplication and Total Probability rules, Independence, Bayes theorem.

Unit II
Random variables, Probability Distributions. Mathematical expectation and variance.
Standard distributions – Binomial, Poisson, Standard continuous distributions –Exponential and Normal distributions.
Two dimensional random Variables-Joint, marginal and conditional probability distributions for discrete case only. Data Correlation Analysis, Regression analysis.

Unit III
Introduction to hypothesis testing - large sample tests for single mean and two means. Small sample tests for single mean and two means – test for single variance – test for equality of two variances. Chi-square test for goodness of fit.
Lab and Case Studies: Implementation of various statistical measures like, mean, mode and deviations. Linear regression and correlations. Case studies with real time data.

Textbooks

1. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Probability and Statistics for Engineers and Scientists, 8th Edition, Pearson Education Asia, 2007.

References

1. Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, John Wiley and Sons Inc., 2005
2. Ross S.M., Introduction to Probability and Statistics for Engineers and Scientists, 3rd edition, Elsevier Academic Press.
3. Ravichandran, J. Probability and Statistics for engineers, First Reprint Edition, Wiley India, 2012.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment (Including lab)	45
End Semester Exam	30
Total Marks	100

*End Semester Exam to be conducted for 60 Marks

23CSA111	DATABASE MANAGEMENT SYSTEM	L-T-P-C: 3-1-0-4

Course Objective(s)

The objective of the course is to present an introduction to database management systems, with an emphasis on how to organize, maintain and retrieve - efficiently, and effectively - information from a DBMS.

Course Outcomes

COs	Description
CO1	Master the basic concepts of DBMS and its types. Understand the concepts of data independence and three schema architecture.
CO2	Be familiar with the CODD's rules and E-R Model and also have clear picture about the structure of the relational databases.
CO3	Master the concept of normalization and different types of normalization. Design normalised database objects and process the data in an optimized way.
CO4	Be familiar with the basics of query evaluation techniques and query optimization and to get a clear picture about transaction processing.
CO5	Comprehend the conversion of queries into relational algebra and to construct query transactions having atomic, consistent, isolated and durable properties.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	1	-	-	-	-	-	-	-	1	-	2
CO2	3	3	-	-	-	1	-	1	-	-	-	-	-	-	1
CO3	3	3	-	-	-	-	1	-	-	-	1	-	1	-	1
CO4	3	3	2	-	1	-	-	-	1	-	-	-	1	-	1
CO5	3	3	2	-	-	-	-	-	-	1	-	1	-	-	1

Syllabus

Unit I

Introduction to Data and Database. Significance of Database Management System, Various Types of DBMS. Data Independence - The Three Levels of Architecture - The External Level - Conceptual Level - Internal Level - Client/Server Architecture- System Structure, Instance and Schema,

Unit II

Keys - CODD’s Rules, Design Issues -ER – Model –Attribute types- Weak Entity Sets - Extended ER Features –ER to Relational Mapping, Structure Of Relational Databases, Creation and Manipulation of Database using Basic SQL(DDL, DML,DCL,TCL)

Unit III

Normalization –Anomalies- Functional Dependency: Armstrong’s axioms- closure of a relation and closure of attribute– Lossless decomposition-1NF, 2NF, 3NF, Boyce - Codd Normal Form

Unit IV

The Relational Algebra -- Query Processing and Optimization: Evaluation of Relational algebra expressions-Query Equivalence-Transaction Processing: ACID properties, states of a transaction- Introduction to concurrency control-Deadlock-Recovery.

Textbooks

1. Silberschatz Korth. Sudarshan: Database System Concepts - 6thEdition Mcgraw-Hill International Edition
2. Ivan Bayross: Sql- PL/SQL The Programming Language of Oracle- 4rd Edition- Bpb Publications

References

1. C.J. Date: An Introduction To Database Systems - Eighth Edition - PearsonEducation Asia
2. Kevin Loney - George Koch: Oracle 9i The Complete Reference Mcgraw-Hill International Edition
3. "Fundamentals of Database Systems" by Elmasri and Navathe

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

23CSA115	OBJECT ORIENTED PROGRAMMING USING JAVA	L-T-P-C: 3-1-0-4

Course Objective(s)

The course aims to provide a thorough understanding of the core concepts of object-oriented programming, including classes, objects, inheritance, polymorphism, encapsulation, and abstraction. Students will grasp the principles behind OOP and learn how to apply them effectively in Java.

Course Outcomes

COs	Description
CO1	Identify classes, objects, members of a class and relationships among them needed for a specific problem.
CO2	Write Java application programs using OOP principles and proper program structuring.
CO3	Demonstrate the concepts of polymorphism, inheritance and thread and document a Java Program using Javadoc.
CO4	Understand and Implement Generics and Collection Framework.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	1	-	-	1	-	-	-
CO2	3	3	3	-	-	-	1	1	1	-	-	2	-	-	1
CO3	3	2	2	-	-	-	-	-	1	-	-	2	-	-	-
CO4	3	3	3	-	-	-	-	-	1	-	-	1	-	-	1

Syllabus

Unit I
Java Fundamentals, Introduction to Classes, Objects and Methods, Object Oriented Concepts, Inheritance, Polymorphism, Abstract Classes & Interfaces.

Unit II
Exception Handling, Using I/O - Streams, read and write binary files, character streams for file I/O

Unit III
Introduction to Threads, Creating Threads, Thread States, Runnable Threads, Coordinating Threads, Interrupting Threads, Runnable Interface, Synchronization.

Unit IV
Collection framework, Generics, Lambda Expressions – expression lambdas, block lambdas, Method & Constructor References.

Textbooks

1. Herbert Schildt, “Java, A Beginner’s Guide”, Ninth Edition, McGraw-Hill Education, 2022

References

1. Ali Bahrami, “Object Oriented Systems Development”, Second Edition, McGraw-Hill,2008.
2. Jaime Nino, Fredrick a Hosch, “An Introduction to Programming and Object-Oriented Design using Java”, Wiley India Private Limited, 2010
3. Herbert Schildt, “Java: The Complete Reference, Eleventh Edition”, Oracle 2018

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

23CSA116	OPERATING SYSTEM	L-T-P-C: 3-1-0-4

Course Objective(s)

A successful student will be able to understand the basic components of a computer operating system, and the interactions among the various components. The course will cover an introduction on the policies for scheduling, deadlocks, memory management, synchronization, system calls, and file systems.

Course Outcome

COs	Description
CO1	Explain the basic concepts of operating system with different types of OS, services and system calls
CO2	Get knowledge of process management, Inter process communication and various CPU scheduling algorithms
CO3	Learn about deadlocks, methods of handling deadlocks and preventing deadlocks
CO4	Describe the concept of memory management -paging and segmentation.
CO5	Learn about various I/O systems and mass storage structures

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	3	2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	2	3	1	3	-	-	-	-	-	-	-	-	-	-	-
CO4	2	1	2	2	-	-	-	-	-	-	-	-	-	-	-
CO5	1	2	2	2	-	-	-	-	-	-	-	-	-	-	-

Syllabus

UNIT I

Introduction to Operating Systems: Mainframe systems-Desktop systems-Multiprocessor systems- Distributed systems-Clustered systems-Real-time systems-Handheld systems.

Operating System Structures: System components-Operating System services-System calls- System Programs.

UNIT II

Process Management: Process Concept-Process Scheduling-Operations on processes-Cooperating processes-Inter Process Communication. CPU Scheduling: Basic concepts-Scheduling criteria- Scheduling Algorithms-First Come First served Scheduling, Shortest job First Scheduling, Round Robin Scheduling, Multilevel Queue Scheduling, Multilevel Feedback Queue Scheduling.Process synchronisation: Background, critical section problem, semaphores, producer consumer problem, dining philosophers problem, readers and writers problem.

UNIT III

Deadlocks: System Model-Deadlock Characterization-Methods for handling Deadlocks-Deadlock Prevention-Deadlock Avoidance-Deadlock detection-Recovery from deadlock.

UNIT IV

Memory Management: Background-Swapping-Contiguous Memory allocation-Paging- Segmentation-Segmentation with Paging. Virtual Memory: Background-Demand paging-Process creation-Page replacement-Allocation of Frames-Thrashing.

UNIT V

I/O Systems: Overview, I/O Hardware

Mass storage structure- Disk structure, disk scheduling, disk management. Case study on desktop and mobile operating system

Textbooks

1. Silberschatz and Galvin, “Operating System Concepts”, 10th Edition, John Wiley and Sons, 2021.

References

1. Godbole - Operating Systems - Tata McGraw Hill Publications
2. H.M Deitel - Operating Systems - Second Edition - Pearson Edition Asia
3. Andrew S. Tannenbaum, “Modern Operating Systems”, 4th Edition, Pearson, 2015.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

23CSA184	OBJECT ORIENTED PROGRAMMING USING JAVA LAB	L-T-P-C: 0-0-2-1

Course Objective(s)

The course aims to provide a thorough understanding of the core concepts of object-oriented programming, including classes, objects, inheritance, polymorphism, encapsulation, and abstraction. Students will grasp the principles behind OOP and learn how to apply them effectively in Java.

Course Outcomes

COs	Description
CO1	The skills to apply OOP in Java programming in problem solving.
CO2	Write a complete class definition and within the class definition, write constructor and overloaded methods.
CO3	Conceptualize, Analyze and write programs to solve more complicated problems using the concepts of multi-threading and Exception handling.
CO4	Understand and Implement Generics and Collection Framework.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	1	-	-	1	-	-	-
CO2	3	3	3	-	-	-	1	1	1	-	-	2	-	-	1
CO3	3	2	2	-	-	-	-	-	1	-	-	2	-	-	-
CO4	3	3	3	-	-	-	-	-	1	-	-	1	-	-	1

Syllabus

Input / Output statements, Manipulators, Structures, Classes, Objects, Static members and functions, Constructors and destructors, Constructor overloading, Function overloading, Forms of inheritance, Exception handling, Interfaces, Multithreading, Thread Synchronization, Generics, Collection Framework, AWT, Swing, Event Handling, Lambda Expressions.

Textbooks

1. Herbert Schildt, “Java, A Beginner’s Guide”, Ninth Edition, McGraw-Hill Education, 2022

References

1. Ali Bahrami, “Object Oriented Systems Development”, Second Edition, McGraw-Hill,2008.
2. Jaime Nino, Fredrick a Hosch, “An Introduction to Programming and Object-Oriented Design using Java”, Wiley India Private Limited, 2010
3. Herbert Schildt, “Java: The Complete Reference, Eleventh Edition”, Oracle 2018

Evaluation Pattern

Assessment	Weightage (%)
Continuous Assessment	70
End Semester Exam	30
Total Marks	100

23CSA185	DATABASE MANAGEMENT SYSTEM LAB	L-T-P-C: 0-0-2-1

Course Objective(s)

- The objective of this lab course is to understand the practical applicability of database management system concepts.
- Working on existing database systems, designing of database, creating relational database, analysis of table design.

Course Outcomes

COs	Description
CO1	Master the basic commands of SQL and its usage
CO2	Design tables and insert Relevant data for query manipulation
CO3	Understand the application of SQL functions, sub queries and joins
CO4	Construct interactive PL/SQL programs for database applications

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	-	1	-	-	-	-	-	-	-	1	-	2
CO2	2	3	2	-	-	-	-	-	-	-	-	-	1	-	2
CO3	2	3	3	-	-	-	-	-	-	-	-	-	1	-	2
CO4	2	3	3	-	1	-	-	-	1	-	-	-	2	-	2

Syllabus

Basic SQL Commands DML- Select, insert, Delete DDL Commands-Create, Drop, Alter
Built in SQL functions- Set operations, Sub Queries-Joins-DCL – TCL- Views – Sequences – Index – Locks
PL/SQL Basics – Exceptions – Cursors - Stored Functions – Triggers Programming with PL/SQL

Textbooks

1. Silberschatz Korth. Sudarshan: Database System Concepts - 6thEdition Mcgraw-Hill International Edition
2. Ivan Bayross: Sql- PL/SQL The Programming Language of Oracle- 4rd Edition- Bpb Publications

References

3. C.J.Date: An Introduction To Database Systems - Eighth Edition - PearsonEducation Asia
4. Kevin Loney - George Koch: Oracle 9i The Complete Reference Mcgraw-Hill International Edition

"Fundamentals of Database Systems" by Elmasri and Navathe

Evaluation Pattern

Assessment	Weightage (%)
Continuous Assessment	70
End Semester Exam	30
Total Marks	100

SEMESTER III

22ADM201	STRATEGIC LESSONS FROM MAHABHARATA	L-T-P-C: 1-0-0-1

Course Objective(s)

To introduce students to the depths and richness of the Indian culture and knowledge traditions, and to enable them to obtain a synoptic view of the grandiose achievements of India in diverse fields. To equip students with a knowledge of their country and its eternal values

Course Outcomes

COs	Description
CO1	Increase student understanding of 'Mahabharata 'with this lesson plan.
CO2	Appreciate the relevance of Mahabharata for modern times.
CO3	Understand the ethical and political strategic concepts to induce critical approach to Mahabharata.
CO4	Familiarize students with the inspirational female characters and regional tales from Mahabharata to gain a coherent understanding of it on Indian values and culture.
CO5	Appreciate the relevance of Mahabharata for modern times and identify its imperativeness in everyday life.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	1	-	1	-	1	1	1	-	1	2	-	-	-
CO2	-	3	2	2	3	-	3	2	2	-	-	3	-	-	-
CO3	-	3	2	-	2	-	2	3	2	-	-	3	-	-	-
CO4	-	-	2	-	-	-	-	2	2	-	2	1	-	-	-
CO5	-	3	2	2	3	-	2	2	2	-	-	3	-	-	-

Syllabus

1. Chapter 1 Mahābhārata - A Brief Summary
2. Chapter 2 A Preamble to the Grand Itihāsa
3. Chapter 3 The Unbroken Legacy
4. Chapter 4 Dharmic insights of a butcher
5. Chapter 5 The Vows we take: Pratijñā
6. Chapter 6 Mahābhārata - The Encyclopaedia for Kingship and Polity Acumen
7. Chapter 7 Karna: The Maestro that Went Wide of the Mark
8. Chapter 8 Strategical Silhouette of An Extraordinary Peace Mission
9. Chapter 9 Yajñaseni, A Woman from Fire.
10. Chapter 10 Popular Regional Tales
11. Chapter 11 Death andDeathlessness

Self-Study / Self-Reading

1. Chapter 12 Mahabharata- An All-Encompassing Text
2. Chapter 13 Mahabharatha- Whats and What Nots
3. Chapter 14 Mahābhārata in Adages

Textbooks/References

1. Strategic Lessons from Mahabharata

Evaluation Pattern

Assessment	Weightage (%)
Internal Assessment	20
Continuous Assessment	30
End Semester Exam	50
Total Marks	100

21SSK201	LIFE SKILLS I	L-T-P-C: 1-0-2-2

Course Objective(s)

To assist students in inculcating soft skills, developing a strong personality, empowering them to face life's challenges, improving their communication skills and problem-solving skills.

Course Outcomes

COs	Description
CO1	**Soft Skills -** To develop greater morale and positive attitude to face, analyze, and manage emotions in real life situations, like placement process.
CO2	**Soft Skills -** To empower students to create better impact on a target audience through content creation, effective delivery, appropriate body language and overcoming nervousness, in situations like presentations, Group Discussions and interviews.
CO3	**Aptitude** – To analyze, understand and solve questions in arithmetic, algebra and data analysis by employing the most suitable methods.
CO4	**Aptitude -** To investigate and apply suitable techniques to solve questions on logical reasoning.
CO5	**Verbal** - To infer the meaning of words & use them in the right context. To have a better understanding of the nuances of English grammar and become capable of applying them effectively.
CO6	**Verbal** - To identify the relationship between words using reasoning skills. The students would also have developed the capacity to communicate their ideas effectively.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	2	2	3	1	2	-	-	-
CO2	-	-	-	-	-	-	-	2	2	3	1	1	-	-	-
CO3	3	3	2	2	-	-	-	-	1	1	-	1	-	-	-
CO4	3	3	3	2	1	-	-	-	-	-		1	1	-	-
CO5	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO6	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-

Syllabus

Unit I
Learning Objectives of Soft Skills

After completion of Soft Skills, the learners will be able to showcase a strong personality, display confidence and do impactful presentations.

Soft Skills and its importance: Pleasure and pains of transition from an academic environment to work-environment. New-age challenges and distractions. Learning to benefit from constructive criticisms and feedback, Need for change in mindset and up-skilling to keep oneself competent in the professional world.

Managing Self: Knowing oneself, Self-perception, Importance of positive attitude, Building and displaying confidence, Avoiding being overconfident, Managing emotions, stress, fear. Developing Resilience and handling failures. Self-motivation, Self-learning, and continuous knowledge up-gradation / Life-long learning. Personal productivity - Goal setting and its importance in career planning, Self-discipline, Importance of values, ethics and integrity, Universal Human Values.

Communication: Process, Language Fluency, Non-verbal, Active listening. Assertiveness vs. aggressiveness. Barriers in communication. Digital communication.

Unit II

Learning Objectives of Aptitude

After completion of Aptitude, the learners will be able to use appropriate results and methods to analyze and solve problems from topics such as numbers, percentage, ratios, averages, data interpretation and data sufficiency.

Numbers: Types, Power Cycles, Divisibility, Prime, Factors & Multiples, HCF & LCM, Surds, Indices, Square roots, Cube Roots, and Simplification.

Percentage: Basics, Profit, Loss & Discount, and Simple & Compound Interest.

Ratio, Proportion & Variation: Basics, Alligations, Mixtures, and Partnership.

Averages: Basics, and Weighted Average.

Equations: Basics, Linear, Quadratic, Equations of Higher Degree and Problems on ages.

Logical Reasoning I: Blood Relations, Direction Test, Syllogisms, Series, Odd man out, Coding \& Decoding, Cryptarithmetic Problems and Input - Output Reasoning.

Unit III

Learning Objectives of Verbal Skills

After completion of Verbal Skills, the learners will be able to use the right diction, avoid grammatical errors, refine their reasoning ability and communicate effectively.

Vocabulary: Familiarize students with the etymology of words, help them realize the relevance of word analysis and enable them to answer synonym and antonym questions. Create an awareness about the frequently misspelt words, commonly confused words and wrong form of words in English.

Grammar (Basics): To learn the usage of grammar and facilitate students to identify errors and correct them.

Reasoning: Stress the importance of understanding the relationship between words through analogy questions. Emphasize the importance of avoiding the gap (assumption) in the argument/ statements/ communication.

Speaking Skills: Make students conscious of the relevance of effective communication in today's world through individual speaking activities.

Writing Skills: Introduce formal written communication and keep the students informed about the etiquette of email writing.

Textbooks/References

1. Gulati. S., (1006) "Corporate Soft Skills", New Delhi, India: Rupa & Co.
2. The hard truth about Soft Skills, by Amazon Publication.
3. Verbal Skills Activity Book, CIR, May 2018
4. Nova's GRE Prep Course, Jeff Kolby, Scott Thornburg & Kathleen Pierce
5. The BBC and British Council online resources
6. Owl Purdue University online teaching resources
7. www.thegrammarbook.com online teaching resources
8. www.englishpage.com online teaching resources and other useful websites
9. Student Workbook: Quantitative Aptitude & Reasoning, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
10. Quantitative Aptitude for All Competitive Examinations, Abhijit Guha.
11. How to Prepare for Quantitative Aptitude for the CAT, Arun Sharma.
12. How to Prepare for Data Interpretation for the CAT, Arun Sharma.
13. How to Prepare for Logical Reasoning for the CAT, Arun Sharma.
14. Quantitative Aptitude for Competitive Examinations, R S Aggarwal.
15. A Modern Approach to Logical Reasoning, R S Aggarwal.
16. A Modern Approach to Verbal & Non-Verbal Reasoning, R S Aggarwal.

Evaluation Pattern

Assessment	Internal Weightage (%)	External Weightage (%)
Continuous Assessment (Soft Skills)	30	-
Continuous Assessment (Aptitude)	10	25
Continuous Assessment (Verbal)	10	25
Total Marks	50	50

23MAT207	LINEAR ALGEBRA	L-T-P-C: 3-0-2-4

Course Objective(s)

- Understand the basic concepts of vector space, subspace, basis and dimension.
- Familiar the inner product space. Finding the orthogonal vectors using inner product.
- Understand and apply linear transform for various matrix decompositions.
- Familiarize the concepts of eigenvalues and eigenvectors and its applications.

Course Outcomes

COs	Description
CO1	Understand the basic concepts of vector space, subspace, basis and dimension.
CO2	Understand the basic concepts of inner product space, norm, angle, Orthogonality, projection and implementing the Gram-Schmidt process, to obtain least square solution.
CO3	Understand the concept of linear transformations, the relation between matrices and linear transformations, kernel, range and apply it to change the basis and to transform the given matrix to diagonal/Jordan canonical form.
CO4	Understand the eigen values and eigen vectors and apply them to transformation problems.
CO5	Perform case studies on least square and image transformations.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	1	2	-	3
CO2	3	3	-	-	-	-	-	-	-	-	-	1	2	-	3
CO3	3	3	-	-	-	-	-	-	-	-	-	1	2	-	3
CO4	3	3	-	-	-	-	-	-	-	-	-	1	1	-	2
CO5	3	3	-	-	-	-	-	-	-	-	-	1	2	-	2

Syllabus

Unit I
Vector Spaces: Vector spaces - Sub spaces - Linear independence - Basis – Dimension.
Inner Product Spaces: Inner products - Orthogonality - Orthogonal basis - Gram Schmidt Process - Change of basis - Orthogonal complements - Projection on subspace - Least Square Principle. QR- Decomposition.

Unit II
Linear Transformations: Linear transformation - Relation between matrices and linear transformations - Kernel and range of a linear transformation - Change of basis - Nilpotent transformations. Symmetric and Skew Symmetric Matrices.

Unit III
Eigen values and Eigen vectors: Eigen Values and Eigen Vectors, Diagonalization, Orthogonal Diagonalization, Quadratic Forms, Diagonalizing Quadratic Forms, Conic Sections. Similarity of linear transformations - Diagonalization and its applications.

Unit IV
Case Studies: Applications on least square and image transformations.
Lab Practice Problems: Matrices, Matrix operations. Solving system of linear equations, rank and nullity. Orthogonality. Matrix of linear transformations. Affine transformations, scaling, shifting and rotation of images. Eigen values and eigen vectors and matrix decompositions.

Textbooks

1. Howard Anton and Chris Rorrs, “Elementary Linear Algebra”, Ninth Edition, John Wiley & Sons, 2000.

References

1. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
2. Gilbert Strang, “Linear Algebraand its Applications”, Third Edition, Harcourt College Publishers, 1988.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment (including lab)	45
End Semester Exam	30
Total Marks	100

*End Semester Exam to be conducted for 60 Marks

23CSA202	EXPLORATORY DATA ANALYSIS USING PYTHON	L-T-P-C: 3-0-2-4

Course Objective(s)

From this course, students can gain a solid foundation in data analysis using Python and gain knowledge of the various tools and techniques used in exploratory data analysis and visualization.

Course Outcomes

COs	Description
CO1	To anlayze the structure, syntax, and semantics of Python language.
CO2	Analyze the basic Python libraries and their usage in preprocessing and visualization of data.
CO3	Apply the appropriate manipulations in different data types of Python.
CO4	Demonstrate various real-time scenarios to build the practical application using Python.
CO5	Explore different Python packages of data analysis for real-world problems.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	-	1	-	3	1	1
CO2	3	3	3	2	-	-	-	-	-	-	-	-	2	1	1
CO3	3	3	3	1	1	-	-	-	-	-	1	2	3	1	1
CO4	3	3	3	1	2	-	-	-	-	-	-	2	3	1	1
CO5	2	2	3	2	3	-	2	-	-	-	1	-	3	2	1

Syllabus

Unit I

Introduction to Python: Python variables, Python basic Operators, Understanding python blocks. Python Data Types, Declaring and using Numeric data types: int, float etc.

Unit II

Python Program: Flow Control-Conditional blocks: if, else and else if, Looping- Simple for loops in python, For loop using ranges, Use of while loops, string, list and dictionaries, Loop manipulation using pass, continue, break and else. Programming using Python conditional and loop blocks.

Unit III

Python Complex data types: String- Using string in-built functions and string operations, List-list slicing, functions and methods in list, and List manipulation. Dictionary-Functions and methods in dictionary, dictionary manipulations Iterators and iterables Python Functions, organizing python codes using functions, File Handling-Read, Write, Create and Delete

Unit IV

Demonstration: The Numerical Python Library (NumPy), Pandas. The Series Data Structure, Querying a Series, Pandas - Data frames -The Data Frame Data Structure, Indexing and Loading, Querying a Data Frame, Handling missing values.

Unit V

Understanding the Python Packages for Data Science- SciKit Learn, MatPlot Lib, Importing and Exporting Data in Python, Getting Started Analyzing Data in Python, Understanding the Data,Data Formatting, Python, Data Summarization, aggregation and grouping of data.

Textbooks/References

1. Yashavant kanetkar, Aditya Kanetkar,"Let us Python",3rd Edition,bpb publication
2. Wesley J. Chun, "Core Python Applications Programming", 3rd Edition , Pearson Education, 2016
3. Jeeva Jose & P.Sojan Lal, "Introduction to Computing and Problem Solving with PYTHON", Khanna Publishers, New Delhi, 2016
4. Downey, A. et al., "How to think like a Computer Scientist: Learning with Python", John Wiley, 2015
5. John Zelle, "Python Programming: An Introduction to Computer Science", Second edition, Course Technology Cengage Learning Publications, 2013, ISBN 978- 15902824.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment (including lab)	45
End Semester Exam	30
Total Marks	100

*End Semester Exam to be conducted for 60 Marks

23CSA203	DATA STRUCTURES AND ALGORITHMS	L-T-P-C: 3-1-0-4

Course Objective(s)

This course intends to give a solid introduction to elementary data structures and its applications. It also gives the basics of algorithm analysis, how to analyse simple algorithms, and express its complexity using 'O' notation.

Course Outcomes

COs	Description
CO1	Analyze the time complexity of simple algorithms.
CO2	Illustrate different sorting and searching algorithms and compare them based on time complexity.
CO3	Implement linear data structures and choose appropriate one for solving problems.
CO4	Use appropriate Tree data structures in solving computing problems.
CO5	Implement Graph data structure and explain major Graph algorithms.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	-	-	-	-	-	-	-	-	-	2	3	1
CO2	3	1	1	-	-	-	-	-	-	-	-	-	3	2	-
CO3	3	3	1	-	-	-	-	-	-	-	-	1	1	3	-
CO4	3	3	1	-	-	-	-	-	-	-	-	-	3	3	1
CO5	2	3	2	-	-	-	-	-	-	-	-	-	3	3	1

Syllabus

Unit I
Algorithm Analysis
Mathematical preliminaries; Efficiency of algorithms - notion of time and space complexity, Basic Complexity Analysis - Worst case, Average case and Best cases, Asymptotic Analysis- notations, analyzing iterative programs – Simple examples; Recurrences, Analysis of Divide and conquer algorithms - Merge sort, Substitution Method, Master method.

Unit II
Searching and Sorting
Linear Search, Binary Search – Analysis
Bubble Sort, Insertion Sort, Merge sort, Quick Sort - Analysis
Recursion – Tower of Hanoi

Unit III
Linear Data Structures
Abstract Data Type, Array, List ADT: Singly linked lists, Doubly linked lists, Circular Linked Lists, Stack ADT implementation and applications, Queue ADT: Implementation and Application. Circular Queue, Priority Queue.

Unit IV
Non- Linear Data Structures
Basic concepts of trees, Implementation of trees, Traversal, Binary tree, Expression tree, Binary search tree, AVL tree, Heaps.

Unit V

Adjacency matrix, Adjacency list, Breadth First Search, Depth First Search, Minimum Spanning Tree- Prim's and Kruskal's Algorithm, Dijkstra's algorithm.

Textbooks

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Second Edition, Pearson Education
2. Narasimha Karumanchi, "Data Structures and Algorithms Made Easy in Java" Second Edition, Career-Monk Publication.

References

1. Samanta, Debasis. Classic Data Structures. PHI Learning Pvt. Ltd., 2004.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein. Introduction to Algorithms, 3rd edition, MIT Press, 2009.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous assessment	25
End Semester Exam	50
Total Marks	100

23CSA204	COMPUTER NETWORKS	L-T-P-C: 3-1-0-4

Course Objective(s)

This course studies the standard models for the layered approach to communication between autonomous machines in a network, and the main characteristics of data transmission across various physical link types. It considers how to design networks and protocols for diverse situations, analyses several protocols, and identifies significant problem areas in networked communications.

Course Outcome

COs	Description
CO1	Explain the basic network concepts, including the structure and operation of the different types of networks
CO2	Must be able to understand the design of different networks and related reference models used.
CO3	Comprehend the basic working principles behind switching techniques used in communication channels.
CO4	Familiarize the routing techniques and congestion control mechanisms used in Routers. Must be able to understand and successfully apply routing algorithms for optimization.
CO5	Must be able to understand, how is the end-to-end connection mechanism works at the transport layer.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	1	2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	1	1	1	-	-	1	-	-	-	1	-	-	-	-	-
CO4	3	3	1	1	3	1	-	-	-	-	-	-	-	-	-
CO5	1	2	2	2	1	-	-	-	-	-	-	-	-	-	-

Syllabus

Unit I: Introduction to Computer Networks
Introduction To Computer Networks: Introduction: Definition of a Computer Network; Components of a computer network; Classification of networks; Transmission Medium; Wireless transmission; Local area networks, Metropolitan area networks, Wide area networks, Wireless networks ; Data transmission modes;

Unit II:-Layered Architecture
Network Software & Network Standardization: Networks Software; Protocol hierarchy, Design issues for the layers, Merits and De-merits of Layered Architecture, Reference models; The OSI Reference Model, The TCP/IP Reference Model, Comparison of the OSI & the TCP/IP Reference Models

Unit III: Physical Layer
Physical Layer: Network topologies; Switching; Circuit switching, Message switching, Packet switching, Relationship between Packet Size and Transmission time, Comparison of switching techniques: Multiplexing; FDM, WDM, TDM

Unit IV: Network Layer
Network Layer: Design issues of Network layer; Nature of the service provided, Routing, Congestion control, Types of routing algorithms, Classes of routing algorithms, Properties of routing algorithms, Optimality principle: Routing algorithms; Shortest path algorithm, Flooding, Distance vector routing, Hierarchical routing, Link state routing, Factors of congestion, Comparison of flow control and congestion control, General principles of congestion control

Unit V: Transport Layer
Transport Layer: Services of Transport layer; Service primitives: Connection establishment: Connection Release: Transport Protocols;

Textbooks

1. Computer Networks, 4th Edition, Andrew S. Tanenbaum.

References

1. Computer Networks: A Top-Down approach, Behrouz A Forouzan, Firouz Mosharraf, McGraw Hill Education.
2. Computer Networking: A Top-Down Approach, 6th Edn, Kurose James F., Keith W Ross, Pearson publications.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

23CSA205	SOFTWARE ENGINEERING	L-T-P-C: 2-1-0-3

Course Objective(s)

- The course provides a professionally guided education in software engineering that helps students to transition into an amateur software engineer by exposing themselves to a broad perspective on software systems engineering, concentrating on widely used techniques for developing large-scale software systems.
- This course covers a wide spectrum of software processes from initial requirements elicitation through design and development to system evolution

Course Outcomes

COs	Description
CO1	Learn to apply the knowledge of software engineering methodologies to identify, formulate, and solve software engineering problems.
CO2	Understand the ability to analyze the complex system by applying analytical, engineering and knowledge-based techniques to clearly understand the requirements.
CO3	An ability to design a system, component, or process to meet desired needs within realistic constraints relevant to the system.
CO4	An ability to implement, verify, validate, test and maintain software systems developed using modern techniques, skills and engineering tools.
CO5	An ability to function on multi-disciplinary teams with an understanding of professional and ethical responsibility to create solutions for significant application domains.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	1	-	-	1	1	-
CO2	3	3	2	-	1	-	-	-	1	1	1		1	-	1
CO3	3	3	2	-	2	-	-	-	1	-	-	-	2	1	1
CO4	3	3	3	-	2	1	-	-	-	-	-	-	2	1	1
CO5	3	2	3	-	2	2	-	-	1	-	-	-	1	1	1

Syllabus

Unit I

Software Engineering Concepts - A Generic view of Process - Categories of Software - Process Models - Waterfall model - Incremental - Evolutionary - Prototyping – Spiral – Concurrent – RAD - Specialized models - Unified Process Models. - Agile Models. Requirements Engineering: Tasks Initiation - Elicitation - Developing Use Cases - Building the analysis model - Use Case Modelling - Negotiation - Validation.

Unit II

Building the Analysis Model: Approaches - Data modelling concepts - Flow Oriented Modelling - Behavioural Modelling – State transition diagram – Sequential Diagram. Data Dictionary. Design Engineering: Design characteristics, Design Process and Quality - Design Concept - Creating an Architectural Design - Software Architecture - Data Design - Architectural Styles and Patterns - Architectural Design - Mapping Data Flow into Software Architecture - Object oriented Design - Agile definition roles in agile, principles of agile manifesto, agile principles, agile characteristics, agile iteration planning. Release planning in agile.

Unit III

Software Testing Fundamentals - Objectives of Testing - Testing Principles – Testability -Testing Process and Methods – Testing Strategies - Testing Tactics. - White Box - Black Box testing - Debugging process.

Textbooks

1. Roger S. Pressman, "Software Engineering – A Practitioner's Approach", Tata McGraw- Hill Publishing Company Pvt. Ltd, Seventh Edition.
2. Ian Somerville, "Software Engineering", 10th Edition, Pearson Publication, 10th edition, 2015.

References

1. Shooman, "Software Engineering", Tata McGraw-Hill Publishing Company, Pvt. Ltd, 1987

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

23CSA281	DATA STRUCTURES AND ALGORITHMS LAB	L-T-P-C: 0-0-2-1

Course Objective(s)

Objective of this course is to teach the implementation of elementary data structures and its applications.

Course Outcomes

COs	Description
CO1	Implement different searching and sorting algorithms.
CO2	Use appropriate data structures to implement solutions to computing problems.
CO3	Implement Tree data structure using Linked list.
CO4	Represent Graph data structure in memory and manipulate it using different Graph algorithms.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	-	-	-	3	2	-	-	-	3	3	1
CO2	3	3	2	1	-	-	-	3	2	-	-	-	3	3	1
CO3	3	3	2	1	-	-	-	3	2	-	-	-	3	3	1
CO4	3	3	2	1	-	-	-	3	2	-	-	-	3	3	1

Syllabus

Unit I
Searching and Sorting
Linear Search, Binary Search – Analysis
Bubble Sort, Insertion Sort, Merge sort, Quick Sort - Analysis
Recursion – Tower of Hanoi

Unit II
Linear Data Structures
Abstract Data Type, Array, List ADT: Singly linked lists, Doubly linked lists, Circular Linked Lists, Stack ADT implementation and applications, Queue ADT: Implementation and Application. Circular Queue, Priority Queue.

Unit III
Non- Linear Data Structures
Basic concepts of trees, Implementation of trees, Traversal, Binary tree, Expression tree, Binary search tree, AVL tree, Heaps.

Unit IV
Adjacency matrix, Adjacency list, Breadth First Search, Depth First Search, Minimum Spanning Tree- Prim's and Kruskal's Algorithm, Dijkstra's algorithm

Textbooks

1. Narasimha Karumanchi, "Data Structures and Algorithms Made Easy in Java" Second Edition, CareerMonk Publication.
2. John R Hubbard, "Data Structures with Java" Schaum's Outline series, McGraw-Hill.

References

1. Sandra Andersen, “Data Structures in Java A Laborartory Course”, Jones and bartlett publishers, Sudbury, Massachusetts.

Evaluation Pattern

Assessment	Weightage (%)
Continuous Assessment	70
End Semester Exam	30
Total Marks	100

23CSA282	SPREADSHEET MODELLING LAB	L-T-P-C: 0-0-2-1

Course Objective(s)

- This course highlights the use of Spreadsheet for data analysis
- Students can do different visualization for the data, which is more appropriate.

Course Outcomes

COs	Description
CO1	Able to demonstrate the functions in Excel.
CO2	Analyse raw data from a non-excel source.
CO3	Integrate exploratory data in appropriate visualization using Excel.
CO4	Demonstrate appropriate Report to analyze the details in the data.
CO5	Plot statistical estimates like chi-square, z-test. T-test and ANOVA.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	1	1	1	1	-	-	-	-	-	1	1	2
CO2	2	1	3	2	1	1	1	-	-	-	-	-	2	3	1
CO3	1	1	3	1	2	3	1	-	-	-	-	-	1	2	1
CO4	1	1	3	2	1	1	-	-	-	-	-	-	1	2	2
CO5	1	2	2	1	1	2	-	-	-	-	-	-	2	1	2

Syllabus

Analysing the Functions of Excel: Operators, Date & Time, Numbers, Logical, Financial, Statistical, Text
Presentation of quantitative data: Data Visualization – types of graphs and charts Analysis of quantitative data – Descriptive Statistics
Presentation of qualitative data: Preparation, Data Conversion using IF, Data conversion from non-excel sources, Data Queries with sort, filter and advanced filter
Conditional formatting, format as table, autosum, fill, Vlookup, Hlookup, Math functions, Name manager, Group and Ungroup data
Analysis of qualitative data – Dealing with errors - Trace, Pivot reports – Pivot table and charts Data Validation, Macros
Inferential statistics of data – Chi-square test, z-test, t-test, confidence intervals for sample statistics, ANOVA

Textbooks/References

1. Hector Guerrero, Excel Data Analysis, Springer International Publishing, 2018
2. Excel Data Analysis for Dummies, Paul Mcfedries, Wiley, 2022

Evaluation Pattern

Assessment	Weightage (%)
Continuous Assessment	70
End Semester Exam	30
Total Marks	100

SEMESTER IV

22ADM211	LEADERSHIP LESSONS FROM RAMAYANA	L-T-P-C: 1-0-0-1

Course Objective(s)

To introduce students to the depths and richness of the Indian culture and knowledge traditions, and to enable them to obtain a synoptic view of the grandiose achievements of India in diverse fields. To equip students with a knowledge of their country and its eternal values.

Course Outcomes

COs	Description
CO1	This part gives a brief introduction of the Great Ithihasa.
CO2	This topic deals with 6 Kandas of Ramayana.
CO3	Ramayana and Modern-day learning [This topic details the relevance of Ramayana and its learning aspects.] Ecological Awareness in the Ramayana [This topic demonstrates the Environment and Ecology]
CO4	This topic explains different Ramayana around the world.
CO5	This topic reveals the authenticity of Uttar Kanda and its attempt to explaining the untold stories in the first six Kanda.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	1	-	-	-	1	2	1	-	-	1	-	-	-
CO2	-	-	2	2	2	-	2	1	2	-	-	2	-	-	-
CO3	-	-	3	3	3	-	3	3	3	-	-	3	-	-	-
CO4	-	-	1	2	2	-	3	2	2	-	-	2	-	-	-
CO5	-	-	2	1	2	-	1	2	2	-	-	1	-	-	-

Syllabus

Chapter 1 - Introduction to the Great Itihasa
Chapter 2 - Bala-Kāṇḍa: (Preparing for the renowned mission.)
And Ayodhya-Kāṇḍa: (Harbinger of an Entire Tradition of Nobleness.)
Chapter 3 - Araṇya-Kāṇḍa: (Tale of the forest life)
And Kishkindha-Kāṇḍa:(The Empire ofHoly Monkeys.)
Chapter 4 - Sundara-Kāṇḍa: (Heart of the Ramayana)
And Yuddha-Kāṇḍa: (The most popular part of the Ramayana)
Chapter 5 - Ramayana and Modern-day learning
Chapter 6 - Ecological Awareness in the Ramayana
Chapter 7 - Different Ramayana: (Epic that connects the world)
Chapter 8 - Uttara-Kāṇḍa: (An attempt to explain the untold stories)

Textbooks/References

1. Leadership Lessons from Ramayana

Evaluation Pattern

Assessment	Weightage (%)
Internal Assessment	20
Continuous Assessment	30
End Semester Exam	50
Total Marks	100

21SSK211	LIFE SKILLS II	L-T-P-C: 1-0-2-2

Course Objective(s)

To help students understand the corporate culture and assist them in improving their group discussion skills, communication skills, listening skills and problem-solving skills.

Course Outcomes

COs	Description
CO1	**Soft Skills -** To improve the inter-personal skills, professional etiquette and leadership skills, vital for arriving at win-win situations in Group Discussions and other team activities.
CO2	**Soft Skills -** To develop the ability to create better impact in a Group Discussions through examination, participation, perspective-sharing, ideation, listening, brainstorming and consensus
CO3	**Aptitude** – To interpret, critically analyze and solve questions in arithmetic, algebra and logical reasoning by employing the most suitable methods
CO4	**Aptitude -** To analyze, understand and apply suitable methods to solve questions on logical reasoning.
CO5	**Verbal** - To be able to use vocabulary in the right context and to be competent in spotting grammatical errors and correcting them.
CO6	**Verbal** - To be able to logically connect words, phrases, sentences and thereby communicate their perspectives/ideas convincingly.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	2	2	3	1	2	-	-	-
CO2	-	-	-	-	-	-	-	2	2	3	1	1	-	-	-
CO3	3	3	2	2	-	-	-	-	1	1	-	1	-	-	-
CO4	3	3	3	2	1	-	-	-	-	-	-	1	1	-	-
CO5	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO6	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-

Syllabus

Unit I

Learning Objectives of Soft Skills

After completion of Soft Skills, the learners will be able to have a smooth transition from academics to corporate and will be able to present their thoughts in a confident and convincing manner.

Professional Grooming and Practices: Basics of corporate culture, key pillars of business etiquette: socially acceptable ways of behavior, body language, personal hygiene, professional attire and cultural adaptability. Handling pressure, multi-tasking. Being enterprising. Adapting to corporate life: Emotional Management (EQ), Adversity Management, Health Consciousness. People skills, Critical Thinking and Problem solving.

Group Discussions: Advantages of group discussions, Types of group discussion and Roles played in a group discussion. Personality traits evaluated in a group discussion. Initiation techniques and maintaining the flow of the discussion, how to perform well in a group discussion. Summarization/conclusion.

Unit II

Learning Objectives of Aptitude

After completion of Aptitude, the learners will be able to use appropriate results and methods to analyze and solve problems from topics such as equations, logarithms, inequalities, sequences, series, time & work, time, speed distance and logical reasoning.

Logarithms, Inequalities and Modulus: Basics
Sequence and Series: Basics, AP, GP, HP, and Special Series.
Time and Work: Basics, Pipes & Cistern, and Work Equivalence.
Time, Speed and Distance: Basics, Average Speed, Relative Speed, Boats & Streams, Races, and Circular Tracks.
Logical Reasoning II: Arrangements, Sequencing, Scheduling, Venn Diagram, Network Diagrams, Binary Logic, and Logical Connectives, Clocks, Calendars, Cubes, Non-verbal reasoning and Symbol based reasoning.

Unit III
Learning Objectives of Verbal Skills

After completion of Verbal Skills, the learners will be able to use words in the right context, spot grammatical errors, reason and communicate confidently.
Vocabulary: Help students understand the usage of words in different contexts.
Grammar (Medium Level): Train Students to comprehend the nuances of Grammar and empower them to spot errors in sentences and correct them.
Reading Comprehension (Basics): Introduce students to smart reading techniques and help them understand different tones in comprehension passages.
Reasoning: Enable students to connect words, phrases and sentences logically.
Oral Communication Skills: Aid students in using the gift of the gab to interpret images, do a video synthesis, try a song interpretation or elaborate on a literary quote.

Textbooks/References

1. Adair. J., (1986), "Effective Team Building: How to make a winning team", London, U.K: Pan Books.
2. Gulati. S., (2006) "Corporate Soft Skills", New Delhi, India: Rupa & Co.
3. The Hard Truth about Soft Skills, by Amazon Publication.
4. Verbal Skills Activity Book, CIR, May 2018
5. Nova's GRE Prep Course, Jeff Kolby, Scott Thornburg & Kathleen Pierce
6. The BBC and British Council online resources
7. Owl Purdue University online teaching resources
8. www.thegrammarbook.com online teaching resources
9. www.englishpage.com online teaching resources and other useful websites
10. Student Workbook: Quantitative Aptitude & Reasoning, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
11. Quantitative Aptitude for All Competitive Examinations, Abhijit Guha.
12. How to Prepare for Quantitative Aptitude for the CAT, Arun Sharma.
13. How to Prepare for Data Interpretation for the CAT, Arun Sharma.
14. How to Prepare for Logical Reasoning for the CAT, Arun Sharma.
15. Quantitative Aptitude for Competitive Examinations, R S Aggarwal.
16. A Modern Approach to Logical Reasoning, R S Aggarwal.
17. A Modern Approach to Verbal & Non-Verbal Reasoning, R S Aggarwal.

Evaluation Pattern

Assessment	Internal Weightage (%)	External Weightage (%)
Continuous Assessment (Soft Skills)	30	-
Continuous Assessment (Aptitude)	10	25
Continuous Assessment (Verbal)	10	25
Total Marks	50	50

23CSA213	DATA MINING	L-T-P-C: 3-0-0-3

Course Objective(s)

It is to equip students with the knowledge and skills needed to use data mining effectively in various contexts, and to enable them to make informed decisions based on data-driven insights.

Course Outcomes

COs	Description
CO1	To device the knowledge of data mining process and making the data for processing.
CO2	To analyze the various data pre-processing techniques.
CO3	To characterize the kinds of patterns that can be discovered by association rule mining.
CO4	To apply prediction and classification algorithms on real time data.
CO5	To categorize the different clustering approach.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	1	-	-	-	-	-	-	-	-	1	1	2
CO2	3	-	3	1	1	-	-	-	-	-	-	-	1	1	2
CO3	3	3	2	1	1	-	-	-	-	-	-	-	1	1	2
CO4	3	3	2	1	1	-	-	-	-	-	-	-	3	3	3
CO5	2	3	2	1	1	-	-	-	-	-	-	-	3	3	3

Syllabus

Unit I
Introduction: Introduction to Data Mining-Types of Data and Patterns Mined- Technologies- Applications-Major Issues in Data Mining.

Unit II
Getting to Know about your Data-data objects and attribute types, basic statistical description of data, measuring data similarity and dissimilarity, Data Pre-processing: Cleaning– Integration–Reduction–Data Transformation and Discretization

Unit III
Mining Frequent Patterns: Basic Concept – Frequent Item Set Mining Methods -Apriori and FP Growth algorithms - Mining Association Rules.

Unit IV
Classification and Predication: Issues – Algorithms- Decision Tree Induction - Bayesian Classification –k, Prediction-linear regression, classification – confusion matrix, Accuracy- Precision, misclassification rate, Recall, ROC.

Unit V
Clustering: Overview of Clustering – Types of Data in Cluster Analysis – K Means and K Medoid, Hierarchical Clustering-single linkage, density-based clustering-DBSCAN.

Textbooks

1. Data Science with R: A Step By Step Guide with Visual Illustrations & Examples, Andrew Oleksy.
2. Practical Data Science with R, Nina Zumel and John Mount, Dreamtech/Manning, 2014
3. R Programming for Data Science, Roger D. Peng, Lean publishing, 2015.
4. Seema Acharya, Data Analytics using R, McGrawHill Education (India), 2018, ISBN: 978-93-5260-524-8.

References

1. R for Data Science", Hadley Wickham and Garett Grolemund, , O'Reilly, 2017
2. Data Mining for Business Analytics: Concepts, Techniques and Applications in R, GalitShmueli, et al, Wiley India, 2018.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

23CSA214	OPTIMIZATION TECHNIQUES	L-T-P-C: 3-0-0-3

Course Objective(s)

- To understand the concept of search space and optimality for solutions of engineering problems.
- To understand some computation techniques for optimizing single variable functions.
- To carry out various computational techniques for optimizing severable variable functions.

Course Outcomes

COs	Description
CO1	Understand different types of Optimization Techniques in engineering problems. Learn Optimization methods such as Bracketing methods, Region elimination methods, Point estimation methods.
CO2	Learn Optimizations Techniques in single variable functions.
CO3	Understand the optimality criteria for the multivariable optimizations.
CO4	Learn Optimizations Techniques in multi variable functions.
CO5	Learn constrained optimization techniques and Kuhn-Tucker conditions

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	1	-	-	-	-	-	-	1	2	-	3
CO2	3	2	1	-	1	-	-	-	-	-	-	1	2	-	3
CO3	2	3	2	-	1	-	-	-	-	-	-	1	2	-	3
CO4	2	2	1	-	1	-	-	-	-	-	-	1	1		2
CO5	2	2	1	-	1	-	-	-	-	-	-	1	2		2

Syllabus

Unit I

Introduction to optimization: classical optimization, Optimality criteria – Necessary and sufficient conditions for the existence of extreme point.

Direct search methods: unidirectional search, evolutionary search method, simplex search method, Introduction, Conditions for local minimization. One dimensional Search methods: Golden search method, Fibonacci method, Newton's Method, Secant Method, Remarks on Line Search Sections. Hook-Jeeves pattern search method.

Unit II

Gradient-based methods- introduction, the method of steepest descent, analysis of Gradient Methods, Convergence, Convergence Rate. Analysis of Newton's Method, Levenberg-Marquardt Modification, Newton's Method for Nonlinear Least-Squares

Conjugate direction method, Introduction The Conjugate Direction Algorithm, The Conjugate Gradient Algorithm for Non-Quadratic Quasi-Newton method.

Unit III

Nonlinear Equality Constrained Optimization- Introduction, Problems with equality constraints Problem Formulation, Tangent and Normal Spaces, Lagrange Condition.

Nonlinear Inequality Constrained Optimization -Introduction - Problems with inequality constraints: Kuhn-Tucker conditions.

Textbooks

1. Edwin K.P. Chong, Stanislaw H. Zak, “An introduction to Optimization”, 2nd edition, Wiley, 2013.

References

1. S.S. Rao, “Optimization Theory and Applications”, Second Edition, New Age International (P) Limited
2. Publishers, 1995.
3. Kalyanmoy Deb, “Optimization for Engineering Design: Algorithms and Examples, Prentice Hall, 2002.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

23CSA215	ARTIFICIAL INTELLIGENCE	L-T-P-C: 3-1-0-4

Course Objective(s)

The main objective of this course is to familiarize the students with how to represent knowledge, including incomplete and uncertain knowledge of the real world; how to reason logically with that knowledge using probabilities; how to use these reasoning models and methods to decide what to do, particularly by constructing plans; and how to reason and make decisions in the presence of uncertainty about the world. It includes some state-of-the-art topics, such as the logical representation of different types of knowledge, reasoning under uncertainty.

Course Outcomes

COs	Description
CO1	Basic knowledge of the origins and development of artificial intelligence (AI).
CO2	Recognize fundamental AI concepts while developing solutions that require knowledge representation, learning, inference, and perception.
CO3	Explore the current scope, potential, limitations, and implications of intelligent systems.
CO4	Identify the different searching strategies, constraint satisfaction issues, and sample problems.
CO5	Experiment with an AI model for simulation and analysis.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11 1	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	1	-	-	-	1	1	1
CO2	3	2	-	-	-	-	2	-	2	-	-	-	1	-	1
CO3	3	3	2	-	-	-	2	-	2	-	1	1	1	-	-
CO4	3	2	2	-	-	-	-	-	2	-	2	1	1	2	2
CO5	3	3	2	-	-	-	2	-	2	1	2	2	1	2	3

Syllabus

Unit I

What is Artificial Intelligence? – The AI Problems – The Underlying Assumption – What is an AI technique – Criteria for Success.

Problems, Problem Spaces and Search – Defining Problem as a State Space Search – Production Systems – Problem Characteristics – Production System Characteristics – Issues in the design of Search Programs.

Unit II

Heuristic Search Techniques - Generate – and – Test – Hill Climbing – Best-First Search – Problem Reduction – Constraint Satisfaction - Means - Ends Analysis. Knowledge Representation issues – Representations and Mapping -Approaches to knowledge Representation – Issues in knowledge Representation – The Frame Problem. Using Predicate Logic – Representing simple facts in Logic – Representing Instance and Isa Relationship.

Unit III

Representing Knowledge Using Rules – Procedural versus Declarative Knowledge – Logic Programming – Forward versus Backward Reasoning – Matching – Control Knowledge.

Symbolic Reasoning under Uncertainty – Introduction to Non-monotonic Reasoning – Augmenting a Problem Solver – Implementation: Depth - First Search. Statistical Reasoning – Probability and Baye's Theorem – Bayesian Networks – Fuzzy Logic.

Unit IV
Game Playing - The Minimax Search Procedure – Adding Alpha-Beta Cutoffs. Understanding – What is Understanding? What makes Understanding hard?

Unit V
Common Sense – Qualitative Physics – Commonsense ontology – Memory Organization - Expert Systems – Representing and Using Domain knowledge – Expert System Shells – knowledge Acquisition - Components of an AI program.

Textbooks
1. Artificial Intelligence (Second Edition) – Elaine Rich, Kevin knight (Tata McGraw-Hill)
2. A Guide to Expert Systems – Donald A. Waterman (Addison-Wesley)

References
1. Principles of Artificial Intelligence – Nils J. Nilsson (Narosa Publishing House)
2. Introduction to Artificial Intelligence – Eugene Charnaik, Drew McDermott (Pearson Education Asia)

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

23CSA216	WEB TECHNOLOGIES	L-T-P-C: 2-0-2-3

Course Objective(s)

Web Technologies course is intended to give the student a comprehensive understanding of latest Internet and web programming tools. The student will be introduced to client side and server side scripting and standards.

Course Outcomes

COs	Description
CO1	Get familiarized with basic web programming technologies and be equipped with the latest web development tools.
CO2	Use HTML and CSS syntax and semantics to build web pages.
CO3	Create Client-Side Scripts using JavaScript and Server-Side Scripts using PHP.
CO4	Create web pages that can interact with databases and manage sessions.
CO5	Apply industrial standards and frameworks for creating web applications.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	-	-	-	-	-	-	-	-	1	-	-
CO2	2	2	2	1	-	-	-	-	-	-	-	-	1	-	-
CO3	3	2	2	2	2	-	-	-	-	-	-	-	1	-	2
CO4	3	3	3	2	3	-	-	-	-	-	-	-	2	2	2
CO5	3	3	3	2	3	-	-	-	-	-	-	-	2	3	2

Syllabus

Unit I: Web Development Basics

History of Internet and web; Web Clients and Web Servers; W3 Consortium; HTML5 and CSS3, HTTP request-response model.

HTML5- Basic syntax and semantics, Basic Tags, lists, Tables, Frames, Forms, Input tags, HTML media, HTMLGraphics, HTML APIs.

CSS - Style Sheets and HTML Style Rule, style Inheritance Background, Borders,margin, Box model. Styling text, fonts, list, links, tables. CSS overflow, float, inline blocks, pseudoclasses, pseudoelements.CSS border images, rounded corners.

Unit II: Client side scripting : JavaScript

Introduction to JavaScript, internal and external Java script files, variables, control statements, loops, Arrays, string handling ,functions in JavaScript, Form Handling, Input Validation, Regular Expression, Event Handling DOM concept, creating html elements using java script. Drawing 2D shapes. Introduction to AJAX JavaScript Framework, Building Single page applications with Angular JS Single page application – introduction, two way data binding, MVC in angular JS, controllers, getting user inputs , loops , Client side routing – accessing URL data, various ways to provide data in angular JS.

Unit III: Server-Side Programming - PHP

Server side scripting, Difference between client side and server side scripting languages. Introduction to PHP, variables, control statements, loops, Arrays, string handling, PHP forms, Global variables in PHP, Regular expression and pattern matching,

Unit IV: Handling Data and State- PHP
Database programming: inputting and outputting data from MySQL using PHP, insertion ,deletion and updating data. State management in web applications, cookies, Query string, URL path, Application and session state.

Unit V: XML
Introduction to XML, usage of XML, XML tags, elements and attributes, XML validation: DTD and XSD, XML DOM ; Extracting data from XML, XSLT, XML & PHP; JSON, XHTML, Web services

Textbooks/Reference:

1. Robin Nixon, "Learning PHP, MySQL &JavaScript with jQuery, CSS and HTML5", 5th Edition, O'Reilly Publications, 2018.
2. The Complete Reference, HTML and CSS by Thomas A Powell latest Edition
3. Zak Ruvalcaba Anne Boehm, "Murach's HTML5 and CSS3", 3rdEdition, Murachs/Shroff Publishers & Distributors Pvt Ltd, 2016.
4. Luke Welling, Laura Thomson, "PHP and MySQL Web Development", 5th Edition, Pearson Education, 2016. (ISBN:978-9332582736)
5. Joe Fawcett, Danny Ayers, Liam R. E. Quin , Beginning XML, 5th Edition, 2012, WILEY.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment(including lab)	45
End Semester Exam	30
Total Marks	100

*End Semester Exam to be conducted for 60 Marks

23CSA283	DATA MINING LAB	L-T-P-C: 0-0-2-1

Course Objective(s)

It is to provide with hands-on experience with data mining techniques and tools, and to enable them to apply the concepts and principles learned in the Data Mining theory course to real-world datasets.

Course Outcomes

COs	Description
CO1	Gain the ability to understand the different pre-processing techniques that can be applied based on the different types of data.
CO2	Gain knowledge to perform association rule mining on transactional data.
CO3	Ability to choose a classification and prediction algorithm from among many which is suitable for the given data.
CO4	Ability to choose a clustering algorithm from among many which is suitable for the given data.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	2	2	-	-	-	-	-	-	-	3	3	1
CO2	3	2	3	2	2	-	-	-	-	-	-	-	1	1	-
CO3	3	3	3	2	2	-	-	-	-	-	-	-	3	2	2
CO4	3	3	3	2	2	-	-	-	-	-	-	-	3	2	2

Syllabus

(In Python use -Jupiter notebook or spider) Dataset Preparation – data summarization-data smoothing using binning-data normalization-data integration using chi square, Data Reduction – PCA, Algorithm implementation-Association-apriori, classification-ID3, naive bayes, Knn , prediction-linear regression, clustering-k-means,single linkage, DBSCAN.

Textbooks

1. Data Science with R: A Step By Step Guide with Visual Illustrations & Examples, Andrew Oleksy.
2. Practical Data Science with R, Nina Zumel and John Mount, Dreamtech/Manning, 2014
3. R Programming for Data Science, Roger D. Peng, Lean publishing, 2015.
4. Seema Acharya, Data Analytics using R, McGrawHill Education (India), 2018, ISBN: 978-93-5260-524-8.

References

1. R for Data Science", Hadley Wickham and Garett Grolemund, , O'Reilly, 2017
2. Data Mining for Business Analytics: Concepts, Techniques and Applications in R, GalitShmueli, et al, Wiley India, 2018.

Evaluation Pattern

Assessment	Weightage (%)
Continuous Assessment	70
End Semester Exam	30
Total Marks	100

23CSA290	CASE STUDY BASED SEMINAR	L-T-P-C: 1-0-0-1

Course Objective(s)

This course introduces the basics of research, ethical principles and challenges, and the elements of the research. Students will be able to prepare and present a case study using research tools and techniques.

Course Outcomes

COs	Description
CO1	Form connections between specific academic topics and real-world problems and applications.
CO2	Help the student to conduct thorough literature review on the problem domain which facilitate interdisciplinary learning.
CO3	Refine analytical, presentation and leadership skills as demonstrated by written and oral communications.
CO4	Reinforce active listening skills, as demonstrated by response to and further development of ideas presented by classmates.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	2	2	1	1	-	-	-	-	-	-	1	1	2
CO2	1	2	1	3	1	-	-	-	-	-	-	-	1	1	-
CO3	1	3	-	1	3	-	-	-	3	3	-	-	-	-	-
CO4	-	-	-	1	-	3	-	-	-	3	-	1	-	-	-

Syllabus

Students to undertake a study on the project area, or a trending topic, or a research paper and presentation. Milestones can be decided at the class committee level. Deliverable to include (a) technical report followed by a (b) presentation.

Evaluation Pattern

Assessment	Weightage (%)
Continuous Assessment	50
End Sem Evaluation	50
Total Marks	100

SEMESTER V

21SSK301	LIFE SKILLS III	L-T-P-C: 1-0-2-2

Course Objective(s)

To help students understand the nuances of leadership, know the importance of working in teams, face challenging situations, crack interviews, improve communication skills and problem-solving skills.

Course Outcome

COs	Description
CO1	**Soft Skills -** To acquire the ability to work in teams, present themselves confidently and showcase their knowledge, skills, abilities, interests, practical exposure, strengths and achievements to potential recruiters through a resume, video resume, and personal interview.
CO2	**Soft Skills -** To have better ability to prepare for facing interviews, analyse interview questions, articulate correct responses and respond appropriately to convince the interviewer of one's right candidature through displaying etiquette, positive attitude and courteous communication.
CO3	**Aptitude** – To manage time while arriving at appropriate strategies to solve questions in geometry, statistics, probability and combinatorics.
CO4	**Aptitude** – To analyze, understand and apply suitable methods to solve questions on data analysis and data sufficiency.
CO5	**Verbal** - To use diction that is less verbose and more refined and to use prior knowledge of grammar to correct/improve sentences.
CO6	**Verbal** - To understand arguments, analyze arguments and use inductive/deductive reasoning to arrive at conclusions. The student would also be able to generate ideas, structure them logically and express them in a style that is comprehensible to the audience/recipient.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	2	2	3	1	2	-	-	-
CO2	-	-	-	-	-	-	-	2	2	3	1	1	-	-	-
CO3	3	3	2	2	-	-	-	-	1	1	-	1	-	-	-
CO4	3	3	3	2	1	-	-	-	-	-		1	1	-	-
CO5	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO6	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-

Syllabus

Unit I

Learning Objectives of Soft Skills

After completion of Soft Skills, the learners will be able to work well in teams, explore the leader in them and perform intelligently in interviews.

Team Work: Value of teamwork in organizations, Definition of a team. Why team? Effective team-building. Parameters for a good team, roles, empowerment and need for transparent communication, Factors affecting team effectiveness, Personal characteristics of members and its influence on team.

Leadership, Internal problem solving, Growth and productivity, Evaluation and co-ordination.

Facing an interview: Importance of verbal & aptitude competencies, strong foundation in core competencies, industry orientation / knowledge about the organization, resume writing, being professional. Importance of good communication skills, etiquette to be maintained during an interview, appropriate grooming and mannerism.

Unit II

Learning Objectives of Aptitude

After completion of Aptitude, the learners will be able to use appropriate results and methods to analyze and solve problems from topics such as geometry, permutations & combinations, probability, statistics and logical reasoning. Also, students will get ready to face various competitive examinations and placement recruitment examinations.

Geometry: 2D, 3D, Coordinate Geometry, and Heights & Distance.

Permutations & Combinations: Basics, Fundamental Counting Principle, Circular Arrangements, and Derangements.

Probability: Basics, Addition & Multiplication Theorems, Conditional Probability, and Bayes' Theorem.

Statistics: Mean, Median, Mode, Range, Variance, Quartile Deviation and Standard Deviation.

Data Interpretation: Tables, Bar Diagrams, Line Graphs, Pie Charts, Caselets, Mixed Varieties, and other forms of data representation.

Data Sufficiency: Introduction, 5 Options Data Sufficiency and 4 Options Data Sufficiency.

Campus recruitment papers: Discussion of previous year question papers of all major recruiters of Amrita Vishwa Vidyapeetham.

Miscellaneous: Interview Puzzles, Calculation Techniques and Time Management strategies.

Unit III

Learning Objectives of Verbal Skills

After completion of Verbal Skills, the learners will be able to use refined language, correct grammatical errors, effectively employ logical thinking and communicate with confidence.

Vocabulary: Create an awareness of using refined language through idioms and phrasal verbs.
Grammar (Advanced Level): Enable students to improve sentences through a clear understanding of the rules of grammar.

Reasoning Skills: Facilitate the student to tap his reasoning skills through Syllogisms, and critical reasoning arguments.

Reading Comprehension (Advanced): Enlighten students on the different strategies involved in tackling reading comprehension questions.

Public Speaking Skills: Empower students to overcome glossophobia and speak effectively and confidently before an audience.

Writing Skills: Practice closet tests that assess basic knowledge and skills in usage and mechanics of writing such as punctuation, basic grammar and usage, sentence structure and rhetorical skills such as writing strategy, organization, and style. Practice formal written communication through writing emails especially composing job application emails.

Textbooks/References

1. Adair. J., (1.986), "Effective Team Building: How to make a winning team", London, U.K: Pan Books.
2. Gulati. S., (2006) "Corporate Soft Skills", New Delhi, India: Rupa & Co.
3. The Hard Truth about Soft Skills, by Amazone Publication.
4. Verbal Skills Activity Book, CIR, May 2018
5. Nova's GRE Prep Course, Jeff Kolby, Scott Thornburg & Kathleen Pierce
6. The BBC and British Council online resources
7. Owl Purdue University online teaching resources
8. www.thegrammarbook.com online teaching resources
9. www.englishpage.com online teaching resources and other useful websites
10. Student Workbook: Quantitative Aptitude & Reasoning, Corporate & Industry Relations, Amrita Vishwa Vidyapeetham.
11. Quantitative Aptitude for All Competitive Examinations, Abhijit Guha.
12. How to Prepare for Quantitative Aptitude for the CAT, Arun Sharma.
13. How to Prepare for Data Interpretation for the CAT, Arun Sharma.
14. How to Prepare for Logical Reasoning for the CAT, Arun Sharma.
15. Quantitative Aptitude for Competitive Examinations, R S Aggarwal.
16. A Modern Approach to Logical Reasoning, R S Aggarwal.
17. Modern Approach to Verbal & Non-Verbal Reasoning, R S Aggarwal.

Evaluation Pattern

Assessment	Internal Weightage (%)	External Weightage (%)
Continuous Assessment (Soft Skills)	30	-
Continuous Assessment (Aptitude)	10	25
Continuous Assessment (Verbal)	10	25
Total Marks	50	50

23CSA302	MACHINE LEARNING	L-T-P-C: 3-1-0-4

Course Objective(s)

- To understand the fundamentals of machine learning and its applications.
- To familiarize with the popular ML algorithms used to solve real world problems.

Course Outcomes

COs	Description
CO1	Able to categorize the problems as supervised or unsupervised and to apply regression algorithm for prediction problems.
CO2	Select and apply supervised algorithms like Naïve bayes algorithm, decision tree and analyze the models using different evaluation parameter.
CO3	To build ML models using KNN, SVM classifiers and to perform feature engineering and selection using PCA and LDA.
CO4	To Apply different clustering algorithms for the unlabeled data and interpret the results.
CO5	Understand the fundamental concepts of deep learning.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	-	1	1	-	-	-	-	-	1	-	-
CO2	3	3	3	-	2	1	1	1	-	-	-	-	1	1	1
CO3	3	3	3	2	2	1	1	1	1	-	1	1	1	1	2
CO4	3	3	3	2	2	1	1	1	1	-	2	1	1	2	2
CO5	2	2	3	2	2	1	1	1	1	-	2	1	1	2	2

Syllabus

Unit 1

Introduction to ML, Goals and applications of machine learning. Aspects of developing a learning system: training and testing data. Types of learning: Supervised, Unsupervised, and Reinforcement. Linear regression, variance, bias, gradient descent, R^2, Ridge and Lasso regression.

Unit 2

Logistic regression, decision boundary, classification parameters: Accuracy, precision, recall, F-measure, RoC curve. Bayesian learning: Probability theory and Bayes rule. Naive Bayes learning algorithm. Regression tree – random forest

Unit 3

Perceptron and backpropagation neural network - k-nearest neighbour rule. Support vector machine: multicategory generalizations, Kernels for learning non-linear functions. ADA Boost classifier. Feature engineering and feature selection. PCA and LDA

Unit 4

Unsupervised learning. Clustering: Learning from unclassified data. Clustering. Hierarchical Agglomerative Clustering. k-means partitional clustering. Expectation maximization (EM) for soft clustering. Semi-supervised learning with EM using labeled and unlabled data.

Unit 5

Deep learning: Deep Neural network, Activation functions, Cost function, feed forward network, CNN, Sequential Models.

Textbooks/References

1. Kevin P. Murphey, “Machine Learning, a probabilistic perspective”, The MIT Press, 2012.
2. Tom Mitchael, “Machine Learning”, McGraw Hill, 1997.
3. EthemAlpaydin,”Introduction to Machine learning”, PHI learning, MIT Press, 2010, 2nd edition
4. John D. Killeher, Brian Mac, Namee, AoiFE D'Arcy, Fundamental of Machine Learning for Predictive Data Analytics, 2015 MITpress.
5. Alex Smola and SVN. Viswanathan, “Introduction to Machine Learning”, Cambridge University Press, 2008.
6. ShaiShalev-Shwartz and Shai Ben-David, “Understanding Machine Learning: From Theory to Algorithms”, Cambridge University Press,2014.
7. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

23CSA303	CLOUD COMPUTING	L-T-P-C: 3-0-2-4

Course Objective(s)

This course aims to provide students with a comprehensive understanding of Cloud Computing, including an extensive analysis of its fundamental components and technologies that facilitate its functioning.

Course Outcomes

COs	Description
CO1	Understand the core concepts of the cloud computing paradigm
CO2	Learn the virtualization and its role in infrastructure as a service
CO3	Learn different features of containers and their orchestration in cloud
CO4	Learn storage technologies, networking, application development and deployment in the cloud
CO5	Understand the role of cloud computing in IoT, Bigdata and machine learning domains

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	3	1	-	-	-	-	-	-	1	1	1
CO2	3	-	1	-	3	1	-	-	-	-	-	-	1	-	-
CO3	3	-	1	-	3	1	-	-	-	-	-	-	2	-	1
CO4	3	1	1	-	3	1	-	-	-	-	-	-	3	3	1
CO5	2	2	2	1	3	1	-	-	-	-	-	-	3	3	3

Syllabus

Unit I
Definition, essential characteristics of cloud computing, history of cloud. NIST reference model – Actors, Cloud orchestration, service models, SLA, deployment models. Applications of cloud, popular cloud platforms.

Unit II
Virtualization- Introduction, Hypervisor and types, Full virtualization, Paravirtualization, Hardware virtualization, Introduction to various hypervisors, VM in cloud.
Resource virtualization- Paging in virtualization, Network virtualization, storage virtualization.

Unit III
Container – Containers introduction, difference between virtualization and containerization, Linux containers, Docker Architecture, Docker Images, Docker Hub, Creation of Docker container, Container orchestration, Kubernetes.

Unit IV
Storage in cloud- Object storage, Cloud SQL
Networking in cloud- Advantages, Virtual private cloud.
Application development in cloud – Environments, Microservice architecture, Develop and deploy cloud applications using a MERN stack, monitoring and load balancing.

Unit V
Cloud and machine learning, Bigdata analytics, Role of IoT in the cloud, machine learning frameworks for cloud, Security and privacy issues in cloud computing

Lab

Create accounts in AWS, Google cloud and Microsoft Azure, Explore the various services offered by Amazon and Google, Virtualization concept in Virtualbox, Create and configure Virtual machine, Host a web server in the virtual machine, Create containers using docker, Kubernetes and orcherstation of containers, Structured and unstructured storage in the cloud, CloudSQL, Application development and deployment in cloud, Load balacing and monitoring of cloud applications.

Textbooks

1. RajkumarBuyya, Christian Vecchiola and ThamariSelvi S, "Mastering in Cloud Computing", McGraw Hill Education (India) Private Limited, 2013.
2. Dan C. Marinescu, Cloud Computing: Theory and Practice, Elsevier Science, Edition 2022

References

1. Anthony T Velte, "Cloud Computing: A practical Approach", Tata McGraw Hill, 2017.
2. https://www.qwiklabs.com/
3. https://sites.google.com/google.com/gcp-teachingresources/home?pli=1&authuser=1

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	45
End Semester Exam	30
Total Marks	100

*End Semester Exam to be conducted for 60 Marks

23CSA386	MACHINE LEARNING LAB	L-T-P-C: 0-0-2-1

Course Objective(s)

- To understand the fundamentals of machine learning and its applications.
- To familiarize with the popular ML algorithms used to solve real-world problems.

Course Outcomes

COs	Description
CO1	Implement linear regression model.
CO2	Implement different classification algorithms used in machine learning.
CO3	Implement different clustering and component analysis techniques.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	-	1	1	-	-	-	-	2	1	1	1
CO2	3	3	3	-	2	1	1	1	-	-	-	2	1	1	1
CO3	3	3	3	2	2	1	1	1	1	-	1	2	1	1	2

Syllabus

1. Linear regression – Gradient Descent
2. Ridge and Lasso regression
3. Logistic regression
4. Regularization
5. SVM, multicategory generalizations, Kernels for learning non-linear functions
6. Calculate the accuracy, precision, and recall, ROC
7. PCA
8. LDA
9. Spectral Clustering
10. GMM
11. EM

Textbooks/References

1. Machine Learning with Python: The Complete Beginner's Guide to Understand Machine Learning with Python from Beginner to Expert by Steve Blair
2. Introduction to Machine Learning with Python: A Guide for Data Scientists by Andreas Muller
3. Practical Machine Learning with Python. A Problem-Solver's Guide to Building Real-World Intelligent Systems by Dipanjan Sarkar , Raghav Bali , Tushar Sharma

Evaluation Pattern

Assessment	Weightage (%)
Continuous Assessment	70
End Semester Exam	30
Total Marks	100

23CSA398	MINOR PROJECT	4 Credits

Course Objective(s)

Data Scientists, employ techniques and theories drawn from many fields within the broad areas of mathematics, statistics, information science, and computer science, in particular from the subdomains of machine learning, classification, cluster analysis, data mining, databases, and visualization to derive actionable insights and help meet specific business needs and goals. The goal of this Minor Project course is to help the student apply the theories and important tools they studied in this program to practice data science and mobilize the students for the next semester Major Project course.

Course Outcomes

COs	Description
CO1	Provide opportunities to identify real world problems.
CO2	Conduct thorough literature review on the problem domain.
CO3	Specialize data science methods, applications and tools.
CO4	Demonstrate independence and originality in thought and application.
CO5	Provide opportunity to work as a team and evaluate the developed product/algorithm both from individuals' and teams' perspective.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	1	3	-	3	2	1	3	2	1	1	1	1	1
CO2	1	3	1	3	-	1	-	1	2	2		1	1	1	1
CO3	2	2	2		3	1	-	-	-	1	1	1	3	3	3
CO4	-	-	-	-	-	-	-	3	1	1		1	-	-	-
CO5	-	-	-	-	-	-	-	3	3	3	1	1	-	-	-

Evaluation Pattern

Assessment	Weightage (%)
Continuous Assessment	60
End Semester Exam	40
Total Marks	100

SEMESTER VI

23CSA313 BIG DATA ANALYTICS AND VISUALIZATION L-T-P-C: 3-0-0-3

Course Objective(s)

This course provides the basic understanding of the Big Data and its technologies and platforms like HDFS, Hadoop, Map Reduce, Massive Datasets, etc. to the students. After completing this course, the students will also be able to pre-process and summarize the Big Data by using different statistical methods and visualize and analyse the Big Data using different visualization tools such as Tableau and Google Chart etc.

Course Outcomes

COs	Description
CO1	To analyse the data through various statistical methods such as measures of centre, correlation and skewness analysis, and probability distributions.
CO2	To define Big Data and its types, Massive Datasets, Big Data evolution, best practices of big data analysis, and challenges faced in Big Data analysis.
CO3	To install and configure Hadoop, MapReduce and HDFS, and build effective solutions for various Big Data issues.
CO4	To solve various organisations' real-life issues and find effective solutions through case studies and various Hadoop ecosystem tools provided by Apache, such as Hive, Mahout, Pig, etc.
CO5	To use various data visualization techniques and standard tools for big data visualization.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	3	-	3	0	-	-	-	-	2	1	2
CO2	3	3	2	-	3	-	3	0	-	-	-	-	1	1	1
CO3	3	2	3	-	3	-	3	0	-	-	-	-	3	3	3
CO4	3	3	3	-	3	-	3	2	2	-	3	-	1	3	1
CO5	2	3	-	-	3	-	3	0	2	-	-	-	2	1	3

Syllabus

Unit I

Introduction to elementary data analysis: Measures of centre: Mean, Median, Mode, Variance, Standard deviation, Range, Normal Distribution: Center, Spread, Skewed Left, Skewed Right, Outlier, Correlation Patterns, Magnitude and Direction in the relationship, Introduction to Bayesian Model.

Unit II

Introduction to Big Data, Types of Digital Data, Characteristics of Big Data, Evolution of Big Data, Definition of Big Data, Data Appliance, Challenges with Big Data, Big data sources, Best practices in Big Data Analytics, Introduction to Data Modelling.

Unit III

Introduction to Big Data Processing and Apache Hadoop, Installation and Configuration of Hadoop in Ubuntu, HDFS Concepts, Map Reduce Framework, Anatomy of a Map Reduce Job Run, Job Scheduling, Shuffle and Sort, Task Execution.

Unit IV
Introduction to Hadoop Eco System, Apache Hive, Apache Mahout, Apache Pig, Case studies: Analyzing big data with twitter, Big data for Ecommerce, Big data for blogs. Mining for Massive Datasets: Mining the data streams, frequent datasets and recommendation systems.

Unit V
History of Visualization, Goals of Visualization, Types of Data Visualization: Scientific Visualization, Information Visualization, Visual Analytics, Impact of Visualization, Big Data Visualization Tools: Tableau, Google Chart.

Textbooks

1. Seema Acharya, Subhasini Chellappan, "Big Data Analytics", 2nd Ed., Wiley, 2019
2. Frank J. Ohlhorst, “Big Data and Analytics: Turning Big Data into Big Money”, 1st Ed., Wiley and SAS Business Series, 2013.
3. Tom White, “Hadoop: The Definitive Guide”, 4th Ed., O’reilly Media, 2015
4. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, “Mining of massive datasets”, 3rd Ed., Cambridge University Press, 2020
5. DT Editorial Services, “Big Data: Black Book”, 1st Ed., Dreamtech Press, 2016

References

1. Michael C. Reingruber, William W. Gregory, “The Data Modeling Handbook: A Best- Practice Approach to Building Quality Data Models”, Wiley QED publications, First Edition.
2. Philip Bobko, “Correlation and Regression: Applications for Industrial Organizational Psychology and Management”, First Edition

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous assessment	25
End Semester Exam	50
Total Marks	100

23CSA314	DATA GOVERNANCE	L-T-P-C: 3-0-0-3

Course Objective(s)

- To ensure legal and regulatory compliance: Studying Data Governance helps individuals understand the laws and regulations governing data handling and how to develop and implement policies and procedures to ensure compliance.
- To improve data quality and usability: Studying Data Governance equips individuals with the knowledge and skills needed to manage data effectively throughout its lifecycle, from collection to disposal, and to use data management tools and techniques to improve data quality and consistency.

Course Outcomes

COs	Description
CO1	Analyse how organizations use data governance to address the challenges of data management and Articulate the Challenges of Data Governance
CO2	Create and document the steps necessary to implement a data governance program
CO3	Evaluate Data Governance Maturity Models to Mitigate Regulatory and Operational Risk Through Data Governance
CO4	Create a Data Governance Document that Describes the Business Need for Data Governance
CO5	Analyze the need for data policy standards and the stakeholders who manage data quality
CO6	Evaluate and describe the impact of big data on organizational policies

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	-	1	-	-	-	1	1	1	-	-
CO2	3	2	1	3	1	-	1	-	-	-	-	-	-	-	-
CO3	1	1	2	2	3	-	1	-	-	-	-	-	-	-	1
CO4	2	2	3	2	1	-	-	1	-	-	-	-	-	-	-
CO5	1	2	3	1	2	-	-	-	-	-	-	1	-	-	-
CO6	1	1	-	1	1	1	1	-	1	1	-	1	1	1	1

Syllabus

Unit I

Data, Data's role in representing objects, events and concepts - Relationship between data and information Data ownership and the relationships between people in a business enterprise -Importance of data in organization - Assess the business issues that data management can resolve -Challenges inherent in data management and governance

Unit II

Data Governance -The Need for Data Governance - How Data Governance fits into Organizational Strategy Data Governance Maturity Models -Data Governance Life Cycle - how to Manage Risk with Data Governance - Organizational Culture Affects Data Governance - Articulate the Challenges of Data Governance

Unit III

Metadata Framework - Evaluate and Explain Master Data Management - Types of Assets that Require Governance - Analyze and Describe Metadata Use for Data Governance - Evaluate the Varying Data Models and Their Bearing on Governance

Regulatory and Operational Risk Through Data Governance - The Relationship Between IT and Business in an Organization - Information Governance Framework -

Optimize Performance with Data Governance - Formal Structure Impacts Data Governance - Create a Data Governance Document that Describes the Business Need for Data Governance

Unit IV
Data Stewardship and Governance – How they fit together – Types of data stewardship – Roles and responsibilities

Unit V
Application of Data Governance in Business – Challenges of Data Governance in a Big Data world - Framework for successful Data Governance strategies - Information Exchanges

Textbooks/References

1. Data Governance: Creating Value from Information Assets, Neera Bhansali, 2013. Auerbach Publications, ISBN: 978-1439879139.
2. Data Governance: Perspectives and Practices, Harkish Sen, Technics Publications, 2019
3. Data stewardship: an actionable guide to effective data management and data governance, David Plotkin, Amsterdam : Elsevier, 2014

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

23CSA387	BIG DATA ANALYTICS AND VISUALIZATION LAB	L-T-P-C: 0-0-2-1

Course Objective(s)

This course provides the basic understanding of setting up and install the Big Data Analytics tools and platforms such as Hadoop, HDFS and MapReduce. The students will also be able to install PIG and run the basic Latin scripts and install and run HIVE on Hadoop and run different queries.

Course Outcomes

COs	Description
CO1	To use standard tools and frameworks to analyse and visualise the Big Data.
CO2	To define the architectural concepts of the Hadoop and Map Reduce paradigms.
CO3	To apply the Java concepts to develop the Map Reduce programs.
CO4	To use the applications and tools of the Hadoop echo system, such as the PIG, HIVE, HBase, etc.
CO5	To analyze the data through the visualization tools Tableau and Google Charts.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	2	2	-	3	-	-	-	-	-	1	1	1
CO2	3	1	-	-	-	-	3	-	-	-	-	-	1	1	1
CO3	3	3	3	3	3	-	3	-	-	-	-	-	3	3	3
CO4	3	3	3	3	3	-	3	1	-	-	-	-	3	3	3
CO5	3	3	1	3	3	-	3	-	-	-	-	-	3	3	3

Syllabus

Unit I
Installation and Configuration of Hadoop in two operating modes (Pseudo distributed & fully distributed), Use of web-based tools to monitor the Hadoop setup, and Performing the different file management tasks in HDFS.

Unit II
Run a basic Word Count program to understand Map Reduce paradigm, stop word elimination using Map Reduce, mine a large dataset to find the average, max and min values using Map Reduce, Tera Sort benchmark comparison for YARN, and set up Hadoop cluster in AWS.

Unit III
Install PIG on Hadoop and write Pig Latin scripts to sort, group, join, project and filter your data.

Unit IV
Install Hive on Hadoop and use it to create, alter and drop databases, tables, views, functions and indexes. Combing different Hadoop tools together – Pig-Hive-Latin-Hbase.

Unit V
Use Tableau and Google charts to visualize a dataset of your choice.

Textbooks/References

1. DT Editorial Services, “Big Data: Black Book”, 1st Ed., Dreamtech Press, 2016
2. Seema Acharya, Subhasini Chellappan, "Big Data Analytics", 2nd Ed., Wiley, 2019
3. Frank J. Ohlhorst, “Big Data and Analytics: Turning Big Data into Big Money”, 1st Ed., Wiley and SAS Business Series, 2013.
4. Tom White, “Hadoop: The Definitive Guide”, 4th Ed., O’reilly Media, 2015
5. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, “Mining of massive datasets”, 3rd Ed., Cambridge University Press, 2020

Evaluation Pattern

Assessment	Weightage (%)
Continuous Assessment	70
End Semester Exam	30
Total Marks	100

23CSA399	MAJOR PROJECT	10 Credits

Course Objective(s)

Data Scientists, employ techniques and theories drawn from many fields within the broad areas of mathematics, statistics, information science, and computer science, in particular from the subdomains of machine learning, classification, cluster analysis, data mining, databases, and visualization to derive actionable insights and help meet specific business needs and goals. The goal of this Major Project course is to help the student experienced in industrial/research projects by applying the skills they acquired by the different courses in this program, to solve real world problems.

Course Outcomes

COs	Description
CO1	Apply the skills a student acquired through the different courses in this program to design software solutions for real world problems.
CO2	To expose the student to the industry-standard project practices, under time and deliverable constraints.
CO3	Provide opportunity to work as a team and evaluate the developed product/algorithm both from individual's and team's perspective.
CO4	Train the student to write and publish research papers.
CO5	Demonstrate independence and originality in thought and application and communicate among software professionals to demonstrate the knowledge and principles.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	1	3	-	3	2	1	3	2	1	1	1	1	1
CO2	1	3	1	3	-	1	-	1	2	2		1	1	1	1
CO3	2	2	2	-	3	1	-	-	-	1	1	1	3	3	3
CO4	-	-	-	-	-	-	-	3	1	1		1	-	-	-
CO5	-	-	-	-	-	-	-	3	3	3	1	1	-	-	-

Evaluation Pattern

Assessment	Weightage (%)
Continuous Assessment	60
End Semester Exam	40
Total Marks	100

ELECTIVE A, B, C

23CSA341	TIME SERIES ANALYSIS	L-T-P-C: 3-0-0-3

Course Objective(s)

- This course handles the basic trend analysis and enable the students to do multivariate trend or pattern estimation.
- This estimation of the pattern helps to know how to put forth the historical knowledge to do accurate prediction in future.
- Time series model is modelled with certain evaluation metric to validate how good our model work.

Course Outcomes

COs	Description
CO1	Acquire the knowledge about time series analysis and the significance of its properties.
CO2	Analyse regression, its types and importance, and the role of model selection in time series analysis.
CO3	Distinguish covariance and prediction in the context of time series data and models.
CO4	Able to classify several types of spectral representation and time series analysis estimation.
CO5	A broad primer Knowledge of multivariate and spatial time series and their applications.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	1	-	-	-	-	-	-	2	2	2
CO2	3	3	3	2	1	-	-	-	-	-	-	-	1	2	1
CO3	2	2	3	3	2	-	-	-	-	-	-	-	2	2	2
CO4	1	1	3	2	1	-	-	-	-	-	-	-	3	1	2
CO5	2	2	3	1	3	2	-	-	-	-	-	-	2	1	2

Syllabus

Unit I
Time Series - First-Order Difference Equations - Pth - order Difference Equations Lag Operators - Initial conditions and Unbounded sequences
Stationary ARMA process - White Noise - Estimation of Time Domain - Auto covariance - Auto Regressive and Moving Average Process

Unit II
Estimation of ARMA model - ARIMA model - SARIMA - Model - Residual Analysis - Forecasting - Univariate analysis - Multi variate Analysis - Maximum Likelihood function - Inequality Constraints - Spectral Analysis

Unit III
Asymptotic Distribution Theory - Least squares - Linear regression Models - Generalised least squares - Instrumental Variables along with Least Squares - Equation Bias - Covariance - stationary vector process - Hypothesis testing for unrestricted vector

Unit IV
Bivariate - Granger Causality test - Impulse-response function - Variance decomposition - Standard errors for Impulse- Response functions - Bayesian Analysis - State- space models - Kalman filter - Non- linear modelling - Neural network in Time series analysis.

Unit V

Multi-variate time series analysis - Modelling non- stationary series - Effect of model uncertainty - Control theory - Estimation of Co-integrated systems - Time series models of Heteroskedasticity - Auto Regressive conditional Heteroskedasticity (ARCH)

Textbooks

1. Chris Chatfield, "The Analysis of Time Series - An Introduction"5th Edition (revised - 2001), Chapman & Hall
2. James D. Hamilton, "Time Series Analysis" (2nd Edition 1994), Princeton University Press
3. R. H. Shumway and D. S. Stoffer (2006), Time series analysis and its applications (With R Examples, Second Edition). Springer, New York.

References

1. http://www-stat.wharton.upenn.edu/~stine/
2. "Time Series Analysis" by James Douglas Hamilton.
3. "The Analysis of Time Series: An Introduction" by Chris Chatfield.
4. "Forecasting: Principles and Practice" by Rob J. Hyndman and George Athanasopoulos.
5. "Introduction to Time Series Analysis and Forecasting" by Douglas C. Montgomery, Chery L. Jennings, and Murat Kulahci.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

23CSA342	INTRODUCTION TO IoT	L-T-P-C: 3-0-0-3

Course Objective(s)

Students will develop a solid understanding of the core concepts and principles of the Internet of Things. They will learn about the interconnectedness of devices, sensors, actuators, and networks, and how these components work together to create smart and interconnected systems.

Course Outcomes

COs	Description
CO1	Understand the key components that make up an IoT system
CO2	Understand where the IoT concept fits within the broader ICT industry and possible future trends
CO3	Familiar with the key technologies and protocols employed at each layer of the IoT stack
CO4	Appreciate the role of big data, cloud computing and data analytics in a typical IoT system
CO5	Apply the knowledge and skills acquired to build and test a complete, working IoT system

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	3	1	-	-	-	-	-	-	-	-	-	1
CO3	1	1	2	1	-	-	-	-	-	-	-	-	-	-	2
CO4	2	1	3	2	2	-	-	-	-	-	-	-	-	-	-
CO5	1	2	3	1	2		-	-	-	-	-	1	-	-	-

Syllabus

Unit 1: Introduction

What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack.

Unit 2: Fundamental devices in IoT

Smart Objects: The "Things" in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies,Smart City IoT Architecture.

Unit 3: Protocols for IoT

IP as the IoT Network Layer, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances, Application Protocols for IoT, The Transport Layer, IoT Application Transport Methods.

Unit 4: Data and Network Analytics in IoT

An Introduction to Data Analytics for IoT, Machine Learning, Network Analytics, Securing IoT, A Brief History of OT Security, Common Challenges in OT Security, IT and OT Security Practices.

Unit 5: Implementing IoT

IoT Physical Devices and Endpoints. IoT Physical Devices and Endpoints - RaspberryPi: Introduction to RaspberryPi, About the RaspberryPi Board: Hardware Layout, Operating Systems on RaspberryPi, Configuring RaspberryPi, Connecting Raspberry Pi via SSH.

Textbooks

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1stEdition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978- 9386873743)
2. Srinivasa K G, "Internet of Things",CENGAGE Leaning India, 2017.

References

1. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014. (ISBN: 978-8173719547).
2. Raj Kamal, "Internet of Things: Architecture and Design Principles", 1st Edition, McGraw Hill Education, 2017. (ISBN: 978-9352605224).

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

23CSA343	EMBEDDED SYSTEMS	L-T-P-C:3-0-0-3

Course Objective(s)

- To acquire knowledge on the basic working of a microcontroller system and its programming.
- To provide experience to integrate hardware and software for microcontroller applications systems

Course Outcomes

COs	Description
CO1	Discuss the basic structure and design of Embedded systems.
CO2	Explain the fundamentals of Embedded processor, Bus Communication in processors, Input/output interfacing.
CO3	Develop programs for Embedded systems.
CO4	Describe the different Phases & Modelling of Embedded system.
CO5	Summarize the architecture of System-on-Chip and design examples.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	1	1	3	-	-	-	-	-	-	-	-	-	-	-
CO3	1	1	3	1	-	-	-	-	-	-	-	-	-	-	-
CO4	2	1	3	2	2	-	-	-	-	-	-	-	-	-	-
CO5	1	2	3	1	2	1	-	-	-	-	-	1	-	-	-

Syllabus

Unit 1: Introduction To Embedded Systems
Introduction to Embedded Systems, Components of Embedded Systems, Structural units in Embedded processor, DMA, Memory management methods- memory mapping, cache replacement concept, Timer and Counting devices, Real Time Clock- CPU architecture of ARM processor- CPU Bus organization.

Unit 2: Embedded Networking And Isr
Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols – Serial Communication Standards and Devices- ISR concept-– multiple interrupts – Serial Bus Protocols- RS232 standard – RS485 –USB – Inter Integrated Circuits (I2C).

Unit 3: Rtos Based Embedded System Design
Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Inter-process Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance.

Unit 4: Programming Concepts Of Embedded Programming
Introduction to Software Development environment-IDE, assembler, compiler, linker, simulator, debugger, In Circuit emulator, Target Hardware Debugging, Features of Embedded C++ and Embedded Java(basic only), Software Implementation, Validation, Testing, system-on-chip.

Unit 5: Embedded System Application Development
Objectives, different Phases & Modeling of the Embedded product Development Life Cycle (EDLC), IPC, Message Queue, Sockets- RPCs.
Case study 1: Study on Smart card- Adaptive Cruise control in a Car -Mobile Phone software for key inputs.
Case study 2: Study of other popular RTOS.

Textbooks/References

1. Rajkamal, _Embedded system-Architecture, Programming, Design‘, TMH,2011.
2. Peckol, ―Embedded system Design‖,JohnWiley&Sons,2010
3. Shibu.K.V, ―Introduction to Embedded Systems‖, TataMcgraw Hill,2009
4. Lyla B Das,‖ Embedded Systems-An Integrated Approach‖,Pearson2013
5. Elicia White,‖Making Embedded Systems‖,O‘Reilly Series,SPD,2011
6. Bruce Powel Douglass,‖Real-Time UML Workshop for Embedded Systems,Elsevier,2011.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

23CSA344	NON-RELATIONAL DATABASES	L-T-P-C: 3-0-0-3

Course Objective(s)

To study basic concepts of database systems, relational and non-relational databases and graph databases.

Course Outcomes

COs	Description
CO1	To understand the concept of how NoSQL databases differ from relational databases from a practical perspective.
CO2	Master the basic concepts of designing NoSQL database management system
CO3	Be familiar with selecting a particular NoSQL database for specific use cases.
CO4	Must be able to Identify what type of NoSQL database to implement based on business requirements

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	3	3	-	-	1	-	1	-	-	-	-	3	3	1
CO4	3	3	3	-	-	-	-	1	-	-	-	-	3	3	2

Syllabus

Unit I
Database Management System – introduction, history of database, management systems- characteristics of dbms, definition, objectives, merits and demerits, entity relationship model, concurrency control.
Environment systems – definition, designing databases, hierarchical data model, network data model

Unit II
RDBMS – relational data model, techniques & components of relational data model, definition of relational terms, features, 12 rules for a fully RDBMS.

Unit III
NOSQL Systems-Introduction to NoSQL, Disadvantages of NoSQL technology, NOSQL Systems, weakness of RDBMS, Key-value database-Key values database, More elements of key values database, Properties of Key-value store

Unit IV
Columnar Databases - Characteristics of a columnar database, Concepts of columnar databases
Document databases with MongoDB - Implement a document database with Mongo DB, MongoDB.

Unit V
Graph Databases - Graph databases, graph traversal and graph problems, graph data structures edge list, adjacency matrix, properties of graph model.
Implementation and systems - Reliable, maintainable and scalable, Different information systems

Textbooks

1. Advanced Data Management: For SQL, NoSQL, Cloud and Distributed Databases By Lena Wiese

References

1. Getting Started with Nosql by Gaurav Vaish. NoSQL for Dummies by Adam Fowler.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

23CSA345	PATTERN RECOGNITION	L-T-P-C: 3-0-0-3

Course Objective(s)

This course provides students with a comprehensive understanding of the principles, techniques, and applications of pattern recognition. Pattern recognition is the process of identifying and classifying patterns in data or signals, enabling automated decision-making and analysis.

Course Outcomes

COs	Description
CO1	Understand the concept of a pattern and the basic approach to the development of pattern recognition based on probabilistic arguments.
CO2	Understand the basic methods of linear and non-linear classifiers regardless of structure of underlying data.
CO3	Understand and apply feature selection methods appropriate for developing a PR system.
CO4	Apply pattern recognition techniques to real-world problems such as object detection and recognition.
CO5	Implement simple pattern classifiers, classifier combinations, and structural pattern recognizers.
CO6	Summarize, analyze, and relate research in the pattern recognition area verbally and in writing.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	-	-	-	-	-	1	-	-	3	3	2
CO2	3	2	3	-	-	2	-	1	-	-	-	1	3	3	2
CO3	3	2	3	-	-	-	1	-		-	-	-	3	3	2
CO4	3	3	3	1	-	2		-	1	-	1	-	3	3	2
CO5	3	3	3	-	-	-	1	1	-	-	-	1	3	3	2
CO6	3	2	3	-	3	-	-	-	1	1	1	-	3	3	2

Syllabus

Unit I

Introduction to Pattern Recognition- Classifiers based on Bayes decision theory - Bayesian Decision Theory- Bayesian classification for normal distribution- Estimation of Unknown probability density functions-maximium estimation, maximium entropy estimation Nearest neighbour rule.

Unit II

Linear Classifiers – Perceptron algorithm, Least square method, SVM, Non-linear classifiers – multilayer perceptron, backpropagation algorithm, non-linear SVM, Decision tree, Combining classifiers- majority voting, ensembling, boosting.

Unit III

Feature Selection – data pre-processing, ROC curves, Class separability measures, Feature subset selection, Bayesian information criteria.

Unit IV

Dimensionality reduction- Singular value decomposition, independent component analysis, PCA, kernel PCA, Fourier transform, wavelets.

Unit V

Unsupervised Methods Exploring the Data for Latent Structure - Clustering, K-Means, Expectation Maximization, Mean Shift.

Textbooks/References

1. Duda, Hart and Stork, Pattern Classification, Second Edition, Wiley, 2001.
2. T.M. Mitchell, Machine learning, Mc Graw-Hill, New York, 1997.
3. S. Theodoridis, K. Koutroumbas, Pattern recognition, Academic Press, 1999.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

23CSA346	DIGITAL IMAGE PROCESSING	L-T-P-C: 3-0-0-3

Course Objective(s)

This course equips the students with the knowledge and skills necessary to understand, analyze, and manipulate digital images. Students will learn various techniques to enhance digital images for better visualization and analysis.

Course Outcomes

COs	Description
CO1	To enable students to learn the fundamental concepts of digital image processing and its working protocols.
CO2	Learn image enhancement techniques in spatial and frequency domain so as to devise algorithms or mathematical models for real time image enhancement problems.
CO3	To enable students to implement algorithms for handling intensive image restoration problems.
CO4	Development of segmentation algorithms used to detect and extract the region of interest from images.
CO5	Interpretation and use of feature extraction and image representation techniques to carry out image labeling and automatic image understanding.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	1	1	1
CO3	2	3	2	-	-	-	-	-	-	-	-	-	1	1	1
CO4	2	3	3	-	-	-	-	-	-	-	-	-	1	1	1
CO5	3	3	3	-	-	-	-	-	-	-	-	-	1	1	1

Syllabus

Unit I

Introduction and Fundamentals of Image Processing: Origins of Digital Image Processing – Examples - Fundamental Steps in Digital Image Processing - Elements of Visual Perception - A Simple Image Formation Model - Basic Concepts in Sampling and Quantization.

Unit II

Representing Digital Images- Zooming and Shrinking Digital Images - Some Basic Relationships between Pixels - Linear and Nonlinear Operations - Connectivity and Relations between Pixels- Simple Operations- Arithmetic, Logical, Geometric Operations.

Unit III

Image Enhancement in the Spatial Domain and Frequency Domain: Some Basic Gray Level Transformations - Histogram Processing – Basics of Spatial Filtering - Smoothing Filters-Mean, Median, Mode Filters - Edge Enhancement Filters – Sobel, Laplacian, Robert, Prewitt filter, Contrast Based Edge Enhancement Techniques.

Unit IV

Design of Low Pass Filters - High Pass Filters- Edge Enhancement - Smoothening Filters in Frequency Domain. Butter Worth Filter, Homomorphic Filters in Frequency Domain-Comparative Study of Filters in Frequency Domain and Spatial Domain.

Unit V

Edge Detection - Line Detection - Edge Linking and Boundary Extraction - Thresholding Algorithms- Region Based Segmentation - Region Growing – Connected Components Labeling - Region Growing and Region Adjacency Graph (RAG), Split and Merge Algorithms - Morphology - Dilation, Erosion, Opening and Closing.

Textbooks

1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Third Edition, Addison Wesley, 2007.

References

1. Arthur R. Weeks, Jr., "Fundamentals of Electronic Image Processing", First Edition, PHI,1996.
2. Milan Sonka, Vaclav Hlavac and Roger Boyle, "Image processing, Analysis, and Machine Vision", Third Edition, Vikas Publishing House, 2007.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

23CSA347	WIRELESS NETWORKS AND COMMUNICATIONS	L-T-P-C: 3-0-0-3

Course Objective(s)

This course provides a comprehensive understanding of wireless communication technologies, protocols, and network architectures. They will learn about the characteristics of wireless channels, modulation techniques, and wireless routing protocols.

Course Outcomes

COs	Description
CO1	Understand the working of a wireless systems, basics of wireless communication, including the features and operation of protocols, antennas, and various propagation modes in wireless communication.
CO2	Explain the basic physical and technical settings of modulation techniques and features of analog and digital data including transmission methods.
CO3	To lay a basic foundation on IEEE wireless communication standards such as WLAN- 802.11, Bluetooth, WiMax and satellite communication.
CO4	Understand the concept of Adhoc network and types of routing protocols supporting wireless communications and simulate protocols such as AODV, TORA, DSDV in NS2 or NS3.
CO5	Must be able to simulate or implement a real word wireless communication system.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	2	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	1	1	-	-	1	-	1	-	-

Syllabus

Introduction to Wireless Systems: Brief History of Wireless Communication. Transmission Fundamentals: Time Domain, Frequency Domain, Bandwidth vs. Data Rate – Channel Capacity - Transmission Media –Protocols and TCP/IP Suite: TCP/IP Protocol Architecture - OSI Model. Antennas and Wave Propagation: Antennas, Propagation Modes, Fading in the q

Modulation Techniques: Signal Encoding, Digital Data - Analog Signal, Analog Data -Analog Signal, Analog Data - Digital Signal, Frequency Hopping Spread Spectrum (FHSS), Direct Sequence Spread Spectrum (DSSS), Code Division Multiple Access (CDMA).

Wireless Networking: Satellite Communications- Capacity Allocation – Frequency Division, Time Division, WiMax and IEEE 802.16 Broadband Wireless Access Standards. WirelessLAN Technology: Infrared, Spread Spectrum, Narrowband LANS- Wi-Fi and IEEE 802.11Standard, Bluetooth and IEEE 802.15 Standard.
Wireless Routing Protocols: Infrastructure, AdHoc Networks, ProActivevs. ReActive, Dynamic Source Routing(DSR), AdHoc On Demand Distance Vector(AODV),Temporarily Ordered Routing Algorithm(TORA), Destination Sequenced Distance Vector(DSDV). Case Study using NS2 / NS3.

Textbooks/References

1. William Stallings,"Wireless Communication and Networks", Pearson Education, Third Edition, 2002.
2. Jochen Schiller, "Mobile Communications", Pearson Education, Second Edition, 2003.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

23CSA348	MULTIMEDIA AND GRAPHICS	L-T-P-C: 3-0-0-3

Course Objective(s)

The course enables the student to learn the concepts of multimedia like text, speech, image and video processing in today's international standards. Further, it also adds an essence of multimedia systems design, multimedia networks, multimedia search engines and emerging multimedia value-added services.

Course Outcomes

COs	Description
CO1	Describe the types of media and define multimedia system
CO2	Describe the process of digitizing (quantization) of different analog signals
CO3	Use and apply tools for image processing, video, sound and animation.
CO4	Apply methodology to develop a multimedia system.
CO5	Apply acquired knowledge in the field of multimedia in practice and independently continue to expand knowledge in this field.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	1	-	-	-	-	-	-	-	-	-	-	-
CO2	2	1	-	1	2	-	-	-	-	-	-	-	-	-	-
CO3	1	1	1	1	2	-	-	1	-	-	-	-	-	-	-
CO4	2	1	3	1	-	-	-	1	-	1	-	-	-	-	-
CO5	2	1	1	1	2	1	1	-	1	1	-	-	-	-	-

Syllabus

Unit I
Introduction: Graphics Systems – Raster Scan & Random Scan systems. Output Primitives,What is Multimedia? Introduction to making Multimedia - Media Skills – Macintosh and Windows Platforms – Basic software tools.

Unit II
Making instant Multimedia – Multimedia Authoring tools.

Unit III
Multimedia Building Blocks: Text – Sound – Images.

Unit IV
Multimedia Building Blocks: Animation: types, techniques, key frame animation, utility, morphing. Virtual Reality concepts. – Video.

Unit V
Multimedia and the Internet: The Internet and how it works – Tools for World Wide Web – Designing for the World Wide Web.

Textbooks/References

1. Nigel Chapman – Digital Multimedia – Wiley – ISBN – 81-265-0489-7
2. John F. Koegel Buford – Multimedia Systems – PEARSON – ISBN – 81-78-08-162-8
3. Donald Hearn, Pauline Baker ― Computer Graphics – C Version‖, Pearson Education.

4. Steinmetz R. & Nahrstedt K. ―Multimedia: Computing, Communications and Applications‖, Pearson
5. Education.
6. David F. Rogers ―Procedural Elements for Computer Graphics‖, Tata McGraw-Hill
7. Foley, van Dam, Feiner & Hughes ―Computer Graphics Principles & Practice‖, Pearson Education.
8. William M. Newman, Robert F. Sproull ―Principles of Interactive Computer Graphics‖, Tata McGraw-Hill.
9. David F. Rogers, J. Alan Adams ―Mathematical Elements for Computer Graphics‖, Tata McGraw-Hill.
10. Tay Vaughan ―Multimedia: Making it Work‖, Tata McGraw-Hill.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

23CSA349	BIOINFORMATICS	L-T-P-C: 3-0-0-3

Course Objective(s)

This course is intended to equip the student to integrate the principles of Biology, Computer Science and Mathematics. This integrates theoretic concepts in life science with computational knowledge and algorithms.

Course Outcomes

COs	Description
CO1	To get introduced to the basic concepts of Bioinformatics and its importance in Biological data analysis.
CO2	Describe the importance of nucleic acids and able to demonstrate the biological and computational aspects of genetic code.
CO3	Get familiarized with publicly available tools and resources aiding bioinformatics applications.
CO4	Apply computational algorithms to solve problems from the domain of bioinformatics.
CO5	Apply data mining and machine learning methods in bioinformatics.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	2	3	-	-	-	-	-	-	-	3	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3

Syllabus

Unit I

Introduction to Bioinformatics: Definition - Importance and Uses of Bioinformatics-Information Technology - Systems Biology. Introduction to Nucleic Acids: DNA and RNA as Genetic Materials - Structure of NucleicAcids - Nucleosides and Nucleotides - DNA Double Helix. Central Dogma of Molecular Biology - Nature of Genetic Code - Deciphering Genetic Code - Wobble Hypothesis -Universalities and Exceptions.

Unit II

Applications of Data Mining to Bioinformatics Problems - Biological Data – Databases -Protein Sequencing - Nucleic Acid Sequencing - Sequence to Structure Relationship. Bioinformatics Software: Clustal V - Clustal W 1.7 - RasMol – Oligo – Molscript – Treeview– Alscript - Genetic Analysis Software- Phylip.

Unit III

Bio-computing: Introduction to String Matching Algorithms - Database Search Techniques - Sequence Comparison and Alignment Techniques - Use of Biochemical Scoring Matrices – Introduction to Graph Matching Algorithms.

Unit IV

Automated Genome Comparison and its Implication - Automated Gene Prediction - Automated Identification of Bacterial Operons and Pathways - Introduction to Signaling Pathways and Pathway Regulation. Gene Arrays -Analysis of Gene Arrays.

Unit V

Machine Learning Methods in Bioinformatics - Hidden Markov models - Applications of HMM in gene identification and Profiles HMMs - Neural Networks and Support Vector machines.

Textbooks/References

1. Rastogi S.C, Mendiratt N. and Rastogi P, "Bioinformatics – Methods and Applications", PHI.
2. Vittal R.Srinivas, " BIOINFORMATICS: A MODERN APPROACH", 2005, ISBN: 978-81-203-2858-7, published by PHI Learning Private Limited, New Delh
3. Pierre Baldi and Soren Brunak, "Bioinformatics- The MachineLearning Approach", Second Edition, A Bradford Book, 2001.
4. Andreas D.Baxevanis, B.F. Francis Ouellette, "Bioinformatics - A Practical Guide to the Analysis of Genes and Proteins", Third Edition, 2005-2006, ISBN: 978-81-265-2192-0, published by John Wiley & Sons INC., U.K
5. Claverie J.M and Notredame C, "Bioinformatics for Dummies", Second Edition, Wiley, 2003.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

23CSA350	SOFT COMPUTING	L-T-P-C: 3-0-0-3

Course Objective(s)

- The main objective of the course is to impart knowledge on the fundamentals concepts of Soft Computing and new paradigms of computation involved in the application of several engineering applications that are used in the industry
- The course covers the model of classification, clustering methods, concepts of neural networks, artificial neural networks, perceptron, fuzzy sets and its properties, fuzzy neural network, genetic algorithms and its types.

Course Outcomes

COs	Description
CO1	To introduce and identify the strategies and functions of the soft computing in smart machines.
CO2	To model concepts of fuzzy logic and thinking.
CO3	To develop neuro fuzzy systems in solving real world applications, analyse the steps in the development
CO4	Resolve problems of engineering and genetic algorithms to substitute issues of optimization.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-		-	-	-	-		-	-	3
CO2	3	3	1	-	-	-	1	-	-	-	-	1	3	3	2
CO3	3	2	3	-	-	-	1	-	-	-	-	1	3	3	-
CO4	3	2	3	-	-	-	1	-	-	-	-	1	-	-	-

Syllabus

Unit I

Basic Concepts - Introduction to learning methods: Supervised and Unsupervised learning, Difference between Classification and Clustering, Neural Network - Introduction to Neural Network, Biological NN, ANN, Mc Culloh Pitts, Linear Separability, Architectures - Single Layer Perception - Multilayer Perception - Back Propagation networks - Kohen's self-organizing networks - Hop field networks – Hebb Network, Distance measures.

Unit II

FUZZY sets - **Introduction to fuzzy theory**, properties, overview of classical set, Membership functions, Fuzzy operations, lambda cuts , fuzzy measures , fuzzy rule base and arithmetic reasoning , formation of rules , composition and aggregation of rules , fuzzy reasoning , fuzzy inference systems.

Unit III

Neuro-Fuzzy Systems- Introduction to Fuzzy neural network , Fuzzy logic, Characteristics of fuzzy Logic , Generation of membership function using Neural Network , Steps in development of NFS, NFS models , Fuzzy Weight Adjustment , Fuzzy Neural Networks for Pattern Classification and feature selection.

Unit IV

Genetic algorithm – Introduction , basic operations ,Traditional algorithm verses genetic ; Genetic algorithms – simple , general ; scheme theorem , classification of genetic algorithms – Holland classifiers system.

Textbooks/References

1. Laurence Fausett, “Fundamentals of Neural Networks”, Seventh Edition, Dorling Kindersley (India) P. Ltd 2006.
2. Satish Kumar - “Neural Networks – A Classroom Approach”, Tata McGraw-Hill, 2004.
3. Timothy J.Rose, ”Fuzzy Logic with Engineering Applications”, Third Edition, John Wiley, 2010.
4. 4. J.S.R Jang,C.T Sun and E.Mizutani, ”Neuro-Fuzzy and Soft Computing”, Second Edition, Prentice Hall of India, 2002.
5. 5. D.E.Goldberg ”Genetic Algorithms in search, optimization and Machine learning”, Second Edition, Addison Wesley, 2007.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

23CSA351 ADVANCED OPERATING SYSTEMS AND DISTRIBUTED COMPUTING L-T-P-C: 3-0-0-3

Course Objective(s)

The aim of this course is to study, learn, and understand the main concepts of advanced operating systems (parallel processing systems, distributed systems, real time systems, network operating systems, and open-source operating systems); Hardware and software features that support these systems.

Course Outcomes

COs	Description
CO1	Understanding the broad problem areas in Advanced Operating Systems
CO2	Exposure to Virtualizing techniques.
CO3	Demonstrate understanding of different architectures used in Distributed OS and analyse their design issues.
CO4	To introduce fundamental principles of distributed systems, technical challenges and key design issues.
CO5	To impart knowledge of the distributed computing models and algorithms.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	1	1	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	2	-	2	-	-	-	-	-	-	-	-	-	-
CO4	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	1	1	2	1	-	-	-	-	-	-	-	-	-

Syllabus

Unit I
Overview of operating System, OS Structures - SPIN, Exokernel, L3 microkernel approach, Process and Threads, File and memory management, Disks, Microkernels.

Unit II
Virtualization - Requirements For Virtualization, Type 1 and Type 2 Hypervisors, Techniques For Efficient Virtualization, Memory Virtualization, I/O Virtualization, Virtual Appliances, Virtual Machines on Multicore Cpus, Licensing Issues. Load Balancing.

Unit III
Distributed Operating System – fundamentals, Distributed Objects and Middleware, Naming, Java RMI , Remote Procedure calls. Parallel Systems - Shared memory machines, Synchronization, Communication, Lightweight RPC, Scheduling, Shared memory multiprocessor OS, Mobile OS.

Unit IV
Fundamentals, Evolution of Distributed Computing Systems, System models, issues in design of Distributed Systems, Distributed computing environment, web based distributed model, computer networks related to distributed systems and web based protocols, Message Passing Distributed Shared Memory, Synchronization.

Unit V

Distributed mutual exchange algorithms, Deadlock detection in distributed systems, checkpoint and rollback recovery, Distributed file servers; Distributed programming environments: Communication primitives.

Textbooks/References

1. Modern Operating Systems, Andrew S. Tanenbaum, ©2015 |Pearson
2. Distributed Operating Systems: Concepts And Design, Pradeep K. Sinha, Phi Learning Pvt Ltd
3. Distributed Systems: Principles and Paradigms / Andrew S. Tanenbaum, Maarten Van Steen, Pearson
4. Distributed Computing: Principles, Algorithms, and Systems, Ajay D. Kshemkalyani, MukeshSingha, Cambridge University Press.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

23CSA352	NATURAL LANGUAGE PROCESSING	L-T-P-C: 3-0-0-3

Course Objective(s)

- The main objective of the course is to impart knowledge on the fundamental concepts of Natural Language Processing and new paradigms of computation that are involved in several engineering applications and many real-time entities.
- The course covers the basics of speech processing, hidden Markov models– Ngram Models, and probabilistic models. It also throws the limelight on parsing, information retrieval, and machine translation, as part of Natural Language Processing.

Course Outcomes

Cos	Description
CO1	Acquires the fundamental concepts and speech basis of Natural Language Processing
CO2	To interpret the approaches of probabilistic and statistical models, for framing Natural Language Processing systems.
CO3	To impart knowledge about parsing, semantics, information retrieval, and machine translation
CO4	Articulation of Natural Language Processing and its usage in various applied domains

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	1	1	1	1	-	1	1	2	1	3
CO2	3	3	2	3	2	-	-	1	1	-	1	1	3	2	2
CO3	3	3	3	1	3	-	-	1	1	-	1	2	3	3	3
CO4	3	3	3	3	3	-	-	1	1	-	1	3	3	3	3

Syllabus

Unit I

Introduction: NLP task- Building blocks of language- Information Extraction - The General Pipeline for IE- Keyphrase Extraction - Named Entity Recognition - Relationship Extraction.Probabilistic models of pronunciation and spelling – Ngram Models of syntax - Hidden markov models and Speech recognition - Word classes and Part of Speech Tagging.

Unit II

Context free Grammars for English – Parsing with Context free Grammar – Features and unification – Lexicalized and Probabilistic Parsing - Language and Complexity- Semantics: Representing meaning - Semantic analysis - Lexical semantics - Word sense disambiguation and Information retrieval.

Unit III

Machine translation Chatbots-Applied- E-commerce & Retail - Healthcare, Finance, and Law.

Textbooks/References

1. Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, Harshit Surana, “Practical Natural Language Processing: A Comprehensive Guide to Building Real-world NLP Systems”, O'Reilly Media, 2020
2. Daniel and Martin J H, “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition”, Prentice Hall, 2009.
3. Manning C D and Schutze H, “Foundations of Statistical Natural Language processing“, First Edition, MIT Press, 1999.
4. Allen J, “Natural Language Understanding”, Second Edition, Pearson Education,2003

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

23CSA353	TEXT MINING AND ANALYTICS	L-T-P-C: 3-0-0-3

Course Objective(s)

- This course helps to understand how deal text in NLP
- It deals with the various parsing approaches: Grammar free, Constituent free and Context aware parsing.
- Enables the student to identify and find the next probable word in the corpus.

Course Outcomes

COs	Description
CO1	Discover the fundamental strategies for extracting information from textual material and retrieving it.
CO2	acquire how to use text processing tools to prepare documents for statistical modelling.
CO3	Able to evaluate the performance of machine learning models for textual data is required.
CO4	Comprehend the methods to use machine learning models to analyse textual data and accurately interpret the results.
CO5	Discover the fundamental strategies for extracting information from textual material and retrieving it.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	2	2	1	1	-	-	-	-	-	1	1	2
CO2	2	1	2	2	2	1	1	-	-	-	-	-	2	3	1
CO3	1	1	2	1	2	3	1	-	-	-	-	-	2	2	2
CO4	1	1	3	2	1	1	-	-	-	-	-	-	1	2	2
CO5	1	2	2	2	1	2	-	-	-	-	-	-	2	1	2

Syllabus

Unit I
Overview: Origins and challenges of NLP Language and Grammar-Processing Indian Languages- NLP Applications Information Retrieval. Language Modeling: Various Grammar- based Language Models-Statistical Language Model.

Unit II
Word Level Analysis: Regular Expressions Finite-State Automata-Morphological Parsing- Spelling Error Detection and correction-Words and Word classes-Part-of Speech Tagging. Syntactic Analysis: Context-free Grammar-Constituency- Parsing-Probabilistic Parsing.

Unit III
Extracting Relations from Text: From Word Sequences to Dependency Paths: Introduction, Subsequence Kernels for Relation Extraction, A Dependency-Path Kernel for Relation Extraction and Experimental Evaluation

Mining Diagnostic Text Reports by Learning to Annotate Knowledge Roles:
Introduction, Domain Knowledge and Knowledge Roles, Frame Semantics and Semantic Role Labeling, Learning to Annotate Cases with Knowledge Roles and Evaluations.

Unit IV

Language Based Web Search: InFact System Overview, The GlobalSecurity.org Experience.

Evaluating Self-Explanations in iSTART: Word Matching, Latent Semantic Analysis, and Topic Models: Introduction, iSTART: Feedback Systems, iSTART: Evaluation of Feedback Systems

Unit V

Textual Signatures: Identifying Text-Types Using Latent Semantic Analysis to Measure the Cohesion of Text Structures:

Introduction, Cohesion, Coh Metrix, Approaches to Analyzing Texts, Latent Semantic Analysis, Predictions, Results of Experiments.

Automatic Document Separation: A Combination of Probabilistic Classification and Finite- State Sequence Modeling:

Introduction, Related Work, Data Preparation, Document Separation as a Sequence Mapping Problem, Results.

Evolving Explanatory Novel Patterns for Semantically-Based Text Mining:

Related Work, A Semantically Guided Model for Effective Text Mining.

Textbooks

1. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.
2. Anne Kao and Stephen R. Poteet (Eds), "Natural Language Processing and Text Mining", Springer-Verlag London Limited 2007.

References

1. Daniel Jurafsky and James H Martin, "Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", 2nd Edition, Prentice Hall, 2008.
2. James Allen, "Natural Language Understanding", 2nd edition, Benjamin/ Cummings publishing company, 1995.
3. Gerald J. Kowalski and Mark.T. Maybury, "Information Storage and Retrieval systems", Kluwer academic Publishers, 2000.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

23CSA354	SECURE DATA ANALYTICS	L-T-P-C: 3-0-0-3

Course Objective(s)

- To understand the basics of data mining for information security
- Understand strategies that can be used to ensure the outputs of information security analytics are accurate, understandable and actionable by security practitioners and business decision makers alike.

Course Outcomes

COs	Description
CO1	Have knowledge of basics of data mining for securing the information
CO2	Categorize different intrusion detection strategies and standard tools
CO3	Analyse anomaly detection methodologies for web and social media security
CO4	Identify the emerging trends and challenges in cybersecurity

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	2	-	2	1	-
CO2	2	2	2	3	1	-	-	-	-	-		1	-	1	1
CO3	1	1	2	1	-	-	-	-	-	-	-	1	-	-	1
CO4	2	2	2	-	1	-	-	-	-	2	-	-	2	1	3

Syllabus

Unit I

Introduction: Introduction to Information Security, Introduction to Data Mining for Information Security Network Intrusion Detection: Signature-based solutions (Snort, etc), Data-mining-based solutions (supervised and unsupervised)

Unit II

Host Intrusion Detection: Analysis of shell command sequences, system call sequences, and audit trails, Introduction to Insider threats, Masquerader/Impersonator/Insider threat detection strategies

Web Security: Anomaly detection of web-based attacks using web server logs, Anomaly detection in web proxy logs Email: Spam detection, Phishing email detection, phishing website detection; Social network security: Detecting compromised accounts, detecting social network spam,

Unit III

Authentication: Anomaly detection of Single Sign On (Kerberos, Active Directory), Detecting Pass-the-Hash and Pass-the-Ticket attacks, Behavioural Biometrics: Active authentication using behavioural and cognitive biometrics, touch and swipe pattern analysis for mobile active authentication,

Unit IV

Authentication: Anomaly detection of Single Sign On (Kerberos, Active Directory), Detecting Pass-the-Hash and Pass-the-Ticket attacks, Behavioural Biometrics: Active authentication using behavioural and cognitive biometrics, touch and swipe pattern analysis for mobile active authentication,

Unit V

Emerging areas: Fraud detection, IoT/Infrastructure security, Mobile/Wireless security, Machine Learning for Security: Challenges in applying machine learning (ML) to security, guidelines for applying ML to security, Current and future trends in security

Textbooks/References

1. Daniel Barbara and SushilJajodia, "Applications of Data Mining in Computer Security", Vol. 6. Springer Science & Business Media, 2002
2. Marcus A. Maloof, "Machine Learning and Data Mining for Computer Security", Springer Science & Business Media, 2006
3. V RaoVemuri, "Enhancing Computer Security with Smart Technology", Auerbach Publications, 2005
4. S. Stolfo, S. Bellovin, S. Hershkop, A. Keromytis, S. Sinclair, S. Smith, "Insider Attack and Cyber Security: Beyond the Hacker", Vol. 39. Springer Science & Business Media, 2008
5. Dhruba K. Bhattacharyya, Jugal K. Kalita, "Network Anomaly Detection: A Machine Learning Perspective", Crc Press, 2013
6. Anoop Singhal, "Data Warehousing and Data Mining Techniques for Cyber Security", Vol. 31. Springer Science & Business Media, 2007
7. Markus Jakobsson and Zulfikar Ramzan, "Crimeware, Understanding New Attacks and Defenses", Addison-Wesley Professional, 2008.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

23CSA355	BUSINESS INTELLIGENCE	L-T-P-C: 3-0-0-3

Course Objective(s)

It is to equip students with the knowledge and skills needed to use data effectively in various business contexts, and to enable them to make informed decisions based on data-driven insights.

Course Outcomes

COs	Description
CO1	To device the concepts of Business Intelligence principles and architecture.
CO2	To Analize Data Warehouses and apply the principles of modelling data warehouse.
CO3	To device the technologies and make use the BI tools through Data warehousing.
CO4	To categorize data reporting and apply to Online analytical processing.
CO5	Apply the practical exposure using BI tools.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	-	-	2	-
CO2	2	2	1	-	1	-	-	-	-	-	-	-	1		1
CO3	2	2	3	1	1	-	-	-	-	-	-	-	3		2
CO4	2	1	-	1	1	-	-	-	-	-	-	-	-	1	-
CO5	2	3	2	1	1	-	-	-	-	-	-	-	-	2	-

Syllabus

Unit1
Introduction to Business Intelligence:, BI Definitions & Concepts, Business Applications of BI, BI Framework, Role of Data Warehousing in BI, BI Infrastructure Components – BI Process, BI Technology, BI Roles & Responsibilities

Unit II
what is data warehouse, Introduction to OLTP and OLAP, , 3-tier data warehouse architecture, Data Marts Data integration: Basics of Data Integration (Extraction Transformation Loading)- concept of Chisquare test,

Unit III
Introduction to MultiDimensional Data Modeling-Introduction to data and dimension modeling, multidimensional data model, ER Modeling vs. multi-dimensional modeling, OLAP operations, concepts of dimensions, facts, cubes, attribute, hierarchies, star ,snowflake and fact constellation schema,the role of concept hierarchies, measures,

Unit IV
OLAP Servers – MOLAP, ROLAP, OLAP query model and query processing, indexing OLAP Data, Data Warehouse Implementation Introduction to business metrics and KPIs, creating cubes using SSAS. Basics of Enterprise Reporting- Introduction to enterprise reporting, concepts of dashboards, balanced scorecards.

Unit V
BI tools:SAP business object,micro strategy,SAS business intelligence,yellowfin BI,qliksense,Zoho analytics,sisense,Microsoft power BI,looker,clear analytics,tableau,oracle BI,domo,IBM cognos analytics

Textbooks/References

1. Loshin D, “Business Intelligence”, First Edition, Elsevier Science (USA), 2003.
2. Jiawei Han, Micheline Kamber and Jian Pei, “Data mining concepts and Techniques”, Third Edition, ElsevierPublisher, 2006.
3. Biere M, “ Business intelligence for the enterprise”, Second Edition, IBM Press,2003.
4. Moss L T, Atre S, “Business intelligence roadmap”, First Edition, Addison-Wesley Longman Publishing Co., Inc. 2003.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

23CSA356	QUANTUM COMPUTING	L-T-P-C: 2-0-2-3

Course Objective(s)

- Introduce the quantum computing paradigm.
- Learn the circuit model of quantum computation, and basic quantum algorithms
- Introduce quantum error correction, and quantum machine learning.
- Provide hands-on experience on quantum programming using IBM Qiskit .

Course Outcomes

COs	Description
CO1	To understand the fundamental concepts of quantum computing.
CO2	To learn the circuit model of quantum computing.
CO3	Implement basic quantum computing algorithms.
CO4	To learn the basics of quantum information processing and machine learning.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	-	-	1	-	2	-	1	3	2	3
CO2	3	3	3	2	3	-	-	-	1	2	-	2	3	2	3
CO3	3	3	3	3	3	-	-	-	-	2	-	2	3	2	3
CO4	3	3	3	3	3	1		-	-	2	-	2	3	2	3

Syllabus

Unit I
Quantum Computation: History & Overview, Review of linear algebra: Dirac notation, Hilbert spaces, Unitary, Hermitian, and Normal matrices, Inner product, Outer product, Tensor product, Postulates of Quantum Mechanics, Stern and Gerlach experiment, Qubit, Bloch Sphere.

Unit II
Circuit model of Quantum Computing: Quantum gates and Circuit, Entanglement: Bell state, Quantum Teleportation, Superdense coding, Phase kickback, No-cloning theorem, Quantum parallelism, Deutsch-Jozsa algorithm, Bernstein-Vazirani algorithm, Grover search algorithm, Qiskit programming.

Unit III
Quantum Fourier Transform, Quantum Phase Estimation, Shor's algorithm, Quantum Error Correction, Gottesman-Knill Theorem, Surface codes, Introduction to Quantum Machine Learning.

Textbooks

1. David McMahon, "Quantum Computing Explained", Wiley-IEEE Computer Society Press, 2007.
2. Maria Schuld, Francesco Petruccione, "Machine Learning with Quantum Computers", Springer International Publications, 2021
3. Venkateswaran Kasirajan, "Fundamentals of Quantum Computing -Theory and Practice", Springer, 2021

References

1. Quantum Computation and Quantum Information: 10th Anniversary Edition by Michael A. Nielsen and Isaac L. Chuang, Publisher: Cambridge University Press
2. Quantum Computing: A Gentle Introduction, by Eleanor Rieffel and Wolfgang Polak,2011 Edition, MIT Press.

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment (including lab)	45
End Semester Exam	30
Total Marks	100

*End Semester Exam to be conducted for 60 Marks

23CSA357	VISUAL PROGRAMMING USING C#	L-T-P-C: 2-0-2-3

Course Objective(s)

By the end of the course, students should be proficient in using C# for visual programming, be able to design and develop interactive graphical user interfaces and implement event-driven functionality in their applications.

Course Outcomes

COs	Description
CO1	Understand in detail .Net Framework and its architecture as well as learn on the features of IDE Visual Studio.
CO2	Must be able to program in C# and work on basic console applications.
CO3	Must be able to build Window applications with event handling and MDI features.
CO4	Understand the working ADO.Net model and design and implement a database application
CO5	Understand the working of file systems, file types, directories and building an interactive window application.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	-	2	-	-	-	-	-	-	1	-	-	-
CO2	2	3	2	-	2	1	-	-	-	-	-	1	-	1	-
CO3	2	3	3	-	3	1	-	-	-	-	-	1	-	1	-
CO4	2	3	2	-	3	-	-	-	-	-	-	1	1	-	-
CO5	2	2	2	-	-2	-	-	-	-	-	-	1	-	-	-

Syllabus

.Net Framework Overview- Architecture-.Net Framework class Libraries-CLR-Metadata- Interoperability-Assemblies-the .net Packaging system-CLR-MSIL, Introduction to Visual Studio.Net-C# Programming Concepts-Predefined Types- Value types and reference type, Classes and Objects, Constructors and methods, Conditional statements, loops, arrays, Collection classes: Array List, Hash Table, Stack, Queue, indexers and properties.

String class: methods and properties of string class, enumerations, boxing and unboxing, OOPS concepts: Encapsulation, data hiding, inheritance, interfaces, polymorphism, operator overloading, overriding Methods, Static Class members, Delegates and events. Exception Handling, garbage collector, generics and collection

Basics of Windows Programming- Event Driven Programming, Windows Forms, Using common controls-Labels, textboxes, buttons, check boxes, radio button, progress bar, combo box, list box. Components-timer, image list, Menus, Modal and Modeless Dialog Boxes, MDI, Mouse and keyboard event handling.

Introduction to ADO. Net-Object Model- System. Data Namespace- Data Bound controls- Connected Mechanism-Disconnected mechanism-.Net Data Providers.
Files: System.IO, directory and file types, Stream readers and stream writers, working with binary data

Textbooks/References

1. C# 4.0 the Complete Reference by Herbert Schildt
2. C# by Balaguruswamy
3. Latest version of Andrew Trolsens C# text from Apress(Pro C# 5.0 and the .NET Framework 4.5)
4. Robert Powel, Richard Weeks, C# and the .NET Framework, Techmedia

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment (including lab)	45
End Semester Exam	30
Total Marks	100

*End Semester Exam to be conducted for 60 Marks

23CSA358	DESIGN PATTERNS	L-T-P-C: 3-0-0-3

Course Objective(s)

- Understand the concept of Design patterns and its importance in software development.
- Understand the structure and knowledge of design patterns for different problems and its solutions
- Relate the Creational, Structural, behavioural Design patterns.
- Apply suitable design patterns in solving real life problem by refining the basic design for given context.

Course Outcomes

COs	Description
CO1	Understand the appropriate roles of subtyping and inheritance, and use them effectively
CO2	Identify the appropriate design patterns to solve object-oriented design problems.
CO3	Develop design solutions using creational patterns
CO4	Apply structural patterns to solve design problems
CO5	Construct design solutions by using behavioral patterns.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	3	1	-	-	1	-	-	-	-	-	-	2	-	-
CO3	3	3	3	1	-	1	-	-	-	-	-	-	2	-	1
CO4	3	3	3	-	-	1	-	-	-	-	-	-	2	-	1
CO5	3	3	3	1	-	1	-	-	-	-	-	-	2	-	1

Syllabus

Unit I
Introduction to Design Patterns: Significance – Software Design and patterns – Model – View - Controller.

Unit II
Observer Pattern - Decorator Pattern - Factory Pattern - Singleton Pattern - Command Pattern - Adapter and Facade Patterns - Template
Method Pattern - Iterator and Composite Patterns –
The State Pattern – The Proxy Pattern – Compound Patterns.

Unit III
GRASP Patterns and Anti-patterns. Case Study: Use of patterns in the Design of a Modern Web Framework.

Textbooks

1. Erich Freeman, Elisabeth Robson, Bert Bates and Kathy Sierra “Head First Design Patterns”, O’Reilly Media Inc., October 2004.

References

1. Erich Gamma, Richard Helm, Ralph Johnson and John M. Vlissides, “Design Patterns: Elements of Re-usable Object Oriented Software”, Second Edition, Addison Wesley, 2000
2. James W. Cooper, “Java Design Patterns: A Tutorial”, Second Edition, Pearson Education, 2003.
3. Mark Grand, “Patterns in Java – A Catalog of Reusable Patterns Illustrated with UML”, Wiley – Dream tech India, 2002

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

23CSA359	BLOCKCHAIN TECHNOLOGIES	L-T-P-C: 3-0-0-3

Course Objective(s)

This course presents a comprehensive introduction to the fundamental principles of Blockchain technology. It examines the evolution of blockchain technology across three generations, tracing its development from Bitcoin to Ethereum and hyper ledger. It enables students to develop and deploy smart contract over Blockchain.

Course Outcomes

COs	Description
CO1	Understand the fundamental characteristics of Blockchain and cryptocurrency
CO2	Understand cryptographic concepts in Blockchain
CO3	Understand the basics concepts of Bitcoin and Ethereum Blockchain
CO4	Develop smart contracts using Solidity and Remix IDE
CO5	Understand the mechanism of permissioned blockchain

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	1	1	-	-	-	-	-	-	-	-	1
CO2	3	-	-	-	2	-	-	-	-	-	-	-	-	-	1
CO3	3	-	-	-	-	1	-	-	-	-	-	-	-	-	1
CO4	1	-	3	-	3	-	-	-	-	-	-	-	-	-	1
CO5	3	-	-	-	1	1	-	-	-	-	-	-	-	-	1

Syllabus

Need for Distributed Record-Keeping, distributed ledger technology, Modeling faults and adversaries, Byzantine Generals problem, Nakamoto's concept with Blockchain-based cryptocurrency, Transaction: - syntax, structure and validation, Blocks- Structure, Genesis block, and Merkle tree. Mining: -target, hash rates, Consensus mechanisms, forking. Byzantine fault-tolerant distributed computing, coins, wallets, Bitcoin scripting language. Algorithms & Techniques: - Public-Key Cryptography, hashing: -Hash and Collison resistant hash. Digital signatures, verifiable random functions, and Zero-knowledge systems.

Ethereum Blockchain: structure, operations, incentive model, gas pricing, Ethereum Virtual Machine, Smart contracts, tokens, Distributed applications (DApps), Decentralized Autonomous Organizations (DAOs),

Ethereum smart contract architecture, contract transactions, comparing Bitcoin scripting vs. Ethereum Smart Contracts, Remix IDE
Solidity: - variables, data types, addresses and balances, strings in Solidity, global Msg-Object, mapping, structure, array, require, assert revert, constructor, fallback functions, View/Pure Getter functions. modifier, inheritance, importing of Files, events and return variables, ABI array, debugging libraries

Blockchain 3.0: Hyperledger fabric, the plug and play platform and mechanisms in permissioned blockchain

Textbooks/References

1. Narayanan, Arvind, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.
2. Ramamurthy, Bina. Blockchain in action. Manning Publications, 2020.
3. Imran, Bashir. "Mastering Blockchain: Distributed ledger technology, decentralization, and smart contracts explained." (2018).
4. https://www.coursera.org/learn/blockchain-basics?specialization=blockchain

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment	25
End Semester Exam	50
Total Marks	100

23CSA360	GRAPH ANALYTICS AND ALGORITHMS	L-T-P-C: 2-0-2-3

Course Objective(s)

- To understand the basic concepts of graphs.
- To understand and apply different graph centralities with networks
- Able to take case studies on large-scale networks with graph centralities.

Course Outcomes

COs	Description
CO1	Understand the basic concepts of graph theory.
CO2	Gain knowledge about different types of graphs and shortest path problems
CO3	Understand the basic concepts of graph centralities and apply to some networks
CO4	Understand and apply graph-based clustering algorithms for different networks.

CO-PO Mapping

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	2	1	-	-	-	-	-	1	2	1	3
CO2	3	2	1	1	2	1	-	-	-	-	-	1	2	1	3
CO3	2	3	2	1	2	1	-	-	-	-	-	1	2	1	3
CO4	2	2	1	1	2	1	-	-	-	-	-	1	1	1	2

Syllabus

Unit I
Review of Graphs: Graphs and Sub graphs, isomorphism, matrices associated with graphs, degrees, walks, connected graphs, shortest path algorithm. Eccentricity.
Connectivity: Graph connectivity, k-connected graphs and blocks.

Unit II
Matching and Colorings: Matchings, maximal matchings. Coverings and minimal coverings. Graph Dominations and Independent sets. Vertex colorings, Planar graphs. Euler theorem on planar graphs.
Large Scale networks: Introduction. Graph and Networks. Network topologies. Examples of large-scale networks and networked systems. Power Law distributions. Scale-free networks. Random graph models for large networks: Erdos-Renyi graphs, power-law graphs, small world graphs, phase transitions. Network stabilities.

Unit III
Graph Networks and Centralities:. Degree and distance centralities. Closeness centrality. Betweeness centrality. Eigenvector centrality and Page ranking algorithm and applications. Clustering coefficient and clustering centrality. Introduction to community detections.

Case Studies: Implementation of the centralities and community detection algorithms with Transport networks, Biological networks, ect.,

Textbooks

1. J.A. Bondy and U.S.R. Murty, Graph Theory and Applications, Springer, 2008.
2. Mohammed Zuhair Al-Taie, Seifedine Kadry, Python for Graph and Network Analysis, Springer, 2018.

References

1. Barabasi and Pasfai, Network Science, Cambride University press, 2016.
2. Meghanathan Natarajan, Centrality Metrics for Complexity Networks Analysis, IGI publisher, 2018.
3. Networks: An Introduction , M. E. J. Newman , Oxford University Press , 2010.
4. Complex Graphs and Networks , F. Chung and L. Lu , American Mathematical Society , 2006
5. Graph Algorithms in Neo4j

Evaluation Pattern

Assessment	Weightage (%)
Midterm	25
Continuous Assessment (including lab)	45
End Semester Exam	30
Total Marks	100

*End Semester Exam to be conducted for 60 Marks