JSS MAHAVIDYAPEETHA

JSS UNIVERSITY, NOIDA

EVALUATION SCHEME AND SYLLABUS

For

Ph.D Course Work

Effective from the Session

2025-2026

JSS UNIVERSITY, NOIDA

C-20/1, Sector-62, Noida, Gautam Budh Nagar,
Uttar Pradesh, India-201301

Preamble: With a view to fulfil the provisions in the UGC (Minimum Standards and Procedure for Award of Ph.D. Degree) Regulations, 2022, The Ph.D coursework is designed. The Ph.D course structure consists of advanced courses to train Research Scholars interested in a particular area of research. The structure offers enough flexibility to choose courses as per their interests. The Ph.D course work spills over to two semesters.

Ph. D Course Work

1. **Paper-I: Research Methodology** (100 marks, 4 credits)

   This course covers essential concepts of research, including research ethics, good laboratory practice/methodology, advanced statistical methods for both quantitative and qualitative research, and computational techniques and applications.

2. **Paper-II: Research and Publication Ethics** (50 marks, 2 credits)

   Topics in this course encompass the basics of the philosophy of science and ethics, research integrity, publication ethics, research misconduct, and issues surrounding predatory publications. It also includes discussions on indexing and citation databases, open access publications, research metrics like citations, h-index, and Impact Factor, and the use of plagiarism tools.

3. **Paper-III: Domain Specific 1** (100 marks, 4 credits)

   This includes a list of advanced level courses relevant to each discipline, approved by the Board of Studies and the Academic Council. Courses will be selected by the Research Supervisor/Co-supervisor in consultation with the Departmental Advisory Committee.

4. **Paper-IV: LITERATURE REVIEW SEMINAR** (50 marks, 2 credits)

   This paper evaluates the quality of the comprehensive literature review on the selected Ph.D. topic, the novelty and relevance of the topic to the specialization, and the critical analysis of literature and the research topic. It also assesses the quality of both written and oral presentations.

Additionally, the University reserves the right to periodically revise and notify the approved courses and their content. This information will be updated on the university's website. All enrolled Ph.D. candidates must complete their coursework within the first one or two semesters (12 months from the date of enrolment). Failure to complete the coursework within this timeframe will result in forfeiture of the Ph.D. program status. Candidates may re-register provisionally, if necessary. In cases of valid medical

emergencies, a candidate may be allowed a third attempt to complete the coursework upon obtaining the necessary permissions from the university and paying any required fees.

Evaluation Scheme

Sl. No	Course Code	Course Title	Teaching Hours/Week		Credits	Marks		Exam Duration
			L	Total		ESE	Total	
1	RM I/II	Research Methodology	4	4	4	100	100	3 Hrs
2	RPE	Research and Publication Ethics (RPE)	2	2	2	50	50	3 Hrs
3	DS	Domain Specific	4	4	4	100	100	3 Hrs
4	RP	Research Presentation	-	-	2	50	50	-
					Total Marks		300	

L: Lecture; **T:** Tutorial; **P:** Practical; **CIE:** Continuous Internal Examination; **ESE:** End Semester Examination; *Non-audited course

DETAILED SYLLABUS

For

Ph.D Course Work

Effective from the Session

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List of Courses for Ph. D Course work

S. No	Course Code	Title of the course	
1.	RM1/RM2	Research Methodology (RM)	
2.	RPE	Research and Publication Ethics (RPE)	
3.	DS ENG	Domain Specific	
4.	LRS	Literature Review and Seminar	
		LIST OF CORE SUBJECTS	**Course incharge**
5.	ECE I	Introduction to the Internet of Things and Applications	ECE (Gayatri Sakya)
6.	ECE II	Artificial Intelligence and its applications in IoT	ECE (Gayatri Sakya) (optional)
7.	CSE 1	Natural Language Processing	CSE (Dhiraj Pandey)
8.	CSE 2	Digital Image processing	CSE (Jaspreet Kaur)
9.	CSE 3	Cloud Computing	CSE (Jaspreet Kaur)
10.	CSE 4	Blockchain, Cybersecurity & Emerging Technology	CSE (Nitima Malsa)
11.	DSPH	Domain Specific subjects from SWAYAM NPTEL	Pharmacy
12.	ENGL	Natural Language Processing	English (Dr. Nishi Sharma)
13.	PHYS	Condensed Matter Physics	Physics (Dr. Richa Sharma)

Research Methodology

Course Code: RM I LTP: 4-0-0

Course Outcomes

CO1: Understand the concept, characteristics, and process of research; identify good research problems; and formulate hypotheses through effective literature review and gap analysis.

CO2: Differentiate between types of research (pure, applied, qualitative, quantitative) and apply appropriate research designs (exploratory, descriptive, causal) for academic and industry problems.

CO3: Apply statistical concepts and techniques such as descriptive and inferential statistics, data types, and use statistical tools (MS-Excel, SPSS, R) to analyse and interpret research data reliably.

CO4: Explain the significance of Intellectual Property Rights (IPR), identify major forms of IPR, and understand the global role of the World Intellectual Property Organization (WIPO).

CO5: Utilize research tools and software for information search, reference management, thesis writing, citation formatting, and effectively present research outcomes through oral and poster presentations.

Units	Syllabus	Hours
Unit I	Introduction to the concept, applications, and outcomes of research; understanding research problems, hypotheses, and the research process. Importance of literature review, sources like journals, books, theses, and techniques for organizing literature, identifying research gaps, and developing a working hypothesis.	**08**
Unit II	Types of research: pure, applied, qualitative, and quantitative, with use cases in academia and industry. Explain research design, its need, types (exploratory, descriptive, causal), and features of a good design.	**08**
Unit III	Introduction to types of data: Nominal, Ordinal, Interval, and Ratio. Descriptive statistics - mean, median, mode, standard deviation, etc. Inferential statistics - hypothesis testing, confidence intervals, normal distribution, skewness, kurtosis. Basic use of statistical software (MS-Excel, SPSS, R) for data analysis and interpretation, focusing on validity and reliability.	**08**
Unit IV	Introduction to Intellectual Property and the importance of Intellectual Property Rights (IPR) protection. Overview of IPR: Patents, Copyrights, Trademarks,	**08**

	Industrial Designs, Integrated Circuits. Introduction to the World Intellectual Property Organization (WIPO) and its role.	
Unit V	Tools for searching information, using reference managers (Sci-finder, PubMed, Mendeley etc.) and formatting papers (LaTeX and MS Office). Understand the structure of a research report/thesis and different citation styles. Practice presenting research through oral and poster presentations and generalizing research findings.	**08**

Textbooks

1. Garg, B.L., Karadia, R., Agarwal, F., & Agarwal, U.K. (2002). *An Introduction to Research Methodology*. Jaipur: RBSA Publishers.
2. Kothari, C.R. (1990). *Research Methodology: Methods and Techniques*. New Delhi: New Age International. 418 pp.

Reference books

1. Anderson, T.W. (2003). *An Introduction to Multivariate Statistical Analysis.* Wiley Eastern Pvt. Ltd., New Delhi.
2. Fink, A. (2009). *Conducting Research Literature Reviews: From the Internet to Paper.* Sage Publications.
3. Maskus, Keith E. (2012). *Private Rights and Public Problems: The Global Economics of Intellectual Property in the 21st Century.* Peterson Institute for International Economics, Washington, DC.

Online Sources:

1. https://onlinecourses.swayam2.ac.in/ntr24_ed08/preview
2. https://archive.nptel.ac.in/courses/121/106/121106007/
3. https://onlinecourses.nptel.ac.in/noc23_ge36/preview

Research Methodology (Pharmacy)

Course Code: RM II LTP: 4-0-0

Course Objectives

CO1: To introduce students to the concept of research and educational research, fostering an understanding of its nature and scope.

CO2: To cultivate an understanding and appreciation of the different types of research.
CO3: To enhance understanding of the methodological issues involved in research.
CO4: To refine the ability to analyse and implement the research process through the effective articulation of ideas in research.

UNITS	Syllabus	Hours
Unit I	Scientific methods, types of reasoning, and how to choose a research topic. Review past work, find gaps, plan research wisely, and finalize the problem. Understand interdisciplinary thinking and design the research or experiment process	**08**
Unit II	General safety rules, personal and lab safety practices, and how to handle fire hazards, biohazards, and chemicals safely. Understand the use of fire equipment, Material Safety Data Sheets (MSDS), proper storage, and safe waste disposal methods. Know basic first aid, how to report accidents, and how to act quickly to manage emergencies.	**08**
Unit III	Maintain lab records, e-notebooks, manage research progress, and track objectives and timelines. Understand how to report data clearly using inferences, diagrams, graphs, and tables. Use common computational tools and perform basic statistical tests like t-test, ANOVA, chi-square, and others for data analysis.	**08**
Unit IV	Innovation, Intellectual Property Rights (IPR), and early methods like secrecy and trade guilds for protection. Understand basic IPR types like patents, copyrights, trademarks, designs, and how IP laws evolved. Explore patent databases, search methods, process vs product patents, and basics of writing patents and claims.	**08**
Unit V	Scientific writing (including Language proficiency), State-of-the-art scientific literature comprehension, Art and ethics of writing research report/paper, writing of an abstract for scientific community and public. Skills of making PowerPoint presentations, Art of web-meeting interactions & presentations using latest video-meeting modes. Letter writing and official correspondence.	**08**

References:

1. Ethics in Science Education, Research and Governance- Kambadur Muralidhar, Amit Ghosh, Ashok Kumar Singhvi - INSA (2019)
2. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches by John W. Creswell and J. David Creswell
3. The Craft of Research by Wayne C. Booth, Gregory G. Colomb, and Joseph M. Williams

4. Research Methodology: A Step-by-Step Guide for Beginners by Ranjit Kumar
5. Research Methodology: methods and techniques by CR Kothari & Gaurav Garg
6. Introducing Research Methodology: A Beginner′s Guide to Doing a Research Project by Uwe Flick
7. Robert A. Day (1998), How to Write & Publish a Scientific Paper. Oryx Press; 5 edition
8. CSIR Guidelines for Ethics in Research and in Governance - CSIR (2019)
9. Suresh C. Sinha and Anil K. Dhiman, (2002), Research Methodology (2 Vols-Set) Vedams Books (P) Ltd
10. Fink, A., 2009. Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications
11. Wadehra, B.L. 2000. Law relating to patents, trademarks, copyright designs and geographical indications. Universal Law Publishing.

Research Publication and Ethics

Course Code: RPE (Credit 2) **LTP: 2- 0- 0**

Course Outcome:

CO1: Explain fundamental concepts of philosophy and ethics and analyze their impact on moral judgments and ethical decisions in research.

CO2: Identify and critically assess scientific misconduct, emphasizing the importance of integrity and honesty in research.

CO3: Describe ethical standards in publication practices, recognize misconduct, and apply guidelines to address conflicts of interest and unethical behavior.

CO4: Explain the significance of open access publishing and effectively use online tools to identify suitable and ethical publication platforms.

CO5: Learn to utilize research metrics and databases to assess research quality and impact.

UNITS	Syllabus	Hours
Unit I	Introduction to philosophy: definition, nature and scope, concept, branches Ethics: definition, moral philosophy, nature of moral judgements and reactions.	**08**
Unit II	Scientific Conduct Ethics with respect to science and research Intellectual honesty and research integrity Scientific misconducts**:** Falsification, Fabrication, and Plagiarism (FFP). Redundant publications: duplicate and overlapping publications, salami slicing, Selective reporting and misrepresentation of data.	**08**
Unit III	Publication ethics means, its importance, and best practice guidelines like COPE and WAME. Understand conflicts of interest, publication misconduct, unethical behaviour, and authorship issues. Identify misconduct, know how to handle complaints, and be aware of predatory publishers and journals.	**08**
Unit IV	Open access publishing, copyright policies with SHERPA/RoMEO, and tools to avoid predatory journals. Use journal finder tools like JANE, Elsevier Journal Finder, and Springer Journal Suggester to choose the right journal. Understand citation databases (Web of Science, Scopus) and key research metrics like Impact Factor, SNIP, SJR, and h-index.	**06**

Textbooks:

1. Steneck, Nicholas H. (2007). *Introduction to the Responsible Conduct of Research.* Office of Research Integrity. Available at: https://ori.hhs.gov/sites/default/files/rcrintro.pdf
2. Oliver, Paul (2003). *The Student's Guide to Research Ethics.* Open University Press.

Reference Books:

1. Shamoo, Adil E., & Resnik, David B. (2003). *Responsible Conduct of Research.* Oxford University Press.
2. Muralidhar, Kambadur; Ghosh, Amit & Singhvi, Ashok Kumar (Eds.) (2019). *Ethics in Science Education, Research and Governance.* Indian National Science Academy. ISBN: 978-81-939482-1-7.
3. Anderson, B.H., Dursaton, & Poole, M. (1997). *Thesis and Assignment Writing.* Wiley Eastern.
4. Gustavii, Björn (2008). *How to Write and Illustrate Scientific Papers.* Cambridge University Press.
5. Bordens, K.S. & Abbott, B.B. (2008). *Research Design and Methods.* McGraw-Hill.
6. Graziano, A.M. & Raulin, M.L. (2007). *Research Methods – A Process of Inquiry* (6th Ed.). Pearson.

ONLINE COURSES

- https://onlinecourses.swayam2.ac.in/nou22_ge73/preview
- https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/272

Domain Specific

Introduction to Internet of Things and its Applications (ECE I)

Course Code: ECE I (Credit; 4) LTP: 4-0-0

CO1: Understand and critically analyse foundational IoT concepts, architectures, and essential networking protocols to support effective IoT deployments.

CO2: Evaluate advanced IoT communication protocols and wireless sensor network architectures to design robust and application-specific IoT solutions.

CO3: Develop integrated IoT applications by effectively utilizing Arduino and Raspberry Pi platforms, emphasizing device interoperability and embedded programming.

CO4: Apply principles of Software-Defined Networking (SDN), data analytics, and cloud-based frameworks to optimize IoT network management and data-driven decision-making.

CO5: Investigate and demonstrate advanced IoT applications in smart environments, industries, healthcare, agriculture, and related fields through real-world case studies and project-based learning.

UNITS	Syllabus	Hours
Unit I	**Unit 1: IoT Fundamentals and Networking** • **Introduction to IoT:** o IoT concepts, characteristics, and architecture o Core IoT components: Sensing, Actuation, Controllers, Connectivity o IoT system examples and use-cases • **Basics of Networking:** o Fundamentals of networking and communication technologies o Network architectures, topologies, addressing schemes (IPv4, IPv6) o Network layers, protocols (TCP/IP stack	**08**
Unit II	**Communication Protocols and Sensor Networks** • **Advanced Communication Protocols:**	**08**

	○ Wired and wireless communication standards (Ethernet, Wi-Fi, Bluetooth, ZigBee, LoRaWAN, MQTT, CoAP) ○ Protocol characteristics, advantages, and limitations ○ Selection of protocols for specific IoT applications • **Sensor Networks:** ○ Architecture and components of Wireless Sensor Networks (WSNs) ○ Energy efficiency, network topology, routing algorithms ○ Machine-to-Machine (M2M) communication principles and protocols	
Unit III	**IoT Platforms, Programming, and Device Integration** Interoperability in IoT: ○ Challenges and standards for interoperability in heterogeneous IoT systems ○ Semantic interoperability and middleware solutions Embedded IoT Development: ○ Introduction to Arduino: hardware, programming environment, libraries ○ Sensor and actuator interfacing with Arduino, real-world applications IoT with Raspberry Pi: ○ Introduction to Raspberry Pi architecture, operating systems, development tools ○ Python programming for IoT development ○ Building practical IoT applications with Raspberry Pi: Data acquisition, device management, remote monitoring	**08**

Unit IV	**Software-Defined Networking and Data Management**
	• Software-Defined Networking (SDN) for IoT:
	  ○ Introduction to SDN: Principles, architecture, controllers, OpenFlow
	  ○ SDN-driven IoT network optimization and management
	  ○ SDN solutions for scalability, flexibility, and network automation
	• Data Handling and Analytics:
	  ○ IoT-generated data types, challenges, and storage solutions
	  ○ Data analytics methods and tools (real-time analytics, batch analytics, visualization)
	• Cloud and Sensor-Cloud Computing:
	  ○ Cloud computing platforms and models (IaaS, PaaS, SaaS)
	  ○ IoT integration with cloud platforms (AWS IoT, Azure IoT, Google Cloud IoT)
	  ○ Sensor-Cloud systems: integration frameworks, real-time data management, and services
		08

Unit – V	**Emerging IoT Technologies and Industry Applications**
	• Fog Computing:
	  ○ Principles of Fog computing architecture and edge analytics
	  ○ Advantages over cloud computing for latency-sensitive IoT applications
	• Smart Environments and Systems:
	  ○ Smart Cities and Smart Home technologies: infrastructure, challenges, opportunities
	  ○ Connected vehicles and smart transportation systems
	  ○ Smart Grids: communication protocols, architecture, and management
	• Industrial IoT and Domain-specific Case Studies:
	  ○ Industrial IoT (IIoT): architectures, technologies, cybersecurity challenges, and solutions
	  ○ Domain-specific IoT implementations:
	  ▪ Agriculture (precision farming, smart irrigation)
	  ▪ Healthcare (remote patient monitoring, smart medical devices)
	  ▪ Activity Monitoring and Human-centric IoT systems
	• Real-world Case Studies and Research Projects:
	  ○ In-depth analysis of successful IoT deployments and current research directions
	  ○ Student-led IoT research projects, industry collaborations, and scholarly publications
		08

Text Books

1. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)

2. "Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madisetti (Universities Press)

Reference Books

1. A. Bahga and V. Madisetti, *Internet of Things: A Hands-On Approach*. Hyderabad, India: Universities Press, 2014.
2. R. Buyya and A. V. Dastjerdi, Eds., *Internet of Things: Principles and Paradigms*. Cambridge, MA, USA: Morgan Kaufmann, Elsevier, 2016.
3. F. Hu and X. Cao, *Wireless Sensor Networks: Principles and Practice*. Boca Raton, FL, USA: CRC Press, 2010.
4. J. Blum, *Exploring Arduino: Tools and Techniques for Engineering Wizardry*, 2nd ed. Hoboken, NJ, USA: Wiley, 2019.
5. S. Monk, *Programming the Raspberry Pi: Getting Started with Python*, 3rd ed. New York, NY, USA: McGraw-Hill Education, 2021.
6. P. Desai, *Python Programming for Arduino*. Birmingham, UK: Packt Publishing, 2015.
7. C. Goursaud and J.-M. Gorce, *Communication Protocols for the Internet of Things*. London, UK: Wiley-ISTE, 2021.
8. S. Cirani, G. Ferrari, M. Picone, and L. Veltri, *Internet of Things: Architectures, Protocols and Standards*. Chichester, UK: Wiley, 2018.
9. P. Göransson, C. Black, and T. Culver, *Software Defined Networks: A Comprehensive Approach*, 2nd ed. Cambridge, MA, USA: Morgan Kaufmann, Elsevier, 2016.
10. G. S. Aujla and N. Kumar, Eds., *Software Defined Internet of Everything (SDIoE): Principles, Methodologies and Applications*. Cham, Switzerland: Springer, 2022

Domain Specific

Artificial Intelligence and its Applications in IoT

Couse code: ECE II (Credit: 4) LTP: 4-0-0

CO1: Analyze different types of AI and problem-solving agents and evaluate their problem formulation and search strategies based on performance measures.

CO2: Apply constraint satisfaction problem (CSP) techniques and reasoning methods to solve AI-based problems, including uncertainty quantification and probabilistic inference.

CO3: Develop Bayesian networks for probabilistic reasoning, implement inference techniques, and evaluate their efficiency in uncertain environments.

CO4: Demonstrate reinforcement learning principles, apply decision-making techniques in uncertain environments, and analyse sequential decision-making models and game theory applications.

CO5: Design AI-powered IoT solutions using machine learning and deep learning, assess AI-enabled architectures for data processing, security, and automation, and examine real-world case studies.

UNITS	Syllabus	Hours
Unit I	Types of AI, Problem-Solving Agent - problem formulation, searching solution and executing actions. Measuring Problem-Solving Performance- Completeness, Optimality, Time complexity, Space complexity. Types of searching, Uninformed search – Depth first Search, Breadth-first Search, Uniform-cost search, Bidirectional Search.	**08**
Unit II	Basics of Constraint Satisfaction Problems (CSP) in AI, including variables, domains, constraints, and solving methods like backtracking, constraint propagation (AC-3), and local search. Understand different types of constraints (unary, binary, higher-order) and reasoning systems for solving CSPs efficiently, with a case study on AI in e-commerce. Study how AI handles uncertainty using probability, conditional probability, Bayes' Rule, and decision-making under incomplete information.	**08**
Unit III	Probabilistic reasoning using Bayesian networks, compact probability representation, and inference methods for uncertain and structured data. Understand temporal models like Hidden Markov Models (HMM), Kalman Filters, and Dynamic Bayesian Networks (DBN) for time-based predictions. Study Bayesian learning techniques, the Expectation-Maximization (EM) algorithm, and methods for tracking multiple moving objects under uncertainty.	**08**
Unit IV	Basics of Reinforcement Learning (RL), difference between active and passive RL, generalization, and its real-world applications. Understand decision-making concepts like utility theory, decision networks, and expert systems for simple and sequential decisions. Explore multi-agent decision-making using Game Theory, Mechanism Design, and handling uncertainty with POMDPs.	**8**
Unit V	Machine Learning and Deep Learning are used for IoT data analytics, predictive modeling, and real-time decision-making. Understand AI-enabled IoT architectures, smart frameworks, automation, and security challenges in AI-powered IoT networks. Explore case studies in smart cities, healthcare, energy efficiency, and discover future trends in AI-IoT integration.	**8**

Total Lecture Hours: 40 hours

1. *Artificial Intelligence: A Modern Approach* by Stuart Russell and Peter Norvig, Third Edition, Pearson Series in Artificial Intelligence, 2022.
2. A*rtificial Intelligence and Internet of Things: Applications and Technologies* by Lalit Mohan Goyal, R. Balasubramanian, and Anand Nayyar, CRC Press, 2021.
3. *Internet of Things and Artificial Intelligence: Technologies, Applications, and Challenges* by Bothina A. Hassan and Mohamed Elhoseny, Springer, 2022.

Reference Books

1. Artificial Intelligence Engines: A Tutorial Introduction to the Mathematics of Deep Learning by James V. Stone, Sebtel Press, 2019.
2. Artificial Intelligence by Example: Acquire Advanced AI, Machine Learning, and Deep Learning Design Skills by Denis Rothman, 2nd Edition, 2020.
3. Pattern Recognition and Machine Learning by Christopher M. Bishop, Springer, 2006.
4. Introduction to Machine Learning by Ethem Alpaydin, MIT Press, Prentice Hall of India, 2021.
5. Artificial Intelligence for IoT Cookbook: AI Solutions for Edge Computing, Analytics, and IoT Applications by Michael Roshak, Packt Publishing, 2021.
6. AI and IoT for Smart City Applications by L. Ashok Kumar and A. Velmurugan, CRC Press, 2020.
7. Machine Learning for the Internet of Things: Intelligent IoT by M. Anthony Lewis, Packt Publishing, 2021.
8. Ed*ge AI: Machine Learning for Embedded Systems by Xiaofei Wang, Springer, 2020.*

Domain Specific subject

Natural Language Processing

Subject Code: CSE 1 (Credit: 4) LTP: 4-0-0

Course Outcome:

CO1: Gain knowledge in automated Natural Language Generation and Machine Translation.
CO2: Provide the student with knowledge of various levels of analysis involved in NLP.
CO3: Understand the applications of NLP.
CO4: Analyze the semantic analysis of natural language.
CO5: Understand language generation and discourse analysis.

Unit I **8 Hrs**

Introduction and Basic Text Processing:

Regular Expressions Basic Regular Expression Patterns – Finite State Automata, Morphology - Inflectional Morphology - Derivational Morphology. Finite-State Morphological Parsing Porter Stemmer.

Unit II **8 Hrs**

WORD LEVEL AND SYNTACTIC ANALYSIS:

N-grams Models of Syntax - Counting Words Unsmoothed N-grams. Smoothing- Back-off Deleted Interpolation – Entropy - English Word Classes - Tag sets for English Part of Speech Tagging-Rule Based Part of Speech Tagging - Stochastic Part of Speech Tagging - Transformation-Based Tagging, Speeling Correction, Language Modeling .

Unit III **8 Hrs**

CONTEXT FREE GRAMMARS:

Context Free Grammars for English Syntax- Context-Free Rules and Trees -Understand the network simulation tools. Sentence- Level Constructions–Agreement – Sub Categorization. Parsing – Top-down – Early Parsing -feature Structures – Probabilistic Context-Free Grammar. Advanced smoothing for language modelling, POS tagging.

Unit IV **8 Hrs**

SEMANTIC ANALYSIS:

Representing Meaning-Meaning Structure of Language-First Order Predicate Calculus Representing Linguistically Relevant Concepts -Syntax-Driven Semantic Analysis - Semantic Attachments -Syntax-Driven Analyzer. Robust Analysis - Lexemes and Their Senses - Internal Structure - Word Sense Disambiguation -Information Retrieval. Consistency parsing, lexical and distributional Semantics.

Unit V **8 Hrs**

LANGUAGE GENERATION AND DISCOURSE ANALYSIS:

Discourse -Reference Resolution - Text Coherence -Discourse Structure – Coherence. Dialog and Conversational Agents - Dialog Acts – Interpretation -Conversational Agents. Language Generation– Architecture-Surface Realizations - Discourse Planning. Machine Translation -Transfer Metaphor– Interlingua – Statistical Approaches, Text Summarization and Text Classification, Sentiment Analysis and opinion Mining.

Textbooks/ Reference Books/ Web References:

1. Deep Learning by Ian Goodfellow, YoshuaBengio, and Aaron Courville, MIT Press.
2. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow by AurélienGéron, O'Reilly Media.
3. Neural Networks and Deep Learning by Michael A. Nielsen, Free Online Book.
4. Deep Learning for Computer Vision by RajalingappaaShanmugamani, Packt Publishing.
5. Deep Reinforcement Learning Hands-On by Maxim Lapan, Packt Publishing.
6. NPTEL course on NLP by Prof . Pawan Goyal,CSE

Domain Specific subject

Digital Image Processing

Subject Code: CSE 2 (Credit: 4) LTP: 4-0-0

Course Objectives:

CO1: To learn and understand the digital image processing.

CO2: To learn and understand various image enhancement technique used in digital image processing.

CO3: To learn and understand various image transform used in digital image processing

CO4: To learn and understand various image restoration technique and methods used in digital image processing.

CO5: To learn and understand various image compression and Segmentation used in digital image processing.

UNIT	Syllabus	Hours
Unit – I	**Introduction to Digital Image Processing:** Basic concept and real-world applications of image processing, Types of Images: Grayscale, color images (RGB), and binary images. Understanding Pixels, Image resolution and basic structure of an image, Human Visual System (HVS), Image Sampling and Quantization, Some basic relationships like Neighbours, Connectivity, Distance Measures between pixels, Linear and Non-Linear Operations.	**8**
UNIT-2	**Image Enhancement in different Domains:** Image Enhancement in the Spatial Domain: Some basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic and Logic operations, Basics of Spatial Filters, Smoothening and Sharpening Spatial Filters, Combining Spatial Enhancement Methods. Image Enhancement in the Frequency Domain: Introduction to Fourier Transform and the frequency	**8**
Unit 3	**Image Restoration:** A model of The Image Degradation / Restoration Process, Noise Models, Restoration in the presence of Noise Only Spatial Filtering, Pereodic Noise Reduction by Frequency Domain Filtering, Linear Position Invarient Dedradations, Estimation of Degradation Function, Inverse filtering, Wiener filtering, Constrained Least Square Filtering, Geometric Mean Filter, Geometric Transformations.	**8**
Unit 4	**Image Segmentation and Feature Extraction:** Image Segmentation: Detection of Discontinuities, Edge linking and boundary detection, Thresholding, Region Oriented Segmentation, Motion based segmentation. Representation and Description: Representation, Boundary Descriptors, Regional Descriptors, Use of Principal Components for Description, Introduction to Morphology, Some basic Morphological Algorithms. Object Recoginition: Patterns and Pattern Classes, Decision-Theoretic Methods, Structural Methods.	**8**
Unit 5	**Image Compression and Applications:** Image Compression: Coding, Interpixel and Psychovisual Redundancy, Image Compression models, Elements of Information Theory, Error free comparison, Image compression standards Lossless vs lossy compression, Run-length encoding, Huffman coding, JPEG, PNG, and other compression algorithms	**8**

Recommended Textbooks

1. Rafael C Gonzalez, Richard E Woods, "Digital Image Processing" - 2nd Edition, Pearson Education 2003

2. Jain A.K., "Fundamentals of Digital Image Processing", Pearson education References
3. William K Pratt, "Digital Image Processing", John Willey 2001
4. Millman Sonka, Vaclav Hlavac, Roger Boyle, Broos/Colic, "Image Processing Analysis and Machine Vision" - Thompson Learning, 1999.
5. Chanda S., Dutta Majumdar - "Digital Image Processing and Applications", Prentice Hall of India, 2000.

Web resources:

1. http://www.nptel.iitm.ac.in/courses/Webcourse-contents/IIT-KANPUR/Digi_Img_Pro

2. https://www.coursera.org/learn/introduction-image-processing

Domain Specific Subject

Cloud Computing

Course Code: CSE 3 (Credit: 4) TP: 4-0-0

Course Outcomes

CO1: Explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, and what characteristics, advantages, and challenges were brought about by the various models and services in cloud computing.
CO2: To provide students with the fundamentals and essentials of cloud computing architecture.
CO3: Identify resource management fundamentals, i.e., resource abstraction, sharing, and sandboxing, and outline their role in managing infrastructure in cloud computing.
CO4: To provide students with a sound foundation of cloud computing to start using and adopting cloud computing services and tools in their real-life scenarios.
CO5: To further study cloud security and its uses in different network systems.

Unit	Syllabus	Hours
Unit I	**Overview of Computing Paradigm**: Recent trends in Computing: Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing Evolution of cloud computing Business driver for adopting cloud computing Introduction to Cloud Computing Cloud Computing (NIST Model) **Introduction to Cloud Computing**: History of Cloud Computing, Cloud service providers, Properties, Characteristics & Disadvantages, Pros and Cons of Cloud Computing, Benefits of Cloud Computing, Cloud computing vs. Cluster computing vs. Grid Computing, Role of Open Standards.	**8**
UNIT 2	**Cloud Computing Architecture**: Cloud computing stack Comparison with traditional computing architecture (client/server), Services provided at various levels, How Cloud Computing Works, Role of Networks in Cloud computing, protocols used, Role of Web services Service Models (XaaS) Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS) Deployment Models Public cloud, Private cloud, Hybrid cloud, Community cloud	**8**
Unit 3	**Infrastructure as a Service (IaaS)**: Introduction to IaaS IaaS definition, Introduction to virtualization, Different approaches to virtualization, Hypervisors, Machine Image, Virtual Machine (VM) Resource Virtualization Server, Storage, Network Virtual Machine (resource) provisioning and manageability, storage as a service, Data storage in cloud computing (storage as a service) Examples Amazon EC2 Renting, EC2 Compute Unit, Platform and Storage, pricing, customers Eucalyptus Platform as a Service (PaaS) Introduction to PaaS What is PaaS, Service Oriented Architecture (SOA) Cloud Platform and Management Computation Storage Examples Google App Engine Microsoft Azure Software as a Service (PaaS) Introduction to SaaS, Web services, Web 2.0, Web OS, Case Study on SaaS	**8**
Unit 4	**Service Management in Cloud Computing**: Service Level Agreements (SLAs), Billing & Accounting, Comparing Scaling Hardware: Traditional vs. Cloud, Economics of scaling: Benefitting enormously, Managing Data, Looking at Data, Scalability & Cloud Services, Database & Data Stores in Cloud, Large Scale Data Processing	**8**

Unit 5	**Cloud Security:** Infrastructure Security Network level security, Host level security, Application level security Data security and Storage Data privacy and security Issues, Jurisdictional issues raised by Data location Identity & Access Management, Access Control, Trust, Reputation, Risk, Authentication in cloud computing, Client access in cloud, Cloud contracting Model, Commercial and business considerations	**8**

References:

1. Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010 •
2. Cloud Computing: Principles and Paradigms, Editors: James Broberg, Andrzej M. Goscinski, Wiley, 2011, Rajkumar Buyya,
3. Cloud Computing: Principles, Systems and Applications, Editors: Nikos Antonopoulos, Lee Gillam, Springer, 2012
4. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010

Domain Specific Subject

Blockchain, Cybersecurity & Emerging Technology

Course Code: CSE 4 (Credit: 04) LTP: 4-0-0

Course Outcomes

CO1: Understand and articulate the principles of Cyber Security and Blockchain technologies.
CO2: Analyse security threats and propose mitigation strategies using blockchain technology.
CO3: Design and implement secure smart contracts for decentralized applications.
CO4: Investigate and assess blockchain security mechanisms, including consensus protocols and network threats.
CO5: Apply advanced blockchain concepts to solve real-world cyber security problems in diverse domains.

UNITS	Syllabus	Hours
Unit – I	**Blockchain Basics:** Bitcoin & Blockchain, Blockchain Structure, Basic Operations, Distributed ledger technology, Cryptographic principles, Consensus mechanisms, Blocks, Chains, Nodes, Miners, Types of Blockchain: Public, Private, and Consortium Blockchains, Blockchain for secure data , transmission, integrity, and privacy **Cybersecurity Basics:** Cyber Security Concepts, threats, and attacks, Types of Cyber Threats: Malware, Phishing, Denial of Service, etc.	**8**
Unit – II	**Cryptography and Block chain Security: Cryptographic Fundamentals:** Symmetric and Asymmetric encryption, Hash functions, Digital signatures, Public Key Infrastructure (PKI) and its role in Cyber Security. Blockchain Cryptography: Elliptic Curve Cryptography (ECC), RSA encryption, SHA-256 and its application in Blockchain. Immutability, Integrity, Privacy, and Authentication. Blockchain Security Threats: 51% attacks, Sybil attacks, Smart contract vulnerabilities Cryptographic protocols for Secure Transactions in Blockchain	**8**
Unit – III	**Smart Contracts and Blockchain in Cyber Security Applications:** Introduction to Smart Contracts: Definition, use cases, and working principles, Smart Contract Platforms: Ethereum, Hyperledger, Solana, etc. Blockchain-based Authentication: Multi-factor authentication using Blockchain, Decentralized Identity Management (DID)Privacy Preservation with Smart Contracts: Zero-knowledge proofs, Secure multi-party computation (SMPC).	**8**
Unit – IV	**Blockchain Security Mechanisms and Threat Mitigation:** Consensus Algorithms: Proof of Work (PoW), Proof of Stake (PoS), Delegated Proof of Stake (DPoS), Practical Byzantine Fault Tolerance (PBFT). Blockchain Network Security: Node security, Peer-to-Peer network security Blockchain Attack Vectors: 51% attack, Eclipse attack, Double-spending attacks, Tools and techniques for securing blockchain systems, Securing Blockchain Ecosystem: Wallets, keys, and transactions, Security Auditing in Blockchain: Best practices for blockchain system audits.	**8**

Unit – V	**Advancement in Blockchain Using IOT and Cloud Storage:** Blockchain and IoT Security: Securing IoT devices using Blockchain, Blockchain-based IoT networks, Cloud storage, data integrity, and secure cloud computing, Privacy and Scalability Issues in blockchain: Layer 2 solutions, sharding, off-chain protocols. Blockchain and AI for **Cyber Security:** AI-driven threat detection, anomaly detection using Blockchain ethical and Legal Aspects of Cyber Security and Blockchain: Data protection laws, GDPR, smart contract legality	**8**

References Books

1. Blockchain Basics: A Non-Technical Introduction in 25 Steps Author: Daniel Drescher1st Edition 2017, (Distributed by Apress)
2. Blockchain Revolution: How the Technology Behind Bitcoin and Other Cryptocurrencies is Changing the World: Don Tapscott and Alex Tapscott1st Edition 2016
3. Cybersecurity and Cyberwar: What Everyone Needs to Know P.W. Singer and Allan Friedman 2014, Oxford University Press
4. Mastering Bitcoin: Unlocking Digital Cryptocurrencies :Andreas M. Antonopoulos , 2nd Edition 2017, Reilly Media Press

Web References:

https://www.coursera.org/learn/blockchain-platforms?specialization=blockchain#modules

Domain Specific Course (Pharmacy) through NPTEL

Subject Code: DSPH (Credit: 04) **LTP: 4 0 0**

For Domain Specific (Pharmacy) Swayam NPTEL Courses
Visit Link: https://onlinecourses.nptel.ac.in/ (A minimum of 4 credits is required)

S. No	Courses	Conducted By
1.	Indian traditional medicinal and aromatic plants	Govt College of Pharmacy, Amravati, Maharastra Dr. Sharada L Deore

2.	Pharmacognosy And Metabolic Engineering	IIT Guwahati Prof. Aninpunya Mita, Dept of agricultural food engineering, IIT, KHARAGPUR
3.	Molecular Biology	DR. NAYAN K. JAIN, Course Co-ordinator (Principal Investigator) SWAYAM MOOCs-Gujarat University. drnj11@yahoo.co.in
4.	Molecular Cell Biology	IIT Madras Prof. D. Karunagaran Department of Biotechnology
5.	Basics of Biology	Prof. Vishal Trivedi, IIT Guwahati
6.	Molecular Cell Biology	IIT Madras Prof. Devarajan Karunagaran
7.	Nutrition, Therapeutics and Health	Dept. of FDNT Prof. Jayashankar Telangana State Agricultural University Dr. V. Vijaya Lakshmi (Instructor Incharge)
8.	Cancer Fundamentals	Indian Cancer Society By Mrs Jyotsna Govil |
9.	Basic Course in Biomedical Research,	ICMR - National Institute of Epidemiology ultifaculty
10.	Experimental Biochemistry	IIT Kharagpur, Prof. Swagata Dasgupta, Prof. Soumya De
11.	BioInformatics: Algorithms and Applications	IIT Madras Prof. Michael Gromiha
12.	Cancer Fundamentals	Indian Cancer Society Mrs Jyotsna Govil
13.	Basic Course in Biomedical Research	ICMR - National Institute of Epidemiology Multifaculty
14.	Experimental Biochemistry	IIT Kharagpur, IIT Kharagpur Prof. Swagata Dasgupta, Prof. Soumya De
15.	Biostatistics and Design of experiments	IIT Madras Prof. Mukesh Doble
16.	Fundamentals of Spectroscopy|	NCL Pune, IISER Pune Prof. Sayan Bagchi, Prof. Anirban Hazra
17.	Food and Nutrition	Department of Studies in Food Science and Nutrition, University of Mysore. Dr. Asna Urooj
18.	Basic Organic Chemistry	IIT Guwahati Dr. Tharmalingam Punniyamurthy
19.	Experimental Biotechnology	IIT Guwahati by Dr. Vishal Trivedi
20.	Molecular Biology	IIT Guwahati Prof. Vishal Trivedi
21.	Microbial Biotechnology	IIT Guwahati by Prof. Utpal Bora

Domain Specific Subjects (English)

Subject Code: ENGL LTP: 4-0-0

Course Objectives:

- To explore contemporary developments in English language studies and literary theories.
- To examine the influence of globalization and digital media on literature.
- To analyze modern linguistic trends and their impact on communication.
- To engage with recent literary movements and critical perspectives.

Unit	Topics	Hours
Unit-1	**Unit I: Evolution of English Language in the Contemporary Era:** o Globalization and English as a Lingua Franca o Varieties of English: World Englishes, Pidgin & Creole o Role of Digital Media and Technology in Language Change	8
Unit-2	**Unit II: Modern Trends in Linguistics** o Cognitive Linguistics and Language Acquisition o Discourse Analysis in Contemporary Communication o Stylistics and Pragmatics in Modern Literature	8
Unit-3	**Unit III: Contemporary Literary Theories and Criticism** o Postmodernism and Postcolonialism o Eco-criticism and Environmental Literature o Feminist, Queer, and Gender Studies in Literature	8
Unit-4	**Unit IV: Popular and Emerging Literary Forms** o Graphic Novels, Web Literature, and Hypertext Fiction o Contemporary Poetry o Dalit Literature o Autofiction and Experimental Writing	8
Unit-5	**Unit V: Global and Indian English Literature in the 21st Century** o Contemporary Indian Writing in English o Diasporic Literature:Indian-American Diasporic Literature o Dalit Literature o Protest Literature and Political Writing	8

Books & Resources:

1. Modern Linguistics: An Introduction by S.K Verma & N. Krishnaswamy. OUP.
2. Contemporary Literary and Cultural Theory: Pramod K. Nayar, Pearson Publication, Ist Edition.
3. Dalit Literature: Reality of marginalized Communities in India, M.S. Wankhede. Yking books. First Edition. 2019
4. World Literature in Your Fist: An Assortment of English Literature by Prem Shankar Pandey. Rigi Publication, Second Edition. 2019
5. The Literature of Indian Diaspora: Theorizing and Diasporic imaginary by Vijay mishra. Taylor & Francis. 2007
6. Gender Studies: https://acrobat.adobe.com/id/urn:aaid:sc:AP:fb81b808-3d4f-4041-897c-eafde17de3fa

Recommended Books

1. Developing Theory through Qualitative Inquiry. Sage Publications. 2022
2. Digital Literacy Unpacked by Katherine and Jo Parker. Facet Publishing. Latest Edition.
3. Literature in the Digital Age: Reading, Writing, Viewing and Computing. Frank B. Withrow. Rowman & Littlefield. 2003
4. Social Media Storytelling by Marie Elisabeth Mueller and Devadas Rajaram. Taylor & Francis. First Edition. 2022

Web resources:

https://acrobat.adobe.com/id/urn:aaid:sc:AP:e893ba30-4c44-4d18-9b7b-6845453f81df

Domain Specific subject

Condensed Matter Physics

Subject Code: PHYS (Credit: 4) **LTP: 4-0-0**

CO1: Understand quantum mechanics and many-body physics in condensed matter systems.
CO2: Apply statistical mechanics to phase transitions and critical phenomena.
CO3: Analyze electronic, structural, and superconducting properties of materials.
CO4: Interpret electromagnetic, optical, and magnetic properties in condensed matter.
CO5: Utilize computational and experimental techniques for material investigation.

Unit	Topics	Hours
Unit 1:	Quantum Mechanics and Many-Body Systems Many-body physics, second quantization, perturbation theory, Green's functions, topological phases, quantum transport	**8**

Unit 2:	Statistical Mechanics and Phase Transitions Equilibrium and non-equilibrium statistical mechanics, renormalization, critical phenomena, quantum criticality	**8**
Unit 3:	Solid-State Physics and Electronic Properties Crystal structures, band theory, phonons, superconductivity, correlated systems, quantum materials	**8**
Unit 4:	Electromagnetic and Optical Properties Maxwell's equations in materials, plasmonics, spintronics, magnetotransport, ultrafast dynamics	**8**
Unit 5:	Computational and Experimental Techniques DFT, Monte Carlo, spectroscopy, transport measurements, scanning probe microscopy	**8**

Textbooks

1. C. Kittel, *Introduction to Solid State Physics*, Wiley.
2. N.W. Ashcroft and N.D. Mermin, *Solid State Physics*, Brooks/Cole.
3. J.M. Ziman, *Principles of the Theory of Solids*, Cambridge University Press.
5. A.J. Dekker, *Solid State Physics*, Macmillan.
6. G. Burns, *Solid State Physics*, Academic Press.
7. M.P. Marder, *Condensed Matter Physics*, Wiley.
8. Mahendra K. Verma, *Practical Numerical Computing Using Python: Scientific & Engineering Applications*.
9. D.W. Heermann, *Computer Simulation Methods in Theoretical Physics*, Springer.
10. H. Gould and J. Tobochnik, *An Introduction to Computer Simulation Methods*, Addison-Wesley.

Web resourse:

https://www.classcentral.com/course/swayam-advanced-condensed-matter-physics-10001