RAMAIAH
Institute of Technology

CURRICULUM

Outcome Based Education

(Effective from the Academic Year 2024 – 2025)

INFORMATION SCIENCE AND ENGINEERING

V & VI SEMESTER B.E.

RAMAIAH INSTITUTE OF TECHNOLOGY
(Autonomous Institute, Affiliated to VTU)
Bangalore – 560054.

About the Institute:

Dr. M. S. Ramaiah a philanthropist, founded 'Gokula Education Foundation' in 1962 with an objective of serving the society. M S Ramaiah Institute of Technology (MSRIT) was established under the aegis of this foundation in the same year, creating a landmark in technical education in India. MSRIT offers 18 UG programs and 13 PG programs. All these programs are approved by AICTE. All eligible UG and PG programs are accredited by National Board of Accreditation (NBA). The institute is accredited with **'A^{+}' grade by NAAC in March 2021** for 5 years. University Grants Commission (UGC) & Visvesvaraya Technological University (VTU) have conferred Autonomous Status to MSRIT for both UG and PG Programs since 2007. The institute has also been conferred autonomous status for Ph.D. program since 2021. The institute is a participant to the Technical Education Quality Improvement Program (TEQIP), an initiative of the Government of India. The institute has 380 competent faculty out of which 70% are doctorates. Some of the distinguished features of MSRIT are: State of the art laboratories, individual computing facility for all faculty members, all research departments active with sponsored funded projects and more than 300 scholars pursuing Ph.D. To promote research culture, the institute has established Centre of Excellence for Imaging Technologies, Centre for Advanced Materials Technology, Centre for Antennas and Radio Frequency Systems (CARFS), Center for Cyber Physical Systems, Schneider Centre of Excellence & Centre for Bio and Energy Materials Innovation. **Ramaiah Institute of Technology has obtained All India Rank 182 in "Scimago Institutions Rankings" for the year 2024.**

The Entrepreneurship Development Cell (EDC) and Section 8 company "Ramaiah Evolute" have been set up on campus to incubate startups. MSRIT has a strong Placement and Training department with a committed team, a good Mentoring/Proctorial system, a fully equipped Sports department, large air-conditioned library with good collection of book volumes and subscription to International and National Journals. The Digital Library subscribes to online e-journals from Elsevier Science Direct, IEEE, Taylor & Francis, Springer Link, etc. The Institute is a member of DELNET, CMTI and VTU E-Library Consortium. The Institute has a modern auditorium, recording studio, and several hi-tech conference halls with video conferencing facilities. The institute has excellent hostel facilities for boys and girls. MSRIT Alumni have distinguished themselves by occupying high positions in India and abroad and are in touch with the institute through an active Alumni Association.

As per the National Institutional Ranking Framework (NIRF), MoE, Government of India, Ramaiah Institute of Technology has achieved 75th rank among 1463 top Engineering Institutions & 21st Rank for School of Architecture in India among 115 Architecture Institutions, for the year 2024.

About the Department:

The Department of Information Science and Engineering (ISE) was established in the year 1992 with an objective of producing high quality professionals to meet the demands of the emerging field of Information Technology. Department offers Bachelor's program in Information Science and Engineering (B. E), Master's program in Data Science (MTech) and Doctoral program (Ph.D.). The Department of Information Science and Engineering, is a progressive department that has made significant contributions to Academics, Research and Innovation. Under Graduate (UG) is accredited by the National Board of Accreditation in 2001, 2004, 2010, 2015, 2018 and reaccredited in 2022 under Tier-1 till 2028. The department has highly qualified and competent faculty members committed to innovative teaching learning and quality research. Department has 8 well-equipped state of the art laboratories which meets the requirement of curriculum, innovation and research. Collaboration with industries such as Apple, Unisys, Mindtree, Intel, Google, SECO, IBM, NVIDIA etc., has a significant impact on the curriculum, computing infrastructure, teaching & learning and research. The curriculum is centered around Data Science, Artificial Intelligence, IOT, Cloud & Distributed Computing, System Programming, Computer Security and Software development. Curriculum and the teaching learning process ensure that the students demonstrate technical competence, ethical reasoning, creativity in identification & formulation of the problems and develop solutions by using appropriate tools & techniques. Department has established technical clubs/ professional student chapters to provide collaborative learning platform for the students. Echo system has been built to initiate start-ups/Innovation at the department level along with the mentorship program. The activities of the Department led to high profile placements, motivation to become an entrepreneur, and encouragement for higher learning.

VISION OF THE INSTITUTE

To be an Institution of International Eminence, renowned for imparting quality technical education, cutting edge research and innovation to meet global socio-economic needs

MISSION OF THE INSTITUTE

MSRIT shall meet the global socio-economic needs through

1. Imparting quality technical education by nurturing a conducive learning environment through continuous improvement and customization
2. Establishing research clusters in emerging areas in collaboration with globally reputed organizations
3. Establishing innovative skills development, techno-entrepreneurial activities and consultancy for socio-economic needs

QUALITY POLICY

We at MS Ramaiah Institute of Technology strive to deliver comprehensive, continually enhanced, global quality technical and management education through an established Quality Management System complemented by the synergistic interaction of the stake holders concerned

VISION OF THE DEPARTMENT

To evolve as an outstanding education and research center of Information Technology to create high quality Engineering Professionals for the betterment of Society

MISSION OF THE DEPARTMENT

Department of Information Science and Engineering shall create high quality IT Engineering Professionals for the betterment of society by:

- Providing education through an ever improving curriculum and effective pedagogy techniques.
- Encouraging extra and co-curricular activities to develop their overall personality along with technical skills.
- Collaborating with industry and academia for strengthening research, innovation and entrepreneurshipecosystem.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

PEO1: Become competent Information Technology professionals with continuous progress in career or learning.

PEO2: Productively engage with society by practicing research or entrepreneurship.

PEO3: Function effectively as professionals in a team environment or individually.

PROGRAM OUTCOMES (POs):

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

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

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

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

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

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

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

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

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

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

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

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

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO1: Apply Mathematical models, programming paradigms and software development practices to solve real world problems

PSO2: Adopt computing and communication models for developing IT solutions.

PSO3: Acquire data engineering skills to develop intelligent systems in a multidisciplinary environment.

Semester wise Credit Breakdown for B.E Degree Curriculum Batch 2022-26

Semester / Course Category	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth	Total Credits
Basic Sciences (BSC)	08	08	03	03	--	--	--	--	22
Engineering Sciences (ESC)	09	08	--	--	--	--	--	--	17
Humanities, Social Sciences and Management (HSMC)	02	02	--	--	03	03	--	--	10
Ability Enhancement Course (AEC)	01	02	01	01	01	--	03	--	09
Universal Human Values (UHV)	--	--	02	--	--	--	--	--	02
Professional Core Courses (PCC)	--	--	11	12	12	06	04	--	45
Integrated Professional Core Course (IPCC)	--	--	04	04	03		04	--	15
Professional Elective Courses (PEC)	--	--	--	--	03	06	03	--	12
Institutional Open Elective Courses (IOE)	--	--	--	--	--	03	03	--	06
Internship (INT)	--	--	--	✔	--	--	--	05	05
Mini Project / Project Work (PW)	--	--	--	--	--	04	--	13	17
Non Credit Mandatory Courses (NCMC)	--	--	--	--	✔	--	--	✔	--
Total Credits	20	20	21	20	22	22	17	18	160

SCHEME OF TEACHING V SEMESTER

Sl. No.	Subject Code	Subject	Teaching Department	Category	Credits				Total contact hours /week
					L	T	P	Total	
1	IS51	Software Engineering	ISE	PCC	3	0	0	3	3
2	IS52	Artificial Intelligence	ISE	IPCC	2	0	1	3	4
3	IS53	Computer Networks	ISE	PCC	4	0	0	4	4
4	IS54	Theory of Computation	ISE	PCC	2	1	0	3	4
5	ISE55x	Program Elective Course – 1	ISE	PEC	3	0	0	3	3
6	ISL56	Data Visualization Lab	ISE	PCC	0	0	1	1	2
7	ISL57	Software Design Lab	ISE	PCC	0	0	1	1	2
8	AL58	Research Methodology & Intellectual property rights	ISE	HSMC	3	0	0	3	3
9	ISAEC59X	Ability Enhancement Course – V	ISE	AEC	1	0	0	1	1
				Total	**18**	**1**	**3**	**22**	**26**
10	HS510	Environmental Studies *		NCMC	0	0	0	0	-

Programme Electives Course - 1

Sl.No	Code	Subject
1	ISE551	Operations Research
2	ISE552	Mobile Application Development - 1
3	ISE553	Computer Vision
4	ISE554	Distributed System
5	ISE555	Software design patterns

Ability enhancement Course - V

Sl.No	Code	Subject
1	ISAEC510	NO SQL Database
2	ISAEC511	Responsive Web Development With Bootstrap
3	ISAEC512	Programming in Scala

Nomenclature: IPCC: Integrated Professional Core Course**, PCC:** Professional Core Course**, HSMC:** Humanity and Social Science & Management Courses**, PEC:** Professional Elective Courses**, AEC–**Ability Enhancement Courses,

NCMC: Non-credit Mandatory Course

L –Lecture, T – Tutorial, P- Practical/ Drawing

Note: ISE55x, where x=1,2,3,4,5

ISAEC59x, where x = 1,2,3…continued from previous

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with practical of the same course. Credit for IPCC is 03 and its Teaching–Learning hours (L : T : P) can be considered as (2 : 0 : 1). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated only by CIE **(no SEE).** However, questions from the practical part of IPCC can be included in the SEE question paper.

Professional Elective Courses: A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in Engineering and Technology curriculum. Multidisciplinary courses that are added to supplement the latest trend and advanced technology in the selected stream of engineering. Each group provides an option to select one course out of five courses. The minimum student's strength for offering professional electives is 10.

AICTE Activity Points to be earned by students admitted to BE program (For more details refer to Chapter 6, AICTE, Activity Point Program, Model Internship Guidelines):

Every regular student, who is admitted to the 4-year degree program, is required to earn 100 activity points in addition to the total credits earned for the program. Students entering 4 years degree program through lateral entry are required to earn 75 activity points in addition to the total credits earned for the program. The activity points earned by the student shall be reflected on the students VIII semester grade card. The activities to earn the points can be spread over the duration of the course. However, minimum prescribed duration should be fulfilled. Activity points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression. Incase student fail to earn the prescribed activity points; VIII semester grade card shall be issued only after earning the required activity Points. Students shall be eligible for the award of degree only after the release of the VIII semester grade card.

SCHEME OF TEACHING VI SEMESTER

Sl. No.	Subject Code	Subject	Teaching Department	Category	Credits				Total contact hours /week
					L	T	P	Total	
1	AL61	Management & Entrepreneurship	ISE	HSMC	3	0	0	3	3
2	IS62	Machine Learning	ISE	PCC	3	1	0	4	5
3	ISE63x	Program Elective Course – 2	ISE	PEC	3	0	0	3	3
4	ISE64x	Program Elective Course – 3	ISE	PEC	3	0	0	3	3
5	ISL65	Machine Learning Lab	ISE	PCC	0	0	1	1	2
6	ISL66	DevOps Lab	ISE	PCC	0	0	1	1	2
7	ISOE0X	Institutional Open Elective - 1		IOE	3	0	0	3	3
8	ISP67	Mini Project	ISE	PW	0	0	4	4	8
Total					**15**	**1**	**6**	**22**	**29**

Programme Electives Course – 2

Sl.No	Code	Subject
1	ISE631	Mobile Application Development - 2
2	ISE632	Internet of Things
3	ISE633	Block chain essentials and DApps
4	ISE634	System Simulation and Modeling

Programme Electives Course - 3

Sl.No	Code	Subject
1	ISE641	Business Analytics
2	ISE643	Natural Language Processing
3	ISE644	Cloud Computing
4	ISE645	Data Engineering and MLOps

Institutional Open Elective - 1

Sl. No.	Sub Code	Name
1	ISOE14	Data Analytics with Python
2	ISOE15	Fundamentals of Database Management Systems

Nomenclature, PCC: Professional Core Course**, PEC:** Professional Elective Courses, **IOE:** Institutional Open Elective, **PW:** Mini Project, **INT –** Internship

L –Lecture, T – Tutorial, P- Practical/ Drawing

Note: ISE63x , where x=1,2,3,4,5
ISE64x , where x=1,2,3,4
ISOE0x*, where x=1,2,.. continued from previous

L –Lecture, T – Tutorial, P- Practical/ Drawing/ Project work

Professional Elective Courses: A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in Engineering and Technology curriculum. Multidisciplinary courses that are added to supplement the latest trend and advanced technology in the selected stream of engineering. Each group provides an option to select one course out of five courses. The minimum student's strength for offering professional electives is 10.

Institutional Open Elective Courses:

Students belonging to a particular stream of Engineering and Technology are not entitled for the open electives offered by their parent department. However, they can take an elective offered by other departments, provided they satisfy the prerequisite condition, if any. Registration to open electives shall be documented under the guidance of the Proctor.

Selection of an open elective shall not be allowed if,

1. The candidate has studied the same course during the previous semesters of the program.
2. The syllabus content of open electives is similar to that of the Departmental core courses or professional electives.
3. A similar course, under any category, is prescribed in the higher semesters of the program.
4. The minimum students strength for offering open electives is 10.

Mini-project work: Mini Project is a laboratory-oriented course which will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications. Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to a group having **not more than 4 students.** The CIE marks shall be awarded by a committee constituted by of the Head of the concerned department. The CIE marks awarded for the Mini-project work shall be based on the evaluation of project report, project presentation skill, and question and answer session as per the rubrics defined by the department. SEE will be conducted by the two examiners appointed by the Institute. SEE marks awarded for the mini project shall be based on the evaluation of project work report, project presentation skill and question and answer session.
Internship - All the students admitted shall have to undergo mandatory internship of 6 - 8 weeks during the intervening vacation of the IV & V semesters / intervening vacation of VI & VII semesters/ VIII semester. **A Viva-Voce CIE examination** shall be conducted during VIII semester as per the rubrics defined by the department and the prescribed credits shall be included in VIII semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared fail and shall have to complete during subsequent examination after satisfying the internship requirements.
AICTE Activity Points to be earned by students admitted to BE program (For more details refer to Chapter 6, AICTE, Activity Point Program, Model Internship Guidelines): Every regular student, who is admitted to the 4-year degree program, is required to earn 100 activity points in addition to the total credits earned for the program. Students entering 4 years degree program through lateral entry are required to earn 75 activity points in addition to the total credits earned for the program. The activity points earned by the student shall be reflected on the students VIII semester grade card. The activities to earn the points can be spread over the duration of the course. However, minimum prescribed duration should be fulfilled. Activity points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression. Incase student fail to earn the prescribed activity points; VIII semester grade card shall be issued only after earning the required activity Points. Students shall be eligible for the award of degree only after the release of the VIII semester grade card.

V SEMESTER

SOFTWARE ENGINEERING	
Course Code: IS51	**Credits: 3:0:0**
Prerequisite: Nil	**Contact Hours: 42**
Course Coordinator: Dr. Pushpalatha M N	

Course Content

Unit I

Introduction: Professional software development, Software engineering ethics, Case studies. Software processes: Software process models, Process activities, coping with change, The Rational Unified process. Agile Software Development: Agile methods, Plan-driven and agile development, Extreme programming. Agile Project Management and Scaling Agile Methods

Unit II

Requirements engineering: Functional and Non-functional requirements, the software requirements document, Requirements specification, Requirements Engineering Processes, Requirements elicitation and analysis, Requirements validation, Requirements management.

Unit III

Architectural Design: Software Design and Implementation, Architectural design decisions, Architectural views, Architectural patterns, Application architectures. Design and implementation: Object-oriented design using the UML, Implementation issues, Open source development.

Unit IV

A Perspective on Testing- Basic Definitions, Test Cases, Insights from a Venn Diagram, Identifying Test Cases- Specification-Based Testing, Code-Based Testing, Specification-Based versus Code-Based Debate, Fault Taxonomies, Levels of Testing, UNIT TESTING, Boundary Value Testing- Normal Boundary Value Testing, Robust Boundary Value Testing, Worst-Case Boundary Value Testing, Special Value Testing, Examples- Test Cases for the Triangle Problem, Test Cases for the NextDate Function, Equivalence Class Testing- Equivalence Classes, Traditional Equivalence Class Testing, Improved Equivalence Class Testing, Equivalence Class Test Cases for the Triangle Problem, Equivalence Class Test Cases for the NextDate Function

Unit V

Software Management: Project management: Risk management, Managing people, Teamwork. Project planning: Software pricing, Plan-driven development, Project scheduling, Agile planning, Quality management: Software quality, Software measurement and metrics.

Course Outcomes (COs):

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

1. Understand the concepts of software engineering and development processes.(PO-1,8,9,10,11,12) (PSO-1)
2. Analyze the functional and non-functional requirements for the given problem (PO-1,2,9,10,11,12) (PSO-1)
3. Apply software architectural design for the given scenario (PO-1,2, 3,9,10,11,12) (PSO-1)
4. Understand Software testing and evolution processes. (PO-1, 9,10,11,12) (PSO-1)
5. Analyze Software Project Management issues and process improvement. (PO-1,2,11) (PSO-1)

Suggested Learning Resources:

Text Books:

1. Ian Sommerville, Software Engineering, 9th Edition, Pearson Education, 2011.
2. Paul C. Jorgensen, Software Testing, A Craftsman's Approach, 4th Edition, Auerbach Publications, 2017. (Unit – 4)

References:

1. Roger S. Pressman, Software Engineering-A Practitioners approach, 8th Edition, McGraw-Hill,2014.
2. Shari Lawrence Pfleeger, Joanne M. Atlee, Software Engineering Theory and Practice, Third Edition, Pearson Education, 2006.
3. Waman S Jawadekar, Software Engineering Principles and Practice, Tata McGraw Hill, 2004.
4. Douglas Bell, Software Engineering for Students, A Programming Approach, 4th Edition, Pearson Education.

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=Z6f9ckEElsU
2. https://www.youtube.com/watch?v=AN5I6fFxyfs
3. https://www.youtube.com/watch?v=vn6QvTb-TuQ
4. https://www.youtube.com/watch?v=krsvQHIGhvc
5. https://www.youtube.com/watch?v=IPlP2R7l-Nc&t=2s
6. https://www.youtube.com/watch?v=wEr6mwquPLY
7. https://www.youtube.com/watch?v=Q50ZyydS7pI

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Case study based on all phases of software engineering project based learning

ARTIFICIAL INTELLIGENCE	
Course Code: IS52	**Credits : 2:0:1**
Prerequisite: Nil	**Contact Hours: 28L+28P**
Course Coordinator: Dr. Rajeshwari S B	

Course Content

Unit I

Introduction: Definition of AI. Foundation of Artificial Intelligence. **Intelligent Agents:** Agents and Environments, Rationality, The Nature of Environments, The Structure of Agents.
Problem-solving by search: Problem-Solving Agents, Uninformed Search Strategies: Bidirectional Search. Informed Search Strategies: A* Search, Heuristic Functions.

Unit II

Adversarial Search: Games, Optimal Decisions in Games, Alpha Beta Pruning, Imperfect Real-Time Decision. **Logical Agents:** Knowledge-Based Agents, The Wumpus World, Logic,
Propositional Logic: A very simple logic, Effective Propositional Model Checking, Agents Based on Propositional Logic. **First Order Logic:** Wumpus World representation, Knowledge Engineering in First-Order Logic.

Unit III

Interference in First-order Logic: Propositional vs. First-Order Inference, Unification and Lifting, Forward chaining, Backward Chaining. Resolution. **Classical Planning:** Definition, Algorithms for Planning as State-Space Search, Planning Graphs, Other Planning Approaches.

Unit IV

Knowledge Representation: Ontological Engineering, Categories and Objects, Events, Mental Objects and Modal Logic, Reasoning Systems for Categories
Uncertainty: Acting under Uncertainty, Inference using Full Joint Distributions, Independence

Unit V

Uncertainty: The Wumpus World Revisited, Learning from Examples: Forms of Learning.
Robotics: Introduction, Hardware, Perception, Planning to Move, Planning Uncertain Movement, Moving, Robotic Software Architecture, Application Domains.

Implement the following Artificial Intelligence Problems in Python:

1. Implement and demonstrate 8-Puzzle problem.
2. Implement and demonstrate Tic-Tac-Toe game.
3. Implement and demonstrate Water-Jug problem.
4. Implement and demonstrate Monkey Banana Problem.
5. Implement and demonstrate Missionaries-Cannibals Problem.

6. Implement and demonstrate Hill Climbing Algorithm.
7. Implement and demonstrate Travelling Salesman Problem (TSP) using heuristic approach (A* Search algorithm).
8. Implementation of the problem solving strategies: either using Forward Chaining or Backward Chaining.
9. Implement resolution principle on First Order Predicate Logic (FOPL) related problems.
10. Implement and demonstrate simple Chatbot with minimum 10 conversations.

Course outcomes (COs):

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

1. Identify the fundamental characteristics and challenging issues of Artificial Intelligence (AI) systems (PO – 1, 2, 3, 4, 5) (PSO – 2)
2. Relate various general purpose search algorithm as solutions for various problem-solving agents (PO – 1, 2, 3,4, 5, 9) (PSO – 2)
3. Explore various symbolic knowledge representation to specify domains and reasoning tasks of a situated intelligent agent. (PO – 1, 4, 5, 9) (PSO – 2)
4. Apply algorithmic approach for planning and solving AI solutions that require problem solving, inference, perception, knowledge representation, and learning. (PO – 1, 4, 5, 9) (PSO – 2)
5. Extract conclusions on learning and quantify the uncertainty in the conclusions obtained from uncertain knowledge. (PO – 1, 2, 4, 5) (PSO – 2)

Text Book:

1. Stuart Russel, Peter Norvig: Artificial Intelligence - A Modern Approach, 3rd Edition, Pearson Education, 2012.
2. Elaine Rich, Kevin Knight, Shivashankar B Nair: Artificial Intelligence, 3rd Edition, Tata McGraw Hill, 2011.

References:

1. Peter Jackson, “Introduction to Expert Systems”, 3rd Edition, Pearson Education, 2007.
2. Deepak Khemani “Artificial Intelligence”, Tata Mc Graw Hill Education 2013.
3. http://nptel.ac.in

COMPUTER NETWORKS	
Course Code: IS53	**Credits: 4:0:0**
Prerequisite: Nil	**Contact Hours: 56**
Course Coordinator: Mr. Suresh Kumar K R	

Course Content

Unit I

Data communication Fundamentals: Introduction, Networks, Network types (LAN, WAN, MAN, Internet), Protocol Layering, TCP/IP protocol suite, OSI Model.

Physical layer: Data and Signals, Basics of Periodic analog signals and digital signals, Transmission impairments, Data rate limits, Line coding schemes (unipolar, polar, bipolar) in digital-to-digital conversion.

Unit II

Data Link layer: Introduction, Link layer addressing – Three types, ARP, Error detection and correction: Types of errors, redundancy, error detection vs error correction, block coding, cyclic codes – CRC and polynomials, checksum, Data link control: Framing, Media Access Control: Random Access Protocols, Controlled Access Protocols, Channelization.

Unit III

Network layer: Network layer services, Packet switching, Network-Layer Performance, IPV4 Addressing, Internet protocol (IP) datagram format, fragmentation, IP options, Routing algorithms: Distance Vector Routing, Link State Routing, Path Vector Routing, Multicast Distance Vector (DVMRP).

Unit IV

Network Layer: IPV6 addressing, The IPV6 Packet format, Extension header, Transition from IPV4 to IPV6, **Transport Layer**: Introduction, Transport layer Protocols, Simple Protocol, Stop-and-Wait Protocol, Go-Back-N Protocol (GBN), Selective-Repeat Protocol, Bidirectional Protocols: Piggybacking.

Unit V

Transport Layer: Services, Port Numbers, User Datagram Protocol (UDP) – user datagram, services and applications, Transmission control Protocol: TCP Services and features, Segment, TCP Connection, Flow control, Error control, and TCP Congestion control; Domain Name System (DNS) – Purpose and Resolution.

Course outcomes (COs):

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

1. Understand the fundamentals of communication models, protocol stacks, topologies and solve problems associated with data and signals. (PO – 1, 2, 5) (PSO – 2)
2. Apply different error detection, error correction and flow control strategies to solve issues induced during data communication. (PO - 1, 2) (PSO – 2)
3. Use different algorithms to make routing decisions (PO – 1, 2, 5, 9, 10, 12) (PSO – 2)
4. Identify and solve the problems associated with IPV4, IPV6 and transition from IPV4 to IPV6 (PO – 1, 2) (PSO – 2)
5. Illustrate the working principles of different transport and application layer protocols (PO – 1, 5, 9, 10, 12) (PSO – 2)

Suggested Learning Resources:

Text Books:

1. Behrouz A. Forouzan - Data Communications and Networking, 5th Edition, Tata McGraw-Hill, 2013
2. Alberto Leon-Garcia and Indra Widjaja - Communication Networks –Fundamental Concepts and Key architectures, Tata McGraw-Hill, 2004.
3. William Stallings - Data and Computer Communication, Eight Edition, Pearson Education, 2007.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/106105082
- https://onlinecourses.nptel.ac.in/noc22_ee61/preview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Network simulation using NS2

THEORY OF COMPUTATION	
Course Code: IS54	**Credits: 2:1:0**
Prerequisite: Nil	**Contact Hours: 28L + 28T**
Course Coordinator: Dr. S R Manisekhar	

Course Content

Unit I

Finite Automata and Regular Expressions: Introduction to Finite Automata: central concepts of Automata theory, Deterministic finite automata, Nondeterministic finite automata, application of finite automata, Finite automata with Epsilon-transitions.

Unit II

Regular Languages, Properties of Regular Languages: Regular expressions; Finite Automata and Regular Expressions, Equivalence and minimization of automata.

Unit III

Context-Free Grammars and Languages: Context free grammars, Parse trees: Constructing parse trees, The yield of a parse tree, Applications, Ambiguity in grammars and Languages, Normal forms for CFGs.

Unit IV

Pushdown Automata: The Pushdown automata: The languages of a PDA, Equivalence of PDA‟s and CFG‟s, Deterministic Pushdown Automata.

Unit V

Introduction to Turing Machine: The turning machine: Programming techniques for Turning Machines, Extensions to the basic Turning Machines, Turing Machine and Computers. Introduction to NP Hard and NP complete

Tutorial Contents:

1. Practice the design of Deterministic Finite Automata problems.
2. Design of Non- Deterministic Finite Automata problems.
3. Construct Ɛ-Non- Deterministic Finite Automata problems.
4. Show the steps for converting NFA to DFA.
5. Show the Converting step from Ɛ-NFA to DFA problems.
6. Construct Regular expression for the given a regular language.
7. Design problems on Minimization of DFA.
8. Construct Context free grammar given a context free language.
9. Normal forms for CFGs
10. Find the Ambiguity in grammars and Languages.

11. Design Deterministic Push Down Automata problems
12. Design Non Deterministic Push Down Automata problems
13. Show the steps for converting PDA to CFG and Vice versa.
14. Design of Turing Machine problems

Course outcomes (COs):

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

1. Design finite state machine using the concept of automata theory (PO-1,2,3,5,9,10,12; PSO-2)
2. Apply Regular Expression for the given finite Automata and vice versa. (PO-1,2,3,5,9,10,12; PSO-2)
3. Apply Context Free Grammar (CFG) for the given Normal Forms. (PO-1,2,3,5,9,10,12; PSO-2)
4. Design Push Down Automata for the given CFG and vice versa. (PO-1,2,3,5,9,10,12; PSO-2)
5. Design Turing Machine for a given language.

Text Book:

1. John E. Hopcroft, Rajeev Motwani, Jeffrey Ullman: Introduction to Automata, Theory, Languages and Computation, 3rd Edition, Pearson education, 2014

Reference Books:

1. John C Martin: Introduction to Languages and Automata Theory, 3rd Edition, Tata McGraw-Hill, 2007.
2. Daniel I.A. Cohen: Introduction to Computer Theory, 2nd Edition, John Wiley & Sons, 2004.

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc21_cs83/preview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- problem solving

DATA VISUALIZATION LAB	
Course Code: ISL56	**Credits : 0:0:1**
Prerequisite: Nil	**Contact Hours: 14L**
Course Coordinator: Ms. Kavya K S	

Cousre Contents

List of Experiments

Part A: Using tools like PowerBI and Tableau

Experiment 1: Exploring and Visualizing Sales Data

Import a sample sales dataset into Tableau. Create a dashboard that includes the following visualizations:

- A bar chart showing total sales by product category.
- A line chart showing monthly sales trends over the past year.
- A geographic map showing sales distribution by region.

Experiment 2: Advanced Visualization Techniques

Using a dataset on customer purchases, create a dashboard with the following advanced visualizations:

- A scatter plot showing the relationship between customer age and total spending.
- A heat map illustrating product sales intensity by store location.
- A dual-axis chart comparing sales and profit margins over time.

3. Analyzing Sales Performance: Create various visualizations to analyze the sales performance.

- Create a line chart to show sales trends over time.
- Create a bar chart to compare sales across different regions.
- Use a pie chart to display the distribution of sales among different product categories.
- Create a dashboard combining these visualizations to provide an overall view of sales performance.

4. Financial Performance Dashboard: Create a comprehensive dashboard to monitor the financial performance of a company.

- Create a combination of line and bar charts to compare actual revenue and expenses against budgeted figures.
- Use a gauge chart to display key financial metrics such as net profit margin.
- Create a waterfall chart to show the contribution of different factors to the overall profit.
- Design an interactive dashboard that allows users to filter data by different time periods (e.g., monthly, quarterly, yearly).

Part B: Python

1. Using Python, create your own having columns plant name, sunlight exposure, plant height and answer the following questions:
    a. Is there a relationship between the number of hours of sunlight exposure and the height of the plants?
    b. Visualize the relationship between sunlight exposure and plant height using a scatterplot.

    c. Calculate the correlation coefficient between sunlight exposure and plant height. Is the correlation positive or negative? Is it strong or weak?
    d. Based on the correlation coefficient, can we conclude that there is a significant association between sunlight exposure and plant growth rate?
2. In a solar panel efficiency study, researchers want to investigate the relationship between the temperature and the efficiency of solar panels. They collected data on the temperature (in Celsius) and the corresponding efficiency (in percentage) of solar panels over a period of time. The dataset contains measurements from 50 different days.
    a. Using Simple Linear Regression, can you develop a model to predict the efficiency of solar panels based on the temperature?
    b. Perform an F-test to determine whether temperature significantly predicts the efficiency of solar panels.
    c. Conduct a t-test to assess the significance of the regression coefficient for temperature.
3. Given the dataset of 30 students' study hours and exam scores, how would you build a linear regression model to predict exam scores? Describe the steps you would take to diagnose the regression model, including checking assumptions, identifying outliers, and handling influential points. Finally, evaluate the model's performance and discuss any insights gained.
4. In a retail experiment, we want to understand how advertising expenditure, store location, and competition affect sales revenue. Using synthetic data, implement multiple linear regression in Python to analyze these factors. Interpret the coefficients, perform an F-test to assess overall model significance, and conduct t-tests to evaluate the significance of individual coefficients.
5. Given data from three different groups, such as control, treatment A, and treatment B, determine if there are significant differences between the groups using a one-way ANOVA test. Implement Python code to compute the F-statistic and p-value, and interpret the results in terms of Type I and Type II errors.
6. Using Python, analyze the impact of different teaching methods on student performance in an educational experiment. Employ ANOVA to assess if there are significant differences among the methods. Further, conduct pairwise comparisons to identify specific method pairs that show significant variations in student scores.
7. Using Python, analyze the effectiveness of a new medication for curing a disease. With a sample of 100 patients, 65 show improvement after taking the medication. Conduct a one-sample test to determine if the observed success rate differs significantly from the expected rate of 70%. Additionally, perform a significance test to assess if the success rate differs significantly from a null hypothesis of 50%, and calculate a 95% confidence interval for the proportion of patients who showed improvement. Interpreted the results in terms of the medication's effectiveness.
8. Compare the effectiveness of two teaching methods, A and B, in helping students pass a test. Analyze the proportions of passing students, calculate confidence intervals for the difference in proportions, conduct significance tests, and evaluate the area under the ROC curve for predictive accuracy.

Course Outcomes (COs):

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

1. Comprehend various data visualization techniques and analyze methods for data pre-processing. (PO- 1, 2, 4)
2. Develop practical skills and expertise in utilizing data visualization tools. (PO – 3, 4, 5) (PSO – 1)
3. Apply data visualization techniques to solve real-world problems, making data-driven decisions in various domains such as business, healthcare, finance etc. (PO – 1, 2, 3, 4, 5) (PSO -1)

Reference Books:

1. Andreas C Muller, Sarah Guido, Introduction to Machine Learning with Python, O'reilly Publications

Web References:

1. https://realpython.com/python3-object-oriented-programming/
2. https://python.swaroopch.com/oop.html
3. https://python-textbok.readthedocs.io/en/1.0/Object_Oriented_Programming.html
4. https://www.programiz.com/python-programming/
5. https://www.geeksforgeeks.org/python-programming-language/

SOFTWARE DESIGN LAB	
Course Code: ISL57	**Credits : 0:0:1**
Prerequisite: Nil	**Contact Hours: 14L**
Course Coordinator: Dr. P M Krishna Raj	

Course Content

List of Experiments
Case studies on:
Strategy Pattern
Façade Pattern
Adapter Pattern
Bridge Pattern
Factory Method
Abstract Factory
Observer Pattern
Decorator Pattern
Template Method Pattern
Proxy pattern
Singleton and Double checked locked pattern

Course outcomes (COs):

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

1. Identify suitable pattern for the given problem (PO 1, 2, 3, 4, 5) (PSO 1)
2. Apply identified pattern to the problem (PO 2, 3, 4, 5) (PSO 1)
3. Document the outcomes in a standard form (PO 10, 11) (PSO 2)

OPERATIONS RESEARCH	
Course Code: ISE551	**Credits: 3:0:0**
Prerequisite: Nil	**Contact Hours: 42**
Course Coordinator: Dr. Sumana M	

Course Content

Unit I

Introduction to Operations Research (OR) and Linear Programming (LP): OR Models, Solving the OR Model, Phases of an OR Study; Modeling with Linear Programming (LP), Two variable LP Model, Graphical LP solution, Solution of a Maximization/Minimization Model, Computer solution with Excel Solver; LP Model in Equation Form, Transition from Graphical to Algebraic Solution; TORA Tool.

Unit II

The Simplex Method: The Simplex Method, Special cases in the Simplex Method, Degeneracy, Alternative optima, Unbounded solutions, Non-existing solutions; Artificial Variable Techniques: Two Phase Method, Big-M method; TORA Tool.

Unit III

Duality and Game Theory: Introduction: Concept of Duality; Definition of Primal Dual Problems; General Rules for Converting any Primal into its Dual; Introduction to Dual Simplex Method; Computational Procedure of Dual Simplex Method; Illustrative Examples. Introduction of Game Theory, Characteristics of Games Theory; Minimax (Maximin) Criterion and Optimal Strategy; Saddle Point, Optimal Strategies and the value of game; Solution of Games with Saddle Point(s); Rectangular Games without Saddle Point; Arithmetic Method for (2x2) Games, Gambit tool for Game theory.

Unit IV

Project Management by PERT-CPM: Introduction, Applications of PERT/CPM Techniques, Basic Steps in PERT/CPM Techniques; Network Diagram representation, Rules for Drawing Network Diagram, Labeling Fulkerson's „I-J" Rule; Time Estimates and Critical Path in Network Analysis; Project Evaluation and Review Technique; TORA tool

Unit V

Transportation and Assignment Problems: Mathematical Formulation of transportation problem (TP); Matrix Form of TP; Feasible Solution, Basic Feasible Solution and Optimum Solution; Tabular Representation; Special Structure of Transportation Table and their Problems; Initial Basic Feasible Solution to TP; Moving Towards Optimality; Degeneracy in TP; Unbalanced TP; Mathematical Formulation of Assignment Problem (AP); Fundamental Theorems; Hungarian Method for AP; TORA tool

Course Outcomes (COs):

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

1. Formulate linear programming model for a given problem. (PO-1,2,3) (PSO-2,3)
2. Solve a linear programming model using appropriate methods. (PO-1,2,5,9,10,12) (PSO-2,3)
3. Apply game theory to model, analyze and solve the given problems. (PO-1,2,3,5,9,10,12) (PSO-2,3)
4. Analyze a Project network using PERT and CPM techniques. (PO-1,2,3,5,9,10,12) (PSO-2,3)
5. Apply transportation and assignment techniques to solve the given problems. (PO-1,2,3,5,9,10,12) (PSO-2,3)

Suggested Learning Resources:

Text Books:

1. Operations Research: An Introduction – Hamdy A Taha – 9th Edition, Pearson Education, India, 2011.
2. Operations Research – S.D. Sharma – 16th Edition, KNRN Publications, 2009.

Reference:

1. Introduction to Operations Research – Frederick S. Hillier and Gerald J. Lieberman – 9th Edition, Tata McGraw Hill,2009

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=a2QgdDk4Xjw&list=PLjc8ejfjpgTf0LaDEHgLB3gCHZYcNtsoX&index=1
- https://www.youtube.com/watch?v=qxls3cYg8to&list=PLjc8ejfjpgTf0LaDEHgLB3gCHZYcNtsoX&index=4
- https://www.youtube.com/watch?v=Q31jKiEXxdc&list=PLjc8ejfjpgTf0LaDEHgLB3gCHZYcNtsoX&index=13
- https://www.youtube.com/watch?v=BUGIhEecipE&list=PLjc8ejfjpgTf0LaDEHgLB3gCHZYcNtsoX&index=16
- http://a.impartus.com/ilc/#/course/171022/1205
- http://a.impartus.com/ilc/#/course/221208/1205

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Problem solving using TORA and Excel solver tools.

MOBILE APPLICATION DEVELOPMENT - I	
Course Code: ISE552	**Credits : 3:0:0**
Pre-requisite: Nil	**Contact Hours: 42**
Course Coordinator: Dr. S R Mani Sekhar	

Course Content

Unit I

Getting Started with App Development - basics of data, operators, and control flow in Swift, debugging, Xcode, building, running and debugging an app, Interface Builder, Swift strings, Guided project - Light.

Unit II

Introduction to UI Kit - functions, structures, collections, and loops. UIKit—the system views and controls that make up a user interface and display data using Auto Layout and stack views. Guided project - Apple Pie

Unit III

More Swift – Collections, Structures, Classes, Closures, Variadics

Unit IV

Navigation and Workflows - build simple workflows and navigation hierarchies using navigation controllers, tab bar controllers, and segues, optionals and enumerations, type casting, Guided project - Personality Quiz

Unit V

Tables and Persistence - scroll views, table views, and building complex input screens, save data, share data to other apps, work with images in the user‘s photo library. Guided project - List, a task-tracking app that allows the user to add, edit, and delete items in a familiar table- based interface.

Course outcomes (COs):

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

1. Design applications using swift as language and Xcode as IDE (PO – 1, 2, 3, 5) (PSO – 1, 2)
2. Create simple user interfaces using UIKit (PO – 1, 2, 3, 5) (PSO – 1, 2)
3. Design applications using advanced constructs of swift like class, structures, enums (PO – 1, 2, 3, 4, 5) (PSO – 1, 2)
4. Create multiple views and connect them using segues and navigation (PO – 1, 2, 3, 4, 5) (PSO – 1, 2)
5. Create apps using table view and scroll views (PO – 1, 2, 3, 4, 5) (PSO – 1, 2)

Text Books:

1. Develop in Swift Fundamentals, Apple Books
2. Develop in Swift Data Collections, Apple Books

Web links and Video Lectures (e-Resources):

1. https://books.apple.com/us/book/develop-in-swift-fundamentals/id1511184145
2. https://www.apple.com/in/education/higher-education/app-development/
3. Swift Programming Tutorial | FULL COURSE | Absolute Beginner - https://www.youtube.com/watch?v=CwA1VWP0Ldw

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning:

- UI Design for an iOS App using Adobe XD or Figma

COMPUTER VISION	
Course Code: ISE553	**Credits : 3:0:0**
Prerequisite: Nil	**Contact Hours: 42**
Course Coordinator: Mrs. Evangeline D	

Course Content

Unit I

Introduction: Computer vision, Imaging modalities, Fundamental steps in image processing, Applications of computer vision. **Digital Image Fundamentals:** Image formation model, Sampling and quantization, Relationships between pixels. Mathematical tools used in image processing.

Unit II

Spatial Filtering: Intensity transformation functions, Histogram processing (Histogram equalization, Histogram matching), Fundamentals of spatial filtering (Mechanics of spatial filtering, correlation and convolution), Smoothing spatial filters, Sharpening spatial filters.

Unit III

Image Segmentation: Fundamentals, Detection of isolated points, line and basic edge, Thresholding, Region-based segmentation. **Representation and Description:** Representation (border following, chain codes, minimum-perimeter polygons) Boundary descriptors (simple descriptors, shape numbers), Region descriptors (simple descriptors, topological descriptors, texture).

Unit IV

Object Recognition: What Should Object Recognition Do? Feature, Geometric and semantic questions, Patterns and pattern classes, Recognition based on decision-theoretic methods, Matching, Optimum statistical classifier, Neural networks.

Unit V

Morphological Processing: Erosion and Dilation, Opening and closing, Hit-or-miss transform, Morphological algorithms (Boundary extraction, Hole filling, Extraction of connected components). **Compression Techniques:** Fundamentals, Compression methods (Huffman, Arithmetic, Run-length coding)

Course outcomes (COs):

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

1. Describe the fundamental concepts of a computer vision (PO-1) (PSO-3).
2. Apply spatial domain filters to improve the quality of the image (PO-1,2,3,5) (PSO-3).
3. Use segmentation, description, and recognition techniques for object identification in the image. (PO-1,2,3,5) (PSO-3).
4. Apply Object recognition techniques in processing the image. (PO-1,2,3,5) (PSO-3).
5. Apply morphological tools and compression techniques on the given image (PO-1,2,3,5) (PSO-3).

Suggested Learning Resources:

Text Books:

1. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", 3rd ed., Pearson.
2. Computer Vision: A modern approach, D.A. Forsyth, Jounce, Pearson Education, 2015

Web links and Video Lectures (e-Resources):

- https://www.tutorialspoint.com/dip/index.html
- https://www.mathworks.com/support/learn-with-matlab-tutorials.html

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Group discussions
- Design and development of solutions for the given problem

DISTRIBUTED SYSTEMS	
Course Code: ISE554	**Credits : 3:0:0**
Pre - requisite:	**Contact Hours: 42**
Course Coordinator: Dr. Shashidhara H S	

Course Content

Unit I

CHARACTERIZATION OF DISTRIBUTED SYSTEMS: Introduction, Focus on resource sharing, Challenges **REMOTE INVOCATION:** Introduction, Request-reply protocols, Remote procedure call, Introduction to Remote Method Invocation

Unit II

DISTRIBUTED FILE SYSTEMS: Introduction, File service architecture,**NAME SERVICES:** Introduction, Name services and the Domain Name System, Directory services

Unit III

TIME AND GLOBAL STATES: Introduction, Clocks, events and process states, Synchronizing physical clocks, Logical time and logical clocks, Global states

Unit IV

COORDINATION AND AGREEMENT: Introduction, Distributed mutual exclusion, Elections, Coordination and agreement in group communication, Consensus and related problems

Unit V

DISTRIBUTED TRANSACTIONS: Introduction, Flat and nested distributed transactions, Atomic commit protocols, Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery **REPLICATION**: Introduction

Course outcomes (COs):

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

1. Understand the goals and challenges of distributed system (PO – 1) (PSO -2)
2. Demonstrate the remote invocation techniques for communication (PO – 1, 2, 3, 9, 10) (PSO - 2)
3. Describe the architecture of distributed file systems and name services (PO – 1, 9, 10, 12) (PSO -2)
4. Apply clock synchronization algorithms to monitor and order the events. (PO – 1, 3, 9, 10) (PSO -2)
5. Analyze the performance of mutual exclusion, election and consensus algorithms. (PO – 1, 2, 9, 10, 12) (PSO -2)
6. Illustrate the fundamental concepts and algorithms related to distributed transactions and replication (PO – 1, 9, 10, 12) (PSO -2)

Suggested Learning Resources:

Text Books:

1. George Coulouris, Jean Dollimore and Tim Kindberg, “Distributed Systems Concepts and Design”, Fifth Edition, Pearson Education, 2012.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=Azyizl9w2xo&list=PLrjkTql3jnm9FEOXHA_qjR-TMODlaIk-W

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Programming Assignment
- Case Studies

SOFTWARE DESIGN PATTERNS	
Course Code: ISE555	**Credits: 3:0:0**
Pre - requisite: Object Oriented Programming, Software Engineering	**Contact Hours: 42**
Course Coordinator: Dr. M Sinthuja	

Course Content

Unit I

The Object Oriented Paradigm – Functional Decomposition, The Problem with Requirements, Dealing with Changes, The OO Paradigm; **The UML—The Unified Modeling Language:** Overview, What Is the UML? Why Use the UML?, The Class Diagram, Interaction Diagrams; The Principles and Strategies of Design Patterns: **The Open-Closed principle, Designing from Context, Encapsulating Variation, Abstract classes vs Interfaces, The principle of Healthy Skepticism**

Unit II

An Introduction to Design Patterns: Overview, Design Patterns Arose from Architecture and Anthropology, Moving from Architectural to Software Design Patterns, Why Study Design Patterns?, Other Advantages to Studying Design Patterns, Summary; **The Facade Pattern:** Overview, Introducing the Façade Pattern, Learning the Façade Pattern, Field Notes: The Façade Pattern; **The Adapter Pattern:** Overview, Introducing the Adapter Pattern, Learning the Adapter Pattern, Field Notes: The Adapter Pattern; **Expanding Our Horizons –** Objects: Traditional Vs New Views, Encapsulation: Traditional Vs New Views, Finding Varying Concept and Encapsulating, Commonality and Variability Analysis and Abstraction

Unit III

The Strategy Pattern: Overview, The International E-Commerce System Case Study: Initial Requirements, Handling New Requirements, The Strategy Pattern; **The Bridge Pattern:** Overview, Introducing the Bridge Pattern, Learning the Bridge Pattern – An example, An Observation About Using Design Patterns, Learning the Bridge Pattern – Deriving It, The Bridge Pattern in retrospect; **The Abstract Factory Pattern:** Overview, Introducing the Abstract Factory Pattern, Learning the Abstract Factory Pattern – An example, Learning the Abstract Factory Pattern – Implementing It

Unit IV

The Observer Pattern: Overview, Categories of Patterns, More Requirements for the International E-Commerce Case Study, The Observer Pattern, Applying the Observer to the Case Study; The Template Method Pattern: Overview, More Requirements for the International E-Commerce Case Study, The Template Method Pattern, Applying the Template Method to the International E-Commerce Case Study, Using the Template Method Pattern to Reduce Redundancy

Unit V

Lessons from Design Patterns: Factories – Factories, The Universal Context Revisited, Factories Follow our Guidelines; **The Singleton Pattern and the Double-Checked Locking Pattern:** Overview, Introducing the Singleton Pattern, Applying the Singleton Pattern to the Case Study; **A**

Variant: The Double-Checked Locking Pattern, Reflections, Use the Singleton and Double-Checked Locking Patterns if applicable for a given problem; **The Factory Method Pattern:** Overview, More Requirements for the Case Study, The Factory Method Pattern, Factory Method Pattern and Object-Oriented Languages

Course Outcomes (COs):

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

1. Design solution to the given problem definition using UML notations (PO – 1, 2, 3) (PSO – 1)
2. Apply Façade and Adapter patterns to given problem with traditional design (PO – 1, 2, 3, 9, 10, 12) (PSO – 1)
3. Apply Strategy, Bridge and Abstract Factory patterns to the given scenario (PO – 1, 2, 3, 9, 10, 12) (PSO – 1)
4. Apply Template Method and/or Observer patterns for a given problem design (PO – 1, 2, 3, 9, 10, 12) (PSO – 1)
5. Use Singleton, Double checked locking pattern and Factory method pattern for a given problem design (PO – 1, 2, 3, 9, 10, 12) (PSO – 1)

Suggested Learning Resources:

Text Books:

1. Alan Shalloway, James R Trot, "Design Patterns Explained – A New Perspective on Object-Oriented Design", Pearson, 2nd Edition, 4th Impression 2010
2. Eric Freeman, Elisabeth Freeman, "Head First Design Patterns", O'reilly Publications, October 2004, 1st Edition
3. Satzinger, Jackson, Burd, "Object Oriented Analysis and Design with Unified Process", Thomson Learning, 1st Indian Reprint 2007.

Web links and Video Lectures (e-Resources):

- https://www.udemy.com/course/design-patterns-java/
- https://nptel.ac.in/courses/106105224

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Case Study Discussion
- Programming assignment

RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHTS	
Course Code: AL58	**Credits : 3:0:0**
Prerequisite: Nil	**Contact Hours: 42**

Course Content

Unit I

Research Methodology

Introduction: Meaning of Research, Objectives of Research, Types of Research, Ethics in Research, Types of Research Misconduct. Literature Review and Technical Reading, New and Existing Knowledge, Analysis and Synthesis of Prior Art, Bibliographic Databases, Conceptualizing Research, Critical and Creative Reading. **Citations:** Functions and Attributes, Impact of Title and Keywords on Citations, Knowledge flow through Citations, Acknowledgments, and Attributions.

- Pedagogy: Chalk and Talk, PowerPoint Presentations
- Links: https://onlinecourses.nptel.ac.in/noc22_ge08/preview

Unit II

Research Design: Need for Research Design, Important Concepts Related to Research Design: Dependent and Independent Variables, Extraneous Variable, Variable, Common Control, Confounded Relationship, Research Hypothesis, Experimental and Control Groups, Treatments.

Experimental Designs: Introduction to Randomized Block Design, Complete Randomized Design, Latin Square Design, and Factorial Design.

- Pedagogy: Chalk and Talk, PowerPoint Presentations
- Links: https://onlinecourses.nptel.ac.in/noc22_ge08/preview

Unit III

Method of Data Collection: Primary and Secondary Data Collection.

Sampling Design: Sampling fundamentals, Measurement, and Scaling Techniques, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design, and Types of Sample Design. **Data Analysis:** Testing of Hypotheses: Null Hypothesis, Alternative Hypothesis, Type I and Type II Errors, Level of Significance. Procedure for Hypothesis Testing: Mean, Variance, Proportions. Chi-square Test, Analysis of Variance (One Way ANOVA), and Covariance (ANOCOVA)

- Pedagogy: Chalk and Talk, PowerPoint Presentations
- Links: https://onlinecourses.nptel.ac.in/noc23_ge36/preview

Unit IV

Intellectual Property Rights

Introduction to IPR: Different forms of IPR, Role of IPR in Research and Development. TRIPS Agreement, Patent Cooperation Treaty (PCT). **Patents:** Brief history of Patents-Indian and Global Scenario, Principles Underlying Patent Law, Types of Patent Applications in India, Procedure for Obtaining a Patent. Non Patentable Inventions. Rights Conferred to a Patentee, Basmati Rice Patent Case.

- Pedagogy: Chalk and Talk, PowerPoint Presentations
- Links: https://archive.nptel.ac.in/courses/110/105/110105139/

Unit V

Design: What is a Design? Essential Requirements for a Registrable Design, Procedure of Registration of a Design, **Trademarks:** Essentials of a Trademark, Registration, and Protection of Trademarks, Rights Conferred by Registration of Trademarks, Infringements, Types of Reliefs, Case Studies. **Copyrights:** Characteristics of Copyrights, Rights Conferred by Registration of Copyrights, Registration of Copyrights, Infringements, Remedies against Infringement of Copyrights, Case studies

- Pedagogy: Chalk and Talk, PowerPoint Presentations
- Links: https://archive.nptel.ac.in/courses/110/105/110105139/

Text Books:

1. C. R Kothari, Gourav Garg, Research Methodology – Methods and Techniques. New Age International Publishers.
2. Dr. B L Wadehra – Law relating to Intellectual property. Universal Law Publishing Co.
3. Dipankar Deb, Rajeeb Dey, Valentina E. Balas "Engineering Research Methodology", ISSN 1868-4394 ISSN 1868-4408 (electronic), Intelligent Systems Reference Library, ISBN 978-981-13-2946-3 ISBN 978-981-13-2947-0 (eBook), https://doi.org/10.1007/978-981-13-2947-0.

Reference Books:

1. David V. Thiel "Research Methods for Engineers" Cambridge University Press, 978-1-107-03488-4

Course Outcomes (COs):

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

1. Possess the knowledge of research and conduct a literature review**.** (PO-8, PO-10, PO-12)
2. Apply the knowledge of research design and design of experiments. (PO-4, PO-8, PO 10, PO-12)
3. Analyze data collection methods, analysis, and sampling design. (PO-4, PO-8, PO-10, PO-12)
4. Understand the global and Indian scenarios of patents and patent applications. (PO-8, PO-10, PO-12)
5. Acquire the requirements of registration and infringements related to trademarks, copyrights, and designs. (PO-8, PO-10, PO-12)

ABILITY ENHANCEMENT COURSE - V	
Course Code: AEC510	**Credits: 1:0:0**
Prerequisite: Nil	**Contact Hours: 14L**
Course Coordinator: Any Department	

Course Content

Ability Enhancement Courses (AEC) are the generic skill courses which are basic and needed by all to pursue any career. These courses are designed to help students enhance their skills in communication, language, and personality development. They also promote a deeper understanding of subjects like social sciences and ethics, culture and human behavior, human rights and the law.

Every student shall register for AEC course under the supervision of his/her proctor. For III, IV & V semester, the student shall select the Ability Enhancement Course online such that the selected course does not overlap with any professional core/ elective course offered by the parent department of the student. After selection, the registration of the course has to be done by the student at his/her parent department.

NO SQL DATABASE	
Course Code: ISAEC510	**Credits:1:0:0**
Pre – requisites: NIL	**Contact Hours:14**
Course Coordinator: Dr. Lincy Meera Mathews	

Course Content

Unit I

Variety of NoSQL Databases : Data Management with Distributed Databases, ACID and BASE, Four Types of NoSQL Databases.

Unit II

Key Value Databases : From Arrays to Key Value Databases, Keys: More than Meaningless Identifiers, Key Value database Terminology: Key Value Database Data Modelling Terms, Key Value Architecture terms, Designing for Key value Databases : Key Design and Partitioning

Unit III

Document Databases: Introduction to Document Databases: Basic Operations on Document Databases, Document Database terminology : Document and Collection Terms, Types of Partition, Data Modelling and Query Processing

Unit IV

Column Family Databases: Introduction, Differences and Similarities to Key value and Document Databases, Column Family Database Terminology: Basic Components, Structures and Processes, Designing for Column Family Databases : Guidelines for Designing Tables, Guidelines for Indexing

Unit V

Graph Databases : Introduction to Graph Databases, Graphs and network Modelling, Advantages of Graph databases, Graph database Terminology: Elements of graphs, operations on Graphs, Properties, types of Graphs, Designing for Graph databases :Querying a graph.

Course Outcomes (COs):

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

1. Explain the emergence and different types of No SQL Databases. (PO-1,2 ,7,9,10,11,12 & PSO-2)
2. Understand the modelling concepts for a Key Value Database. (PO-1,2,7,9,10,11,12 & PSO-2)
3. Demonstrate the detailed architecture of Document Databases (PO-1,2,5,7,9,10,11,12 & PSO-2).
4. Demonstrate the detailed architecture of Column Family Databases (PO-1,2,5,7,9,10,11,12 & PSO-2).
5. Demonstrate the detailed architecture of Graph Databases. (PO-1,2,5,7,9,10,11,12 & PSO-2)

Suggested Learning Resources:

Text Books:

1. Dan Sullivan, 2016 Edition, NoSQL for Mere Mortals, Pearson publication

References:

1. Sadalage, P. & Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Pearson Addision Wesley, 2012

Web links and Video Lectures (e-Resources):

1. https://www.ibm.com/cloud/learn/nosql-databases
2. https://www.coursera.org/lecture/nosql-databases/introduction-to-nosql-VdRNp
3. https://www.geeksforgeeks.org/introduction-to-nosql/
4. https://www.javatpoint.com/nosql-databa

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Case study based on all phases of software engineering
- project based learning

RESPONSIVE WEB DEVELOPMENT WITH BOOTSTRAP	
Course Code: ISAEC511	**Credits:1:0:0**
Pre – requisites: NIL	**Contact Hours:14**
Course Coordinator: Dr. Sumana M	

Course Content

Unit I

Bootstrap Scaffolding: Introduction to Bootstrap , file structure, global styles, default Grid System, Fluid Grid system ,Container Layouts, Responsive Design.

Unit II

Bootstrap CSS : Typography, Code, tables, forms, buttons, images, icons

Unit III

Bootstrap Layout Components: Dropdown Menus, Button Groups, Button with dropdowns, Navigation Elements, Navbar, Pagination, Labels and Badges, Typographic Elements

Unit IV

Bootstrap JayaScript Plugins: Programmatic API, Transitions, Modal, Dropdown, Scrollspy,Toggleable Tabs, Tooltips, Popover, Alerts, Buttons, Collapse.

Unit V

Carousel, Typeahead, **Using Bootstrap:** Customizing Bootstrap using LESS, text snippets, themes, Built with Bootstrap.

Course Outcomes (COs):

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

1. Understand the structure of Bootstrap. (PO-1,8,9,10,11,12) (PSO-1)
2. Apply bootstrap concepts to HTML components. (PO-1,2,9,10,11,12) (PSO-1)
3. Apply bootstrap layout components on designing web pages. (PO-1,2, 3,9,10,11,12) (PSO-1)
4. Apply bootstrap as plugins to JavaScript. (PO-1, 9,10,11,12) (PSO-1)
5. Apply Bootstrap in building web applications. (PO-1,2,11) (PSO-1)

Suggested Learning Resources:

Text Books:

1. Jake Spurlock , “Responsive Web Development Bootstrap”, O’Reilly publications 2013

Web links and Video Lectures (e-Resources):

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Case study based Statistical Approaches in Machine Learning
- Problem Solving for Analysis

PROGRAMMING IN SCALA	
Course Code: ISAEC512	**Credits:1:0:0**
Pre – requisites: NIL	**Contact Hours:14**
Course Coordinator: Dr. Shashidhara H S	

Course Content

Unit I

Introduction to Scala, First Steps, Classes and Objects – classes, fields and methods, semicolon inference, singleton objects, case classes, a scala application, Basic type and operations, literals, string interpolation, Arithmetic operations, Relational and logical operations, Bitwise operations, Object equality, Operator precedence and associativity

Unit II

Functional Objects - class Rational, Reimplementing the toString method, Checking preconditions, Adding fields, Self-references, Auxiliary constructors, Private fields and methods, Defining operators, Identifiers in Scala, Method overloading, Extension methods

Unit III

Built-in Control Structures - If expressions, While loops, For expressions, Exception handling with try expressions, Match expressions, Living without break and continue, Variable scope, Refactoring imperative-style code

Unit IV

Functions and Closures – Methods, Local functions, First-class functions, Short forms of function literals, Placeholder syntax, Partially applied functions, Closures, Special function call forms, SAM types, Tail recursion

Unit V

Composition and Inheritance - A two-dimensional layout library, Abstract classes, Defining parameter less methods, Extending classes, Overriding methods and fields, Defining parametric fields, Invoking superclass constructors, Using override modifiers, Polymorphism and dynamic binding, Declaring final members, Using composition and inheritance, Implementing above, beside, and toString, Defining a factory object, Heighten and widen

Course Outcomes (COs):

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

1. Explain the features and need of Scala programming language
2. Create classes and methods for a given problem definition
3. Apply built-in control structures to the given problem
4. Apply closures to improve readability of code
5. Optimize the code using composition and inheritance concepts.

Suggested Learning Resources:

Text Books:

1. Martin Odersky, Lex Spoon - Programming in Scala Fifth Edition, Artima Press

References:

1. Jason Swartz - Learning Scala: Practical Functional Programming for the JVM, Shroff/O'Reilly
2. Dean Wampler - Programming Scala: Scalability = Functional Programming + Objects, Third Edition, Shroff/O'Reilly

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=LQVDJtfpQU0&list=PLS1QulWo1RIagob5D6kMIAvu7DQC5VTh3
2. https://www.youtube.com/@cloudanddatauniverse

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Code demo

ENVIRONMENTAL STUDIES	
Course Code: HS59	**Credits : 0:0:0**
Pre - requisite: Nil	**Contact Hours: 14L**

Course Content

Unit I

Environment, Ecology and Biodiversity

Definition, scope and importance. Multidisciplinary nature of Environmental studies. Food chain and food web. Energy flow and material cycling in ecosystem. Biodiversity and threats to biodiversity. Concept of sustainable development: Definition, objectives and applications.

- Pedagogy/Course delivery tools: Chalk and Talk, Power point presentations, Videos, Models
- Link: https://youtu.be/I_bnGkviWOU
- Link: https://youtu.be/Ar04qG1P8Es

Unit II

Natural resources

Forest resources: Ecological importance of forests. Water resources: Global water resources distribution. Mineral resources: Environmental effects of extracting and processing Mineral resources. Food resources: Effects of modern agriculture. Land resources: Soil erosion and Desertification.

- Pedagogy/Course delivery tools: Chalk and Talk, Power point presentations, Videos
- Link: https://youtu.be/vsXv3anIBSU
- Link: https://youtu.be/1rOVPqaUyv8

Unit III

Energy sources

Growing energy needs. Conventional and non-conventional / Renewable and Non-renewable energy sources. Bio Energy-Ethanol and Bio mass energy. Energy of the future – Hydrogen fuel cells and Nuclear energy. Environmental Impact Assessment (EIA): Definition, Objectives and benefits. Step by step procedure of conducting EIA.

- Pedagogy/Course delivery tools: Chalk and Talk, Power point presentations, Animations, Models
- Link: https://youtu.be/mh51mAUexK4
- Link: https://youtu.be/XS-eXqppf_w

Unit IV

Environmental pollution

Definition, Causes, Effects and control measures of Water pollution, Air pollution and Soil/ land pollution. Management of Municipal Solid Waste and treatment methods of municipal solid waste.

- Pedagogy/Course delivery tools: Chalk and Talk, Power point presentations, Videos
- Link: https://youtu.be/NRoFvz8Ugeo
- Link: https://youtu.be/DAQapF-F4Vw

Unit V

Environmental protection

Global warming and Climate change, Acid rain, Ozone layer depletion. Salient features of Environmental Protection Act, Air & Water Acts. Functions of Central and State Pollution Control Boards.

- Pedagogy/Course delivery tools: Chalk and Talk, Power point presentations, Open source software
- Link: https://youtu.be/iV-BvYwl4Y8
- Link: https://youtu.be/BYqLRGawoH0

Text Books:

1. **Dr. S M Prakash** – Environmental Studies, Elite Publishers, 2007.

Reference Books:

1. **P. Venugopala Rao** – Principles of Environmental Science & Engineering Prentice Hall of India, 1st edition, 2006.

Web links and video Lectures (e- Resources):

1. https://youtu.be/I_bnGkviWOU
2. https://youtu.be/vsXv3anIBSU
3. https://youtu.be/mh51mAUexK4
4. https://youtu.be/NRoFvz8Ugeo
5. https://youtu.be/iV-BvYwl4Y8

Course Outcomes (COs):

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

1. Describe the importance of environmental studies, sustainable development and biodiversity (PO-1, 7)
2. Explain the importance and conservation of impacts of natural resources (PO-1, 7)
3. Distinguish the energy sources and identify the alternative energy sources for sustainable development (PO-1, 7)
4. Identify the causes, effects and control measures of pollution in developmental activities (PO-1, 7)
5. Outline the current environmental issues and the role of the agencies for environmental protection (PO-1, 7)

VI SEMESTER

MANAGEMENT & ENTREPRENEURSHIP	
Subject Code: AL61	**Credits: 3:0:0**
Pre requisites: NIL	**Contact Hours: 42L**
Course Coordinators: Dr. M Shilpa/ Dr. M Rajesh	

Course Content

Unit I

Introduction to Management: Definition of Management, Its nature and purpose, Contributions of F.W. Taylor and Henry Fayol to management theory, Functions of managers. **Planning:** Types of plans, Steps in planning, the planning process, Management by Objectives (MBO) **Organizing:** The nature and purpose of organizing, Formal and informal organization. Organization levels and Span of management, Principle of span of management, the structure and process of organizing

- Pedagogy: Chalk and Talk, PowerPoint Presentations
- Links: https://onlinecourses.nptel.ac.in/noc23_mg33/preview
  https://www.digimat.in/nptel/courses/video/110107150/L01.html

Unit II

Staffing: Situational factors affecting staffing. **Leading:** Human factors in managing, definition of leadership, Ingredients of leadership **Controlling:** Basic control process, Critical control points and standards, Control as a feedback system, Feed forward control, Requirements for effective controls.

- Pedagogy: Chalk and Talk, PowerPoint Presentations
- Links: https://nptel.ac.in/courses/110107150

Unit III

Introduction to Entrepreneurship: The Foundations of Entrepreneurship: What is an Entrepreneurship? The benefits of Entrepreneurship, The potential drawbacks of Entrepreneurship; Inside the Entrepreneurial Mind: From Ideas to Reality: Creativity, Innovation and Entrepreneurship, Creative Thinking, Barriers to Creativity

- Pedagogy: Chalk and Talk, PowerPoint Presentations
- Links:https://www.youtube.com/watch?v=Hgj_kRrvbhQ&list=PL7oBzLzHZ1wXW3mtolxV5nIGn48NLKwrb

Unit IV

The Entrepreneurial Journey: Crafting a Business Plan: The benefits of creating a business plan, the elements of a business plan; Forms of Business Ownership and Buying an Existing Business: Sole proprietorships and partnership. **Launching the Business:** Franchising and the Entrepreneur: Types of Franchising, the benefits of buying a Franchise

- Pedagogy: Chalk and Talk, PowerPoint Presentations
- Links:https://www.youtube.com/watch?v=Tzzfd6168jk&list=PLyqSpQzTE6M8EGZbmNUuUM7Vh2GkdbB1R
  https://www.youtube.com/watch?v=5RMqxtMwejM&list=PLyqSpQzTE6M9zMKj_PSm81k9U8NjaVJkR

Unit V

Small Scale Industry: Definition, Characteristics, types, role of SSI in Economic Development, steps to start SSI- Govt. Policy towards SSI, Institutional support- TECKSOK, KIADB, KSSIDC, KSIMC, DIC, NSIC, SIDBI, KSFC.

- Pedagogy: Chalk and Talk, PowerPoint Presentations
- Links:https://www.nptel.ac.in/courses/110/105/110105067/

Text Books:

1. Harold Koontz, H. Weihrich, and A.R. Aryasri, Principles of Management, Tata McGraw-Hill, New Delhi, 2004.
2. Essentials of Entrepreneurship and Small Business Management – Norman Scarborough & Jeffrey Cornwall (Pearson, 2016)
3. Management and Entrepreneurship by K. R. Phaneesh, Sudha Publications, Bangalore

References:

1. Innovation & Entrepreneurship – Peter Drucker (Harper, 2006)
2. Entrepreneurship: The Art, Science, and Process for Success – Charles Bamford & Garry Bruton (McGraw-Hill, 2015)
3. Managent and Enterpreneuship-NVR Naidu, T Krishna Rao, I.K. International Publishing House Pvt. Ltd.@ 2008
4. Poornima M Charantimath, Entrepreneurship Development and Small Business Enterprises, Pearson Education, 2006.

Course Outcomes (COs):

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

1. Plan and organize for the manpower in the given type of organization (PO-6,9,11)
2. Use staffing Leading and controlling functions for the given organization. (PO-6,8,9,10)
3. Analyze the advantages and potential drawbacks of Entrepreneurship. (PO-6,7,8)
4. Develop a basic business plan and analyze the benefits of buying Franchise. (PO-3,5,7,8,11)
5. Identify the various institutions that provide financial support to small scale industries. (PO-6,11)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO1, CO2
Internal test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30marks.		
Other components		
Quiz	10	CO1, CO2,CO3
Assignment	10	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

MACHINE LEARNING	
Course Code: IS62	**Credits: 3:1:0**
Pre - requisite: Nil	**Contact Hours: 42L + 14T**
Course Coordinator: Dr. Pushpalatha M N	

Course Content

Unit I

Machine Learning Introduction: Learning, Types of Machine Learning, Supervised Learning, The Machine Learning Process.

Machine Learning Preliminaries: Terminology - Weight Space, The Curse of Dimensionality; Testing Machine Learning Algorithms – Over-fitting, Training, Testing and Validation Sets, The Confusion Matrix, Accuracy Metrics, ROC Curve, Unbalanced Dataset, Measuring Precision.

Model selection & evaluation: Holdout Method and Random Subsampling, Cross-Validation, Bootstrap, Model Selection Using Statistical Tests of Significance.

Turning Data into Probabilities: Minimizing Risk, maximum a posteriori hypothesis; Basic Statistics: Averages, Variance and Covariance, The Gaussian; Bias-Variance Trade-off.

Unit II

Measuring Data Similarity and Dissimilarity: Data Matrix versus Dissimilarity Matrix, Proximity Measures for Nominal Attributes, Proximity Measures for Binary Attributes, Dissimilarity of Numeric Data: Minkowski Distance, Proximity Measures for Ordinal Attributes, Dissimilarity for Attributes of Mixed Types, Cosine Similarity.

Concept Learning: Concept learning task, Concept learning as search, Find-S algorithm, Version space, Candidate Elimination algorithm, Inductive Bias. Problems on Candidate Elimination and Find-S.

Dimensionality Reduction - Supervised: LDA (Linear Discriminant Analysis) -Technique, Examples as Numerical.

Unit III

Supervised Learning Algorithms - Regression: Linear Regression - Technique, Examples as Numerical; Multiple Linear Regression, Logistic Regression Examples as Numerical, ID3, CART, K-Nearest Neighbour Methods - Technique, Examples as Numerical

Probabilistic Learning: The Naive Bayes Classifier -examples and numerical

Support Vector Machines: Linear and Nonlinear - Technique, Examples as Numerical; Kernel Functions

Unit IV

Unsupervised Learning: Partitional Clustering - K-Means, Dealing with noise, Examples as Numerical, Elbow method to choose the right value of ‘k’, problems with k-means clustering, Hierarchical Clustering - Agglomerative(AGNES), Divisive(DIANA), Examples as numericals, Density-based (DBSCAN: Density-Based Clustering Based on Connected Regions with High Density), Expectation maximization.

Unit V

Dimensionality Reduction - Unsupervised: Introduction, Subset Selection, PCA (Principal Component Analysis) – Technique, Examples as Numerical.

Neurons, Neural Networks and Linear Discriminants: The Brain and the Neuron, Neural Networks, The Perceptron, Linear Separability.

Introducing Ensemble Methods: Bagging, Boosting and AdaBoost, Random forests, Improving Classification Accuracy of Class-Imbalanced Data.

Tutorial - Numerical Examples On:

Confusion Matrix and Accuracy Metrics
Decision Tree
ID3 - Classification
CART - Classification
CART - Regression
Linear Regression
Logistic Regression
K Nearest Neighbor Classifier
Naive Bayesian Classifier
Support Vector Machine
Partitional Clustering: K-Means
Hierarchical Clustering - Agglomerative and Divisive
Dimensionality Reduction Supervised - LDA
Dimensionality Reduction Unsupervised - PCA

Course Outcomes (COs):

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

1. Understand various types of data and their preprocessing methods. (PO- 1) (PSO- 3)
2. Analyze the various performance metrics used in machine learning. (PO- 1, 2, 9, 10) (PSO- 3)
3. Use supervised learning methods for Classification and Regression (PO- 1, 2, 3, 9,10,12) (PSO- 3)
4. Apply appropriate clustering techniques for a given scenario (PO- 1, 2, 3, 9,10,12) (PSO- 3)
5. Understand various validation methods for appropriate model selection (PO- 1) (PSO-3)

Suggested Learning Resources:

Text Books:

1. Stephen Marsland, “Machine Learning - An Algorithmic Perspective”, Second Edition, CRC Press - Taylor and Francis Group, 2015
2. Tom Mitchell, ―Machine Learning‖, McGraw Hill, 3rd Edition,1997.
3. Jiawei Han, Micheline Kamber and Jian Pei, Data Mining: Concepts and Techniques, 3rd ed, The Morgan Kaufmann Series in Data Management Systems Morgan Kaufmann Publishers, July 2011.

Reference Books:

1. Ethem Alpaydin, “Introduction to Machine Learning”, Second Edition, MIT Press, Prentice Hall of India (PHI) Learning Pvt. Ltd. 2010
2. Christopher Bishop, “Pattern Recognition and Machine Learning”, CBS Publishers & Distributors, 2010.
3. Mehryar Mohri, Afshin R, Ameet Talwalkar, "Foundations of Machine Learning”, MIT Press, 2012.
4. Charu C. Aggarwal, “Data Classification Algorithms and Applications”, CRC Press, 2014
5. Kevin P. Murphy "Machine Learning: A Probabilistic Perspective", The MIT Press, 2012

Web links and Video Lectures (e-Resources):

- https://www.coursera.org/specializations/machine-learning-introduction

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Project based learning

MACHINE LEARNING LAB	
Course Code: ISL65	**Credits : 0:0:1**
Pre - requisite: Python	**Contact Hours: 28**
Course Coordinator: Ms. Kavya K S	

Course Content

Sl.NO	List of Experiments
	Part-A
1	**Model Measurement Analysis**: Using ***any dataset***, calculate TP, TN, FP ,FN and different metrics (Accuracy, Precision, Recall(Sensitivity), F1-Score, MCC, Specificity, Negative Predictive Value) by defining your own functions. Compare your values with scikit-learn's library functions. Get the result of Confusion Matrix using sklearn. Using sklearn, plot the ROC & AUC Curves for your test data and random probabilities. Using sklearn, calculate the AUC of your test data and of random probabilities. Interpret the results. Write the inference/analysis of each output.
2	Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample. Interpret the results. Write the inference/analysis of each output.
3	Design an experiment to investigate the impact of varying the number of trees in a Random Forest classifier on its performance for a given dataset. Write Python code to implement the Random Forest algorithm with different numbers of trees and evaluate its classification performance using appropriate evaluation metrics.
4	**Supervised Learning Algorithms - Linear Regression:** Assume the dataset to Create a Simple Linear Regression model. Predict the scores on the test data and output RMSE and R Squared Score. Include appropriate code snippets to visualize the model. Interpret the result.
5	**Supervised Learning Algorithms - Logistic Regression (Univariant):** Implement logistic regression and test it using any dataset. Give new test data and predict the classification output. Print the confusion matrix, accuracy, precision, recall, MSE , RMSE etc. Analyze and write the inference.
6	**Probabilistic Supervised Learning - Naive Bayes:** Create a dataset and Perform the necessary pre-processing steps. Train the model using Naive Bayes Classifier. Give new test data and predict the classification output. Analyze and write the inference.
7	Build a KNN model for predicting if a person will have diabetes or not with a high accuracy score. Perform some appropriate Pre-Processing steps on the given dataset for better results. Implement the KNN algorithm on your own. Try other possible processes that can be done to dataset and tuning the model to increase accuracy such as Increase K value, Normalization and Different Distance Metrics.
8	**Un-Supervised Learning Algorithms - K-Means Clustering:** Build a K-Means Model for any dataset. Assume K value as 2,3,4 .Compare and interpret the results of different clusters..

9	**Un-Supervised Learning Algorithms - Hierarchical Clustering:** Using any dataset implement Hierarchical Clustering (AGNES and DIANA). Plot the Dendrogram for Hierarchical Clustering and analyze your result. Plot the clustering output for the same dataset using these two hierarchical techniques. Compare the results. Write the inference.
10	Design an experiment to compare the performance of AdaBoost and XGBoost algorithms on a binary classification task using a dataset of your choice. Write Python code to implement both algorithms and evaluate their performance using appropriate evaluation metrics.

Course Outcomes (COs):

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

1. Understand the implementation procedures for the machine learning algorithms. (PO – 1, 2, 3, 4, 5) (PSO – 1, 3)
2. Design Java/Python programs for various Learning algorithms. (PO – 1, 2, 3, 4, 5) (PSO -1, 3)
3. Apply appropriate data sets to the Machine Learning algorithms. (PO - 1, 2, 3, 4, 5) (PSO – 1, 3)
4. Identify and apply Machine Learning algorithms to solve real world problems. (PO - 1, 2, 3, 4, 5) (PSO – 1, 3)

DEVOPS LAB	
Course Code: ISL66	**Credits : 0:0:1**
Pre - requisites:	**Contact Hours: 28**
Course Coordinator: Ms. Shruthi J R	

Course Content

Sl.NO	List of Experiments
1.	Students are expected to identify and build one complete project that has separate modules and working files.
2.	**Version Control:** Explore Git and practice source code management of the project using GitHub: PUSH, PULL, MERGE, staging, diff, BRANCH, log, stash, git remote, clone. Fork etc. Alternative Tools : GitLab, Azure Repos, Fossil, Mercurial, Subversion etc
3.	**Collaboration:** Create work items, manage backlogs, and track progress with Kanban boards, dashboards, and reporting tools. This helps in implementing agile development practices and provides visibility into the project status. Tools : GitLab, Azure Boards, Gitea, Mattermost etc
4.	**Continuous Integration Tools:** Explore tools to build and deploy the project. Tools : Jenkins , Azure Pipelines, Gitlab CI/CD, Drone, Hudson, Buildbot etc
5.	**Configuration Management**: Explore tools used to automate the configuration of the desired state of a system for deployment of project. Tools : Chef, Puppet, Ansible, Terraform, SaltStack, Azure Pipelines etc
6.	**Containerization:** Command to containerize the project application to ensure consistency and portability across different environments. Tools : Docker, Azure pipelines, rkt, podman etc.
7.	**Orchestration :**Automate the process of performing containerized orchestration on the project developed in exercise 1 using Kubernetes.
8.	**Testing:** Automate test cases for the built project with open source tools. Selenium, Cucumber, Junit Vintage, TestNG, Pytest etc..

Course Outcomes (COs):

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

1. Demonstrate the DevOps culture by illustrating application's cloud infrastructure and configuration management with Ansible. (PO-2, 3, 5, 9, PSO-3)
2. Apply the DevOps pipeline process starting with continuous integration and continuous deployment principles. (PO-2, 3, 5, 9, PSO-3)
3. Demonstrate how to create and run a container from a Docker file and deploy a complex application on Kubernetes. (PO-2, 3, 5, 9, PSO-3)

MINI-PROJECT	
Course Code: ISP67	**Credits: 0:0:4**
Pre - requisites:	**Contact Hours:**
Course Coordinator: Internal Guide	

Course Content

Guidelines:

Students have to work in a group of 3/4 to solve a problem in the specific domain. An Internal Guide is allotted per batch based on their domain of expertise who guides and monitors the project progress. The Internal Guide can arrange for doubt clarification classes if requested by his/her project student and records the same.

Following are the Rubrics considered for Evaluation of mini-project:
Relevance of Project: Student are expected to clearly state the relevance of project to current IT environment and Society in general

Literature Survey: Student need to study research articles/ existing projects to identify the gaps in the identified problem statement.

Design: Student should prepare design document by considering class/use case/component diagram/state model/sequence model/activity/Interaction model.
Implementation: Student need to implement the designed model using the suitable techniques.

Presentation: Periodically student need to present their progress in front of the evaluation committee. Depending upon the quality of ppt, depth of coverage, answering capabilities to questions raised and division of labor identified during presentation and team work, evaluation committee will be deciding score in this criteria for individual students.

Report: Each group need to prepare the project report and submit the same to the department. Reports need to be adhered to the standard format defined by the department.

Course Outcomes (COs):

At the end of the course Students will be able to:

1. Identify a problem, review research literature and analyze requirements (POs – 1,12) (PSO - 1, 2, 3)
2. Schedule milestone and deliverables using appropriate project management techniques (POs – 8,9,10,11).
3. Design and implement the solution to selected problem using standard models and processes (POs – 1,2,3,4,5,6,7,8,9, 10,11,12) (PSO – 1,2, 3)
4. Analyze the results and produce substantial written documentation (POs – 1,2, 4,8,9, 10,11,12) (PSO – 1,2, 3)

MOBILE APPLICATION DEVELOPMENT-II	
Course Code: ISE631	**Credits : 3:0:0**
Pre - requisites: Mobile Application Development-I	**Contact Hours: 42**
Course Coordinator: Dr. S R Mani Sekhar	

Course Content

Unit I

Scroll View and Table View Controllers

Protocols - CustomStringConvertible, Equatable, Comparable, Codable, Creating Protocol, Delegation, App Anatomy and Life-Cycle - Stages of App Life-Cycle, AppDelegate Methods, SceneDelegate Methods, Example code - App Event Count, Model-View-Controller - Meal List TableView Controller, Project Organisation, Example code - Favorite Athletes, Scroll Views - Example code - I Spy, Table Views - Anatomy of a TableView, Custom TableView Cells, Edit TableViews, Add and Edit Emoji, Example code - Favorite Books.

Unit II

System view controllers and data persistence

Saving Data - Encoding and Decoding using Codable, Writing Data to a File, Example code - Remember your Emoji, System View Controllers - Share with the Activity Controller, Use Safari Services to Display Web Contents, present an AlertController, Access the Camera, Send Email from your App, Example Code - Home Furniture Sharing, Complex Input Screens - Date Pickers, Binary Input, Predefined Options, Employee Roaster Example

Unit III

Closures - Syntax, Passing Closures as Arguments, Additional Syntactic Sugars while using Closures as Parameters, Collection Functions using Closures (map, reduce, filter and sort(by:)) , Extensions - Adding Computed Properties, Adding Instance or Type Methods, Organizing Code using Extensions, Practical Animations - Uses of Core Animation in Apps, Animation Closures, The Transform Property, Animation at work using Music App Template, HTTP and URL - Creating URLs, Creating and Executing a Network Request, Processing the Response, Work with API, Modify a URL with URL Components, Decoding JSON - JSON Basics, Decoding into Swift Types, Decoding into Custom Model Objects, Write a Completion Handler, Addressing Failure, Concurrency - Concurrency and Grand Central Dispatch, App Transport Security and HTTP Protocol

Unit IV

Collection View - Anatomy of a Collection View, Collection View Layout, Emoji Dictionary App, Swift Generics - Generic Types, Generic Functions, Morse Code App, Dynamic Data - Adding a Search Controller, Handling Data Changes, Diffable Data Source, Compositional Layout Components, Supplementary and Decoration Views, Multiple Layouts, Local Notifications - Best Practices, Requesting Permissions, Handling and Responding to Notifications, Actionable Notifications, Foreground Notification Handling

Unit V

Guided Projects - List (using Tables and Persistence), Restaurant (using Web), Habits (using Advanced Data Display), App Personality, App Icons Best Practices, Launch Screens, Color, Images and Icons, Animation, Typography, The Design Cycle

Course outcomes (COs):

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

1. Create lists using scroll view and table view controllers (PO – 1, 2, 3, 5)(PSO – 1, 2)
2. Use system view controllers and build complex views (PO – 1, 2, 3, 4, 5)(PSO – 1, 2)
3. Encode and decode data to and from web (PO – 1, 2, 3, 5)(PSO – 1, 2)
4. Work with Collection Views (PO – 1, 2, 3, 5)(PSO – 1, 2)
5. Design, prototype and architect a project (PO – 1, 2, 3, 4, 5)(PSO – 1, 2)

Text Books:

1. Develop in Swift Data Collections, Apple Books

Web links and Video Lectures (e-Resources):

- https://books.apple.com/us/book/develop-in-swift-data-collections/id1581183203
- https://www.youtube.com/@iOSAcademy

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning:

- Design and develop a fully functional iOS App

INTERNET OF THINGS	
Course Code: ISE632	**Credits: 3:0:0**
Pre - requisites: Nil	**Contact Hours: 42**
Course Coordinator: Mr. Jagadeesh Sai D	

Course Content

Unit I

Introduction to Internet of Things Definition & Characteristics of IoT, Physical Design of IoT Things in IoT, IoT Protocols, Logical Design of IoT, IoT Functional Blocks, IoT Communication Models, IoT Communication APIs, IoT Enabling Technologies, Communication Protocols, Embedded Systems IoT Levels & Deployment Templates, IoT Levels

Unit II

IoT and M2M: Introduction, M2M, Difference between IoT and M2M, SDN and NFV for IoT, Software Defined Networking, Network Function Virtualization, IoT System Management with NETCONF-YANG, Need for IoT Systems Management, Simple Network Management Protocol (SNMP)

Unit III

IoT Platforms Design Methodology: IoT Design Methodology, Purpose & Requirements Specification, Process Specification, Domain Model Specification, Information Model Specification, Service Specifications, IoT Level Specification, Functional View Specification, Operational View Specification, Device & Component Integration, Application Development**, IoT Systems** - Logical Design using Python, Functions Modules, Packages, File Handling Operations Classes, Python Packages of Interest for IoT.

Unit IV

Raspberry Pi, About the Board, Linux on Raspberry Pi, Raspberry Pi Interfaces, Serial SPI, I2C, Programming Raspberry Pi with Python, Controlling LED with Raspberry Pi, interfacing an LED and Switch with Raspberry, Interfacing a Light Sensor (LDR) with Raspberry Pi, Other IoT Devices, pcDuino, Beagle Bone Black, Cubie board.

Unit V

Python Web Application Framework – Django, Django Architecture, Starting Development with Django, designing a RESTful Web API, Amazon Web Services for IoT, Amazon EC2, Amazon AutoScaling, Amazon S3, Amazon RDS Amazon DynamoDB, Amazon Kinesis, Amazon SQS, Amazon EMR, SkyNet IoT Messaging Platform, INTEL Gen2, UDDO Board example.

Course Outcomes (COs):

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

1. Understand the design issues and fundamentals of IoT (PO-1,9,10,12) (PSO-2,3)
2. Design various methodologies for M2M and SDN architectures. (PO-1,9,10,12) (PSO-2,3)
3. Distinguish different cloud-based solution for IoT (PO-1,2,9,10,12) (PSO-2,3)
4. Develop IoT-based solutions for real-world problems. (PO-1,2,3,4,5,6,9,10,12)(PSO-2,3)
5. Analyze the various data analytical tools in IoT (PO-1,2,9,10,12) (PSO- 2,3)

Suggested Learning Resources:

Text Books:

1. Internet of Things (A Hands-on-Approach) by Arshdeep Bagha, Vijay Madisetti University press 2015.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/106105166

Activity Based Learning (Suggested Activities in Class)/ Practical Based Learning

- Project-based learning

BLOCKCHAIN ESSENTIALS & DAPPS	
Course Code: ISE633	**Credits : 3:0:0**
Pre - requisites: Nil	**Contact Hours: 42L**
Course Coordinator: Ms. Shruthi J R	

Course Content

Unit I

Distributed systems, CAP theorem, Byzantine Generals problem, Consensus. The history of blockchain, Introduction to blockchain, Various technical definitions of blockchains, Generic elements of a blockchain, Features of a blockchain, Applications of blockchain technology, Tiers of blockchain technology, Consensus in blockchain, CAP theorem and blockchain, Benefits and limitations of blockchain

Unit II

Decentralization using blockchain, Methods of decentralization, Blockchain and full ecosystem decentralization, Smart contract, Decentralized organizations, Decentralized autonomous organizations, Decentralized autonomous corporations, Decentralized autonomous societies Decentralized applications, Platforms for decentralization,

Cryptographic primitives: Symmetric cryptography, Asymmetric cryptography, Public and private keys Hash functions: Compression of arbitrary messages into fixed length digest, Easy to compute, Pre-image resistance, Second pre-image resistance, Collision resistance, Message Digest (MD), Secure Hash Algorithms (SHAs), Merkle trees, Patricia trees, Distributed hash tables (DHTs), Digital signatures, Elliptic Curve Digital signature algorithm (ECDSA)

Unit III

Bitcoin, Bitcoin definition, Transactions, The transaction life cycle, The transaction structure, Types of transaction, The structure of a block, The structure of a block header, The genesis block, The bitcoin network, Wallets, Smart Contracts-History, Definition, Ricardian contracts, Smart contract templates, Oracles, Smart Oracles, Deploying smart contracts on a blockchain, The DAO

Unit IV

Ethereum 101, Introduction, Ethereum clients and releases, The Ethereum stack, Ethereum blockchain, Currency (ETH and ETC), Forks, Gas, The consensus mechanism, The world state, Transactions, Contract creation transaction, Message call transaction, Elements of the Ethereum blockchain, Ethereum virtual machine (EVM), Accounts, Block, Ether, Messages, Mining, The Ethereum network Hands-on: Clients and wallets -Geth

Unit V

Hyperledger, Hyperledger as a protocol, Fabric, Hyperledger Fabric, Sawtooth lake, Corda

Course Outcomes (COs):

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

1. Illustrate the Blockchain terminologies with its applications. design (PO – 1) (PSO – 2)
2. Analyze the working principles of Blockchain (PO – 1, 2, 9, 10, 12) (PSO – 2)
3. Comprehend the principles and methodologies used in Bitcoin (PO – 1, 9, 10, 12) (PSO – 2)
4. Create Ethereum Network, Wallets, Nodes, Smart contract & DApps (PO – 1, 2, 3, 5, 9, 10, 12) (PSO – 2)
5. Develop Blockchain Based Application Architecture using Hyperledger (PO – 1, 2, 3, 5, 9, 10, 12) (PSO – 2)
6. Illustrate the Smart Contract Lifecycle (PO – 1, 2, 3, 9, 10, 12) (PSO – 2)

Text books:

1. Imran Bashir. "Mastring BlockChain", Packt

Reference:

1. Mastering Bitcoin: Programming the Open Blockchain Paperback – 2017 by Andreas M. O'rielly

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/106104220

Activity Based Learning (Suggested Activities in Class)/ Practical Based Learning

- Project-based learning
- Tool Demonstration

SYSTEM SIMULATION AND MODELING	
Course Code: ISE634	**Credits: 3:0:0**
Pre - requisites: Engineering Mathematics	**Contact Hours: 42**
Course Coordinator: Mr. Mushtaq Ahmed D M	

Course Content

Unit I

Introduction to Simulation: When simulation is the appropriate tool and when it is not appropriate, Advantages and disadvantages of Simulation, Areas of application, Systems and system environment, Components of a system, Discrete and continuous systems, Model of a system, Types of Models, Discrete-Event System Simulation, Steps in a Simulation Study; Simulation **examples**: Simulation of queuing systems, Simulation of inventory systems

Unit II

Concepts in Discrete-Event Simulation: The Event-Scheduling / Time-Advance Algorithm, World Views, Manual simulation Using Event Scheduling; List processing, Simulation in Java, Simulation in GPSS; **Statistical Models in Simulation:** Review of terminology and concepts, Discrete distributions, Continuous Distributions-Uniform distribution, Exponential distribution, Normal distribution.

Unit III

Queuing Models: Characteristics of queuing systems, Queuing notation, Long-run measures of performance of queuing systems, Steady-state behavior of M/G/1 queue, Networks of queues: **Input Modeling**: Data Collection, Identifying the distribution with data, Parameter estimation, Goodness of Fit Tests, Selecting input models without data, Time Series Input Model.

Unit IV

Random-Number Generation: Properties of random numbers, Generation of pseudo-random numbers; Techniques for generating random numbers; Tests for Random Numbers. **Random Variate Generation**: Inverse transform technique-Exponential Distribution, Uniform Distribution, Discrete Distributions, **Acceptance-Rejection technique**: Poisson Distribution, Convolution method.

Unit V

Measures of performance and their estimation: Output analysis for terminating simulations Continued., Output analysis for steady-state simulations. **Verification and Validation of Simulation Models:** Model building, verification and validation, Verification of simulation models, Calibration and validation of models, **Estimation of Absolute Performance**: Types of simulations with respect to output analysis, Stochastic nature of output data; Absolute measures of performance and their estimation,

Course Outcomes (COs):

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

1. Understand the concepts used to develop simulation models. (PO 1,2) (PSO-2)
2. Apply discrete event and statistical models simulation techniques to solve the given problem. (PO-1,2,3) (PSO-2)
3. Apply various techniques for random number and random variate generation. (PO-1,2,3) (PSO-2)
4. Analyze Queueing and Input modeling techniques. (PO-1,2) (PSO-2)
5. Understand the concepts of verification, validation and estimation of simulation models. (PO 1) (PSO-2)

Suggested Learning Resources:

Text Book:

1. Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol: Discrete-Event System Simulation, Fifth Edition, Pearson Education, 2013.

References:

1. Lawrence M. Leemis, Stephen K. Park: Discrete – Event Simulation: A First Course, Pearson Prentice-Hall, 2006.
2. Sheldon M. Ross: Simulation, Fourth Edition, Elsevier, 2006.
3. Averill M. Law: Simulation Modeling and Analysis, Fourth Edition, Tata McGraw-Hill, 2007

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=zmbS_TmNDP4&list=PLSGws_74K01-4rcWuB5BEATHSsOrBd1ye

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning · Case Studies on different simulation applications.

- Quizzes
- Seminar

BUSINESS ANALYTICS	
Course Code: ISE641	**Credits : 3:0:0**
Pre - requisites: Nil	**Contact Hours: 42L**
Course Coordinator: Mr. Mushtaq Ahmed D M	

Course Content

Unit I

Introduction: Why Analytics, Business Analytics: The Science of data driven decision making, Descriptive Analysis, Predictive Analytics, Prescriptive Analytics, Big Data Analytics, Web and Social Media Analytics, Machine Learning Algorithms, Framework for data driven decision making, Analytics Capability Building, Roadmap, Challenges, Types (Descriptive, Predictive and Prescriptive).

Unit II

Descriptive Analytics: Data Types and Scales, Types of Data Measurement Scales, Population and Sample, Measures of Central Tendency, Percentile, Decile, and Quartile, Measures of Variation, Measures of Shape −Skewness and Kurtosis, Data Visualization.

Unit III

Data Mining: Data Mining, application of data mining, Anomaly Detection, Association Rule Learning, Cluster Analysis, Statistical Classification, Regression Analysis, Automatic Summarization, Examples of Data Mining.

Unit IV

Data Warehousing: Data Warehouse, Data Mart, Master Data Management, Dimension (Data Warehouse), Slowly Changing Dimension, Data Vault Modeling, Extract, Transform, Load, Star Schema, snowflake scheme, Mapping problems to machine learning tasks, Evaluating models, Validating models.

Unit V

Essential Aspects of Business Intelligence: Context Analysis, Business Performance Management, Business Process Discovery, Information System, Organizational Intelligence, Data Visualization, Data Profiling, Data Cleansing, Process Mining, Competitive Intelligence, Operational Intelligence, Business Activity Monitoring, Complex Event Processing, Business Process Management, Metadata, Root Cause Analysis.

Course Outcomes (COs):

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

1. Understand various elements of analytics: business context, technology and data science. (PO-1, 2, 3, 12) (PSO-2)
2. Understand the emergence of analytics as a competitive strategy. (PO-1, 2, 3, 12) (PSO-2)
3. Manipulate data preprocessing, data Warehouse and OLAP technology, data cube technology; mining frequent patterns and association, classification, clustering, and outlier detection. (PO-1, 2, 3, 4, 12) (PSO-2)
4. Analyze effective communication using analytics. (PO-1, 2, 3, 4, 12) (PSO-2)
5. Analyze various tools and techniques in analytics with business applications. (PO-1, 2,3, 4, 5, 12) (PSO-2)

Suggested Learning Resources:

Text Books:

1. Sharda R, Delen D, Turban E, Aronson J, Liang T. P, (2014), Business Intelligence and Analytics: Systems for Decision Support, 10th edition, Pearson Education.
2. Drew Bentley, "Business Intelligence and Analytics" Library Press publication -2017
3. U. Dinesh Kumar, "Business Analytical – The science of data driven decision
4. making", Wiley 2017

Reference Books:

1. Glenn J. Myatt, "Making Sense of Data: A Practical Guide to Exploratory Data Analysis and Data Mining", John Wiley & Sons, Second Edition, 2014.
2. Carlo-Vercellis, "Business intelligence datamining and optimization for decision making", First Edition.
3. An Introduction to Business Analytics, Ger Koole, Lulu.com, 2019.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/110106050

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- MOOC Course
- Business Analysis on Social Media Plat form.

NATURAL LANGUAGE PROCESSING	
Course Code: ISE643	**Credits : 3:0:0**
Pre - requisites: Nil	**Contact Hours: 42**
Course Coordinator: Dr. Rajeshwari S B	

Course Content

Unit I

NLP-A Primer: NLP in the Real World, NLP Tasks, What is Language?, Building Blocks of Languages, Why is NLP Challenging?, Machine Learning, Deep Learning, Learning, and NLP: An Overview, Approaches to NLP, Heuristics-Based NLP, Machine Learning for NLP, Deep Learning for NLP, Why Deep Learning Is Not Yet the Silver Bullet for NLP, **NLP Pipeline**.

Unit II

Text Representation: Vector Space Models, Basic Vectorization Approaches, One-Hot Encoding, bag of Words, bag of N-Grams, TF-IDF, Distributed, Representations, Word Embeddings, Going Beyond Words, Distributed Representations Beyond Words and Characters, Universal Text Representations, Visualizing Embeddings, Handcrafted Features Representations.

Unit III

Text Classification: Applications, A Pipeline for Building Text Classification Systems, One Pipeline-Many Classifiers, Using Neural Embeddings in Text Classification, Deep learning for Text Classification, Interpreting Text Classification models, Learning with No or Less Data and Adapting to New Domains, Case Study: Corporate Ticketing.

Unit IV

Information Extraction: IE Applications, IE Tasks, The General Pipeline for IE, Key phrase Extraction, Implementing KPE, Practical Advice, Named Entity Recognition, Building an NER System, NER using an Existing Library, NER using Active Learning, Practical Advice, Named Entity Disambiguation and Linking, NEL using Azure API, Relationship Extraction, Approaches to RE, RE with the Watson API, Other Advanced IE Tasks, Temporal Information Extraction, Event Extraction, Template Filling, Chatbots.

Unit V

BERT: Starting Off with the BERT, A Primer on Transformers, Understanding the BERT Model, Getting Hands-On with BERT.

Course outcomes (COs):

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

1. Gain insights into the foundational principles of NLP and explore diverse methodologies for constructing NLP models. (PO – 1, 2, 4, 5, 9, 10) (PSO – 2)
2. Exemplify various methods of representing text within the realm of NLP. (PO – 1, 2, 4, 5, 9 ,10) (PSO – 2)
3. Illustrate the mechanisms of text classification and interpretation within NLP frameworks. (PO – 1, 2, 4, 5, 9, 10) (PSO – 2)
4. Build NER system by investigating various methodologies for Information Extraction. (PO – 1, 2, 4, 5, 9,10) (PSO – 2)
5. Design NLP models leveraging BERT for diverse language processing endeavours. (PO – 1, 2, 4, 5, 9,10) (PSO – 2)

Suggested Learning Resources:

Text Books:

1. Practical NLP: A Comprehensive Guide to Building Real-World NLP Systems, Sowmya, Vajjala, Bodhisattwa Majumder, Anuj Gupta & Harshit Surana, O'Reilly, 2020.
2. Getting Started with Google BERT: Build and Train State-of-the-Art NLP Models using BERT, Sudharsan Ravichandiran, 2021.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=bDPULOFFlaI
- https://www.youtube.com/watch?v=iY-YRQp-UD0

Activity Based Learning (Suggested Activities in Class)/ Practical Based Learning

- Programming Assignment
- Case Study

CLOUD COMPUTING	
Course Code: ISE644	**Credits: 3:0:0**
Pre - requisites: Nil	**Contact Hours: 42**
Course Coordinator: Dr. S R Mani Sekhar	

Course Content

Unit I

Introduction: Network centric computing and network centric content, Peer-to-peer systems, Cloud Computing, Cloud Computing delivery models & Services, Ethical issues, Cloud vulnerabilities, Challenges. **Cloud Infrastructure:** Amazon, Google, Azure & online services, open source private clouds. Service level and compliance level agreement, Responsibility sharing.

Unit II

Cloud Computing: Applications & Paradigms, Challenges, existing and new application opportunities, Architectural styles of cloud applications, Workflows: Coordination of multiple activities, Coordination based on a state machine model – the ZooKeeper, High performance computing on a cloud, cloud computing for biological research

Unit III

Cloud Resource Virtualization: Virtualization, Layering and virtualization, Virtual machine monitors, Virtual machines, Performance and security isolation, Full virtualization and paravirtualization, Case study: *Xen* -a VMM based on paravirtualization, A performance comparison of virtual machines, The darker side of virtualization.

Unit IV

Cloud Resource Management and Scheduling: Policies and mechanisms for resource management, Applications of control theory to task scheduling on a cloud, Stability of a two-level resource allocation architecture~~,~~ **Resource bundling:** combinatorial auctions for cloud resources, Scheduling algorithms for computing clouds, fair queuing.

Unit V

Storage systems: Storage models, file systems, databases, DFS, GFS, Locks & Chubby. **Cloud security:** Risks, Security, privacy and privacy impacts assessments, Trust, VM Security, Security of virtualization.

Course Outcomes (COs):

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

1. Apply the concepts of cloud delivery models and services. (PO-1,2,3,5,7,9,10,12) (PSO-2,3)
2. Build various cloud based applications. (PO-1,2,3,5,7,9,10,12) (PSO-2,3)
3. Illustrate different cloud resource virtualization strategies with case studies. (PO-1,7) (PSO-2,3)
4. Describe cloud resource management and scheduling policies (PO-1 ,7) (PSO-2,3)
5. Create cloud instances by applying storage models and security aspects. (PO-1,2,3,5,7,9,10,12) (PSO-2,3)

Suggested Learning Resources:

Text Book:

1. Dan Marinescu, Cloud Computing: Theory and Practice, 1st edition, MK Publishers, 2013.

References:

1. Kai Hwang, Jack Dongarra, Geoffrey Fox, Distributed and Cloud Computing, From Parallel Processing to the Internet of Things, 1st edition, MK Publishers, 2012.
2. Anthony T. Velte, Toby J. Velete, Robert Elsenpeter, Cloud Computing: A Practical Approach, Tata McGraw Hill, 2010.

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc21_cs14/preview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Tool

DATA ENGINEERING AND MLOPS	
Course Code: ISE645	**Credits: 3:0:0**
Pre - requisites: Nil	**Contact Hours: 42**
Course Coordinator: Dr. Sumana M	

Course Content

Unit I

Data Engineering: Definition, The Data Engineering Lifecycle, Evolution of the Data Engineer, Data Engineering and Data Science, Data Engineering Skills and Activities, Data Maturity and the Data Engineer, The Background and Skills of a Data Engineer, Business Responsibilities, Technical Responsibilities, The Continuum of Data Engineering Roles, Data Engineers Inside an Organization, Internal-Facing Versus External-Facing Data Engineers, Data Engineers and Other Technical Roles, Data Engineers and Business Leadership.

Data Engineering Lifecycle: The Data Lifecycle Versus the Data Engineering Lifecycle, Generation: Source Systems, Major Undercurrents Across the Data Engineering Lifecycle

Unit II

Data Architecture: Enterprise Architecture Defined, Data Architecture Defined, "Good" Data Architecture, Principles of Good Data Architecture, Major Architecture Concepts, Domains and Services, Distributed Systems, Scalability, and Designing for Failure, Tight Versus Loose Coupling: Tiers, Monoliths, and Microservices, User Access: Single Versus Multitenant, Event-Driven Architecture, Examples and Types of Data Architecture

Choosing Technologies Across the Data Engineering Lifecycle: Team Size and Capabilities, Speed to Market, Interoperability, Cost Optimization and Business Value, Total Cost of Ownership Total Opportunity Cost of Ownership, FinOps, Today Versus the Future: Immutable Versus Transitory Technologies: Hybrid Cloud, Multicloud , Decentralized: Blockchain and the Edge ,Monolith Versus Modular , Serverless Versus Servers, Server Versus Serverless evaluation

Unit III

MLOps Challenges, MLOps to Mitigate Risk, Risk Assessment, Risk Mitigation, MLOps for Responsible AI, MLOps for Scale.

Key MLOps Features: Model Development, Establishing Business Objectives, Data Sources and Exploratory Data Analysis, Feature Engineering and Selection, Training and Evaluation, Reproducibility, Responsible AI, Productionalization and Deployment, Model Deployment Types and Contents, Model Deployment Requirements, Monitoring

Developing Models: Machine Learning Model, Required Components, Different ML Algorithms, Different MLOps Challenges, Data Exploration, Feature Engineering and Selection, Feature Engineering Techniques, How Feature Selection Impacts MLOps Strategy,
Experimentation, Evaluating and Comparing Models, Choosing Evaluation Metrics, Cross-Checking Model Behavior, Impact of Responsible AI on Modeling, Version Management and Reproducibility

Unit IV

Preparing for Production: Runtime Environments, Adaptation from Development to Production Environments, Data Access Before Validation and Launch to Production, Final Thoughts on Runtime Environments, Model Risk Evaluation, The Purpose of Model Validation, The Origins of ML Model Risk, Quality Assurance for Machine Learning

Deploying to Production: CI/CD Pipelines, Building ML Artifacts, The Testing Pipeline, Deployment Strategies, Categories of Model Deployment, Considerations When Sending Models to Production, Maintenance in Production, Containerization, Scaling Deployments, Requirements and Challenges

Unit V

Monitoring and Feedback Loop: Models Be Retrained, Understanding Model Degradation, Ground Truth Evaluation, Input Drift Detection, Drift Detection in Practice, Example Causes of Data Drift, Input Drift Detection Techniques, The Feedback Loop, Logging, Model Evaluation, Online Evaluation

Model Governance: Governance the Organization Needs, Matching Governance with Risk Level, Current Regulations Driving MLOps Governance, Pharmaceutical Regulation in the US: GxP Financial Model Risk Management Regulation, GDPR and CCPA Data Privacy Regulations, The New Wave of AI-Specific Regulation, The Emergence of Responsible AI, Key Elements of Responsible AI (Element 1 to element 5), A Template for MLOps Governance (Step 1 to 8)

Text Books:

1. Joe Reis, Matt Housley Fundamentals of Data Engineering: Plan and Build Robust Data Systems, O'Reilly, 2022
2. Mark Treveil and the Dataiku Team. Introducing MLOps How to Scale Machine Learning in the Enterprise, O'Reilly, 2020

Course Outcomes (COs):

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

CO1: Understand data engineering life cycle (PO – 1, 4, PSO - 3)
CO2: Choose technologies across data engineering life cycle (PO – 2, 4, PSO - 3)
CO3: Evaluate machine learning models for MLOps (PO – 2, 4, PSO - 3)
CO4: Understand MLOps deployment strategies (PO – 1, 2, PSO - 3)
CO5: Understand MLOps model governance (PO – 1, 2, PSO - 3)

DATA ANALYTICS WITH PYTHON	
Course Code : **ISOE14**	**Credits**: 3**:0:0**
Prerequisites: **NIL**	**Contact Hours : 42L**
Course Coordinator: Ms. Kavya K S	

Course Content

Unit I

Introduction to Data Science: The data science process- The roles in a data science project, Stages of a data science project and setting expectations, the data science process and A Data Scientist's Role in this Process. **Data Visualization-** Basics of simple plotting, Line Chart vs Line Graph, Bar Graph, Pie Chart, Histogram, Frequency Polygons, Box Plot, Scatter Plot, Saving Plots or Graph or chart to a file.

Unit II

The way of the program: The Python programming language, debugging, Formal and natural languages, the first program, Debugging. Variables, expressions and statements, Functions, Conditionals **and recursion:** Modulus operator, Boolean expressions, Logical operators, Conditional execution, Alternative execution, chained conditionals, Nested conditionals, Recursion, Stack diagrams for recursive functions, Infinite recursion, Keyboard input, Fruitful functions: Return values, Incremental development, Composition, Boolean functions. Iteration: Multiple assignment, Updating variables, the while statement, break, Square roots, Algorithms.

Unit III

A string is a sequence: Traversal with a for loop, String slices, Strings are immutable, Searching, Looping and counting, String methods, the in operator, String comparison. Lists: A list is a sequence, Lists are mutable, traversing a list, List operations, List slices, List methods, Map, filter and reduce, deleting elements, Lists and strings, Objects and values, Aliasing, List arguments.

Unit IV

Dictionaries: Dictionary as a set of counters, Looping and dictionaries, Reverse lookup, Dictionaries and lists, Memos, Global variables, Long integers, Debugging. Tuples: Tuples are immutable, Tuple assignment, Tuples as return values, Variable-length argument tuples, Lists and tuples, Dictionaries and tuples, Comparing tuples, Sequences of sequences

Unit V

Python for Data Science: Managing data- Cleaning data and sampling for modeling and validation, Scikit-learn, Essential libraries and tools- Jupyter notebook, Numpy, Scipy, matplotlib, pandas, mglearn , Supervised Machine learning algorithms- K-Nearest Neighbor, A first Application- Classifying Iris Species.

Course Outcomes (COs):

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

1. Identify Data science problem for different domains (PO 2) (PSO 3)
2. Describe the basic programming concepts of python and Functions (PO 1) (PSO 3)
3. Apply string and List related concepts to a given problem (PO 1, 2, 3,5,9,10,12) (PSO 3)
4. Apply appropriate data types/ data structures for the given problem using Lists, Dictionaries, Tuples. (PO 1, 2, 3,5,9,10,12) (PSO 3)
5. Apply python to solve different data science problems and visualize the data. (PO 1, 2, 3,5,9,10,12) (PSO 3)

Suggested Learning Resources:

Text Books:

1. Allen Downey, Think Python(How to Think Like a Computer Scientist), 2nd Edition by O'Reilly Media
2. Introduction to Machine Learning with Python, A guide for Data Scientists, Andreas C. Müller & Sarah Guido, O'Reilly Publications
3. Practical Data Science with R, Nina Zumel, John Mount, Manning Shelter Island.

References:

1. Learning Python, Fourth Edition, Mark Lutz, O'Reilly publication
2. Doing Data Science Cathy O'Neil and Rachel Schutt Straight Talk from The Frontline.O'Reilly 2014

FUNDAMENTALS OF DATABASE MANAGEMENT SYSTEMS	
Course Code : **ISOE15**	**Credits**: 3**:0:0**
Prerequisites: **NIL**	**Contact Hours : 42L**
Course Coordinator: Dr. Lincy Meera Mathews	

Course Content

Unit I

Introduction; An example; Characteristics of Database approach; Actors on the scene, Workers Behind the Scene, Advantages of using DBMS approach, Data models, Schemas and Instances; Three-schema architecture and data independence; Database languages and interfaces; Introduction to NoSQL, Types of NoSQL Database, NoSQL vs SQL Comparison, ACID & BASE Property.

Unit II

Using High-Level Conceptual Data Models for Database Design; An Example Database Application; Entity Types, Entity Sets, Attributes, and Keys; Relationship types, Relationship Sets, Roles, and Structural Constraints; Weak Entity Types; Refining the ER Design; Case study on ER Diagrams (Example –Company Database)

Unit III

Relational Model Concepts; Relational Model Constraints and Relational Database Schemas; Update Operations, Transactions, and dealing with constraint violations; Relational Database Design using ER- to-relational Mapping, Case Study on ER-to relational mapping.
SQL Data Definition and Data Types; Specifying basic constraints in SQL; Schema change statements in SQL; Basic queries in SQL: where, aggregate functions, order by

Unit IV

More complex SQL Queries. Insert, Delete, and Update statements in SQL; JOINS, Views (Virtual Tables) in SQL. Triggers, procedures, functions, and Best Practices in SQL Programming. MongoDB: Create collections, Inserting, Update, and Deleting the documents, Querying the documents

Unit V

Informal Design Guidelines for Relation Schemas; Functional Dependencies; Normal Forms Based on Primary Keys; General Definitions of Second and Third Normal Forms; Properties of Relational Decompositions

Course outcomes (COs):

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

1. Master the basic concepts and appreciate the applications of database systems. (PO-1, 2, 3,9) (PSO- 2, 3)
2. Identify the methodology of conceptual modeling through the Entity Relationship model
3. Understand the concepts of relational schema and convert ER model to the Relational model. (PO- 3, 9, 10, 12) (PSO- 1, 2, 3)
4. Ability to apply SQL to solve problems in a given scenario. (PO- 1, 3, 9, 10, 12) (PSO-1, 2, 3).
5. Apply normalization techniques to improve database design (PO- 1, 3, 9, 10, 12) (PSO-1, 2, 3)

Suggested Learning Resources:

Text Books:

1. Elmasri and Navathe: Fundamentals of Database Systems, 5thEdition, Addison-Wesley, 2016

References:

1. Silberschatz, Korth and Sudharshan: Database System Concepts, Fifth Edition, Mc-GrawHill, 2006.