

MINUTES OF THE SPECIAL COMMITTEE WHOSE AGENDA WAS CIRCULATED VIA EMAIL ON OCTOBER 14, 2024 FOR CONSIDERATION AND APPROVAL THROUGH CIRCULATION

AGENDA 6: To consider and approve the revised/new course curriculum of the following courses for M.Tech./Ph.D. Programmes (**Annexure A6**):

S.No.	Course Name (Number)	Programme	Status	Proposer
1.	Natural Language Processing (CS-760)	M.Tech (CST)	Revised	Prof. Piyush Pratap Singh
2.	Reliability Analysis and Prediction	M.Tech (CST/Data Science)/Ph.D.	New	Dr. Tirthankar Gayen
3.	Low Power VLSI Design	M.Tech (CST)/Ph.D.	New	Dr. Asutosh Srivastava
4.	VLSI devices and circuits for AI chips	M.Tech (CST)/Ph.D.	New	Dr. Asutosh Srivastava

Resolution: The Special Committee of SC&SS resolved to approve the above.

Natural Language Processing (CS-760)

Unit 1

Introduction To Artificial Intelligence And Its Application, Introduction Of NLP, History And Evolution Of NLP, Natural Language Generation, Natural Language Understanding, Natural Language Learning, NLP Application, Optical Character Recognition, Hand Writing Recognizer, Spell Checker, Parsing, POS Taggers, Taggers, Chunking, Named Entity Recognition (Information Extraction).

Unit 2

Semantic Role Labeling (Shallow Semantic Parsing), Syntax Tree, Semantic Net, Word Net, Question Answering, Sentiment Analysis, Speech Recognition Details, Speech to Text, Text To Speech, Speech Segmentation, Text Segmentation, Topic Segmentation, Word Segmentation, Corpus Generation, Corpus Management, Word Sense Disambiguation.

Unit 3

Information System Details, Information Retrieval, Information Extraction, Text Mining, Knowledge Mining, Natural Language Search, Query Expansion, PNL, Preci Writing, Verb Analyzer, Grammatical Analyzer, Text Summarization, Cognition, Perception, Sentiment Analysis, Text Prediction, Sentence Prediction.

Unit 4

Ontological Linguistics, Epistemology, Phonetics, International Phonetic Alphabet, Discourse, Natural Language Programming, Pragmatic Discourse, In-Context Learning.

References:

1. Daniel Jurafsky, James H. Martin, "Speech And Language Processing: An Introduction To Natural Language Processing, Computational Linguistics And Speech Recognition", January 2013, Pearson Education India, Second Edition.
2. R. Kibble, "Introduction To Natural Language Processing", 2013.
3. Ralf Herbrich And Thore Graepel, "HANDBOOK OF NATURAL LANGUAGE PROCESSING", February 2010, Chapman & Hall/CRC Machine Learning & Pattern Recognition Series, Second Edition.
4. Steven Bird, Ewan Klein And Edward Loper, "Natural Language Processing With Python", June 2009, O'Reilly Media, Inc., ISBN: 9780596516499.
5. Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta & Harshit Surana, "Practical Natural Language Processing: A Comprehensive Guide To Building Real-World NLP Systems", June 2020, O'Reilly Media, Inc., ISBN: 9781492054054.

RELIABILITY ANALYSIS AND PREDICTION

Definitions. Causes and types of failures. Reliability expressions for constant, increasing and decreasing hazard rates. Data Analysis, Probability plots for various distributions (exponential, Weibull, Normal and Gamma). Series, Parallel, Series-Parallel, Standby and K-out-of-M modeling. System Reliability evaluation techniques, including methods of bounds, decomposition and transformation techniques. Analysis of dependent failures. Reliability computations using similar and dissimilar stress-strength distributions (exponential, Weibull, normal and Gamma). Time dependent stress-strength distributions, fatigue failures, Software Reliability: Issues and Challenges. Errors: their causes and consequences. Software testing and reliability assessment methods. Human Reliability analysis. Recent trends in reliability assessment.

Suggested reading

1. Charles E. Ebeling, An introduction to reliability and maintainability engineering, McGraw-Hill Education
2. K. B Misra, Reliability Analysis and Prediction: A Methodology Oriented Treatment, Elsevier
3. K.B Misra, New Trends in System Reliability Evaluation, Elsevier
4. Hoang Pham, Software Reliability and Testing, Wiley-IEEE Computer Society Press.
5. Hoang Pham, System Software Reliability, Springer
6. Michael R Lyu, Handbook of Software Reliability Engineering, IEEE Computer Society Press and McGraw-Hill Book Company.
7. B. Kirwan, A Guide To Practical Human Reliability Assessment, CRC Press - Taylor and Francis.



New Courses

1. Low Power VLSI Design

Syllabus

Introduction to Low power CMOS VLSI design. Sources of power dissipation. Low power design Techniques: Voltage scaling, Clock Gating, Power gating, Dynamic Voltage and frequency scaling Multi threshold CMOS. Design for low power: Architectural Techniques, Algorithm optimization, circuit level techniques. Energy efficient memory design: Low power SRAM/DRAM, Non Volatile Memories. Energy harvesting and Power management Power analysis and optimization : static and Dynamic Power analysis. Case studies (low power static RAM architecture).

References:

1. Kaushik Roy and Sharat Prasad "Low Power CMOS VLSI Circuit Design", Wiley (2009).
2. Jan M Rabaey and Massoud Pedram "Low Power Design Methodologies", Springer Science + Business Media (1996).
3. Ajit Pal "Low Power VLSI Design: Circuits and Systems", Springer (2015).

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2. VLSI devices and circuits for AI chips

Syllabus

VLSI Fundamentals for AI Chips Introduction to AI-specific VLSI design requirements. Transistor-Level Design. Design and optimization of logic gates for AI applications. Low-power design techniques. Memory Design for AI Memory hierarchy and architecture for AI chips, Cache design and management for neural network accelerators. Dataflow Architectures in processors Pipelining and parallelism in data processing, Custom data paths for AI workloads. Low power transistors for AI chips.

Power Management, Circuit Reliability and Testing: Fault tolerance and error correction in AI chips. Emerging Technologies e.g. Neuromorphic circuits and brain-inspired computing.

References:

1. Jan M. Rabaey, Anantha Chandrakasan, and Borivoje Nikolic "Digital Integrated Circuits: A Design Perspective", Pearson (2003).
2. Neil Weste and David Harris "CMOS VLSI Design: A Circuits and Systems Perspective", Pearson (2015).
3. Ashutosh Mishra, Jaekwang Cha, Hyunbin Park, Shiho Kim "Artificial Intelligence and Hardware Accelerators", Springer, 2023.

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