RAMAIAH
Institute of Technology

CURRICULUM

Outcome Based Education

Academic year 2023 – 2024

ARTIFICIAL INTELLIGENCE
AND
MACHINE LEARNING

V & VI SEMESTER B.E.

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

About the Institute

Dr. M. S. Ramaiah a philanthropist, founded Gokula Education Foundation" in 1962 with an objective of serving the society. M S Ramaiah Institute of Technology (MSRIT) was established under the aegis of this foundation in the same year, creating a landmark in technical education in India. MSRIT offers 17 UG programs and 11 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 67% are doctorates. Some of the distinguished features of MSRIT are: State of the art laboratories, individual computing facility for all faculty members, all research departments active with sponsored funded projects and more than 300 scholars pursuing Ph.D. To promote research culture, the institute has established Centre of Excellence for Imaging Technologies, Centre for Advanced Materials Technology, Centre for Antennas and Radio Frequency systems (CARFS), Center for Cyber Physical Systems, Schneider Centre of Excellence & Centre for Bio and Energy Materials Innovation. **Ramaiah Institute of Technology has obtained "Scimago Institutions Rankings" All India Rank 107 & world ranking 600 for the year 2022.**

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

As per the National Institutional Ranking Framework (NIRF), MoE, Government of India, Ramaiah Institute of Technology has achieved 78th rank among 1314 top Engineering Institutions & 23rd Rank for School of Architecture in India for the year 2023.

About the Department

Year of Establishment	2021
Names of the Programme offered	UG: B.E. in Artificial Intelligence and Machine Learning

The Department of Artificial Intelligence and Machine Learning has eminent professor and faculty with the doctorate degree. The faculty has been publishing research papers in refereed journals and in conference proceedings. The department has state of the art laboratories and class rooms. Technical seminars, workshops and hackathons are conducted regularly for students. The department encourages the students to conduct and participate in extra-curricular/sports activities. The department conducts subjects with more of hands-on sessions and encourages students to take up MOOC based online courses in NPTEL, IIT Bombay, Coursera, Udacity and edX.

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 M. S. 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 provide quality technical education and research opportunities in the domain of Artificial Intelligence and Machine Learning and produce technical experts to face the challenges of present century

MISSION OF THE DEPARTMENT

1. To facilitate students in designing and developing systems, products or simulations using Artificial Intelligence and Machine Learning
2. To develop skills in graduates to become lifelong independent learners and be successful in industries, entrepreneur as well as research activities
3. To facilitate students with quality technical education through competitive curriculum along with communication skills and other soft skills for the overall development and attain sustainability.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

A B.E (Artificial Intelligence and Machine Learning) graduate of Ramaiah Institute of Technology should, within three to five years of graduation

PEO1: Develop intelligent software solutions using his/her education, constantly learning and contribute to the profession as an excellent employee or as an entrepreneur

PEO2: Be aware of the developments in the field of intelligent technology and promote research

PEO3: Demonstrate leadership qualities and work in interdisciplinary team in contributing to the betterment of the society

PROGRAMME OUTCOMES (POs):

The Outcomes of the Bachelor of engineering in Artificial Intelligence and Machine Learning Programme are as follows:

Engineering Graduates must be able to:

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

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

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

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

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

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

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

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

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

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

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

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

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO1: Understand the principles, architecture of computers, analysis, design and development of systems using concepts of Artificial intelligence & Machine Learning

PSO2: Apply the concepts of Artificial intelligence & Machine Learning to evaluate the results with appropriate tools and techniques

PSO3: Use Artificial Intelligence and Machine Learning models on data to develop software applications in emerging areas for better decision making

Semester wise Credit Breakdown for B.E Degree Curriculum
Batch 2021-25

Course Category \ Semester	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth	Total Credits
Basic Sciences (BSC)	08	08	03	03	--	--	--	--	22
Engineering Sciences (ESC)	09	11	--	--	--	--	--	--	20
Humanities, Social Sciences and Management (HSMC)	02	--	01	01	03	03	--	--	10
Ability Enhancement Course (AEC)	01	01	01	01	01	--	03	--	08
Universal Human Values (UHV)	--	--	02	--	--	--	--	--	02
Professional Core Courses (PCC)	--	--	11	12	11	05	04	--	43
Integrated Professional Core Course (IPCC)	--	--	03	03	03	--	04	--	13
Professional Elective Courses (PEC)	--	--	--	--	03	06	03	--	12
Institutional Open Elective Courses (IOE)	--	--	--	--	--	03	03	--	06
Internship (INT)	--	--	--	02	--	02	--	05	09
Mini Project / Project Work (PW)	--	--	--	--	--	03	03	09	15
Non Credit Mandatory Courses (NCMC)	--	--	Yes	--	Yes	--	--	--	--
Total Credits	20	20	21	22	21	22	20	14	160

SCHEME OF TEACHING V SEMESTER

Sl. No.	Course Code	Course Name	Teaching Department	Category	Credits				Total contact hours /week
					L	T	P	Total	
1	AI51	Introduction to Data Science	AIML	PCC	3	0	0	3	3
2	AI52	Operating Systems	AIML	IPCC	2	0	1	3	4
3	AI53	Natural Language Processing	AIML	PCC	3	0	0	3	3
4	AI54	Soft Computing	AIML	PCC	3	0	0	3	3
5	AIE55x	Program Elective Course – 1	AIML	PEC	3	0	0	3	3
6	AIL56	Natural Language Processing Laboratory	AIML	PCC	0	0	1	1	2
7	AIL57	Android Application Development Laboratory	AIML	PCC	0	0	1	1	2
8	AL58	Research Methodology & Intellectual Property Rights	AIML	HSMC	3	0	0	3	3
9	AEC510	Ability Enhancement Course-V		AEC	1	0	0	1	1
				Total				21	25
10	HS59	Environmental Studies *		NCMC	0	0	0	0	1

* Environmental Studies is under the category of NCMC, 1 hour teaching per week has to be allocated in the time table.

AIE55x: Program Elective Course – 1								
Course Code	Course Name	Teaching Department	Category	Credits				Total contact hours /week
				L	T	P	Total	
AIE551	Graph Theory	AIML	PEC	3	0	0	3	3
AIE552	Computer Vision	AIML	PEC	3	0	0	3	3
AIE553	Computer Organization and Architecture	AIML	PEC	3	0	0	3	3
AIE554	Advanced Algorithms	AIML	PEC	3	0	0	3	3
AIE555	Software Engineering and Project Management	AIML	PEC	3	0	0	3	3

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

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

Note: XXE55x, where x=1,2,3,4,5

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

Professional Elective Courses: A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course out of five courses. The minimum student's strength for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

Innovation/ Societal/ Entrepreneurship based Internship: At the End of fourth Semester four - weeks Summer Internship Shall Be Carried Out – Based On industrial/Govt./NGO/MSME/Rural Internship/Innovation/Entrepreneurship. Credited in fifth Semester. All the students admitted shall have to undergo mandatory internship of 04 weeks during the vacation of IV semester. A Viva-Voce examination shall be conducted during VI semester and the prescribed credit shall be included in VI semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared fail and shall have to complete during subsequent examination after satisfying the internship requirements.
AICTE Activity Points to be earned by students admitted to BE program (For more details refer to Chapter 6, AICTE, Activity Point Program, Model Internship Guidelines): Every regular student, who is admitted to the 4-year degree program, is required to earn 100 activity points in addition to the total credits earned for the program. Students entering 4 years" degree program through lateral entry are required to earn 75 activity points in addition to the total credits earned for the program. The activity points earned by the student shall be reflected on the students 8th semester grade card. The activities to earn the points can be spread over the duration of the course. However, minimum prescribed duration should be fulfilled. Activity points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression. Incase student fail to earn the prescribed activity points; 8th semester grade card shall be issued only after earning the required activity Points. Students shall be eligible for the award of degree only after the release of the 8th semester grade card.
The Non-Credit Mandatory Course The students shall attend classes for the course during the semester and complete all formalities of attendance and CIE. 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. This Course shall not be considered for vertical progression, but completion of the course shall be mandatory for the award of the degree.

SCHEME OF TEACHING VI SEMESTER

Sl. No.	Subject Code	Subject	Teaching Department	Category	Credits				Total contact hours /week
					L	T	P	Total	
1	AI61	Management & Entrepreneurship	Humanities	HSMC	3	0	0	3	3
2	AI62	Deep Learning	AIML	PCC	3	0	0	3	3
3	AIE63x	Program Elective Course – 2	AIML	PEC	3	0	0	3	3
4	AIE64x	Program Elective Course – 3	AIML	PEC	3	0	0	3	3
5	AIL65	Web Technologies Laboratory	AIML	PCC	0	0	1	1	2
6	AIL66	Deep Learning Laboratory	AIML	PCC	0	0	1	1	2
7	AIOE0x*	Institutional Open Elective – 1	AIML	IOE	3	0	0	3	3
8	AIP67	Mini Project	AIML	PW	0	0	3	3	-
9	INT68	Innovation/Societal/ Entrepreneurship based Internship	Humanities	INT	0	0	2	2	-
		Total						22	19

AIE63x: Program Elective Course – 2									
Sl. No.	Course Code	Course Name	Teaching Department	Category	Credits				Total contact hours /week
					L	T	P	Total	
1	AIE631	Statistical Machine Learning Algorithms	AIML	PEC	3	0	0	3	3
2	AIE632	Robotics Process Automation - Design and Development	AIML	PEC	3	0	0	3	3
3	AIE633	3D Printing	AIML	PEC	3	0	0	3	3
4	AIE634	Digital Signal Processing	AIML	PEC	3	0	0	3	3
5	AIE635	Business Intelligence	AIML	PEC	3	0	0	3	3

SI. No.	Course Code	Course Name	Teaching Department	Category	Credits				Total contact hours /week

AIE64x: Program Elective Course – 3

SI. No.	Course Code	Course Name	Teaching Department	Category	L	T	P	Total	Total contact hours /week
1	AIE641	Semantic Web and Ontology Engineering	AIML	PEC	3	0	0	3	3
2	AIE642	Edge Computing	AIML	PEC	3	0	0	3	3
3	AIE643	Optimization Techniques in Machine Learning	AIML	PEC	3	0	0	3	3
4	AIE644	Block Chain Technology	AIML	PEC	3	0	0	3	3
5	AIE645	Information Retrieval	AIML	PEC	3	0	0	3	3

AIOE0x*: Institutional Open Elective – 1

SI. No.	Course Code	Course Name	Teaching Department	Category	L	T	P	Total	Total contact hours /week
1	AIOE01	Introduction to Artificial Intelligence and Machine Learning	AIML	PEC	3	0	0	3	3
2	AIOE02	Robotics Process Automation - Design and Development	AIML	PEC	3	0	0	3	3
3	AIOE03	AI in Healthcare	AIML	PEC	3	0	0	3	3
4	AIOE04	Social Network Analysis	AIML	PEC	3	0	0	3	3
5	AIOE05	Data Visualization	AIML	PEC	3	0	0	3	3

Nomenclature, PCC: Professional Core Course**, PEC:** Professional Elective Courses, **IOE:** Institutional Open Elective, **PW:** Mini Project, **INT –**Internship
L –Lecture, T – Tutorial, P- Practical/ Drawing

Note: XXE63x , where x=1,2,3,4,5
        XXE64x , where x=1,2,3,4,5
        XXOE0x*, where x=1,2,..,… continued from previous

L –Lecture, T – Tutorial, P- Practical/ Drawing/ Project work
Professional Elective Courses: A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course out of five courses. The minimum student's strength for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.
Institutional Open Elective Courses: Students belonging to a particular stream of Engineering and Technology are not entitled for the open electives offered by their parent department. However, they can take an elective offered by other departments, provided they satisfy the prerequisite condition, if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. **Selection of an open elective shall not be allowed if,** 1. The candidate has studied the same course during the previous semesters of the program. 2. The syllabus content of open electives is similar to that of the Departmental core courses or professional electives. 3. A similar course, under any category, is prescribed in the higher semesters of the program. 4. The minimum students" strength for offering open electives is 10. However, this condition shall not be applicable to cases where the admission to the program is less than 10.
Mini-project work: Mini Project is a laboratory-oriented course which will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications. Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary

Mini- project can be assigned to an individual student or to a group having not more than 4 students.

CIE procedure for Mini-project:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of project report, project presentation skill, and question and answer session as per the rubrics defined by the department.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project.

The CIE marks awarded for the Mini-project, shall be based on the evaluation of project report, project presentation skill, and question and answer session as per the rubrics defined by the parent department.

SEE component for Mini-Project: SEE will be conducted by the two examiners appointed by the Institute. SEE marks awarded for the mini project shall be based on the evaluation of project work report, project presentation skill and question and answer session.

Research/Industrial Internship - At the end of sixth / seventh semester (in two cycles to accommodate all the students of the) Research/Industrial Internship shall be carried out – Based on Industrial/Govt./NGO/MSME/Rural Internship/Innovation/Entrepreneurship. All the students admitted shall have to undergo mandatory internship of 24 weeks during the vacation of VI/VII semesters. A Viva-Voce examination shall be conducted during VII semester and the prescribed credit shall be included in VII semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared fail and shall have to complete during subsequent examination after satisfying the internship requirements.

Research internship Students have to take up research internship at Centers of Excellence (CoE) / Study Centers established in the same institute and /or out of the institute at reputed research organization / Institutes. Research internship is basically intended to give you the flavor of current research going on in a particular topic/s. The internships serve this purpose. They help students get familiarized with the field, the skill needed the effort amount and kind of effort required for carrying out research in that field.

Industry internships: Is an extended period of work experience undertaken by /Institute students looking to supplement

their degree with professional development. The students are allowed to prepare themselves for the workplace and develop practical skills as well as academic ones. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with "unexpected contingencies" helps students recognize, appreciate, and adapt to organization realities by tempering knowledge with practical constraints.

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

Every regular student, who is admitted to the 4-year degree program, is required to earn 100 activity points in addition to the total credits earned for the program. Students entering 4 years" degree program through lateral entry are required to earn 75 activity points in addition to the total credits earned for the program. The activity points earned by the student shall be reflected on the students 8th semester grade card. The activities to earn the points can be spread over the duration of the course. However, minimum prescribed duration should be fulfilled. Activity points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression. Incase student fail to earn the prescribed activity points; 8th semester grade card shall be issued only after earning the required activity Points. Students shall be eligible for the award of degree only after the release of the 8th semester grade card.

Semester V

INTRODUCTION TO DATA SCIENCE

Subject Code: AI51	Credits: 3:0:0
Pre requisites: Basic Mathematics	Contact Hours: 42 L
Course Coordinator: Dr. Sowmya B J	

Course Content

Unit I

What is Data Science? Visualizing Data, matplotlib, Bar Charts, Line Charts, Scatterplots, Linear Algebra, Vectors, Matrices, Statistics, Describing a Single Set of Data, Correlation, Simpson"s Paradox, Some Other Correlational Caveats, Correlation and Causation. Probability, Dependence and Independence, Random Variables, Continuous Distributions, The Normal Distribution.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- Links: https://nptel.ac.in/courses/106106179
        https://nptel.ac.in/courses/106106212

Unit II

Statistical Hypothesis Testing, Example: Flipping a Coin, p-Values, Confidence Intervals, p-Hacking, Example: Running an A/B Test, Bayesian Inference, Gradient Descent, The Idea Behind Gradient Descent, Estimating the Gradient, Using the Gradient, Choosing the Right Step Size, Using Gradient Descent to Fit Models, Minibatch and Stochastic Gradient Descent,

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links**: https://nptel.ac.in/courses/106106179
        https://nptel.ac.in/courses/106106212

Unit III

Getting Data, stdin and stdout, Reading Files: The Basics of Text files, Delimited files, Scraping the Web, HTML and the Parsing Thereof, Example: Keeping Tabs on Congress, Using APIs, JSON (and XML), Using an Unauthenticated API, Finding APIs, Example: Using the Twitter APIs, working with Data, Exploring Your Data, Using Named Tuples, Data classes, Cleaning and Munging, Manipulating Data, Rescaling, An Aside: tqdm, Dimensionality Reduction.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links:** https://nptel.ac.in/courses/106106179
  https://nptel.ac.in/courses/106106212

Unit IV

Modeling, What Is Machine Learning? Overfitting and Underfitting, Correctness, The Bias-Variance Tradeoff, Feature Extraction and Selection, The Model, Example: The Iris Dataset, The Curse of Dimensionality, A Really Dumb Spam Filter, A More Sophisticated Spam Filter, Implementation, Testing Our Model, Using Our Model, The Model, Using Gradient Descent, Maximum Likelihood Estimation.

- **Pedagogy/Course delivery tools:** Chalk and talk, Power Point Presentation, Videos
- **Links:** https://nptel.ac.in/courses/106106179
  https://nptel.ac.in/courses/106106212

Unit V

Multiple Regression, The Model, Further Assumptions of the Least Squares Model, Fitting the Model, Interpreting the Model, Goodness of Fit, Digression: The Bootstrap, Standard Errors of Regression Coefficients, Regularization, Logistic Regression, The Problem, The Logistic Function, Applying the Model, Goodness of Fit. Random Forests, Clustering, The Idea, The Model, Example: Meetups, Choosing k, Example: Clustering Colors, Bottom-Up Hierarchical Clustering.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links:** https://nptel.ac.in/courses/106106179
  https://nptel.ac.in/courses/106106212

Suggested Learning Resources

Text Book:

1. Joel Grus, "Data Science from Scratch", 2nd Edition, O"Reilly Publications/Shroff Publishers and Distributors Pvt. Ltd., 2019. ISBN-13: 978-9352138326

Reference Books:

1. Emily Robinson and Jacqueline Nolis, "Build a Career in Data Science", 1st Edition, Manning Publications, 2020. ISBN: 978-1617296246.
2. **Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems", 2nd Edition, O'Reilly Publications/Shroff Publishers and Distributors Pvt. Ltd., 2019. ISBN-13: 978-1492032649.**
3. François Chollet, "Deep Learning with Python", 1st Edition, Manning Publications, 2017. ISBN-13: 978-1617294433
4. Jeremy Howard and Sylvain Gugger, "Deep Learning for Coders with fastai and PyTorch", 1st Edition, O'Reilly Publications/Shroff Publishers and Distributors Pvt. Ltd., 2020. ISBN-13: 978- 1492045526.
5. Sebastian Raschka and Vahid Mirjalili, "Python Machine Learning: Machine Learning and Deep Learning with Python, scikit-learn, and TensorFlow 2", 3rd Edition, Packt Publishing Limited, 2019.ISBN-13: 978-1789955750.

Course Outcomes (COs):

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

1. Demonstrate data using visualization tools. (PO-1,2,3,5,6,8, 12.PSO-2)
2. Interpret Statistical hypothesis tests to choose the properties of data, curate and manipulate data. (PO-1,2,3,4,5,8, 12.PSO-1,2)
3. Interpret the data and dimensionality reduction. (PO-1,2,3,5,6,8, 12.PSO-1,2)
4. Illustrate the machine learning algorithms and techniques to develop models. (PO-1,2,3,5,6, 12.PSO-1,2,3)
5. Demonstrate the construction of decision tree and data partition using clustering. (PO-1,2,3,5,6,8, 12.PSO-1,2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Internal Test-I (CIE-I)	30	CO1, CO2, CO3
Internal Test-II CIE-II)	30	CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Quiz	10	CO1, CO2, CO3
Assignment	10	CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz +Marks scored in Assignment		
Semester End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

OPERATING SYSTEMS

Subject Code: AI52	Credits: 2:0:1
Pre requisites: Nil	Contact Hours: 28L+14P
Course Coordinator: Dr. Vaneeta M	

Course Content

Unit I

What operating systems do, Operating System Structures, Operating System operations, Process management, Memory management, Storage management, Protection and security. **System Structures**- Operating System Services, System calls, Operating System design and implementation, Operating System structure, Virtual machines. **Process Management**

- Process concept, Process scheduling, Operations on processes, Inter-process communication

- **Pedagogy/Course delivery tools:** Chalk and talk, Power Point Presentation, Videos
- **Links:** https://nptel.ac.in/courses/106106144
  https://nptel.ac.in/courses/106102132
  https://www.youtube.com/watch?v=vBURTt97EkA

Unit II

Multi-threaded Programming: Overview; Multithreading models**,** Threading issues. **Process Scheduling**- Basic concepts, Scheduling criteria, Scheduling algorithms, Multiple-Processor scheduling. **Process Synchronization**-Background, The Critical section problem, Synchronization hardware, Semaphores, Classical problems of synchronization.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links:** https://nptel.ac.in/courses/106106144
  https://nptel.ac.in/courses/106102132
  https://www.youtube.com/watch?v=OrM7nZcxXZU

Unit III

Deadlocks- System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection and recovery from deadlock. **Memory Management Strategies**- Background, Swapping, Contiguous memory allocation, Paging, Structure of page table, Segmentation. **Virtual Memory Management**- Background, Demand paging, Page replacement,

Thrashing.

- **Pedagogy/Course delivery tools:** Chalk and talk, Power Point Presentation, Videos
- **Links:** https://nptel.ac.in/courses/106106144
  https://nptel.ac.in/courses/106102132
  https://www.youtube.com/watch?v=rWFH6PLOIEI

Unit IV

File System- File concept, Access methods, Directory structure, Protection. Implementing File System- File system structure, File system implementation, Directory implementation, Allocation methods, Free space management. Secondary Storage Structures-Mass storage structures, Disk structure, Disk scheduling.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links:** https://nptel.ac.in/courses/106106144
  https://nptel.ac.in/courses/106102132
  https://www.youtube.com/watch?v=Uro0GDMR2A8

Unit V

Dockers-Docker Basics and Architecture, what is containerization, how are containers different from physical machines and VMs, Docker evolution and architecture, Developments in Docker world, Docker tooling, Basic Docker commands. **Docker Networking**- Introduction, Types of Docker networks, Using Networks, Identifying container networks. **Docker Volumes**-Managing data in Docker containers with volumes, Volume file systems and basic Docker image file systems, Creating and managing volumes.

- **Pedagogy/Course delivery tools:** Chalk and talk, Power Point Presentation, Videos
- **Links:** https://nptel.ac.in/courses/106106144
  https://nptel.ac.in/courses/106102132
  https://docs.docker.com/

Text Book:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne: Operating System a Principles, 9th edition, Wiley-India, 2012.

Link:

1. URL: https://docs.docker.com/

Laboratory Component:

1. Working with Linux commands
2. Implementation of simple System programs
3. Implement CPU Scheduling algorithms
4. Illustrate producer consumer problem using semaphore
5. Illustrate Inter process communication using suitable method
6. Illustrate Bankers algorithm for deadlock avoidance
7. Develop Paging technique for memory management
8. Illustrate page replacement algorithms
9. Implement any two file allocation strategies
10. Working with Docker commands

Reference Books:

1. William Stallings: Operating systems Internals and Design Principles, Ninth Edition, Pearson Education, 2018.
2. Remzi H. Arpaci-Dusseau and Andrea C. Arpaci- Dusseau, Operating, systems: Three easy pieces,
3. URL: http://pages.cs.wisc.edu/~remzi/OSTEP/.
4. James Turnbull: The Docker Book: Containerization is the new virtualization Kindle Edition, Kindle Edition,2014**.**

Course Outcomes (COs):

At the end of the course students should be able to:

1. Describe operating system operations and operating system structures.(PO-1,2,3. PSO-1)
2. Assess different scheduling algorithms and concurrency control techniques to provide co-ordination among threads and processes. (PO-1,2,3,.4, 5.PSO-1,2)
3. Illustrate various methods for handling deadlocks and memory management Techniques. (PO-1,2,3,.4, 5.PSO-1,2)
4. Demonstrate different directory structure, file allocation methods and disk scheduling algorithms used for managing the disk. (PO-1,2,3,.4, 5.PSO-1,2)
5. Illustrate Dockers techniques for various networking and file system applications. (PO-1,2,3,.4, 5.PSO-1,2,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Internal Test-I (CIE-I)	30	CO1, CO2, CO3
Internal Test-II CIE-II)	30	CO3, CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Lab Test	10	CO1, CO2, CO3, CO4, CO5
Lab Record	10	CO1, CO2, CO3,CO4,CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Lab Test		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

NATURAL LANGUAGE PROCESSING

Subject Code: AI53	**Credits: 3:0:0**
Pre requisites: Python Programming	**Contact Hours: 42L**
Course Coordinator: Dr.A.Ajina	

Course Content

Unit I

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

- • **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- • **Links:** https://youtu.be/ICV5SMVvUwE
  https://youtu.be/aeOLjFe256E

Unit II

Word level and syntactic analysis: Word Level Analysis: Regular Expressions-Finite State Automata-Morphological Parsing-Spelling Error Detection and correction-Words. **Word classes-Part-of Speech Tagging**: Part-of- Speech Tagging, Rule-based Part-of-speech Tagging, Stochastic Part-of-speech Tagging, Transformation-Based Tagging;

- • **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- • **Links:** https://youtu.be/fv6Z3ZrAWuU
  https://youtu.be/y84W2ddg_tg
  https://archive.nptel.ac.in/courses/106/101/106101007/

Unit III

N-grams: Counting Words in Corpora, Smoothing, N-grams for Spelling and Pronunciation, Entropy; **Context Free Grammars for English:** Constituency, grammatical relations, Context Free Grammar. **Syntactic Parsing**: Parsing as Search.

- • **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- • **Links:** https://youtu.be/GiyMGBuu45w
  https://archive.nptel.ac.in/courses/106/101/106101007/

Unit IV

Discourse: Cohesion, Reference Resolution; **Generation:** Introduction to Language Generation, An Architecture for Generation; **Machine Translation**: Problems in Machine Translation, Characteristics of Indian Languages, Corpus based Machine Translation.

- **Pedagogy/Course delivery tools:** Chalk and talk, Power Point Presentation, Videos.
- **Links:** https://onlinecourses.nptel.ac.in/noc20_cs87/preview

Unit V

Information Retrieval and Lexical Resources: Information Retrieval: Design features of Information Retrieval Systems-Classical, Non classical, Alternative Models of Information Retrieval – valuation Lexical Resources: World Net-Frame Net- Stemmers-POS Tagger- Research Corpora.

- **Pedagogy/Course delivery tools:** Chalk and talk, Power Point Presentation, Videos.
- **Links:** https://onlinecourses.nptel.ac.in/noc20_cs87/preview

Suggested Learning Resources

Text Books:

1. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.
2. Daniel Jurafsky and James H Martin, "Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Prentice Hall, 2nd Edition, 2008.

Reference Books:

1. Anne Kao and Stephen R. Poteet (Eds), "Natural Language Processing and Text Mining", Springer-Verlag London Limited 2007.
2. James Allen, "Natural Language Understanding", 2nd edition, Benjamin/Cummings publishing company, 1995.
3. Gerald J. Kowalski and Mark.T. Maybury, "Information Storage and Retrieval systems", Kluwer academic Publishers, 2000.

Course Outcomes (COs):

At the end of the course, students will be able to:
1. Understand the importance of natural language applications and its need. (PO-1,2, 3, 5.PSO-1,2)
2. Analyze the natural language text and parse the grammar. (PO-1,2, 5.PSO-1,2)
3. Apply information retrieval techniques and machine translation on Indian languages. (PO-1,2,3,5, 7.PSO-1,2)
4. Illustrate the way N-gram tool is used for spelling and pronunciation processing, and part-of-speech tagging mechanism using various categories. (PO-1,2,3, 5.PSO-1,2)
5. Emphasize problems that NLP systems face, natural language outputs construction from non-linguistic inputs and machine translation framework approaches. (PO-1,2,3,4,5, 7.PSO-1,2,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Mark S**	**Course Outcomes (COs) Addressed**
Internal Test-I (CIE-I)	30	CO1, CO2
Internal Test-II CIE-II)	30	CO3, CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Programming Competition/ Hackathon/Codethon	20	CO1, CO2, CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in other component		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

SOFT COMPUTING	
Subject Code: AI54	**Credits: 3:0:0**
Pre requisites: Nil	**Contact Hours: 42L**
Course Coordinator: Dr. Jagadish S Kallimani	

Course Content

Unit I

Introduction: Neural networks, Fuzzy logic, Genetic algorithms, Hybrid systems, **Artificial Neural Networks**: Fundamental concept, Evolution, Basic model of ANN, Important terminologies of ANN, MP neuron, Hebb Network.

- • **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- • **Links:** https://nptel.ac.in/courses/106105173
  https://www.youtube.com/watch?v=K9gjuXjJeEM

Unit II

Supervised Learning Network: Perceptron Networks, Adaptive linear neuron, multiple adaptive linear neurons, Back propagation Network

- • **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- • **Links**: https://nptel.ac.in/courses/106105173

Unit III

Introduction to Fuzzy logic, classical sets and fuzzy sets: Classical sets, Fuzzy sets. Classical relations and fuzzy relations: Cartesian product of relation, Classical relation, Fuzzy relations, Tolerance and equivalence relations. Membership functions: Features, Fuzzification, methods of membership value assignments.

- • **Pedagogy/Course delivery tools:** Chalk and talk, Power Point Presentation, Videos
- • **Links**: https://nptel.ac.in/courses/106105173

Unit IV

Defuzzification: Lambda-cuts for fuzzy sets, Lambda-cuts for fuzzy relations, Defuzzification methods. Fuzzy decision making: Individual, multi person, multi objective, multi attribute, and fuzzy Bayesian decision making.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links:** https://nptel.ac.in/courses/106105173

Unit V

Genetic algorithms: Introduction, Basic operations, Traditional algorithms, Simple GA, General genetic algorithms, the schema theorem, Genetic programming, applications.

- **Pedagogy/Course delivery tools:** Chalk and talk, Power Point Presentation, Videos
- **Links:** https://nptel.ac.in/courses/106105173

Text Book:

1. Principles of Soft computing, S N Sivanandam, Deepa S. N, Wiley, India, (Chapters 1, 2, 3(Up to 3.5), 7, 8, 9, 10, 13, 15 (up to 15.6 & 15.9,15,10).

Reference Book:

1. Neuro-fuzzy and soft computing, J.S.R. Jang, C T Sun, E Mizutani, PHI (EEE edition) ISBN: 978-81-203-2243-1.

Course Outcomes (COs):

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

1. Describe various problems on artificial neural networks and familiarize all concepts on various networks and applications in them. (PO-1,2, 4.PSO-1,2)
2. Identify the compositions of neural networks, perceptrons and other networks. (PO-1,2,3, 4.PSO-1,2)
3. Examine various fuzzification techniques and practice them. (PO-1,2,3, 4. PSO-1,2)
4. Design problems and obtain crisp values from fuzzy data using defuzzification. (PO-1,2,3, 4.PSO-1,2)
5. Summarize various compositions and complexities of genetic algorithms. (PO-1,2,3, 4.PSO-1,2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	Marks	Course Outcomes (COs) Addressed
Internal Test-I (CIE-I)	30	CO1, CO2
Internal Test-II CIE-II)	30	CO3, CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Quiz	10	CO1, CO2, CO3
Assignment	10	CO3 CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz + Marks scored in Assignment		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

AIE55x*: Program Elective Course – 1

GRAPH THEORY	
Subject Code: AIE551	Credits: 3:0:0
Pre requisites: Nil	Contact Hours: 42L
Course Coordinator: Dr. Vinay T.R	

Course Content

Unit I

Introduction to Graph Theory: Definitions and Examples, Subgraphs, Complements, and Graph Isomorphism, Vertex Degree, Euler Trails and Circuits.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links:** https://digimat.in/nptel/courses/video/106108054/L17.html
  http://www.digimat.in/nptel/courses/video/111106102/L26.html

Unit II

Planar Graphs, Hamilton Paths and Cycles, Graph Colouring, and Chromatic Polynomials

- **Pedagogy/Course delivery tools:** Chalk and talk, Power Point Presentation, Videos
- **Links:** https://digimat.in/nptel/courses/video/106108054/L21.html
  https://www.youtube.com/watch?v=C0A-O1UVEdk

Unit III

Trees: Definitions, Properties, and Examples, Routed Trees, Trees and Sorting, Weighted Trees, and Prefix Codes

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links:** https://www.youtube.com/watch?v=fZqfkJ-cb28
  https://www.youtube.com/watch?v=0ZhwzXX_bp8

Unit IV

Optimization and Matching: Dijkstra‟s Shortest Path Algorithm, Minimal Spanning Trees – The algorithms of Kruskal and Prim, Transport Networks – Max-flow, Min-cut Theorem, Matching Theory

- **Pedagogy/Course delivery tools:** Chalk and talk, Power Point Presentation, Videos

- **Links**: https://onlinecourses.nptel.ac.in/noc22_cs17/preview
  http://www.digimat.in/nptel/courses/video/111106102/L11.html

Unit V

Fundamental Principles of Counting: The Rules of Sum and Product, Permutations, Combinations – The Binomial Theorem, Combinations with Repetition, The Catalon Numbers
- **Pedagogy/Course delivery tools:** Chalk and talk, Power Point Presentation, Videos
- **Links:** https://onlinecourses.nptel.ac.in/noc23_ma58/preview

Suggested Learning Resources

Text Book:

1. S.Arumugam and S.Ramachandran, "Invitation to Graph Theory", SCITECH Publications India Pvt. Ltd., 7/3C, Madley Road, T.Nagar, Chennai – 17

Reference Books:

1. **S.Kumaravelu, SusheelaKumaravelu, Graph Theory, Publishers, 182, Chidambara Nagar, Nagercoil-629 002.**
2. S.A.Choudham, A First Course in Graph Theory, Macmillan India Ltd.
3. Robin J.Wilson, Introduction to Graph Theory, Longman Group Ltd.
4. J.A.Bondy and U.S.R. Murthy, Graph Theory with Applications, Macmillon, London.

Course Outcomes (COs):

At the end of the course, the student should be able to:
1. Understand the basic concepts of graphs, directed graphs, and weighted graphs and able to present a graph by matrices. (PO-1,2, 3.PSO-1)
2. Identify the properties of trees. (PO-1,2, 3.PSO-1)
3. Apply Eulerian and Hamiltonian graphs for the suitable applications. (PO-1,2, 3.PSO-1,2)
4. Summarize the principles of counting in permutation and combination.(PO-1,2, 3.PSO-1,2)
5. Apply the knowledge of graphs to solve the real-life problem. (PO-1,2, 3,4, 5.PSO-1,2,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) Addressed**
Internal Test-I (CIE-I)	30	CO1, CO2
Internal Test-II CIE-II)	30	CO3, CO4
Average of the two CIE shall be taken for 30 marks		
Other Components		
Quiz	10	CO1, CO2
Assignment	10	CO3, CO4
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz +Marks scored in Assignment		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

COMPUTER VISION

Subject Code: AIE552	Credits: 3:0:0
Pre requisites: Nil	Contact Hours: 42L
Course Coordinator: Dr. Anita Kanavalli	

Course Content

Unit I

Introduction to Computer Vision: Image representation and analysis, Image Formation – geometric primitives and transformations, photometric image formation, digital camera, Image Processing – point operators, linear filtering, segmentation, Features and object recognition, Image segmentation.

- • **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- • **Links:** https://onlinecourses.nptel.ac.in/noc23_ee78/preview
  https://nptel.ac.in/courses/108103174

Unit II

Binary Machine Vision: Thresholding, hierarchical segmentation, spatial clustering, split & merge, rule-based segmentation, motion-based segmentation. Area Extraction: Concepts, Data-structures, Edge, Line-Linking, Hough transform, Line fitting, Curve fitting (Least-square fitting).

- • **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- • **Link:** https://nptel.ac.in/courses/117105101
  https://www.youtube.com/watch?v=vaS6rS8ZpkU

Unit III

Object motion and tracking, Optical flow and feature matching, Robot localization, Graph slam, Object detection, face recognition, instance recognition, category recognition, Stereo Correspondence – Epipolar geometry, correspondence, 3D reconstruction.

- • **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- • Links: https://www.youtube.com/watch?v=W5mLa8p9xaw
  https://www.youtube.com/watch?v=6hr6xpOU-uw

Unit IV

Image formation, projective geometry, lighting, Practical linear algebra, Image processing, descriptors, Image warping, Linear models with optimization.

- **Pedagogy/Course delivery tools:** Chalk and talk, Power Point Presentation, Videos
- **Links:** https://www.youtube.com/watch?v=IzXBT9GkzJ4
    https://archive.nptel.ac.in/courses/106/106/106106198/

Unit V

CNN architecture, Recurrent neural networks, Attention mechanisms, Image captioning, Neural networks, Applications of neural networks, Motion and flow, Single-view geometry, multi-view geometry, Applications, Course Project.

- **Pedagogy/Course delivery tools:** Chalk and talk, Power Point Presentation, Videos
- **Links:** https://nptel.ac.in/courses/108103174
    https://nptel.ac.in/courses/117105101

Suggested Learning Resources

Text Books:

1. Computer Vision: Algorithms and Applications by Richard Szeliski.
2. Szeliski R., "Computer Vision: Algorithms and Applications", Springer, 2010
3. Computer Vision: A Modern Approach (Second Edition) by David Forsyth and Jean Ponce.
4. Multiple View Geometry in Computer Vision (Second Edition) by Richard Hartley and Andrew Zisserman.

References:

1. Computer Vision - A modern approach, by D. Forsyth and J. Ponce, Prentice Hall Robot Vision, by B. K. P. Horn, McGraw-Hill.

Course Outcomes (COs):

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

1. Understand the fundamental image processing techniques required for computer vision. (PO-1,2, 3.PSO-1,2)
2. Understand the shape analysis. (PO-1,2, 3.PSO-1,2)
3. Understand motion related techniques and 3D vision techniques. (PO-1,2, 3.PSO-1,2)
4. Apply CNN concepts in computer vision. (PO-1,2, 3,4, 5.PSO-1,2,3)

5. Apply the knowledge of computer vision techniques to solve the real-life problem. (PO-1,2, 3,4, 5.PSO-1,2,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Internal Test-I (CIE-I)	30	CO1, CO2
Internal Test-II CIE-II)	30	CO3, CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Quiz	10	CO1, CO2, CO3
Assignment	10	CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz +Marks scored in Assignment		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

COMPUTER ORGANIZATION AND ARCHITECTURE

Subject Code: AIE553	Credits: 3:0:0
Pre requisites: Nil	Contact Hours: 42L
Course Coordinator: Mrs.Megha J	

Course Content

Unit I

Basic Structure of Computers: Basic Operational Concepts, Bus Structures, Performance – Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement. Machine Instructions and Programs: numbers, arithmetic operations and characters, Memory Location and Addresses, Memory Operations

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: https://youtu.be/4TzMyXmzL8M

Unit II

Instructions and Instruction Sequencing: register transfer notation, assembly language notation, basic instruction types, branching, condition codes, generating memory address, **Addressing Modes:** variables and constants, indirection and pointers, indexing and arrays, relative addressing, Basic Input and Output Operations

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: https://youtu.be/4TzMyXmzL8M

Unit III

Arithmetic unit: Multiplication of two numbers, A signed operand multiplication, Booth algorithm, Bit pair recoding and CSA – integer division, IEEE standard for floating point numbers, Operations, Guard bits and truncation.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: https://youtu.be/4TzMyXmzL8M

Unit IV

The Processor: Introduction, a basic MIPS Implementation, Logic Design Conventions: Clocking methodology, building a data path, an overview of pipelining: Designing instruction sets for pipelining, Pipeline hazards, Pipelined data path and control: Graphically representing pipelines, Data hazards: Forwarding versus stalling.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: https://youtu.be/4TzMyXmzL8M
  https://youtu.be/MIWTxHbPBA0

Unit V

Memory system: cache memory, mapping functions, replacement algorithms, Performance Considerations: interleaving, hit rate and miss penalty, virtual memories, address translation.

Input Output Unit: Accessing I/O devices, Interrupts: Interrupt hardware, Enabling and disabling of interrupts

Text Books:

1. Carl Hamacher, ZvonkoVranesic, SafwatZaky: Computer Organization, 5th Edition, Tata McGraw Hill, 2002.
2. David A. Petterson, John L. Hennessy: Computer Organization and Design, M.K Publishers, 4th edition, 2010
3. John L Hennessy, David A Patterson: Computer Architecture A Quantitative Approach, Elsevier, 5 th Edition 2012.

Reference Books:

1. W. Stallings: Computer Organization and Architecture: Designing For Performance, 8th edition, Prentice hall, 2012.
2. L L Wear: Computer - An introduction to hardware and software design, McGraw Hill international edition, 1991.

Course Outcomes (COs):

At the end of the course, the student should be able to:
1. Describe an overview of computer hardware and software which includes the basic functional units, interconnection (PO-1,2,3. PSO-1)
2. Illustrate Instruction sequencing and Addressing modes (PO-1,2,3. PSO-1).
3. Appraise different algorithms used to perform fast multiplication, division and to represent floating point numbers in binary. (PO-1,2,3,4. PSO-1)
4. Illustrate building a datapath for MIPS architecture and the advantages of pipelining to achieve instruction level parallelism. (PO-1,2,3.4, PSO-1,2)
5. Illustrate cache memory mapping techniques, various memory architectures and assessing the cache performance and Summarize the basics concepts of I/O, interrupts (PO-1,2,3.4, PSO-1,2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) Addressed**
Internal Test-I (CIE-I)	30	CO1, CO2
Internal Test-II CIE-II)	30	CO3, CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Quiz	10	CO1, CO2, CO3
Assignment	10	CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz +Marks scored in Assignment		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3, CO4,CO5

ADVANCED ALGORITHMS

Subject Code: AIE554	Credits: 3:0:0
Pre requisites: Design and Analysis of Algorithms	Contact Hours: 42L
Course Coordinator: Dr. Sowmya B J	

Course Content

Unit I

Analysis Techniques: Growth of Functions, Asymptotic notations, Standard notations and common functions, Recurrences and Solution of Recurrence equations – The Substitution method, The recurrence – tree method, The master method, Amortized Analysis: Aggregate, Accounting and Potential Methods.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links:** https://pages.cs.wisc.edu/~shuchi/cou res/787-F07/about.html https://www.youtube.com/watch?v=0JUN9aDxVmI&list=PL2SOU6wwxB0u P4rJgf5ayhHWgw7akUWSf

Unit II

Graph Algorithms: Bellman-Ford Algorithm, Single source shortest paths in a DAG, Johnson‟s Algorithm for sparse graphs, Maximum bipartite matching. Trees: B-trees, Red- Black trees. Hashing: General Idea, Hash Function, Separate Chaining, Open addressing, Rehashing, Extendible hashing.

- **Pedagogy/Course delivery tools:** Chalk and talk, Power Point Presentation, Videos
- **Links:** https://pages.cs.wisc.edu/~shuchi/cou res/787-F07/about.html https://www.youtube.com/watch?v=tWVWeAqZ0WU

Unit III

Number – Theoretic Algorithms: Elementary notations, GCD, Modular Arithmetic, Solving modular linear equations, The Chinese remainder theorem, Powers of an element, RSA cryptosystem. Heaps: Heaps, Priority Queues, Binomial Heaps, Fibonacci Heaps.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links:** https://pages.cs.wisc.edu/~shuchi/cou res/787-F07/about.html https://www.youtube.com/watch?v=0JUN9aDxVmI&list=PL2SOU6wwxB0u P4rJgf5ayhHWgw7akUWSf

Unit IV

String Matching Algorithms: Naïve string matching, Rabin – Karp algorithm, String matching with finite automata, Knuth-Morris-Pratt algorithm, Boyer- Moore Algorithms.

- • **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- • Links: https://pages.cs.wisc.edu/~shuchi/cou res/787-F07/about.html
    https://www.youtube.com/watch?v=NkivfrexTw8

Unit V

Algorithmic Puzzles: Magic Square, n-queens problem, Glove Selection, Ferrying Soldiers, Jigsaw Puzzle Assembly, A Stack of Fake Coins, Maximum Sum Descent, Hats of Two Colors, Pluses and Minuses, Searching for a Pattern, Locker Doors, Palindrome Counting, Inverting a Coin Triangle, Sorting 5 in 7.

- • **Pedagogy/Course delivery tools**: Chalk and talk, Power PointPresentation, Videos
- • **Links:** https://pages.cs.wisc.edu/~shuchi/cou res/787-F07/about.html

Suggested Learning Resources

Text Books:

1. T H Cormen, C E Leiserson, R L Rivest and C Stein: Introduction to Algorithms 3/e, PHI, 2011.
2. Mark Allen Weiss: Data Structures and Algorithm Analysis in C++, 3rd Edition, Pearson Education, 2011.
3. Anany Levitin and Maria Levitin: Algorithmic Puzzle, Oxford University Press, 2011.

Reference Books:

1. Ellis Horowitz, Sartaj Sahni, S Rajasekharan: Fundamentals of Computer Algorithms, University Press, 2007.
2. Alfred V Aho, John E Hopcroft, J D Ullman: The Design and Analysis of Computer Algorithms, Pearson Education, 2011.

Course Outcomes (COs):

At the end of the course the student will be able to:
1. Devise recurrence relations and amortized cost of various operations. (PO-1,2, 3, 4.PSO-1,2,3)
2. Illustrate graph algorithms such as Bellman-Ford, Shortest path, and bipartite matching, B-trees, Red-Black trees and hashing techniques. (PO-1,2, 3, 4.PSO-1,2,3)
3. Identify the methods for solving modular linear equations, Chinese remainder theorem and RSA cryptosystem, Describe types of heaps such as Binomial and Fibonacci heaps. (PO-1,2, 3, 4, 5.PSO-1,2,3)
4. Assess the string-matching algorithms such as Boyer-Moore and Knuth-Morris- Pratt algorithm. (PO-1,2, 3, 4, 5.PSO-1,2,3)
5. Create mathematical models, objective functions and constraints to solve algorithmic puzzles. (PO-1,2, 3, 4, 5.PSO-1,2,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	Marks	Course Outcomes (COs) addressed
Internal Test-I (CIE-I)	30	CO1, CO2
Internal Test-II CIE-II)	30	CO3, CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Programming Competition/ Hackathon/Codethon	20	CO1, CO2, CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in other component		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

SOFTWARE ENGINEERING AND PROJECTMANAGEMENT

Subject Code: AIE555	Credits: 3:0:0
Pre requisites: Nil	Contact Hours: 42L
Course Coordinator: Mrs. Swetha B N	

Course Content

Unit I

Introduction: Some Basic Definitions and terminology, the processes and activities of software configuration management, configuration status accounting, configuration audit, software configuration management in geographically distributed teams, Metrics in software configuration management, software configuration management tools and automation. Software Crisis, Need for Software Engineering. Professional Software Development, Software Engineering Ethics. Case Studies. **Software Processes:** Models: Waterfall Model, Incremental Model and Spiral Model, Process activities. **Requirements Engineering:** Requirements Engineering Processes, Functional and non-functional requirements, Requirements validation, Requirements Management.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Link:** https://youtu.be/AN5I6fFxyfs
  https://rb.gy/84l71 https://rb.gy/pzzb0

Unit II

Introduction, Modelling Concepts and Class Modelling: What is Object orientation? What is OO development? OO Themes; Evidence for usefulness of OO development; OO modelling history. Modelling as Design technique: Modelling; abstraction; The Three models. Class Modelling: Object and Class Concept; Link and associations concepts; Generalization and Inheritance; A sample class model; Navigation of class models;

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Link:**
  https://youtu.be/0lhVNEf1QeQ?list=PLrgz73xxhUkPBK2de3CuRb7F3zKh_sqUp

Unit III

System Models: Context models, Interaction models. Structural models. Behavioral models, Model-driven engineering. Design and Implementation: Introduction to RUP, Design Principles. Object-oriented design using the UML. Design patterns. Implementation issues. Open-source development.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Link:** https://rb.gy/33hxs

Unit IV

MONITORING AND CONTROL: Creating the Framework, Collecting the Data, Review, Project Termination Review, Visualizing Progress, Cost Monitoring, Earned Value Analysis, Prioritizing Monitoring, Getting Project Back to Target, Change Control, Software Configuration Management.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Link:** https://rb.gy/s3a33
       https://rb.gy/0hxjjhttps://rb.gy/oi85v

Unit V

MANAGING PEOPLE AND WORKING IN TEAMS: Introduction, Understanding Behaviour, Organizational Behaviour: A Background, Selecting the Right Person for the Job, Instruction in the Best Methods, Motivation, The Oldham–Hackman Job Characteristics Model, Stress– Health and Safety Working In Teams, Becoming a Team, Decision Making, Leadership.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Link:** https://youtu.be/ZKOL-rZ79gs
       https://www.youtube.com/watch?v=XNDePDD_CV4
       https://youtu.be/5d16JwWwjKo

Text Books:

1. Ian Sommerville: Software Engineering, 9th Edition, Pearson Education, 2012.
2. Michael Blaha, James Rumbaugh: Object Oriented Modelling and Design with UML,2nd Edition, Pearson Education,2005.
3. Bob Hughes, Mike Cotterell, Rajib Mall, "Software Project Management", Fifth Edition, TataMcGrawHill,2011.

Reference Books:

1. Roger S. Pressman: Software Engineering-A Practitioners approach, 7th Edition, Tata McGraw Hill.
2. Pankaj Jalote: An Integrated Approach to Software Engineering, Wiley India
3. "Accounting for Management" Jawaharlal, 5th Edition, Wheeler Publications, Delhi.
4. Jack Marchewka," Information Technology- Project Management", Wiley Student Version,4th Edition,2013.
5. James P Lewis," Project Planning, Scheduling & Control", McGrawHill,5th Edition, 2011.

Course Outcomes (COs):

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

1. Design a software system, component, or process to meet desired needs within realistic constraints. (PO-1,2, 3, 4, 5, 6.PSO-1,2)
2. Understand professional and ethical responsibility. (PO-1,2, 3, 4, 5.PSO-1,2,3)
3. Apply function on multi-disciplinary teams. (PO-1,2, 3, 4, 5.PSO-1,2,3)
4. Apply the practices and methods for successful software project management. (PO-1,2, 3, 4, 5.PSO-1,2,3)
5. Identify techniques for requirements, policies and decision making for effective resource management. (PO-1,2, 3, 6.PSO-1,2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) Addressed**
Internal Test-I (CIE-I)	30	CO1, CO2
Internal Test-II CIE-II)	30	CO3, CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Quiz	10	CO1, CO2, CO3
Assignment	10	CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz +Marks scored in Assignment		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

NATURAL LANGUAGE PROCESSING LABORATORY

Subject Code: AIL56	**Credits: 0:0:1**
Pre requisites: Python Programming	**Contact Hours: 14P**
Course Coordinator: Dr. A.Ajina	

Course Content

Sl. No.	Topics Covered
1.	Installation of libraries NLTK on Python, basic commands to access text
2.	Perform Preprocessing (Tokenization, Stop word removal and stemming) of Text
3.	Perform Removal of regular expression pattern from textual data
4.	Perform Morphological Analysis
5.	Implement N-Gram Model
6.	Implement Part-of-Speech (POS) Tagging
7.	Implement Chunking to extract Noun Phrases
8.	Identify semantic relationships between the words from given text
9.	Case study 1: Identify the Sentiment of tweets
10.	Case study 2: Detect hate speech in tweets

Note: Each Lab Session is of two hours duration/week

Suggested Learning Resources

Text Book:

1. Steven Bird, Ewan Klein and Edward Loper: Natural Language Processing with Python 9th Edition, O"REILLY, 2019.

Reference Books:

1. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.
2. Daniel Jurafsky and James H Martin, "Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Prentice Hall, 2nd Edition, 2008.

Course Outcomes (COs):

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

1. Understand and Apply fundamental Concept of Natural Language Text Processing in real time scenario. (PO-1,2,3, 4, 5,9, 12.PSO-1,2,3)
2. Apply Morphological analysis on Natural Language Text. (PO-1,2,3, 4, 5, 9, 12.PSO-1,2,3)
3. Identify Semantic relationships between words using semantic analysis. (PO-1,2,3, 4, 5, 9, 12.PSO-1,2,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) Addressed**
Lab Test-I	10	CO1, CO2
Lab Test-II	10	CO3
Weekly Evaluation-Lab Record	30	-
The Final CIE out of 50 Marks = Marks of Lab Record + Marks scored in Lab Test-I + Marks scored in Lab Test-II		
Semester End Examination (SEE)		
Course End Examination (One full question from the Lab Question Bank, Programs will be coded using C and executed)	50	CO1, CO2, CO3

ANDROID APPLICATION DEVELOPMENT LABORATORY	
Subject Code: AIL57	**Credits: 0:0:1**
Pre requisites: Java Programming	**Contact Hours: 14P**
Course Coordinator: Mr. Amruthesh S M	

Course Content

Experiments that are to be conducted as a part of the course:

1. Introducing different Android development tools and developing Hello World application.
2. Develop an android application to investigate the activity life cycle.
3. Develop an android application to investigate the fragments.
4. Develop an android application to create user interfaces with different layouts and views.
5. Develop an android application to create a Registration form using appropriate widgets.
6. Develop an android application to embed Picker Views in an activity.
7. Develop an android application on using implicit & explicit Intents.
8. Develop an android application to utilize Action bar.
9. Develop an android application to utilize Toasts and Notifications.
10. Develop an android application to work SQLite data storage and create a table.
11. Develop an android application to work SQLite data storage and perform various operations on the table.
12. Develop an android application to introduce content providers.
13. Developing applications to work with messaging and telephony services.
14. Develop an android application for creating location-based service.

Suggested Learning Resources

Text Books:

1. Professional Android 4 Application Development, by Reto Meier, WROX Press, Wiley Publishing.
2. Hello Android, Introducing Google‟s Mobile Development Platform, 3rd Edition, by Ed Burnette, Pragmatic Programmers, LLC.ISBN-10: 1-934356-56-5, ISBN-13: 978-1-934356-56-2

3. https://developer.android.com/training/index.html
4. http://www.codelearn.org/android-tutorial

Reference Books:

1. Android Application Development, Programming with the Google SDK, by, Rick Rogers, John Lombardo, Zigurd Mednieks, Blake Meike, SPD, Oreilly, ISBN10: 81-8404-733-9, ISBN13:978-81-8404-733-2
2. R2. Hello Android, Introducing Google‟s Mobile Development Platform, 3rd Edition, by Ed Burnette, Pragmatic Programmers, LLC.ISBN-10: 1-934356-56-
    5, ISBN-13: 978-1-934356-56-2

Course Outcomes (COs):

At the end of the course, the student will be able to:
1. Identify the various aspects of android platform, different android developer tools and activity life cycle, views and view groups. (PO-1,3, 5, 9, 12.PSO-1,2,3)
2. Demonstrate the usage of intents, menu creation and SQLite database to perform different. (PO-1,3, 5, 9, 12.PSO-1,2,3)
3. Develop the Android applications using SMS services, Telephony services. (PO-1,3, 5, 9, 12.PSO-1,2,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Lab Test-I	10	CO1, CO2
Lab Test-II	10	CO3
Weekly Evaluation-Lab Record	30	-
The Final CIE out of 50 Marks = Marks of Lab Record + Marks scored in Lab Test-I + Marks scored in Lab Test-II		
Semester End Examination (SEE)		
Course End Examination (One full question from the Lab Question Bank, Programs will be coded using C and executed)	50	CO1, CO2, CO3

RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHTS	
Subject Code: AL58	**Credits: 3:0:0**
Pre requisites: Nil	**Contact Hours: 42L**
Course Coordinator: Dr. Jagadish S Kallimani	

Course Content

Unit I

Research Methodology

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

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

Unit II

Research Design: Need for Research Design, Important Concepts Related to Research Design: Dependent and Independent Variables, Extraneous Variable, Variable, Common Control, Confounded Relationship, Research Hypothesis, Experimental and Control Groups, Treatments. **Experimental Designs:** Introduction to Randomised Block Design, Complete Randomised Design, Latin Square Design, and Factorial Design.

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

Unit III

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

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

Unit IV

Intellectual Property Rights

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

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

Unit V

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

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

Text Books:

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

Reference Book:

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

Course Outcomes (COs):

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

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcome attained**
Internal test – 1	30	CO1, CO2, CO3
Internal test – 2	30	CO4, CO5
The average of the two internal tests will be taken for 30 marks		
Other Components		
Assignment	10	CO1, CO2
Quiz	10	CO3, CO4, CO5
Semester End Examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

ABILITY ENHANCEMENT COURSE - V

Subject Code: AEC510	**Credits: 1:0:0**
Pre requisites: Nil	**Contact Hours: 14L**
Course Coordinator: Teaching Dept.	

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

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

ENVIRONMENTAL STUDIES

Course Code: HS59	Credits: 0:0:0
Pre – requisites: Nil	Contact Hours: 14L
Course Coordinator:	

Course Content

Unit I

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

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

Unit II

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

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

Unit III

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

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

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

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

Unit V

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

- Pedagogy/Course delivery tools: Chalk and Talk, Power pointpresentations, Opens source softwares
- Link: https://youtu.be/iV-BvYwl4Y8
    https://youtu.be/BYqLRGawoH0

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

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

Web links and video Lectures (e- Resources):
1. https://youtu.be/I_bnGkviWOU
2. https://youtu.be/vsXv3anIBSU
3. https://youtu.be/mh51mAUexK4
4. https://youtu.be/NRoFvz8Ugeo
5. https://youtu.be/iV-BvYwl4Y8

Course Outcomes (COs):
At the end of the course, the student will be able to:
1. Describe the importance of environmental studies, sustainable development and biodiversity (PO-1, 7)
2. Explain the importance and conservation of impacts of natural resources (PO-1, 7)

3. Distinguish the energy sources and identify the alternative energy sources for sustainable development (PO-1, 7)
4. Identify the causes, effects and control measures of pollution in developmental activities (PO-1, 7)
5. Outline the current environmental issues and the role of the agencies for environmental protection (PO-1, 7)

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	CO4, CO5
Average of the two internal test shall be taken for 30 marks		
Other components		
Assignment – MCQ, Objectives	10	CO1, CO2
Assignment – Quiz, Group presentation	10	CO3, CO4
Semester End Examination (SEE)	50	CO1, CO2, CO3, CO4, CO5

MANAGEMENT & ENTREPRENEURSHIP

Course Code: AI61	Credits: 3:0:0
Pre – requisites: Nil	Contact Hours: 42L
Course Coordinator: Dr. M Rajesh/Dr. Siddhartha kar	

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, Power Point Presentation, Videos
- • **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, Power Point Presentation, Videos
- • **Links:** https://nptel.ac.in/courses/110107150
  https://digimat.in/nptel/courses/video/110104068/L01.html

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, Power Point Presentation, Videos
- **Links:**
  https://youtu.be/Hgj_kRrvbhQ?list=PL7oBzLzHZ1wXW3mtolxV5nIGn48NLKwrb
  https://youtu.be/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.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links:**
  https://www.youtube.com/watch?v=Tzzfd6168jk&list=PLyqSpQzTE6M8EGZbmNUuUM7Vh2GkdbB1R
  https://youtu.be/9kbZnFYDYIs?list=PL7oBzLzHZ1wXW3mtolxV5nIGn48NLKwrb

Unit V

Launching the Business: Franchising and the Entrepreneur: Types of Franchising, The benefits of buying a Franchise; E-Commerce and the Entrepreneur: Factors to consider before launching into E-commerce, Ten Myths of E-Commerce.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links:**
  https://www.youtube.com/watch?v=5RMqxtMwejM&list=PLyqSpQzTE6M9zMKj_PSm81k9U8NjaVJkR
  https://www.youtube.com/watch?v=0apynSCov-4&list=PL7oBzLzHZ1wXW3mtolxV5nIGn48NLKwrb&index=32

Suggested Learning Resources

Text Books:

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

References

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

Course Outcomes (COs):

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

1. Plan and organize for the manpower in the given type of organization (PO- 6,9, 11.PSO-3)
2. Use staffing Leading and controlling function for the given organization. (PO: 6,8,9,10. PSO-3)
3. Understand the fundamentals of entrepreneurship with the goal of fulfilling the requirements of the industries and holding the responsibilities towards the society. (PO-6,7,8. PSO-3)
4. Design a basic business plan by considering case studies and show the involvement of ownership in Business. (PO-3,7,8,11. PSO-3)
5. Start a new small business with the help of E-Commerce and the current available technologies. (PO-5,11. PSO-3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) Addressed**
Internal Test-I (CIE-I)	30	CO1, CO2, CO3
Internal Test-II CIE-II)	30	CO3, CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Quiz -I	10	CO1, CO2, CO3
Assignment	10	CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz-I +Marks scored in Assignment		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

DEEP LEARNING	
Course Code: AI62	**Credits: 3:0:0**
Pre – requisites: Java Programming	**Contact Hours: 42L**
Course Coordinator: Dr. Jagadish S Kallimani	

Course Content

Unit I

Introduction: What is a Neural Network? The Human Brain, Models of a Neuron, Neural Networks Viewed as Directed Graphs, Feedback, Network Architectures, Rosenblatt's Perceptron: Introduction, Perceptron, The Perceptron Convergence Theorem, Relation Between the Perceptron and Bayes Classifier for a Gaussian Environment.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links:** https://onlinecourses.nptel.ac.in/noc20_cs62/preview

Unit II

Multilayer Perceptrons: Introduction, Batch Learning and On-Line Learning, The Back-Propagation Algorithm, XOR Problem, Heuristics for Making the Back-Propagation Algorithm Perform Better, Back Propagation and Differentiation.

- **Pedagogy/Course delivery tools:** Chalk and talk, Power Point Presentation, Videos
- **Links:** https://onlinecourses.nptel.ac.in/noc20_cs62/preview

Unit III

Regularization for Deep Learning: Parameter Norm Penalties - L2 Parameter Regularization, Dataset Augmentation, Semi-Supervised Learning. Optimization for Training Deep Models: Challenges in Neural Network Optimization – Ill Conditioning, Local Minima, Plateaus, Saddle Points and Other Flat Regions.

- **Pedagogy/Course delivery tools:** Chalk and talk, Power Point Presentation, Videos
- **Links**: https://onlinecourses.nptel.ac.in/noc20_cs62/preview

Unit IV

Convolution neural networks: The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution

Algorithms, Convolutional Networks and the History of Deep Learning.

- **Pedagogy/Course delivery tools:** Chalk and talk, Power Point Presentation, Videos
- **Links**: https://onlinecourses.nptel.ac.in/noc20_cs62/preview

Unit V

Sequence Modeling: Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, The Long Short-Term Memory and Other Gated RNNs

- **Pedagogy/Course delivery tools:** Chalk and talk, Power Point Presentation, Videos
- **Links**: https://onlinecourses.nptel.ac.in/noc20_cs62/preview

Suggested Learning Resources

Text Books:

1. Simon Haykin, Neural networks and Learning Machines, Third Edition, Pearson, 2016
2. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016.

Reference Book:

1. Neural Networks and Deep Learning by Michael Nielsen http://neuralnetworksanddeeplearning.com/

Course Outcomes (COs):

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

1. Illustrate the concepts and applications of neural networks and deep learning. (PO-1,2,3, 4.PSO-1)
2. Illustrate various types of learning work and its applications. (PO-2,3, 4.PSO-2)
3. Illustrate the Regularization and Optimization for Deep learning. (PO-2,3, 4.PSO-2)
4. Apply deep feed forward networks and convolutional to solve practical problems. (PO-1,2,3, 4, 5.PSO-3)
5. Demonstrate recurrent, recursive nets function and practical problems can be mapped to these functions. (PO-3,4, 5.PSO-3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) Addressed**
Internal Test-I (CIE-I)	30	CO1, CO2
Internal Test-II CIE-II)	30	CO3, CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Programming Competition/ Hackathon/Codethon	20	CO1, CO2, CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in other component		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit-Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

AIE63x*: Program Elective Course – 2

STATISTICAL MACHINE LEARNING ALGORITHM	
Course Code: AIE631	**Credits: 3:0:0**
Pre – requisites: Basics of linear algebra, probability, statistics algorithm design and analysis	**Contact Hours: 42L**
Course Coordinator: Dr.A.Ajina	

Course Content

Unit I

Classifications -KNN, Bayes Classifier, Naïve Bayes Classifier, Logistic Régression and SVM.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links:** https://youtu.be/uFydF-g-AJs

Unit II

Clustering-K-means, GMM, Spectral clustering

- **Pedagogy/Course delivery tools:** Chalk and talk, Power Point Presentation, Videos
- **Links:** https://youtu.be/uFydF-g-AJs

Unit III

Feature Selection and Dimension Reduction -PCA and SVD

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links**: https://youtu.be/uFydF-g-AJs

Unit IV

Model Selection: Variance and Bias, Cross-validation; HMM .

- **Pedagogy/Course delivery tools:** Chalk and talk, Power Point Presentation, Videos
- **Links:** https://youtu.be/uFydF-g-AJs

Unit V

Advanced topics-graph learning, sparse learning

- **Pedagogy/Course delivery tools:** Chalk and talk, Power Point Presentation, Videos

- **Links**: https://youtu.be/uFydF-g-AJs

Suggested Learning Resources

Text Book:
1. Pattern Recognition and Machine Learning, Christopher M. Bishop,2006

Reference Book:
1. The Elements of Statistical Learning: Data Mining, Inference, and Prediction(2ndEdition).Trevor Hastie, Robert Tibshirani and Jerome Friedman. Springer-Verlag,2009.
(http://web.stanford.edu/~hastie/local.ftp/Springer/OLD/ESLII_print4.pdf)

Course Outcomes (COs):
At the end of the course, the student will be able to:
1. Understand the concept of Machine Learning with respect to Statistics. (PO-1, 2.PSO-1)
2. Understand Feature and model selection in relation to statistics. (PO-1, 2.PSO-1)
3. Apply the concept of ML and various classification methods in a project, (PO-3, 4.PSO-2)
4. Apply the ML concepts to implement Regression, Clustering and Classification. (PO-3, 4.PSO-2)
5. Apply the analytics in application and practical system. (PO-3, 4, 5.PSO-2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Internal Test-I (CIE-I)	30	CO1, CO2
Internal Test-II CIE-II)	30	CO3, CO4
Average of the two CIE shall be taken for 30 marks		
Other Components		
Quiz	10	CO1, CO2
Assignment	10	CO3, CO4
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz +Marks scored in Assignment		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3, CO4

ROBOTICS PROCESS AUTOMATION -DESIGN AND DEVELOPMENT

Course Code: AIE632	Credits: 3:0:0
Pre – requisites: Nil	Contact Hours: 42L
Course Coordinator: Dr. Ganeshayya I Shidaganti	

Course Content

Unit I

Programming Basics: Introduction to Programming, Data and Data Structure, Algorithms**,** Variables and Arguments**,** Software Application and Software Development Life Cycle (SDLC)**,** Frameworks and Languages. Automation **and RPA**: History of Automation, Automation and its benefits, Introduction to RPA, Automation vs RPA, Process and Flowchart, RPA Programming Constructs, Robots in RPA, Introduction to Robots, Types of Robots, Benefits and Implementation of RPA.

- • **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- • **Links**: https://www.uipath.com/rpa/robotic-process-automation.

Unit II

RPA Tool Introduction and Basics: RPA Development Life Cycle, How does RPA Work, Challenges in RPA, Variables and Types of Variables, Variables vs. Arguments, Namespaces, and Importing New Namespace. **Control Flow Activity:** Sequences, Control Flow and its types, Decision control-IF, Switch, IF vs Switch, Loops-Do While, While, For each, Other control flow activities - Delay, Break, Assign, Continue and Parallel.

- • **Pedagogy/Course delivery tools:** Chalk and talk, Power Point Presentation, Videos
- • **Links**: https://www.uipath.com/rpa/robotic-process-automation.

Unit III

Data Manipulation: Data Manipulation and Its Importance, String Manipulations, Data Table Manipulations, Collection, Its Types and Manipulations. **UI Automation & Selectors**: UI interactions, Input actions and Input methods, Containers, Recording & its types, Selectors, Types of Selectors- Full and Partial, Containers and Partial Selectors, Dynamic Selectors.

- **Pedagogy/Course delivery tools:** Chalk and talk, Power Point Presentation, Videos
- **Links**: https://www.uipath.com/rpa/robotic-process-automation.

Unit IV

Automation Concepts and Techniques: Desktop and Web Recording, extraction and its techniques- Screen scraping, Data scraping and PDF Extraction. Automation Techniques- Workbook and Excel automation (read/write). **Email Automation:** Incoming Email automation - Sending Email automation.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links:** https://www.uipath.com/rpa/robotic-process-automation.

Unit V

Error and Exception Handling: Errors, Error handling approach, Try Catch, Retry Scope, Exception Handling, Types of Exceptions, Global Exception Handler, Best Practice for Error Handling. **Orchestrator:** Overview, Orchestrator Functionalities, Orchestrator User Interface- Automations, Management and Monitoring.

- **Pedagogy/Course delivery tools:** Chalk and talk, Power Point Presentation, Videos
- **Links:** https://www.uipath.com/rpa/robotic-process-automation.

Text book:

1. Alok Mani Tripathi, Learning Robotic Process Automation, Publisher: Packt Publishing. March 2018.

Reference Books:

1. Frank Casale (Author), Rebecca Dilla (Author), Heidi Jaynes (Author), Lauren
2. Livingston (Author), Introduction to Robotic Process Automation: a Primer, Institute of Robotic Process Automation.
3. Richard Murdoch, Robotic Process Automation: Guide to Building Software
4. Robots, Automate Repetitive Tasks & Become An RPA Consultant.
5. Srikanth Merianda, Robotic Process Automation Tools, Process Automation and
6. their benefits: Understanding RPA and Intelligent Automation.

Course Outcomes (COs):

At the end of the course, students should be able to:

1. Describe the History of Automation, Advent of Automation and Benefits of RPA. (PO-2,3, 4, 5.PSO-2)
2. Demonstrate the use of Sequence, Flowchart, and Control Flow Activities to build Workflow in Automation. (PO-2,3, 4, 5.PSO-2)
3. Examine the RPA Techniques for Data Manipulation and UI automation. (PO-2,3, 4, 5.PSO-2)
4. Experiment the Automation Concepts and Techniques to interact with Desktop, Web and Email Applications. (PO-2,3, 4,5, 9.PSO-2)
5. Test the Bot using Orchestration server and Use Exception Handling Techniques for Error free Applications. (PO-2,3, 4,5, 9.PSO-2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) Addressed**
Internal Test-I (CIE-I)	30	CO1, CO2
Internal Test-II CIE-II)	30	CO3, CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Programming Competition/ Hackathon/Codethon	20	CO1, CO2, CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in other component		
Semester End Examination (SEE)		

3D PRINTING	
Course Code: AIE633	**Credits: 3:0:0**
Pre – requisites: Nil	**Contact Hours: 42L**
Course Coordinator: Mr. Amruthesh S M	

Course Content

Unit I

Additive Manufacturing, The Generic AM Process, AM Information work flow, AM – An Integral part of Time compression Engineering, Classification of AM processes, The Benefits of AM, Distinction Between AM and CNC Machining.**Vat Photopolymerization** Processes: Introduction, Photo polymerization Process (SLS), **Extrusion-Based Systems**: Introduction, Basic Principles, Fused Deposition Modeling process, Materials, Limitations of FDM.

- • **Pedagogy/Course delivery tools**: Chalk and talk, Power point presentation
- • **Links**: https://www.youtube.com/watch?v=ICjQ0UzE2Ao

  https://www.youtube.com/watch?v=7jNodHYUQc8

Unit II

Solid Ground curing: Introduction, Basic Principles, SGC Process, Materials. LOM, Binder Jetting process, Benefits and Drawbacks, Applications

- • **Pedagogy/Course delivery tools**: Chalk and talk, Power point presentation
- • **Links:** https://www.youtube.com/watch?v=ThwFB12cbnM

Unit III

Design for Additive Manufacturing: Design for Manufacturing and Assembly, Introduction to Design for Additive Manufacturing, General Guidelines for Designing AM Parts, Design to Minimize Print Time, Design to Minimize Post-processing.

Post-processing: Support Material Removal, **Polymer Surface Treatments**: Vapour Smoothing, Sand Blasting, Tumbling, Metal **Surface Treatments**: Shot-Peening, Machining and Grinding, Anodizing, Plasma Spraying, Plating and PVD.

- • **Pedagogy/Course delivery tools**: Chalk and talk, Power point presentation
- • **Links:** https://www.youtube.com/watch?v=U0xxd70g0y0

  https://www.youtube.com/watch?v=uuCt_8nGDrM

Unit IV

Powder Bed Fusion: Selective Laser Sintering: Introduction, Process parameter, SLS sintering process, Electron Beam melting (EBM) process.

Directed Energy Deposition Processes: Introduction, General DED Process Description, Material Delivery, DED Systems, Process Parameters, DED Benefits and Drawbacks.

- • **Pedagogy/Course delivery tools**: Chalk and talk, Power point presentation
- • **Links:** https://youtu.be/LjWL-lQe6ok

Unit V

Indirect Methods for Rapid Tool Production, Role of Indirect Methods in Tool Production, Metal Deposition Tools, RTV Tools, Epoxy Tools, **Direct Methods for Rapid Tool Production:** Classification of Direct Rapid Tool Methods, RapidTool process, Sand Form, Pattern for Investment and Vacuum Casting, Functional Models.

- • **Pedagogy/Course delivery tools**: Chalk and talk, Power point presentation
- • **Links:** https://youtu.be/RQVjwSG1-XY

Suggested Learning Resources

Text Books:

1. Additive Manufacturing Technologies, I. Gibson l D. W. Rosen l B. Stucker, Springer New York Heidelberg Dordrecht London, 2010.
2. Applications of 3D Printing Technology, K.G.Jaya Christiyan, DVSSV Prasad, K.R.Senthil Kumar, Kavita Karambelkar, Scientific International Publishing House

Reference Books:

1. Stereo lithography and other RP & M Technologies, Paul F.Jacobs: "SME, NY 1996.
2. Rapid manufacturing, Fiham D.T & Dinjoy S.S Verlog London 2001.
3. Rapid Prototyping: Principles and Application, by Rafiq I. Noorani

Course Outcomes (COs):

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

1. Illustrate the concepts, working principle and construction of Additive Manufacturing technologies. (PO-2.PSO-1)

2. Design and manufacturing, modern development in additive manufacturing process. (PO-2,3. PSO-2)
3. Enhance the production sequence by choosing the correct optimization and proper Design. (PO-2,3,4. PSO-2)
4. Implement AM techniques for specific application leading to better ROI for the company that uses Laser AM machines. (PO-2,3,4. PSO-3)
5. Analyze the productivity sequence by choosing the right AM technology. (PO-3,4. PSO-3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) Addressed**
Internal Test-I (CIE-I)	30	CO1, CO2, CO3
Internal Test-II CIE-II)	30	CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Quiz	10	CO1, CO2, CO3
Assignment	10	CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz +Marks scored in Assignment		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

DIGITAL SIGNAL PROCESSING

Course Code: AIE634	Credits: 3:0:0
Pre – requisites: Java Programming	Contact Hours: 42L
Course Coordinator: Dr. Anita Kanavalli	

Course Content

Unit I

Digital Image Fundamentals: What is Digital Image Processing? Origins of Digital Image Processing, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships Between Pixels, Linear and Nonlinear Operations.

- **Pedagogy/Course delivery tools:** Chalk and talk, Power point presentation
- **Links:** https://https://nptel.ac.in/courses/106/105/106105032/

Unit II

Spatial Domain: Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters Frequency Domain: Preliminary Concepts, The Discrete Fourier Transform (DFT) of Two Variables, Properties of the 2-D DFT, Filtering in the Frequency Domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters, Selective Filtering.

- **Pedagogy/Course delivery tools:** Chalk and talk, Power point presentation
- **Links:** https://https://nptel.ac.in/courses/106/105/106105032/

Unit III

Restoration: Noise models, Restoration in the Presence of Noise Only using Spatial Filtering and 03092022 Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power point presentation
- **Links**: https://https://nptel.ac.in/courses/106/105/106105032/

Unit IV

Color Image Processing: Color Fundamentals, Color Models, Pseudo color Image Processing. Wavelets: Background, Multiresolution Expansions. Morphological Image Processing: Preliminaries, Erosion and Dilation, Opening and Closing, The

Hit-or Miss Transforms, Some Basic Morphological Algorithms.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power point presentation
- **Links:** https://https://nptel.ac.in/courses/106/105/106105032/

Unit V

Segmentation: Introduction, classification of image segmentation algorithms, Detection of Discontinuities, Edge Detection, Hough Transforms and Shape Detection, Corner Detection, Principles of Thresholding. Representation and Description: Representation, Boundary descriptors.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power point presentation
- **Links:** https://https://nptel.ac.in/courses/106/105/106105032/

Suggested Learning Resources

Text Books:

1. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, Third Ed., Prentice Hall, 2008.
2. S. Sridhar, Digital Image Processing, Oxford University Press, 2ndEdition, 2016

Reference Books:

1. Digital Image Processing- S.Jayaraman, S.Esakkirajan, T.Veerakumar, TataMcGraw Hill 2014.
2. Fundamentals of Digital Image Processing-A. K. Jain, Pearson 2004.

Course Outcomes (COs):

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

1. Understand the fundamentals of Digital Image Processing. (PO-1. PSO-1)
2. Apply different Image transformation techniques. (PO-2,3. PSO-2)
3. Analyze various image restoration techniques. (PO-2,3,4. PSO-2)
4. Understand colour image and morphological processing (PO-1,2. PSO-1)
5. Design image analysis and segmentation techniques (PO-2,3. PSO-2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) Addressed**
Internal Test-I (CIE-I)	30	CO1, CO2, CO3
Internal Test-II CIE-II)	30	CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Quiz	10	CO1, CO2, CO3
Assignment	10	CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz +Marks scored in Assignment		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

BUSINESS INTELLIGENCE	
Course Code: AIE635	**Credits: 3:0:0**
Pre – requisites: Computer Application	**Contact Hours: 42L**
Course Coordinator: Mrs. Megha J	

Course Content

Unit I

Data, Information and Knowledge, Defining Business Intelligence, Important Factors in Business Intelligence, Business Intelligence Architecture, Business Intelligence Framework, Role of Mathematical Models in BI, Factors Responsible for a Successful BI Project, Development of BI System, Obstacles to Business Intelligence in an Organization, Ethics and Business Intelligence.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power point presentation
- **Links**: https://youtu.be/7yHLA6BlnMU

Unit II

DECISION SUPPORT SYSTEM: Concept of Decision Making, Techniques of Decision Making, Understanding Decision Support System (DSS), Evolution of Information System, Development of Decision Support System, Application of DSS, Role of Business Intelligence in Decision Making.

- **Pedagogy/Course delivery tools:** Chalk and talk, Power point presentation
- **Links:** https://youtu.be/7yHLA6BlnMU

Unit III

BI AND DATA MINING: ERP and Business Intelligence, BI Applications: CRM, Marketing, Logistics and Production, Finance, Banking, Telecommunications, Fraud Detection, Clickstream mining, Retail Industry

- **Pedagogy/Course delivery tools**: Chalk and talk, Power point presentation
- **Links:** https://youtu.be/7yHLA6BlnMU

Unit IV

Data Mining, Data Mining Functionalities, Data Mining Task Primitives, Integration of a Data Mining System with a Data Warehouse, Issues in Data Mining, Classification by Artificial Neural Networks (Backpropagation), Lazy learners (learning from Neighbors), Support Vector Machine (SVM).

- **Pedagogy/Course delivery tools**: Chalk and talk, Power point presentation
- **Links:** https://youtu.be/7yHLA6BlnMU

BI APPLICATIONS IN BUSINESS: Cases to be discussed each on the BI applications in various Business streams.

- • **Pedagogy/Course delivery tools**: Chalk and talk, Power point presentation
- • **Links**: https://youtu.be/7yHLA6BlnMU

Suggested Learning Resources

Text Books:

1. Data Mining and Business Intelligence, S.K. Shinde, Uddagiri Chandrasekhar, dreamTech press, 2015
2. Business Intelligence, Analytics, and Data Science: A Managerial Perspective, Ramesh Sharda, Dursun D, Efraim T, Pearson, 2017.

Reference Book:

1. Data Warehousing & Data Mining, Varsha Bhosale, Deepali Vora

Course Outcomes (COs):

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

1. Understand the conceptual framework concepts of BI and its importance in every business organization. (PO-1,2,3. PSO-1)
2. Analyze theoretical understanding of DSS and its applications. (PO-2,3. PSO-2)
3. Understanding of various BI applications currently used in various organizations spread across several verticals. (PO-1,3,4. PSO-2)
4. Apply theoretical understanding of data mining and Neural Networks. (PO-3,4. PSO-2)
5. Apply concepts of BI, DSS and data mining across business domains. (PO-3,4. PSO-3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) Addressed**
Internal Test-I (CIE-I)	30	CO1, CO2, CO3
Internal Test-II CIE-II)	30	CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Quiz	10	CO1, CO2, CO3
Assignment	10	CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz +Marks scored in Assignment		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

AIE64x*: Program Elective Course - 3

SEMANTIC WEB AND ONTOLOGY ENGINEERING

Course Code: AIE641	Credits: 3:0:0
Pre – requisites: Web Technology	Contact Hours: 42L
Course Coordinator: Dr. Vinay T. R	

Course Content

Unit I

Web Intelligence: Thinking and Intelligent Web Applications, The Information Age, The World Wide Web, Limitations of Today"s Web, The Next Generation Web, Machine Intelligence, Artificial Intelligence, Ontology, Inference engines, Software Agents, Berners-Lee www, Semantic Road Map, Logic on the semantic Web.
- **Pedagogy/Course delivery tools:** Chalk and talk, Power point presentation
- **Links:** https://youtu.be/V6BR9DrmUQA

Unit II

Knowledge Representation for the Semantic Web Ontologies and their role in the semantic web, Ontologies Languages for the Semantic Web – Resource Description Framework (RDF) / RDF Schema, Ontology Web Language (OWL), UML, XML/XML Schema.
- **Pedagogy/Course delivery tools:** Chalk and talk, Power point presentation
- **Links:** https://youtu.be/V6BR9DrmUQA

Unit III

Ontology Engineering, Ontology Engineering, Constructing Ontology, Ontology Development Tools, Ontology Methods, Ontology Sharing and Merging, Ontology Libraries and Ontology Mapping, Logic, Rule and Inference Engines.
- **Pedagogy/Course delivery tools:** Chalk and talk, Power point presentation
- **Links:** https://youtu.be/FvljxJA6x0U

Unit IV

Semantic Web Applications, Services and Technology Semantic Web applications and services, Semantic Search, e-learning, Semantic Bioinformatics, Knowledge Base, XML Based Web Services, Creating an OWL-S Ontology for Web Services, Semantic Search Technology, Web Search Agents and Semantic Methods.

- **Pedagogy/Course delivery tools:** Chalk and talk, Power point presentation
- **Links:** https://youtu.be/FvljxJA6x0U
  https://youtu.be/v3JaWbAdTTg

Unit V

Social Network Analysis and semantic web What is social Networks analysis, development of the social networks analysis, Electronic Sources for Network Analysis – Electronic Discussion networks, Blogs and Online Communities, Web Based Networks. Building Semantic Web Applications with social network features.

- **Pedagogy/Course delivery tools:** Chalk and talk, Power point presentation
- **Links:** https://youtu.be/v3JaWbAdTTg

Suggested Learning Resources

Text Books:

1   Thinking on the Web - Berners Lee, Godel and Turing, Wiley inter science, 2008.
2   Social Networks and the Semantic Web, Peter Mika, Springer, 2007.

Reference Books:

1   Semantic Web Technologies, Trends and Research in Ontology Based Systems. John Davies (Editor), Rudi Studer (Co-Editor), Paul Warren (Co-Editor) ISBN: 978-0-470-03034-9
2   Semantic Web and Semantic Web Services - Liyang Lu Chapman and Hall/CRC Publishers, (Taylor & Francis Group).
3   Programming the Semantic Web, T Segaran, C Evans, J Taylor, O"Reilly

Course Outcomes (COs):

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

1   Demonstrate the semantic web technologies like RDF Ontology and others. (PO-1,2. PSO-1)
2   Learn the various semantic web applications. (PO-2,3. PSO-2)
3   Identify the architectures and challenges in building social networks. (PO-1,2. PSO-1)
4   Analyze the performance of social networks using electronic sources. (PO-2,3. PSO-2)
5   Illustrate Semantic Web Applications with social network features. (PO-2,3,4,5. PSO-2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) Addressed**
Internal Test-I (CIE-I)	30	CO1, CO2, CO3
Internal Test-II CIE-II)	30	CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Quiz	10	CO1, CO2, CO3
Assignment	10	CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz +Marks scored in Assignment		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

EDGE COMPUTING

Course Code: AIE642	**Credits: 3:0:0**
Pre – requisites: Nil	**Contact Hours: 42L**
Course Coordinator: Dr. Sowmya B J	

Course Content

Unit I

IoT and Edge Computing Definition and Use Cases Introduction to Edge Computing Scenario's and Use cases - Edge computing purpose and definition, Edge computing use cases, Edge computing hardware architectures, Edge platforms, Edge vs Fog Computing, Communication Models - Edge, Fog and M2M.

- **Pedagogy/Course delivery tools:** Chalk and talk, Power Point Presentation, Videos
- **Links :** https://nptel.ac.in/courses/106104242

Unit II

IoT Architecture and Core IoT Modules-A connected ecosystem,IoT versus machine-to-machine versus, SCADA, The value of a network and Metcalfe's and Beckstrom's laws, IoT and edge architecture, Role of an architect, Understanding Implementations with examples-Example use case and deployment, Case study – Telemedicine palliative care, Requirements, Implementation, Use case retrospective.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links** : https://nptel.ac.in/courses/106104242

Unit III

RaspberryPi: Introduction to RaspberryPi, About the RaspberryPi Board: Hardware Layout and Pinouts, Operating Systems on RaspberryPi, Configuring RaspberryPi, Programming RaspberryPi, Connecting Raspberry Pi via SSH, Remote access tools, Interfacing DHT Sensor with Pi, Pi as Webserver, Pi Camera, Image & Video Processing using Pi.

- **Pedagogy/Course delivery tools:** Chalk and talk, Power Point Presentation, Videos
- **Links :** https://nptel.ac.in/courses/106104242

Unit IV

Implementation of Microcomputer RaspberryPi and device Interfacing, Edge to Cloud Protocols- Protocols,MQTT, MQTT publish-subscribe, MQTT architecture details, MQTT state transitions, MQTT packet structure, MQTT data types, MQTT communication formats, MQTT 3.1.1 working example.

- • **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- • **Links :** https://nptel.ac.in/courses/106104242

Unit V

Edge computing with RaspberryPi, Industrial and Commercial IoT and Edge, Edge computing and solutions.

- • **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- • **Links** : https://nptel.ac.in/courses/106104242

Text Books:

1   IoT and Edge Computing for Architects - Second Edition, by Perry Lea, Publisher: Packt Publishing, 2020, ISBN: 9781839214806
2   Raspberry Pi Cookbook, 3rd Edition, by Simon Monk, Publisher: O'Reilly Media,
3   Inc., 2019, ISBN: 978149204322.

References:

1   Fog and Edge Computing: Principles and Paradigms by Rajkumar Buyya, Satish
2   Narayana Srirama, wiley publication, 2019, ISBN: 9781119524984.
3   David Jensen, "Beginning Azure IoT **Edge Computing**: Extending the Cloud to theIntelligent **Edge**, MICROSOFT AZURE

Course Outcomes (COs):

At the end of the course the students should be able to:

1   Identify the need, communication models and comparison between of Edge and Fog computing. (PO-1,2. PSO-1)
2   Explain the architecture and core components of IoT. (PO-1,2. PSO-1)
3   Illustrate the architecture and programming essentials of RaspberryPi. (PO-2,3. PSO-1)

5   Demonstrate the implementation of MQTT protocol. (PO-3,4. PSO-2)
6   Apply Edge computing in Industrial and commercial IoT. (PO-2,3. PSO-2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) Addressed**
Internal Test-I (CIE-I)	30	CO1, CO2, CO3
Internal Test-II CIE-II)	30	CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Quiz	10	CO1, CO2, CO3
Assignment	10	CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz +Marks scored in Assignment		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

OPTIMIZATION TECHNIQUES IN MACHINE LEARNING

Course Code: AIE643	Credits: 3:0:0
Pre – requisites: Linear Algebra, Calculus, Basic Programming	Contact Hours: 42L
Course Coordinator: Dr. A. Ajina	

Course Content

Unit I

Basics of Linear Algebra and Calculus: Subspaces, EigenValue Decomposition, Singular Value Decomposition - Algorithms and Methods, PSD Matrices and Kernel Functions, Vector Calculus.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links :** https://onlinecourses.nptel.ac.in/noc23_cs64/preview

Unit II

Convex Functions, First and Second Order Conditions for Optimizations, Convex and Non Convex Optimization problems in Machine Learning

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links** : https://onlinecourses.nptel.ac.in/noc23_cs64/preview

Unit III

Gradient Descent: math, programming basic optimization problems and their solutions.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links** : https://onlinecourses.nptel.ac.in/noc23_cs64/preview

Unit IV

Variants of Gradient Descent: Projected, Stochastic, Proximal, Accelerated, Coordinate Descent, Training a Neural Network: Theory.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links** : https://onlinecourses.nptel.ac.in/noc23_cs64/preview

Unit V

Newton"s Method, Optimization for ML in practice: Pytorch/Tensor Flow. Training a Neural Network, Implementation.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links** : https://onlinecourses.nptel.ac.in/noc23_cs64/preview

Text Books:

1   Linear Algebra and Learning from Data, Gilbert Strang Convex Optimization by Stephen Boyd
2   Optimization for Machine Learning by Suvrit Sra, MIT Press.

Reference Book:

1   Foundations of Data Science, Avrim Blum and Ravi Kannan, Hindustan Book Agency/Cambridge University Press

Course Outcomes (COs):

At the end of the course the students should be able to:
1   Illustrate the foundations of Subspaces, Eigenvalue Decomposition, Singular Value Decomposition - Algorithms and Methods, required for solving optimization problems in the context of machine learning. (PO-1,2. PSO-1)
2   Illustrate the foundations of PSD Matrices and Kernel Functions, Vector Calculus. (PO-2,3. PSO-1)
3   Demonstrate optimization algorithms like stochastic gradient descent and its various variants to solve machine learning problems. (PO-3,4. PSO-2)
4   Illustrate use of standard problem formulations as convex (SVM etc). (PO-1,2. PSO-1)
5   Illustrate use of standard problem formulations as non-convex (Neural Networks and Deep Neural Networks). (PO-1,2. PSO-1)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) Addressed**
Internal Test-I (CIE-I)	30	CO1, CO2, CO3
Internal Test-II CIE-II)	30	CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Quiz	10	CO1, CO2, CO3
Assignment	10	CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz +Marks scored in Assignment		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

BLOCKCHAIN TECHNOLOGY

Course Code: AIE644	Credits: 3:0:0
Pre – requisites: Nil	Contact Hours: 42L
Course Coordinator: Dr.Vaneeta M	

Course Content

Unit I

Introduction: Basic Cryptographic primitives used in Blockchain – Secure, Collison-resistant hash functions, digital signature, public key cryptosystems, zero-knowledge proof systems. Need for Distributed Record Keeping, Modelling faults and adversaries, Byzantine Generals problem, Consensus algorithms and their scalability problems, Why Nakamoto Came up with Blockchain based cryptocurrency.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links** : https://onlinecourses.nptel.ac.in/noc20_cs01/preview

Unit II

Technologies Borrowed in Blockchain – hash pointers, Consensus, Byzantine Models of fault tolerance, digital cash etc.Bitcoin blockchain - Wallet - Blocks - Merkley Tree - hardness of mining - transaction verifiability - anonymity - forks - double spending - mathematical analysis of properties of Bitcoin. Bitcoin, the challenges, and solutions.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links :** https://onlinecourses.nptel.ac.in/noc20_cs01/preview

Unit III

Abstract Models for BLOCKCHAIN - GARAY model - RLA Model - Proof of Work (PoW) as random oracle - formal treatment of consistency, liveness and fairness - Proof of Stake (PoS) based Chains - Hybrid models (PoW + PoS).Bitcoin scripting language and their use.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links** : https://onlinecourses.nptel.ac.in/noc20_cs01/preview

Unit IV

Ethereum - Ethereum Virtual Machine (EVM) - Wallets for Ethereum - Solidity – Smart Contracts - The Turing Completeness of Smart Contract Languages and

verification challenges, Using smart contracts to enforce legal contracts, comparing Bitcoin scripting vs. Ethereum Smart Contracts. Some attacks on smart contracts.

- • **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- • **Links** : https://onlinecourses.nptel.ac.in/noc20_cs01/preview

Unit V

Hyperledger fabric, the plug and play platform and mechanisms in permissioned blockchain. Beyond Cryptocurrency – applications of blockchain in cyber security, integrity of information, E-Governance and other contract enforcement mechanisms. Limitations of block chain as a technology, and myths vs. reality of block chain technology.

- • **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- • **Links :** https://onlinecourses.nptel.ac.in/noc20_cs01/preview

Text Books:

1. S. Shukla, M.Dhawan, S. Sharma,S. Venkatesan "Block chain Technology: Cryptocurrency and Applications" Oxford University Press,2019
2. Josh Thompson "Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain

Reference Books:

1. Arvind Narayanan et. Al, "Bitcoin and cryptocurrency technologies: a comprehensive introduction", Princeton University Press,2016
2. Joseph Bonneau et al, SoK, "Research perspectives and challenges for Bitcoin and cryptocurrency", IEEE Symposium on security and Privacy,2015
3. J.A.Garay et al, "The bitcoin backbone protocol - analysis and applications", EUROCRYPT LNCS VOl 9057, (2015VOLII), pp 281-310,2015
4. Programming" Create Space Independent Publishing Platform 2017

Course Outcomes (COs):

At the end of the course, students will be able to:
1. Illustrate the Blockchain terminologies with its applications. (PO-1. PSO-1)
2. Analyse the working principles of Blockchain. (PO-1,2. PSO-1)
3. Comprehend the principles & methodologies used in Bitcoin and able to deploy smart Contract. (PO-1,2. PSO-1,2)
4. Create Ethereum Network, Wallets, Nodes, Smart contract & Dapps. (PO-1,2,3. PSO-1)

5. Develop Blockchain Based Application Architecture using Hyperledger. (PO-1,2,3,5. PSO-1,2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) Addressed**
Internal Test-I (CIE-I)	30	CO1, CO2, CO3
Internal Test-II CIE-II)	30	CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Quiz	10	CO1, CO2, CO3
Assignment	10	CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz +Marks scored in Assignment		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

INFORMATION RETRIEVAL

Course Code: AIE645	Credits: 3:0:0
Pre – requisites: Nil	Contact Hours: 42L
Course Coordinator: Dr. Meeradevi	

Course Content

Unit I

Introduction: Overview, History of IR, **Text Operations:** Document preprocessing, Document Clustering, Text Compression, **Indexing:** Inverted files, **Mathematics for IR:** Set Theory, Mathematical Logic, Probability and Linear algebra, **Classic IR Models:** Boolean Model, Vector space model: tf-idf weighing, Probabilistic Model. **Language models for IR:** The language model and the query likelihood model.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links**: https://youtu.be/44XmuZgGgzI

Unit II

Evaluation Measures: Precision, Recall, Alternative Measures, **Reference Collections:** TREC, **Relevance Feedback and Query Expansion**, **Text Classification:** The text classification problem, **Flat clustering:** Clustering in information retrieval, Problem Statement, **Hierarchical clustering:** Hierarchical agglomerative clustering, Single-link and Complete-link clustering.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links**: https://youtu.be/44XmuZgGgzI

Unit III

String Matching algorithms: Knuth Morris Pratt and Rabin Karp, **Stemming algorithm:** Porter, **Map reduce algorithms:** tf- idf calculation and indexing, **Classification:** Naive Bayes algorithm, **Clustering:** k-means algorithm. **Machine learning Algorithms:** Machine- learned scoring, Result ranking by machine learning.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links**: https://youtu.be/44XmuZgGgzI

Unit IV

Web search basics: web characteristics**, Architecture of web search engine, Web Crawling and Indexing:** Overview, Crawling, Distributing Indexes, and Connectivity Servers. **Link analysis:** Web as a graph**,** Page Rank, Hubs and Authorities.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links**: https://youtu.be/44XmuZgGgzI

Unit V

XML Retrieval: Basic XML Concepts, Challenges in XML retrieval, a vector space model for XML retrieval, **Introduction to Semantic Web:** Purpose, Semantic Web Stack, RDF, RDFS, Ontology, Web ontology language (OWL) and ontology tools**.**

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links**: https://youtu.be/44XmuZgGgzI

Text Books:

1. Ricardo Baeza-Yates, Berthier Ribeiro-Neto: Modern Information Retrieval, Pearson Education, 1999.
2. Introduction to Information Retrieval. C.D. Manning, P. Raghavan, H. Schütze. Cambridge UP, 2008.

Reference Books:

1. William B Frakes, Ricardo Baeza Yates: Information Retrieval Data Structures and Algorithms, PH PTR, 1992.
2. David A Grossman, Ophir Frieder: Information Retrieval Algorithms and Heuristics, 2e, Springer, 2004
3. Mathematics for Classical Information Retrieval: Roots and Applications: Dariush Alimohammadi,
4. http://www.dcc.fc.up.pt/~zp/aulas/1213/pde/geral/bibliografia/MIT.Press.A. Semantic. Web.Primer.eBook-TLFeBOOK.pdf

Course Outcomes (COs):

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

1. Describe text operations and various information retrieval models. (PO-3. PSO-1)
2. Evaluate an IR system using various evaluation measures. (PO-2,3,4. PSO-1)

3. Apply various algorithms such as string matching, map reduce, classification and clustering. (PO-2,3,4. PSO-2)
4. Design web search engine, web crawling and link analysis techniques. (PO-3,4. PSO-2)
5. Explain XML Retrieval and various semantic web technologies. (PO-2,3,4. PSO-2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) Addressed**
Internal Test-I (CIE-I)	30	CO1, CO2, CO3
Internal Test-II CIE-II)	30	CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Quiz	10	CO1, CO2, CO3
Assignment	10	CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz +Marks scored in Assignment		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

WEB TECHNOLOGIES LABORATORY

Course Code: AIL65	**Credits: 0:0:1**
Pre – requisites: HTML and Java Programming	**Contact Hours: 14P**
Course Coordinator: Mrs. Megha J	

Course Content

List of problems for which student should develop program and execute in the Laboratory

There shall be a minimum of 2 exercises conducted on each of the following topics:

1. HTML5
2. Advanced CSS
3. Java Script
4. Advanced java Script
5. Inheritance In java Script
6. Scopes and Closures
7. Develop a Server-side programming using java Script: Node.Js
8. Implement CRUD Operation using MongoDB and Node.Js

Text Book:

1. Web Application Design and Implementation: Apache 2, PHP5, MySQL, JavaScript, and Linux/UNIX Steven A. Gabarro, December 2006, ©2007, Wiley-IEEE Computer Society Press.

Reference Books:

1. Nate Murray, Felipe Coury, Ari Lerner and Carlos Taborda, "ng-book, The Complete Book on Angular 4" September 2016.
2. KrasimirTsonev, "Node.js by Example Paperback", May 2015.

Course Outcomes (Cos):

At the end of the course students should be able to:

1. Develop web pages with various media contents using HTML5. (PO-3,5,9,12. PSO-2,3)
2. Create a robust Client-side validation with java script. (PO-3,5,9,12. PSO-2,3)
3. Design dynamic data-driven Web sites using Node.js. (PO-3,5,9,12. PSO-2,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Lab Test-I	10	CO1, CO2
Lab Test-II	10	CO3
Weekly Evaluation-Lab Record	30	-
The Final CIE out of 50 Marks = Marks of Lab Record + Marks scored in Lab Test-I + Marks scored in Lab Test-II		
Semester End Examination (SEE)		
Course End Examination (One full question from the Lab Question Bank, Programs will be coded using C and executed)	50	CO1, CO2, CO3

DEEP LEARNING LABORATORY

Course Code: AIL66	Credits: 0:0:1
Pre – requisites: Nil	Contact Hours: 14P
Course Coordinator: Dr. Jagadish S Kallimani	

Course Content

List of Exercises / Experiments

1. Basic image processing operations: Histogram equalization, thresholding, edge
2. detection, data augmentation, morphological operations
3. Implement SVM/Softmax classifier for CIFAR-10 dataset: (i) using KNN
4. Study the effect of batch normalization and dropout in neural network classifier
5. Familiarization of image labelling tools for object detection, segmentation
6. Image segmentation using Mask RCNN, UNet, SegNet
7. Object detection with single-stage and two-stage detectors (Yolo, SSD, FRCNN, etc.)
8. Image Captioning with Vanilla RNNs
9. Image Captioning with LSTMs
10. Network Visualization: Saliency maps, Class Visualization
11. Generative Adversarial Networks
12. Chatbot using bi-directional LSTMs
13. Familiarization of cloud based computing like Google COLAB.

Text Books:

1. Simon Haykin, Neural networks and Learning Machines, Third Edition, Pearson, 2016
2. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016.

Reference Book:

1. Neural Networks and Deep Learning by Michael Nielsen http://neuralnetworksanddeeplearning.com/

Course Outcomes (COs):

At the end of the course, students will be able to-
1. Apply concepts the various deep learning algorithms in Python. (PO-3,5,9,12. PSO-2,3)
2. Demonstrate with different deep learning frameworks like Keras, Tensor flow,
3. PyTorch, Caffe etc. (PO-3,5,9,12. PSO-2,3)
4. Demonstrate recurrent, recursive nets function and practical problems can be mapped to these functions. (PO-3,5,9,12. PSO-2,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	Marks	Course Outcomes (COs) addressed
Lab Test-I	10	CO1, CO2
Lab Test-II	10	CO3
Weekly Evaluation-Lab Record	30	-
The Final CIE out of 50 Marks = Marks of Lab Record + Marks scored in Lab Test-I + Marks scored in Lab Test-II		
Semester End Examination (SEE)		
Course End Examination (One full question from the Lab Question Bank, Programs will be coded using C and executed)	50	CO1, CO2, CO3

AIOE0x*: Institutional Open Elective - 1

INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Course Code: AIOE01	**Credits: 3:0:0**
Pre – requisites: Nil	**Contact Hours: 42L**
Course Coordinator: Dr. Meeradevi	

Course Content

Unit I

Introduction: What is AI? Intelligent Agents: Agents and Environments, Rationality, The Nature of Environments, The Structure of Agents. Solving Problems by Searching: Problem-Solving Agents, Example Problems, Search Algorithms: Best-first search, Uniformed Search Strategies- Breadth-first search, , Informed (Heuristic) Search Strategies- A* search.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links:** https://nptel.ac.in/courses/106105077
        https://nptel.ac.in/courses/106102220

Unit II

Logical Agents: Knowledge-Based Agents, The Wumpus World, First- Order Logic: Representation Revisited, Syntax and Semantics of First-Order Logic- Models for first-order logic, Symbols and Interpretations, Atomic Sentences, Complex Sentences, The knowledge Engineering Process, Inference in First-order Logic: Propositional vs. First-Order Inference, Forward chaining, Backward chaining.

- **Pedagogy/Course delivery tools:** Chalk and talk, Power Point Presentation, Videos
- Links: https://nptel.ac.in/courses/106105077
        https://nptel.ac.in/courses/106102220

Unit III

Introduction: Machine learning Landscape: what is ML?, Why, Types of ML, main challenges of ML Concept learning and Learning Problems – Designing Learning systems, Perspectives and Issues – Concept Learning – Find S-Version Spaces and Candidate Elimination Algorithm –Remarks on VS- Inductive bias.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links:** https://nptel.ac.in/courses/106106139
  https://nptel.ac.in/courses/106106202

Unit IV

End to end Machine learning Project: Working with real data, Look at the big picture, Get the data, Discover and visualize the data, Prepare the data, select and train the model, Fine tune your model. Classification: Binary classifier, multiclass classification, error analysis, multi label classification, multi output classification

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links:** https://nptel.ac.in/courses/106106139
  https://nptel.ac.in/courses/106106202

Unit V

Training Models: Linear regression, gradient descent, polynomial regression, learning curves, regularized linear models, logistic regression Support Vector Machine: linear, Nonlinear, SVM regression and under the hood

- **Pedagogy/Course delivery tools:** Chalk and talk, Power Point Presentation, Videos
- **Links:** https://nptel.ac.in/courses/106106139
  https://nptel.ac.in/courses/106106202

Suggested Learning Resources

Text Books:

1. Stuart J Russel and Peter Norvig: "Artificial Intelligence - A Modern Approach", 4th Edition, Pearson Education, 2021.
2. Tom M Mitchell, "Machine Learning", McGraw-Hill Education (Indian Edition), 2013.

Reference Books:

1. Ethem Alpaydin, Introduction to Machine Learning, PHI Learning Pvt. Ltd, 2nd Ed., 2013
2. T. Hastie, R. Tibshirani, J. H. Friedman, The Elements of Statistical Learning, Springer, 1st edition, 2001
3. Machine Learning using Python, Manaranjan Pradhan, U Dinesh Kumar, Wiley, 2019

Course Outcomes (COs):

At the end of the course, the student should be able to:
1. Identify the modern view of artificial intelligence and its applications based on agent Philosophy. (PO-1,2,3. PSO-1,2)
2. Apply intelligent agents for Artificial Intelligence programming techniques. (PO-1,2,3. PSO-1,2)
3. Understand the concept of Machine Learning and Concept Learning. (PO-1,2,3. PSO-1,2)
4. Apply the concept of ML and various classification methods in a project. (PO-1,2,3. PSO-1,2)
5. Apply the ML concepts to implement Regression. (PO-1,2,3. PSO-1,2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) Addressed**
Internal Test-I (CIE-I)	30	CO1, CO2, CO3
Internal Test-II CIE-II)	30	CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Quiz -I	10	CO1, CO2, CO3
Assignment	10	CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz-I +Marks scored in Assignment		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

ROBOTICS PROCESS AUTOMATION - DESIGN AND DEVELOPMENT

Course Code: AIOE02	Credits: 3:0:0
Pre – requisites: Nil	Contact Hours: 42L
Course Coordinator: Dr. Ganeshayya I Shidaganti	

Course Content

Unit I

RPA Foundations- What is RPA – Flavors of RPA- History of RPA- The Benefits of RPA- The downsides of RPA- RPA Compared to BPO, BPM and BPA – Consumer Willingness for Automation- The Workforce of the Future- RPA Skills-On-Premise Vs. the Cloud- Web Technology- Programming Languages and Low Code- OCR-Databases-APIs- AI-Cognitive Automation-Agile, Scrum, Kanban and Waterfall0 DevOps- Flowcharts.

- • **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- • **Links:** https://www.uipath.com/rpa/robotic-process-automation.

Unit II

RPA Foundations- What is RPA – Flavors of RPA- History of RPA- The Benefits of RPA- The downsides of RPA- RPA Compared to BPO, BPM and BPA – Consumer Willingness for Automation- The Workforce of the Future- RPA Skills-On-Premise Vs. the Cloud- Web Technology- Programming Languages and Low Code- OCR-Databases-APIs- AI-Cognitive Automation-Agile, Scrum, Kanban and Waterfall0 DevOps- Flowcharts.

- • **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- • **Links**: https://www.uipath.com/rpa/robotic-process-automation.

Unit III

Sequence, Flowchart, and Control Flow-Sequencing the workflow-Activities-Control flow, various types of loops, and decision making-Step-by-step example using Sequence and Flowchart-Step-by-step example using Sequence and Control flow-Data Manipulation-Variables and Scope-Collections Arguments – Purpose and use-Data table usage with examples-Clipboard management-File operation with step-by-step example-CSV/Excel to data table and vice versa (with a step-by-step example).

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links**: https://www.uipath.com/rpa/robotic-process-automation.

Unit IV

Taking Control of the Controls- Finding and attaching windows- Finding the control- Techniques for waiting for a control- Act on controls – mouse and keyboard activities- Working with UiExplorer- Handling events- Revisit recorder- Screen Scraping- When to use OCR- Types of OCR available- How to use OCR- Avoiding typical failure points.

- **Pedagogy/Course delivery tools:** Chalk and talk, Power Point Presentation, Videos
- **Links**: https://www.uipath.com/rpa/robotic-process-automation.

Unit V

Exception Handling, Debugging, and Logging- Exception handling- Common exceptions and ways to handle them- Logging and taking screensHOT- Debugging techniques- Collecting crash dumps- Error reporting- Future of RPA

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links:** https://www.uipath.com/rpa/robotic-process-automation.

Suggested Learning Resources

Text Book:
1. Alok Mani Tripathi, Learning Robotic Process Automation, Publisher: Packt Publishing .March 2018.

Reference Books:
1. Frank Casale (Author), Rebecca Dilla (Author), Heidi Jaynes (Author), Lauren
2. Livingston (Author), Introduction to Robotic Process Automation: a Primer, Institute of Robotic Process Automation.
3. Richard Murdoch, Robotic Process Automation: Guide to Building Software
4. Robots, Automate Repetitive Tasks & Become An RPA Consultant.
5. Srikanth Merianda, Robotic Process Automation Tools, Process Automation and their benefits**:** Understanding RPA and Intelligent Automation.

Course Outcomes (COs):

At the end of the course, students should be able to:
1. Describe the History of Automation, Advent of Automation and Benefits of RPA. (PO-1,2,3. PSO-1,2)
2. Demonstrate the use of Sequence, Flowchart, and Control Flow Activities to build Workflow in Automation. (PO-1,2,3. PSO-1,2)
3. Examine the RPA Techniques for Data Manipulation and UI automation. (PO-1,2,3. PSO-1,2)
4. Experiment the Automation Concepts and Techniques to interact with Desktop, Web and Email Applications. (PO-1,2,3. PSO-1,2)
5. Test the Bot using Orchestration server and Use Exception Handling Techniques for Error free Applications. (PO-1,2,3,4. PSO-1,2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) Addressed**
Internal Test-I (CIE-I)	30	CO1, CO2, CO3
Internal Test-II CIE-II)	30	CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Quiz -I	10	CO1, CO2, CO3
Assignment	10	CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz-I +Marks scored in Assignment		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

AI IN HEALTHCARE

Course Code: AIOE03	Credits: 3:0:0
Pre – requisites: Nil	Contact Hours: 42L
Course Coordinator: Mrs. Megha J	

Course Content

Unit I

Introduction to AI: History, state of the art, Need for AI in Medicine. Thinking and acting humanly, intelligent agents, structure of agents.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links**: https://youtu.be/GHpchgLoDvI

Unit II

Problem Solving using AI: Solving problems by searching –Informed search and exploration–Constraint satisfaction problems– Adversarial search, knowledge and reasoning–knowledge representation – first order logic.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links:** https://youtu.be/GHpchgLoDvI

Unit III

Introduction to Healthcare Data Analytics: Healthcare Data Sources and Basic Analytics, Advanced data analytics for healthcare, application and practical system for healthcare, Resources for healthcare data analytics.

- **Pedagogy/Course delivery tools:** Chalk and talk, Power Point Presentation, Videos
- **Links:** https://youtu.be/ToIWiUmSmuM

Unit IV

Social Media Analytics for Healthcare: Social Media analysis for detection and tracking of infectious disease outbreak, social media analysis for public health research, analysis of social media use in healthcare.

- **Pedagogy/Course delivery tools:** Chalk and talk, Power Point Presentation, Videos
- **Links:** https://youtu.be/ToIWiUmSmuM

Unit V

Applications and Practical system for Healthcare: Data analytics for Pervasive Health, Fraud detection in healthcare.

- • **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- • **Links:** https://youtu.be/3mg1ESLKkAg

Suggested Learning Resources

Text Books:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence: A modern approach", Pearson Education, India, 2016.
2. Chandan K Reddy, Chall C Aggarwal, "Healthcare Data Analytics", Chapan &Hall/ CRC, CRC Press

Reference Books:

1. David Jefferis, "Artificial Intelligence: Robotics and Machine Evolution", Crabtree Publishing Company, 1992.
2. Negnevitsky, M, "Artificial Intelligence: A guide to Intelligent Systems", Harlow: Addison Wesley, 2002.
3. Sergio Consoli, Diego Reforgiato Recupero, "Data Science for Healthcare" Springer International Publishing, 2019

Course Outcomes (COs):

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

1. Identify problems that are amenable to solution by AI methods (PO-1,2,3,6. PSO-2,3)
2. Identify appropriate AI methods to solve a given problem. (PO-1,2,3,6. PSO-2,3)
3. Discuss the basic of healthcare data analytics. (PO-2,3,6,7. PSO-2,3)
4. Explain the importance of social media in healthcare. (PO-2,3,6,7. PSO-2,3)
5. Apply the analytics in application and practical system for healthcare. (PO-2,3,6,7. PSO-2,3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Internal Test-I (CIE-I)	30	CO1, CO2, CO3
Internal Test-II CIE-II)	30	CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Quiz -I	10	CO1, CO2, CO3
Assignment	10	CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz-I +Marks scored in Assignment		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

SOCIAL NETWORK ANALYSIS

Course Code: AIOE04	Credits: 3:0:0
Pre – requisites: Nil	Contact Hours: 42L
Course Coordinator: Mrs. Swetha B N	

Course Content

Unit I

Introduction to Semantic Web: Limitations of current Web - Development of Semantic Web - Emergence of the Social Web. Social Network analysis: Development of Social Network Analysis - Key concepts and measures in network analysis. Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities - Web-based networks.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links** : https://www.youtube.com/watch?v=BQWoMRS5CGA
    https://onlinecourses.nptel.ac.in/noc20_cs78/preview

Unit II

Knowledge Representation on the Semantic Web: Ontology and their role in the Semantic Web – Ontology based knowledge Representation - Ontology languages for the Semantic Web - Resource Description Framework and schema - Web Ontology Language. Modelling and aggregating social network data: State-of-the-art in network data representation - Ontological representation of social individuals - Ontological representation of social relationships - Aggregating and reasoning with social network data.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links**:   https://www.youtube.com/watch?v=IiUDKDxScxI
    https://onlinecourses.nptel.ac.in/noc20_cs78/preview

Unit III

Detecting communities in social networks - Definition of community - Evaluating communities - Methods for community detection - Tools for detecting communities Decentralized online social networks - Introduction - Challenges for DOSN - The Case for Decentralizing OSNs - General Purpose DOSNs - Specialized Application Centric DOSNs - Social Distributed Systems – Delay Tolerant DOSN.

- **Pedagogy/Course delivery tools:** Chalk and talk, Power Point Presentation, Videos
- **Links:** http://www.nitttrc.edu.in/nptel/courses/video/106106146/L21.html
  https://onlinecourses.nptel.ac.in/noc20_cs78/preview

Unit IV

Understanding and predicting human behaviour for social communities: User data management - Inference and Distribution - Enabling new human experiences – The Technologies. Managing Trust in Online Social Networks: Trust in online environment - Trust models based on subjective logic - Trust network analysis - Trust transitivity analysis - Combining trust and reputation - Trust derivation based on trust comparisons.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links:** https://www.youtube.com/watch?v=MQsTxRMy3Xg
  https://www.youtube.com/watch?v=BQWoMRS5CGA
  https://onlinecourses.nptel.ac.in/noc20_cs78/preview

Unit V

Visualization of Social Networks: Social Network Analysis - Visualization - Visualizing online social networks, Novel Visualizations, and Interactions for Social Networks Exploration: Visualizing social networks with matrix-based representations - Matrix and Node-Link Diagrams - Hybrid representations. Applications of Social Network Analysis: Applications of Social Network Analysis - Covert networks - Community welfare - Collaboration networks - Co-Citation networks.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links**: https://www.youtube.com/watch?v=DTxE9KV3YrE
  https://onlinecourses.nptel.ac.in/noc20_cs78/preview

Suggested Learning Resources

Text Books:
1. Peter Mika, "Social Networks and the Semantic Web", First Edition, Springer 2007.
2. Borko Furht, "Handbook of Social Network Technologies and Applications", 1st Edition, Springer, 2010.

Reference:

1. Guandong Xu ,Yanchun Zhang and Lin Li, "Web Mining and Social Networking – Techniques and applications", First Edition Springer, 2011.
2. Dion Goh and Schubert Foo, "Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively", IGI Global Snippet, 2008.
3. Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, "Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modelling", IGI Global Snippet, 2009.
4. John G. Breslin, Alexander Passant and Stefan Decker, "The Social Semantic Web", Springer, 2009

Course Outcomes (COs):

At the end of the course the student will be able to:
1. Understand the Semantic Web and Electronic sources for social network analysis. (PO-1,2,3. PSO-2,3)
2. Understand the Representation, Modelling and Aggregating social network data. Understand the Semantic Web and Electronic sources for social network analysis. (PO-2,3. PSO-2)
3. Analyse the human behaviour in social network. (PO-3,4. PSO-2)
4. Apply techniques for detection and decentralization of social network. (PO-3,4. PSO-2)
5. Illustrate the visual representation of social network data. (PO-2,3,4. PSO-2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) Addressed**
Internal Test-I (CIE-I)	30	CO1, CO2, CO3
Internal Test-II CIE-II)	30	CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Quiz -I	10	CO1, CO2, CO3
Assignment	10	CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz-I +Marks scored in Assignment		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

DATA VISUALIZATION

Course Code: AIOE05	Credits: 3:0:0
Pre – requisites: Nil	Contact Hours: 42L
Course Coordinator: Mr. Amruthesh S M	

Course Content

Unit I

Principles of Data Visualization: Visual processing and perceptual ranking: Anscombe''s Quartet, Gestalt principles of visual perception, preattentive processing; Five Guidelines for better data visualizations: Show, reduce, integrate, avoid and start with gray; Form and Function: Interacting with data.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links :** https://youtu.be/UjYzNhBVIvY

Unit II

Chart Types: Comparing categories: bar charts, paired bar, stacked bar, Diverging bar, Dot plot, Marimekko and mosaic charts, Unit, isotype and Waffle charts Time charts: Line chart, Circular line chart, slope chart, sparklines, bump chart, cycle chart, area chart, stacked area chart, steamgraph, horizon chart, gantt chart, flow charts and time lines. Distribution charts: Histogram, pyramid charts, Box and whisker plot, candlestick chart, violin chart, ridgeline plot, uncertainty visualization, stem and leaf plot.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links:** https://youtu.be/UjYzNhBVIvY

Unit III

Geospatial Maps: Choropleth map, cartogram, proportional symbols, dot density maps, flow map. Relationship Maps: Scatterplot, Parallel coordinate plot, radar charts, chord diagram, arc chart, correlation matrix, network diagrams, tree diagrams Others: Tree map, Sunburst diagram, nightingale chart.

- **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- **Links**: https://youtu.be/UjYzNhBVIvY

Unit IV

Qualitative data Maps: Icons, word clouds and specific words, word trees, quotes, coloring phrases, matrices and lists: Tables: Ten guidelines for better tables.

- • **Pedagogy/Course delivery tools:** Chalk and talk, Power Point Presentation, Videos
- • **Links:** https://youtu.be/UjYzNhBVIvY

Unit V

Developing data visualization style guide: Anatomy, Color palette, fonts, guidance, exporting images, Accessibility, Diversity and inclusions, Putting it all together. Redesigning charts: Paired bar charts, stacked bar charts, line charts, choropleth maps, dot plots.

- • **Pedagogy/Course delivery tools**: Chalk and talk, Power Point Presentation, Videos
- • **Links**: https://youtu.be/UjYzNhBVIvY

Suggested Learning Resources

Text Books:

1. Better Data Visualizations: A Guide to Scholars, Researchers, and Wonks – Jonathan Schwabish, Columbia University press, New York, 2021
2. Microsoft Power BI Cookbook: Creating Business Intelligence Solutions of Analytical Data Models, Reports, and Dashboards, Brett Powell

Reference Books:

1. Leland Wilkinson, The Grammar of Graphics, Springer
2. Joshua N. Milligan, Learning Tableau: Tools for Business Intelligence, data prep, and visual analytics, 3rd Edition, Packt publication
3. Dr. Mark Gardener, "Beginning R: The Statistical Programming Language", Wiley 2013.

Course Outcomes (COs):

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

1. Understand the importance of visualization in decision making. (PO-1,2,3. PSO-1)
2. Understand conceptually and practically basics chart types and understand their applications in business decision making. (PO-1,2,3. PSO-1)

3. Inculcate the best practices of data visualization using advanced charts in business decision making. (PO-2,3,4. PSO-2)
4. Demonstrate conceptually and practically on creating various ad hoc charts, reports and dashboards across platforms using Data studio and PowerBI. (PO-2,3,4. PSO-2)
5. Apply concepts learnt and demonstrate ability on how to apply visualization in creating reports, research papers and other articles. (PO-2,3,4. PSO-3)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tools	**Marks**	**Course Outcomes (COs) addressed**
Internal Test-I (CIE-I)	30	CO1, CO2, CO3
Internal Test-II CIE-II)	30	CO4, CO5
Average of the two CIE shall be taken for 30 marks		
Other Components		
Quiz -I	10	CO1, CO2, CO3
Assignment	10	CO3, CO4, CO5
The Final CIE out of 50 Marks = Average of two CIE tests for 30 Marks+ Marks scored in Quiz-I +Marks scored in Assignment		
Semester End Examination (SEE)		
Course End Examination (Answer One full question from each Unit- Internal Choice)	100	CO1, CO2, CO3, CO4, CO5

MINI PROJECT

Course Code: AIP67	Credits: 0:0:3
Pre – requisites: Nil	Contact Hours:
Course Coordinator: Artificial Intelligence and Machine Learning Faculty	

Based on the curriculum learnt by the students, they are advised to choose suitable project topics and propose the methodologies involved in it. Students are required to carry out this mini project work for a duration of approximately 42 hours during their sixth semester particularly in the domain of artificial intelligence and machine learning. Based on their experiences in intra internship, as well as inter internships, which they carried out previously, they can propose its extension, as mini-project work. This course addresses innovation/societal contributions or should evolve a student's entrepreneurial skill sets. Students are required to submit a report on the same in the format provided by the internship committee at the department. The students will be evaluated by the training committee based on the below rubrics informed to students by the committee.

Rubrics for assessment of student performance in AIP67: Mini-Project

		Level of achievement					
Sl No		Excellent (5)	Good (4)	Average (3)	Acceptable (2)	Unacceptable (1)	Score
1.	**Identification of Problem Domain and Detailed Analysis**	Purpose and need of the project is very well explained.	Purpose and need of the project is explained well.	Purpose and need of the Project is moderately explained	Purpose and need of the Project is satisfactorily explained	Purpose and need of the Project is not at all explained	
2.	**Study of the Existing Systems / Literature Survey**	Existing systems are very well studied. Documents of high standards like IEEE papers, reputed online resources and books are studied.	Existing systems are well studied. Documents of good standards like international journal/conference papers, good online resources and books are studied.	Existing systems are moderately studied. Documents of average standards, online resources and books are studied.	Existing systems are satisfactorily studied. Documents of satisfactory standards, online resources and books are studied	Existing systems are not studied. Documents of very poor standards, online resources and books are studied.	

3.	**Objectives of the Proposed Work**	All objectives of the proposed work are very well defined.	All objectives of the proposed work are well defined.	Most of the objectives of the proposedwork are well defined.	Only few objectives of the proposed work are well defined	Objectives of the proposed work are either not defined properly.	
4.	**Design Methodology**	Steps to be followed to solve the defined problem are clearly specified.Most suitable design .Methodology is used and is properly justified	Steps to be Followed to solve the defined problem is specified but detailing is not done. Suitable design Methodology is used and properly justified	Steps are mentioned but are unclear; without justification to objectives Appropriate design Methodology is used but not justified properly	Steps to be followed to solve the defined problem are not specified properly. Design Methodology used is ambiguous and not justified	Steps to be followed to solve the defined problem are not at all specified. Design Methodology used is not correct and is not justified	
5.	**Tools used for Design**	Clear Understanding	Acceptable	Good	Average	Not Acceptable	
6.	**Planning of Project Work**	Time frame properly specified and being followedaccurately	Time frame properly specified and being followed most of the time	Time frame properly specified, but not being followed	Time frame is vaguely specified, and is not followed	Time frame itself is not properly specified	
7.	**Understanding of the modules**	Clear understanding	Acceptable	Good	Average	Not Acceptable	
8.	**Demonstartion and Presentation**	Objectives achieved as per time frame. Contents of Presentation Is Appropriate and well arranged. Proper eye contact with audience and clear voice with good spoken language	Objectives achieved as per time frame. Contents of Presentation is appropriate but not well arranged. Satisfactory demonstration, clear voice with good spoken language but eye contact not proper	Objectives achieved as per time frame. Contents of Presentation is appropriate but not well arranged. Presentation not satisfactory and average demonstration	Objectives not achieved as per time frame. Contents of presentation is not appropriate. Eye contact with few people and unclear voice	No objectives achieved. Contents of Presentations are not appropriate and not well delivered Poor delivery of presentation	
9.	**Regularity**	Student reports to the guide	Student does not report to	Student reports to the guide	Student does not report to guide	Student does not meet guide at all and the work is	

		regularlyand is consistent in work	guide very regularly but is consistent in the work	but lacks consistency	regularly and is not consistent in work	always incomplete	
10.	**Report on Mini-Project**	Project report is according to the specified format References and citations are appropriate and well mentioned	Project report is according to the specified format References and citations are appropriate but not mentioned well	Project report is according to the specified format with few mistakes In-sufficient references and citations	Project report is not fully according to the specified format Insufficient references and citations	Project report not prepared according to the specified format References and citations are not appropriate	

INNOVATION/SOCIETAL/ENTREPRENEURSHIP BASED INTERNSHIP

Course Code: INT68	**Credits: 0:0:2**
Pre – requisites: Nil	**Contact Hours: -**
Course Coordinator: Artificial Intelligence and Machine Learning Faculty	

Course content

Students are required to carry out training in Artificial Intelligence and Machine Learning industry or research organization or with a start-up for not less than four weeks after 4th or during 5th semester. The internship addresses innovation/societal contributions or should evolve a student's entrepreneurial skill sets. Students are required to submit a report on the same in the format provided by the internship committee at the department. The students will be evaluated by the training committee based on the rubrics informed to students by the committee.

Course Outcomes (COs):
On successful completion of this course, students will be able to
1. Analyze the functional aspects of Artificial Intelligence and Machine Learning systems/blocks (PO-2,4,7,11,12, PSO-1,2,3)
2. Enhance the communication skills to work in interdisciplinary teams in industry/organization. (PO-9, 10, PSO-2,3)
3. Realize the professional and ethical responsibility. (PO-6, 7, 8, PSO-2, 3)

Rubrics for Assessment of INT68: Internship

Deliverables for Student Performance in Internship:

Internship Title: _____

Company Name: _____

Name of Student: _____

Name of Supervisor at Company: _____

Name of Supervisor at College: _____

Each supervisor must fill a rubric for each student:

	Basic (0-4 Pts)	Good (5-7 Pts)	Very Good (10 Pts)	Total	
				Possible	Earned
Tools and new Technology Learnt	Few sources at the Industry, aware of quality of resources and relevance to tools and Techniques at hand	Multiple sources of high quality, good judgment of the information, identification of gaps in knowledge at the Industry and Academics.	Multiple sources of high quality, well researched and analyzed, continuous efforts at acquiring Information. Identification of the application of the tools and Technology learnt to the present market.	10	
Relevance of the topic chosen to the current market	Fairly Relevant	Moderately Relevant	Highly Relevant	10	
Report Writing	Reasonably good organization and lacks clarity in few topics, complete, few omissions, grammatically correct, lacks style	Sound organization and structure, clear, very few errors, complete, reasonably good style	Excellent organization, no technical or grammar errors, concise and precise, complete documentation	10	
Demonstration of the Tools Learnt	Moderately be able to demonstrate the tools learnt at the Industry	Efficiently be able to demonstrate the skills learnt and be able to propose an application for the same.	Excellent demonstration of the tools and techniques learnt and be able to apply it to any simple case study.	10	
Presentation and viva voce	Reasonably good communication and presentation, able to give technical answers to some extent	Good, professional communication, good visual aids, able to give technical answers	Excellent professional and technical communication, effective presentations, able to analyze technically and clarify views in viva-voce	10	