CURRICULUM

Academic Year 2026– 2027

Batch-2024

V & VI Semester B. E.

INFORMATION SCIENCE AND ENGINEERING

RAMAIAH INSTITUTE OF TECHNOLOGY

(Autonomous Institute, Affiliated to VTU)

(Approved by AICTE, New Delhi & Govt. of Karnataka)

Accredited by NBA & NAAC with A^+ Grade

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 15 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.

The Entrepreneurship Development Cell (EDC) and "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, M S Ramaiah Institute of Technology has achieved 75th rank among 1584 top Engineering Institutions & 31st Rank among 131 Schools of Architecture in India for the year 2025.

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:

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

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.

KNOWLEDGE AND ATTITUDE PROFILE (WK)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, reuse of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behaviour and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

PROGRAM OUTCOMES (POs):

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WKS)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

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 2024-28

Semester / Course Category	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth	Total Credits
Applied Science Course (ASC)	08	08	03	03	--	--	--	--	**22**
Engineering Science Course (ESC)	09	11	--	--	--	--	--	--	**20**
Humanities, Social Sciences and Management (HSMC)	02	-	--	--	03	03	--	--	**08**
Ability Enhancement Course (AEC)	01	01	01	01	01	01	02	--	**08**
Universal Human Values (UHV)	--	--	02	--	--	--	--	--	**02**
Professional Core Courses (PCC)	--	--	11	12	12	06	04	--	**45**
Professional Core Course (IC)	--	--	04	04	03	--	04	--	**15**
Professional Elective Course (PEC)	--	--	--	--	03	06	03	--	**12**
Open Elective Course (OEC)	--	--	--	--	--	03	03	--	**06**
Internship (INT)	--	--	--	00	--	--	--	05	**05**
Mini Project / Project Work (PW)	--	--	--	--	--	04	--	13	**17**
Non Credit Mandatory Courses (NCMC)	--	--	Yes	Yes	Yes	--	--	--	**--**
Total Credits	**20**	**20**	**21**	**20**	**22**	**23**	**16**	**18**	**160**

SCHEME OF TEACHING V SEMESTER (2024 Batch)

Sl. No.	Subject Code	Subject	Teaching Department	Category	Credits				Total contact hours /week	Total Contact hours/week			
					L	T	P	Total		L	T	P	S*
1	IS51	Machine Learning	ISE	PCC	3	0	0	3	3	3	0	0	3
2	IS52	Software Engineering	ISE	PCC(IC)	2	0	1	3	4	2	0	2	2
3	IS53	Computer Networks	ISE	PCC	4	0	0	4	4	4	0	0	4
4	IS54	Theory of Computation	ISE	PCC	2	1	0	3	4	2	2	0	2
5	ISE55x	Program Elective Course – 1	ISE	PEC	3	0	0	3	3	3	0	0	3
6	ISL56	Machine Learning Lab1	ISE	PCC	0	0	1	1	2	0	0	2	0
7	ISL57	Computer Networks lab	ISE	PCC	0	0	1	1	2	0	0	2	0
8	AL58	Research Methodology & Intellectual property rights	ISE	HSMC	3	0	0	3	3	3	0	0	3
9	ISAEC59X	Ability Enhancement Course – V	ISE	AEC	1	0	0	1	1	1	0	0	1
				Total	**18**	**1**	**3**	**22**	**26**	**18**	**2**	**6**	**18**
10	HS510	Environmental Studies *		NCMC	0	0	0	0	1				

Programme Electives Course - 1

Sl.No	Subject Code	Subject
1	ISE551	Advanced Data Structures and Algorithms
2	ISE552	Artificial Intelligence
3	ISE553	Computer Vision

Ability enhancement Course - V

Sl.No	Subject Code	Subject
1	ISAEC591	Engineering Economics
2	ISAEC594	Front end Development using ReactJS

*** Environmental Studies is under the category of NCMC, 1-hour teaching per week has to be allocated in the time table.**
NOTE: Minimum of 1 subject should have a Tutorial component of 1 Credit.

Nomenclature: IC: Integrated Course (Practical Integrated with Theory Course), **PCC:** Professional Core Course, **PEC:** Professional Elective Course, **AEC:** Ability Enhancement Course**, HSMC:** Humanity, Social Science & Management Course, **NCMC:** Non-credit Mandatory Course

Credit Definition:

- **1 credit = 1 hour/week of lecture (L)**
- **1 credit = 2 hours/week of tutorial (T)**
- **1 credit = 2 hours/week of practical(P)**
- **Self-Learning Hours (S)**

PCC(IC) is an Integrated course, combining theory with practical components.

- Theory sessions shall be conducted for 3 hours per week, while the practical sessions shall be conducted for 2 hours per week.
- Theory components shall be evaluated through both Continuous Internal Evaluation (CIE) and Semester End Examination (SEE).
- The practical component shall be assessed only through CIE (No SEE).

- The CIE shall consist of two internal test of 30 marks each. Each test will have three questions and student shall answer any two full questions. Each question shall have all CO's addressed for that test. An average of two test shall be taken to award 30 marks.
- The CIE for the practical component shall be evaluated for 20 marks. Each laboratory experiment shall be evaluated for 10 marks based on the experiment record, conduction of the experiment, and observations, and the cumulative marks shall be scaled down to 15 marks. Another 05 marks from a lab test and viva.
- The SEE shall be evaluated for 100 marks, which shall be scaled down to 50 marks.
- The SEE examination shall consist of 10 questions with internal choice and student shall answer any five full questions.
- However, questions from the practical component of the Integrated course (IC) can be included in the SEE question paper.

PCC & PEC & HSMC courses are theory courses with or without tutorial sessions.

- Each theory credit corresponds to one contact hour per week, while each tutorial credit corresponds to two contact hours per week.
- The course shall be evaluated through Continuous Internal Evaluation (CIE) and Semester End Examination (SEE), each having a weightage of 50%.
- The CIE is evaluated for 50 marks through internal tests (30 marks) and other components (20 marks). Each internal test will have three questions and students shall answer any two full questions. Each question shall address all the Course Outcomes (COs) prescribed for that test. The average of the two tests shall be considered for awarding 30 marks. The remaining 20 marks shall be assessed through assignments, tutorial tests, quizzes, surprise tests, mini-projects, or other components as decided by the course instructor.
- The SEE shall be evaluated for 100 marks, which shall be scaled down to 50 marks.
- The SEE examination shall consist of ten questions with internal choice (two questions per unit). Students shall answer any five full questions, selecting at least one question from each unit.

AEC is a 1-credit course involving 1 contact hour per week and NCMC is a 0-credit course involving 1 contact hour per week. The courses shall be evaluated through Continuous Internal Evaluation (CIE) and Semester End Examination (SEE), each having a weightage of 50%.

- The CIE will comprise of two tests of 30 marks each having Part-A with MCQs for 6 marks and Part-B with Descriptive questions. The remaining 20 marks shall be assessed through assignments, surprise tests, quizzes, or other components as decided by the course instructor.
- The SEE will comprise of Part-A with MCQs (10 marks) and Part-B (5x8=40 marks) with descriptive questions.

PCC Laboratory is a 1-credit lab course involving 2 hours of lab sessions per week and uses both Continuous Internal Evaluation (CIE) and Semester End Examination (SEE) for assessment.

- CIE totals 50 marks, with 30 marks for lab sessions (Each laboratory experiment shall be evaluated for 10 marks based on the experiment record, conduction of the experiment, and observations, and the cumulative marks shall be scaled down to 30 marks.). Another 15 marks from a lab test and 05 marks for viva.
- SEE totals 50 marks, comprising 40 marks for procedure write up, experiment conduction & results and 10 marks for viva voce.

NCMC is a 0-credit course involving 1 contact hour per week: The students shall attend classes for the course during the semester and complete all formalities of attendance and CIE. The CIE shall be evaluated for 100 marks. In case, any student fails to secure the minimum 40% of the prescribed CIE marks, he/she shall be deemed to have secured 'F' grade. In such a case, the student has to fulfill the requirements during subsequent semester/s to appear for CIE. Incase student fails to register for the said course/ falls short of attendance, he/she will repeat the course whenever it is offered next. This course shall have CIE component only and **no SEE component**. The completion of the course shall be mandatory for the award of the degree.

AICTE Activity Points Requirement for BE Programs: As per AICTE guidelines (refer Chapter 6 – *AICTE Activity Point Program, Model Internship Guidelines*), in addition to academic requirements, students must earn a specified number of **Activity Points** to be eligible for the award of the degree. The points to be earned is:

1. **Regular students** admitted to a 4-year degree program must earn **100 Activity Points**.
2. **Lateral entry students** (joining from the second year) must earn **75 Activity Points**.
3. **Students transferred** from other universities directly into the V semester must earn **50 Activity Points** from the date of entry into VTU.

These Activity Points are non-credit and will not be considered for the SGPA/CGPA or be used for vertical progression. However, earning Activity Points is mandatory for the award of the degree, and the points earned will be reflected on the eighth semester Grade Card. If a student completes all the semesters (eight or six) at the end of the program but fails to earn the required Activity Points, the VIII semester Grade Card will be withheld until the requirement is fulfilled. Also, the degree will be awarded only after the Grade Card has been released. The hours spent earning the activity points will not be counted for regular attendance requirements. Students can accumulate these points at any time during their program period, including weekends, holidays, and vacations, starting from the year of admission, provided they meet the minimum hours of engagement prescribed for each activity by AICTE.

SCHEME OF TEACHING VI SEMESTER

Sl. No.	Subject Code	Subject	Teaching Department	Category	Credits				Total contact hours /week	Total Contact hours/week			
					L	T	P	Total		L	T	P	S*
1	AL61	Management & Entrepreneurship	ISE	HSMC	3	0	0	3	3	3	0	0	3
2	IS62	Cloud Computing	ISE	PCC	4	0	0	4	3	4	0	0	4
3	ISE63x	Program Elective Course – 2	ISE	PEC	3	0	0	3	3	3	0	0	3
4	ISE64x	Program Elective Course – 3	ISE	PEC	3	0	0	3	3	3	0	0	3
5	ISL65	Machine Learning Lab2	ISE	PCC	0	0	1	1	2	0	0	2	0
6	ISL66	DevOps Lab	ISE	PCC	0	0	1	1	2	0	0	2	0
7	ISOE0X	Open Elective - 1	ISE	IOE	3	0	0	3	3	3	0	0	3
8	ISP67	Mini Project	ISE	PW	0	0	4	4	-	0	0	8	0
9	IS68	Technical Skill Enhancement Course	Industry Expert	SDC	0	1	0	1	2	0	2	0	0
Total					**16**	**1**	**6**	**23**	**23**	**16**	**2**	**12**	**16**

Programme Electives Course – 2

Sl.No	Subject Code	Subject
1	ISE631	Mobile Application Development
2	ISE632	Internet of Things
3	ISE633	Block chain essentials and DApps

Programme Electives Course - 3

Sl.No	Subject Code	Subject
1	ISE641	Quantum Computing
2	ISE642	Data Engineering and MLOps
3	ISE643	Natural Language Processing

Institutional Open Elective - 1

Sl. No.	Subject Code	Subject
1	23ISOE01	Data Analytics with Python
2	23ISOE02	Fundamentals of Database Management Systems

NOTE: Minimum of 1 subject should have a Tutorial component of 1 Credit.

Nomenclature: PCC: Professional Core Course, **PEC:** Professional Elective Course, **SDC:** Skill Development Course**, OEC:** Open Elective Course**, PW:** Project Work, **NCMC:** Non-credit Mandatory Course.

Credit Definition:

- **1 credit = 1 hour/week of lecture (L)**
- **1 credit = 2 hours/week of tutorial (T)**
- **1 credit = 2 hours/week of practical(P)**
- **Self-Learning Hours (S)**

PCC & PEC & OEC courses are theory courses with or without tutorial sessions.

- Each theory credit corresponds to one contact hour per week, while each tutorial credit corresponds to two contact hours per week.
- The course shall be evaluated through Continuous Internal Evaluation (CIE) and Semester End Examination (SEE), each having a weightage of 50%.
- The CIE is evaluated for 50 marks through internal tests (30 marks) and other components (20 marks). Each internal test will have three questions and students shall answer any two full questions. Each question shall address all the Course Outcomes (COs) prescribed for that test. The average of the two tests shall be considered for awarding 30 marks. The remaining 20 marks shall be assessed through assignments, tutorial tests, quizzes, surprise tests, mini-projects, or other components as decided by the course instructor.
- The SEE shall be evaluated for 100 marks, which shall be scaled down to 50 marks.
- The SEE examination shall consist of ten questions with internal choice (two questions per unit). Students shall answer any five full questions, selecting at least one question from each unit.

SDC Courses:

- The Technical Skill Enhancement course is designed on the Finishing School model, providing students with an industry-oriented overview and integration of the technical concepts studied from the I to VI semesters.
- Industry experts are invited to deliver the course during the semester, with **two-hour sessions held every week**, focusing on the application-oriented coverage of core technical concepts from the I to VI semesters.
- Assessment shall be based on CIE for 100 marks. Marks shall be awarded for each session by the **internal faculty coordinator** for attendance and performance in quiz/assignment/ capstone projects/session-specific activity designed. Ten session specific activities to be designed for 10 marks each.
- The Technical Skill Enhancement course shall have CIE component only and **no SEE component.**

Mini-project work Assessment (PW):

- 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.
- A guide/s shall be allocated to the group in the beginning of the semester.
- The CIE totals 50 marks and shall be awarded by a committee constituted by of the Head of the concerned department. The CIE marks shall be awarded with 20 marks for the first presentation and 30 marks for the second presentation as per the rubrics defined by the department.
- SEE shall be conducted for 50 marks by two examiners appointed from within the Institute/ Department. SEE marks awarded for the mini project shall be based on the evaluation of brief outline of the work, presentation & report for 40 marks and 10 marks question & answer session.

PCC Laboratory is a 1-credit lab course involving 2 hours of lab sessions per week and uses both Continuous Internal Evaluation (CIE) and Semester End Examination (SEE) for assessment.

- CIE totals 50 marks, with 30 marks for lab sessions (Each laboratory experiment shall be evaluated for 10 marks based on the experiment record, conduction of the experiment, and observations, and the cumulative marks shall be scaled down to 30 marks.). Another 15 marks from a lab test and 05 marks for viva.
- SEE totals 50 marks, comprising 40 marks for procedure write up, experiment conduction & results and 10 marks for viva voce.

AICTE Activity Points Requirement for BE Programs: As per AICTE guidelines (refer Chapter 6 – *AICTE Activity Point Program, Model Internship Guidelines*), in addition to academic requirements, students must earn a specified number of **Activity Points** to be eligible for the award of the degree. The points to be earned is:

1. **Regular students** admitted to a 4-year degree program must earn **100 Activity Points**.
2. **Lateral entry students** (joining from the second year) must earn **75 Activity Points**.
3. **Students transferred** from other universities directly into the V semester must earn **50 Activity Points** from the date of entry into VTU.

These Activity Points are non-credit and will not be considered for the SGPA/CGPA or be used for vertical progression. However, earning Activity Points is mandatory for the award of the degree, and the points earned will be reflected on the eighth semester Grade Card. If a student completes all the semesters (eight or six) at the end of the program but fails to earn the required Activity Points, the VIII semester Grade Card will be withheld until the requirement is fulfilled. Also, the degree will be awarded only after the Grade Card has been released. The hours spent earning the activity points will not be counted for regular attendance requirements. Students can accumulate these points at any time during their program period, including weekends, holidays, and vacations, starting from the year of admission, provided they meet the minimum hours of engagement prescribed for each activity by AICTE.

The Non Credit Mandatory Course, Physical Education (Sport and Athletics)/Yoga/National Service Scheme (NSS):

1. Student shall select any one of the NCMC's namely, Physical Education (Sport and Athletics)/Yoga/ NSS prescribed for four semesters and shall attend the course from the III semester to VI semester to complete all the formalities of the course and earn requisite CIE score. The Pass/Fail shall be reflected in the VI semester grade card.
2. The above mentioned NCMC's shall not be considered for vertical progression as well as for the calculation of SGPA/CGPA but completion of the courses shall be mandatory for the award of degree.
3. CIE marks will be allotted by the concerned course teacher based on attendance and performance in the practice sessions/field work every semester (III to VI) for 100 marks and the total 400 marks scored by the student are scaled down to 100 in the VI semester.
4. In case, any student fails to secure the minimum 40% of the prescribed marks, he/she shall be deemed to have secured 'F' grade.

Machine Learning	
Course Code: IS51	**Credits: 3:0:0:3**
Pre – requisites: NIL	**Contact Hours: 45L+45S**
Course Coordinator: Dr. Sumana M	

Course Content

Unit I

Introduction: Need for Machine Learning, Machine Learning Explained, Machine Learning in Relation to other Fields, Types of Machine Learning, Challenges of Machine Learning, Machine Learning Process, Machine Learning Applications.
Understanding Data – 1: Introduction, Big Data Analysis Framework, Descriptive Statistics, Univariate Data Analysis and Visualization, Bivariate Data and Multivariate Data, Multivariate Statistics

- **Pedagogy/Course Delivery tools:** Chalk and talk, PowerPoint Presentation, Videos
- **Links:** https://nptel.ac.in/courses/106106198

Unit II

Understanding Data – 2: Mathematics for Multivariate Data, Feature Engineering and Dimensionality Reduction Techniques.
Basic Learning Theory: Design of Learning System, Introduction to Concept of Learning, Induction biases, Modelling in Machine Learning , learning Frameworks.

- **Pedagogy/Course Delivery tools:** Chalk and talk, PowerPoint Presentation, Videos
- **Links:** https://nptel.ac.in/courses/106106198
  https://www.youtube.com/watch?v=TIFFfLejkcA

Unit III

Similarity-based Learning: Nearest-Neighbor Learning, Weighted K-Nearest-Neighbor Algorithm, Nearest Centroid Classifier, Locally Weighted Regression (LWR).
Regression Analysis: Introduction to Regression, Introduction to Linear Regression, Multiple Linear Regression, Polynomial Regression, Logistic Regression.
Decision Tree Learning: Introduction to Decision Tree Learning Model, Decision Tree Induction Algorithms.

- **Pedagogy/Course Delivery tools:** Chalk and talk, PowerPoint Presentation, Videos
- **Links:** https://www.youtube.com/watch?v=DlQli0OCkf8
  https://www.youtube.com/watch?v=OQV8WmUdeIo&list=PLbMVogVj5nJSpj5sl-8tdKARg1lw2wEa
  https://www.youtube.com/watch?v=XX8jz3jOXOs

Unit IV

Rule Based Learning : Introduction, Sequential Covering Algorithm, First order Rule Learning, Association Rule Mining.
Bayesian Learning: Introduction to Probability-based Learning, Fundamentals of Bayes Theorem, Classification Using Bayes Model, Naïve Bayes Algorithm for Continuous Attributes.
Artificial Neural Networks: Introduction, Biological Neurons, Artificial Neurons, Perceptron and Learning Theory, Types of Artificial Neural Networks, Popular Applications of Artificial Neural Networks, Advantages and Disadvantages of ANN, Challenges of ANN

- **Pedagogy/Course Delivery tools:** Chalk and talk, PowerPoint Presentation, Videos
- **Links:** https://www.youtube.com/watch?v=GSEu5hn2q98
  https://www.youtube.com/watch?v=Lveq5dIaiXY
  https://www.youtube.com/watch?v=xbYgKoG4x2g

Unit V

Ensemble Learning : Introduction, Parallel Ensemble Models, Incremental Ensemble Models, Sequential Ensemble Models
Clustering Algorithms: Introduction to Clustering Approaches, Proximity Measures, Hierarchical Clustering Algorithms, Partitional Clustering Algorithm, Density-based Methods, Grid-based Approach.

- **Pedagogy/Course Delivery tools:** Chalk and talk, PowerPoint Presentation, Videos
- **Links:** https://www.youtube.com/watch?v=kB44EPN33GI
  https://www.youtube.com/watch?v=WF9hVgUOgP4

Text Book:

1. S Sridhar, M Vijayalakshmi, "Machine Learning", OXFORD University Press 2021, First Edition.
2. T. M. Mitchell, "Machine Learning", McGraw Hill, 1997.

Reference Books:

1. M N Murty and Ananthanarayana V S, "Machine Learning: Theory and Practice", Universities Press (India) Pvt. Limited, 2024.
2. Stephen Marsland, "Machine Learning - An Algorithmic Perspective", Second Edition, CRC Press - Taylor and Francis Group, 2015.
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.

Self-Learning: Programming Assignment/ Case Study/ Project Based Learning/ MOOC based learning / GATE oriented aptitude test / Simulation

Course Outcomes(COs):

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

1. Describe the need for machine learning, its relationship to other fields, and different types of machine learning.
2. Analyse the fundamental principles of univariate, bivariate and multivariate data, dimensionality reduction techniques and learning system.
3. Apply similarity-based learning methods and perform linear, polynomial regression analysis
4. Apply supervised learning techniques to classify datasets and make predictions.
5. Analyse unsupervised learning techniques to cluster data and discover associations.

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	**Marks**	**Course outcomes attained**
Internal Test-I	30	CO1, CO2, CO3
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other Components		
Programming Assignment	10	CO1, CO2, CO3, CO4,CO5
Gate based Aptitude Tests	10	CO1, CO2, CO3, CO4,CO5
Semester-End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

Software Engineering	
Course Code: IS52	**Credits: 2:0:1:2**
Pre – requisites: NIL	**Contact Hours: 30L+15P+30S**
Course Coordinator: Mushtaq Ahmed D M	

Course Content

Unit I

Introduction: Professional software development; Software engineering ethics; Case studies. Software processes: Software process models; Process activities; Coping with change; Process improvement. Agile software development: Agile methods; Plan-driven and agile development; Extreme programming; Agile project management; Scaling agile methods.

Lab Exercises:
Initialize a GitHub repository and set up a Kanban board to manage tasks for a sample project. Define a Product Backlog and perform a mini-sprint including task estimation and daily updates.

- **Pedagogy:** Lecture with case-based discussion
- **Links:** https://nptel.ac.in/courses/106105182

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. System modeling: Context models; Interaction models; Structural models; Behavioral models; Model-driven engineering.

Lab Exercises:
Develop a Software Requirements Specification (SRS) document for a given problem statement. Draw Use Case and Activity diagrams for a chosen system using a tool like StarUML or Draw.io.

- **Pedagogy:** Problem-based learning and modeling exercises
- **Links:** https://nptel.ac.in/courses/106105182

Unit III

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

Lab Exercises:
Create detailed Class and Sequence diagrams to represent the internal logic of the system. Map system requirements to a specific architectural pattern.

- **Pedagogy:** Design-oriented discussions and worked examples
- **Links:** https://nptel.ac.in/courses/106105182

Unit IV

Software testing: Development testing; Test-driven development; Release testing; User testing. Software evolution: Evolution processes; Legacy systems; Software maintenance.

Lab Exercises:
Write and execute test cases for core modules using frameworks like JUnit or PyTest.
Set up a simple automated build pipeline (e.g., GitHub Actions) to run tests on every code push.

- **Pedagogy**: Demonstration-based learning with illustrative examples
- **Links:** https://nptel.ac.in/courses/106105182

Unit V

Project management: Management activities; Project planning; Risk management; Project scheduling. Project planning: Software pricing; Plan-driven development; Project scheduling; Estimation techniques. Quality management: Software quality; Software standards; Reviews and inspections; Software measurement and metrics**.**

Lab Exercises:
Develop a complete project plan for a given case study.
Run a static code analysis tool to identify "code smells" and technical debt in your project.

- **Pedagogy:** Case-study based learning and numerical problem solving
- **Links:** https://nptel.ac.in/courses/106105182

Text Book:

1. Ian Sommerville, Software Engineering, 10th Edition, Pearson, 2020.

Reference Books:

1. Roger S. Pressman and Bruce R. Maxim, Software Engineering: A Practitioner's Approach, 9th Edition, McGraw-Hill, 2020.
2. Len Bass, Paul Clements, Rick Kazman, Software Architecture in Practice, 4th Edition, Addison-Wesley, 2021

Self-Learning: Students shall carry out a hands-on exercise such as preparing a Software Requirements Specification (SRS) and UML models for a given problem statement. It may also include reviewing an open-source project to understand its software process, design structure and version control practices.

Course Outcomes(COs):
At the end of the course, the student will be able to:

1. Apply the concepts of software engineering and agile development processes using modern project management tools. (PO1, 5, 8, 9, 10, 11) (PSO 1)
2. Analyze functional and non-functional requirements to create comprehensive software specifications and system models. (PO1, 2, 5, 9, 11) (PSO 1)
3. Design architectural patterns and object-oriented systems using modeling tools and design principles. (PO1, 2, 3, 5, 9) (PSO 1)
4. Implement software testing strategies and automated build pipelines to manage software evolution. (PO1, 4, 5, 11) (PSO 1)
5. Evaluate software project plans, quality metrics and ethics through risk management and static analysis. (PO1, 2, 5, 7, 10) (PSO 1)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	**Marks**	**Course outcomes attained**
Internal Test-I	30	CO1, CO2, CO3
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other Components		
Tool Demonstration (Jira Tool)	10	CO1, CO2, CO3, CO4,CO5
Case Study	10	CO1, CO2, CO3, CO4,CO5
Semester-End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

Computer Networks	
Course Code: IS53	**Credits: 4:0:0:4**
Pre – requisites: NIL	**Contact Hours: 60L+60S**
Course Coordinator: 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.

- **Pedagogy/Course Delivery tools:** Chalk & talk, Power Point and Multimedia Presentation
- **Links:** https://nptel.ac.in/courses/106105082
  https://nptel.ac.in/courses/106105080
  https://nptel.ac.in/courses/106105183

Unit II

Data Link layer: Introduction, Three types of addresses, ARP, Error detection and correction: Types of errors, redundancy, error detection vs error correction, block coding, cyclic codes - CRC and polynomials, checksum (Basic concept and internet checksum), **Data link control**: Framing, Media Access Control, Random Access Protocols, Controlled Access Protocols, Channelization.

- **Pedagogy/Course Delivery tools:** Chalk & talk, Power Point and Multimedia Presentation
- **Links:** https://nptel.ac.in/courses/106105082
  https://nptel.ac.in/courses/106106091
  https://nptel.ac.in/courses/106105183

Unit III

Network layer: Network layer services, Introduction to connectionless service and connection oriented service, Congestion control, IPV4 Addresses (Address space, classful addressing, classless addressing, and NAT), Internet protocol (IP) datagram format, fragmentation, IP options, ICMP error reporting and query messages, Routing algorithms: Distance Vector Routing, Link State Routing, Multicast Distance Vector (DVMRP).

- **Pedagogy/Course Delivery tools:** Chalk & talk, Power Point and Multimedia Presentation
- **Links:** https://nptel.ac.in/courses/106105082
  https://nptel.ac.in/courses/106106091
- **Impartus recording:** https://a.impartus.com/ilc/#/course/81474/295

Unit IV

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

- **Pedagogy/Course Delivery tools:** Chalk & talk, Power Point and Multimedia Presentation
- **Links:** https://nptel.ac.in/courses/106105081
  https://nptel.ac.in/courses/106106183
- **Impartus recording:** https://a.impartus.com/ilc/#/course/81474/295

Unit V

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

- **Pedagogy/Course Delivery tools:** Chalk & talk, Power Point and Multimedia Presentation
- **Links:** https://nptel.ac.in/courses/106105091
  https://nptel.ac.in/courses/106106183
- **Impartus recording:** https://a.impartus.com/ilc/#/course/81474/295

Text Book:

2. Behrouz A. Forouzan – "Data Communications and Networking", 5th Edition, Tata McGraw- Hill

Reference Books:

3. Alberto Leon-Garcia and Indra Widjaja – "Communication Networks –Fundamental Concepts and Key architectures", Second Edition, Tata McGraw-Hill.
4. William Stallings – "Data and Computer Communication", Eight Edition, Pearson Education.

Self-Learning:

1. **Tool Demonstration:** The students (in a group of 3/4 members) has to demonstrate the topics learnt in the above syllabus using the following tools:
   - ✓ Cisco Packet Tracer
   - ✓ GNS3 (Graphical Network Simulator)
   - ✓ Wireshark
   - ✓ tcpdump (Linux)
   - ✓ Advanced IP Scanner
   - ✓ nslookup / dig
   - ✓ Speedtest / iPerf

2. **Case Study:** The students (in a group of 3/4 members) has to give a seminar on any two case study topics from the below list.
   - ✓ ARP Spoofing Attack in Corporate Network
   - ✓ Congestion in Video Streaming Platforms
   - ✓ Routing Failure in Data Centers
   - ✓ Communication in Autonomous Vehicles
   - ✓ UDP in Online Gaming Applications
   - ✓ TCP Congestion Collapse in Large Networks
   - ✓ DNS Outage in Major Websites
   - ✓ Performance Analysis of Wi-Fi vs Ethernet
   - ✓ Rural Internet Connectivity Using Wireless Links
   - ✓ Routing Optimization in Railway Communication System
   - ✓ Email Protocols (SMTP, POP3, IMAP)
   - ✓ VoIP Protocols (SIP, RTP, RTCP)

Course Outcomes(COs):

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

1. Describe the fundamentals of data communication, network types, layered architectures (OSI and TCP/IP), and signal transmission techniques. (PO-1,2,3,5,9,11; PSO-2)
2. Understand the functioning of the Data Link Layer through addressing techniques, framing mechanisms, media access protocols and solve the errors induced during data transmission. (PO-1,2,3,5,9,11; PSO-2)
3. Use different algorithms to make the routing decisions, analyze IP addressing techniques and packet delivery mechanisms in IPv4 networks. (PO-1,2,3,4,5,8,9,11; PSO-2)
4. Differentiate between IPv4 - IPv6 protocols and explain transport layer communication through basic protocols. (PO-1,2,3,4,5,8,9,11; PSO-2)
5. Illustrate the working principles of UDP, TCP and the process of domain name resolution using DNS. (PO-1,2,3,5,8,9,11; PSO-2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes attained**
Internal Test-I	30	CO1, CO2, CO3
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other Components	**Marks**	**Course outcomes attained**
Tool Demonstration	10	CO1, CO2, CO3, CO4, CO5
Case Study	10	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE)	100 (Scale down to 50 Marks)	CO1, CO2, CO3, CO4, CO5

Theory of Computation	
Course Code: IS54	**Credits: 2:1:0:2**
Pre – requisites: NIL	**Contact Hours: 30L+15T+30S**
Course Coordinator: Dr. Rajeshwari S B	

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.

- **Pedagogy/Course Delivery tools:** Chalk-and-talk
- **Links:** https://nptel.ac.in/courses/106104148
- **Impartus recording:** https://a.impartus.com/ilc/#/course/96129/452

Unit II

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

- **Pedagogy/Course Delivery tools:** Chalk-and-talk
- **Links:** https://nptel.ac.in/courses/106104148
- **Impartus recording:** https://a.impartus.com/ilc/#/course/96129/452

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.

- **Pedagogy/Course Delivery tools:** Chalk-and-talk
- **Links:** https://nptel.ac.in/courses/106104148
- **Impartus recording:** https://a.impartus.com/ilc/#/course/96129/452

Unit IV

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

- **Pedagogy/Course Delivery tools:** Chalk-and-talk
- **Links:** https://nptel.ac.in/courses/106104148
- **Impartus recording:** https://a.impartus.com/ilc/#/course/326267/703

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

- **Pedagogy/Course Delivery tools:** Chalk-and-talk
- **Links:** https://nptel.ac.in/courses/106104148
- **Impartus recording:** https://a.impartus.com/ilc/#/course/326267/703

Text Book:

3. John E. Hopcroft, Rajeev Motwani, Jeffrey Ullman: Introduction to Automata, Theory, Languages and Computation, 3rd Edition, Pearson education 2015

Reference Books:

5. John C Martin: Introduction to Languages and Automata Theory, 3rd Edition, Tata McGraw- Hill, 2018
6. Daniel I.A. Cohen: Introduction to Computer Theory, 2nd Edition, John Wiley & Sons, 2014

Self-Learning:
Demonstrate the simulation of finite automata, regular expressions, context-free grammars, pushdown automata and Turing machines using the JFLAP simulator tool.

Course Outcomes(COs):
At the end of the course, the student will be able to:

1. Design and evaluate different types of finite state machines using automata theory principles. (PO-1,2,3,5,8,9; PSO-2)
2. Derive regular expressions from finite automata and construct finite automata from regular expressions. (PO-1,2,3,5,8,9; PSO-2)
3. Generate context free grammars for given languages and apply grammar transformation techniques to convert context free grammar into chomsky normal form. (PO-1,2,3,5,8,9; PSO-2)
4. Build pushdown automata from context free grammar and derive context free grammar from pushdown automata. (PO-1,2,3,5,8,9; PSO-2)
5. Apply turing machine programming techniques and extensions to design turing machines for given languages. (PO-1,2,3,5,8,9; PSO-2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	**Marks**	**Course outcomes attained**
Internal Test-I	30	CO1, CO2, CO3
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other Components		
JFLAP Simulator Tool Demonstration	10	CO1, CO2, CO3, CO4,CO5
MCQ Test	10	CO1, CO2, CO3, CO4,CO5
Semester-End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

Advanced Data Structures	
Course Code: IS551	**Credits: 3:0:0:3**
Pre – requisites: Data Structures-IS33, Design and Analysis of algorithms-IS43	**Contact Hours: 45L+45S**
Course Coordinator: Dr. Sumana M	

Course Content

Unit I

Mathematical Foundations and Advanced Algorithm Analysis: Introduction to Algorithm Design and Analysis, Mathematical Foundations for Algorithm Analysis, Asymptotic Notations (Review), Recurrence Relations, Solving Recurrences using Substitution, Iteration and Generating Functions, Complexity Analysis of Recursive Algorithms, Lower and Upper Bounds.

- **Pedagogy/Course Delivery tools:** Chalk-and-talk and Programming Demonstration.
- **Links:**
  1. https://onlinecourses.swayam2.ac.in/nou25_ma09/preview
  2. https://www.nptel.ac.in/courses/106106131

Unit II

Advanced Search Trees and Priority Structures: Abstract Data Types (Review), Ordered Dictionaries, Balanced Search Trees, AVL Trees (Review), Splay Trees, 2-3-4 Trees, Red-Black Trees, Binomial Heaps, Fibonacci Heaps, Comparative Study of Balanced Trees.

- **Pedagogy/Course Delivery tools:** Chalk-and-talk and Programming Demonstration.
- **Links:**
  1. https://www.nptel.ac.in/courses/106106131
  2. https://nptel.ac.in/courses/106102064

Unit III

Advanced Algorithm Design Techniques: Dynamic Programming (Advanced Applications), Optimization Problems using Dynamic Programming, Backtracking Technique, State Space Trees, Branch and Bound Technique, Traveling Salesperson Problem, 0/1 Knapsack, Assignment Problem, Comparative Study of Backtracking and Branch & Bound.

- **Pedagogy/Course Delivery tools: Chalk-and-talk and Programming Demonstration.**
- **Links:**
  1. https://onlinecourses.nptel.ac.in/noc24_cs46/preview
  2. https://onlinecourses.nptel.ac.in/noc21_cs53/preview

Unit IV

Randomized Algorithms: Introduction to Randomization, Monte Carlo and Las Vegas Algorithms, Complexity Classes of Randomized Algorithms, Randomized Searching and Selection, Randomized Data Structures (Conceptual), Applications of Randomized Algorithms in Modern Computing.

- **Pedagogy/Course Delivery tools:** Chalk-and-talk and Programming Demonstration.
- **Links:**
  1. https://onlinecourses-archive.nptel.ac.in/noc19_cs16
  2. https:// https://www.nptel.ac.in/courses

Unit V

Parallel Algorithms: Introduction to Parallel Computing, Parallel Computational Models, Parallel Random Access Machine (PRAM), Parallel Algorithm Design Principles, Parallel Prefix Computation, Parallel Merge Algorithm, Parallel Searching, Applications of Parallel Algorithms**.**

- **Pedagogy/Course Delivery tools: Chalk-and-talk and Programming Demonstration.**
- **Links:**
  1. https://archive.nptel.ac.in/courses/106/103/106103188
  2. https :// https://www.nptel.ac.in/courses

Text Book:

1. Harsh Bhasin, Algorithms Design and Analysis, Oxford University Press, First Edition, 2015.

Reference Books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, Introduction to Algorithms, Fourth Edition, MIT Press, 2022.
2. Jon Kleinberg and Éva Tardos, Algorithm Design, Second Edition, Pearson, 2022.
3. Richard F. Gilberg and Behrouz A. Forouzan, Data Structures: A Pseudocode Approach with C, Second Edition, Cengage Learning, 2007.
4. Advanced Data Structures, Second Edition, Cambridge University Press, 2018

- **Self-Learning**: Programming Assignments, Case Studies, Project-Based Learning

Course Outcomes(COs):

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

1. Analyze advanced data structures and algorithmic techniques for computational problems. (PO1, PO2, PO4, PO5 & PSO1)
2. Apply advanced data structures and algorithms to solve complex engineering problems. (PO1, PO2, PO3, PO5, PO9 & PSO1)
3. Design efficient algorithmic solutions using appropriate data structures. (PO1, PO2, PO3, PO5, PO9, PO10 & PSO1)
4. Implement advanced data structures and algorithms for real-world applications. (PO1, PO2, PO3, PO5, PO9, PO10 & PSO1)
5. Evaluate the performance of advanced data structures and algorithms for effective problem solving. (PO1, PO2, PO4, PO5, PO9, PO10, PO11 & PSO1

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	**Marks**	**Course outcomes attained**
Internal Test-I	30	CO1, CO2, CO3
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other Components		
Programming Assignment/Mini Project	20	CO1, CO2, CO3, CO4,CO5
Semester-End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

ARTIFICIAL INTELLIGENCE	
Course Code: ISE552	**Credits: 3:0:0:3**
Pre – requisites: NIL	**Contact Hours: 45L+45S**
Course Coordinator: Dr. Lincy Meera Mathews	

Course Contents

Unit 1

Introduction: What is AI? **Intelligent Agents:** Agents and Environments, Rationality, The Nature of Environments, The Structure of Agents. **Problem-solving:** Problem-Solving Agents.

Recommended Resources / Links:

1. https://nptel.ac.in/courses/112103280
2. https://nptel.ac.in/courses/106106126
3. https://media.dev.nptel.ac.in/content/mp4/112/103/112103280/MP4/mod01lec02.mp4

Unit II

Problem-solving: Example Problems, Search Algorithms, Uninformed Search Strategies, Informed Search Strategies: Greedy Best-First search, A* search, Heuristic functions:

Recommended Resources / Links:

1. https://media.dev.nptel.ac.in/content/mp4/112/103/112103280/MP4/mod03lec08.mp4
2. https://media.dev.nptel.ac.in/content/mp4/112/103/112103280/MP4/mod03lec09.mp4
3. https://media.dev.nptel.ac.in/content/mp4/112/103/112103280/MP4/mod04lec11.mp4

Unit III

Adversarial Search: Optimal Decisions in Games, Heuristic Alpha-Beta Tree Search. Logical Agents: Knowledge Based Agents, The Wumpus World, Logic, **Propositional Logic:** A very simple logic.

Recommended Resources / Links:

1. https://media.dev.nptel.ac.in/content/mp4/112/103/112103280/MP4/mod08lec23.mp4
2. https://nptel.ac.in/courses/106106140
3. https://media.dev.nptel.ac.in/content/mp4/112/103/112103280/MP4/mod04lec10.mp4

Unit IV

First-Order Logic: Representation Revisited, Syntax and semantics of First-Order Logic, Using First - Order logic, Knowledge Engineering in First-Order Logic.

Inference in First Order Logic: Propositional Versus First Order Inference, Unification, Forward Chaining, Backward Chaining, Resolution.

Recommended Resources / Links:

1. https://media.dev.nptel.ac.in/content/mp4/112/103/112103280/MP4/mod07lec18.mp4
2. https://nptel.ac.in/courses/106106143
3. https://media.dev.nptel.ac.in/content/mp4/112/103/112103280/MP4/mod12lec32.mp4

Unit V

Automated Planning: Definition of Classical Planning, Algorithms for Classical Planning.

Philosophy, Ethics and Safety of AI: The limits of AI, Can Machines Really Think? The Ethics of AI.

Recommended Resources / Links:
https://media.dev.nptel.ac.in/content/mp4/107/106/107106090/MP4/mod01lec03.mp4
https://nptel.ac.in/courses/106105077
https://media.dev.nptel.ac.in/content/mp4/106/102/106102220/MP4/mod12lec92.mp4

Text Books:

1. Russell, S. J., & Norvig, P. (2021). Artificial Intelligence: A Modern Approach, Global Edition 4e.

Reference Books:

1. Elaine Rich, Kevin Knight, Shivashankar B Nair: Artificial Intelligence, 3rd Edition, Tata McGraw Hill, 2017.
2. Deepak Khemani "Artificial Intelligence", Tata Mc Graw Hill Education 2013.
3. Peter Jackson, "Introduction to Expert Systems", 3rd Edition, Pearson Education, 2007.

Course Outcomes:

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

1. Understand the fundamentals of Artificial Intelligence and apply problem-solving techniques using agents to solve the problems. (PO-1,2,3,5,12; PSO-1,3)
2. Analyze uninformed and informed search strategies in solving real world problems. (PO - 1,2,3,5,12; PSO-1,3)
3. Apply adversarial search methods to make optimal game decisions and construct knowledge-based agents using logical reasoning. (PO- 1, 2,3,5,12; PSO-1,3)
4. Apply knowledge using the syntax and semantics of First-Order Logic, and inference techniques to solve reasoning problems. (PO- 1, 2,3,5,6,12; PSO-1,3).
5. Apply algorithms for classical planning in AI and analyze the philosophical, ethical, and safety implications of artificial intelligence. (PO- 1, 2,3,5,8, 12; PSO-1,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes attained**
Internal Test-I	30	CO1, CO2, CO3
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other Components		
Lab experimental work & Record writing	10	CO1, CO2, CO3, CO4, CO5
NPTEL course/ Lab Test	10	CO1, CO2, CO3, CO4, CO5
Semester-End Examination (SEE)	100 (Scale down to 50 Marks)	CO1, CO2, CO3, CO4, CO5

Computer Vision	
Course Code: ISE553	**Credits: 3:0:0:3**
Pre – requisites: NIL	**Contact Hours: 45L+45S**
Course Coordinator: Dr. D. Evangeline	

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

- **Pedagogy/Course Delivery tools:** Chalk-and-talk and Demonstration.
- **Links:**
  1. https://onlinecourses.nptel.ac.in/noc21_ee78/preview
  2. https://onlinecourses.nptel.ac.in/noc23_ee39/preview

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.

- **Pedagogy/Course Delivery tools:** Chalk-and-talk and Demonstration.
- **Links:**
  1. https://www.youtube.com/watch?v=9NG8CThRJgI&t=636s
  2. https://www.youtube.com/watch?v=ivmjfTFQ0oA

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).

- **Pedagogy/Course Delivery tools:** Chalk-and-talk and Demonstration.
- **Links:**
  1. https://www.youtube.com/watch?v=j3_Ck5oP5oI&list=PLqhXzDruUpI-UV7R5nuJ6UcuQgK07AuDE&index=56
  2. https://www.youtube.com/watch?v=4S7BezwSAmQ&list=PLqhXzDruUpI-UV7R5nuJ6UcuQgK07AuDE&index=58

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.

- **Pedagogy/Course Delivery tools:** Chalk-and-talk and Demonstration.
- **Links:**
  1. https://www.youtube.com/watch?v=eVugfKb91ZY&list=PL1F076D1A98071E24&index=33
  2. https://www.youtube.com/watch?v=4-AsEtIpEWg

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)

- **Pedagogy/Course Delivery tools:** Chalk-and-talk and Demonstration.
- **Links:**
    1. https://www.youtube.com/watch?v=9BG7OUu3Qr4&list=PLuv3GM6-gsE08DuaC6pFUvFaDZ7EnWGX8&index=55
    2. https://www.youtube.com/watch?v=nlwH07G9Efg&list=PLuv3GM6-gsE08DuaC6pFUvFaDZ7EnWGX8&index=51

Text Book:

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

Reference Books:

1. Anil K. Jain, "Fundamentals of Digital Image Processing", Pearson Education, 2001.
2. B. Chanda and D. Dutta Majumdar ,"Digital Image Processing and Analysis", PHI, 2003.

Self-Learning: Case Studies and Real World Applications**.**

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-1,2) (PSO-3).
2. Apply spatial domain filters to improve the quality of the image (PO-1,2,3,4,5,8) (PSO-3).
3. Use segmentation, description, and recognition techniques for object identification in the image. (PO-1,2,3,4,5,8,9) (PSO-3).
4. Apply morphological operations and compression techniques in processing the image. (PO-1,2,3,4,5,8,9) (PSO-3).
5. Design solution for the identified problem by applying appropriate computer vision algorithm (PO-1,2,3,4,5,8,9) (PSO-3).

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	**Marks**	**Course outcomes attained**
Internal Test-I	30	CO1, CO2, CO3
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other Components		
Mini Project	20	CO1, CO2, CO3, CO4,CO5
Semester-End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

Machine Learning Lab -1	
Course Code: ISL56	**Credits: 0:0:1**
Pre – requisites: Python	**Contact Hours: 15P**
Course Coordinator: Dr. Shruti G	

Course Content

PART -A

1. Exploring and Visualizing Sales Data. Import a sample sales dataset into Tableau. Create a dashboard that includes the following visualizations:
    1. A bar chart showing total sales by product category.
    2. A line chart showing monthly sales trends over the past year.
    3. A geographic map showing sales distribution by region.
    4. Use a dual-axis chart or side-by-side bar charts to compare sales and return rates across regions.

2. Using a dataset on customer purchases, create a dashboard with the following advanced visualizations:
    1. A scatter plot showing the relationship between customer age and total spending.
    2. A heat map illustrating product sales intensity by store location.
    3. A dual-axis chart comparing sales and profit margins over time.
    4. Create a bar chart or treemap showing total sales revenue by product and region.

3. Analysing Sales Performance: Create various visualizations to analyze the sales performance.
    1. Create a line chart to show sales trends over time.
    2. Create a bar chart to compare sales across different regions.
    3. Use a pie chart to display the distribution of sales among different product categories.
    4. Create a dashboard combining these visualizations to provide an overall view of sales
    5. performance.

PART – B

1. Dataset (https://archive.ics.uci.edu/ml/datasets/wine+quality)
(a) Analyze and visualize the dataset to understand the relationship between physicochemical features and wine quality.
(b) Build a regression model using Linear Regression and Ridge Regression.
(c) Evaluate and interpret the model performance using R^2, RMSE, and MAE metrics.

2. Dataset (https://archive.ics.uci.edu/ml/datasets/heart+disease)

(a) Analyze and visualize the dataset to understand patterns and relationships among clinical features and heart disease outcomes.
(b) Build a classification model using Logistic Regression and apply a variant approach using Multinomial Logistic Regression.
(c) Evaluate and interpret the model performance using Accuracy, Precision, Recall, F1-score, and ROC-AUC metrics.

3. Dataset https://archive.ics.uci.edu/ml/datasets/parkinsons

(a) Analyze and visualize the dataset to explore correlations and relationships among features related to Parkinson's disease.
(b) Build a classification model using K-Nearest Neighbors (KNN) and apply a variant approach using Weighted KNN. Use the Elbow Method to determine the optimal value of *k*.
(c) Evaluate and interpret the model performance using Accuracy and Confusion Matrix metrics.

4. Dataset (https://archive.ics.uci.edu/ml/datasets/breast+cancer+wisconsin+(diagnostic))

(a) Analyze and visualize the dataset to explore feature correlations and patterns among diagnostic attributes.
(b) Apply Principal Component Analysis (PCA) for dimensionality reduction and build a classification model using Support Vector Machine (SVM) with a variant approach using Kernel SVM (RBF).
(c) Evaluate and interpret the model performance using Accuracy and ROC-AUC metrics.

5. Dataset
(https://archive.ics.uci.edu/ml/datasets/human+activity+recognition+using+smartphones)

(a) Analyze and visualize the dataset to explore feature distributions and relationships among activity-related attributes.
(b) Build a classification model using Random Forest and apply a variant approach using Extra Trees Classifier.
(c) Evaluate and interpret the model performance using Accuracy and Macro-F1 Score metrics.

6. Dataset (https://archive.ics.uci.edu/ml/datasets/spambase)

(a) Analyze and visualize the dataset to understand the distribution and characteristics of spam-related features. Analyze the UCI Spambase dataset to understand the distribution and characteristics of spam-related features such as word frequency, character frequency, and capital run length.Visualize the dataset using appropriate plots to study the patterns of spam and non-spam emails.
(b) Build a classification model using Naïve Bayes and apply a variant approach using Gaussian Naïve Bayes.
(c) Evaluate and interpret the model performance using Accuracy, Precision, Recall, and F1-score metrics.

7. Dataset (https://archive.ics.uci.edu/ml/datasets/default+of+credit+card+clients)

(a) Analyze the dataset to study class distribution and visualize the imbalance between defaulters and non-defaulters.
(b) Build a baseline Random Forest classification model for default prediction and apply data balancing techniques such as oversampling, undersampling, and SMOTE.
(c)Evaluate the models using Precision, Recall, F1-score, ROC-AUC, and PR-AUC.
Implement Gradient Boosting as a variant algorithm and compare the performance of models with and without data balancing.

8. Dataset https://archive.ics.uci.edu/ml/datasets/bank+marketing

(a) Analyze the Bank Marketing dataset and visualize the distribution of customers subscribing to term deposits. Use appropriate plots to study class distribution and the behavior of numerical features.
(b) Develop a Bayesian classification model to predict whether a customer will subscribe to a term deposit. Explain the working principle of the Bayesian classifier.
(c)Evaluate the model using Accuracy and ROC-AUC metrics.
Implement Logistic Regression as a variant algorithm and compare its performance with the Bayesian classifier. Interpret the results and justify the better-performing model.

9. Dataset
https://archive.ics.uci.edu/ml/datasets/optical+recognition+of+handwritten+digits

(a) Analyze the Optical Recognition of Handwritten Digits dataset and visualize sample digit images and feature patterns using appropriate plots.
(b) Build a classification model using the Multilayer Perceptron (MLP) method for handwritten digit recognition. Implement a variant MLP with different hidden layer sizes and discuss the effect of network architecture on performance.
(c) Evaluate the models using Accuracy and Confusion Matrix measures, and compare the performance of the baseline and variant MLP models.

Text Book:

1. S Sridhar, M Vijayalakshmi, "Machine Learning", OXFORD University Press 2021, First Edition.
2. T. M. Mitchell, "Machine Learning", McGraw Hill, 1997.

Reference Books:

1. M N Murty and Ananthanarayana V S, "Machine Learning: Theory and Practice", Universities Press (India) Pvt. Limited, 2024.
2. Stephen Marsland, "Machine Learning - An Algorithmic Perspective", Second Edition, CRC Press -Taylor and Francis Group, 2015

Self-Learning (Programming Assignment/ Case Study/ Project Based Learning/ MOOC based learning / GATE oriented aptitude test / Simulation):

Course Outcomes(COs):

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

Course outcomes (Cos):

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

1. Understand and implement various machine learning procedures algorithms using appropriate datasets.(PO: 1, 2, 3, 4, 5, PSO: 1, 3)

2. Design and develop Java/Python programs for supervised, unsupervised, and ensemble learning methods. (PO: 1, 2, 3, 4, 5, PSO: 1, 3)

3. Apply machine learning techniques to analyze and solve real-world problems. (PO: 1, 2, 3, 4, 5, PSO: 1, 3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes attained**
Internal Test	20	CO1, CO2, CO3
Other Components:		
Weekly Evaluation- Lab Record	20	CO1, CO2, CO3
Quiz	10	CO1, CO2, CO3
The Final CIE out of 50 Marks = Marks Scored in Lab Test + Marks of Lab Record + Marks Scored in Quiz		

Conduction, Calculation, Record and Viva	30	CO1, CO2, CO3
Semester-End Examination (SEE)	50	CO1, CO2, CO3

Computer Networks Laboratory	
Course Code: ISL57	**Credits: 0:0:1**
Pre – requisites: NIL	**Contact Hours: 15P**
Course Coordinator: Charunayana V	

Course Content

Part A: Implement the following using C/C++/Java

1. Write a program to implement the internet checksum for detecting errors during data transfer in unreliable network. Demonstrate the generation of the checksum at sender site and verify for the correctness of the received data at the receiver site demonstrating the two cases – without error and with error.

2. Write a program for implementing the error detection during data transfer in unreliable network code using 16-bit CRC Technique. Generate the codeword at sender site and verify for the correctness of the received codeword at the receiver site demonstrating the two cases – without error and with error.

3. Write a program to find shortest paths from any node as source to all other nodes using Distance vector routing for any given graph (with atleast 5 nodes). Print the least cost and next node to reach all possible destinations from the selected source node.

4. An essential requirement in managing congestion control is to regulate the data flow. Write a program to implement the traffic management at flow level by smoothing out the bursty traffic and ensuring a steady data out flow using Leaky Bucket Algorithm. Demonstrate the output in tabular format.

5. Write a program to find shortest paths from any node as source to all other nodes using Link state routing for any given graph (with atleast 5 nodes). Print the least cost and next node to reach all possible destinations from the selected source node.

6. Write a program to implement the simple sliding window in achieving flow control. Demonstrate the frame transmission within the window limit, waiting for acknowledgements and handle the cases of sliding the window or retransmission of window contents.

7. Variable sized framing needs synchronization to ensure that data patterns do not conflict with control patterns. Write a program to demonstrate bit stuffing and unstuffing to achieve synchronization in variable sized frames at data link layer.

8. Packets from different flows arrive at a switch or router for processing. A good scheduling technique treats the different flows in a fair and appropriate manner. Write a program to implement priority queuing as a technique to improve Quality of Service. Demonstrate the output using two queues with switch cases that includes enqueue, dequeue and display operations.

9. Using TCP/IP sockets, write a client-server program to make client send the file name and the server to send back the contents of the requested file name “sample.txt” with the

following contents: “Hello we are at Computer Networks Lab” Display suitable error message in case the file is not present in the server.

Part B: Simulation Using NS-2

1. Simulate three nodes point-to-point networks with simplex links between them. Apply UDP agent, set the queue size and vary the bandwidth and find the number of UDP packets sent, received and dropped.

2. Simulate three nodes point-to-point networks with duplex links between them. Apply TCP agent, set the queue size and vary the bandwidth and find the number of
   i. TCP packets sent, received and dropped
   ii.Acknowledgment packets sent and received

3. Simulate a four-node point-to-point network, and connect the links as follows: n0->n2, n1->n2 and n2->n3. Apply TCP agent between n0->n3 and UDP agent between n1->n3 agent. Changing the parameters, determine the number of –
   i. UDP packets sent, received and dropped
   ii. TCP packets sent, received and dropped
   iii. Acknowledgment packets sent and received.

4. Simulate a ring topology network with four nodes (n0, n1, n2 and n3). Apply one UDP agent between n0->n2 and another UDP agent between n1->n3 agent. Changing the parameters, determine the number of UDP packets sent, received and dropped.

5. Simulate a star topology network where four nodes (n0, n1, n2 and n3) are connected to central hub. Apply one TCP agent between n0->n2 and another TCP agent between n1->n3 agent. Changing the parameters, determine the number of -
   i. TCP packets sent, received and dropped.
   ii. Acknowledgment packets sent and received.

Text Book:

1. Behrouz A. Forouzan – “Data Communications and Networking”, 5th Edition, 2017, Tata McGraw- Hill

Reference Books:

1. NS2 manual - https://networksimulator2.com/ns2-manual/
2. Alberto Leon-Garcia and Indra Widjaja – “Communication Networks –Fundamental Concepts and Key architectures”, Second Edition, Tata McGraw-Hill.
3. William Stallings – “Data and Computer Communication”, Eight Edition, Pearson Education.

Course Outcomes(COs):

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

1. Design and implement the functionalities of different layers of the OSI model. (PO-1, 2, 3, 4, 5, 8, 9, 11; PSO-2)
2. Simulate and analyze the network behavior against different parameters using NS2. (PO-1, 2, 3, 4, 5, 8, 9, 11; PSO-2)
3. Interpret the results and produce the substantial document. (PO-8, 9, 11; PSO-2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	**Marks**	**Course Outcomes Attained**
Internal Test	20	CO1, CO2, CO3
Other Components		
Weekly Evaluation- Lab Record	20	CO1, CO2, CO3
Quiz	10	CO1, CO2, CO3
The Final CIE out of 50 Marks = Marks Scored in Lab Test + Marks of Lab Record + Marks Scored in Quiz		
Semester-End Examination (SEE)	50	CO1, CO2, CO3

Research Methodology and IPR	
Course Code: AL58	**Credits: 3:0:0**
Pre – requisites: NIL	**Contact Hours: 45L**
Course Coordinator: Dr. Anitha P	

Course Content

Unit I

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/Course Delivery tools:** Chalk-and-talk and ppts.
- **Links:** https://www.nptel.ac.in/courses/121106007?

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 Randomised Block Design, Complete Randomised Design, Latin Square Design, and Factorial Design**.**

- **Pedagogy/Course Delivery tools:** Chalk-and-talk, ppts.
- **Links:** https://nptel.ac.in/courses/121106007

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/Course Delivery tools:** Chalk-and-talk, ppts.
- **Links:** https://nptel.ac.in/courses/111104032.

Unit IV

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/Course Delivery tools:** Chalk-and-talk, ppts.
- **Links:** https://nptel.ac.in/courses/109105191.

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/Course Delivery tools:** Chalk-and-talk, ppts.
- **Links:** https://nptel.ac.in/courses/109104135.

Text Book:

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. 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.

Self-Learning: Problem solving**.**

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.
2. Apply the knowledge of research design and design of experiments.
3. Analyze data collection methods, analysis, and sampling design.
4. Understand the global and Indian scenarios of patents and patent applications.
5. Acquire the requirements of registration and infringements related to trademarks, copyrights, and designs.

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	**Marks**	**Course outcomes attained**
Internal Test-I <Times, size=12>	30	CO1, CO2, CO3
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other Components		
Assignment	10	CO1, CO2, CO3, CO4,CO5
MCQ	10	CO1, CO2, CO3, CO4,CO5
Semester-End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

Engineering Economics	
Course Code: ISAEC591	**Credits: 1:0:0:1**
Pre – requisites: NIL	**Contact Hours:14L+14S**
Course Coordinator: Dr Kusuma S	

Course Contents

Unit 1

Economics: Definition and Scope of Engineering Economics, Flow in an Economy, Law of Supply and Demand, Concept of Engineering Economics, Types of Efficiency, Elements of Costs, Other Costs/Revenues, Break-Even Analysis, Profit/Volume Ratio (P/V Ratio), Elementary Economic Analysis, Design Selection for A Product, Building Material Selection, Process Planning/Process Modification

- Pedagogy: Lecture, chalk-and-board explanation, numerical problem solving, real-life examples
- Links: https://nptel.ac.in/courses/112107209

Unit 2

Interest Formulas and Their Applications: Time Value of Money, Interest Formulas, Single-Payment Compound Amount, Present Worth Amount, Equal-Payment Series Compound Amount, Equal-Payment Series Sinking Fund, Present Worth Method of Comparison, Revenue-Dominated Cash Flow Diagram, Cost-Dominated Cash Flow Diagram, Future Worth Method.

- Pedagogy: Lecture, worked examples, case-based discussion, tutorial problems
- Links: https://nptel.ac.in/courses/112107209

Unit 3

Depreciation: Methods of Depreciation, Straight Line Method of Depreciation, Declining Balance Method of Depreciation, Sum-Of-The-Years-Digits Method of Depreciation. Evaluation of Public Alternatives, Inflation Adjusted Decisions, Procedure to Adjust Inflation, Inflation Adjusted Economic Life of Machine

- Pedagogy: Lecture, numerical demonstrations, tutorial sheets, problem-solving sessions
- Links: https://nptel.ac.in/courses/112107209

Unit 4

Inventory Control: Purchase Model, Manufacturing Model, Make or Buy Decision, Approaches for Make or Buy Decision, Simple Cost Analysis, Economic Analysis, Break-Even Analysis

- Pedagogy: Lecture, numerical problem solving, exam-oriented practice
- Links: https://nptel.ac.in/courses/112107209

Unit 5

Project Management: Phases of Project Management, Guidelines for Network Construction, Critical Path Method (CPM), Gantt Chart/Time Chart, Pert (Project Evaluation and Review Technique), Value Analysis/Value Engineering 2 When to Apply Value Analysis, Value Engineering Procedure

- Pedagogy: Lecture, numerical problems, case studies, revision discussions
- Links: https://nptel.ac.in/courses/112107209

Text Books:

- Engineering Economics, R. Panneerselvam**,** PHI Learning Private Limited**,** 2nd Edition, 2012**.**
- Engineering Economy, William G. Sullivan, Elin M. Wicks, and C. Patrick Koelling**,** Pearson Education**,** 17th Edition, 2022**.**

Reference Books:

1. Prasanna Chandra, *Fundamentals of Financial Management*, McGraw-Hill 2.

Self-Learning Case Study

Course Outcomes:

After completing the course, the student will be able to:

1. Understand basic economic principles relevant to engineering decisions (PO1, PO2, PO11, PSO-1)
2. Analyze cost structures and break-even conditions (PO1, PO2, PO3, PO4, PO11, PSO-1)
3. Apply time value of money concepts (PO1, PO2, PO3, PO11, PSO-1)
4. Evaluate engineering projects using economic appraisal techniques (PO1, PO2, PO3, PO4, PO11, PSO-2)
5. Assess replacement, depreciation and inflation effects (PO1, PO2, PO3, PO4, PO11, PSO-1)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes attained**
Internal Test	30	CO1, CO2, CO3
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other Components		
MCQ	20	CO1, CO2, CO3, CO4,CO5
Semester-End Examination	100 (Scale down to 50 Marks)	CO1, CO2, CO3, CO4, CO5

Front end Development using ReactJS	
Course Code: ISAEC594	**Credits: 1:0:0:1**
Pre – requisites: HTML, CSS, and JavaScript	**Contact Hours: 15L+15S**
Course Coordinator: J R Shruti	

Course Content

Unit I

Introduction to React and JSX: Introduction to React: Features of React, React Philosophy (Declarative UI, Component-Based Architecture, One-Way Data Flow), Virtual DOM, React vs. Other Frameworks (Angular, Vue), Setting up React Environment (Node.js, npm, Vite), Project Structure, Introduction to JSX: JSX Syntax, Embedding Expressions, Conditional Rendering, JSX Compilation with Babel & JSX Transform.

- **Pedagogy/Course Delivery tools:** PowerPoint Presentations, Live Coding Sessions, Demonstrations, Hands-on Practice
- **Links:** https://legacy.reactjs.org/docs/introducing-jsx.html
  https://reactnative.dev/docs/next/intro-react

Unit II

Components, Props and State: Components: Functional Components, Overview of Class Components, Creating and Rendering Components, Passing & Accessing Props, Props vs. State, React Fragments, this.props.children, Introduction to State using useState, Rendering Components.

- **Pedagogy/Course Delivery tools:** Chalk and talk, PowerPoint Presentations, Live Coding Sessions, Demonstrations, Hands-on Practice
- **Links:** https://reactnative.dev/docs/next/intro-react
  https://legacy.reactjs.org/docs/components-and-props.html
  https://legacy.reactjs.org/docs/react-component.html

Unit III

Events and Form Handling: Handling Events in React: SyntheticEvent, Arrow Functions, bind(), Event Handling in Functional and Class Components, Controlled and Uncontrolled Components (Overview), Controlled Inputs (Forms), Form Elements: input, textarea, select, Lifting State Up.

- **Pedagogy/Course Delivery tools:** Chalk and talk, PowerPoint Presentations, Live Coding Sessions, Demonstrations, Hands-on Practice
- **Links:** https://legacy.reactjs.org/docs/handling-events.html
  https://www.freecodecamp.org/news/how-to-handle-events-in-react-19/
  https://www.scaler.com/topics/react/event-handling-in-react/
  https://www.angularminds.com/blog/best-practices-of-form-handling-and-event-binding-in-react

Unit IV

React DevTools and Routing: Introduction to React Developer Tools: Installing and Inspecting Components, Props and State, Introduction to React Router: BrowserRouter, Routes and Route, Setting up Routes, Navigating with Link and NavLink, Using useParams and useLocation.

- **Pedagogy/Course Delivery tools:** Chalk and talk, PowerPoint Presentations, Live Coding Sessions, Demonstrations, Hands-on Practice
- **Links:** https://www.youtube.com/watch?v=943D7U74_sQ
  https://www.contentful.com/blog/react-routing/
  https://www.geeksforgeeks.org/reactjs/link-and-navlink-components-in-react-router-dom/
  https://blog.logrocket.com/react-router-dom-tutorial-examples/

Unit V

Hooks, Styling, Deployment Basics & Project Integration: Introduction to React Hooks: useState, useEffect, useRef, Styling in React: CSS Modules, Inline Styles, CSS-in-JS (Overview), Environment Variables (.env Setup), Basic Deployment Concepts: Production Build Process, Netlify Hosting Overview, Project Integration and Deployment.

- **Pedagogy/Course Delivery tools:** Chalk and talk, PowerPoint Presentations, Live Coding Sessions, Demonstrations, Hands-on Practice
- **Links:** https://www.freecodecamp.org/news/style-react-apps-with-css/
  https://thehumblecoder.medium.com/mastering-css-styling-in-react-js-a-practical-guide-697de390f215
  https://docs.netlify.com/build/frameworks/framework-setup-guides/react/

Text Book:

1. Chris Minnick, Beginning ReactJS Foundations Building User Interfaces with ReactJS An Approachable Guide,2022.

Reference Books:

1.Anthony Accomazzo, Ari Lerner, Nate Murray, Clay Allsopp, David Gutman, and Tyler McGinnis, Fullstack React The Complete Guide to ReactJS and Friends,2017.

Self-Learning: Programming Assignment/ / Mini React Application: Students shall collaboratively develop a small React-based application by applying the concepts of JSX, components, state management, event handling, routing, styling, and deployment.

Course Outcomes(COs):

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

1. Understand the fundamentals of React, including React philosophy, Virtual DOM, JSX syntax, component-based architecture, project setup, and comparison with other front-end frameworks. (PO-1, PO-2, PO11, PSO-1)
2. Develop reusable user interfaces using functional components, overview of class components, props, state, and component composition in React. (PO-1, PO-2, PO-3, PO-5, PSO-1, PSO-2)
3. Implement event handling, controlled forms, and state management techniques, including lifting state up, to build interactive React applications. (PO-1, PO-2, PO-3, PO-5, PSO-1, PSO-2)
4. Build single-page React applications using React Developer Tools for debugging and React Router for navigation and routing. (PO-1, PO-3, PO-5, PO-11, PSO-1, PSO-2)
5. Apply React Hooks (useState, useEffect, useRef), styling techniques, environment configuration, and deployment concepts to develop and deploy complete React applications. (PO-1, PO-3, PO-5, PO-11, PSO-1, PSO-2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	**Marks**	**Course outcomes attained**
Internal Test-I	30	CO1, CO2, CO3
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other Components		
Project	20	CO1, CO2, CO3, CO4,CO5
Semester-End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

VI SEMESTER

MANAGEMENT & ENTREPRENEURSHIP	
Course Code: AL61	**Credits: 3:0:0:3**
Pre – requisites: -Nil-	**Contact Hours: 45L+45S**
Course Coordinator: 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/Course Delivery tools:** 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/Course Delivery tools:** 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/Course Delivery tools:** 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/Course Delivery tools:** 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/Course Delivery tools: Chalk and Talk, PowerPoint Presentations

- **Links:** https://www.nptel.ac.in/courses/110/105/110105067/

Text Book:

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

Reference Books:

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, the 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 attained**
Internal Test-I	30	CO1, CO2
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other Components	**Marks**	**Course outcomes attained**
Quiz	10	CO1, CO2, CO3
Assignment	10	CO1, CO2, CO3, CO4, CO5
Semester End Examination (SEE)	100 (Scale down to 50 Marks)	CO1, CO2, CO3, CO4, CO5

Cloud Computing	
Course Code: IS62	**Credits: 4:0:0:4**
Pre – requisites: OS, CN, DBMS	**Contact Hours:60L+60S**
Course Coordinator: Dr Jagadeesh Sai D	

Course Contents

Unit 1

Introduction to Cloud Computing: Evolution of computing, distributed and utility computing, NIST definition, essential characteristics, service models (IaaS, PaaS, SaaS), deployment models (public, private, community, hybrid), cloud benefits, challenges, cloud reference model.

- Pedagogy: Conceptual Learning through NPTEL video lectures and discussion-based sessions
- Links: https://nptel.ac.in/courses/106105167

Unit 2

Cloud Architecture and Technology: Cloud reference architecture, resource pooling, elasticity, scalability, multi-tenancy, virtualization, hypervisors, containerization concepts, cloud infrastructure, storage architecture, network architecture, cloud design patterns.

- Pedagogy: Architecture-based learning and case studies.
- Links: https://nptel.ac.in/courses/106105167

Unit 3

Cloud Services and Resource Management: SLA, provisioning, scheduling, allocation, cloud workloads, performance metrics, storage services, database services, monitoring, automation concepts, governance, cloud cost models.

- Pedagogy: Problem-based learning with cloud management scenarios.
- Links: https://nptel.ac.in/courses/106105167

Unit 4

Cloud Security: Shared responsibility model, IAM, authentication, authorization, encryption, key management, network security, VM and container security, privacy, risk assessment, compliance, governance.

- Pedagogy: Security case studies.
- Links: https://nptel.ac.in/courses/106105167

Unit 5

Cloud Applications and Emerging Trends: Cloud application design, migration strategies, cloud-native applications, microservices (introduction), serverless overview, edge computing, multi-cloud, green cloud computing, AI-enabled cloud services, business models, future trends.

- Pedagogy: Seminar and case-study based learning.
- Links: https://nptel.ac.in/courses/106105167

Text Books:

1. Thomas Erl and Eric Barceló Monroy, Cloud Computing: Concepts, Technology, Security, and Architecture, 2nd Edition, Pearson, 2023.

Reference Books:

1. Barrie Sosinsky, Cloud Computing Bible, 2nd Edition, Wiley, 2020.
2. Rajkumar Buyya, Christian Vecchiola and S. Thamarai Selvi, Mastering Cloud Computing, McGraw-Hill.
3. Tim Mather, Subra Kumaraswamy and Shahed Latif, Cloud Security and Privacy, O'Reilly.

Self-Learning: AWS Cloud Practitioner / Azure Fundamentals / Google Cloud Digital Leader / NPTEL Cloud Computing.

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

Course Outcomes (COs):

1. Explain cloud computing concepts, service and deployment models. (PO-1,2,3,4, PSO-1,2)
2. Analyze cloud architecture, virtualization and resource management. (PO-2,3,4, PSO-1,2)
3. Apply cloud services, governance and monitoring concepts. (PO-2,3,4,5, PSO-1,2)
4. Evaluate cloud security and compliance mechanisms. (PO-1,2,3,4,5,6 PSO-2,3)
5. Analyze cloud applications, migration strategies and emerging trends. (PO-3,4,5,9,10,PSO-2,3)

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes attained**
Internal Test	30	CO1, CO2, CO3
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other Components		
MCQ/ Project/Certification	20	CO1, CO2, CO3, CO4, CO5
Semester-End Examination	100 (Scale down to 50 Marks)	CO1, CO2, CO3, CO4, CO5

MOBILE APPLICATION DEVELOPMENT	
Course Code: IS631	**Credits: 3:0:0:3**
Pre – requisites: Nil	**Contact Hours: 45L+45S**
Course Coordinator: Dr S R Mani Sekhar	

Course Content

Unit I

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

- **Pedagogy/Course Delivery tools:** Chalk & talk and PPT
- **Links:** https://books.apple.com/us/book/develop-in-swift-fundamentals/id1511184145 https://www.apple.com/in/education/higher-education/app-development/ https://www.youtube.com/watch?v=CwA1VWP0Ldw

Unit II

Introduction to UI Kit – string, functions, structures, collections. UIKit—the system views and controls that make up a user interface and display data using Auto Layout and stack views

- **Pedagogy/Course Delivery tools:** Chalk & talk and PPT
- **Links:** https://books.apple.com/us/book/develop-in-swift-fundamentals/id1511184145 https://www.apple.com/in/education/higher-education/app-development/ https://www.youtube.com/watch?v=CwA1VWP0Ldw

Unit III

More Swift –UIkit: Controls In Action, Loops, Structures, Classes, Inheritance, Closures, Variadics

- **Pedagogy/Course Delivery tools:** Chalk & talk and PPT
- **Links:** https://books.apple.com/us/book/develop-in-swift-fundamentals/id1511184145 https://www.apple.com/in/education/higher-education/app-development/ https://www.youtube.com/watch?v=CwA1VWP0Ldw

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

- **Pedagogy/Course Delivery tools:** Chalk & talk and PPT
- **Links:** https://books.apple.com/us/book/develop-in-swift-fundamentals/id1511184145 https://www.apple.com/in/education/higher-education/app-development/ https://www.youtube.com/watch?v=CwA1VWP0Ldw

Unit V

Tables and Persistence – models, views, controllers, scroll views, table views, and building complex input screens, save data, 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.

- **Pedagogy/Course Delivery tools:** Chalk & talk and PPT
- **Links:** https://books.apple.com/us/book/develop-in-swift-fundamentals/id1511184145 https://www.apple.com/in/education/higher-education/app-development/ https://www.youtube.com/watch?v=CwA1VWP0Ldw

Text Book:

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

Reference Books:

1. Head First Swift: A Learner's Guide to Programming with Swift by Jonathon Manning and Paris Buttfield-Addison, 2021

Self-Learning: Programming Assignment

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)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	**Marks**	**Course outcomes attained**
Internal Test-I	30	CO1, CO2
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other Components		
Programming Assignment / Case Study	20	CO1, CO2, CO3, CO4,CO5
Semester-End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

Internet of Things	
Course Code: ISE632	**Credits: 3:0:0:3**
Pre – requisites: Micro Controller, CN	**Contact Hours:42L+42S**
Course Coordinator: Dr Jagadeesh Sai D	

Course Contents

Unit 1

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

- Pedagogy: Conceptual Learning through NPTEL video lectures and discussion-based sessions
- Links: Links: https://nptel.ac.in/courses/106105166

Unit 2

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)

- Pedagogy: Case-based Learning using NPTEL videos and real-world IoT-M2M comparisons
- Links: https://nptel.ac.in/courses/106105166

Unit 3

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.

- Pedagogy: Hands-on Learning with NPTEL tutorials and guided Python-based implementation
- Links: Links: https://nptel.ac.in/courses/106105224

Unit 4

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.

- Pedagogy: Experiential Learning using Coursera videos and Raspberry Pi practical labs
- Links: https://www.coursera.org/learn/raspberry-pi-platform

Unit 5

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

- Pedagogy: Application-oriented Learning via YouTube tutorials and cloud-based integration projects
- Links: https://www.youtube.com/watch?v=F5mRW0jo-U4

Text Books:

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

Reference Books:

1. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things – David Hanes et al, Cisco Press,2017, ISBN: 978-1-58714-456-1
2. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Florian Michahelles, Springer Berlin Heidelberg,2011, ISBN: 978-3-642-19156-5

Self-Learning: Project Based Learning

Course Outcomes:

1. Understand the design issues and fundamentals of IoT (PO-1,9,10,11) (PSO-2,3)
2. Design various methodologies for M2M and SDN architectures. (PO-1,9,10,11) (PSO-2,3)
3. Distinguish different cloud-based solution for IoT (PO-1,2,9,10,11) (PSO-2,3)
4. Develop IoT-based solutions for real-world problems. (PO-1,2,3,4,5,6,9,10,11) (PSO-2,3)
5. Analyze the various data analytical tools in IoT (PO-1,2,9,10,11) (PSO- 2,3)

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes attained**
Internal Test	30	CO1, CO2, CO3
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other Components		
MCQ/ Project	20	CO1, CO2, CO3, CO4,CO5
Semester-End Examination	100 (Scale down to 50 Marks)	CO1, CO2, CO3, CO4, CO5

Blockchain Essentials and DApps	
Course Code: ISE633	**Credits: 3:0:0:3**
Pre – requisites: Basic Cryptography concepts	**Contact Hours: 45L+45S**
Course Coordinator: J R Shruti	

Course Content

Unit I

Blockchain 101 : The growth of blockchain technology, Distributed systems, The history of blockchain and Bitcoin, Blockchain Consensus, CAP theorem and blockchain

- **Pedagogy/Course Delivery tools:** Chalk-and-talk and PowerPoint Presentations
- **Links:** https: //nptel.ac.in/courses/106104220
  https://andersbrownworth.com/blockchain/
  https://subscription.packtpub.com/book/data/9781788839044/1/
  ch01lvl1sec01/blockchain-101
  Introduction to Blockchain Technology and Applications by Prof. Sandeep Shukla, IIT Kanpur:"

Unit II

Decentralization: Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Pertinent terminology, Platforms for decentralization: Ethereum, MaidSafe, Lisk, Innovative trends: Decentralized web.
Symmetric Cryptography: Introduction, Cryptographic primitives, Advanced Encryption Standard (AES)- How AES works
Public Key Cryptography: Mathematics, Asymmetric cryptography.

- Pedagogy/Course Delivery tools: Chalk-and-talk and PowerPoint Presentations
- Links: https: //nptel.ac.in/courses/106104220
  https://subscription.packtpub.com/book/data/9781788839044/2/
  ch02lvl1sec09/decentralization
  Introduction to Blockchain Technology and Applications by Prof. Sandeep Shukla, IIT Kanpur:"

Unit III

Public key Cryptography: Cryptographic constructs and blockchain technology
Introducing Bitcoin: Bitcoin- an overview, Cryptographic keys, Transactions, Blockchain, Mining
The Bitcoin Network and Payments: The Bitcoin network, Wallets

- **Pedagogy/Course Delivery tools:** Chalk-and-talk and PowerPoint Presentations
- **Links:** https: //nptel.ac.in/courses/106104220
  https://subscription.packtpub.com/book/data/9781788839044/4/ch04lvl1sec23/public-key-cryptography
  Introduction to Blockchain Technology and Applications by Prof. Sandeep Shukla, IIT Kanpur:"

Unit IV

Smart contracts: History, Definition, Ricardian contracts, Smart contract templates, Oracles, Deploying smart contracts on blockchain, The DAO
Ethereum 101: Ethereum – an overview, The Ethereum network, Components of Ethereum ecosystem, The Ethereum Virtual Machine (EVM)

- **Pedagogy/Course Delivery tools:** Chalk-and-talk and PowerPoint Presentations, Hands-on Laboratory Sessions using Remix IDE, Ganache, and MetaMask for Smart Contract Development and Deployment
- **Links:** https: //nptel.ac.in/courses/106104220

https://subscription.packtpub.com/book/data/9781788839044/9/ch09lvl1sec52/smart-contracts
Introduction to Blockchain Technology and Applications by Prof. Sandeep Shukla, IIT Kanpur:"

Unit V

Further Ethereum: Blocks and blockchain, Wallets and client software, Nodes and miners
Hyperledger: Projects under Hyperledger, Hyperledger reference architecture, Hyperledger fabric, Hyperledger Sawtooth

- **Pedagogy/Course Delivery tools:** Chalk-and-talk and PowerPoint Presentations, Hyperledger Fabric Network Setup and Configuration
- **Links:** https: //nptel.ac.in/courses/106104220
  https://hyperledger-fabric.readthedocs.io/en/release-2.0/build_network.html
  https://subscription.packtpub.com/book/data/9781788839044/11/ch11lvl1sec63/further-ethereum
  Introduction to Blockchain Technology and Applications by Prof. Sandeep Shukla, IIT Kanpur:"

Text Book:

1. Imran Bashir, Mastering Blockchain, Third Edition, Packt, 2020.

Reference Books:

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

Self-Learning: Literature Survey on Emerging Blockchain Topics

Course Outcomes(COs):

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

2. Illustrate the Blockchain terminologies with its applications. design (PO – 1) (PSO – 2)
3. Analyze the working principles of Blockchain (PO – 1, 2, 9, 10, 11) (PSO – 2)
4. Comprehend the principles and methodologies used in Bitcoin (PO – 1, 9, 10, 11) (PSO – 2)
5. Illustrate the Smart Contract Lifecycle (PO – 1, 2, 3, 9, 10, 11) (PSO – 2)
6. Create Ethereum Network, Wallets, Nodes, Smart contract & DApps also develop Blockchain Based Application Architecture using Hyperledger (PO – 1, 2, 3, 5, 9, 10, 11) (PSO – 2)

Course Assessment and Evaluation:

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

Introduction to Quantum Computing	
Course Code: ISE641	**Credits: 3:0:0:3**
Pre – requisites: Computer Networks	**Contact Hours: 45L+45S**
Course Coordinator: Dr.Geetha V	

Course Content

Quantum Building Blocks: Quantum mechanics of Photon Polarization, Single Quantum bits, Single Qubit Measurement, A Quantum key Distribution Protocol, State Space of a Single-Qubit System, Direct Sums and Tensor Products of Vector Spaces, State Space of an n-Qubit System, Entangled States, Multi-Qubit Measurement, QKD using Entangled states

- **Pedagogy/Course Delivery tools:** Chalk-and-talk , Power Point Presentations
- **Links:** https://nptel.ac.in/courses/106106232
  https://quantumindia.net/wp-content/uploads/2023/03/Quantum-Vibes-newsletter-March2023.pdf

Unit II

Multiple-Qubit States Measurements: Dirac's bra/ket Notation for Linear transformations, Projection operators, Hermitian OperatorFormalism, Bell's Theorem.

- **Pedagogy/Course Delivery tools:** Chalk-and-talk , Power Point Presentations
- **Links:** https://quantumindia.net/wp-content/uploads/2024/06/Quantum-Vibes-Q1-2024.pdf
  https://quantumindia.net/wp-content/uploads/2025/05/Quantum-Vibes-Q1-2025.pdf

Unit III

Quantum State Transformations: Unitary transformations, Simple Quantum Gates, Pauli transformations, Hadamard Transformations, Multiple-Qubit Transformations, Controlled-NOT and other singly controlled gates, Applications of Simple Gates, Dense coding, Quantum teleportation

- **Pedagogy/Course Delivery tools:** Chalk-and-talk , Power Point Presentations
- **Links :** https://nptel.ac.in/courses/106106241
  https://onlinecourses.nptel.ac.in/noc23_cs04/preview

Unit IV

Quantum Algorithms: Computing with Superpositions, Walsh-Hadamard transformation, Quantum Parallelism, Notions of Complexity, Query Complexity, Communication Complexity, Simple Quantum Algorithm

- **Pedagogy/Course Delivery tools:** Chalk-and-talk , Power Point Presentations
- **Links:** https://www.youtube.com/watch?v=BQhZpcg0sc4
  https://nptel.ac.in/courses/106106241

Unit V

Simon's And Grover's Algorithm: Classical reduction to Period-Finding, Example illustrating Simon's Algorithm, DLP and Hidden Subgroup Problems, Grover's Algorithm, Amplitude amplification

- **Pedagogy/Course Delivery tools:** Chalk-and-talk , Power Point Presentations
- **Links:** https://quantumindia.net/cdac-quantum-activties/

https://quantumindia.net/qc-workshops-events/

Text Book:

1. Quantum Computing: A Gentle Introduction, Eleanor Rieffel and Wolfgang Polak, 2014, The MIT Press, ISBN 9780262015066
2. An introduction to Quantum Computing, Phillip Kaye, Raymond Laflamme, Muchele Mosca, Oxford University Press, 2007, ISBN-13: 978-0198570493, ISBN-10: 019857049X

Reference Books:

1. Quantum Computing for Computer Scientists, 1st Edition, Noson S. Yanofsky and Mirco A. Mannucci, Cambridge University Press, 2008, ISBN 978-0-521-879965
2. Quantum Computing for Everyone, Chris Bernhardt, MIT Press, 2019, ISBN: 9780262039253

Self-Learning: Programming Assignment

Course Outcomes(COs):

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

1. Explain the various essentials of quantum computation, Qubits, and Quantum operators (PO-1,2,3,7).
2. Analyse working of quantum transformations and quantum gates.(PO-1,3,8,9).
3. Describe principle of working of some of the standard quantum algorithms and their applications.(PO-1, 3, 4,10).
4. Investigate the applications of quantum computing and quantum cryptography (PO-1, 3, 4,,6).
5. Understand Quantum computing concepts and its approaches(PO-1, 3, 4,5).

Course Assessment and Evaluation:

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

DATA ENGINEERING AND MLOPS	
Course Code: ISE642	**Credits: 3:0:0:3**
Pre – requisites: NIL	**Contact Hours: 45L+45S**
Course Coordinator: Dr. Pushpalatha M N	

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.

- **Pedagogy/Course Delivery tools: Chalk and talk, Power Point Presentation**
- **Links: https://www.youtube.com/watch?v=mPSzL8Lurs0, https://www.youtube.com/watch?v=_ceJDkdwpbg>**

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.

- **Pedagogy/Course Delivery tools:** Chalk and talk, Power Point Presentation
- **Links:** https://www.youtube.com/watch?v=FGkkOfrVN5c

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.

- **Pedagogy/Course Delivery tools:** Chalk and talk, Power Point Presentation.
- **Links:**https://www.youtube.com/watch?v=e1rl1DYfPy4, https://www.youtube.com/watch?v=7Xjrp9j9bLw

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.

- **Pedagogy/Course Delivery tools:** Chalk and talk, Power Point Presentation
- **Links:** https://www.youtube.com/watch?v=7Xjrp9j9bLw
  https://www.youtube.com/watch?v=eRyQDkCrZrk

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)

- **Pedagogy/Course Delivery tools:** Chalk and talk, Power Point Presentation
- **Links:** https://www.youtube.com/watch?v=eRyQDkCrZrk

Text Book:

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

Self-Learning: Assignment/ Course Project

Course Outcomes(COs):

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

1. Understand data engineering life cycle (PO – 1, 4, PSO - 3)
2. Choose technologies across data engineering life cycle (PO – 2, 4, PSO - 3)

3. Evaluate machine learning models for MLOps (PO – 2, 4, PSO - 3)
4. Understand MLOps deployment strategies (PO – 1, 2, PSO - 3)
5. Understand MLOps model governance (PO – 1, 2, PSO - 3)

Course Assessment and Evaluation:

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

Natural Language Processing	
Course Code: ISE643	**Credits: 3:0:0:3**
Pre – requisites: Nil	**Contact Hours: 45L+45S**
Course Coordinator: Dr. Rajeshwari S B	

Course Content

Unit I

Introduction: Knowledge in Speech and Language Processing, Ambiguity, Models and Algorithms; Language, Thought, and Understanding; **Morphology and Finite-State Transducers:** Inflectional and Derivational Morphology, Lexicon-free FSTs: The Porter Stemmer, Human Morphological Processing. **N-grams:** Counting Words in Corpora, Smoothing, N-grams for Spelling and Pronunciation, Entropy;

- **Pedagogy/Course Delivery tools:** Chalk-and-talk and Power Point Presentation
- **Links:** https://nptel.ac.in/courses/109106083
  https://nptel.ac.in/courses/106101007
  https://media.dev.nptel.ac.in/content/mp4/106/106/106106211/MP4/mod01lec01.mp4

Unit II

Word Classes and Part-of-Speech Tagging: Part-of-Speech Tagging, Rule-based Part-of-speech Tagging, Stochastic Part-of-speech Tagging, Transformation-Based Tagging. **Context-Free Grammars for English:** Constituency, Context-Free Rules and Trees, Sentence-Level Constructions. **Parsing with Context-Free Grammars:** The Earley Algorithm;

- **Pedagogy/Course Delivery tools:** Chalk-and-talk and Power Point Presentation
- **Links:** https://nptel.ac.in/courses/106101007
  https://media.dev.nptel.ac.in/content/mp4/106/106/106106211/MP4/mod01lec02.mp4
  https://media.dev.nptel.ac.in/content/mp4/108/105/108105572/MP4/mod01lec04.mp4

Unit III

Features and Unification: Feature Structures, Unification of Feature Structures, Features Structures in the Grammar, Implementing Unification. **Lexicalized and Probabilistic Parsing:** Probabilistic Context-Free Grammars, Problems with PCFGs. **Representing Meaning:** First Order Predicate Calculus, Some Linguistically Relevant Concepts, Related Representational Approaches, Alternative Approaches to Meaning.

- **Pedagogy/Course Delivery tools:** Chalk-and-talk and Power Point Presentation
  Links: https://nptel.ac.in/courses/106105158
  https://media.dev.nptel.ac.in/content/mp4/108/105/108105572/MP4/mod01lec03.mp4
  https://nptel.ac.in/courses/109106083

Unit IV

Semantic Analysis: Syntax-Driven Semantic Analysis. **Lexical Semantics**: Relations Among Lexemes and Their Senses, **WordNet:** A Database of Lexical Relations. **Word Sense Disambiguation and Information Retrieval:** Selection Restriction-Based Disambiguation, Robust Word Sense Disambiguation, Information Retrieval, Other Information Retrieval Tasks.

- **Pedagogy/Course Delivery tools:** Chalk-and-talk and Power Point Presentation
- **Links:** https://nptel.ac.in/courses/106105158
  https://nptel.ac.in/courses/106101007
  https://media.dev.nptel.ac.in/content/mp4/106/106/106106211/MP4/mod01lec03.mp4

Unit V

Discourse: Reference Resolution, Text Coherence, Discourse Structure. **Generation:** Introduction, Architecture, Surface Realization, Discourse Planning, **Machine Translation:** Language Similarities and Differences, Transfer Metaphor, Interlingua Idea, Direct Translation, Using Statistical Techniques.

- **Pedagogy/Course Delivery tools:** Chalk-and-talk and Power Point Presentation
- **Links:** https://onlinecourses.nptel.ac.in/noc20_cs87/preview
  https://onlinecourses.nptel.ac.in/noc20_cs87/preview
  https://nptel.ac.in/courses/106101007

Text Book:

1. Daniel Jurafsky and James H Martin, "Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Prentice Hall, 2nd Edition, 2013.

Reference Books:

1. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2015.
2. Steven Bird, Ewan Klein, Edward Loper, "Natural Language Processing with Python-Analyzing Text with the Natural Language Toolkit", O'reilly Publications , 2011.

Self-Learning:

Explore and demonstrate the functionalities of the following NLP tools by developing & executing relevant code snippets: NLTK, spaCy, TextBlob, VADER, Gensim, Word2Vec, FastText, GloVe, T5, BART, Ollama, LangChain, Whisper, Tesseract OCR, iNLTK, IndicBERT, Scikit-learn, Qiskit, PennyLane etc.

Course Outcomes(COs):

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

1. Explain and apply foundational concepts of speech and language processing, including morphological analysis using finite-state transducers and probabilistic language modelling with N-grams for handling ambiguity and linguistic variability. (PO-1,2,3,5,8,9; PSO-2)
2. Describe the role of part-of-speech tagging and context free grammar in performing spell checking and handling pronunciation-related tasks. (PO-1,2,3,5,8,9; PSO-2)
3. Analyse and implement feature-based and probabilistic parsing techniques, and represent linguistic meaning using formal logical approaches such as First Order Predicate Calculus and related semantic frameworks. (PO-1,2,3,5,8,9; PSO-2)
4. Apply semantic analysis techniques and lexical resources such as WordNet to perform word sense disambiguation and enhance information retrieval tasks through syntax-driven and sense-based approaches. (PO-1,2,3,5,8,9; PSO-2)
5. Analyse the structure and coherence of discourse through reference resolution and planning, and apply natural language generation and machine translation techniques to build intelligent language processing systems. (PO-1,2,3,5,8,9; PSO-2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	**Marks**	**Course outcomes attained**
Internal Test-I	30	CO1, CO2, CO3
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other Components		
NLP Tool Demonstration	10	CO1, CO2, CO3, CO4,CO5
MCQ Test	10	CO1, CO2, CO3, CO4,CO5
Semester-End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

Machine Learning Lab -2	
Course Code: ISL65	**Credits: 0:0:1**
Pre – requisites: ISL56, Machine Learning	**Contact Hours: 15P**
Course Coordinator: Dr. Lincy Meera Mathews	

1. Dataset URL:
https://archive.ics.uci.edu/ml/datasets/optical+recognition+of+handwritten+digits
(a) Visualize sample handwritten digit images and analyze feature patterns to understand pixel intensity distributions and class-wise variations that justify the use of neural network–based models.
(b) Build a handwritten digit classification model using the Multilayer Perceptron (MLP) method and implement a variant MLP with different hidden layer sizes to study the effect of network architecture on learning.
(c) Evaluate and compare the models using Accuracy and Confusion Matrix, and justify the best-performing configuration
2. Dataset URL:
https://archive.ics.uci.edu/ml/datasets/human+activity+recognition+using+smartphones
(a) Analyze and visualize sensor signal patterns and feature correlations to understand activity-wise variations that motivate the use of neural network classifiers.
(b) Develop an activity recognition model using the Multilayer Perceptron (MLP) method and implement a suitable variant to improve learning stability.
(c) Evaluate the model using Accuracy and Macro F1-score, and interpret the results.

3. Dataset URL: https://archive.ics.uci.edu/ml/datasets/breast+cancer+wisconsin+(diagnostic)
(a) Visualize feature distributions and relationships to understand differences between benign and malignant tumors and justify nonlinear classification.
(b) Build a classification model using the Multilayer Perceptron (MLP) method and apply hyperparameter tuning as a variant approach.
(c) Evaluate the models using Accuracy and ROC–AUC, and analyze the impact of tuning on performance.

4. Dataset URL: https://archive.ics.uci.edu/ml/datasets/heart+disease
(a) Analyze and visualize feature correlations and value distributions to identify factors influencing heart disease prediction.
(b) Develop a prediction model using a Neural Network and implement regularization techniques to reduce overfitting.
(c) Evaluate the model using Accuracy and Validation Loss, and justify the effectiveness of regularization.
5. Dataset URL: https://archive.ics.uci.edu/ml/datasets/sms+spam+collection
(a) Visualize word frequency patterns and class distribution to understand text characteristics influencing spam detection.
(b) Build a text classification model using a Recurrent Neural Network (RNN) and implement a variant using GRU.
(c) Evaluate the models using Accuracy, Precision, Recall, and F1-score, and compare their effectiveness.
6. Dataset URL: https://archive.ics.uci.edu/ml/datasets/sentiment+labelled+sentences
(a) Analyze and visualize sentiment class distribution to justify sequence-based modeling.
(b) Develop a sentiment classification model using LSTM and implement a Bidirectional LSTM variant.
(c) Evaluate the models using Accuracy and F1-score, and interpret the improvements achieved.

7. Dataset URL: https://archive.ics.uci.edu/ml/datasets/default+of+credit+card+clients
(a) Analyze and visualize class imbalance between defaulters and non-defaulters to understand the need for imbalance handling.
(b) Build a credit default prediction model using Random Forest and apply data balancing techniques including oversampling, undersampling, and SMOTE.
(c) Evaluate and compare models using Precision, Recall, F1-score, ROC–AUC, and PR–AUC, and justify the most effective approach
8. Dataset URL: https://archive.ics.uci.edu/ml/datasets/bank+marketing
(a) Visualize customer subscription patterns and numerical feature distributions to understand factors influencing term deposit subscription.
(b) Build a prediction model using a Bayesian classifier and implement Logistic Regression as a variant approach.
(c) Evaluate and compare the models using Accuracy and ROC–AUC, and justify the better-performing method.
9. Dataset URL: https://archive.ics.uci.edu/ml/datasets/spambase
(a) Analyze and visualize word frequency, character frequency, and capital run features to understand patterns distinguishing spam and non-spam emails.
(b) Develop a spam classification model using Naïve Bayes and implement Gaussian Naïve Bayes as a variant.
(c) Evaluate the models using Accuracy, Precision, Recall, and F1-score, and interpret the results.
10. Dataset URL:
https://archive.ics.uci.edu/ml/datasets/individual+household+electric+power+consumption
(a) Visualize time-series trends and seasonal patterns in power consumption data to justify sequence modeling.
(b) Build a forecasting model using LSTM and implement a GRU variant.
(c) Evaluate the models using RMSE, MAE, MAPE, and R^2 Score, and compare forecasting accuracy.
11. Dataset URL:
https://www.kaggle.com/datasets/zalando-research/fashionmnist
(a) Visualize sample fashion item images and analyze spatial patterns and pixel intensity variations to justify the need for convolution-based feature extraction.
(b) Develop an image classification model using a Convolutional Neural Network (CNN) and implement a variant by modifying the number of convolutional layers or filter sizes to study their effect on classification performance.
(c) Evaluate and compare the models using Accuracy and Confusion Matrix, and justify the effectiveness of CNNs over fully connected networks for image data.
12. Dataset URL:
https://archive.ics.uci.edu/ml/datasets/breast+cancer+wisconsin+(diagnostic)
(a) Analyze and visualize feature distributions to understand redundancy and correlations among attributes, motivating the need for representation learning.
(b) Build an Autoencoder-based model to learn compressed feature representations and implement a variant using a denoising autoencoder to improve robustness.
(c) Evaluate the reconstruction performance using Mean Squared Error (MSE) and analyze how learned representations can support dimensionality reduction or anomaly detection.

Self-Learning (Programming Assignment/ Case Study/ Project Based Learning/ MOOC based learning / GATE oriented aptitude test / Simulation):

Programming

Course Outcomes (COs):

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

1. Analyse and visualise diverse real-world datasets (images, text, tabular, and time-series) to understand data characteristics, patterns, class distributions, and feature relationships. (PO :1,2,4,5; PSO: 1,3)
2. Design and implement suitable machine learning and deep learning and their variants to solve classification and prediction problems using UCI benchmark datasets. (PO:1,5; PSO: 1,3)
3. Evaluate and compare the performance of implemented models using appropriate quantitative performance measures and interpret the results to identify the most effective model configuration. (PO:2,4,5,11; PSO: 1,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes attained**
Internal Test	20	CO1, CO2, CO3
Other Components		
Conduction, Calculation, Record and Viva	30	CO1, CO2, CO3
Semester-End Examination (SEE)	50	CO1, CO2, CO3

DevOps Lab	
Course Code: ISL66	**Credits: 0:0:1**
Pre – requisites: NIL	**Contact Hours: 15P**
Course Coordinator: Dr. Lincy Meera Mathews	

Course Content

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.
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.
   GitLab, Azure Boards, Gitea, Mattermost etc
4. **Continuous Integration Tools:** Explore tools to build and deploy the project.
   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 a project.
   Chef, Puppet, Ansible, Terraform, SaltStack, Azure Pipelines, etc
6. **Containerization:** Command to containerize the project application to ensure consistency and portability across different environments.
   Docker, Azure pipelines, rkt, podman etc.
7. **Orchestration:** Automate the process of performing containerised 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..

Text Book:

1. Aashikha Narasimhan, Roshan Sham, Harish Subramanian, A Beginner's Handbook To Devops, 2023.

2. Mikael Krief, Learning DevOps- A comprehensive guide to accelerating DevOps culture adoption with Terraform, Azure DevOps, Kubernetes, and Jenkins, Second Edition,2022.

3. Jennifer Davis and Ryn Daniels, Effective DevOps Building a Culture of Collaboration, and Tooling at Scale, 2016

Reference Books:

1. Milindanath Hewage, A Practical Guide to Azure DevOps Learn by doing Third Edition, 2016.

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)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	**Marks**	**Course Outcomes Attained**
Continuous Internal Evaluation	10	CO1, CO2, CO3
Quiz	10	CO1, CO2, CO3
Tool Demo for various stages of DevOps using Jenkins/Azure DevOps	30	CO1, CO2, CO3
The Final CIE out of 50 Marks = Marks Scored in Lab Test + Marks of Lab Record + Marks Scored in Quiz		
Semester-End Examination (SEE)	50	CO1, CO2, CO3

Data Analytics with Python	
Course code: 23ISOE01	**Credits: 3:0:0:3**
Prerequisites: NIL	**Contact Hours : 45L+45S**
Course coordinator(s): Dr Yogish H K	

Course Contents:

Unit I

Introduction to Data Analysis, Data Analytics and Data Interpretation: Why is Data Analytics Important? Types of Data Analytics - Descriptive, Diagnostic, Predictive, Prescriptive. Understanding the Nature of the Data. Types of Data, Data Analysis or Analytics lifecycle or stages. Tools Used in Data Analytics/analysis. Applications of Data Analytics. Complete Data Analytics Scenario. Quantitative and Qualitative Data Analysis. Open data. Role of Python in Data Analytics.

Introduction to Python Programming: Syntax, Keyboard input, variables, data types, operators and Expressions.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: https://youtu.be/ua-CiDNNj30?si=jPGQEekJarPJ-7bm
  https://youtu.be/t2_Q2BRzeEE?si=EnsOA_0HFX0MJUUE

Unit II

Control structures and Functions: loops and conditional statements. Functions and modules in Python, Conditionals and recursion: Stack diagrams for recursive functions, Infinite recursion, Fruitful functions: Return values, Incremental development, Composition, Boolean functions.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: https://youtu.be/t2_Q2BRzeEE?si=EnsOA_0HFX0MJUUE

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.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: https://youtu.be/Ctqi5Y4X-jA?si=jwAFElBZIQI5vT6x

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.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links : https://youtu.be/2IsF7DEtVjg?si=hG9nbo7vytxaBAjO

Unit V

Python libraries for data analytics: NumPy: Arrays, mathematical operations, array manipulation. Pandas: Data structures (Series, DataFrame), data manipulation, data alignment, indexing, grouping, merging , matplotlib. **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.

- Pedagogy/Course delivery tools:- Chalk and talk, Power Point Presentation, Videos, Jupyter notebook.
- Links: https://www.youtube.com/watch?v=eWRfhZUzrAc&t=1s
  https://www.youtube.com/watch?v=JXY7KGOZ89U

Text Books:

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

Reference Books:

1. Doing Data Science Cathy O'Neil and Rachel Schutt Straight Talk from The Frontline.O'Reilly 2014

Course outcomes:

The students will be able to

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

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes attained**
Internal Test-I	30	CO1, CO2, CO3
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other Components		
Project implementation	10	CO1, CO2, CO3, CO4, CO5
Project presentation and Report	10	CO1, CO2, CO3, CO4, CO5
Semester-End Examination (SEE)	100 (Scale down to 50 Marks)	CO1, CO2, CO3, CO4, CO5

Fundamentals of Database Management Systems	
Course Code: 23ISOE02	**Credits: 3:0:0:3**
Pre – requisites: NIL	**Contact Hours: 45L+45S**
Course Coordinator: Shanmuga Priya R	

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.

Pedagogy: PPT, Chalk and Talk Method

Links:

- https://nptel.ac.in/courses/106106220
- https://www.youtube.com/watch?v=OWX4RvijwLw&list=PLIwC9bZ0rmjSkm1VRJROX4vP 2YMIf4Ebh&index=3
- https://www.youtube.com/watch?v=rrG7azSlyWI&list=PLIwC9bZ0rmjSkm1VRJROX4vP2Y MIf4Ebh&index=4
- https://www.youtube.com/watch?v=DRSog3SA4Y&list=PLIwC9bZ0rmjSkm1VRJROX4vP2 YMIf4Ebh&index=5

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.

Pedagogy: PPT, Chalk and Talk Method

Links:

- https://www.youtube.com/watch?v=cx7rBTS2dBM&list=PLIwC9bZ0rmjSkm1VRJROX4vP2 YMIf4Ebh&index=12
- https://www.youtube.com/watch?v=pm_Tr3eZAac&list=PLIwC9bZ0rmjSkm1VRJROX4vP2 YMIf4Ebh&index=13
- https://www.youtube.com/watch?v=pm_Tr3eZAac&list=PLIwC9bZ0rmjSkm1VRJROX4vP2 YMIf4Ebh&index=14

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.

Pedagogy: PPT, Chalk and Talk Method

Links:

- https://www.youtube.com/watch?v=w1XdPholzWY&list=PLIwC9bZ0rmjSkm1VRJROX4vP 2YMIf4Ebh&index=6
- https://www.youtube.com/watch?v=ywUn5qNmxNo&list=PLIwC9bZ0rmjSkm1VRJROX4vP 2YMIf4Ebh&index=7

Unit IV

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

Pedagogy: PPT, Chalk and Talk

Links:

- https://www.youtube.com/watch?v=ywUn5qNmxNo&list=PLIwC9bZ0rmjSkm1VRJROX4vP 2YMIf4Ebh&index=8

Unit V

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

Pedagogy: PPT, Chalk and Talk Method

Links:

- https://www.youtube.com/watch?v=2tPNtnCfGzo&list=PLyqSpQzTE6M-xymXgqewlzcC3U4cdRoSu&index=24
- https://www.youtube.com/watch?v=Q5jbdZtnOjg&list=PLyqSpQzTE6MxymXgqewlzcC3U4cdRoSu&index=22

Text Book:

1. RamezElmasri and ShamkantB.Navathe: Fundamentals of Database Systems, 7th Edition, Addison-Wesley, 2016.
2. Benjamin Rosenzweig, Elena Silvestrova Rakhimov : Oracle PL/SQL by Example, 6th Edition, 2023.
3. https://www.tutorialspoint.com/mongodb/mongodb_tutorial.pdf

Reference Books:

1. Silberschatz, Korth, and Sudharshan: "Database System Concepts, Seventh Edition, Mc-GrawHill, 2019".
2. Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems, Third Edition", McGraw-Hill, 2003.
3. Kyle Banker Peter Bakkum Shaun Verch Douglas Garrett Tim Hawkins "MongoDB In Action 2nd Edition" , 2016

Self-Learning: (Programming Assignment/ Case Study/Project-Based Learning/MOOC-based learning / GATE-oriented aptitude test / Simulation):

The class assignment is provided twice during the semester.

Course Outcomes(COs):
At the end of the course, the student will be able to:

1. Understand the fundamental concepts of databases, the DBMS approach, data models, and the differences between SQL and NoSQL databases. (POs-1, 2, 3, 4, 5, 10, 12) (PSO- 1, 2)
2. Develop the ability to design databases using the Entity-Relationship (ER) model, including defining entities, relationships, and attributes, and translating ER diagrams into relational schemas. (POs-1, 2, 3, 4, 5, 9, 10, 11, 12) (PSO-1, 2, 3)
3. Gain proficiency in using SQL for defining, manipulating, and querying relational databases, as well as understanding relational database constraints and schema design. **(** POs-1, 2, 3, 4, 5, 9, 10, 11,12) (PSO-1, 2, 3)
4. Master advanced SQL techniques, including joins, subqueries, and views, and acquire practical knowledge of MongoDB, including CRUD operations and database management. (POs -1, 2, 3, 4, 5, 9,10, 11, 12) (PSO-1, 2, 3)
5. Understand and apply database normalization techniques, including functional dependencies and normal forms (1NF, 2NF, 3NF, BCNF), to design efficient and scalable relational schemas. (POs-1, 2, 3, 4, 5, 9, 10, 11, 12) (PSO-1, 2, 3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	**Marks**	**Course outcomes attained**
Internal Test-I	30	CO1, CO2, CO3
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other Components		
Class Assignment 1	10	CO1, CO2. CO3
Class Assignment 2	10	CO3, CO4, CO5
Semester-End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

MINI-PROJECT	
Course Code: ISP67	**Credits: 0:0:4**
Pre – requisites: Nil	**Contact Hours:60P**
Course Coordinator: Internal Guide	

Course Contents

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

Phases of Evaluation for CIE:

Phases	**Particulars**	**Marks(50)**
Phase-I	Acceptance of Problem Statement, Objectives and Expected Outcome.	10
Phase-II	Literature Review, Requirement Specifications, Design & Methodology, Partial Implementation of the project	20
Phase–III	Implementation, Testing, Conclusion & Future Enhancement, References, Demonstration of the Project.	20

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). (PSO - 1, 2, 3)

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)

RUBRICS FOR MINI PROJECT WORK

Maximum Marks: 50

Sl No	Performance indicators	Excellent	Good	Average	Poor
1.	**Identification of Problem Domain and Motivation (5)**	(1). Detailed and extensive explanation of the purpose and need of the project. (2). Detailed and extensive explanation of the specifications and the limitations of the existing system. (5 Marks)	Good explanation Of the purpose and need of the project. Collects a great deal of information and a good study of the existing systems. (3 Marks)	Average Explanation about the purpose and need of the project. A moderate study of the existing systems collects some basic information.(2 Marks)	Moderate explanation of the purpose and need of the project. The explanation of the specifications and the limitations of the existing systems is not very satisfactory, limited information. (1 Mark)
2.	**Novelty of Project(4)**	Demonstration of novel or unique and innovative ideas, designs, products, or approaches to generate new knowledge or creative works. The student has created their own design or product with originality.(4 marks)	Application of the existing ideas in the literature with some originality. • Attempts to create a novel or unique idea, design, product, or approach. • Reformulates an idea or collection of available ideas or approaches with very little originality shown. (2 marks)	Application of the existing ideas in the literature with some originality. • Attempts to create a novel or unique idea, design, product, or approach. • Reformulates an idea or collection of available ideas or approaches with very little originality shown.(1 mark)	Creativity and originality is very limited.

2	**Detailed analysis of Objectives (5)**	All objectives of the proposed work are well defined. (5 Marks)	A good justification for the objectives. (3 Marks)	Incomplete justification of the objectives proposed. (2 Marks)	Only some objectives of the Proposed work are well defined. (1 Mark)
3	**Literature survey (5)**	Relevant Information is gathered from multiple, research-based sources. Detailed conclusions are reached from the evidence offered (5 Marks)	Relevant Information is gathered from a limited number of sources. There is some indication of conclusions from the evidence offered. (3 Mark)	--	--
4.	**Methodology of Project Proposal (8)**	Steps to be followed to solve the defined problem are clearly specified. (8 Marks)	The methodology to be followed is specified but no detailed explanation. (6 Marks)	Steps are mentioned but unclear, without justification for objectives (3 Marks)	The steps to be followed to solve the defined problem are not specified properly. (2 Mark)
5.	**Communication Skills (5)**	The entire audience can hear the presentation; maintains eye contact with the audience; has a clear, expressive voice; is poised, has good posture, and has no distracting mannerisms. (5 Marks)	Most of the audience can hear the presentation; eye contact most of the time; clear voice, but not as expressive; a little nervous, not as polished. (3 Marks)	--	Difficult to hear; occasional eye contact; some mumbling, little or no expression; nervous, some distracting mannerisms; reads much of slide. (1 Mark)
6.	**Quality, appropriateness, and accuracy of project Implementation (8)**	Has decided on the relevant tools and platforms required for the project by evaluating the alternatives. Has coded all the components designed by the student by following the standard coding guidelines. The code is completely documented with comments. (8 marks)	Has coded all the components designed by the student by following the standard coding guidelines. The code is completely documented with comments. (6 marks)	Has coded more than 80% of the components designed by the student but has not followed the standard coding guidelines. The code is not documented well with comments. (4 marks)	Has coded less than 50% of the components designed by the student but has not followed the standard coding guidelines. The code is not documented with comments. (2 marks)

7.	**Interpreting the findings(5 marks) Or Deliverables**	Student provides a logical interpretation of the results and findings and clearly solves the problem (5 marks)	The student provides a logical but incomplete interpretation of the results and findings and clearly solves the problem (3 marks)	The student does not provide an interpretation of the results and findings but solves the problem. (2 marks)	The student does not interpret the findings / reach a conclusion (1 mark)
8.	**Individual Contribution (5 marks)**	Excellent Contribution showing his/her dependency on the project (5 Marks)		Some contributions as reflected in the overall work. (2 Mark)	

Performance Indicators for SEE	**Marks(50 M)**
Write – Up	10
Demonstration + Presentation	30
Viva-Voce	10

TECHNICAL SKILL ENHANCEMENT COURSE	
Course Code: IS68	**Credits: 0:1:0**
Pre – requisites: Operating system, DBMS, Computer Networks, Software Design Patterns, Object Oriented Concepts and Data Structures	**Contact Hours: 15T**
Course Coordinator: Dr. Lincy Meera Mathews	

Course Contents

Week 1 & 2: Data Structures & Algorithms

Quiz, Assignments, Project Based Learning on:

- Complexity, Arrays & Strings (sliding window, hashing, two pointers), Trees & Graphs (Algorithms), Dynamic Programming (Algorithms), Segment Trees, Fenwick Trees, Tries, Greedy vs Divide & Conquer vs DP Comparison.

Recommended Resources / Links/ Assignments:

1. LeetCode (Medium/Hard)
2. GeeksforGeeks Practice
3. Codeforces contests

Week 3 & 4: Computer Networks

Quiz, Assignments, Project Based Learning on:

- OSI vs TCP/IP, TCP vs UDP (congestion control, flow control, 3-way handshake, Routing protocols and algorithms, Subnetting, IPv4 vs IPv6., HTTP/1.1 → HTTP/2 → HTTP/3, Network Security basics (SSL/TLS, firewalls).

Recommended Resources / Links:

1. Wireshark packet analysis
2. Cisco Packet Tracer labs
3. Linux commands: netstat, ping, ss, traceroute

Week 5 & 6 : Database Management Systems

Quiz, Assignments, Project Based Learning on:

- Advanced SQL , Transactions & ACID, Indexing & Query optimization, Normalization vs Denormalization, Concurrency control: 2PL, Deadlocks, Recovery, Triggers, Stored Procedures, NoSQL basics

Recommended Resources / Links:

1. LeetCode DB problems
2. HackerRank SQL challenges
3. DB-Fiddle experiments

Week 7: Object-Oriented Programming

Quiz, Assignments, Project Based Learning on:

- Abstraction, Encapsulation, Inheritance, Polymorphism, Method Overloading vs Overriding, Abstract class vs Interface, Multiple inheritance, Static vs Dynamic binding, Heap vs Stack memory in OOP

Recommended Resources / Links:

1. GFG OOP Interview Questions
2. Implement mini-OOP design case studies in Java/Python

Week 8: Software Design Patterns

Quiz, Assignments, Project Based Learning on:

- Creational: Singleton, Factory, Structural: Adapter, Decorator, Behavioral: Observer, Strategy, SOLID principles, Clean code best practices, Low-level design

Recommended Resources / Links:

1. Refactoring Guru implementations
2. GitHub System Design Primer

Week 9–10: Operating Systems (Linux + Kernel Focus)

Quiz, Assignments, Project Based Learning on:

- Kernel: Monolithic vs Microkernel, System calls, Device drivers, Kernel space vs User space, Process Management: Scheduling , Memory Management: Paging, Segmentation, Virtual memory, Thrashing, Deadlocks, File Systems
- Linux/Ubuntu Specific:
    - Commands: ps, top, kill, chmod, chown, df, du, grep, awk, sed, nohup, jobs, fg/bg.
    - Signals: SIGKILL, SIGTERM, SIGSTOP.
    - Hard vs Soft links.
    - Package management: apt-get, dpkg.
    - Logs: dmesg, /var/log/.

Recommended Resources / Links:

1. Implement fork/exec programs in C.
2. Bash scripting basics.
3. Debugging with gdb on Linux.

Weeks 11–14: Capstone Projects

Quiz, Assignments, Project Based Learning on:

- Students to work on projects covering the topics mentioned above.

TUTORIALS

Assigned by the handling faculty each week.

Reference Books:

1. Aaron M. Tanenbaum, Yedidyah Langsam and Moshe J. Augenstein, “Data Structures Using C”, 2nd Edition, PHI
2. Reema Thareja, S. Rama Sree, Advanced Data Structures, Oxford University Press, 2017
3. Tanenbaum Computer Networks, Pearson Education; Sixth edition , 2022.
4. E Balagurusamy Object Oriented Programming With C++, 8th Edition
5. Erich Gamma. Design Patterns: Elements of Reusable Object Oriented Software, 2015
6. Rajiv Chopra. Operating Systems: A Practical Approach. S Chand Publishing; Fourth edition

Course Outcomes:

1. Apply core concepts of Data Structures, Computer Networks, Database Management Systems, Operating Systems, Object-Oriented Programming, and Software Design Patterns for real world computing problems. (PO -1,2,3,4,5,6,7,8,9,10,11) (PSO -1,2,3)
2. Exhibit problem-solving, critical thinking, and technical communication skills by engaging in coding challenges, assignments, and project-based learning activities aligned with professional practices (PO -1,2,3,4,5,6,7,8,9,10,11) (PSO -1,2,3)
3. Implement theoretical knowledge to practical and industry-relevant challenges. (PO -1,2,3,4,5,6,7,8,9,10,11) (PSO -1,2,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes attained**
Quiz, Assignments, Project Based Learning Assessment	30	CO1, CO2
Other Components		
Project Evaluation	20	CO3