INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY
HYDERABAD

Syllabus for Courses of Spring 2025

Date: 09.12.2024 Ver.1

S.No.	Course No	Ccourse Name	Credits L-T-P-C	Faculty Name(s)
1	CS1.406	Advanced Algorithms	3-1-0-4	Suryajith Ch
2	SC3.303	Advanced Bioinformatics	3-1-0-4	Nita Parekh
3	**EC2.411**	Advanced Devices	3-1-0-4	Anshu Sarje
4	CS1.501	Advanced Optimization: Theory and Applications	3-1-0-4	Pawan Kumar
5	CE1.603	Advanced Structural Analysis	3-1-0-4	Pravin Kumar Venkat Rao
6	EC4.501	Advances in Robotics & Control	3-1-0-4	Spandan Roy
7		Algebraic Methods in Reaction Networks	3-1-0-4	Abhishek Deshpande
8	EC2.103	Analog Electronic Circuits	3-1-3-5	Zia Abbas
9	EC2.401	Analog IC Design	3-1-0-4	Abhishek Srivastava
10	CE1.608	Analysis & Design of Precast and Prestressed Structures	3-1-0-4	Shubham Singhal
11	CE1.609	Analysis and Design of Bridge Structures	3-1-0-4	Jofin George
12	CL3.408	Applications of LanguageModels **(H)**	3-1-0-2	Vasudeva Varma
13	CS9.441	Applied Attention Theory **Open Elective**	3-1-0-4	Priyanka Srivastava
14	OC2.102	Arts-2 **(H1&H2)**	2-0-0-2	Saroja TK (Coordinator)
15	HS0.203a	Basics of Ethics **(H1)**	3-0-0-2	Yusuf Indorewala
16	HS0.203b	Basics of Ethics **(H2)**	3-0-0-2	Saurabh Todariya
17	CG3.403	Behavioral Research: Statistical Methods	3-0-1-4	Vishnu Sreekumar + Bapi Raju S
18	SC2.203	Biomolecular Structures **(H1)**	3-1-0-2	Deva Priyakumar

19	PD2.422	Business Finance **(H1)**	3-1-0-2	Sarath Babu
20	SC1.102	Classical Mechanics **(H1)**	3-1-0-2	Diganta Das
21	CG2.401	Cognitive Neuroscience	3-1-0-4	Bhaktee Dongaonkar
22	CG3.501	Cognitive Science and AI	3-1-0-4	Bapi Raju S
23	EC5.203	Communication Theory	3-1-0-4	Sachin Chaudhari
24	CS1.403	Compilers	3-1-0-4	Venkatesh Choppella
25	CL3.101	Computational Linguistics 1	3-1-0-4	Parameswari Krishnamurthy
26	CL2.404	Computational Psycholinguistics	3-1-0-4	Rajakrishnan P Rajkumar
27	CS7.302	Computer Graphics **(H2)**	3-1-0-2	**TBD**
28	CS2.201	Computer Systems Organization	3-1-0-4	Praveen Paruchuri + Deepak Gangadharan
29	CS7.505	Computer Vision	3-1-0-4	Makarand Tapaswi + Ravi Kiran
30	SC4.102	Computing in Sciences II **(H2)**	3-1-0-2	Prabhakar B
31	CS0.302	Computing Tools	3-1-3-4	Sriranjani K
32	MA7.501	Continuous Variable Quantum Information Theory and Computation	3-1-0-4	UttamSingh
33	CS1.201	Data Structures and Algorithms	3-1-3-5	Lini Thomas + Kshitij Gajjar
34	CS4.401	Data Systems	3-1-0-4	Kamal Karlaalem
35	CS4.302	Data Visualisation **(H1)** -	2-0-1-2	Kamal Karlapalem
36	CS6.301	Design and Analysis of Software Systems	3-1-0-4	Raghu Reddy
37	CE5.501	Design of Hydraulic Structures	3-1-0-4	Shaik Rehana
38	**HS4.303**	Digital Democracy and Data Governance	3-1-0-4	Aakansha Natani
39	CS7.303	Digital Signal Analysis	3-1-0-2	Anil Kumar Vuppala
40	CE8.401	Disaster Management	3-1-0-4	Jofin George + Shubham Singhal

41	CS3.401	Distributed Systems Prerequisite: Operating Systems. Networks desirable	3-1-0-4	Lini Thomas
42	CE1.601	Earthquake Engineering	3-1-0-4	Sunitha P
43	SC1.101	Electrodynamics **(H2)**	3-1-0-2	Diganta Das
44	EC2.202	Electronics Workshop II	0-1-3-4	Arti Yardi + Spandan Roy
45	HS8.303	Environmental & Social Governance in Mineral Extraction	3-1-0-4	Radhika Krishnan
46	HS0.217	Ethics and the Digital Society **(H1)**	3-0-0-2	Nimmi Rangaswamy
47	HS0.218	Ethics in Research **(H1 & H2)**	3-0-0-2	Bhaktee Dongaonkar + Vinoo Alluri + Priyanka Srivastava
48	HS2.303	Ethnography in praxis: An investigation into Field, Scales and Theory **(H)**	3-1-0-2	Rajorshi Ray
49	CL3.409	Evaluation Methods for NLP **(H1)**	3-1-0-2	Manish Shrivastava & Parameswari Krishnamurthy
50	EC2.502	Flexible Electronics	3-1-0-4	Aftab Hussain
51	HS8.202	Gender, Culture and Representation	3-1-0-4	Subha Chakraburtty
52	SC2.101	General and Structural Chemistry	3-1-0-4	Tapan Kumar Sau
53	HS0.219	Governance of AI: Ethics and Regulation **(H2)**	3-0-0-2	Amber Sinha
54	HS3.304	Gutenberg Parenthesis	3-1-0-4	Aniket Alam
55	CS9.433	Hydro Informatics **(Max:40) Open Elective**	3-1-0-4	Shaik Rehana
56	EC5.102	Information and Communication	3-1-0-4	Arti Yardi + Lalitha Vadlamani
57	CS8.402	Information Security Audit and Assurance	3-1-0-4	Shatrunjay Rawat
58	CS3.404	Internals of Application Servers	3-1-0-4	Ramesh Loganathan + Arjun Rajashekar
59	EC2.204	Intro to Processor Architecture **(H1)**	3-1-0-2	Deepak Gangadharan
60	EC4.402	Intro to UAV Design	3-1-0-4	Harikumar K
61	CS1.305	Introduction to Algorithms Engineering**(H2)**	3-1-0-2	Kishore Kothapalli
62	CS9.311	Introduction to Brain and Cognition **(H2)**	3-1-0-2	Kavitha Vemuri

63	EC5.205	Introduction to Coding Theory **(H1)**	3-1-0-2	Lalitha Vadlamani
64	CS1.408	Introduction to Game Theory	3-1-0-4	Sujit Gujar
65	HS8.102	Introduction to Human Sciences	3-1-0-4	Aakansha Natani + Ashwin Jayanti (with 4 other HSRC faculty)
66	CS8.301	Introduction to Information Security **(H1)**	3-1-0-2	Ankit Gangwal
67	CS3.303	Introduction to IoT	1-0-3-3	Kavitha Vemuri + Suresh Purini
68	CL1.102	Introduction to Linguistics II	3-1-0-4	Aditi Mukherjee
69	CS7.401	Introduction to NLP	3-1-0-4	Manish Shrivastava
70	SC1.420	Introduction to Particle Physics	3-1-0-4	Subhadip Mitra
71	HS0.204	Introduction to Philosophy of Technology	3-1-0-4	Ashwin Jayanti
72	CS9.312	Introduction to Quantum Information and Computation **(H1)**	3-1-0-2	Uttam Singh
73	CS6.201	Introduction to Software Systems **(H1)**	1-0-3-2	Sai Anirudh Karre
74	GS0.301	Introduction to Spatial Sciences **(H2)**	3-1-0-2	RC Prasad + KS Rajan
75	EC5.206	Introduction to Statistical Signal Processing **(H2)**	3-1-0-2	Santosh Nannuru
76	HS0.220	Language and Power **(H2)**	3-0-0-2	Priya Prithiviraj
77	CL2.204	Language Typology and Universals	3-1-0-4	Radhika Mamidi
78	MA2.101	Linear Algebra	3-1-0-4	Siddhartha Das + Indranil Chakrabarty
79	MA4.303	Linear Partial Differential Equations and Variational Calculus	3-1-0-4	Samyadeb Bhattacharya
80	SC4.411	Machine Learning for Natural Sciences	3-1-0-4	Prabhakar B + Vinod PK
81	CS7.301	Machine, Data and Learning	3-1-0-4	Praveen Paruchuri + Sujit Gujar
82	HS8.101	Making of Contemporary World	3-1-0-4	Anirban Dasgupta + Isha Dubey
83	CS1.503	Mathematical Foundations of Data Science **(Open for MS&PhD Students)**	3-1-0-4	Suryajith Ch + Girish Verma
84	SC3.316	Mathematical Models in Biology	3-1-0-4	Abhishek Deshpande

85	EC4.404	Mechatronics System Design	3-1-0-4	Nagamanikandan + Harikumar K
86	EC4.201	Mechatronics System Design-1 **(H1)**	3-1-0-2	Nagamanikandan + Harikumar K
87	HS3.305	Migrants and Migrations in Modern South Asia	3-1-0-4	Isha Dubey
88	SC2.316	Molecular Modeling and Simulations	3-1-0-4	Deva Priyakumar + Marimuthu Krishnan
89	SC2.315	Molecular Symmetry and Quantum Mechanics	3-1-0-4	Harjinder Singh
90	HS1.209	Music Language Creativity	3-1-0-4	TK Saroja
91	CG4.401	Music, Mind, and Technology **(Open Elective)**	3-1-0-4	Vinoo Alluri
92	CS1.306	Numerical Algorithms **(H2)**	3-1-0-2	Pawan Kumar
93	GS1.401	Optical Remote Sensing	3-1-0-4	RC Prasad
94	CS1.404	Optimization Methods	3-1-0-4	Naresh Manwani
95	SC2.202	Organic Chemistry **(H2)**	3-1-0-2	Prabhakar B
96	PD2.423	Organizational Operations **(H2)**	3-1-0-2	Santanu Mandal
97	CS3.307	Performance Modeling of Computer Systems **(H1)**	3-1-0-2	Tejas Bodas
98	HS0.304	Philosophy of Mind and Cognition	3-1-0-4	Saurabh Todariya
99	SC2.301	Physics of Soft Condensed Matter	3-1-0-4	Marimuthu Krishnan
100	CS8.401	Principles of Information Security	3-1-0-4	Kannan Srinathan
101	PD1.411	Product Design Workshop	3-1-0-4	Prakash Yalla+Raghu Reddy
102	PD2.502	Product Lifecycle Management	3-1-0-4	Ravi Warrier
103	CS1.409	Quantum Algorithms	3-1-0-4	Shantanav Chakraborty
104	EC2.205	Radio Frequency Based Sensors design: Principles and Applications	3-1-0-2	Andleep
105	HS0.302	Research Methods in Human Sciences	3-1-0-4	Isha Dubey + Anirban Dasgupta
106	CS7.405	Responsible & Safe AI Systems	3-1-0-4	Ponnurangam Kumaraguru
107	EC4.403	Robotics: Planning and Navigation	3-1-0-4	Madhava Krishna K

108	HS0.207	Science and Technology: Critical Perspectives **(H1)**	3-0-0-2	Yusuf Indorewala
109	SC1.111	Science II	3-1-0-4	Nita Parekh + Chittaranjan Hens
110	SC4.111	Science Lab II **(H)**	0-0-3-2	Tapan Kumar Sau + Chittaranjan Hens
111	HS7.301	Science, Technology and Society	3-1-0-4	Radhika Krishnan
112	HS2.304	Sociology of Platform Economies	3-1-0-4	Rajorshi Ray
113	CS6.401	Software Engineering	3-1-0-4	Karthik Vaidhyanathan
114	CS3.302	Software Programming for Performance **(H2)**	3-1-0-2	Suresh Purini
115	CS4.410	Spatial Data Sciences	3-1-0-4	KS Rajan
116	EC5.408	Speech Signal Processing	3-1-0-4	Anil Kumar Vuppala
117	SC1.205	Statistical Mechanics **(H2)**	3-1-0-2	Harjinder Singh
118	CS7.403	Statistical Methods in AI	3-1-0-4	Vineet Gandhi + CV Jawahar
119	CS8.403	System and Network Security	3-1-0-4	Ashok Kumar Das
120	CS9.424	Technology Product Entrepreneurship	3-1-0-4	Ramesh Loganathan + Prakash Yalla
121	SC1.308	The Universe Across Scales	3-1-0-4	Subhadip Mitra+Chittaranjan Hens+Diganta Das
122	SC1.204	Thermodynamics **(H1)**	3-1-0-2	Harjinder Singh
123	HS0.201	Thinking and Knowing in the Human Sciences-I	3-1-0-4	Saurabh Todariya + Subha Chakraburtty
124	EC5.402	Time Frequency Analysis	3-1-0-4	Anil Kumar Vuppala + Chiranjeevi Yerra
125	CS8.502	Topics in Information-Theoretic Privacy	3-1-0-4	Gowtham Kurri + Prasad Krishnan
126	CS7.603	Topics in Reinforcement Learning	3-1-0-4	Tejas Bodas + Harikumar K
127	CL5.401	Topics in SSMT	3-1-0-4	Chiranjeevi Yerra + Parameswari Krishnamurthy
128	CS5.401	User Interaction and Usability of Digital Products **(Open Elective)**	3-1-0-4	Raman Saxena
129	OC3.102	Value Education II **(H)**	0-2-0-2	Shatrunjay Rawat (Coordinator)

Title of the Course : Advanced Algorithms

Faculty Name : Suryajith Ch
Course Code : CS1.406
L-T-P : 3-1-0
Credits : 4
Name of the Academic Program : B. Tech. in CSE
Semester& Year : Spring 2025

Prerequisite Course / Knowledge:
Should have taken Introduction to Algorithms, and Formal Languages, or equivalent courses
Course Outcomes (COs):

After completion of this course successfully, the students will be able to..
CO-1 :Demonstrate familiarity with using randomness in computing
CO-2: Apply principles of randomized algorithm design and analyze them for correctness and efficiency
CO-3: Synthesize randomized algorithms with either zero-error or one sided error for a variety of problems

CO-4: Explain the significance of parallelism to modern day computing and problem-solving needs
CO-5: Apply principles and paradigms of parallel algorithm design and analyze parallel algorithms for correctness and efficiency
CO-6: Create efficient parallel algorithms for a variety of semi-numerical problems and problems on graphs
Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	1	2	2	2	1	1	1	2	1	1	1	2	3	1	1	3
CO2	2	3	2	2	1	1	1	2	2	2	1	3	3	1	1	3
CO3	2	2	2	2	1	1	1	2	1	1	1	2	3	1	1	3
CO 4	1	3	2	2	1	1	1	2	2	2	1	3	3	1	1	3
CO5	2	2	2	2	1	1	1	2	2	2	1	3	3	1	1	3
CO 6	2	2	2	2	1	2	1	2	1	1	1	2	3	1	1	3

Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs). Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping Mapping with PSOs, where applicable.

Detailed Syllabus:

Unit 1: Randomness in computing: Tail inequalities and applications, fingerprinting, proofs of existence, expander graphs
Unit 2: randomized rounding, approximate counting

Unit 3: Parallelism in computing: Models of PRAM, Basic algorithms for prefix, search, sort, merge,
Unit 4: Parallel algorithms for lists, graphs,andsymmetry breaking

Reference Books:

1. R. Motwani and P. Raghavan (1995), Randomized Algorithms, Cambridge University Press.USA.
2. J. JaJa (1992), Introduction to Parallel Algorithms, Addison-Wesley, USA.
3. G. Tel (2000).Distributed Algorithms,2nd Edition, Cambridge University Press. USA.

Teaching-Learning Strategies in brief (4 to 5 sentences):

The course lectures will include activities that promote the understanding of the lecture content by using small examples that students work out during the class itself and promote active and participatory learning. A good part of the lecture will involve problem solving and finding solutions to problems rather than expositing known material. In class tests that are held periodically are useful as summative assessments. Homework assignments are designed to reiterate the material covered in class lectures and also solve problems that are based on simple extensions of concepts described in the lectures.

Assessment methods and weightages in brief (4 to 5 sentences):

- Homeworks: 20%
- In-class Objective Tests: 20%
- Quiz1: 15%
- Quiz 2: 15%
- End Exam: 30%

Title of the Course : Advance Bioinformatics

Faculty Name : Nita Parekh
Course Code : SC3.303
L-T-P : 3-1-0
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Credits : 4
Name of the Academic Program : CND
Semester& Year : Spring 2025

1. Prerequisite Course / Knowledge: Bioinformatics Course, Basic Statistics and computing skills

2.Course Outcomes (COs) (5 to 8 for a 3 or 4 credit course):

After completion of this course successfully, the students will be able to
CO-1: Learn, extract and utilize information related to structure-function analysis of proteins
CO-2: Develop methods for various biological data analysis, viz., secondary structure prediction, Hidden Markov model for pattern search, e.g., CpG islands, gene prediction, etc. and sequence comparison (pairwise and multiple sequence alignments), and phylogenetic reconstruction, gene prediction

CO-3: Learn to perform genome analysis to understand evolutionary relatedness between species at various levels, viz., genes, proteins, noncoding conserved regions, horizontally transferred regions, etc.
CO-4: Perform high-throughput data analysis, such as microarray data analysis, computational proteomics, protein interaction networks.
CO-5: Familiarize with various sequence and structural variations in human genome and their functional impact
CO-6: The course provides breadth and depth of various types of bioinformatics data analysis and prepares a student to embark on a research project.

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3												2	2		
CO2		3		3	3										3	3
CO3		3		3	3										3	3
CO4		3		3	3										3	3
CO5		3		3	3										3	3
CO6			3													3

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4.Detailed Syllabus:

Unit 1: Statistical approaches for pattern search. Markov Chains and Hidden Markov models and their applications in identifying CpG islands and gene prediction. Viterbi algorithm, Forward and Backward algorithms, Baum-Welsch algorithm

Unit 2: Genome Variation Analysis. Types of Genomic Variations – Tandem & Interspersed Repeats, Segmental Duplications, SNPs & Haplotypes, Copy Number Variations (CNVs). Polybayes approach to SNP identification, SNP-Haplotypes
Unit 3: Clustering techniques – Distance measures, Linkage rules, Hierarchical clustering. Application to Bioinformatics - In Phylogeny Construction, Clustering of EST Sequences, Clustering of Gene Expression Data, Clustering Mass Spectral Data
Unit 4: Structural classification of Proteins. Statistical, Physico-chemical and machine learning methods, e.g., Chou-Fasman method, GOR method, Nearest Neighbour methods, Neural networks, Patterns of hydrophobic amino acids, Hydrophobic moment, SSP accuracy – Mathews correlation coefficient, Jackknife test, NR-dataset
Unit 5: Protein Structure Prediction. Homology determination based on full-length sequence information – PSI-BLAST, PIRSF, COGs & KOGs, MSA, SSP, Identifying domains, Homology Modeling - Finding a structural template for protein sequence, Homology determination based on 3D-structural information – comparative homology, fold recognition methods, Alignment of sequence to tertiary structure, ab initio methods, Based on sequence and structural motifs, Genetic Algorithm

Unit 6: Comparative Genomics and Proteomics. Genome Analysis, Comparative and Functional Genomics, Role of Conserved Noncoding sequences, Gene Clustering, Horizontal Gene Transfer, Applications of Comparative Genomics. Overview of Proteomics – experimental techniques and computational methods for identifying protein-protein interactions, Protein identification by MS

Reference Books:

1. Bioinformatics Sequence and Genome Analysis, David W. Mount, Cold Spring Harbor Laboratory Press, 2001.
2. Biological Sequence Analysis, Probabilistic Models of Proteins and Nucleic Acids, Richard Durbin, Sean R. Eddy, Anders Kroghs and G. Mitchison, Cambridge University Press 1998.
3. Computational Genome Analysis – An Introduction, Richard C. Deonier, Simon Tavae and Michael S. Waterman, Springer 2005.

5.Teaching-Learning Strategies in brief (4 to 5 sentences):

The objective of the course is to familiarize the students with mathematical, algorithmic, and computational foundations of common tools used in genomics and proteomics. Hands-on sessions on using various bioinformatics resources and implementation of algorithms would give them necessary skills to build similar tools for their research. At the end of the course the students would have a good idea about the computational approaches in biological data analysis and also learn to how to use them intelligently. This would prepare them for their research work.

6.Assessment methods and weightages in brief (4 to 5 sentences):

1. Assignments – written, implementation of algorithms and tutorial session (25%), Class Quizzes + Two Mid-term evaluation (35%), Final exam (40%)

Title of the Course : Advanced Devices

Faculty Name : Anshu Sarje
Course Code : EC2.411
L-T-P : 3-1-0
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Credits : 4
Name of the Academic Program : ECE – VLSI & ES Elective
Semester& Year : Spring 2025

Pre-requisite: Network Theory and Signals, Analog Electronics, Principle of Semiconductor devices

Course Outcomes: After the completion of this course students, should be

1. Explains the principle and working of device (understand)
2. Explain specific behaviour and characteristics observed (explain)
3. Apply the learning to improve device operation and reduce unwanted characteristics (apply)
4. Apply the learning to design new devices and for new applications (apply)
5. Solve design parameter requirement (i.e. device length, cross section, doping) etc (understand and apply)

Course Topics:

Unit1: Review: Semiconductors (Quantum, EK diagram, Transport), MS junctions, PN junction and FETs. Body effect, Subthreshold operation, Effect of Temperature on device characteristics. FINFETs and current sub nanometer devices.

Unit2: Special semiconductors & devices: Fast switching and high temperature devices; Compound Semiconductors, Metal oxide sensors, SiC device, GaAs/GaN devices - properties and applications.

Unit3: Imagers and Optoelectronics. Types of Imagers and how Imagers Work. Noise reduction techniques. LEDs, LASERs and Photovoltaic cells characteristics.

Unit4: Other material: CNT, Graphene, other Nano materials: basic transport phenomenon and applications. Micro-devices using flexible material.

Unit5: Electronic Noises and their type and origins & reduction: Johnson noise, Shot noise, Popcorn noise, Flicker noise.

Unit6: Semiconductor fabrication: Fabrication of MOS device and special devices like EDRAM. Fabrication techniques for sub nm devices.

Unit7: Packaging, Testing and Reliability.

Preferred Textbooks: No single textbook but topics will be taken from multiple books & publications

Semiconductor Physics and Devices by Donal Neamen
Semiconductor Optoelectronics by Jasprit Singh
Fundamentals of modern VLSI devices by Ning & Taur
Device Electronics for ICs by Muller and Kamins
Fundamentals of Semiconductor fabrications by May & Size

References:
IEEE Journal: Electron Devices, Reliability
E-book Links: -
Grading Plan:

Type of Evaluation	Weightage (in %)
Weekly Evaluations in Tutorial	**20**
Class Quiz (weekly)	**20**
Homeworks	**10**
Midterm	**25**
Endterm	**25**

REMARKS:

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	1	3	2	1	1	1	-	2	2	2	3	1
CO2	3	3	3	3	2	2	1	1	1	2	-	2	3	3	3	3
CO3	3	3	3	3	3	2	2	2	1	1	-	3	3	3	3	1
CO4	3	3	3	1	3	3	2	1	1	1	-	3	3	3	3	3
CO5	3	3	3	3	2	2	1	1	1	2	-	2	3	3	3	3

Title of the Course : **Advanced Optimization: Theory and Applications**
Name of the Faculty : Pawan Kumar
Course Code : CS1.501
L-T-P : 3-1-0.
Credits : 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Academic Program: B.Tech. in Computer Science and Engineering

1. Prerequisite Course / Knowledge:
Linear Algebra, Calculus

2. Course Outcomes (COs)

After completion of this course successfully, the students will be able to –

CO-1. Learn basic mathematics tools of convex sets, functions, optimization methods.
CO-2. Learn advanced theory on nonlinear optimization, non smooth, and min-max optimization.
CO-3: Learn to prove convergence estimates and complexity of the algorithms rigorously.
CO-4. Learn to code advanced optimization solvers efficiently using Python.
CO-5. Demonstrate expertise in applying optimization methods in computer science such as data science and machine learning.

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	1	1	1	-	-	2	2	1	3	3	3	1	3

CO2	3	3	3	3	3	1	-	-	2	2	1	3	3	3	2	3
CO3	1	3	1	3	1	-	-	-	2	2	1	3	3	3	2	3
CO4	1	2	3	2	3	-	-	-	2	2	3	3	3	3	2	3
CO5	3	3	3	3	3	-	-	-	2	2	3	3	3	3	2	3

'3' in the box denotes 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4. Detailed Syllabus:

Unit 1: Review of convexity, duality, and classical theory and algorithms for convex optimization (6 hours)
Unit 2: Nonlinear and non-smooth optimization, projected gradient methods,accelerated gradient methods,sub-gradient projection methods, adaptive methods, second order methods, dual methods,solvers for min-max, alternating minimization, EM algorithm, convergence estimates (12 hours)
Unit 3: Applications of advanced optimization: sparse recovery, low rank matrix recovery, recommender systems, extreme classification, generative adversarial methods(6 hours)

- A project related to the above syllabus will be done by students.

References :

- Stephen Boyd and Lieven Vandenberghe, Convex Optimization, Cambridge University Press, 2004.
- Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016.
- Prateek Jain and Purushottam Kar, Non-convex Optimization for Machine Learning, 2017, arXiv. https://arxiv.org/pdf/1712.07897.pdf
- W. Hu, Nonlinear Optimization in Machine Learning, https://web.mst.edu/~huwen/lectures_Nonlinear_Optimization_in_Machine_Learning.pdf

5.Teaching-Learning Strategies in brief:

Lectures by integrating ICT into classroom teaching, weekly tutorials involving problem solving and active learning by students and Project-based Learning by doing one mini-project.

6. Assessment methods and weightages in brief :

Assignments in theory: 15 marks, Mid Semester Examination: 25 marks , End Semester Examination: 30 marks, Assessment of four projects: 30 marks

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Title of the Course : Advanced Structural Analysis
Faculty Name : P. Pravin Kumar Venkat Rao
Course Code : CE1.603

L-T-P : 3-1-0
Credits : 4
Name of the Academic Program : M.Tech in CASE
Semester& Year : Spring 2025

1.Prerequisite Course / Knowledge: Basic Structural Analysis

2.Course Outcomes (COs):
After completion of this course successfully, the students will be able to:

CO 1: Develop the stiffness matrix for prismatic members and have a sound knowledge of matrix computations.

CO 2: Analyze determinate and indeterminate plane and space truss/frame system.
CO3: Derivethe collapse load factors for a given structure
CO4: Understand how standard software packages (routinely used for frame analysis in design offices) operate.

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2	3	3	3	3	3	3	3	1	3	3
CO2	3	3	2	1	3	2	2	3	3	3	2	2	3	3
CO3	3	3	2	2	3	3	3	3	2	3	3	1	3	2
CO4	3	3	2	2	3	3	3	3	3	3	3	2	3	3

4.Detailed Syllabus:

Unit 1: Linear and non-linear analysis, Types of structures, Idealized structure, type of elements, type of connections, Degree of freedom, Degree of static and kinematic indeterminacy.Introduction to stiffness and flexibility approach.

Unit 2: Stiffness matrix for spring, Bar, torsion, Beam (including 3D), Frame, and Grid elements, Displacement vectors, Local and Global co-ordinate system, Transformation matrices, Global stiffness matrix and load vectors, Assembly of structure stiffness matrix with structural load vector, Effect of sinking and rotation of a support.

Unit 3: Analysis of spring and bar assembly, Analysis of plane truss, space truss, plane frame, plane grid and space frames subjected to joint loads, Analysis of structures for axial load, Frames with inclined members, Analysis for member loading (Self, Temperature & Imposed), Inclined supports, Lack of fit, Initial joint displacements, Effect of shear deformation, Inclined roller supports.

Unit 4: Elastic and plastic behaviour of steel, Plastic hinge, Fundamental conditions for plastic analysis, Combination of mechanisms, Theorems of plasticity, Mechanism method, Statical method, Uniformly distributed loads, Continuous beams and frames, Collapse load analysis for prismatic and non-prismatic sections.

Reference Books:

1. Cheng, F.Y. "Matrix Analysis of Structural Dynamics", M. Dekke, NY, 2000.
2. Menon, D. "Structural Analysis", Narosa Publishing House, 2008.
3. Kanchi, M.B. "Matrix Analysis of Structural Analysis", John Willey & Sons, 2nd Edition 1999.
4. Kasmali A. "Matrix Analysis of Structures", Brooks/Cole Publishing Co., 1999.
5. Gere, W. and Weaver, J.M. "Matrix Analysis of Structural Analysis", 3rd Edition, Van Nostrand Reinhold, NY, 1990.
6. Martin, H.C. "Introduction to Matrix Method of Structural Analysis", McGraw Hill Book Co., 1996.
7. Menon, D. "Advanced Structural Analysis", Narosa Publishing House, 2009.
8. Ghali, A., Neville, A.M. and Brown, T.G. "Structural Analysis: A Unified Classical and Matrix Approach" 6th Edition, Chapman & Hall, 2007.
9. Mcguire, W, Gallagher R.H., Ziemian, R.D. "Matrix Structural Analysis", 2nd Edition, John Wiley & Sons, Inc., 2000.
10. Wong, M.B. "Plastic Analysis and Design of Steel Structures", Elsevier Publications, 2009.

5.Teaching-Learning Strategies in brief (4 to 5 sentences):

In this course, the main objective is to enable the student to have a good grasp of all the fundamental issues in these advanced topics in structural analysis, besides enjoying the learning process, developing analytical, and intuitive skills.

6.Assessment methods and weightages in brief (4 to 5 sentences):

Assignments and Quizzes - 40%
Mid Semester Exam - 25%
End Semester Exam - 35%

Title of the Course : Advances in Robotics and Control

Faculty Name	: Spandan Roy
CourseCode	: EC4.501
Name of the Academic Program	: B. Tech. in ECE
L-T-P	: 3-1-0
Credits	: 4
Semester& Year	: Spring 2025

Prerequisite Course / Knowledge:
Should have taken courses Systems Thinking / Introduction to Robotics & Control/ Robotics: Dynamics and Control

Course Outcomes (COs):

After completion of this course successfully, the students will be able to..

CO-1: Demonstrate familiarity with Euler-Lagrange dynamics

CO-2: Apply principles of computed torque method for controller development of a robotic system

CO-3: Understanding the concepts of Lyapunov theory for stability analysis

CO-4: Apply principles of Lyapunov theory for controller design

CO5: Design inversedynamics based robust controller toaddressuncertaintyinrobot dynamics

CO-6: Designadaptive-robustcontrollerforroboticsystemstoaddressunmodelled dynamics

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

	PO1	PO2	PO3	PO4	PO 5	PO6	PO7	PO8	PO9	PO1 0	PO11	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO1	2	3	2	2	1	1	1	2	1	1	1	3	1	1	1	3
CO2	2	3	2	2	1	1	1	2	2	2	1	3	1	1	1	3
CO3	2	3	2	3	1	1	1	2	1	1	1	3	1	1	1	3
CO4	2	3	2	2	1	1	1	2	2	2	1	3	1	1	1	3
CO5	3	3	1	3	1	1	1	2	2	2	1	3	1	1	1	3
CO6	3	3	1	3	1	1	1	2	2	1	1	3	1	1	1	3

Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs). Write'3'intheboxfor'High-level'mapping,2for'Medium-level'mapping,1for'Low'-level' mapping

Mapping with PSOs, where applicable.

Detailed Syllabus:

Unit 1: Introduction to robotic systems and control

Unit 2: Stability analysis and design

Unit 3: Robust control design via inverse dynamics and switching gain

Unit 4: Model reference adaptive control and robust adaptation against uncertainties

Reference Books:

1) Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, Robot Modeling and Control, John Wiley &Sons.

2) Nonlinear Systems by Hassan Khalil, PrenticeHall.

3) Applied Nonlinear Control by Slotine and Lee, PrenticeHall.

Teaching-Learning Strategies in brief (4 to 5 sentences):

Thecourselectureswillincludeactivitiesthatpromotetheunderstandingofthe lecturecontentbyusingsmallexamplesthatstudentsworkoutduringtheclass itself and promote active and participatory learning. A good part of the lecture will involve problem solving and finding solutions to problems rather than expositing known material. Homework assignments are designed to

reiterate the material covered in class lectures and apply them in robotic systems via simulation. The course project will help to read, understand and implement relevant scientificpublications.

Assessment methods and weightages in brief (4 to 5 sentences):

- Assignments:20%
- Project:20%
- Quiz1:15%
- Quiz 2:15%
- End Exam:30%

Title of the Course : Algebraic Methods in Reaction Networks

Name of the Faculty : Abhishek Deshpande

Course Code :

Credits : 4

Type-When : Spring 2025

PRE-REQUISITE : Linear Algebra, Basic Algebra

OBJECTIVE : This course is meant to introduce algebraic techniques used in modeling reaction networks. Applications include analysis of reaction networks, and regions of multistationarity, bistability and oscillations.

COURSE TOPICS :

1) Short treatise on Algebra and Geometry.
2) Binomials and monomial parametrization.
3) Multistationarity in reaction networks
4) Polyhedral geometry, Newton polytopes.
5) Degree theory
6) Bistability and oscillations

PREFERRED TEXT BOOKS:

1) Biochemical reaction networks: an invitation for algebraic geometersby Alicia Dickenstein.

2) Foundations of chemical reaction network theory by Martin Feinberg.

***REFERENCE BOOKS:** 1) Algebraic geometric tools in systems biology by Alicia Dickenstein

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Assignments	25
Midterm I	20
Midterm II	20

Final	**35**

OUTCOME: At the end of the course, students would have

(i) been acclimatized to basic concepts in reaction network theory.

(ii) learnt to use algebraic techniques to solve problems in mathematicalbiology

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Title of the Course : Analog Electronic Circuits

Faculty Name : Zia Abbas
CourseCode : EC2.103
Name of the Academic Program : B. Tech. in ECE
L-T-P : 3-1-3
Credits : 5
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Semester& Year : Spring 2025

1.Prerequisite Course / Knowledge:NeSS, DSM, EW1,

2.Course Outcomes (COs) (5 to 8 for a 3 or 4 credit course):

After completion of this course successfully, the students will be able to..

CO-1 Describe the devices: diode, transistors and their operation.
CO-2 Explain the operation for basic MOSFET & BJT circuits: mirrors, biasing circuits and different amplifier configurations.
CO-3 Draw equivalent circuit and examine the circuit, formulate gain & ac/dc parameters (dc analysis & small signal analysis).
CO-4 Demonstrate simulation of the above mentioned basic circuits, change parameters to obtain desired output.
CO-5 Simulate, plot & perform frequency analysis of amplifiers, predict temperature based behavior and explain mismatch.
CO-6 Design simple MOSFET biasing circuits and amplifiers.
CO-7 Design circuit on breadboard and characterize it.

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1		PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3		1	1	1	1	1	1	1	1	1	1	3	2	2	1	3

CO2	3		3	1	1	1	1	1	1	1	3	1	3	2	3	3	3
CO3	2		2	3	2	1	1	1	1	1	1	1	3	2	2	3	3
CO4	2		1	2	3	3	1	2	1	1	1	1	3	2	3	1	3
CO5	2		2	2	2	3	2	2	1	2	1	2	3	3	3	1	3
CO6	2		1	3	2	1	3	2	1	1	2	3	3	2	2	3	3
CO7	3		3	3	3	3	2	1	2	3	3	3	3	3	2	3	3

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4.Detailed Syllabus:

Unit 1: Semiconductor Basics & P-N junction
Unit 2: MOSFET Operation & Biasing
Unit 3: Single stage Amplifiers

Unit 4: Differential Amplifier & Operational Amp
Unit 5:BJT
Unit6: Misc Topics
Unit7 (Laboratory): Super position theorem, transistor biasing etc.

Reference Books:

1.Fundamentals of Microelectronics by Behzad Razavi
2. Microelectronics Circuits by Sedra and Smith

5.Teaching-Learning Strategies in brief (4 to 5 sentences):

Students will be applying the lecture discussion to solved examples shared with them in the class. The assignments given will reinforce the concepts. Class room learning will be done in interactive method as much as possible. Occasionally self assessment test (1minute paper) will be given. In lab class, students will make simple circuits using simple basic components.

6.Assessment methods and weightages in brief (4 to 5 sentences):

Type of Evaluation [3 credit-lecture]	**Weightage (in %)**

Mid Sem Exam 1	**15***
Mid Sem Exam 2	**15***
End Exam	**15***
Assignments	**25**
Mini Project	**25**
1 minute paper (in class) [weekly prescheduled]	**5**

Title of the Course	**Analog IC Design**
Name of the Faculty	Abhishek Srivastava
Course Code	EC2.401
L-T-P	3-1-0
Credits	4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)	
Academic Program	B.Tech. in Electronics and Communication Engineering
Semester& Year	Spring 2025

1. **Prerequisite Course / Knowledge:**

Analog Electronics, Network theory.

2. Course Outcomes (COs)

After completion of this course successfully, the students will be able to:

CO-1: Analyze different classes of analog amplifiers with respect to linearity and noise

CO-2: Apply the knowledge of design trade-offs and different biasing styles to develop power, noise and area optimized stable analog integrated circuits

CO-3: Analyze the circuit performance with respect to process, supply and temperature variations using theoretical models and SPICE tools

CO-4: Evaluate the topological choices for the basic building blocks of an opamp for the given specifications

CO-5: Design basic building blocks of an opamp such as biasing circuits, amplifiers and common-mode-feedback circuits up to layout level

CO-6: Design a compensated opampuptotapeout level, which will be power-noise-area optimized for the given requirements, and verify its post layout performance using SPICE tools

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2	2	2	-	-	1	3	1	-	2	3	-	-	-
CO2	3	3	3	2	2	-	-	1	3	3	1	3	3	-	-	-
CO3	3	3	3	2	2	-	-	1	3	3	1	3	3	-	-	-
CO4	3	3	3	2	2	-	-	1	3	3	1	3	3	-	-	-
CO5	3	3	3	2	2	-	-	1	3	3	1	3	3	-	-	-
CO6	3	3	3	2	2	2	-	1	3	3	1	3	3	-	-	-

'3' in the box denotes 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping.

1. **Detailed Syllabus:**

Unit 1 (Basics of analog design): MOS model for analog circuits, large signal modeling, incremental modeling, MOS parasitics, mismatches, speed (f_T), passive components for IC design (R, C and L), biasing, negative feedback for biasing, introduction to layout, Gain-BW-Swing-Power-Noise-Area trade-offs. (4-lectures/6-hours)

Unit 2 (Single stage and differential amplifier design): Review of single stage amplifiers, single-ended and differential amplifier design, gm/Id design technique, sub-threshold design technique for low power consumption, techniques to increase gain of amplifiers- active loads, cascode, differential amplifier with current mirror load, mirror pole, stability issues and utility of negative feedback in high gain amplifiers. (7-lectures/10.5-hours)

Unit 3 (Noise): Noise types, noise analysis in analog circuits. (3-lectures/4.5-hours)

Unit 4 (Operational amplifier design): Review of op amp characteristics, CMRR, offset, single stage op amp, high gain op amps - telescopic, two stage, stability and frequency compensation, fully differential amplifier (FDA), common-mode-feedback, review of low noise, low voltage op amp design techniques. (8-lecturs/12-hours)

Unit 5 (Other topics): Layout techniques, effect of off-chip components and packaging on IC design, oscillators, phase noise and PLLs. (4-lectures/6-hours)

REFERENCES:

1. B. Razavi, "Design of Analog CMOS Integrated Circuits," 2nd ed., McGraw Hill, 2017.

2. P. E. Allen and D. R. Holberg, "CMOS Analog Circuit Design," 3rd ed., Oxford, 2013.

3. Paul R. Gray & Robert G. Mayor, "Analysis and Design of Analog Integrated Circuits," 4th ed., JohnWily& Sons, 2008.

5.Teaching-Learning Strategies in brief:

Fundamentals of analog IC design and practical design approaches will be discussed in the course with examples. SPICE tools will be introduced, and regular assignments will be given based on

topics covered in lectures. Weekly tutorials will be conducted for problem solving and further discussions on any questions related to topics covered in lectures. A course project will be given that will involve analysis, design and simulations (schematic and post-layout level) of an analog circuit for given specifications.

1. **Assessment methods and weightages in brief:**

Type of Evaluation	Weightage (in %)
HomeWorks	20%
Course project	20%
Mid Semester Exam-1	15%
Mid Semester Exam-2	15%
End semester exam	30%

Title of the Course : **Analysis &Design of Precast and Prestressed Structures**
Faculty Name : **Shubham Singhal**
Course Code : **CE1.608**
Name of the Program: M.Tech.- Computer Aided Structural Engineering
Credits : 4
L - T - P :3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring, 2025

Pre-Requisites : Solid Mechanics,Structural Analysis, Reinforced Concrete Design

Course Outcomes :

After completion of this course successfully, the students will be able to:

1. Explain the theory and concepts of precast and pre-stressed technology, and identify the challenges in precast construction.
2. Apply the concepts of structural analysis in analysis of precast and pre-stressed reinforced concrete structural elements.
3. Analyze and design precast and pre-stressed reinforced concrete structural elements and their joint connections.
4. Design precast reinforced concrete building using computer software.
5. Develop GUI tool for design of joint connections.

Course Topics :

Unit 1: Introduction
Introduction; Precast versus prefabrication; Pre-stressing and post-tensioning- types, Need and scope; Advantages and challenges; Materials; Construction methodology; Introduction to joints; Types of joints- dry joint and wet joint; Loading on precast elements; Precast building systems- skeletal frame, braced frame, cross-walls, composite system, volumetric system.
Unit 2: Design Philosophy and Criterion
Precast elements: Design philosophy, principles and criteria; Handling, transportation and erection considerations; Functionality considerations; Force transfer mechanism; Progressive collapse; Floor

diaphragm action; Damage pattern and failure modes; Codal provisions, Pre-stressed elements: losses.

Unit 3: Design of Structural Elements

Design of precast beams; Design of precast columns- solid and hollow core; Design of precast slab- solid and hollow forms; Design of precast walls- solid and hollow core, braced and unbraced walls; Design of precast sandwich systems; Design of pre-stressed elementsfor flexure, shear -beams, slabs; Deflection and crackwidth; Transmission of pre-stress, detailing; Stability analysis.

Unit 4: Design of Joint Connections

Joint considerations; Compressive, tensile and shear joints; Flexural and torsional joints; Friction in joints; Horizontal and vertical joints; Mechanical connections and their types; Design of bearing; Design of corbel; Design of beam-column joint connections- reinforcement bars, steel inserts, headed bars, steel plate; Design of column-footing joint connections- dowel connection, socket connection, base plate; Design of wall-wall joint connections- dowel bars, loop connection using steel wire ropes, U-bar loop connection, structural ties; Design of slab-beam connections.

Unit 5: Numerical Simulation

Modeling, analysis and design of precast buildings in software- gravity load and lateral load analysis; Computational seismic evaluation- static and dynamic analysis; Structural assessment and codal compliance; Development of GUI tool in MATLAB for joint connections.

Preferred Textbooks:

1. L H Sai, and P Kjcerbye (2001), "Structural Precast Concrete Handbook", Building andConstruction Authority, 2nd Ed., Singapore.
2. K S Elliott (2019), "Precast Concrete structures", CRC Press, 2nd Ed., USA.
3. M K Hurst (2003), "Prestressed Concrete Design", E & FN SPON, 2nd Ed., London.

Reference Books :

1. H Wilden (2017), "PCI Design Handbook: Precast and Prestressed Concrete", PCI Institute, 8th Ed., Chicago.
2. "Precast Construction Technology", Building Materials & Technology Promotion Council, 2019.

E-book Links :

1. https://www1.bca.gov.sg/docs/default-source/docs-corp-news-and-publications/publications/for-industry/buildability-series/1structural_precast_concrete_handbook_lowres_compressed.pdf
2. http://students.aiu.edu/submissions/profiles/resources/onlineBook/w3s7W6_Precast%20Concrete%20Structures.pdf
3. https://www.pci.org/ItemDetail?iProductCode=EPUB-MNL-120-17&Category=EPUB
4. https://railtec.illinois.edu/wp/wp-content/uploads/Nawy-2009-Prestressed-Concrete.pdf

Grading Plan :

Type of Evaluation	Weightage (in %)
Quiz-1	10
Mid SemExam	15
Quiz-2	10

End Sem Exam	35
Assignments	10
Project	20

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	2	-	3	-	-	-	-	-	-	2	-	2	1
CO2	2	3	1	1	-	1	-	-	-	2	-	-	3	-	2	2
CO3	2	3	1	1	-	1	-	-	-	2	-	-	3	-	2	2
CO4	3	3	3	2	3	2	-	1	-	3	-	-	2	3	3	2
CO5	3	3	3	2	3	2	-	1	-	3	-	-	2	3	3	3

Teaching-Learning Strategies in brief:

Lectures on theoretical concepts and principles, followed by analysis and design examples using manual approach as well as software. Students will be encouraged to apply concepts taught in class in individual assignments and group projects. Project based learning through application of computer software and programming language. Efforts will be made to organize an industrialguest lecture to make students learn about the practical aspects and field implementation of the course.

Title of the Course : **Analysis and Design of Bridge Structures**

Faculty Name : Jofin George

NameoftheProgram : Computer Aided Structural Engineering(CASE)

CourseCode : **CE1.609**

Credits : **4**

L- T -P : 3-1-0

Semester, Year : Spring2025

Pre-Requisites

1. Structural Analysis
2. Basic understanding of Structural Design
3. Strength of Materials

Course Outcomes (COs) :

CO1: Description of basic typologies and structural components of bridges.

CO2: Quantitative comparison of load transfer mechanisms and structural behaviour of different bridge typologies.

CO3: Apply basic concepts of structural modelling of bridges in concurrence with codal recommendations.

CO4: Expertise on Earthquake resistant design of bridges.

CO5: Perform structural analysis and design of bridge infrastructure.

CO6: Evaluate the bridge performance using skills acquired in CO3, CO4 and CO5.

Preferred Textbooks

Chen,W.-F., and Duan,L., (Eds.) (2000), Bridge Engineering Handbook

Reference Books

1. Krishna Raju,N., (2009), Design of Bridges, Oxford & IBH Publishing Company Private Limited, New Delhi.
2. Parke,G., and Hewson,N, (Eds.), (2008), ICE Manual of Bridge Engineering, Second Edition, Thomas Telford Limited, London, UK.
3. Zhao,J.J., and Tonias,D.E., (2012), Bridge Engineering – Design, Rehabilitationand Maintenance of Modern Highway Bridges, Third Edition, McGraw Hill, New York.
4. Priestley,M.J.N., Seible,F., and Calvi,G.M., (1996), Seismic Design and Retrofitof Bridges, John Wiley & Sons, Inc.
5. Hendy,C.R., and Smith,D.A., (2010), Designers' Guide to EN 1992-2 – Eurocode 2 Design of Concrete Structures.
6. Part 2 Concrete Bridges, Thomas Telford Limited, London, UK.

Grading Plan

Type of Evaluation	Weightage (in %)
Quiz-1	10
Mid Sem Exam	20
Quiz-2	10
End Sem Exam	30
Assignments	10
Project	20

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 –Highest)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	1	-	-	-	2	-	1	-	1	1	-	2	1
CO2	3	2	1	-	2	2	-	1	-	2	3	2	2	2
CO3	3	3	2	-	2	1	-	1	-	2	2	2	3	3
CO4	3	3	3	-	2	-	-	1	1	2	3	1	2	3
CO5	3	3	3	-	3	2	-	1	2	3	3	3	3	3
CO6	1	3	1	1	3	2	-	-	1	3	3	-	3	3

Detailed Syllabus

Module 1: Introduction to Bridge Engineering, basic components, Types: Truss, Arch, Concrete, Prestressed, Evolution of bridge typologies and design philosophies. Bridge Span: Simply supported, Balanced cantilever, Continuous. Skewed bridges, Bridge foundation types.

Module 2: Load transfer mechanisms, load distribution, characteristic loads, Structural Modeling: Geometry, Material Properties, and Boundary Conditions; Basics of Earthquake Resistant Design, Codal specifications IRC, IRS, and BIS, Bridge Amplification factor: Significance, estimation.

Module 3: Analysis of bridges: Methods of Analysis: Linear Static; Linear Dynamic response of bridges: Modal Analysis, Vibration Analysis, Nonlinear Static-Geometric & Material Nonlinearities. Choice of analysis method for bridge typologies.

Module 4: Design of Short and Medium Span Bridges: Methods of Design: Design for Multiple Levels of Hazard, Methods of Deterministic Design: Gravity, Earthquake & Temperature Effects, Concrete Beam-and-Slabs: Box Girders: Design. Steel Truss Bridges: Connections, Bridge Bearings: Classification, Substructure Design.

Module 5: Methods of bridge Assessment: Levels: visual inspection, simplified safety checks, thumb rules, equilibrium analysis, limit analysis for arches, Finite element for bridge assessment.

Teaching-Learning Strategies in brief:

1. Classroom Lectures.
2. Bi-weekly tutorials for understanding formulations from first principles and designprocess.
3. Term project for understanding the design process in detail using analytical numericalmethods (Design software).
4. Active learning by students.

Title of the Course **: Applications of Language Models**
Faculty Name : Vasudeva Varma
CourseCode : CL3.408
Credits **: 2**
L- T -P : 3-1-0
Semester, Year **:** Spring 2025
Designed for **:** Research students in CS/CL/Human Sciences
(Max Students: 25)
Prerequisite Course / Knowledge: Introduction to NLP

Course Description:

This course explores the applications of both Large Language Models (LLMs) and Small Language Models (SLMs) across domains, with a primary focus on Education and Healthcare. Students will engage with fundamental principles of language models and learn to design agentic frameworks

that leverage LLMs and SLMs for real-world tasks. The course emphasizes hands-on, project-based learning where students will develop language model-driven solutions for diverse applications.

Course Objectives:

By the end of this course, students will:

- Understand the core architectures and functionalities of LLMs and SLMs.
- Explore the role of agentic frameworks in applying language models to real-world problems.
- Analyse applications of language models in Education and Healthcare.
- Design and implement project-based solutions using language models across multiple domains.
- Critically evaluate the challenges and ethical considerations in deploying LLMs and SLMs.

Detailed Syllabus:

Module 1: Foundations of Language Models

- Introduction to Language Models: Definition, evolution, and comparison between LLMs and SLMs.
- Key Architectures: Understanding transformers, attention mechanisms, and training techniques.
- Small Language Models (SLMs): Strengths, limitations, and specialized applications.
- Introduction to Agentic Frameworks: Using language models for task-specific applications.

Module 2: Applications in Education and Healthcare

- Education: Adaptive learning, personalised learning, scaffolding learning, student assessment, and accessibility.
- Healthcare: Virtual assistants for triage, medical record generation, and AI-powered clinical decision support.
- Ethical Concerns: Addressing bias, fairness, and data privacy in sensitive domains.

Module 3: Broader Applications of Language Models

- Other Domains: LM Applications in domains such as customer service, legal tech, and software development.
- Emerging Trends: Combining language models with multi-modal systems and reinforcement learning agents.

Evaluation:

- **Project (70%):**
    - Students will work in teams to design, implement, and present a project that applies language models to a specific domain, with special focus on Education or Healthcare.
    - Deliverables include proposal, prototype, and final presentation.
- **Class Participation and In-Class Activities (30%):**
    - Active engagement in class discussions and peer reviews.
    - Completion of hands-on activities that complement theoretical concepts.

Teaching Learning Strategy:

This course emphasizes **activity-based and project-based learning** to encourage students to apply theoretical concepts to practical scenarios. We will also employ **flip-classroom model** for a few topics. Each module will include interactive workshops, group discussions, and case studies, promoting a hands-on understanding of language model applications. The project-based structure ensures students gain real-world experience in designing and implementing LLM and SLM solutions for diverse challenges.

Title of the Course : Applied Attention Theory
Faculty Name : Priyanka Srivastava
Course Code : CS9.441
L-T-P : 3-0-1
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Credits : 4
Name of the Academic Program: Open Electives (UG4 and Entry MS)
Semester, Year : Spring 2025

1. **Prerequisite Course / Knowledge:** None
2. **Course Outcomes (COs) (5 to 8 for a 3 or 4 credit course):**

After completion of this course successfully, the students will be able to..

CO-1: demonstrate familiarity with major concepts, theories, models, and overarching themes in attentionalresearch and be able to appreciate the role of attention in our everyday experiences. (Understand Level)

CO2: discuss the role of attention and effort in single and multiple task performances. (understand level)

CO3: discuss the relationship between attention, emotion, and working memory. (understand level)

CO4: design empirical study to investigate attentional phenomena using lab and field observational method.(Create)

CO5: analyze, evaluate, and interpret attentional processing required to perform a given task/ activity. (Apply andAnalyze Level)

CO6: apply research ethics of human/ behavioral sciences to design and conduct empirical study designed toexamine attentional phenomenon/ processing. (Apply)

CO7: communicate about their idea and course project work pertaining to attentional phenomenon/ processing(communication)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	2	1	1	2	2	1	1	1	1	2	1	1	1	1
CO2	2	1	2	2	1	2	2	1	1	1	1	1	1	1	1	1
CO3	2	1	2	2	1	2	2	2	1	1	1	1	1	1	1	1
CO4	2	1	2	3	1	3	1	3	2	3	1	2	1	1	1	1
CO5	1	1	2	3	1	3	1	2	2	3	1	2	1	1	1	1
CO6	1	1	2	3	1	3	1	3	2	2	1	2	1	1	1	1
CO7	1	1	1	1	1	2	1	1	3	3	1	2	1	1	1	1

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write'3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4. Detailed Syllabus:

Unit 1	Unit 2	Unit 3	Unit 4
Introduction	**Emerging Issuesin Attention Applied Research**	**Theory and Applications**	**Course Project**

Nature of Attention Failures of selection in space, time, and limitation; Successesof selection; Information processing theories of attention**(2)**	Affect, Attention,and automation (3)	Single resource theory, automaticity and multiple resource theory of attention (4)	Course project Presentations (AssignedTopic presentation) Idea presentations and Final presentation [finalpresentation will be out of class]
Factors that influence attentional processing (1)	Individual differences in attention and working memory (2)	Attentional control, visual attention and scanning, visual search, spatial attention and displays, resource and efforts (3)	
Limitations and how it canbe improved (1)	Emotional States, Attention, and Working Memory(2)	Concurrent task performance andsequential multitasking (2)	
		Attention and its application indriving, interface design and disorders (2)	
		Attention and Aging (2)	
		Attention and psychological health focusing on SADness (stress, anxiety, and depression)(2)	
Hours: 4.5 hours	**Hours: 10.5 hours**	**Hours: 22.5 hours**	**Hours: 4.5 hours**
Classes: 3	**Classes: 7**	**Classes: 15**	**Classes: 3**
CO1, 2, and 3	**CO1, 2, 3, and 5**	**CO2, 3, 5, and 6**	**CO4, 5, 6, and 7**

Reference Books:

1. The Psychology of Attention. Elizabeth, A. Style. (2005).
2. Applied Attention Theory. Wickens, D. C. & McCarley S. J. (2012).
3. Attention: From Theory to Practice (Series in Human-Technology

Interaction). (2006). Kramer, F.Arthur., Wiegmann, A. Douglas., & Kirlik Alex.

4. Driven to Distraction (revised): Recognizing and Coping with attention deficit disorder. (2011). MdHallowell, M. Edward., & Ratey, J. John.
5. Engineering Psychology and Human Performance (4th Edition). Wickens, D. Christopher., Hollands, G. Justin., Parasuman Raja, & Banbury, Simon. (2012).

Journal Articles: Will be announced before a few key topics.

5. Teaching-Learning Strategies in brief (4 to 5 sentences):

The course will be primarily lecture and project-based learning course. Students will be required to make presentations for the projects. Students will be required to engage in discussions, and to present topics based on the chosen project topics. Each student will be required to do at least two presentations during idea presentation and final project presentation. Students will be encouraged to take assignments and projects inspired from their everyday experiences and will be asked to evaluate the event/phenomenon/ processes critically and scientifically using attentional research paradigm, tasks, and experimental methods. They will be asked to perform some of the activities in team and demonstrate the individual contribution to the team activities. Students may be asked to perform peer review as well.

6. Assessment methods and weightages in brief (4 to 5 sentences):

Assessment Scheme:

S.No.	Component	Count	Weight	Course Outcomes
1.	Assignment/ Home and Class Activities (Studentpresentation)	N=2	10%	CO: 1, 2,3, 5, and 7
2.	Quiz	N=2	15%	CO: 1, 2, 3,5 and 6
3.	Project in Group – 3-4 students	N=1	20%	CO: 4, 5, 6, and 7
4.	Mid Exam	N=1	20%	CO: 1, 2, 3, and 5
5.	Final Exam	N=1	25%	CO: 2, 3,5 and 6
6.	Experiment participation based on credits	N=3	5%	CO:7
7.	Class participation		5%	CO:7
		TOTAL	**100%**	

Grading Policy: Absolute grading policy scheme

A	**>90**

A-	**>80**
B	**>70**
B-	**>60**
C	**>55**
C-	**>50**
D	**>/=45**
F	**< 45**

Academic Honesty:

Do's: Discussion on meaning and interpretation of assignments, general approaches and strategies with otherstudents in the course.

Don'ts: No sharing/copying of assignment with any student who is not in your group for any reason; not asking another student for help debugging your assignment code, method, or topics; no copying of code or document or assignment from any other sources (including internet).

The course will use plagiarism-detection software to check your assignments/ projects/ codes/ exam/ quiz responses. Copying from another student will be treated equally to plagiarism. Violation of any of the above policies, whether you are the giver or receiver of help, will result in zero on the assignment or the respective assessment components and fail the course in case of repetition.

Title of the Course : Arts 1 and 2

Name of the Faculty : Saroja T K

Course code : OC2. 102

L-T-P : 3 Hour a week

Credits : 2-0-0-2

(L= Lecture hours, T=Tutorial hours, P=Practical hours)

Name of the Academic Program: Arts

Semester, Year : Spring 2025

1.Prerequisite Course / Knowledge: None

2.Course Outcomes (COs) (5 to 8 for a 3 or 4 credit course):

After completion of this course successfully, the students will be able to.

CO-1 Understands and appreciate art in a deeper sense, and realize the importance of Art

CO-2 Enhances Imagination and aesthetic sensibility

CO-3 Imparts humanities and artistic skills

CO-4 Understands Art as a system of knowledge

CO-5 Understands the effectiveness of informed Art practice

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	1	1	0	2	1	2	3	1	0	3	0	0	0	0
CO2	1	1	1	1	0	2	1	2	3	1	0	3	0	0	0	0
CO3	1	1	1	1	0	2	1	2	3	1	0	3	0	0	0	0
CO4	1	1	1	1	0	2	1	2	3	1	0	3	0	0	0	0
CO5	1	1	1	1	0	2	1	2	3	1	0	3	0	0	0	0

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4.Detailed Syllabus:

Unit 1: Raga and Rhythm: This course emphasizes understanding the nuances of sound and timing, the basic concepts of any system of music in the world. The students are made to learn different songs, melodic exercises, and rhythmic exercises with a focus on concepts of Indian music and are exposed to the logical elements of the art form in general. The unique concepts of Indian music, raga and tala are introduced to them to make them realize the depth of this system of music and its connections to various branches of study. The introduction of these elements through personal demonstrations, presentation of audio, and videos of acclaimed artists, intends to attract their attention towards the artistic sensibilities, creativity, and discipline in life.

Unit 2: Painting: The course's primary focus is to help students express their ideas and feelings through lines and colors. For this basic drawing and painting skills will be taught to the students in the class. The students will also be given different tasks like oral and visual storytelling,

creating logos, symbols, and portraiture. Through these tasks, the student will understand different ways of visual thinking.
Unit 3: Dance: The course informs the students about the significance of dance, and the training involved to perform the dance movements. The course instructs about basic stretches and fundamental movements of the dance of various Indian dance forms. The knowledge about various dance forms of India and the significance of the dance forms in the past and present is discussed. The course helps the students to compose movements and dance their individual units of movements they create out of the instructions and assistance received. In the course, the emphasis point on evaluation is not based on the dancing skills of the students but on their participation in the session in progress.
Unit 4: Sculpture: The course deals with understanding three-dimensional form and creativity. Clay modelling is a great activity that helps students develop in many ways, like self-expression and creativity. In this course, students are taught to make sculptures out of clay. Through this, I try to connect them to nature. The students get a personal experience of the texture of clay, which is an important part of understanding nature. In this course, they will learn how to use different materials to make art.
Unit 5 Collage: Collage is not just a compilation of photos that we create to share on social media. It's an art form where one assembles images from a magazine or newspapers or photographic images, maps, diagrams by cutting pasting or painting or drawing over it to create a unique composition. Artists have manipulated mass produced images to comment on or question body images and narrow beauty standards, gender stereotypes, consumerism, racism and much more. The aim of this course is to equip students with visual tools to explore the possibility this medium offers through a set of exercises. Students will learn to express their ideas or imagination through the process of selection and deduction and addition.

5.Teaching-Learning Strategies in brief (4 to 5 sentences):

The course is on Imagination, aesthetic sensibility, goodness in life and improving humanities skill. This is achieved by offering training on artistic skills and Art Education. The course does not focus on creating artists out of the students which would be intense, but the course is designed on the thought that the end form is secondary, while the means to achieve is primary. The course introduces the students to the thought and the process of Art creation and Art appreciation. The course explains the confluence of art and other popular knowledge systems.

6.Assessment methods and weightages in brief (4 to 5 sentences):
It is a 2-credit course The semester evaluations are based on the participation of students in the sessions.

Title of the Course	**: Basics of Ethics**
Name of the faculty	: Yusuf Indorewala
Course code	: HS0.203a
L-T-P	: 3-1-0
Credits	: 2
Name of the Academic Programs	: B.Tech. in CSE, B.Tech in ECE
1.Prerequisite Course / Knowledge:	: Nil
Semester, Year	: Spring 2025

2.Course Outcomes (COs)
After completion of this course successfully students will be able to:

CO1: Explain the philosophical nature of the basic concepts and principles of ethics
CO2: Analyze ethical arguments for logical validity, soundness, and informal fallacies
CO3: Demonstrate the knowledge of conceptual challenges involved in normative inquiry in the ethical domain
CO4: Develop skills to formulate fundamental nuances in ethical justification and explanations
CO5. Identify the various kinds of normative elements that constitute ethical frameworks
CO6. Discuss the major tenets of normative ethical theories and their scope of application

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	3	1	1	3	2	3	1	1	-	3	1	1	2	3
CO2	2	2	3	3	2	3	2	3	1	3	1	3	1	1	2	3
CO3	2	2	2	3	1	3	2	3	1	2	1	1	1	1	2	3
CO4	1	2	2	3	1	2	2	3	2	2	-	2	1	2	1	3
CO5	2	2	3	3	1	2	3	3	1	1	1	3	1	2	2	2
CO6	2	2	3	3	1	3	3	3	2	2	1	2	1	1	3	2

'3' in the box denotes 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4.Detailed Syllabus:

Unit I – Introduction (3 hours): Distinction between conventional and critical ethics, philosophical tools for argument analysis, intuition, evidence, justification, and explanation.
Unit II – Skepticism (4.5 hours): Intrinsic vs Instrumental value, challenge of egoism, problem of cultural relativity and subjectivism, error theory and nihilism, distinction between being ethical and seeming ethical.
Unit III – Goodness (3.5 hours): the problem of defining 'good', naturalistic fallacy and the open question argument, implications of the experience machine thought experiment.
Unit IV – Responsibility (3.5 hours): challenge of attributing moral responsibility to agents, the control, competence and epistemic conditions of responsibility, moral luck.
Unit V – Normative theories (5 hours): Consequentialism, deontology, and virtue ethics

Reference books:
1) Shafer-Landau, R. 2019. *Living Ethics: An Introduction with Readings*. Oxford University Press.
2) Shafer-Landau, R. 2013. *Ethical Theory: An Anthology 2nd Edition*. Wiley-Blackwell.
3)Stich, S. and Donaldson. T. 2019. *Philosophy: Asking Questions, Seeking Answers*. Oxford University Press.

5.Teaching-Learning Strategies in brief:

The general teaching strategy employed is the use of moral dilemmas and conceptual puzzles to introduce course topics. Lectures make use of this strategy to impress upon students the need to critically reflect on ethical issues and the relevance of doing a careful, philosophical investigation of those issues. Student interaction at this stage is aimed at bringing out conflicting ethical intuitions. This is followed up by introducing proper vocabulary to map out the problems involved in normative moral assessment. Using case studies and toy examples, ethical principles and methods of inquiry are taught so that students develop effective reasoning skills to engage with any real-world ethical matter. Student interaction and discussion at this stage is aimed to give flesh to the intuitions identified in the previous stage. The teaching-learning strategy emphasizes the merits of avoiding simplistic solutions to complex ethical problems and instead ask meaningful questions that enrich moral debates.

6.Assessment methods and weightages in brief:

This is mainly a writing-driven course, and the exercise questions are carefully designed to make students think independently in ethical contexts. Students are assessed for abilities like logically dissecting issues, questioning assumptions, clarifying distinctions, and bringing out nuances. In assignments and exams, students are expected to demonstrate these abilities by presenting their views clearly, assessing competing positions systematically, anticipating possible objections to a reasoned conclusion and composing cogent responses to those objections. The assessment components and their weightages are as follows. Assignments: 60 marks, class participation: 10 marks, Mid semester exam: 10 marks, End semester exam: 20 marks.

Title of the Course	**: Basics of Ethics**
Name of the faculty	: Saurabh Todariya
Course code	: HS0.203b
L-T-P	: 3-1-0
Credits	: 2
Name of the Academic Programs	: B.Tech. in CSE, B.Tech in ECE
Semester, Year	: Spring 2025

1.Prerequisite Course / Knowledge: : Nil

2.Course Outcomes (COs)

After completion of this course successfully students will be able to:

CO1: Explain the philosophical nature of the basic concepts and principles of ethics
CO2: Analyze ethical arguments for logical validity, soundness, and informal fallacies
CO3: Demonstrate the knowledge of conceptual challenges involved in normative inquiry in the ethical domain
CO4: Develop skills to formulate fundamental nuances in ethical justification and explanations
CO5. Identify the various kinds of normative elements that constitute ethical frameworks
CO6. Discuss the major tenets of normative ethical theories and their scope of application

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	3	1	1	3	2	3	1	1	-	3	1	1	2	3
CO2	2	2	3	3	2	3	2	3	1	3	1	3	1	1	2	3
CO3	2	2	2	3	1	3	2	3	1	2	1	1	1	1	2	3
CO4	1	2	2	3	1	2	2	3	2	2	-	2	1	2	1	3
CO5	2	2	3	3	1	2	3	3	1	1	1	3	1	2	2	2
CO6	2	2	3	3	1	3	3	3	2	2	1	2	1	1	3	2

'3' in the box denotes 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4.Detailed Syllabus:

Unit I – Introduction (3 hours): Distinction between conventional and critical ethics, philosophical tools for argument analysis, intuition, evidence, justification, and explanation.
Unit II – Skepticism (4.5 hours): Intrinsic vs Instrumental value, challenge of egoism, problem of cultural relativity and subjectivism, error theory and nihilism, distinction between being ethical and seeming ethical.
Unit III – Goodness (3.5 hours): the problem of defining 'good', naturalistic fallacy and the open question argument, implications of the experience machine thought experiment.
Unit IV – Responsibility (3.5 hours): challenge of attributing moral responsibility to agents, the control, competence and epistemic conditions of responsibility, moral luck.
Unit V – Normative theories (5 hours): Consequentialism, deontology, and virtue ethics

Reference books:
1) Shafer-Landau, R. 2019. *Living Ethics: An Introduction with Readings*. Oxford University Press.
2) Shafer-Landau, R. 2013. *Ethical Theory: An Anthology 2nd Edition*. Wiley-Blackwell.
3)Stich, S. and Donaldson. T. 2019. *Philosophy: Asking Questions, Seeking Answers*. Oxford University Press.

5.Teaching-Learning Strategies in brief:

The general teaching strategy employed is the use of moral dilemmas and conceptual puzzles to introduce course topics. Lectures make use of this strategy to impress upon students the need to critically reflect on ethical issues and the relevance of doing a careful, philosophical investigation of those issues. Student interaction at this stage is aimed at bringing out conflicting ethical intuitions. This is followed up by introducing proper vocabulary to map out the problems involved in normative moral assessment. Using case studies and toy examples, ethical principles and methods of inquiry are taught so that students develop effective reasoning skills to engage with any real-world ethical matter. Student interaction and discussion at this stage is aimed to give flesh to the intuitions identified in the previous stage. The teaching-learning strategy emphasizes the merits of avoiding simplistic solutions to complex ethical problems and instead ask meaningful questions that enrich moral debates.

6.Assessment methods and weightages in brief:

This is mainly a writing-driven course, and the exercise questions are carefully designed to make students think independently in ethical contexts. Students are assessed for abilities like logically dissecting issues, questioning assumptions, clarifying distinctions, and bringing out nuances. In assignments and exams, students are expected to demonstrate these abilities by presenting their views clearly, assessing competing positions systematically, anticipating possible objections to a reasoned conclusion and composing cogent responses to those objections. The assessment components and their weightages are as follows. Assignments: 60 marks, class participation: 10 marks, Mid semester exam: 10 marks, End semester exam: 20 marks.

Title of the Course : Behavioral Research: Statistical Methods
Course Code : CG3.403
Faculty Name : Vishnu Sreekumar + Bapi Raju
L-T-P : 3-1-0
Credits : 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Semester, Year : Spring 2025

1.Prerequisite Course / Knowledge: None

2. Course Outcomes (COs):
After completion of this course successfully, the students will be able to

CO-1: develop an understanding of various experimental designs
CO-2: recognize and employ appropriate statistical packages to analyzedata
CO-3: apply appropriate parametric and non-parametric analyses techniques
CO-4: perform exploratory data analysis and examine intrinsic relationships between variables
CO-5: reflect and draw appropriate inferences post analyses
CO-6: create custom code by adapting exploratory and confirmatory analyses techniques

3. Mapping of Course Outcomes (COs) with Program Outcomes (POs) and ProgramSpecific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	3	1	1	1	2	1	1	1	1	-	-	-	-	-	-
CO2	2	2	2	3	3	2	1	1	3	1	-	-	-	-	-	-
CO3	2	3	2	3	3	3	1	1	3	1	-	-	-	-	-	-
CO4	2	3	2	3	3	3	1	1	3	1	-	-	-	-	-	-
CO5	1	1	1	1	1	3	1	1	2	1	-	-	-	-	-	-
CO6	2	2	3	3	3	1	1	1	2	2	-	2	1	1	2	3

4. Detailed Syllabus:

Module 1: Introduction to Experimental Design; Foundations of Inferential Statistics

Experimental Design: Literature review, Hypothesis Testing, Type I and II errors, Hypothesis-based vs Exploratory Research, Types of variables and levels of Measurements, Different types of experimental designs: Between-subject and within-subject factors in an experiment; Factorial designs, Simple repeated measures design, Randomized blocks design, Latin square type designs, Foundations of Inferential Statistics, Standardized Distributions, Probability.
Module 2: Parametric tests of difference and association
Parametric tests of difference: Multivariate Analysis, Linear Models (GLM) and Mixed models; Multivariate Regression Techniques, Multi-level tests (ANOVA), MANOVA, ANCOVA, MANCOVA. Main effects and interaction.
Module 3: Non-parametric tests of difference and association
Nonparametric tests of association – chi-square test, Mann Whitney U test, Binomial Sign test, Wilcoxon's T test,
Related and Unrelated t tests; correlation, regression; Power Analysis
Module 4: Multivariate Methods

Multidimensional Scaling, Data Reliability, Tests of Normality and Data Transformation, Outliers, Collinearity in
Data, Data Summarization vs Data Reduction Techniques: Exploratory Factor Analysis, Principal Component Analysis, Multiple Comparison problems
Module 5: Special Topics
Behavioral time-series analysis, Structural Equation Modelling.

Reference Material:

Lecture slides and supplementary reading materials (journal articles, books/book chapters, online resources) will be uploaded on the course page on Moodle.

5. Teaching-Learning Strategies inbrief:

Students will be introduced to the different statistical methods employed in the analysis of behavioral data. The material will be delivered as a combination of lectures and practical sessions. In the practical sessions, students will be provided with data and code snippets to help them practice the concepts taught in the lectures. They will also receive regular problem sets/assignments which will comprise the majority of the course evaluation. We will primarily rely on R for statistical analysis but may also use other tools as deemed appropriate for the material being covered.

6. Assessment methods and weightages in brief:

In-class problem sets = 30%
Take-home assignments and problem sets = 50%
Final Project = 20%

Title of the Course	**: Biomolecular Structures**
Faculty Name	: U Deva Priyakumar
Course Code	: SC2.203
Name of the Academic Program	: CND
L-T-P	: 3-1-0
Credits	: 2
Semester, Year	: Spring 2025

1.Prerequisite Course / Knowledge:
Basic thermodynamics, mathematics, and computing skills

2.Course Outcomes (COs) (5 to 8 for a 3 or 4 credit course):
After completion of this course successfully, the students will be able to

CO-1 Describe how different building blocks of biomolecules assemble to form diverse biomolecular architectures that drive many biological processes
CO-2 Familiarize with different types of biomolecular interactions and analyze how they contribute to the structural and thermodynamic stability of biomolecules and biomolecular complexes
CO-3 Outline different experimental techniques commonly used to characterize the structure and dynamics of biomolecules
CO-4 Interpret experimental binding affinity data using molecular thermodynamic and statistical principles
CO-5 Familiarize with the theory of enzymatic reactions

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2														
CO2	3	2			2									2	2	2
CO3	3	2													1	2
CO4	3	3		1											2	2
CO5	3	1													1	1

4.Detailed Syllabus:
Unit 1: Hierarchy of length and time scales in biological systems and processes
Unit 2: Biological macromolecules: proteins, nucleic acids, lipids, carbohydrates (The building blocks of these biomolecules and their chemical bonding and interactions will be discussed. The following topics will be covered in this module: different amino acids, their classification, dipeptides, conformations, different nucleotides, nucleobases)
Unit 3: Structure and properties of biomolecules: (Levels of protein structure: primary, secondary, tertiary and quaternary structures, Ramachandran plot, double helical structure of DNA, RNA structures, experimental techniques commonly used for analyzing structures and interactions including NMR, ESR, X-Ray, CD, Fluorescence)
Unit 4: Interactions between biomolecules (covalent and noncovalent interactions, base pairing, hydrogen bonding, salt bridges, hydrophobic interactions, solvation, protein-ligand, protein-protein, protein-nucleic acid interactions)
Unit 5: Thermodynamics of protein folding (entropic vs enthalpic factors), energy landscape, structural stability and mutations
Unit 6: Introduction to enzymes, enzyme catalysis, enzyme kinetics, Michaelis-Menten equation
Unit 7: Biomolecular assemblies: biomembranes, chromatin, molecular motors, cellulose, riboswitches

Unit 8: Molecular modeling and docking: concepts and techniques
Unit 9: Biomolecular databases and tools: protein data bank, nucleic acid databases
Unit 10: Dry lab: Models, visualization, calculation of structural properties

Reference Books:
1. Lehninger Principles of Biochemistry - D. L. Nelson and M. M. Cox
2. Biochemistry - L. Stryer et al
3. Fundamentals of Biochemistry: Life at the Molecular Level - J. G. Voet, D. Voet, and C. W. Pratt
5.Teaching-Learning Strategies in brief (4 to 5 sentences):

6.Assessment methods and weightages in brief (4 to 5 sentences):

Quizzes (20%), Assignments (25%), Reading Projects (25%), Final Exam (30%)

Title of the Course : Business Finance

Faculty Name : Sarath Babu
Course Code : PD2.422
Credits : 2 Credits
L - T - P : 1.5 -0- 3
(L - Lecture hours, T-Tutorial hours,
P - Practical hours)
Semester, Year : 2nd Sem
Name of the Program : M. Tech in Product Design and Management program
Semester, Year : Spring 2025
Pre-Requisites : None
Course Objective :

As a part of the Business Finance course, we go over the fundamentals of business finance in the contemporary world. We discuss some basic definitions and concepts of business finance regarding organizations required to understand their financial health concerning the markets. The managers need to know, understand and analyze the three main arms of the organization's financial health. The course will cover the financial statements in detail. The course also covers aspects of assets, liabilities, debits, credits, profit, loss, earning, lending, and a detailed dive into financial ratios. The other main modules we cover are as follows:

- Working capital decision-making,
- forecasting,
- Startup Valuation, and
- Time Value of Money (TVM)

CO-1 Demonstrate a good understanding of an organization's financial health and position through the study of financial statements**.**
CO-2 Demonstrate a good understanding of various Financial Ratios and parameters derived out of the monetary positions of an organization.
CO-3 Demonstrate the ability to understand and analyze the working capital decision-making based on the above parameters and hands-on skills in applying allocation of the working capital.
CO-4 Demonstrate the ability to understand and analyze the valuation exercise as an entrepreneur of one's startup organization and make decisions on the decision making again related to the Use Case Scenarios.
CO-5 Demonstrate the ability to determine, analyze and make decisions as per the Time Value of Money (TVM) of the assets owned in running own businesses.

Course Topics :

- Basics of Business Finance/ Corporate Finance, two sessions
- Financial statements and Ratios, three sessions
- Working capital decision-making, three sessions
- Startup Valuation and entrepreneur's view, three sessions
- Forecasting, two sessions
- Time Value of Money (TVM), three sessions
- Case Scenarios and Case studies, five sessions

Preferred Text Books :
Fundamentals of Financial Management,
Author(s): Eugene F. Brigham | Joel F. Houston
Reference Books :

- Finance: The Basics by Erik Banks. Author: Erik Banks Publisher: Routledge.
- Finance Sense: Corporate Finance For Non-Finance Executives by Chandra Author: Prasanna Chandra

Grading Plan : (The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz-1	**10**
Mid SemExam	**20**
Quiz-2	**10**
End Sem Exam	**40**
Assignments	**20**

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not relevant).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	3	1	3			
CO2	3	3	3	2	3			1
CO3	3	3	3	2	3			3
CO4	3	2	3	2	3			3

CO5				1	1			

Teaching-Learning Strategies in brief (4-5 sentences) :
I believe in inclusive teaching with involvement from the class as much as possible. I tend to keep the teaching and learning hand in hand and ensure we teach, learn and evaluate as we go. This helps students to pace the subject well and also makes them accustomed to the subject in a better way. I keep quizzes and assignments to include them in the classes as much as possible. We keep the Case studies and hands-on culture intact.

Title of the Course : Classical Mechanics

Faculty Name : Diganta Das
Course Code : SC1.102
Credits : 2 Credits
L - T - P : 3-1-0-2
(L - Lecture hours, T-Tutorial hours,
Semester, Year : Spring 2025

1.Prerequisite Course / Knowledge: None

2.Course Outcomes (COs):

After completing this course successfully, the students will be able to

CO-1 **Discover** how symmetry is connected to the conservation laws and **identify** the symmetries of mechanical problems and **select** the suitable generalized coordinates.
CO-2 **Solve** basic mechanics problems using Lagrangian or Hamiltonian formulation
CO-3 **Explain** the basic idea of special theory of relativity and compute simple problems involving length contraction and time dilation.

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	3								1		1		
CO2	2	3	2	3												
CO3	1	3		2										1		1

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4.Detailed Syllabus:

Unit 1: What is Mechanics? The domain of Mechanics. Newtonian formulation. Single-particle dynamics, laws of motion, angular momentum and torque.
Unit 2: Lagrangian formulation. Calculus of variations, Conserved quantities,

Unit 3: Central force motion. Conversion of a 2-body problem to c.m. and relative coordinates, elastic collisions, Rutherford scattering
Unit 4: Small oscillations & rigid body dynamics. Geometric description of mechanics, nonlinear oscillations
Unit 5: Hamiltonian formulation. Liouville Theorem. Virial Theorem
Unit 6: Special theory of relativity

Reference Books:

1. Classical Dynamics of Particles and Systems by S T Thornton and J B Marion
2. Course Of Theoretical Physics, Vol. 1 Mechanics by L D Landau & E M Lifshitz
3. Classical Mechanics by H Goldstein

5.Teaching-Learning Strategies in brief:

This is the basic course on Classical Mechanics. The focus would be on concepts and intuition building with reasonable stress on the underlying mathematical structure.

6.Assessment methods and weights in brief:

Assignments + Quizzes – (60%), Final exam (40%)

Title of the Course : Cognitive Neuroscience

Faculty Name : BhakteeDongaonkar
Course Code : CG2.401
L-T-P : 3-0 -1.
Credits : 4
Semester, Year : Spring 2025

1.Prerequisite Course / Knowledge:

1. Intro topsychology
2. CognitiveScience

2.Course Outcomes (COs) (5 to 8 for a 3 or 4 creditcourse):

A student introduced to the concepts in the course will be able to:
CO-1: Neuroanatomy
CO-2: Brain &Behavior – perceptual systems
CO-3: Techniques for brain imaging
CO-4: Brain signal analysis
CO-5: Clinical case studies
CO-6: Cognitive process – memory, decision making, empathy, learning
CO-7: Ethics of Neuroscience findings

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course ArticulationMatrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	0	2	0	0	0	3	0	0	0	3	0	0	0	4

CO2	3	3	3	3	3	3	1	3	3	3	0	3	2	1	2	4
CO3	3	3	2	4	2	1	2	1	0	1	1	3	3	3	1	4
CO4	3	3	3	3	1	3	1	3	1	1	1	2	2	2	1	4
CO5	3	3	3	3	3	1	1	1	3	2	3	3	2	2	2	4
CO6	2	2	3	3	2	1	1	1	3	1	1	1	2	1	1	4
CO7	1	1	1	1	2	1	4	4	2	1	1	1	2	1	1	4

4. Detailed Syllabus:

OBJECTIVE : Understand the mechanisms of the brain in sensory & higher order cognitiveprocessing.

The course will examine how modern cognitive neuroscientists explore the neural underpinnings of sensory information – vision, sound, touch,taste& smell, the neural processing supporting visual/auditory attention, areas of the brain attributed to motion & depth perception and action; higher order cognitive processes like language processing, memory, empathy/emotion, the theory of intelligence, and decision making. The topics will be introduced after a brief review of neuroanatomy & evolution. The latest research from clinical & non-clinical studies will be presented to the class. Brain imaging techniques like functional magnetic resonance imaging (fMRI) and electroencephalogram (EEG) will be introduced along with the limitations of each in making inferences about the brain functionality. Equal emphasis is on understanding analytical methods and the limitations of each.

The focus will not be on memorizing biological vocabulary details but on understanding principles on the sensory perceptual & cognitive process of human brain which are necessary to design and build any technological interventions.

COURSETOPICS :

(please list the order in which they will be covered)

1. Neuroanatomy &evolution
2. Sensory inputs (vision,auditory, taste,touch,smell)
3. Motion & depth perception andaction
4. Language
5. Memory
6. Decisionmaking
7. Emotion/empathy

Wide topics covering human intelligence and models for AI. Also clinical conditions for each topic will be covered.

Reference Books:

1. Cognitive Neuroscience byGazzaniga
2. Required researchpapers.

5. Teaching-Learning Strategies in brief (4 to 5sentences):

The inclass lectures will cover basics – developmental brain, areas, neurons, followed by discussions based on research findings. As each topic is introduced as case studies supported by videos, the learning is reenforced. Quizzes are conducted periodically to evaluate transfer of knowledge and critical thinking of the implication of each study finding.

6. Assessment methods and weightages in brief (4 to 5sentences):

Type of Evaluation	Weightage (in %)

Mid Sem-1 Exam	15
Mid Sem-2 Exam	15
End Sem Exam	20
Quiz (2)/viva	20
Project/term paper	30
Other Evaluation	

Title of the Course **: COGNITIVE SCIENCE AND AI**
Faculty Name : S. BAPI RAJU
Name of the Program : Computer Science & Engineering (Graduate Elective)
Course Code : CG3.501
L - T–P **: 3-1-0**
Credits **: 4**
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring 2025

Pre-Requisites :
It is preferable that students have taken Introduction to Cognitive Science / Cognitive Neuroscience; a course with emphasis on ML, AI, Neural Networks (such as SMAI); have an aptitude for programming; and familiarity with ML and Deep Learning tools such as Scikit-learn / PyTorch / Keras / TensorFlow. Efforts will be made to run tutorials or assigned practice for course participants who do not have familiarity with the ML/DL programming tools.

CourseOutcomes :

(list about 5 to 6 outcomes for a full 4 credit course)
After completion of this course successfully, the students will be able to...

CO-1: Learn and demonstrate understanding of how basic concepts in machine learning (ML) and deep learning (DL) are applied for problems in neuroscience and cognitive science

CO-2: Demonstrate use of ML/DL algorithms on simple problems in neuroscience and cognitive science.

CO-3: Analyze and evaluate ML/DL algorithms about their ability to unravel the functional architecture of cognition

CO-4: For a selected problem, design computational solutions and evaluate their goodness of fit to the actual empirical data from cognitive neuroscience

CO-5: Create and develop novel solutions in either direction: Cognitive Science-to-AI or AI-to- Cognitive Science and compare their strengths and limitations vis-à-vis existing solutions

CourseTopics :

(please list the order in which they will be covered, and preferably arrange these as five to six modules.)

Module 1: Introduction to cognitive science and neuroscience. A brief tour of the principlesof cognitive science, cognitive architecture, principles of information processing in the brain/mind, brain anatomy and functional parcellation of the brain.

Introduction to AI, Machine Learning (ML) and Deep Learning (DL). Basic introduction to supervised, unsupervised and reinforcement learning paradigms, recent advances in ML and DL withafocusontheirapplicationsinneuroscience.Debatesonthestrengthsandlimitations ofdeep neural networks as models of information processing in the brain as well as models for artificial general intelligence(AGI).

Module2:Vision. Brieftourofrecentdevelopmentsofapplicationofdeepneuralnetworks(DNN) incomputervision.Introductiontohumanperceptualprocessing(withemphasisonvision) andthe neuralcorrelatesoftheperceptualfunction.Therelationbetweentherepresentationofinf ormation across layers (of DNN) and their match with visual cortical areas in the brain. Current knowledge of the perceptual and neural phenomena in human visual system and the ability and lack thereof of deep neural networks in mimicking thesephenomena.

Module 3: Language. Introduction to higher-level cognitive phenomena, including human language processing. Current understanding of the neural correlates of language processing, or the extraction of meaning from spoken or written phrases, sentences, and stories. Recent developments in applying word embedding models and transformer models for brain encoding decoding. Debates about the kind of representations learned in deep learning models and their relation to how brain represents and processes language.

Module 4: Motor function and Skill Learning. Principles of hierarchical motor control in the mammalianbrain,inAIsystemsandtheirrelationship.Applicationoftheconceptsofreinfor cement learning (RL) and deep RL for motor control, relationship to neurotransmitter activity of dopamine and the cortical and subcortical systems participating in motor learning, planning and control. Skill acquisition in humans and machines. Debates about the adequacy of RL-framework for understanding various aspects of skill acquisition such as compositionality, abstraction, curiosity, mental simulation,etc.

Module5:Predictive(Bayesian)Brain. PredictivecodingandtherelatedideasofBayesianB rain and Free Energy Principle -- theoretical frameworks of brain function. Generate-compare-update processofamentalmodeloftheenvironment.DebatesaboutthePredictiveBrainandFree Energy Principle.

Tutorials: Special tutorials will be conducted to familiarize with fMRI experiments, Neuroimaging dataandpreprocessing,ML/DLtoolsandhowtosetupthesetocompleteassignmentsand project.

Preferred Text Books : No text book is available on this topic. Apart from the general reference books, list of readings will be assigned for various topics (sample references given below).

ReferenceBooks :

Grace Lindsey (2021). Models of the Mind: How Physics, Engineering and Mathematics Have Shaped Our Understanding of the Brain. Bloomsbury Publisher (General Reading)

Pearl, J. & Mackenzie, D. (2018). The Book of Why: The New Science of Cause and Effect. Basic Books. (General Reading)

V. Srinivasa Chakravarthy (2019). Demystifying the Brain: A Computational Approach (1st Edition), Springer, Singapore. (General Reading)

Shimon Edelman (2008). Computing the Mind: How the Mind Really Works. New York: Oxford University Press, 2008

Kenji Doya, Shin Ishii, Alexandre Pouget, Rajesh PN Rao (2007). Bayesian brain: Probabilistic approaches to neural coding. MIT press

Rumelhart, D.E., J.L. McClelland and the PDP Research Group (1986). Parallel Distributed Processing: Explorations in the Microstructure of Cognition. Volume 1: Foundations, & Volume 2: Psychological and Biological Models, Cambridge, Massachusetts: MIT Press (Still a classic, highlights various issues in Cognitive Science & Computational Models)

C. M. Bishop (2006). Pattern Recognition and Machine Learning. Springer.

I. Goodfellow, Y. Benjio, A. Courville (2016). Deep Learning. MIT Press

Example Readings/Viewings:

Jacob, RT Pramod, Harish Katti, SP Arun (2021), Qualitative similarities and differences invisual object representations between brains and deep networks, Nature Communications, 12, 1872.https://doi.org/10.1038/s41467-021-22078-3

Martin Schrimpf, Idan Asher Blank, Greta Tuckute, Carina Kauf, Eghbal A. Hosseini, Nancy Kanwisher, Joshua B. Tenenbaum, Evelina Fedorenko (2021). The neural architecture of language: Integrative modeling converges on predictive processing. Proceedings of the National Academy of Sciences Nov 2021, 118 (45) e2105646118; DOI: 10.1073/pnas.2105646118

Marcus, G. (2020). The Next Decade in AI: Four Steps Towards Robust Artificial Intelligence. https://arxiv.org/abs/2002.06177.

Manfred Eppe, Christian Gumbsch, Matthias Kerzel, Phuong Nguyen, Martin V. Butz, and Stefan Wermter (2020). Hierarchical principles of embodied reinforcement learning: A review. arXiv:2012.10147v1

Matt Botvinick (Jul 3, 2020): Neuroscience, Psychology, and AI at DeepMind | Lex Fridman Podcast #106https://www.youtube.com/watch?v=3t06ajvBtlo&ab_channel=LexFridman

Yoshua Bengio and Gary Marcus on the best way forward for AI (Moderated by Vincent Boucher, Dec 2019).https://www.youtube.com/watch?v=EeqwFjqFvJA&ab_channel=Montreal.AI

Merel, J., Botvinick, M. & Wayne, G. Hierarchical motor control in mammals and machines. Nat Commun 10, 5489 (2019). https://doi.org/10.1038/s41467-019-13239-6

Blake A. Richards, Timothy P. Lillicrap, Philippe Beaudoin, Yoshua Bengio, et al. (2019). A deep learning framework for neuroscience. Nature Neuroscience, 22: 1761–1770. https://doi.org/10.1038/s41593-019-0520-2

Doya K, Taniguchi T (2019). Toward evolutionary and developmental intelligence. Current Opinion in Behavioral Sciences, 29, 91-96. http://doi.org/10.1016/j.cobeha.2019.04.006.

Schrimpf M, Kubilius J, Hong H, et al. (2018). Brain-Score: Which Artificial Neural Network for Object Recognition is most Brain-Like?.bioRxiv. 2018. doi:https://doi.org/10.1101/407007

Pereira, F., Lou, B., Pritchett, B. et al. (2018). Toward a universal decoder of linguistic meaning from brain activation. Nat Commun 9, 963 (2018). https://doi.org/10.1038/s41467-018-03068-4

Pearl, J. (2018). Theoretical impediments to machine learning with seven sparks from the causal revolution. arXiv:1801.04016.

Lake, B., Ullman, T., Tenenbaum, J., & Gershman, S. (2017). Building machines that learn and think like people. Behavioral and Brain Sciences, 40, E253. doi:10.1017/S0140525X16001837

Kumaran, Dharshan, Demis Hassabis, and James L. McClelland (2016). "What learningsystems do intelligent agents need? Complementary learning systems theory updated." Trendsin cognitive sciences 20.7 (2016):512-534.

Friston, K. J. The free-energy principle: a unified brain theory? Nature Neuroscience, 11:127– 138, 2010.

E-bookLinks :

GradingPlan :

(The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz-1	**10%**
Mid Sem Exam	**15%**
Quiz-2	**10%**
End Sem Exam	**--**
Assignments / Term Paper / In-class Presentation / Peer Review	**25%**
Project	**40%**
Term Paper	**-- See Above --**

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant). Program outcomes are posted at

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 1 0	PO1 1	PO 12	PSO 1	PSO2	PSO3	PSO4
CO 1	2	1	1	1	1	1	1	1	1	1	1	2	2	1	2	1
CO 2	3	3	1	2	1	1	1	1	1	1	1	2	2	2	3	2
CO 3	2	2	2	3	2	1	1	1	1	1	1	2	2	2	3	2
CO 4	2	3	2	3	3	1	1	1	3	3	1	2	3	2	2	3
CO 5	2	2	3	2	1	1	2	2	2	1	1	3	3	1	3	3

Teaching-Learning Strategies in brief (4-5 sentences):

Lectureswillinitiallyintroducethemotivationsandconcepts,illustratedwithsimplerexamples.This will be followed by assignments and in-class presentation of relevant papers that will ensure that the students are engaged with the methods and the debates. Deeper lectures and final projectare expectedtoleadthestudentstoabroaderbutmoreconcreteunderstandingoftheissuesin Cogsci& AI. The practical (programming) assignments and the final project (with significant programming component) give hands-on experience of application of ML and DL algorithms for problems in cognitiveneuroscience.

Title of the Course : **Communication Theory**
Faculty Name : Sachin Chaudhari
Course Code : **EC5.203**
L-T-P : **3-1-0.**
Credits : **4**
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Academic Program : **B.Tech. in Electronics and Communication Engineering**
Semester, Year : Spring 2025

1.Prerequisite Course / Knowledge:
A prior knowledge of signalsand systems, probability theory, random variables, and random process is required.

2.Course Outcomes (COs) After completion of this course successfully, the students will be able to
CO-1.Explain the basic elements of a communication system.
CO-2. Interpret the complex baseband representation of passband signals and systems and its critical role in modeling, design, and implementation.
CO-3. Explainthe basic concepts and implementations of analog modulation and demodulation techniques.
CO4: Explain different linear digital modulation techniques using constellations such as PAM, QAM, PSK, orthogonal modulation and its variants.
CO-5: Apply the concepts of power spectral density, energy spectral density and bandwidth occupancy, Nyquist pulse shaping criterion for avoidance of intersymbol interference.

CO-6. Derive the optimal demodulation schemes for the digital schemes in the presence of AWGN
CO-7: Evaluate the performance of different digital communications schemes in the presence of AWGN.

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO1	1	1	1	1	1	-	-	-	-	1	-	3	1	3	2	1
CO2	3	3	-	3	3	-	-	-	-	1	-	3	1	3	-	-
CO 3	3	3	-	3	3	-	-	-	-	1	-	3	1	3	2	1
CO 4	3	3	-	3	3	-	-	-	-	1	-	3	1	3	2	1

CO 5	3	3	-	3	3	-	-	-	-	1	-	3	-	3	-	-
CO 6	3	3	-	3	3	-	-	-	-	1	-	3	-	3	-	-
CO7	3	3	-	3	3		-			1	-	3	-	3	-	-

'3' in the box denotes 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4.Detailed Syllabus:

Unit 1: Representation of bandpass signals and systems; linear bandpass systems, response of bandpass systems to bandpass signals, representation of bandpass stationary stochastic processes

Unit 2: Analog Communication Methods: AM-DSB and SSB, PM, FM-narrowband and wideband, demodulation of AM and PM/FM, Phased locked loop (PLL); Brief view of Line Coding and PWM

Unit 3: Digital Modulation: Representation of Digitally Modulated Signals; Memoryless modulation methods: PAM, PSK, QAM, Orthogonal Multi-Dimensional Signals

Unit 4: Random Processes: Review of Correlation, Energy Spectral Density and Power Spectral Desity; Noise Modelling, Thermal Noise, AWGN.

Unit 5: Optimum digital demodulation: Hypothesis testing, Signal Space Concepts, Performance analysis of ML reception, Bit error probability, Link budget analysis

References:

- U. Madhow,"Introduction to Communication Systems," Cambridge University Press, 2014.
- J.G.Proakis, M.Salehi, "Fundamentals of Communication Systems", Pearson Education 2006.
- B.P.Lathi, "Modern Digital and Analog Communication Systems", 3rd Edition, Oxford University Press, 2007.

5.Teaching-Learning Strategies in brief:

Lectures will be integrating ICT into classroom teaching, active learning by students, followed by weekly tutorials involving problem solving,and project-based learning by doing theoretical and simulation assignments.

6.Assessment methods and weightages in brief :

Quizzes: 20
MidSem: 20
Assignments: 20
Final Quiz: 40

Title of the Course : **Compilers**
Faculty Name : Venkatesh Choppella
Course Code : CS1.403
L-T-P : 3-1-0.
Credits : 4
(L = Lecture Hours, T = Tutorial Hours, P = Practical Hours)
Semester, Year : Spring 2025

1. Prerequisite Course / Knowledge:

Computer Programming. Data structures and algorithms. Computer Systems Organization. Operating Systems. Automata Theory.

2. Course Outcomes (COs)

After completion of this course successfully, the students will be able to:

CO-1: Explain the principles and practices underlying production quality compilers such as GCC and LLVM (Cognitive Level: **Understand**)

CO-2: Modify open source compilers such as GCC and LLVM to support new languages and processor architectures; and write custom analysis and transformation passes. (Cognitive Leve: **Apply**)

CO-3: Identify problems or sub-problems in real world projects which can be solved by building custom compilers and interpreters of varying scale and complexity. (Cognitive Levels: **Analyze, Evaluate and Create**)

CO-4: Employ software engineering principles and practices to design, develop and manage complex software engineering tasks. Examples include object oriented design and programming, choosing appropriate design patterns, good support for debugging the system with ease and, develop comprehensive test suite with good coverage. (Cognitive Levels: **Analyze, Evaluate** and **Create**)

CO-5: Use software management tools such as GIT, build systems such as Make/Ant etc. Write proper software design documents and end-user manuals (Cognitive Levels: **Apply**)

3. Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	3	3	-	2	-	-	-	-	2	3	3	3	3
CO2	3	3	3	3	3	-	-	-	-	-	-	2	3	3	3	3
CO3	3	3	3	3	3	-	-	-	-	-	-	2	3	3	3	3
CO 4	2	3	3	3	3	-	-	-	3	3	-	2	3	3	3	3
CO5	2	2	3	3	3	-	-	3	3	3	3	2	3	3	3	3

4. Detailed Syllabus

- **Unit 1: Syntax Analysis**
  - Micro and macro syntax specification using regular expressions and context free grammars
  - Lexical Analysis
  - Top-down (LL(1)) and bottom-up (LR(1), LALR(1)) parsing
- **Unit 2: Semantic Analysis and IR Generation**
  - Abstract Syntax Tree (AST) construction
  - Static and Dynamically typed language
  - Type Checking
- **Unit 3: Intermediate Representations and their Generation**
  - Intermediate representations such as three address tuples, stack code
  - AST to linear intermediate representation generation
  - Basic blocks and control flow graphs
  - Static Single Assignment Form (SSA)
  - LLVM IR case study
- **Unit 4: Machine Independent Optimizations**

- Local and regional optimizations using value numbering optimization as a case study
- Global optimizations like constant propagation and dead code elimination
- Data flow analysis theory and practice. Examples include Available expressions analysis and live variable analysis.
- Compiler phase sequencing problem

- **Unit 5: Code Generation and Register Allocation**
  - Runtime environment for C-like programming languages
  - Scope and lifetime of variables. Parameter passing mechanisms.
  - Generating machine code with virtual registers from machine independent linear intermediate representation.
  - Local and global register allocation. Mapping virtual registers to physical registers.
  - Basics of instruction scheduling

Reference Books:

1. Keith Cooper and Linda Torczon. 2011. Engineering a Compiler, Second Edition. Morgan Kaufmann Publishers Inc., San Francisco, CA, USA.

Alfred V. Aho, Monica S. Lam, Ravi Sethi, and Jeffrey D. Ullman. 2006. Compilers: Principles, Techniques, and Tools (2nd Edition). Pearson.

5. Teaching-Learning Strategies in brief

The most important component of this course is the project in which students design a C like imperative programming language. Write a manual for their programming language specifying syntactic and semantic rules along with example programs written in their own language. Over the course, as students are introduced to principles and practices involved in designing various compiler modules, they build the corresponding modules for their programming language. At the end of the course, students will be able to run the example programs they have written by compiling them with the compiler built by them. The target language for the compiler is usually LLVM IR.

Through the mini homeworks, theoretical ideas introduced in the class are reinforced. Students get continuous support through tutorial sessions, office hours conducted by teaching assistants and the concerned faculty.

6. Assessment methods and weightages in brief

1. Mini Homeworks (7 to 8) : 15 percent
2. Course Project
   a. Syntax Analysis: 10 percent
   b. AST Construction: 10 percent
   c. Semantic Analysis: 10 percent
   d. LLVM IR Generation: 10 percent
3. Mid Term Quiz: 15 percent
4. Final Theory Exam: 30 percent

Title of the Course : **Computational Linguistics 1**
Faculty Name : Parameswari Krishnamurthy
Course Code : **CL3.101**
L-T-P : 3-1-0.
Credits : 4

(L = Lecture Hours, T = Tutorial Hours, P = Practical Hours)
Semester, Year : Spring 2025
Name of the Academic Program: CLD

1.Prerequisite Course / Knowledge:

Introduction to Linguistics-1

2.Course Outcomes (COs) (5 to 8 for a 3 or 4 credit course):

After completion of this course successfully, the students will be able to:

CO-1 Use computational methods to analyse language at morpho-syntactic levels

CO-2 Develop requisite skills for text and speech problem solving

CO-3 Develop computational resources and tools for Indian languages with different language structures

CO-4 Perform theoretical research at phonology, morphology and syntax levels

CO-5 Apply CL/NLP techniques for real world applications by using real time data

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	1	1	3	1	2	2	1	1	2	3	1	2	3
CO2	3	3	2	3	3	3	1	2	2	1	1	2	3	1	2	3
CO3	3	2	2	3	3	3	3	2	2	3	1	1	3	1	3	3
CO4	3	2	2	3	3	3	1	2	2	1	1	2	3	1	3	3
CO5	2	2	2	1	1	3	1	2	3	3	1	3	3	1	2	3

Note: '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4.Detailed Syllabus:

Unit 1: What is CL and where does it apply? Issues and challenges; Language processing pipeline for text processing: Structural Analysis at various levels – word (POS, morphology), phrase (chunk), sentence (syntactic parsing). Word meaning: Lexical Semantics, Dealing with Ambiguities (WSD/WTD)

Unit 2: Morph analysis: Morph analysers and word generators; Recap of basic units in word formation: morphemes, allomorphs. Word formation: Affixation, suffixation, prefixation, infixation; Non-concatenative, Compounding, Morphotactics; Constraints on affixes; Morphophonology; Types of word formation processes (function based): inflectional, derivational; Developing morph analysers and generators: finite state automata, paradigmtables, add-delete rules; **Word Meaning:** Lexical semantics, Hypernymy, hyponymy, synonymy, antonymy, lexicon and lexicography; machine readable dictionaries, WordNet, ConceptNet, VerbNet etc.

Unit 3: Shallow parsing and sentence analysis: Words and their arrangements in a sentence. **POS Tagging** Word classes, Parts of Speech, POS tagging, Rule based parts of speech taggers, Statistical parts of speech taggers, Annotating POS tagged data, Issues in tagging, Definingtagset for your languages. **Shallow parsing (arrangement of words in a sentence) Local Word Grouping (LWG)** Grouping functional words such as prepositions/postpositions and auxiliaries with the content words (nouns, verbs); **Chunking:** Forming minimal phrases; **Multi-Word Expressions (MWEs):** Named entities (NEs), Idioms, compounds. Types of named entities; compositionality in MWEs.

Unit 4: Syntactic Parsing: Analysing the structure of a sentence, grammatical approaches; Constituency Analysis: Constituents/ phrases; Deriving sentences using phrase structure rules (CFG); Constraints on rules; Subcategorization; verb argument structure. Representing phrase structures: X-bar schema, Complements and Adjuncts; Syntactic operations: Substitution, adjunction and movement. Syntactic phenomena: Passive, Raising, Control; **Dependency Analysis:** Dependency structures: Head – modifier relations. Paninian grammar – a dependency framework – relations in Paninian grammar: karaka, tadarthya, hetuetc; Vibhakti - relation marker; karaka vibhakti mapping, karaka chart; **Parsing approaches:** English parsers, Hindi/IL parsing using Paninian framework.

Unit 5: Speech Processing: Introduction to speech processing: Speech production; Speech perception; Speech analysis; Speech Recognition; Speech Synthesis

Reference Books:

1. Jurafsky& Martin, 2000; Speech and Language Processing, Pearson Education

2. Bharati et al., 1995; Natural Language Processing: A Paninian Perspective

3. Fundamentals of Speech Recognition by Lawrence Rabiner, Biing-Hwang Juang

4. The Oxford Handbook of Computational Linguistics. 2003. RuslanMitkov (ed)

5.Teaching-Learning Strategies in brief (4 to 5 sentences):

This is a mix of theory and project based. The focus is on using the methods taught in class to extend to Indian languages

6.Assessment methods and weightages in brief (4 to 5 sentences):

How the students are able to connect the linguistic concepts by using computational techniques to analyse and generate data at the level of sound, word and sentence. The course will have a project content where students will study and solve a problem using real language data. The focus is on individual as well as collaborative learning.

Type of Evaluation	Weightage (in %)
Assignments	15%,
Seminar	10%
Project	25%,
Midsem Exam	15%,
Endsem Exam	35%

Title of the Course : Computational Psycholinguistics
Faculty Name : Rajakrishnan Rajkumar
NameoftheProgram : MS byResearch in Computational Linguistics (LTRC)
CourseCode : CL2.404
Credits : 4credits
L-T-P : 3-1-0
(L-Lecturehours,T-Tutorialhours,P-Practicalhours)

Semester, Year : Spring,2025

Pre-Requisites : None

Desirable (but not required): 1. Exposure to Natural Language Processing (NLP)/ComputationalLinguistics courses offered by LTRC, IIIT Hyderabad 2. Familiarity with a programming language.

Course Outcomes :

After completing this course, students will be able to achieve the following outcomes (eachoutcome is linked to unit(s) listed in the next section *Course Topics):*

CO1: Describe the psychological and neural basis of language processing (Cognitive Level: *Understand*; Unit 1)
CO2. Describe how information-theoretic methods can be used to model typologically diverselanguages (Cognitive Level: *Understand*; Units 2,3)

CO3: Explain influential computational theories of language processing (Cognitive Level:
Understand and Apply; Unit 4)
CO4: Develop hypotheses about language comprehension and production phenomena using computational theories of language processing (Cognitive Levels: *Understand, Apply, Analyze and Create*; Unit 4)
CO5. Apply standard NLP tools and techniques on language datasets for hypothesis testing (Cognitive Levels: *Understand, Apply and Analyze*; Unit 5)
(list about 5 to 6 outcomes for a full 4 credit course)

Course Topics :

(please list the order in which they will be covered, and preferably arrange these as five to six modules.)

Unit 1: Introduction: Language Mind and the Brain

- *Basics of language processing (comprehension and production)*
- *The mind-brain distinction: A philosophical review*
- *Survey of computational theories of the mind*
- *Neural basis of language processing and speech impediments*

Unit 2: Mathematical foundations

- *Elementary probability theory (Random variables and conditional probability),*
- *Concepts from information theory (entropy and mutual information),*
- *Noisy channel model of communication*

Unit 3: Processing of Linguistic structure

- *Processing of words (agglutinative and inflectional structures) and their meanings*
- *Principles of human sentence processing*
- *Syntactic and morphological complexity (word order, case markers etc)*
- *Language universals and typological diversity*

Unit 4: Computational theories of Language Processing

- *Working memory: Dependency Locality Theory and ACT-R framework of cognitiveprocessing*
- *Surprisal Theory*
- *Information Locality Hypothesis (ILH) combining locality and surprisal theories.*
- *The Uniform Information Density (UID) hypothesis*
- *Generating hypotheses about language production and comprehension using abovetheories*

Unit 5: Computational Methods for hypotheses testing

- *Language models: Lexical and syntactic models for modelling human behavioralmeasures (like reading time and spoken word duration)*
- *Surprisal/information density estimates using language models (starting from simplelexical and syntactic language models to neural models like LSTMs, RNNs etc).*

- *Eye tracking corpora for sentence comprehension research (basics of eye movements)*
- *Analyzing behavioural data using computational models*

Preferred Text Books :

Introduction to Psycholinguistics: Understanding Language Science, Matthew J. Traxler. JohnWiley and Sons Ltd., 2012

Speech and Language Processing: An Introduction to Natural Language Processing,Computational Linguistics and Speech Recognition (Prentice Hall Series in Articial Intelligence). Daniel Jurafsky and James H. Martin. Prentice Hall, 2 nd Edition 2013.

Reference Books :

Fundamentals of Psycholinguistics, Eva Fernandez and Helen Smith Cairns, WileyBlackwell,2012

Example Readings/Viewings:

Edward Gibson. 2000. Dependency locality theory: A distance-based theory of linguistic complexity. In Alec Marantz, Yasushi Miyashita, and Wayne O'Neil, editors, Image, Language, brain: Papers from the First Mind Articulation Project Symposium. MIT Press, Cambridge, MA.

Roger Levy. 2008. Expectation-based syntactic comprehension. Cognition, 106(3):1126 – 1177.

Anderson, John R., Daniel Bothell, Michael D. Byrne, Scott Douglass, Christian Lebiere, &Yulin Qin. 2004. An Integrated Theory of the Mind. Psychology Review 111.1036–1060.

John Hale. 2001. A probabilistic Earley parser as a psycholinguistic model. In Proceedings of the second meeting of the North American Chapter of the Association for Computational Linguistics on Language technologies, NAACL '01, pages 1–8, Pittsburgh, Pennsylvania. Association for Computational Linguistics.

Richard Futrell, Edward Gibson, and Roger P. Levy. 2020. Lossy-context surprisal: An information-theoretic model of memory effects in sentence processing. Cognitive Science, 44(3):e12814

Temperley, David. 2007. Minimization of dependency length in written english. Cognition 105.300– 333

Vera Demberg and Frank Keller. 2008. Data from eye-tracking corpora as evidence for theoriesof syntactic processing complexity. Cognition, 109(2):193–210.

E-book Links : None

Grading Plan : (The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz-1	**10**
Mid SemExam	**20**
Quiz-2	**10**
End Sem Exam	**30**
Assignments	**10**
Project	**20**
Term Paper	**-**
Other Evaluation	**-**

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest,or a '-' dash mark if not at all relevant). Program outcomes are posted at

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO1 0	PO11	PO1 2	PSO 1	PSO2	PSO3	PSO4
CO 1	-	-	-	-	-	-	-	-	2	1	-	3	2	-	-	3
CO 2	-	-	-	-	-	-	-	-	2	1	-	3	2	-	-	3
CO 3	-	-	2	2	-	-	-	-	2	1	-	3	2	-	-	3
CO 4	-	-	2	3	3	-	-	-	3	2	-	3	3	-	-	3
CO 5	1	2	1	3	3	1	-	-	-	1	-	3	3	-	-	3

Teaching-Learning Strategies in brief (4-5 sentences) :

The lectures of this course will introduce basic concepts related to language comprehension and production and illustrate this with linguistic examples. This will be followed by assignments and in-class discussion of relevant papers/videos, which will introduce learners to the influential computational theories of sentence processing. Practical assignments involving the testing of psycholinguistic theories on datasets containing behavioural data (like eyetracking and speech corpora) will introduce learners to the hands-on experience of scientific hypothesis testing.

Title of the Course : Computer Graphics
Faculty Name : TBD
Course Code : CS7.302
Credits : 02
L - T - P : 19.5 hrs (L) – 13 hrs (T)
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring 2025
Name of the Program : Introduction to Computer Graphics

Prerequisites: C, C++ programming

Course Outcomes:

- Understand the basics of virtual scene representations.
- Understand basics of the physics of light transport (propagation).
- Understand and be able to work with light transport implementations with ray-tracing.
- Be able to write a photorealistic renderer based on path tracing (ray tracing).

Course Topics:

1. Geometry
    a. Geometry & Transformations
    b. Geometry representation
2. Cameras & Radiometry
3. BVH
4. Texture Mapping
5. Monte Carlo Integration
6. Monte Carlo ray tracing
7. BRDF & Importance Sampling
8. Sampling
9. Path Tracing

Preferred Textbooks: PBRT V3(Available for free: https://www.pbr-book.org/3ed-2018/contents)

Reference Textbooks:PBRT V3(Available for free: https://www.pbr-book.org/3ed-2018/contents)

Grading Plan: (The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz	10 %
Final Exam	35 %
Assignments	55 %

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant).Program outcomes are posted at

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1	2	2	1	1	1	1	1	1	2	3	2	1	2
CO2	2	1	2	1	3	1	1	1	3	1	1	2	3	2	2	3
CO3	2	3	3	3	3	1	1	1	3	1	1	3	3	3	2	3
CO4	2	3	3	3	3	2	2	1	3	1	1	3	3	3	3	3

Teaching-Learning Strategies in Brief (4-5 sentences): This course introduces physically based rendering by understanding the physics of light transport. We will look at how light propagates in the real world and perform a simulation of it in virtual worlds. By doing this, we will learn about ray tracing or path tracing, which is the industry standard to generate photorealistic images for applications like VFX, architecture visualization (or any visualizations) and now even games (primarily with NVIDIA RTX).

This course lies at the intersection of art, computer science and physics and should be interesting to teach as well as for students to take.

Title of the Course : **Computer Systems Organization**
Faculty Name : Praveen Paruchuri + Deepak Gangadharan
Course Code : CS2.201
L-T-P : 3-1-0.
Credits : 4
(L = Lecture Hours, T = Tutorial Hours, P = Practical Hours)
Name of the Academic Program:**B.Tech in Computer Science and Engineering**
Semester, Year : Spring 2025

1. Prerequisite Course / Knowledge:
Digital logic circuits and design. Combinational and Sequential Circuits. Fundamentals of Programming.

2. Course Outcomes (COs)
After completion of this course successfully, the students will be able to:
CO-1: Explain the Von Neumann Model of Computing. Describe all the steps involved in the execution of a program: composition, compilation, assembly, linking, loading and hardware interpretation of the program instructions. (Cognitive Level: **Understand**)
CO-2: Describe the instruction set architecture design principles. Show how programming language constructs can be mapped to sequences of assembly language instructions. Analyze and assess any given ISA. (Cognitive Levels: **Analyze and Evaluate**)
CO-3: Describe processor design architectural approaches. Compare and contrast sequential designs with pipelined designs. Propose new architectural approaches to optimize on performance and hardware costs (Cognitive Levels: **Apply**, **Analyze and Create**)
CO-4: Describe the basic functionality of an operating system. Clearly explain the system call interface, its design and implementation. Build systems akin to a bash shell, file server etc. using system calls. (Cognitive Levels: **Understand and Apply**)

CO-5: Describe the basics of process control and management. (Cognitive Levels: **Understand and Apply**)

CO-6: Describe the principles of virtual memory management. Analyze various memory management schemes for process isolation and physical memory utilization across multiple processes (Cognitive Levels: **Understand**, **Apply** and **Analyze**)

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2	2	-	-	-	2	2	1	1	3	2	3	3
CO2	3	3	2	2	2	-	-	-	2	2	1	1	3	2	3	3
CO3	3	3	2	2	2	-	-	-	2	2	1	1	3	2	3	3
CO4	3	3	2	2	2	-	-	-	2	2	1	1	3	2	3	3
CO5	3	3	2	2	2	-	-	-	2	2	1	1	3	2	3	3
CO6	3	3	2	2	2	-	-	-	2	2	1	1	3	2	3	3

4.Detailed Syllabus

- **Unit 1:**
  - Basic computer organization, Von Neumann architecture and stored program concept
  - High level programming languages, assemble code, binary instructions, compilers and assemblers
  - Programming editing, compilation and execution cycle
- **Unit 2:**
  - Instruction Set Architecture Design Principles
  - CISC vs RISC ISAs
  - Binary encoding of the instructions
  - Mapping language constructs such as expressions, if-then-else statements, loops, functions to assembly code
  - Machine representation of numbers
- **Unit 3:**
  - Processor design fundamentals
  - ALU Design
  - Single Cycle and Multi Cycle Processor Design
  - Pipelined Architectures
  - Hazards in Pipelined Architectures and approaches to resolve them.
- **Unit 4:**
  - Introduction to Operating Systems. Bootstrapping Process
  - System Calls, their design, implementation and application.
  -
- **Unit 5:**
  - Process Control and Management

- Scheduling multiple processes on multiple cores.
- Basics of scheduling mechanisms and policies.

- **Unit 6:**
  - Physical vs Virtual Memory
  - Process and memory isolation/protection mechanisms
  - Virtual memory management
  - Page replacement algorithms

Reference Books:

1. Computer Systems: A Programmer's Perspective. Randal Bryant and David O'Hallaron
2. Computer Organization and Design. The Hardware/Software Interface. David A. Patterson and John L. Hennessy.
3. Operating Systems: Three Easy Pieces by Remzi H. Arpaci-Dusseau and Andrea C. Remzi H. Arpaci-Dusseau

5.Teaching-Learning Strategies in brief

Lectures are conducted in a highly interactive fashion. Use of various system tools such as compilers, assemblers, loaders, linkers, simulators etc. are demonstrated live in the class. Assignments include assembly language programming, digital system design exercises such as Arithmetic and Logic Unit Design, programming using system calls. Most of the ideas introduced in the class are emphasized through these assignments. Teaching Assistants and Faculty conduct office hours every day. Thus students have continuous access to resources to get their doubts clarified and seek any extra help that is required. Some times students are encouraged to come to the board and explain the novel design ideas they came up with while solving assignments or mini-projects.

6.Assessment methods and weightages in brief

1. Programming Assignments (5 to 6) :25 percent
2. Two Quizes: 2 x 10 percent
3. Mid Term: 20 percent
4. Final Exam: 35 percent

Title of the Course : Computer Vision

Faculty Name : Makarand Tapaswi + Ravi Kiran
Course Code : **CS7.505**
Credits : **4**
L - T - P : **40.5 (L) – 13 (T)**
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Name of the Program : Introduction to Computer Vision
Semester, Year : **Spring 2025**

Pre-Requisites : Computer Graphics and/or Digital Image processing
Course Outcomes :

After completion of this course successfully, the students will be able to.
CO-1 Introduce the image formation process and camera modelling.
CO-2 Introduce multi-view geometry methods in computer vision.
CO-3 Introduce classical computer vision techniques for semantic segmentation, retrieval, 3d reconstruction.

CO-4 Explain modern computer vision techniques with focus on deep learning architectures.
CO-5 Introduce 3D computer vision research problems and latest deep learning solutions.

Course Topics :

Module 1: Introduction
Image Formation ,Traditional Feature Detection & Description, Pinhole Camera Model & Projective Geometry, Camera Calibration.
Module 2: Multi-view Geometry
2-View Geometry, Homography, Multi-camera Geometry (Image Rectification), Stereo Correspondence, Depth from Stereo.
Module 3: Classical Computer Vision Methods

Motion Estimation and Optical Flow, Segmentation as Labelling: Introduction to Ncut, Image Segmentation by MRF, SFM / Bundle Adjustment, Bag-of-Words Representation.

Module 4: Modern Computer Vision

Intro to Conv-Neura-Nets (CNN), CNNs for Detections, CNN for Recognition, Recurrent NN for Video Analysis, Generative Models for CV (GAN,VAE, DM) , Vision Transformers (VT) for CV Applications.

Module 5: 3D Computer Vision Applications

Intro do 3D Vision (Representation and Learning), 6Dof Pose Estimation, Human Body Modelling, Neural Radiance Field (NeRF).

Preferred Text Books: Forsytn and Ponce' Computer Vision: a modern approach, Pearson Education Inc.
Reference Books : Multi-view Geometry by Hartley & Zisserman, Computer Vision by Rick Szeliski
E-book Links :https://szeliski.org/Book/

Grading Plan :(The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz	**5**
Mid SemExam	**15**
End Sem Exam	**20**
Assignments	**30**
Project	**30**

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant).Program outcomes are posted at

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1	2	2	1	1	1	1	1	1	2	3	2	1	2
CO2	2	1	2	1	3	1	1	1	3	1	1	2	3	2	2	3
CO3	2	3	3	3	3	1	1	1	3	1	1	3	3	3	2	3
CO4	2	3	3	3	3	1	1	1	2	1	1	3	3	3	2	3
CO5	2	3	3	3	3	2	2	1	3	1	1	3	3	3	3	3

Teaching-Learning Strategies in brief (4-5 sentences) :

The course lectures will include technical content on algorithm with appropriate visualization for effectively conveying the basic concepts as well as small activities to promote the understanding of the lecture content. Significant focus will be on problem solving aspect and concepts will be introduced in the context of relevant research challenges. Tutorials will further try to bridge the gap between theoretical understanding and practical aspects of problem solving. Assignments are designed to solve problems that are based on simple extensions of concepts described in the lectures. Course project will encourage learning collaborative skills with goal to induce system building capability among students to complement lecture-based learning.

Title of the Course **: Computing in Sciences-2**
Faculty Name : Prabhakar Bhimalapuram
Course Code : SC4.102
Credits : 2
Name of the Academic Program CND
Semester, Year : Spring 2025
L-T-P 3-1-0 (L= Lecture hours, T=Tutorial hours, P=Practical hours)
1.Prerequisite Course / Knowledge:

The course "Computing in Sciences-1" can be considered the paired-course; if the student has not done it before this course, it should be done after this course.

2.Course Outcomes (COs) (5 to 8 for a 3 or 4 credit course):

After completion of this course successfully, the students will be able to..

CO-1 Demonstrate skill of **converting** a word statement of a problem to a mathematical problem statement

CO-2 Formulate a solution by application of learned concepts (in other Math coures) and employ computer to solve the problem

CO-3 Demonstrate skills in computer visualization of data, solution.

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2	2	2	1	1	1	2	2	2	2	2	1	1	1
CO2	2	2	2	3	1	1	1	1	2	2	2	2	2	2	2	1
CO3	2	2	2	1	2	1	1	1	1	2	1	1	1	1	1	1

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4.Detailed Syllabus:

Unit 1: Introduction / review concepts in Python, data structures, flow control and modules NumPy, MatPlotLib, and SciPy
Unit 2: Simple integration of 1-d and 2-d functions. Adaptive grid scheme and monte carlo method.
Unit 3: Nonlinear dynamics of Logistic map: fixed point, bifurcation, period doubling, deterministic chaos.
Unit 4: Coin toss statistics, gaussian distribution, tails of distribution (Cramers Theorem)
Unit-5: Epicycles in 2-dimensions. Fourier analysis for characterization of periods and amplitudes of component circular motions.
Unit 6: Simple molecular dynamics of noble gases. Fixed temperature simulation using Langevin dynamics.

Reference Books:
1. Python refernce book: https://docs.python.org/3.5/tutorial/
2. https://www.learnpython.org/

5.Teaching-Learning Strategies in brief (4 to 5 sentences):
After going over the theory in the first lecture, the next two meetings (1 lecture and 1 turotiral) will be hands on practice, after which student will hand in the submssion for that Unit. Students are encouraged to form small groups and work through the compter programming and solving teh problems.

6.Assessment methods and weightages in brief (4 to 5 sentences):

Each unit will have a submission of a workbook. All submissions will be given equal weightage and will have a weightage of 75% of the grade. An endsem will be conducted which will have one problem, and will have a weightage of 25%; the problem will be choosen to have (a) graphical visualsation, (b) use of one or more scientific modules in python and (c) some amount of theory covered in the lectuers.

Title of the Course : Computing Tools
Name of the Faculty : Sriranjani K
Course Code : CS0.302
L-T-P : 3-1-3

Credits : 4

Name of the Academic Program:M.Tech. in CASE, Bioinformatics (1st year, 2nd semester)

Prerequisite Course / Knowledge:

1. First course on programming and problem-solving
2. Basics of Python language, to be able to use relevant libraries and toolkits

Course Outcomes (COs):

After completion of this course successfully, the students will be able to:

CO-1. Model and create datasets.
CO-2. Visualize and present data**.**
CO-3. Collect data from across networks and internet to store in databases
CO-4. Prepare and preprocess datasets to make them ready for application of various data analytics algorithms**.**
CO-5. Employ known algorithms to solve common analytics tasks in practical applications, setting their parameter values, and using relevant libraries and toolkits.
CO-6. Evaluate and determine the best algorithm among known algorithms for specific datasets and applications.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	2	2	1	2	1	1	3	1	1	1	3	1	2	3
CO2	3	2	1	2	3	1	1	1	3	2	1	2	3	1	2	3
CO3	3	1	3	1	3	1	1	1	3	1	1	2	3	1	2	2
CO 4	3	2	3	3	3	3	2	2	3	2	2	3	2	2	2	3
CO5	3	1	3	1	3	2	1	1	3	3	2	3	2	1	2	3
CO 6	2	3	3	1	1	1	2	1	3	3	2	3	2	2	2	3

'3' in the box denotes 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping.

Detailed Syllabus:

Unit 1: Databases (Design, SQL)
Unit 2: Visualization (e.g. Bokeh, VTk)
Unit 3: Networking and data collection (e.g. requests and json modules)
Unit 4: Scientific Python Modules: NumPy, Matplotlib, Tkinter, SciPy
Unit 5: Data analytics: Preprocessing, Clustering, Classification (e.g. pandas, scikitlearn)

Reference Books:

1. Official documentation and online tutorials on Python, VTk, etc.
2. Python – https://docs.python.org/3/tutorial/

Teaching-Learning Strategies in brief (4 to 5 sentences):
This is a highly practicals-oriented course. Lectures showcase handson usage of various computing tools and modules for interdisciplinary students. Theoretical concepts in database design and data analytics are also covered with a practical focus, with examples and assignments. A mini-project is given in each module. Mini projects may be done in groups of 3. Lab exams may be done as a single large problem with intermediate milestones and choice of 1 out of 3 problems to solve. Python modules specified are suggestive and may be replaced with better ones.

Assessment methods and weightages in brief (4 to 5 sentences):

- Mini Projects: 5x10=50%
- Lab reports: 10%
- Mid semester exams: 10+15=25%
- Lab exams: 15%

Title of the Course: Continuous Variable Quantum Information Theory and Computation

Faculty Name : Uttam Singh
Name of the Program: PhD
Course Code : MA7.501
Credits : 4
L - T - P : 24 – 6 - 0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year **:** Spring, 2025

Pre-Requisites **: Basic Quantum Mechanics and Linear Algebra**

Course Outcomes **:**(1) Familiarity with continuous variable (CV) quantum systems
(2) Analyze intricacies of infinite dimensional quantum systems
(3) Conclude usefulness of Gaussian systems for practical uses
(4) Apply above to understand correlations among CV systems
(5) Apply the techniques above in quantum metrology
(6) Understand universal quantum computation with CV systems

Course Topics **:**

Part 1: Quadratic Hamiltonians and Gaussian states

Quantum states and measurement; CP-dynamics, Continuous variables, Quadratic Hamiltonians and Gaussian states, Symplectic group, Decomposition of Gaussian Gaussian states (Bloch-Messiah Decomposition), Williamson's Theorem, Covariance matrices, Uncertainty principle, Coherent states

Part 2: Dynamics and phase space methods

Fourier-Weyl transform, Characteristic functions and Wigner functions, Gaussian Unitaries: Linear interferometers and squeezers, Gaussian CP-maps, Gaussian measurements: homodyne and heterodyne, Choi-Jamiolkowski description of Gaussian-CP maps

Part 3: Entanglement, quantum information theory and computation

Entanglement of continuous variable systems: Separability criterion, entanglement distillation, Gaussian quantum metrology, Boson sampling, Universal quantum computation with continuous variable systems

Preferred Textbooks: Quantum Continuous Variables by A. Serafini

Reference Books **:**Above book and various research papers

E-book Links **:**

Grading Plan **:**

Type of Evaluation	Weightage (in %)
Quiz-1	**20**
Quiz-2	**20**
End Sem Exam	**25**
Assignments	**35**

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant).Program outcomes are posted at

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1																
CO2																
CO3																
CO4																
CO5																

Teaching-Learning Strategies in brief (4-5 sentences):I would encourage active participation of students throughout the class hours. I will present the course with good mathematical rigor so that students can apply the techniques themselves to various other problems. The assignments will be thought provoking and will be at the edge of current state-of-the-art theory.

Title of the Course **: Data Structures and Algorithms**

Faculty Name : Lini Thomas + Kshitij Gajjar

Course Code : CS1.201

L-T-P **: 3-1.5-3.**

Credits **: 4**

(L = Lecture Hours, T = Tutorial Hours, P = Practical Hours)
Name of the Academic Program :B.Tech in Computer Science and Engineering

1. Prerequisite Course / Knowledge:

CS1.302 - Computer Programming

2. Course Outcomes (COs)

After completion of this course successfully, the students will be able to:

CO-1: Explain the design and implementation details of fundamental data structures and sorting/searching algorithms. (Cognitive Level: Understand)
CO-2: Write programs involving fundamental data structures and sorting/searching algorithms (Cognitive Levels: Apply and Analyze)
CO-3: Compare and contrast the performance of different data structures and sorting/searching algorithms with respect to time and memory. (Cognitive Levels: Analyze and Evaluate)
CO-4: Discover the algorithmic logic and new composite data structures required to solve well-defined computational problems while following specified compute constraints. (Cognitive Levels: Apply and Analyze)

3. Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO12	PSO1	PSO 2	PSO 3	PSO 4
CO 1	1	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO 2	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO 3	1	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO 4	3	1	3	3	1	1	1	1	3	1	1	1	1	1	1	1

4. Detailed Syllabus

- Unit-1
  - Recap: Array, Pointers, Structures, Asymptotic Complexity
  - Abstract Data Types

- Unit-2: Linear Data Structures
    - Linked Lists
    - Stacks
    - Queues
- Unit-3: Non-linear Data Structures
    - Binary Trees and Search Trees
    - Hash Tables, Sets, Maps
- Unit-4: Sorting Algorithms
    - Sorting – Insertion
    - Sorting – Selection, Merge, Quicksort
    - Heapsort
    - Counting Sorts
    - Radix Sort, External Sorting
    - Sorting – External, Selection Algorithms
    - Selection Algorithms
- Unit-5: Graph Algorithms
    - Graphs – Representation and Algorithms
    - Graphs – Representation and Algorithms (DFS, Dijkstra, Bellman)
    - Graphs – Representation and Algorithms (MST)
    - Graphs - Strongly Connected Components
- Unit-6: Advanced Data Structures
    - AVL Trees
    - Suffix Trees

Reference Books:

1. Data Structures and Algorithm Analysis in C (M.A. Weiss), Pearson

5. Teaching-Learning Strategies in brief

Lectures are conducted in a highly interactive fashion. The design and implementation of data structures and sorting/searching algorithms is done as an in-class coding exercise. Tutorial sessions are used to teach the utilization of tools such as Visual Studio Code, Git etc. Lab sessions are used to solve programming assignments and teaching assistants help students in developing program logic, debugging etc. on an individual basis. Faculty conducts office hours once in week. Additionally, teaching assistants conduct office hours. This ensures continuous support to students. Five to six programming assignments are designed which gives an in-depth understanding of various concepts discussed in the class and their application to new problem scenarios along with proper analysis. Some problems involve evaluating, comparing multiple solution approaches.

6. Assessment methods and weightages in brief

1. Programming Assignments (5): 40%
2. Programming Lab Exam: 15%
3. Best 2 out of 3 Theory Quiz: 30%
4. Mini Project (4 members per team): 15%

For programming assignments and lab exams, online judges such as DMOJ are used to provide immediate feedback to students. While some test cases are revealed, others are hidden. Partial marks are allocated for code peer-reviewing in programming assignments. For mini project, a presentation followed by a code-execution demonstration is used for evaluation.

Title of the Course : Data Systems

Name of the Faculty : Kamal Karlapalem
Course Code : CS4.401
L-T-P : 3-1-0
Credits : 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Academic Program B.Tech. in Computer Science and Engineering

1. Prerequisite Course / Knowledge:

Basic principles of Operating systems, Structured Query Language, Relational Data Model, Data structures, Programming language, Algorithms,

2. Course Outcomes (COs)

After completion of this course successfully, the students will be able to..

CO-1. Develop the tree-based and hash-based indexing algorithms to improve efficiency of the retrieval

CO-2. Tune the optimizer module of DBMS to meet the performance demands of diverse applications, including distributed applications.

CO-3: Design the recovery sub-system of any given information system

CO-4. Design archival strategy for any given information system

CO-5. Develop a concurrency control algorithm for any given database system

CO-6. Develop a framework for building a large scale big data system.

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2	3	-	1	-	3	1	3	2	3	3	2	3
CO2	3	3	3	1	3	-	1	-	2	2	2	3	3	2	1	1

CO 3	3	2	2	1	2	2	1	-	2	2	2	1	3	3	3	2
CO 4	3	2	2	1	2	2	1	-	2	2	2	1	3	3	3	2
CO 5	3	2	2	1	2	2	1	-	2	2	2	1	3	3	3	2
CO 6	3	3	3	3	2	2	1	-	2	2	3	2	3	3	3	3

'3' in the box denotes 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4. Detailed Syllabus:

Unit 1: Introduction, Data storage, Representing data elements (9 hours)

Unit 2: Index structures, Multidimensional indexes (7.5 hours);

Unit 3: Query execution, The query compiler (9 hours)

Unit 4: Coping with system failures, Concurrency control (7.5 hours);

Unit 5: Transaction management, NoSQL and big data systems (9 hours)

- Five mini projects related to the above syllabus will be done by students in the laboratory

References :

- Hector Garcia-Molina, Jeffrey D. Ullman and Jennifer Widom , Database System Implementation, Pearson Education, 2003
- Elmasri&Navathe, Fundamentals of Database Systems, 6th Edition, Pearson Education, 2013
- Raghu Ramakrishnan and Johannes Gehrke ,Database Management Systems, Third edition, Mc Graw Hill, 2017
- Abraham Silberschatz, Henry F.Korth, S.Sudarshan, Database system concepts, fifth edition, Mc Graw Hill, 2006
- Research papers

5.Teaching-Learning Strategies in brief:

Lectures by integrating ICT into classroom teaching, weekly tutorials involving problem solving and active learning by students and Project-based Learning by doing 5 mini-projects in laboratory by the students

6. Assessment methods and weightages in brief :

Assignments in theory: 10 marks, Quizzes in theory: 10 marks, Mid Semester Examination in theory: 20 marks , End Semester Examination in Theory: 30 marks, Assessment of 5 mini projects in Laboratory: 30 marks

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Title of the Course : Data Visualisation
Faculty Name : Kamal Karlapalem
Course Code : CS4.302
Credits : (2)2-0-1-2
L - T - P : (2)2-0-1-2
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring 2025

Pre-Requisites : Statistics
Course Outcomes :
(list about 5 to 6 outcomes for a full 4 credit course)

1. Comprehend purpose of visualization
2. Learn visualization design
3. Perform exploratory data analysis
4. Utilize perception and interaction in data visualization
5. Learn using space in 2d and about colors in visualization

Course Topics :
(please list the order in which they will be covered, and preferably arrange these as five to six modules.)

ThePurposeofVisualization.VisualizationDesign.
ExploratoryDataAnalysis.Perception.
Interaction.
Using Space Efficiently:2DColor.
Aprojecttoshowcasedatavisualizationofcomplex dataset.

Preferred Text Books :
Visualization Analysis and Design Tamara Munzner 2014 CRC.
Reference Books :
TheVisualDisplayofQuantitativeInformation(2ndEdition).E.Tufte.GraphicsPress.
E-book Links :
Grading Plan :
(The table is only indicative)

Type of Evaluation	Weightage (in %)
Assignments	**40%**
Project	**60%**
Term Paper	**Nil**
Other Evaluation	**100%**

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant).Program outcomes are posted at

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2	3	3	2	3	4	3	3	3	4	3	3	2
CO2	3	3	2	2	3		1	2	3	1	2	3	3	2	2	3
CO3	3	3	2	1	1			2	3	3	2	3	2	2	2	3
CO4	3	3	3	1	1	1	3	2	2	2	3	2	2	3	3	3
CO5	3	3	3	1	2	1	3	1	3	3	1	3	1	4	2	2

Teaching-Learning Strategies in brief (4-5 sentences) :
Significant in class lab exercises with relevant reasoning for visualization. Practice by doing, and learning with doing, Detailed assignments and projects to comprehend the materials

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Title of the Course : Design & Analysis of Software Systems

Faculty Name : Raghu Reddy
Course Code : CS6.301
Credits : 4
L-T-P:
(L= Lecture hours, T=Tutorial hours, P=Practical hours)

Name of the Academic Program: Bachelor of Technology in Computer Science and Engineering

1.Prerequisite Course / Knowledge: Intro to Software Systems

2.Course Outcomes (COs) (5 to 8 for a 3 or 4 credit course):

After completion of this course successfully, the students will be able to…

CO-1: Understand the process of building software, through a live project
CO-2:Inculcate software engineering knowledge, skills, and technologies needed to build software
CO-3: Understand the structured approach and disciplined process (iterative) to develop software
CO-4: Learn the steps in building a reasonably complex piece of usable that is maintainable
CO-5:Enhance written and oral communication skills, needed for software engineering

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

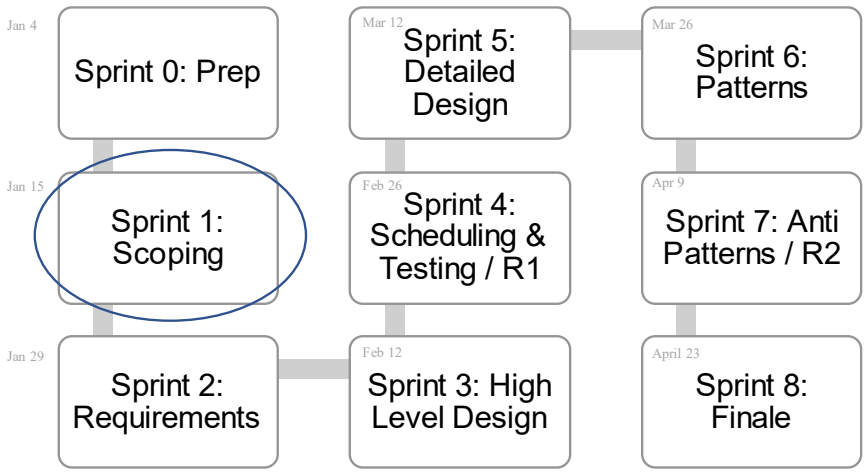
	PO1		PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2			2	1					2		1	1		1		
CO2	3			1		2						1		1	3		
CO3	2		1	1								1		1	2		1
CO4	2		2	2						3				2		1	
CO5											3						

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4.Detailed Syllabus:

The course will be run as units, following typical agile development sprints

1. Introduction
    a. Introduction to Software Engineering
    b. Development Lifecycle, Process Model - Traditional Vs Agile processes.
    c. Project and Team Management - Project organization concepts (roles, tasks, work products),
2. Requirements
    a. Analysis and Specification),
    b. Estimation, Release Planning, Organizational activities (communication, status meetings).
3. Design
    a. Modelling (UML), Architecture and Design,
    b. System Decomposition, Software Architectural styles, Documenting Architectures,
4. Testing
    a. Quality Assurance - Unit, Integration, System and Acceptance Testing, Introduction to various testing techniques (e.g. Stress testing) ,
5. Design Patterns
    a. Design patterns, UI design
    b. Software Development for startups



Reference Books:
Software Engineering – A Practitioner's Approach, 10th Edition, Roger Pressman.

5.Teaching-Learning Strategies in brief (4 to 5 sentences):

The proposed course provides an introduction to software engineering concepts and techniques to undergraduate students using project based methodology. Students work in a small teams to deliver a software system that are proposed by real industrial clients. The course content and project introduces various software technologies, process and project management skills that are needed for the delivery of software in a team setting.

6.Assessment methods and weightages in brief (4 to 5 sentences):

Component	Percentage (%)
Project	40
Client Feedback (R1 1% + R2 3%)	4
Coding Assignments (4)	20
Quizzes (Q1 + Q2, no midterm)	12
Class submissions (3 Questions)	4
Class Assignments	8
End Exam/Research Paper	12
TOTAL	100

Title of the Course : Design of Hydraulic Structures
Faculty Name : Shaik Rehana
Name of the Program : M.Tech in CASE
Course Code : CE5.501
Credits : 4
L - T - P :3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)

Semester, Year **:** Spring, 2024
Pre-Requisites **:** Basics of fluid mechanics and hydraulics

Course Outcomes :
After completion of this course successfully, the students will be able to

- Develop a detailed understanding about the design aspects of the hydraulic structures those are constructed for the purpose of storage, diversion, conveyance and distribution of water.
- Design various major hydraulic structures such as dams, reservoirs, aqueducts, weirs, canals, etc.
- Understand how basic principles of hydraulics can be used in the design of structures in terms of safety measures, etc.

Course Topics :
(please list the order in which they will be covered, and preferably arrange these as five to six modules.)

Introduction of Hydraulics: Fluid Properties and Classification, Hydrostatics, Equation of Motion, Continuity Equation, Flow Measurements
Introduction: Storage, Diversion, Conveyance and Distribution structures
Gravity Dams: Site selection, Forces, Stability analysis, Modes of Failure
Reservoirs: Storage Capacity of a Reservoir and Design aspects
Design of Diversion Works: Weirs and Barrages, Spillways

Preferred Text Books :

- *Hydraulic Structures*, P. Novak, A. I. B. Moffat, C. Nalluri and R. Narayanan, Taylor and Francis, U. K
- Irrigation Engineering and Hydraulic Structures- Garg S.K- Khanna Publishers N.D.13th ed, 1998.
- Irrigation and Water Resources Engineering by G. L. Asawa, New Age International Publishers, 2008.

Grading Plan **:**(The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz-1	**10%**
Mid SemExam	**20%**
Quiz-2	**10%**
End Sem Exam	**30%**
Assignments	**20%**
Project	**10%**
Term Paper	**Nil**
Other Evaluation	**Nil**

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant).Program outcomes are posted at

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	1	2	2	3	1	1	3	1	1	1	2	2	3	2	3
CO2	1	3	2	3	2	1	1	1	1	3	1	2	2	2	2	2
CO 3	2	2	2	2	3	1	2	1	1	1	1	2	2	2	2	2
CO 4	2	2	3	2	3	1	2	1	1	1	1	2	2	2	2	2
CO 5	2	3	2	2	3	2	3	2	1	1	1	2	2	2	2	2
CO 6	2	2	3	2	2	2	2	2	1	3	1	2	2	1	2	2

Teaching-Learning Strategies in brief (4-5 sentences) :

Lectures and tutorials to solve various hydraulic structures, practice problems, assignments with real-time case studies and data. Starting from basic hydraulics to design of large structures such as Weirs, dams, canals, aqueducts, spillways, the lectures try to cover diverse topics related to safety and design aspects for the better water resources management.

Course Title : Digital Democracy and Data Governance in the European Union
Faculty Name : Aakansha Natani
Course Code : **HS4.303**
Credits :4
L - T - P :
(L - Lecture hours, T-Tutorial hours, P - Practical hours) Semester,
Year : Spring 2025
Name of the Program : B.Tech in Computer Science and Engineering

Pre-Requisites : None

Course Outcomes :

After completion of this course successfully students will be able to

CO1: Understand and explain key concepts in digital democracy and data governance.

CO2 Critically assess the EU's philosophy and experiments in utilising information and communication technologies (ICT) for democratic practices and processes.

CO3: Assess the impact and relevance of tech-policy initiatives in the EU member states.

CO4 Understand the European approach on data governance and its contradiction with the American and Chinese approach.

CO5: Understand the Brussels Effect in the information society, particularly in the Global South.
CO6: Develop an understanding of emerging challenges in digital democracy and data governance.

Course Topics :

The course is divided into five modules

(i) **Introduction to Digital Democracy and the EU Governance Structure:** democracy in the digital

age, EU perspective and philosophy, EU governance structure, challenges to digital democracy

(ii) **Digital Democracy in the EU:** e-Governance, digital public infrastructure, digital citizenship and identity, digital rights, EU values and commitments, contradiction with American and Chinese approach on data collection, protection and distribution

(iii) **Digital Democracy Experiments in Europe:** Case studies of different European countries, policy visions and objectives, strategies and outcomes
(iv) **Data Governance Framework in the EU:** Digital sovereignty, data protection regulations, digital platforms regulations, responsible AI, transparency, accountability and right to explanation, sustainable data governance
(v) **'Brussels Effect' on the Data Governance Frameworks:** North-South dynamics in global data governance; How EU's data policies influence Global South countries, data protection regulations in select countries of Asia, Africa and Latin America

Module 1: Definition and scope of digital democracy; overview of EU political institutions (European Commission, Parliament, Council); Role of the EU in shaping digital policies; digital divides and their socio-economic implications; rise of misinformation and disinformation

Module 2: Digital Democracy Promotion Policies of the European Union: White Paper on European Governance (2001), Plan D- Democracy, Dialogue, Debate (2004); European Broadband: Investing in Digitally Driven Growth (2010), The Digital Agenda for Europe (2010), The European citizens' initiative (2011) Cyber security Strategy of the European Union (2013), Declaration of Digital Rights and Principles (2022), European Digital Identity Framework (2024); Digital Targets for 2030, Comparative analysis of the EU, American and Chinese approach on data collection, protection and distribution

Module 3: Case studies of I-Voting in Estonia, Digital Infrastructure Strategy in Finland, French Digital Republic Act, Digital Democracy Commission in the UK, National Digital Strategy of Malta, National Strategy for Digital Skills in Italy

Module 4: General Data Protection Regulation (2018), Digital Service Act (2022), Digital Market Act (2022), Data Governance Act (2023), Artificial Intelligence Act (2024)

Module 5: Global South perspectives on data governance, 'Brussels Effect', Digital Personal Data Protection Act of India (2023), Data Protection Act of Kenya (2019), General Data Protection Law (LGPD) of Brazil (2020)

Preferred Text Books:

Selected Chapters from-

1. Hacker, Kenneth L. & Dijk, Jan van (2000), *Digital Democracy: Issues of Theory and Practice*, London: SAGE
2. Anu Bradford (2020), *The Brussels Effect: How the European Union Rules the World:* Oxford University Press
3. David Ramiro Troitiño (2024), *e-Governance in the European Union: Strategies, Tools and*

Implementation: Springer

4. Jonathan Olsen (2021), *The European Union: Politics and Policies (7th edition)*: Routledge Publications
5. Erik Jones, Anand Menon and Stephen Weatherill (2012), *Oxford Handbook of the European Union:* Oxford University Press

Reference Books, Articles and Policy Papers:

Andrew Chadwick and Philip N Howard (2009): *Routledge Handbook of Internet Politics*, Routledge Publications

Cynthia Alexander and Leslie A Pal (1998): *Digital Democracy: Politics and Policy in the Wired World*, Oxford University Press

European Commission (2016), *General Data Protection Regulation*, Eur-lex: Brussels

Greenberg, Sherri and Newell, Angela (2012), *Transparency Issues in E-Governance and Civic Engagement*, USA: IGI Global.

Hindman, Matthew (2008), *The Myth of Digital Democracy,* Princeton NJ: Princeton University Press.

Kies, Raphaël (2010), *Promises and Limits of Web-deliberation*, New York: Palgrave Macmillan.
Lutz, Barend and Toit, Pierre du (2014), *Defining Democracy in a Digital Age: Political Support on Social Media,* Basingstoke: Palgrave Macmillan.

Madise, Ulle&Maaten, Epp(2010),"Internet Voting in Estonia" in David Rios Insua& Simon French (eds.) *e- Democracy: A Group Decision and Negotiation Perspective*, New York: Springer.

McCormick, John (2021), *Understanding the European Union : a concise introduction:* Red Globe Press

Norris P (2001), *Digital Divide, Civic Engagement, Information Poverty and the Internet worldwide*, Cambridge UK: Cambridge University Press.

O'neil Cathy (2016), *Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy,* New York: Crown Publications.

OECD (2003), *Promise and Problems of E-democracy: Challenges of Online Citizen Engagement,*

Paris: OECD.

Reinsalu, Kristina (2010), *Handbook on E- democracy,* Finland: EPACE Theme Publication. Rice, Ronald E et al (2020), *The Oxford Handbook of Digital Information and Society*, UK:OUP

Rifkin, Jeremy (2014), *The Zero Marginal Cost Society: The internet of things, the collaborative commons and the eclipse of capitalism*, New York: Palgrave Macmillan.

Simon et al. (2017), *Digital Democracy: The tools transforming political engagement,* UK: Nesta.
Weymouth S (2023), *Digital Globalisation: Politics, Policy and a Governance Paradox:* Cambridge University Press

Journal and Web Articles

Turning Finland into the world leader in communications networks - Digital Infrastructure Strategy 2025: Ministry of Transport and Communications, Helsinki 2019

French Digital Republic Act: Explanatory Memorandum, URL: https://www.republique-numerique.fr/pages/digital-republic-bill-rationale

Open Up! Report of the Speaker's Commission on Digital Democracy (UK), URL: https://digitaldemocracy.parliament.uk/documents/Open-Up-Digital-Democracy-Report.pdf

Malta Digital (2022-2027), URL: https://www.maltadigitali.mt/wp-content/uploads/2022/11/Malta-Digitali-Layout-of-document_Nov2022_v1_for-web-5.pdf

National Strategy for Digital Skills (Italy), URL: https://repubblicadigitale.gov.it/portale/documents/20122/992735/National+Strategy+for+Digital+Skills.pdf/c3ff7732-e9ce-498e-71b3-f441ae55afcd?t=1666000144226

Questions and answers on the Digital Services Act: European Commission, URL: https://ec.europa.eu/commission/presscorner/api/files/document/print/en/qanda_20_2348/ QANDA_20_2348_EN.pdf

Matthias Bauer et al (2022), The EU Digital Markets Act: Assessing the Quality of Regulation, URL: https://ecipe.org/wp-content/uploads/2022/01/ECI_22_PolicyBrief-TheEuDigital_02_2022_LY03.pdf

The EU Artificial Intelligence Act, URL: https://artificialintelligenceact.eu/high-level-summary/ The Digital Personal Data Protection Act of India (2023), URL: https://www.meity.gov.in/writereaddata/files/Digital%20Personal%20Data%20Protection%20Act%202023.pdf

Personal Data Protection Handbook (Kenya): Office of the Data Protection Commissioner, URL: https://www.odpc.go.ke/wp-content/uploads/2024/02/PERSONAL-DATA-PROTECTION-HANDBOOK.pdf

General Personal Data Protection Act (Brazil), URL: https://lgpd-brazil.info/

Grading Plan (The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz-1	**10%**
Mid SemExam	**20%**
Quiz-2	**10%**
End Sem Exam	**30%**
Assignments	
Project	**30%**

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant). Program outcomes are posted at

Matrix for CSE

	PO 1	PO 2	PO 3	PO	PO 5	PO 6	PO 7	PO	PO 9	PO1	PO1	PO1	PSO	PSO	PSO	PSO

				4				8		0	1	2	1	2	3	4
CO 1						2	2	3		2		3				2
CO 2				1		2	2	2		2		3				3
CO 3						2		2				2				2
CO 4						2		2		2		2				2
CO 5			2	2	3	2	2	1	2	2	2	2	1	2		3
CO 6			2		2	2		3	2	2		2	1	2		3

Matrix for ECE

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO 1						2	2	3		2		3				2
CO 2				1		2	2	2		2		3				3
CO 3						2		2				2				2
CO 4						2		2		2		2				2
CO 5			2	2	3	2	2	1	2	2	2	2	1	2		3
CO 6			2		2	2		3	2	2		2	1	2		3

Teaching-Learning Strategies in brief :

The course will be based on classroom lectures and in class discussion of assigned reading material. On an average, each student will be required to read between 500 to 700 pages of books and articles and submit written work between 3000-4000 words, cumulatively. The students will be expected to follow the latest news and developments on the topics to be discussed in this course. The assignments and project will focus on training students to develop their own ideas and research skills in social sciences. Audio-visual and interactive materials may be used.

Title of the Course : Digital Signal Analysis
Faculty Name : Anil Kumar Vuppala
CourseCode : CS7.303
L-T-P :3-1-0
Credits :2
NameoftheAcademicProgramB.Tech.inCSE

PrerequisiteCourse/Knowledge: **No prerequisite as it is a core course for CLD program.**

Course Outcomes (COs):
After completion of this course successfully, the students will be able to..

CO-1 : Introduce the fundamentals of digital signal representation and processing toundergraduate students of CLD/CS/CSD.
CO-2: Introduce the advantage of a transformed domain representation.
CO-3: Application of basic signal processing tospeechsignals.

MappingofCourseOutcomes
(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs)

	PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O1	PS O2	PS O3	PS O4
CO 1	3	2	1	1	1	1	1	1	2	1	1	2	-	3	-	-
CO 2	3	2	1	1	1	1	1	1	2	1	1	2	-	3	-	-
CO 3	3	2	2	1	1	1	1	1	2	1	1	2	-	3	-	-

EachCourseOutcome(CO)maybemappedwithoneormoreProgramOutcomes(POs).Write‘3’intheboxfor‘High-level’mapping,2for‘Medium-level’mapping, 1 for ‘Low’-level’mapping
Mapping with PSOs, where applicable.

DetailedSyllabus:

Unit1: BasicsofFourierseriesandtransform,samplingandquantisation,differenttypes of signals and systems.

Unit 2: Z-transform, FIR and IIR systems. Introduction to digital filter design.

Unit 3: Application of concepts using speech signals.

ReferenceBooks:

1. Digital signal processing by John G. Proakis and Dimitris K Manolakis.
2. DigitalsignalprocessingbyAlanV.OppenheimandRonaldW.Schafer.
3. Introduction to Digital Speech Processing by Lawrence R. Rabiner andRonaldW.Schafer,nowPublishersInc.Hanover,USA,2007

Teaching-LearningStrategiesinbrief(4to5sentences):

It is a mathematical oriented signal processing course, so regular problem solvingassignmentsaregiventounderstandtheconcepts.Surpriseclasstestsareconducted based on assignments to test the seriousness in assignment solving. As apart of teaching practical examples like speech signal is used for demonstration ofmathematical concepts learned.

Assessmentmethodsandweightagesinbrief(4to5sentences):

Assignments -- 20%
Quiz -- 30%End
exam -- 50%

Title of the Course : **Disaster Management**
Faculty Name : Jofin George + Shubham Singhal
Course Code : CE8.401
L-T-P : 3-1-0.
Credits : 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)

1. Prerequisite Course /Knowledge:

General awareness about disasters, computer programming skills, and electronic hardware knowledge to develop tools and aids to assist effective disaster management.

2. Course Outcomes(COs)

After completion of this course successfully, the students will be able to:

CO-1. Develop awareness about natural and man-made disasters and help contribute holistically towards a disaster resilient community
CO-2. Employ the core area skills in developing disaster management tools and sensors
CO-3. Illustrate problem solving skills for various disaster scenarios and work towards a research- based disaster management for the country.
CO-4: Develop critical thinking to help policy making in disaster management activities
CO-5. Analyze ethical and effective disaster management practices and related e-governance
CO-6. Reorganise inter-personal skills required to manage inter-disciplinary, inter-departmental collaborations in disaster management

3. Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course ArticulationMatrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO 3	PSO 4
CO1	1	1	1	2	1	3	3	3	2	2	3	3	1	1	1	1
CO2	3	3	3	2	3	1	1	1	2	2	2	1	2	2	2	3
CO3	3	3	3	3	2	1	1	1	1	1	1	1	3	3	2	3
CO4	1	1	1	1	1	2	2	3	3	3	3	3	1	1	1	2
CO5	1	1	2	2	2	3	3	3	1	1	2	2	1	1	2	1
CO6	1	1	2	2	2	2	2	2	3	3	3	3	1	2	3	1

'3' in the box denotes 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4. DetailedSyllabus:

Unit 1: Disaster Management Cycle- Mitigation, Preparedness, Response, Rehabilitation, Reconstruction, Recovery, Resilience, Capacity Building (9 hours);
Unit 2: Institutional Arrangements-NDMA, SDMA, DDMA, FEMA (7 hours);
Unit 3: Management of Natural and Man-made- Case Studies- Flood, Drought, Earthquakes, Cyclones, Tsunami, Landslides, Avalanche, Forest Fire, Air Pollution, Terrorist attacks, Nuclear Disaster, Chemical Disaster (12 hours);
Unit 4: Role of Information and Communications Technologies in Disaster Management Mitigation, Preparedness, Response, Recovery-Early Warning Systems, Mobile Communications, Information Dissemination (7hours);
Unit 5: Disaster Risk Analysis-Mapping, Modelling, Risk Analysis, Introduction to Risk Modelling & Analysis using softwares, hands-on training (QGIS) (7 hours)

References :

1. Alexander, D., (1999), *Natural Disasters*, Kluwer Academic,London
2. Bhandani, R.K., *An Overview on Natural & Man-made Disasters and their Reduction*, CSIR, NewDelhi
3. Bryant,E., (1995), *Natural Hazards*, Cambridge University Press, NewYork
4. Coppola, D.P., (2007), I*ntroduction to International Disaster Management*, Elsevier Science (B/H),London
5. Federal Emergency Management Agency (FEMA), *Guidelines*, FEMA,USA

6. Kanda, M., (2017), *Disaster Management in India Evolution of Institutional Arrangements and Operational Strategies*, Centre for Good Governance, Hyderabad, India
7. Malhotra, S., (2005), *Natural Disaster Management*, Avishkar Publishers, Distributors, Jaipur,India
8. National Disaster Management Authority (NDMA), *Guidelines*, NDMA, India (https://ndma.gov.in/en/ndma-guidelines.html)
9. Robinson, A., (1996), *Earth Shock: Hurricanes, Volcanoes, Earthquakes, Tornadoes and other Forces of Nature*, Thames and Hudson, NewYork
10. Sinha, P.C., (2006), *Disaster Vulnerabilities and Risks: Trends, Concepts, Classification & Approaches*, SBS Publishers & Distributors, New Delhi,India

5.eaching-Learning Strategies inbrief:

Lectures by integrating ICT into classroom teaching, tutorials involving simulation modelling, analysing GIS data for predicting disasters, critical and active learning, and project-based learningbydoingterm-projectswhichinvolveshands-onuseofcomputerprogrammingskills and software/hardware tools applications.

6. Assessment methods and weightages inbrief:

Assignments in theory: 20 marks, Quizzes in theory: 10 marks, Mid Semester Examination in theory: 20 marks, End Semester Examination in Theory: 30 marks, Term-project: 20 marks

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Title of the Course: Distributed Systems

Faculty Name : Lini Thomas
Course Code : CS3.401
L-T-P :3-1-0
Credits :4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Academic Program B. Tech. in Computer Science and Engineering

1.Prerequisite Course / Knowledge:

An understanding of operating systems, networks, and algorithms

2.Course Outcomes (COs):

After completion of this course successfully, the students will be able to..

CO-1 : Explain the challenges faced by distributed systems in terms of lack of global time, synchrony, faults, programming support, etc.
CO-2 :Employ standard distributed programming frameworks to write distributed programs for problem solving
CO-3 : Explain the properties and design principles of various real-world and practical distributed systems
CO-4 :Interpret the impact of faults in distributed systems in the context of important problems such as distributed agreement, distributed consensus, and distributed transaction processing

CO-5 :Analyze distributed algorithms for graphs with respect to correctness, round complexity, and message complexity.
CO-6 : Analyze the limitations of distributed systems and assess the operational scope of large scale distributed systems

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO 1		PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	1		1	1	1	1	1	1	1	1	2	1	2	3	3	3	3
CO 2	1		2	2	2	3	2	1	1	2	1	2	2	3	3	3	3
CO 3	1		1	2	2	1	2	1	1	1	2	1	2	3	3	3	3
CO 4	1		2	2	2	1	2	1	1	2	2	1	2	3	3	3	3
CO 5	2		2	2	2	1	1	1	1	2	1	2	2	3	3	3	3
CO 6	2	2	2	2	2	1	2	1	1	2	2	2	2	3	3	3	3

Note: '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4.Detailed Syllabus:

- Unit 1
  - Introduction
  - Communication models
  - Time and Synchronization
  - Practice: MPI/Map-Reduce
- Unit 2
  - Distributed file systems
  - Consensus, Agreement, Locking
  - Practice: GFS, Chubby
- Unit 3
  - Distributed Database systems
  - Practice: NoSQL, MongoDB
- Unit 4
  - Limitations of distributed computing
  - Self-Stabilization
  - CAP Theorem
- Unit 5
  - Distributed algorithms for graphs
  - Advanced Topics such as Blockchain, Distributed Storage, and Distributed Program Verification

Reference Books:

1. A.D. Kshemkalyani, M. Singhal, (2011) Distributed Computing: Principles, Algorithms, and Systems, ISBN: 9780521189842, paperback edition, Cambridge University Press, USA.
2. N. Lynch, 1996. Distributed Algorithms, Morgan Kauffman, USA, Chapter 5.
3. Other significant papers from conferences such as OSDI, USENIX, NSDI, for material that is not part of textbooks

5.Teaching-Learning Strategies in brief:

Lectures of the class use the active learning methodology and allow students to learn concepts thoroughly in class along with practising small examples. Homeworks assigned as part of the course are useful to impart knowledge of using practical distributed programming tools and libraries. To promote team work, some of the homeworks are done in a team of two students. The overall learning from the course is enhanced by doing a substantial practice-based project – usually in a team of two students. The course will also have a summative assessment in the form of a final/end-semester exam.

6.Assessment methods and weightages in brief :

- In-class Quiz Exams (Cumulative over several): 15%
- Homeworks: 20%
- Project: 25%
- End Semester Examination: 40%

Title of the Course : **Earthquake Engineering**
NAME OF FACULTY : Sunitha P
Course Code : CE1.601
L-T-P :3-1-0
Credits : 4
Name of the Academic Program: M.Tech in Computer Aided Structural Engineering

1.Prerequisite Course / Knowledge:

B.Tech in Civil Engineering subjects i.e., Engineering Mechanics, Reinforced Concrete Design, Structural Analysis, Structural dynamics

2.Course Outcomes (COs) (5 to 8 for a 3 or 4 credit course):

After completion of this course successfully, the students will be able to..

CO-1 Use the understanding of the earthquake engineering forstructuraldesign;
CO-2 Write computer programs, to understand earthquake behaviour;
CO-3 Analyse and design the structure using commercially available software
CO-4 Apply the knowledge of code provisions for design of buildings and structures
CO-5 Appreciate the challenges in construction industry and get equipped to address some of the challenges

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1	1	2	3	3	-	-	-	-	-	3	3	2	3
CO2	2	1	2	2	2	1	1	-	-	-	-	-	2	2	3	3
CO3	1	2	3	2	2	3	2	-	-	-	-	-	2	3	3	3
CO 4	3	3	2	3	3	3	2	-	-	-	-	-	3	2	2	3

CO5	2	2	2	3	3	3	3	-	-	-	-	-	3	3	2	2

Note: '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4.Detailed Syllabus:

Unit 1: Earthquake Hazard on Buildings: Plate tectonics, Origin of earthquakes, types of faults and seismic waves, measurement of earthquakes, magnitude and intensity, characteristics of earthquake ground motion

Unit 2: Earthquake Behavior and Analysis of Buildings: Behavior of MRFs, behavior of SWs, Earthquake Analysis of Buildings, methods of Analysis

Unit 3:Earthquake Resistant Design and Detailing of Buildings: IS 1893-2016, concept of earthquake resistant design, seismic code Provisions for design of buildings, earthquake Resistant Detailing of Buildings, IS 13920-2016

Unit 4:Earthquake Safety Assessment of Building: Pre-earthquake safety assessment, post-earthquake evaluation of structures & Retrofitting

Unit 5: Earthquake Strengthening of Buildings and Special Topics: Methods of Retrofitting, Methods of Strengthening, Special topics, non-engineered constructions**Reference Books:**

1. Seismic Design of Reinforced Concrete and Masonry Buildings by T. Paulay and M.J.N. Priestley.
2. Earthquakes by Bruce A. Bolt.
3. Earthquake Engineering, Application to Design by Charles K. Erdey.
4. Earthquake Engineering: From Seismology to Performance Based Design by Yousef Bozorgnia and VitelmoBertero.

5.Teaching-Learning Strategies in brief (4 to 5 sentences):

A lecture on a theory concept will be preceded by its practical relevance, appreciation of field level challenges and immediately followed by on-hands-practice using manual approach as well as using appropriate scientific software. Student will be encouraged to come up with issues and how the theory and hands-on experience is helping them. Student is also encouraged to do homework and assignments individually and mini-projects as a group task.

6.Assessment methods and weightages in brief (4 to 5 sentences):

The course will rely heavily on looking at problem solving capability of student and hence the assessment is divided as follows i.e..

a) 20% weightage is given to individual assignments for checking the concepts taught in the class,
b) 20% weightage is for group projects for checking software application
c) 30% is quizzes & Mid exam for checking the application of concept and,
d) 30% for end-sem exam is for overall assessment.

Title of the Course : **Electrodynamics**
NAME OF FACULTY : Diganta Das
Course Code : SC1.101
L-T-P :3-1-0
Credits : 2
Name of the Academic Program: **CND**

1.Prerequisite Course / Knowledge: None

2.Course Outcomes (COs):

After completing this course successfully, the students will be able to

CO-1 **Explain** how to compute the notion of scalar and vector potentials and use them to **compute electric and magnetic fields in various problems.**

CO-2 **Solve** basic problems of finding electric and magnetic fields of configurations of charges/currents including dipoles in free space or in matter.

CO-3 **Recognize** the Maxwell's equations and **explain** how they lead to electromagnetic waves in free space.

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	3										1		
CO2	2	3	2	3												
CO3	1	3		2										1		2

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4.Detailed Syllabus:

Unit 1: Mathematical background. Basic vector calculus, orthogonal coordinate systems and Dirac delta function.

Unit 2: Electrostatics. Coulomb's law, electric field, Gauss's law, electric potential, electrostatic energy, conductors, electric fields in matter: polarization, bound charges, dielectrics

Unit 3: Magnetostatics. Lorentz force law, Bio-Savart law, Ampère's law, vector potential, magnetic fields in matter: dia-/para-/ferro-magnets, bound currents

Unit 4: Electromotive force, Faraday's law

Unit 5: Maxwell's equations and electromagnetic waves

Reference Books:

1. Introduction to Electrodynamics by David J Griffiths
2. Classical Electrodynamics by J D Jackson
3. The Feynman Lectures on Physics, Volume II

5.Teaching-Learning Strategies in brief:

This is the basic course on Electrodynamics. The focus would be on concepts and intuition building with reasonable stress on the underlying mathematical structure.

6.Assessment methods and weights in brief:

Assignments + Quizzes – (60%), Final exam (40%)

Title of the Course : ElectronicsWorkshop-II

Name ofthe faculty : Arti Yardi + Spandan Roy

Course Code : EC2.202

L-T-P : 0-0-6
Credits : 4
Nameofthe Academic Program:B. Tech.inECE
PrerequisiteCourse/Knowledge:
BasicknowledgeofElectronicsdesign (digital,analog, etc.).

Course Outcomes (COs):
After completion of this course successfully, the students will be able to.
CO-1: EW-II will enable students to have conceptual understanding and practical implementations of theoretical knowledge e.g.,p-njunctiondiode,need of rectifiers, understanding offilters, understanding the working of transistors in various configuration;understanding of MOSFET, amplification, conversion,processing,etc. Practical implementations will reinforce various concepts.
CO-2: Able to use various tools used in electronic, such as Soldering Iron, soldering wire,flux, Multimeter (analog and digital), male and female connectors (audio, video), Use ofvariousdevices(MOS,transistors,Diodes,SCR,etc.),Op-amp,Useofelectronicinstruments(multi-meter, signalgenerator,power supply, oscilloscope),etc.
CO-3: At the end of the course students are expected to be able to design and analyseelectroniccircuits, which involvemanydiscreteactive and passive components.
CO-4:Abletoarticulatethefunctionalityofsuchcircuitsaswellasbeproficientinimplementing thesameinvarious domains.

CO-5:Posedwithanon-obviousdesignproblemthestudentshouldfeeladequatelyconfident to come up with thedesign,implement, debugand get it towork.

MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes(PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	1	1	1	2	2	2	1	1	3	3	2	2	2
CO2	3	3	2	2	2	1	1	2	1	1	1	3	3	2	2	2
CO3	3	3	3	2	2	1	1	2	2	2	1	2	3	3	3	3
CO4	3	3	3	3	2	1	1	2	2	2	1	3	3	3	3	3
CO5	2	3	3	3	2	1	1	2	3	3	3	3	3	3	3	3

Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs). Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping. Mapping with PSOs, where applicable.

DetailedSyllabus:
EW-II is a project intensive course focused on Electronics (analog, digital, mixed) designandapplicationwhileelementsofmicrocontrollerprogrammingthataidsthisdesignisanoption .The course isbroadlydivided intwoprojects;
Project-1(e.g., Design of an Audio Amplifier) is common to all students (in a group of 2studentswiththefollowing specifications (forillustrationonly)

- Supply: 5V
- Input:10-20mVpeaktopeak
- Gain: G1 x G2 ≥ 500 (Pre ampandGainstage)

- Frequency: Audible range (20Hz-20KHz)
- Power: P ≥ 1.5W
- Filter should not attenuatethe gain; Power amp shouldn't beusedforgain.
- Load:10Ω

Project-2isanindividualproject (ina groupof2students), which areveryappliedtest thestudents' mettle in the following areas broadly-

- FilterDesign
- Amplifier and RectifierDesign
- RegulatorDesign
- ADC
- Sensor Integration to Controllersand Calibration
- SignalProcessing
- Robotics
- IoT,etc.

ReferenceBooks:

Nopreferredtextbookasthisisaprojectcourse.IndicativetextbookincludeMicroelectronicCircuitsby Sedra and Smith.

Teaching-LearningStrategiesinbrief(4to5sentences):

Projectsarethebestwaytoopenstudentmindstolearningelectronicspractically.Makingprojects that do an exciting real-world task will make students curious to understandelectronicsbetter.Theaimofthissubjectistoprovidetheknowledgeofthefundamentalconceptsrelatedto Electronics.Thelearningwillinvolvehandlingwidevarietyofinstruments while testing, trouble shooting, calibration etc. The study of EW-II will helpstudentstogaintheknowledgeofworkingprinciplesandoperationofdifferentinstruments. During EW-II practical sessions, they will acquirethe requisite skills.

Assessmentmethodsand weightagesinbrief (4to5sentences):

- Project1:40%
- Project2:60%

Title of the Course : Environmental, Social and Governance Strategies in Mineral Extractive Industries

Faculty Name : Radhika Krishnan

Name of the Program: HumanitiesElective offered to UG3/UG4

Course Code : HS8.303

Credits : 4

L - T - P :3-0-0

(L - Lecture hours, T-Tutorial hours, P - Practical hours)

Semester, Year : Spring 2025

Pre-Requisites: Environment and Politics in India (preferred), Introduction to Sociology or Introduction to Politics

Course Outcomes:

CO-1: Students will be introduced to the political economy of mineral extraction and the connections between governance, society and the environment.

CO-2: Students have an understanding of the various narratives around mineral extraction globally and specifically in the Global South.

CO-3: Students willunderstand the continuities and disruptions in the history of mineral extraction in India.
CO-4: Students will be able to critically analysepolicy conundrums within mineral resource governance, with a specific focus on India.
CO-5: Students will have an understanding of the various impacts of mineral extraction in the Global South, with a specific focus on coal mining.
CO-6: Students will be encouraged to think through and critically analyse ideas around the future(s) of existing mineral extractive industries.

Course Topics:

Unit 1:

Impacts of mineral extraction: Social (displacement, loss of land/associated status and familiar spaces), economic (loss of livelihoods, access to resources such as water and forests) and ecological (forest destruction, water table, loss of agricultural land). Case studies, exploring socio-cultural,

economic and ecological disruptions and responses from the state as well as local communities and non-state actors.

Unit 2:

Conundrums in Mineral Resource Governance: Important milestones in mineral resource governance in India. Shifting policy priorities in legislations related to land acquisition, land ownership and rights, indigenous/*adivasi* rights as well as in environmental legislations related to mineral resource governance. Debates and discourses around the question of legality and illegality in mineral governance.

Unit 3:

History of Mineral Extraction in India: Continuities and disruptions in the history of mineral extraction in India, using coal as a case study. Historical legacies from India's colonial past that continue to inform and influence contemporary mineral policy.

Unit 4:

Political Economy of Mineral Extraction: Brief introduction to the political economy of mineral extraction. Actors and relations between actors in mineral extractive industries.

Unit5:

Narratives around Mineral Extraction: Introduction to various discourses around mineral extraction, and the role of significant actors and processes in shaping these discourses. Shifting discourses, introduction of new themes and agendas (such as environmental sustainability and indigenous rights).

Unit 6:
Future(s) of Mineral Extraction:Exploring possibilities of new relations and entanglements. Possibilities, tensions and contradictions in imagining futures without a socio-economic dependence on minerals (coal as a case study).

Preferred Textbooks:

Kuntala Lahiri-Dutt (ed.), *Coal Nation: Histories, Ecologies and Politics of Coal in India* (Surrey: Ashgate Publishing Company, 2014).

Saleem H. Ali., *Mining, the Environment, and Indigenous Development Conflicts* (Tucson: University of ArizonaPress, 2003).

Timothy Mitchell, *Carbon Democracy: Political Power in the Age of Oil* (London: Verso, 2011).

Reference Books/articles:

<u>Impacts of mineral extraction</u>

Anthony Bebbington et. al., 'Resource extraction and infrastructure threaten forestcover and community rights', *PNAS*, Vol. 115, No. 52 (2018), 13164–13173.

Murat Arsel, Bengi Akbulut and Fikret Adaman, 'Environmentalism of the malcontent: anatomy of an anti-coal power plant struggle in Turkey', *Journal of Peasant Studies* (2015).

Patrik Oskarsson, Kuntala Lahiri-Dutt and Patrick Wennstrom, 'From Incremental Dispossession to a Cumulative Land Grab: Understanding Territorial Transformation in India's North Karanpura Coalfield' *Development and Change*, Vol. 50 No. 6 (2019), 1485–1508.

Sunila S. Kale, 'From company town to company village: CSR and themanagement of rural aspirations in eastern India's extractive economies', *The Journal of Peasant Studies*(2020).

<u>Conundrums in Mineral Resource Governance</u>

David Szablowski, 'Operationalising Free, Prior, and Informed Consent in the extractive industries sector? Examining the challenges of a negotiated model of justice', *Canadian Journal of Development Studies*, Vol. 30, No. 1-2 (2010), 111-130.

Kanhaiya Singh and Kaliappa Kaliranjan, 'A decade of economic reforms in India: The mining sector', *Resources Policy*, Vol. 29 (2003), 139-151.

Kuntala Lahiri-Dutt, 'Illegal coal mining in Eastern India: Rethinking legitimacy and limits of justice', *Economic and Political Weekly,* Vol. 42. No 49 (2007), 57-67.

Roy Maconachie and Galvin Hilson, 'Editorial introduction: The extractive industries, community development and livelihood change in developing countries', *Community Development Journal*, Vol. 48 No. 3 (July 2013), 347–359.

<u>History of Mineral Extraction in India</u>

Kuntala Lahiri-Dutt (ed.), 'Part III: Social perspectives to inform mining policy' in *Coal Nation: Histories, Ecologies and Politics of Coal in India* (Surrey: Ashgate Publishing Company, 2014), 257-305.

Ramdas Rupavath, 'The persistence of land alienation: The experience of tribal people of Andhra Pradesh', *Journal of Asian and African Studies* (2014), 1-17.

Ramesh Sharan, 'Alienation and restoration of tribal land in Jharkhand', in Nandini Sundar (ed.), *Legal Grounds: Natural Resources, Identity and the Law In Jharkhand* (New Delhi: Oxford University Press, 2009), 82-113.

Tarun Choudhary, 'Use of eminent domain: Process and its critique', in *India Infrastructure Report 2009: Land: - Critical Resource for Infrastructure* (2009).

Political Economy of Mineral Extraction

France Bourgouin and Havard Haarstad, 'From "good governance" to the contextual politics of extractive regime change', *Resource governance and developmental states in the global south: Critical international political economy perspectives* (2013), 87-106.

Henry Veltmeyer, 'The political economy of natural resource extraction: A new model or extractive imperialism?', *Canadian Journal of Development Studies,* Vol. 34 No. 1 (2013), 79-95.

Paul Gellert, 'Extractive regimes: Toward a better understanding of Indonesian development', *Rural Sociology,* Vol. 75 No. 1 (2010), 28-57.

Narratives around Mineral Extraction

This module will use references from several papers, thinkers and policy documents to introduce students to various narratives around mineral extraction.

Amber Murrey & Nicholas A. Jackson, 'A Decolonial Critique of the Racialized "Localwashing" of Extraction in Central Africa', *Annals of the American Association of Geographers* (2019), 1-24.

Fikret Adaman, Murat Arsel& Bengi Akbulut, 'Neoliberal developmentalism, authoritarian populism, and extractivism in the countryside: the Soma mining disaster in Turkey', *The Journal of Peasant Studies*, Vol. 46 No. 3 (2019), 514-536.

Lorenzo D'Angelo and Robert J. Pijpers, 'Mining Temporalities: An Overview', *The Extractive Industries and Society* (2018).

Mukul Kumar, 'Fossil neoliberalism and its limits: Governing coal in South India', *Nature and Space* (2022), 1-19.

Future(s) of Mineral Extraction

Andrea Cardoso and Ethemcan Turhan, 'Examining new geographies of coal: Dissenting energyscapes in Colombia and Turkey', *Applied Energy*, 224 (2018), 398-408.

Benjamin Brown and Samuel J. Spiegel, 'Coal, Climate Justice, and the Cultural Politics of Energy Transition', *Global Environmental Politics,*Vol. 19 No. 2 (May 2019).

Nicholas Bainton, Deanna Kemp, Eleonore Lèbre, John R. Owen, and Greg Marston, 'The energy-extractives nexus and the just transition', *Sustainable Development,* Vol. 29 (2021), 624-634.

Paul K. Gellert and Paul S. Ciccantell, 'Coal's Persistence in the Capitalist World-Economy: Against Teleology in Energy "Transition" Narratives', *Sociology of Development*, Vol. 6No2, (2020), 194-221.

Grading Plan:

Type of Evaluation	Weightage (in %)
Quiz-1	**7.5 (Questions related to Unit I)**
Mid SemExam	**20 (Questions related to Units 2-3)**
Quiz-2	**7.5 (Questions related to Unit 4)**

End Sem Exam	**35 (Emphasis on Units 5-6, some questions from 1-4)**
Group Project	**30 (Designed to use frameworks discussed in the course)**

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

Applicable for CSE

	PO1		PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	-		-	1	1	-	2	2	2	-	-	-	1	-	-	-	-
CO2	-		-	-	1	-	2	2	2	-	-	-	1	-	-	-	-
CO3	-		-	1	-	-	2	2	2	-	-	-	1	-	-	-	-
CO4	-		-	1	2	-	2	2	2	-	-	-	1	-	-	-	-
CO5	-		-	2	2	-	3	3	3	-	-	-	1	-	-	-	-
CO6	-		-	2	2	-	3	3	3	-	-	-	1	-	-	-	-

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

Applicable for ECE

	PO1		PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	-		-	1	1	-	2	2	2	-	-	-	1	-	-	-	-
CO2	-		-	-	1	-	2	2	2	-	-	-	1	-	-	-	-
CO3	-		-	1	-	-	2	2	2	-	-	-	1	-	-	-	-
CO4	-		-	1	2	-	2	2	2	-	-	-	1	-	-	-	-
CO5	-		-	2	2	-	3	3	3	-	-	-	1	-	-	-	-
CO6	-		-	2	2	-	3	3	3	-	-	-	1	-	-	-	-

Teaching-Learning Strategies in brief (4-5 sentences):

Students will be introduced to theories and concepts through lectures, and will be encouraged to read specific papers that are central to the ideas being discussed in class. Photographs, short 4-5 minutes videos, posters and pamphlets will be used during the lectures. Discussions and interventions in the classroom are highly encouraged. The Mid Semester as well as the End Semester exams will be designed to test the grasp over specific issues and concepts discussed in the course, and the quizzes will require to apply concepts to specific case studies. The group project

will involve students working together to analyse the socio-political and economic dynamics of the extraction of a specific mineral in a specific region.

Title of the Course : Ethics and the Digital Society

Name of faculty : Nimmi Rangaswamy
Name of the Academic Program : B. Tech. in CSE
Course Code : HS0.217
Credits : 2
L-T-P: 14 Hours of Class Lectures
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Core Course for BTech 4th Year

Prerequisite Course / Knowledge: UG4 and above – no other prerequisite knowledge

2. Course Outcomes (COs) - After completion of this course successfully, the students will be able to

CO-1. Learn a few foundational aspects of Digital society from the perspective of sociology and anthropology disciplines.

CO-2. Develop understanding of ethics as applied to digital life

CO-3: Examine the interplay between moral/ethical/social values and human-digital interactions.

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PSO1	PSO2	PSO3	PSO4
CO1		2											
CO2			3										
CO3			3										

'3' in the box denotes 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

Course Structure in Detail

Overview

What does social responsibility look in the age of the Digital Society? The concern with ethical principles and moral values makes us reflect on the digitization of everyday life and its implications for the social and economic well-being of people. This course seeks to identify and analyze the responsibility of participating both in a digital and an information society.

Broad Objectives:

To introduce ethics as an inter-disciplinary domain of study to students of Engineering and the Social Sciences

To bring a social perspective and the importance of lived contexts in the framing and understanding of human-computer interaction and ethical dilemmas and predicaments that arise from this interaction

To get a grasp of a few foundational theoretical and applied frameworks to understand the digital society

COURSE TOPICS/OUTLINE/CONTENT

This course is an introduction to Digital Ethics with a focus on 'human-computer interaction' and its interface with the social sciences. The course begins with a selection of seminal work that establish the HCI domain: interactive systems/techniques, design and user interfaces.

1.Understanding Ethics as an academic course and in everyday life

Students will learn fundamental concepts of ethics and their application to understand the digital society. We will discuss the influence of a few key current and upcoming technologies and their implications from an ethical perspective.

2.Technology and Ethics: An Interdisciplinary approach

Introduce the idea of cross-fertilization of domains, especially computer sciences and humanities to discuss debate and organize topics on ethics and society as a fertile research and academic science

3.Ethical AI- Under the broad rubric of Ethical AI we will discuss and debate the following:

Ethics of Digital Identity and its Discontents

Examine how people behave on the internet, and contrast this with traditional

views of good ethical standards, or " doing the right thing"

Big Data Ethics

Big data generated and collected through various digital sources, offers unprecedented opportunities for innovation, insights, and efficiency across industries and everyday life.

Algorithmic Fairness

Algorithms used in decision-making processes must be unbiased and not discriminate against individuals or groups based on protected characteristics such as race, gender, ethnicity, religion, or socioeconomic status.

All the above topics will be discussed through select case studies, focusing on specific problems people face in their everyday lives to discuss, debate and analyse them. Topics may range from evaluating decision-making in autonomous systems to artificial intelligence in health care and their reliability and dependability for the well-being of society and citizens

SELECT REFERENCE BOOKS:

1.Mark Coeckelbergh, *AI Ethics*, MIT Press, 2021

2.Virginia Eubanks, *Automating Inequality*, St. Martin's Press, , NY, United States, 2018

3.Jaron Lanier, *Ten Arguments for Deleting your Social Media Accounts Right Now*, New York : Henry Holt and Company, 2018

4.Cathy O'Neil, *Weapons of Math Destruction*, Penguin Books, 2017

5.Postman Neil, *Technopoly: The Surrender of Culture to Technology*, New York, Knopf, 1992

6. Spinello, Richard A., ' Informational Privacy', in George G. Brenkert (ed.), *The Oxford Handbook of Business Ethic*s, Oxford Handbooks, 2009

7. Shoshana, Zuboff. *The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power.* New York: Public Affairs, 2019.

GRADING PLAN:

Type **Evaluation**	**Weightage (in %)**
Quizzes	**60%**
Individual Class presentations	**30%**
Class participation	**10%**

LEARNING OUTCOMES:

Students will be able to reflect on their actions as citizens of a digital society as well as future computer professionals. They will learn how to evaluate digital technologies encountered each day and trade-offs inherent in new technologies to suit lifestyles. Students will learn to engage with how to design information systems supporting wants, needs and desires of a digital society. Students will hopefully obtain the ability to apply ethical thinking to novel technological systems, societal problems ensuing thereof and potential solutions.

Title of the Course : Ethics in Research

Name of faculty : Bhaktee Dongaonkar, Vinoo Alluri, Priyanka Srivastava
Course Code : HS0.218
Credits :
L-T-P:
(L= Lecture hours, T=Tutorial hours, P=Practical hours)

Course Description:

This course explores the ethical issues that arise in research, particularly in the context of psychology, science, and engineering. The course draws upon classic studies and current ethical frameworks to help students critically evaluate research practices, understand the responsibilities of researchers, and navigate ethical dilemmas in scientific inquiry. Using case studies students will engage with real-world issues in research ethics, such as informed consent, research integrity, the ethics of experimentation, and the role of researchers in society, amongst others.

Course Objectives:

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

CO1: Understanding Ethical Principles in Research

CO2. Ability to Critically Analyze Research Practices

CO3. Awareness of Research Misconduct and Integrity

CO4. Ethical Handling of Human and Animal Subjects

CO5. Ability to Navigate Conflicts of Interest in Research

CO6. Understanding Ethical Guidelines and Global Research Ethics

Textbooks:

1. Polk, Thad A. *Shocking Psychological Studies and the Lessons They Teach* (2020)
2. Briggle, A., & Mitcham, C. (2012). *Ethics and Science: An Introduction* (Cambridge University Press).
3. Resnik, D. B. (2022). *Research Ethics: A Reader* (2nd Edition, Oxford University Press).

Course Outline:

Topic 1: Introduction to Ethics in Research; History of Ethical Issues in Research

- **Key Topics**:
    - What is research ethics? Importance and historical context.
    - Ethical principles: Integrity, transparency, accountability, fairness.
    - Role of the researcher in society.
    - Review of major ethical scandals in research history.
    - The lessons learned from historical ethical violations (e.g., Tuskegee, Milgram, Stanford Prison Experiment).

    - The evolution of ethical guidelines: Nuremberg Code, Belmont Report, Declaration of Helsinki.
- **Readings**:
    - Briggle & Mitcham: Chapter 1 – *Introduction to Ethics in Science*
    - Resnik: Chapter 1 – *Introduction to Research Ethics*
    - Polk: Chapter 1 – *Milgram's Obedience Study and Its Ethical Aftermath*
    - Briggle & Mitcham: Chapter 2 – *Ethics of Science and the Role of Values*
    - Resnik: Chapter 4 – *Ethical Principles in Scientific Research: A Historical*

Topic 2: Research Integrity and Misconduct

- **Key Topics**:
    - Defining research misconduct: fabrication, falsification, plagiarism.
    - Consequences of research misconduct for science, society, and public trust.
    - Promoting research integrity: the role of researchers, institutions, and journals.
- **Readings**:
    - Briggle & Mitcham: Chapter 3 – *Science, Ethics, and Society*
    - Resnik: Chapter 2 – *The Ethics of Scientific Research: General Principles*

Topic 3: Informed Consent and Ethical Research with Human Subjects

- **Key Topics**:
    - Principles of informed consent in research.
    - Ethical challenges in obtaining consent: vulnerability, coercion, and understanding.
    - Ethics of deception and withholding information in research.
    - Institutional Review Boards (IRBs) and their role.
- **Readings**:
    - Polk: Chapter 2 – *The Ethics of Deception in Psychological Studies*
    - Briggle & Mitcham: Chapter 4 – *Ethics in Human and Animal Research*
    - Resnik: Chapter 10 – *Ethics of Human Research*

Topic 4: Ethics of Psychological Studies and Experiments

- **Key Topics**:
    - Ethical challenges in experimental psychology.
    - The role of psychological experiments in advancing knowledge and public policy.
    - The boundaries between research and manipulation.
- **Readings**:
    - Polk: Chapter 3 – *The Ethics of the Stanford Prison Experiment*
    - Resnik: Chapter 6 – *Ethics of Psychological Research*

Topic 5: Conflicts of Interest and Financial Ethics

- **Key Topics**:
    - Defining conflicts of interest (COI) in research.
    - Financial conflicts: funding, grants, sponsorships, and commercialization.
    - Transparency, disclosure, and the management of COI.
    - Balancing professional integrity with financial incentives in research.
- **Readings**:
    - Briggle & Mitcham: Chapter 5 – *Conflicts of Interest in Science*
    - Resnik: Chapter 8 – *Financial Conflicts of Interest in Research*

Topic 6: Ethics in Collaborative and International Research

- **Key Topics**:
    - Ethical challenges in collaborative research.
    - Global research ethics and cultural differences in research practices.
    - The role of international guidelines and ethical considerations in cross-border research.
    - Ethics in sustainable and environment related collaborative research
- **Readings**:
    - Briggle & Mitcham: Chapter 8 – *Science and Ethics in a Global Context*
    - Resnik: Chapter 16 – *International Ethics in Research*
- **Discussion**: The ethics of conducting research in developing countries or cross-cultural settings.

Assessment:

1. **In-Class Activity/Assignments (30%)**
2. **Quiz (30%)**
3. **Final Exam (40%)**

Program Outcomes (for CSE)

PO1 Engineering knowledge: Use concepts from varied disciplines including Computer Science, Electronics, Mathematics, and the Sciences, to engineer and develop systems of varying scale.
PO2 Problem analysis: Identify, formulate and analyze complex engineering problems reaching substantial conclusions using first principles of Mathematics, Natural Sciences and Engineering Sciences.
PO3 Design/Development of solutions: Identify and bring to fore the necessary concepts from Computer Science and arrive at creative ways to solve problems that take into account the societal, cultural, and ethical considerations.
PO4 Conduct investigations of complex problems: Interpolate and extrapolate based on existing knowledge base and self-learning skills to investigate the dynamics of complex problems and find solutions.
PO5 Modern tool usage: Demonstrate requisite hands-on skills to work with a variety of software packages, libraries, programming languages, and software development environment tools useful in engineering large scale systems
PO6 The engineer and society: Make judicious use of resources and understand the impact of technology across the societal, ethical, environmental, and economic aspects.
PO7 Environment and sustainability: Find technological solutions by considering the environmental impact for sustainable development

PO8 Ethics: Practice principles of professional ethics and make informed decisions after a due impact analysis.
PO9 Individual and team work: Work efficiently in individual and team-oriented projects of varying size, cultural milieu, professional accomplishments, and technological backgrounds.
PO10 Communication: Effectively communicate and exchange ideas and solutions to any individual including peers, end-users, and other stakeholders.
PO11 Project management and Finance: Apply the principles of project management in general and software project management in particular with focus on issues such as the life cycle, scoping, costing, and development.
PO12 Life-long learning: Exhibit the aptitude for independent, continuous, and lifelong learning required to meet professional and career goals.

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	2	1	3	1	1	1	3
CO2	1	1	1	1	1	2	1	3	1	2	1	3
CO3	1	1	1	1	1	2	1	3	2	1	1	3
CO4	1	1	1	1	1	1	1	2	1	1	1	1
CO5	1	1	1	1	1	2	3	3	2	2	3	2
CO6	1	1	1	1	1	2	3	3	2	1	1	3

Course Outcomes
CO1: Understanding Ethical Principles in Research
CO2. Ability to Critically Analyze Research Practices
CO3. Awareness of Research Misconduct and Integrity
CO4. Ethical Handling of Human and Animal Subjects
CO5. Ability to Navigate Conflicts of Interest in Research
CO6. Understanding Ethical Guidelines and Global Research Ethics

Teaching-Learning Strategies:
Lectures are highly interactive as the course requires students to actively participate and contribute to the discussions. We will employ case-based learning and collaborative group work to engage students with real-world ethical dilemmas in research.

Title of the Course : Ethnography in praxis

Faculty Name : Rajorshi Ray

Name of the Academic Program : HS2.303

Course Code :

L-T-P : 3-0-0

(L= Lecture hours, T=Tutorial hours, P=Practical hours)

Credits : 2

1.Prerequisite Course / Knowledge:

2.Course Outcomes (COs) (5 to 8 for a 3 or 4 credit course):

After completion of this course successfully, the students will be able to.

CO-1

Students will develop a foundational understanding of how to conduct an ethnography. They would become aware of the various methods and data sources which form the essential framework of ethnography.

CO-2

Students will be able to acknowledge the panoply forms of data of different origin and scales. The This course would aid them in analyzing data of various scales (macro – meso -micro) in order to investigate a real world sociological phenomenon.

CO-3

The students would gain a hands on experience in data cleaning, data analysis and primary coding of qualitative data. Following which they would develop a holistic understanding of how crude data needs to transformed into thematic categories, which are used to answer the raised research question.

CO-4

In addition to the process from data collection to data analysis, this course envisages to inculcate ethical consideration within students. They are expected to develop a reflexive standpoint, in order to be aware of biases and judgements that might affect their research.

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

Matrix for CSE

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1			1	1		3	3	3				2				
CO2			1	1		3	3	3				2				

CO3			1	1		3	3	3				2				
CO4			1	1		3	3	3				2				
CO5			1	1		3	3	3				2				

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

Matrix for ECE

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1			1	1		3	3	3				2				
CO2			1	1		3	3	3				2				
CO3			1	1		3	3	3				2				
CO4			1	1		3	3	3				2				
CO5			1	1		3	3	3				2				

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4.Detailed Syllabus:

Unit-1
Ethnography: An introduction

- Introduction to qualitative methodologies
- History and politics of qualitative research
- Interpretivist approach
- Ethnography as a qualitative research: Access, Immersion, Data Saturation, and Exit

Unit-2
Field Days

- Research Design: Case selection and Sampling
- Gathering Data via Interviewing
- Gathering data via Observation
- Gathering data via computational methods

- Gathering data via archival work

Unit-3

Analysis and Writing

- Fieldnotes and memos
- Coding – Grounded and Thematic
- Working with NVivo and ATLAS.Ti
- Reflexivity and Ethics

Reference books:

Flick, U. (Ed.). (2013). *The SAGE handbook of qualitative data analysis*. sage.

O'Reilly, K. (2012). Ethnographic methods. Taylor and Francis.

Hammersley, M., & Atkinson, P. (2019). *Ethnography: Principles in practice*. Routledge.

Small, M. L., & Calarco, J. M. (2022). *Qualitative literacy: A guide to evaluating ethnographic and interview research*. Univ of California Press.

There would be other state of the art articles used as a part of the course.

5.Teaching-Learning Strategies in brief (4 to 5 sentences):

This course aims to gives an extensive introduction to ethnography as an interpretive methodological framework through which social phenomenon can be investigated. Being used in multiple disciplines such as sociology, anthropology, digital humanities, management and communication , ethnography allows scholars to probe the scales and depth of the research objective. The lectures will include videos, interviews, and primary data to foster active learning. The quiz would include a writing exercise to evaluate the understanding of basic concepts. There would be an assignment rather than an end-semester examination. The students are supposed to collect primary data and submit a thematic analysis from the data itself. This assignment requires the students to read 30-50 pages of scholarly material and conduct fieldwork.

6.Assessment methods and weightages in brief (4 to 5 sentences):

Type of Evaluation	Weightage (in %)
Assignment 1	**70%. Related to Unit I, II, III (Sociological film review)**
Quiz 1	**30% Related to Unit I and II**

Title of the Course : **Evaluation Methods for NLP**

Faculty Name : Parameswari K and Manish Shrivastava

Course Code : CL3.409

Credits : 2

L-T-P :
(L= Lecture hours, T=Tutorial hours, P=Practical hours)

1. Prerequisite Course / Knowledge:
Introduction to NLP

Course Objectives

After completing this course, students will be able to:

1. Understand the importance of evaluation in NLP and the differences between automatic and human evaluation methods.
2. Apply various evaluation metrics to assess the performance of NLP models and algorithms.
3. Utilize human evaluation frameworks effectively to gather qualitative insights.
4. Address challenges in evaluating NLP models in multilingual and low-resource settings.
5. Benchmark NLP models using widely accepted datasets and evaluation protocols.

Syllabus

- **Unit 1: Introduction to Evaluation in NLP:** Covers the basics of evaluation, metrics (precision, recall, F1-score, BLEU, ROUGE), paradigms (intrinsic vs. extrinsic, task- based vs. corpus-based), and statistical significance testing.
- **Unit 2: Human Evaluation Techniques:** Discusses the role of human judgments, frameworks (crowd-sourcing, expert evaluation), quality annotation, and Multidimensional Quality Metrics (MQM).
- **Unit 3: Automatic Evaluation Techniques:** Focuses on metrics (BLEU, METEOR, TER, COMET, ROUGE, content-based metrics, precision, recall, F1-score).
- **Unit 4: Advanced Topics in NLP Evaluation:** Explores bias and fairness in evaluation, challenges in multilingual and low-resource settings, and benchmarking with GLUE, SuperGLUE, and indicGLUE.

References:

- Jurafsky, D., C Martin, J. H. (2024). *Speech and Language Processing* (3rd ed.). Prentice-Hall.
- Manning, C. D., C Schütze, H. (1999). *Foundations of Statistical Natural Language Processing*. MIT Press.
- Gehrmann, S., Belz, A., C Berant, J. (2021). The GEM benchmark: Natural language generation, its evaluation, and metrics. *Transactions of the Association for Computational Linguistics, S*, 165-184.
- Sellam, T., Das, D., C Parikh, A. (2020). BLEURT: Learning robust metrics for text generation. *Proceedings of the 58th Annual Meeting of the Association for Computational Linguistics*, 7881-7892.
- Leiter, J., Rodrigues, P., Kaushik, D., C Lipton, Z. C. (2022). Towards explainable evaluation

metrics for natural language generation. *arXiv preprint arXiv:2205.01Sc1.*

- Papinenko, A., Roumi, P., Turunen, D., C Kazakov, V. (2002). BLEU: a method for automatic evaluation of machine translation. In *Proceedings of the 40th Annual Meeting of the Association for Computational Linguistics*. Philadelphia, Pennsylvania.
- Mathur, S., Freitag, A., Kocmi, A., C Liu, Y. (2020). COMET: A Neural Framework for MT Evaluation. arXiv preprint arXiv:2004.14040. **GitHub Repository:** https://github.com/Unbabel/COMET
- Lommel, A., Graham, D., C Popovic, M. (2014). Multidimensional Quality Metrics for Machine Translation: A Framework and Evaluation. In *Proceedings of the Ninth International Workshop on Statistical Machine Translation.*
- **GLUE (General Language Understanding Evaluation):** https://gluebenchmark.com/
- **SuperGLUE (Supernatural Language Understanding Evaluation):** https://super.gluebenchmark.com/
- **indicGLUE Benchmark:** https://huggingface.co/spaces/evaluate-metric/indic_glue

Teaching-Learning Strategies

This course combines theory-based and hands-on learning, with a focus on applying evaluation techniques to real-world NLP tasks. The approach includes:

- **Lectures:** to introduce and explain fundamental concepts of evaluation in NLP, including both automatic and human evaluation techniques.
- **Case Studies:** to analyze different evaluation metrics and their application to various NLP tasks like Machine Translation, Text Summarization, and more.
- **Practical Sessions:** to provide students with the opportunity to work with datasets and benchmarks, applying evaluation techniques to NLP models.
- **Projects and Group Discussions:** to foster collaborative learning and problem- solving skills, focusing on the challenges of multilingual and low-resource NLP evaluation.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	1	1	3	3	2	2
CO2	3	3	3	2	1	1	1	3	3	3	2
CO3	1	3	3	3	2	1	1	3	3	3	3
CO4	1	1	1	1	1	2	3	3	2	2	2
CO5	1	2	2	1	1	2	3	3	3	2	2

'3' in the box denotes 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

Assessment Methods and Weightages

This course emphasizes evaluating and benchmarking NLP models using both theoretical knowledge and practical applications. Students will gain hands-on experience by engaging with projects and case studies involving real-world datasets.

Type of Evaluation	Weightage (in %)
Assignments	30%
Seminar	10%
Project	40%
Quiz	20%

Detailed Syllabus:

Unit 1: Introduction to Evaluation in NLP

- **Class 1: Introduction to Evaluation in NLP**
  - Importance of evaluation in NLP
  - Overview of automatic vs. human evaluation methods
  - Evaluation metrics: Precision, Recall, F1-Score, Accuracy, BLEU, ROUGE
- **Class 2: Evaluation Paradigms**
  - Intrinsic vs. extrinsic evaluation
  - Task-based vs. corpus-based evaluation
  - Benchmarking datasets and quality analysis
- **Class 3: Statistical Significance Testing**
  - T-test, Chi-square, Bootstrapping
  - Confidence intervals and their importance in NLP evaluation

Unit 2: Human Evaluation Techniques

- **Class 4: Human Evaluation in NLP**
  - Role and importance of human judgments
  - Human evaluation frameworks: Crowd-sourcing, Expert evaluation
- **Class 5: Quality Annotation and Rating Scales**
  - Likert scales, Semantic Differential scales
  - Annotator agreement: Cohen's Kappa, Krippendorff's Alpha
- **Class 6: Multidimensional Quality Metrics (MQM)**
  - Introduction to MQM framework
  - Error categories and quality dimensions in MQM
  - Applying MQM in Machine Translation and other NLP tasks

Unit 3: Automatic Evaluation Techniques

- **Class 7: Machine Translation Evaluation**
  - BLEU, METEOR, TER, COMET
  - Challenges and limitations of automatic metrics
- **Class 8: Evaluation of Text Summarization**
  - ROUGE, Content-based metrics
  - Summary Length, Coherence, Relevance
- **Class G: Evaluation of Text Classification and Information Retrieval**
  - Precision, Recall, F1-Score,
- **Class 10: Evaluating Embedding Quality**
  - Word Embedding benchmarks
  - Sentence embeddings and their evaluation

Unit 4: Advanced Topics in NLP Evaluation

- **Class 11: Bias and Fairness in NLP Evaluation**
  - Detecting and measuring bias in NLP models
  - Fairness-aware evaluation metrics
- **Class 12: Evaluation in Multilingual and Low-resource Settings**
  - Challenges in multilingual NLP evaluation
  - Transferability and generalizability of evaluation metrics
- **Class 13-14: Benchmarking with GLUE, SuperGLUE, indicGLUE and Beyond**
  - Introduction to GLUE and SuperGLUE benchmarks
  - Evaluating general language understanding with GLUE

Title of the Course : Flexible Electronics

Faculty Name : Aftab Hussain
Course Code :EC2.502
L-T-P :3-1-0
Credits :4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)

1.Prerequisite Course / Knowledge:
Understanding of basic concepts of Physics and Chemistry taught up to the 10+2 level

2.Course Outcomes (COs) (5 to 8 for a 3 or 4 credit course):

After completion of this course successfully, the students will be able to..

CO-1: Describe the physical reason for flexibility in various material systems.
CO-2: Explain the various processes, such as lithography, etching, deposition etc., that are involved in silicon semiconductor fabrication.
CO-3: Compare the fabrication and functioning of flexible electronic systems with their rigid counterparts.
CO-4: Employ various microfabrication techniques to obtain flexible electronic systems.
CO-5: Choose the correct approach for designing and fabricating a fully flexible system including, flexible memory, processor, display, power source and so on.
CO-6: Create a report of the various advances in the state-of-the-art of a specific topic in flexible electronic systems.

3. Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Progr:am Specific Outcomes (PSOs) – Course ArticulationMatrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO 3	PSO 4
CO1	3	2	1	1	1	1	1	1	1	1	1	2	2	1	1	2
CO2	3	2	1	1	1	1	1	1	1	1	1	2	3	1	1	1
CO3	2	3	3	1	1	2	2	1	1	1	1	1	2	1	2	2
CO4	1	3	3	2	1	1	1	1	1	2	1	1	2	1	2	1
CO5	1	1	3	2	1	2	2	2	1	2	2	1	1	2	2	1
CO6	1	3	1	3	2	1	2	2	3	3	2	2	1	1	1	1

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs.

Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4. DetailedSyllabus:

Unit 1: Physics of silicon electronics, silicon band structure, flexible materials
Unit 2: VLSI fabrication: silicon wafer, deposition, lithography, etching
Unit 3: Flexible electronic systems, flexible PCBs, interconnects, flexible silicon processes Unit 4: Flexible displays, flexible TFTs, OLEDs, flexible memory
Unit 5: Flexible energy harvesters, photovoltaics, flexible interconnects

Reference Books:

1. Sami Franssila, *Introduction to Microfabrication*, Wiley VCH,2010

2. Mario Caironi, Yong-Young Noh, *Large Area and Flexible Electronics*, Wiley VCH,2015
3. Takao Someya, *Stretchable Electronics*, Wiley VCH,2013

5. Teaching-Learning Strategies in brief (4 to 5sentences):
The course instruction is delivered through lectures slides explained by the instructor. The slides include theoretical concepts with examples of real-world applications of flexible electronic systems to foster student understanding and interest. Assignments are designed to encourage students to critically think about the concepts discussed in the class and to learn to independently solve problems. The students are asked to create a literature survey report detailing the advances in the state-of-the-art of one of the topics in flexible electronic systems.

6. Assessment methods and weightages in brief (4 to 5sentences):

Continuous evaluations: Assignments – 20% MCQ Quizzes –20%
Comprehensive exams: End semester exam – 35% Term-paper report – 25%

Title of the Course: **Gender, Culture and Representation**
Nameof the Faculty: **Subha Chakraburtty**
CourseCode: **HS8.202**
Credits: **4**
L - T – P: **3-0-0**
(L-Lecture hours, T-Tutorial hours, P-Practicalhours)
Name of theAcademicProgram: HumanitiesElective

Semester, Year: Spring, 2025

Pre-Requisites: Nil
CourseOutcomes :

Upon successful completion of this course, studentsshouldbeableto:

CO-1: Understand and engage with central debates in the field of Gender Studies.
CO-2: Define and apply basic terms and concepts central to this field.
CO-3: Apply a variety of methods of analyzing gender in the social context, drawing uponbothprimary and secondary sources.
CO-4: Apply concepts and the oriesof Gender Studies to life experience sand historical events andprocesses.
CO5: Communicate effectively about gender issues in both writing and speech,drawing upon Gender Studiesscholarship and addressingapublicaudience.

CourseTopics:

Unit1:

Introduction to Gender Studies – Understanding the definitions, concepts and theoriesHistoricalperspectives – The Evolutionof Gender Roles

Unit 2:

SocialConstructionofGender

Gender as a social construct: Deconstructing

Strategies Language and Discourse: how wordsshape genderTheimpact of socialization ongender

Unit 3:

GenderandInequality

Gender inequality and gender pay gap Gender and education: access and outcomes

Unit 4:

Non-normative gender identities and experiences

Intersectionality and marginalization with intransgender and non-binary identities

Unit 5:

Applying Gender Studies

Gender in the workplace: bias, leadership Gender and politics: Representation and policy

Preferred Text books:

Bateson,MaryCatherine.*ComposingaLife.*Plume,1990.

Beauvoir,Simonede.*TheSecondSex*.TranslatedbyConstanceBordeandSheilaMalovanyChevallier, VintageBooks, 2011.

Bornstein,Kate,andS.BearBergman,editors.*GenderOutlaws:TheNextGeneration.*SealPress, 2010.

Bourdieu, Pierre. "Structures, Habitus, Power: Basis for a theory of Symbolic Power."*Culture, Power, History: A Reader in Contemporary Social Theory,* edited by Nicholas B.Dirks,GeoffEley andSherryB. Ortner,PrincetonUniversity Press,1994, pp.155-59.

Butalia,Urvashi.*TheOtherSideofSilence.*Penguin,1998.

Butler,Judith.*GenderTrouble:FeminismandtheSubversionofIdentity*.Routledge,1990.Cresswel

l,Tim. *Place:A Short Introduction.*Blackwell Publishing. 2004.

Fincher,Ruth."Space,GenderandInstitutionsinProcessesCreatingDifference",*Gender,Placean d Culture,* vol. 14, 2007, pp. 5-27.

Hall, Stuart. "The Work of Representation." *Representation: Cultural Representation andSignifyingPractices*, editedby StuartHall,SagePublications, 1997.

Hermans,Theo.*TheConferenceoftheTongues.*St.Jerome,2007.

Hochschild,Arlie.*TheSecondShift:WorkingParentsandtheRevolutionatHome.*

PenguinBooks,2003.

hooks,bell.*TheWilltoChange:Men,Masculinity,andLove.*WashingtonSquarePress,2004.

Kimmel, Michael S. *The Gendered Society.* 4th ed., Oxford University Press,

2018.Lefebvre,Henri. *TheProduction ofSpace.*Verso, 1991.

Lorber,Judith.*TheSocialConstructionofGender.*SagePublications,1991.

Serano,Julia.WhippingGirl:ATranssexualWomanonSexismandtheScapegoatingofFemininity.Seal Press, 2007.

ReferenceBooks:

Arnold, David, and Stuart Blackburn. "Introduction: Life Histories in India." *Telling Livesin India: Biography, Autobiography, and Life History,* edited by David Arnold and StuartBlackburn,PermanentBlack, 2004, pp. 1-28.

Athens, L.H. *Violent Criminal Acts and Actors: A Symbolic Interactionist Study.* London,Routledgeand Kegan Paul, 1980.

Becker, G. *Disrupted Lives: How People Create Meaning in a Chaotic World.* Universityof CaliforniaPress,1997.

Belknap. J. *The Invisible Woman: Gender, Crime and Justice.* Wadsworth Publishing Co,2001.

Bhabha, Homi K. "The Third Space. Interview with Homi Bhabha." *Identity, Community,Culture,Difference,*editedbyJonathanRutherford,LawrenceandWishart,1990,pp. 207-211.

Bhabha,Homi.K.*TheLocationofCulture.*Routledge,2006.
Cixous,Helen."TheLaughoftheMedusa."TranslatedbyKeithCohenandPaulaCohen, *Signs*,vol.1, no.4, 1976,pp. 875-93.
Halberstam,Judith.*TheQueerArt ofFailure.*DukeUniversityPress, 2011.
hooks,bell.*FeministTheory:FromMargintoCenter.*SouthEnd Press,1984.
Derrida,Jacques."Structure,SignandPlayintheDiscourseoftheHumanSciences." *WritingandDifference*,translatedbyAlanBass,London,Routledge,1978.
Schaffer,Kay,andSidonieSmith.HumanRightsandNarratedLives:TheEthicsofRecognition.Pal grave-Macmillan, 2004.

GradingPlan:

TypeofEvaluation	Weightage(in%)

2 major Writing Assignments over the course of the semester	**40**(typed essaysof 1000- 1500 words,double spaced, Times New Roman, 12 font size. One pageequals250 words)
End Sem Exam	**40** (2 – 3 subjective questions; in-class writingexercises)
Class Participation	**20** (Activeparticipationinclassdiscussionis necessary to receive full credit for the participationcomponent)

MappingofCourseOutcomestoProgramObjectives:(1–Lowest,2—Medium,3–Highest,or a'-' dash mark if notat allrelevant).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3															
CO2	3															
CO3		3	3												2	3
CO4				2		2		3								3
CO5									3	3		3				

Teaching-LearningStrategies:

This course is structured in a format that blends lectures and discussions. It is crucial thatstudents come to class on time, with required texts, well prepared to offer insightfulresponses to the assigned readings. To be effective as class participants, students need tocompletereading and writing tasks bytheassigned dates.

Avitalongoingintellectualconversation–whichactivelyquestionsthemeaningofgenderinplacesandspacesisattheheartofthecourse.Manyissuesthatweaddressinthecourseare controversial and students may have or voice different viewpoints. It is crucial that weacknowledgeandrespectoneanother'sexperiencesandperspectivessothatourclassroomis asafeandsupportive spaceto converseproductively acrossour differences.

Title of the Course : **GENERAL AND STRUCTURAL CEMISTRY**

Faculty Name : Tapan K. Sau
Course Code : SC2.101
L-T-P : 3-1-0
Credits : 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Academic Program: CND
1.Prerequisite Course / Knowledge: None

2.Course Outcomes (COs):

After completion of this course successfully, the students will be able to..

CO-1. Define quantum numbers for electrons, draw orbital diagrams, and state and apply the Pauli Exclusion Principle and Hund's Rule to write the electronic configurations of atoms.
CO-2. Explain the position of elements in the periodic table and the general periodic trends in atomic size, ionic size, ionization energy, etc. of elements.
CO-3. State why chemical bonds form, identify the types of bonding that occur between metals/metal-nonmetal/nonmetal-nonmetal, state the current bonding models for simple inorganic and organic molecules, and predict important bonding parameters, structures, and properties.
CO-4. Compare the various acid base theories, identify acid-base conjugate pairs, predict the strengths of acids and bases, and describe the properties of acids and bases.
CO-5. Apply bonding theories of coordination compounds to explain their optical and magnetic properties.
CO-6. Describe the properties and applications of various modern materials like semiconductors, superconductors, magnetic materials, polymers and composite materials, and nanomaterials.
CO-7. Distinguish intermediates and transition state; use chemical reaction theories to explain chemical reactions and their rates.
CO-8. Be able to describe how chemistry plays a central role in modern science.

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3															3
CO2	3															3
CO3	3															3
CO4	3															3
CO5		2														3
CO6	3															
CO7		3														3
CO8			2													3

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4.Detailed Syllabus:

Unit 1. THE STRUCTURE OF ATOMS – A BASIC QM TREATMENT (2L)
Quantization of the energy levels; quantum numbers; s, p, d and f atomic orbitals; Pauli's Exclusion Principle and Hund's Rule of Maximum Multiplicity.

Unit 2. CHEMICAL PERIODICITY (2L)

Periodic classification of elements; Atomic Radius; Ionic Radius; Ionization Energy; Electron Affinity; Polarizability; The Inert-Pair Effect; Diagonal Relationships; Chemistry with emphasis on group relationship and gradation in properties (metals and non-metals; Main Group Elements (s and p blocks); Transition Metals (d block): 3d elements); Relativistic Effects.

Unit 3. CHEMICAL BONDS, MOLECULAR GEOMETRY AND STRUCTURE (6L)

a. Ionic Bond Formation and Lattice Energy

b. Covalent Bonding; Valence-Bond Theory; Molecular Orbital Theory; How do we know that electrons are not paired; How do we know the energies of MOs? Major technique: XPS.

c. Strengths and Lengths of a Bond; How do we know the length of a bond? How do we know the strength of a bond? Major techniques: Rotational & Vibrational Spectroscopies.

d. VSEPR Model.

e. ISOMERISM: Types; Optical isomerism in compounds (containing one and two asymmetric centers); Isomerism in coordination compounds; Major Techniques: Chromatography/Mass Spectroscopy

Unit 4. COORDINATION COMPOUNDS (2L)

The Shapes of Complexes; The electronic structures of complexes: Crystal Field Theory; Ligand Field Theory; Color and magnetic properties; Major technique: UV-Vis Spectroscopy.

Unit 5. SOLIDS AND MODERN MATERIALS (4L)

Solid structures; Bonding in the Solid State; Semiconductors; Superconductors; Luminescent Materials; Magnetic Materials; Composite Materials; Nanomaterials; Major Technique: XRD

Unit 6. POLYMER MATERIALS: SYNTHETIC AND BIOLOGICAL (2L)

Synthetic Polymers: Synthesis of Organic Polymers; Electrically Conducting Polymers; Biological Polymers: Proteins and Nucleic Acids; Major Techniques: NMR & CD spectroscopy

Unit 7. LIQUIDS (1L)

Intermolecular forces; Liquid structure; Liquid Crystals; Ionic Liquids

Unit 8. PROPERTIES OF SOLUTIONS (2L)

Solubility and Common ion effect; Vapor Pressure; Colligative Properties; How to use colligative properties to determine the molar mass? The impact on biology and materials: Colloids; Biomimetic materials

Unit 9. SOLUTION CHEMISTRY (2L)

Bronsted-Lowry Acids; Buffers; Polyprotic systems

Unit 10. KINETICS (3L)

Mechanism of chemical reactions; Activated Complex Theory; Reactions in Solution; Reaction Dynamics; Enzymatic Catalysis

Reference Books:

1. Peter Atkins and Loretta Jones (2010), *Chemical Principles: The Quest for Insight*, 5th Edition, W. H. Freeman and Company, New York.

2. Theodore L. Brown, H. Eugene LeMay, Bruce E. Bursten, Catherine J. Murphy, Patrick M. Woodward, Matthew W. Stoltzfus (2018), *Chemistry: The Central Science*, 14th Edition, Pearson Education, Harlow, United Kingdom.
3. Donald A. McQuarrie, Peter A. Rock, and Ethan B. Gallogly (2011), *General Chemistry*, 4th Edition, University Science Books, California.
4. Raymond Chang and Jason Overby (2011), *General Chemistry: The Essential Concepts*, 6th Edition, (McGraw-Hill, New York.
5. Martin S. Silberberg (2013), *Principles of General Chemistry*, 3rd Edition, McGraw-Hill, New York.

5.Teaching-Learning Strategies in brief (4 to 5 sentences):

The course will involve lectures, exercises/assignments, quizzes, tutorials, and exams.

6.Assessment methods and weightages in brief (4 to 5 sentences):

The student assessment in the course involves written tests, quizzes, and assignments.

1. Assignments: 20%
2. Quizzes (2*10): 20%
3. Mid-Sem Exam: 20%
4. End-Sem Exam (*WHOLE Syllabus*): 40%

Title of the Course **: Governance of AI: Ethics and Regulation**
Faculty Name : Amber Sinha
Course Code : HS0.219
L-T-P :3-1-0
Credits :2
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Type When : Ethics elective, Spring 2025
PRE-REQUISITE: Ethics – 1 (Basics of Ethics)

OBJECTIVE

CO1) Introduction to ethics and governance questions for AI developers and designers.

CO2) Grounding of emerging Ai ethics discourse within normative and applied ethical principles.

CO3) Understanding different domains of AI development and deployment which require ethical and regulatory interventions.

CO4) Introduction to competing regulatory methods for AI governance.

CO5) Develop a broad framework to approach governance of AI

COURSE TOPICS

Module 1: Introduction

A short history of AI governance

Key events that spurred the discourse

Actors, Instruments and Processes

Module 2: What is AI (for the purpose of governance)

How AI has been defined in computational cultures?

Chess, games and the theatre of AI

How regulations define AI?

Module 3: Proliferation of AI ethics

The rise of ethical principles in AI

Influence of prior biomedical and computational ethics

Grounding AI ethics in normative ethics

Grounding AI ethics in applied ethics

Module 4: Fairness, Transparency and Accountability

Fairness and questions of bias

A critical look at algorithmic transparency

Accountable AI as multi-dimensional exercise.

Module 5: Regulation of AI

Why regulate AI?

When to regulate AI?

How to regulate AI?

A survey of global regulation of AI.

GRADING PLAN

Type of Evaluation	**Weightage (in %)**
Response Papers	25
Project Report	50
Presentation	25
TOTAL	100

OUTCOME

1) To think critically about questions of AI governance.

2) Learn to locate AI ethics within the broader ethical discourse.

3) Have tools to critically question whether Ai is fair and accountable.

4) Build a framework for appropriate ethical and regulatory interventions in AI development and deployment.

REMARKS

All students are expected to familiarise themselves with concepts in assigned readings before the lecture and participate in class discussions. The classroom readings shall take up to 2 hours for each class. Students shall be graded on understanding of concepts and application of ethics; and regulatory principles to AI.

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-'dash mark if not at all relevant).

Matrix for CSE

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
C O1						2	2	3		3		3				2
C O2				1		2	3	2		2		2				3
C O3						2		2				2				3
C 04				1		2		2		2		2				3
C 05				1		2		2		2		2				3

Matrix for ECE

	P O1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
C O1						2	2	3		3		3				2
C O2				1		2	3	2		2		2				3
C O3						2		2				2				3
C 04				1		2		2		2		2				3

C 05				1		2		2		2		2				3

Title of the Course **: The Gutenberg Parenthesis**

Faculty Name : Aniket Alam
Course Code : HS3.304
Credits : 4
L - T - P : 3 – 1 – 0
Semester, Year : Spring 2025
Name of the Program : B.Tech in Computer Science and Engineering

Pre-Requisites **:** BTech Students: Passed Intro to Human Sciences, and One other HSS elective; CHD 3rd and 4th Year students.

Course Outcomes:

After completion of this course successfully students will be able to:

CO1: Define the concept of Orality, Literacy, and Textuality.
CO2: Describe the features of Oral Societies and Literate Societies.
CO3: Explain the importance of Print Technology in historical transformation and the concept of the Gutenberg Parenthesis.
CO4: Analyze the various aspects of the emergence of Capitalism, Enlightenment, Modernity in relation to Print Cultures.
CO5. Evaluate the range of academic theories relating to global historical transformations.
CO6. Develop their own understanding about the role of technology, historical change, and emerging futures.

Course Topics:

The Gutenberg Parenthesis refers to the 500 year long period of modernity, coterminous with print cultures, within a longer stretch of oral civilisations. This parenthesis started with the print revolution in medieval Europe which turned the world textual over the next few centuries. The parenthesis is perhaps closing now with the emergence of the new, post-textual, orality of the digital age. The idea of the Gutenberg Parenthesis suggests that despite its dominance and prestige, print-literacy is an exception in the much longer trajectory of human thought, whose primacy may be in the process of being restored through digital modes of speech and instantaneous ephemeral communication, rather than that based on space and time delay.

This course will study Print Cultures as an interregnum within the larger history of oral cultures. It will be organized into the following modules.

(1) **Orality and Oral Cultures:**The structures and features of oral communications. How this in turn structures mental categories and thought and thus social organization. The specificities of societies based on orality and how scholars define these terms. The idea of primary orality.
(2) **Literacy and Textual Cultures:** The historical rise of script, literacy and text based civilisations. What are the features and consequences of this technology and how it restructures society.
(3) **Technology of Print and Print Cultures:** The emergence of print technology in Asia and Europe and its main product: books. The definition of print culture and its historical spread.

(4) **Historical Transformations:**The changes in society, economy and politics consequent to the spread of print technology and print cultures. The emergence of capitalism, colonialism, Enlightenment Rationality and the scientific revolution. The linkages between printing and new ways of thinking and communicating. The economic, political and cultural effects of mass literacy and education. How the world has become textual.

(5) **The New Orality:** The emergence of digital technologies and re-emergence of orality and instantaneous communications. The new orality as secondary orality based on textual foundations. How is this secondary orality changing our ways of thinking, of communicating and our social/political structures.

Preferred Text Books:

1. Walter J. Ong: *Orality and Literacy*
2. Elizabeth Eisenstein: *The Printing Revolution in Early Modern Europe*
3. Alfred W. Crosby: *The Measure of Reality*
4. Umberto Eco: *This Is Not The End Of The Book;*
5. V. Gordon Childe: *Man Makes Himself*

Reference Books:

1. Lucien Febvre, Henri-Jean Martin: *The Coming of the Book*
2. Fernand Braudel: *Capitalism and Material Life, 1400-1800*
3. Eric Hobsbawm: Industry and Empire.
4.
5. Marshal McLuhan: *The Gutenberg Galaxy: The Making of Typographical Man*
6. Neil MacGregor: *The History of the World in 100 Objects*
7. Ruth Finnegan: *Literacy and Orality: Studies in the Technology of communication*.
8. Ruth Finnegan: *Oral Poetry – Its Nature, Significance and Social Context*.
9. Elizabeth Eisenstein: *Divine Art, Infernal Machine: the Reception of Printing in the West from First Impressions to the Sense of Ending*.
10. Umberto Eco: *Travels in Hyperreality*.
11. Roger Chartier: *The Order of Books: Readers, Authors, and Libraries in Europe Between the Fourteenth and Eighteenth Centuries*.
12. David Diringer: *The Book Before Printing*.
13. David Diringer: *The Alphabet – The Key to the History of Mankind*.
14. Jack Goody: *Literacy in Traditional Societies*.
15. Andre Gunder Frank: *ReOrient – Global Economy in the Asian Age*
16. Bhavani Raman: *Document Raj: Writing and Scribes in Early Colonial India*
17. A R Venkatachalapathy: *The Province of the Book*
18. Krishna Kumar: *Politics of Education in Colonial India*
19. Eric Havelock: *Communication Arts in the Ancient World*.
20. C. K. Ogden, I. A. Richards: *The Meaning of Meaning – A Study of the Influence of Language upon Thought and of the Science of Symbolism*.
21. Pierre Maranda, Elli Kongas Maranda: *Structural Analysis of Oral Tradition*.
22. Vladimir Propp: *Morphology of the Folktale*.
23. Benjamin Stolz, Richard Shannon: *Oral Literature and the Formula*.
24. Douglas Boyd, Mary Larson: *Oral History and Digital Humanities – Voice, Access, and Engagement*.
25. Jan Vansina: *Oral Tradition as History*.
26. Max Tegmark:*Life 3.0: Being Human in the Age of Artificial Intelligence*

Reference Articles:

1. Jack Goody and I. Watt: "The Consequences of Literacy" Comparative Studies in Society and History.
2. Thomas Pettitt: "Opening the Gutenberg Parenthesis"
3. Thomas Pettitt: "Bracketing the Gutenberg Parenthesis"
4. The Edge: "What is the Most Important Invention in the Past Two Thousand Years?"
5. Franz H. Bauml: "Varieties and Consequences of Medieval Literacy and Illiteracy"
6. John Miles Foley: "The Traditional Oral Audience".
7. John Miles Foley: "Oral Literature – Premises and Problems"
8. Eric Havelock: "The alphabetization of Homer"
9. Bronislaw Malinowski: "The problem of meaning in primitive languages"

Grading Plan :

Type of Evaluation	Weightage (in %)
Quiz-1	**10%**
Mid SemExam	**20%**
Quiz-2	**10%**
End Sem Exam	**40%**
Project	**20%**

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	-	-	1	2	1	3	2	3	2	1	-	3	-	2	1	3
CO2	-	-	1	1	1	2	2	2	2	1	-	3	-	1	1	2
CO3	1	-	1	2	1	3	3	3	1	1	-	3	-	2	1	3
CO4	-	-	1	2	1	3	3	3	2	1	1	3	-	1	2	2
CO5	-	-	1	1	1	3	2	2	1	1	1	3	-	1	2	3
CO6	1	1	3	2	2	3	3	3	2	2	1	3	-	2	3	3

Teaching-Learning Strategies in brief (4-5 sentences) :

The course will be based on classroom lectures and will require intensive reading and writing. On an average, each student will be required to read between 1,000 to 1,500 pages of books and articles and submit written work between 6,000 to 8,000 words, cumulatively.
In each class some select students will be given a small topic from the next class to read up on, and they will be expected to initiate discussions around these.

Pictures, Extracts from primary sources, audio and video resources will be used to illustrate the points being taught.
The project will focus on training students to develop their own ideas, and apply computer science tools, to the topic given.

Title of the Course : Hydro informatics

Faculty Name : Shaik Rehana
Course Code : CS9.433
Credits : 4
L - T - P : 3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring, 2025
Pre-Requisites : NIL

Course Outcomes :

After completion of this course successfully, the students will be able to

CO-1: Handle various types of hydrological, climate data sources obtained from models, experimental, remote sensing and geographic information system based.
CO-2: Process various dimensions of data from open sources and acquiring data driven information using statistical methods
CO-3: Employ computer science skills in processing the hydroclimatic information
CO-4: Employ statistical and machine learning algorithms for predicting hydroclimatic processes
CO-5: Develop critical thinking to help in processing data from various sources to solve water related issues using computational algorithms and technologies
CO-6: To improve the problem-solving skills for solving water and climate related problems

Course Topics:

Acquisition and Processing of Hydroinformatics Data: Automated data collection, data storage, file formats and standards, web-based data distribution, access and processing, geographic information system; digital image processing, digital elevation modeling.
Technologies in Hydroinformatics: Regression, Stochastic Models, Optimization, Data Driven Models.
Application of Hydroinformatics: Operation, management and decision making, development of decision support systems for water, agriculture, energy, climate and environment.

Preferred Text Books :

- Introduction to Geographic Information Systems by Kang-Tsung Chang
- Geographical information systems and science by Paul A. Longley, Michael F. Goodchild, David J. Maguire, and David W. Rhind
- Haan, C.T., Statistical Methods in Hydrology, East West Publishers, 1998
- Remote Sensing and Image Interpretation by Lillesand, T., Kiefer, R. W., and Jonathan Chipman.
- Lo, C. P., and Albert K. W. Yeung., Concepts and techniques of geographic information systems by C P Lo and Albert K W Yeung

Grading Plan :

(The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz-1	**10%**
Mid SemExam	**15%**
Quiz-2	**10%**
End Sem Exam	**10%**
Assignments	**25%**
Project	**30%**
Term Paper	**Nil**
Other Evaluation	**Nil**

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant).Program outcomes are posted at

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2	2	3	1	1	3	1	1	1	2	2	3	2	3
CO2	1	3	2	3	2	1	1	1	1	3	1	2	2	2	2	2
CO3	2	2	2	2	3	1	2	1	1	1	1	2	2	2	2	2
CO4	2	2	3	2	3	1	2	1	1	1	1	2	2	2	2	2
CO5	2	3	2	2	3	2	3	2	1	1	1	2	2	2	2	2
CO6	2	2	3	2	2	2	2	2	1	3	1	2	2	1	2	2

Teaching-Learning Strategies in brief (4-5 sentences) :
Lectures and tutorials to analyze, process, visualize and map various water and climate related information. Hands on sessions and assignments with real-time case studies and data to process and understand hydroinformatics with the use of computer programming skills.

Title of the Course : **Information and Communication**
Faculty Name : Arti Yardi + Lalitha Vadlamani
CourseCode : EC5.102
L-T-P : 3-1-0

Credits : 4

(L=Lecturehours,T=Tutorialhours,P=Pracocalhours)

Name of the Program : B. Tech in Electronics and Communication Engineering

Semester, Year : Spring 2025

Pre-Requisites

Course Outcomes :

After completion of this course successfully, the students will be able to:

CO-1: List all components in a typical communication system, and distinguish between analog and digital communications.

CO-2: Apply principles of information theory to calculate the entropy of a random source and the channel capacity of some simple noisy communication channels.

CO-3 : Discuss Shannon's Source Coding and Channel Coding Theorems and recognize their significance for modern communication and Employ probabilistic and combinatorial ideas to obtain a sketch of the proof of the Shannon's source coding and channel coding theorems for some simple sources and channels.

CO-4: Analyze the performance of Huffman source coding for any given random source and some basic error correcting codes for some simple noisy communication channels.

CO-5: Evaluate the essential information and communication theoretic quantities in a wide variety of communication systems used in practice

Course Topics :

Unit 1 : **Examples of analog and digital signals, Conversion of Signals to Bits via Sampling, Quantization and Analog-Digital converters.**

Unit 2: **Sources of information, Information measure, Entropy, Representing sources as bit sequences, Source codes, Shannon's Source Coding Theorem, Huffman Coding**

Unit 3: **Communication Resources – Analog and Digital Modulation, Probability of Error, Types of Channels (Wireless/Wireline), Noise, Binary Input-Binary Output Channels, Derivation of Binary Symmetric Channel from Gaussian Channels with Power Limitations.**

Unit 4: **Channel Codes, Shannon's Channel Coding Theorem, Motivation and Simple Examples of Error Correcting Codes**

Unit 5: Point-to-point t**ransmitter and receiver block diagram, RF Front end, Synchronization, Receiver Imperfections,** Upper layers in the OSI model – MAC, Transport, Multiple access schemes and Routing, Cryptography, Cellular Systems, Storage Systems.

Preferred Textbooks:

1.Todd K Moon, Error Correction Coding, Mathematical Methods and Algorithms.
2.Upamanyu Madhow - Fundamentals of digital communication (2008, Cambridge University Press)
3.Thomas M. Cover, Joy A. Thomas, "Elements of Information Theory", 2nd Edition, ISBN: 978-0-471- 24195-9, June 2006,.

Reference Books :

1. Gallager, R. (2008). Principles of Digital Communication. Cambridge: Cambridge University Press. doi:10.1017/CBO9780511813498.

2. Essential Coding Theory , V. Guruswami, A. Rudra, M. Sudan (Ebook)

E-book Links : https://cse.buffalo.edu/faculty/atri/courses/coding-theory/book/
Grading Plan :
(The table is only indicative)

Type of Evaluation	Weightage (in %)
Quizzes	**15%**
Mid Sem	**20%**
End Sem	**35%**
Project	**15%**
Assignments	**15%**

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	1	1	2	1	1	1	1	2	2	3	2	3	2
CO2	3	2	2	1	1	1	1	1	1	1	1	2	3	3	2	1
CO3	3	2	2	1	1	2	1	2	1	1	2	2	3	3	2	1
CO4	3	1	3	1	1	1	1	1	2	1	1	2	2	3	1	1
CO5	3	2	3	1	2	1	2	1	1	1	2	2	3	3	1	1

Teaching-Learning Strategies in brief (4-5 sentences):

The course has lectures supported by assignments. Via the assignments, problems related to the concepts presented in the class are solved by teaching assistants. Problem Sets will be provided for students to apply the concepts learned in the class (some of them could be programming assignments). Exams are conducted periodically so that students can actively engage with the course material.

Title of the Course : Information Security Audit and Assurance
Faculty Name : Shatrunjay Rawat
Name of the Program : M.Tech CSIS and other programmes
Course Code : CS8.402
Credits : 4
L - T - P :3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)

Semester, Year **:** Spring, 2025

Pre-Requisites **:** Computer Networks and Operating Systems

Course Outcomes:

CO-1 Demonstrate understanding of security needs and issues of IT infrastructure

CO-2 Have basic skills on security audit of IT systems, do risk assessment and work out risk mitigation strategies

CO-3 Understand information security and privacy related laws, and their implication on IT systems

CO-4 Understand standards related to information security and develop security policies and procedures for an organisation.

CO-5 Understand functioning of security products, and design a reliable and secure IT infrastructure

CO-6 Respond to IT and other disasters in appropriate manner

Course Topics:

Unit 1: Introduction to information security, various aspects of information security; Review of TCP/IP, basic components of computer networks; Security products such as Firewall, IDS/IPS, VPN Concentrator, Content Screening Gateways, PKI, etc

Unit 2: Audit of various networking protocols/infrastructure from information security perspective– IP*, TCP/UDP, HTTP*, SMTP, OSPF/BGP/PIM, Ethernet/WiFi, switches/routers, etc.; Security audit of various Operating Systems

Unit 3: Information security standards – ISMS (ISO 27000 family), HIPAA, GDPR, etc; Security audit practices; Preparing security policies and procedures for organisations

Unit 4: Business Continuity Management, Disaster Recovery/Management; Designing security ready IT infrastructure

Unit 5: Information security related laws – Indian IT Act, IPR and privacy laws, various court judgements; Security Guidelines of various regulators (RBI, TRAI, IRDAI, etc); CERT and other information security organisations/bodies/industry associations**.**

Preferred Text Books:

No single text books. Required study material will be shared/identified as course progresses.

Reference Books:

Some references are listed below

1. RFCs of networking protocols
2. Various acts/laws - India IT Act, IPR and Privacy Laws, Court Judgements
3. Information security standards - ISO 27000 family, HIPPA, GDPR
4. Research papers
5. Security guideline documents/whitepapers published by Operating Systems and IT Systems manufacturers/developers.

E-book Links:

Grading Plan:

Based on class participation, presentations, assignments, security audits, Mid/End Sem exams, Simulation exercise, etc. Tentative marks distribution for grading is as follows:

Type of Evaluation	Weightage (in %)
Participation in class discussions, presentations	25
Assignments	25
Mid Semester Examination	20
End Semester Examination	30

Mapping of Course Outcomes to Program Objectives:
(1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	3	2	-	3	-	1	1	2	-	2	3	2	-	2
CO2	-	1	2	3	1	3	-	2	1	2	3	3	2	3	-	2
CO3	2	1	3	2	-	3	-	3	2	2	1	3	2	1	-	2
CO4	-	-	2	2	-	3	-	3	3	3	3	3	2	2	-	2
CO5	3	3	3	3	1	2	2	1	2	2	1	3	3	3	-	2
CO6	-	2	3	3	-	2	2	2	3	3	3	2	2	1	-	2

Teaching-Learning Strategies in brief:
Course will be primarily driven by classroom discussions, readings, surveys, exploratory practical assignments. It will involve a lot of critical thinking and active learning by the students to solve practical problems. Students will be asked to make presentations on topics assigned to them for exploration/experiment.

Title of the Course : **Internals of Application Servers**
Faculty Name : Ramesh Loganathan + Arjun Rajashekar
Course Code : CS3.404
Credits : 4
L - T - P :(3-1-0)
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring 2025
Pre-Requisites : None

Course Outcomes :
A systems level understanding of distributed application platforms through building a contemporary platform.Key objectives of the course:

CO1: Understand Middleware systems concepts:
CO2: Understand Distributed Application Platforms through a project-based system building course structure.

CO3: Understand Key aspects of distributed applications, and the requirements from an underlying applications' platform
CO4:Understand the design of key subsystems of a contemporary application platform, and the same to be built as part of the course project

Course Topics :

Following topics will be covered in the context of the course project. Specific to the course project.
Lectures – 4 or 5 3-hour classes per Module

- *M1- Understand essence of middlewares and distributed object technology*
- *M2- App Server architecture*
- *M3- Lifecycle of a Web Service request*
- *M4- Things "in" the Internet*
- *M5- Project problems Discussions*
- *M6- Project problems Discussions*
- *M7- Project problems Discussions*
- *M7- Project problems Discussions*

Labs – L1 to L8 (16 hrs)
Seminars – 6 hrs (6 groups, 1 hr each)
Mini Project review – 3-4 hrs
Various topics that will be covered in the lectures:

- **Middleware/ App Server concepts**
  - Understanding concepts related to CMS, Application server, web server, message-oriented middleware etc.
- **Distributed App Platforms components**
  - Understanding distributed applications tools, architecture and workings
  - RPC, servlets, stubs, Messaging services.
- **Project Overview and Understanding**
  - Project Idea discussion and idea finalization.
  - Blackbox overview of project from view points of various actors.
  - Idea Hackathon
- **Project Platform Deep dive (concepts)**
  - Discussion on major platform components.
  - Functionality finalization and designing major components
  - Project Documentation.
- **System Building Experience**
  - A full distributed app platform will be built.
  - Endpoint for each microservice.
  - Hackathon.
- **Integration of Platform Components.**
  - Designing endpoints for each component & integration with other components.
  - Testing use case for each component.

Preferred Text Books: None. Reading references will be provided in class.
Reference Books : -
E-book Links : -
Grading Plan :

Type of Evaluation	Weightage (in %)

Class quizzes	**5**
Lab submissions	**15**
Hackathons	**10**
Projects	**40**
- Reqts& Design docs	15
- Pre Demos	10
- Final Demos	15
End Sem Exam	**30**

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant).Program outcomes are posted at

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P2O9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2	1	1	1	1	1	2	2	1	2	3	1	2	2
CO2	1	2	2	1	2	1	1	1	2	2	2	2	2	3	2	1
CO3	3	2	2	3	2	1	1	1	3	3	2	2	2	2	2	1
CO4	3	1	2	3	2	1	1	1	3	3	3	2	2	2	3	1

Teaching-Learning Strategies in brief (4-5 sentences) :
Project problems Discussions; Project architecture & design reviews; Guest lectures from Industry (Projects built in previous years- JMS Server. Distributed web services platform (SOA). MiroServices Platforms. Ai on the Edge. Fog computing (IOT) platform)

There will be labs to understand basic concepts and then hackathons to help build susbsystems. And through the course projects understand the various elemensot and subsystems of a distributed applications erver platforms.

Title of the Course : Introduction to Human Sciences

Name of the faculty : Aakansha Natani + Ashwin Jayanti
Course code : HS8.102
L-T-P : 3-1-0
Credits : 4
Name of the Academic Programs: B.Tech. inCSE, B.Tech in ECE
Course: UG2 Humanities core for CSE, ECE

1.Prerequisite Course / Knowledge: Nil
2.Course Outcomes (COs)
After completion of this course successfullystudents will be able to:
CO1:Discuss the origin and development of key disciplines in the human sciences
CO2:Identify some of the fundamental questions that shape and drive inquiry in human sciences

CO3:Demonstrate knowledge of concepts related to theorizing about reflection, society, and culture
CO4: Analyzecrucial normative elements and descriptive frameworks in human sciences inquiry
CO5:Develop skills to formulate nuances involved in problems concerning humans and societies
CO6:Write clear and well thought out short essays on topics in humanities and social sciences

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	3	1	1	3	2	3	1	1	-	3	1	1	2	3
CO2	2	2	3	3	2	3	2	3	1	3	1	3	1	1	2	3
CO3	2	2	2	3	1	3	2	3	1	2	1	1	1	1	2	3
CO4	1	2	2	3	1	2	2	3	2	2	-	2	1	2	1	3
CO5	2	2	3	3	1	2	3	3	1	1	1	3	1	2	2	2
CO6	2	2	3	3	1	3	3	3	2	2	1	2	1	1	3	2

'3' in the box denotes 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4.Syllabus:

The course will be divided into fourmodules, each of which will introduce students to a particulardiscipline in the human sciences. The various disciplines that constitute human sciences are:

1. Philosophy
2. Psychology
3. Literature
4. History
5. Sociology
6. Anthropology

Each module will offer a systematic worldview, tools of enquiry to study and analytical frameworks tomake sense of topics taken up for discussion. Detailed list of topics under a module will be provided by the faculty teaching that module when the lectures begin. The overarching theme for the topics are the fundamentals of human sciences so that students grasp what humans sciences are all about.

Reference books:

Readings for each of the modules will be given with thecommencement of the lectures. There is no single textbook as such for all four modules.

5.Teaching-Learning Strategies in brief:

Each module will have one faculty giving six lectures of 90 mins each Through discipline specific modes of understanding and everyday examples, class lectures will enablestudents to connect and ponder about themselves, the society and cultures that surrounds them. The teaching-learning strategy emphasises the merits of avoiding simplistic solutions to complex problems and instead ask meaningful questions that enrich debates about how we produce, distribute, consume, reflect, represent, and governourselves.Lectures impress upon students the need to critically reflect on issues that are impacted by technology, the historical and social context of the world they live in, the literary and philosophical ideas that permeate human thought and psychological principles of human behaviour.

6.Assessment methods and weightages in brief:

This is mainly a writing-driven course, and the evaluation questions are carefully designed to make students think independently. Students are assessed for abilities likecritically assessing issues,

questioning assumptions,clarifying distinctions, and bringing out nuances. In assignments and exams, students are expected to demonstrate these abilities by presenting their views clearly and systematically. Students will be evaluated for each of the four modules and the pattern of evaluation will be decidedby the respective faculty.
Evaluation pattern can include weekly assignments, quizzes and term papers. Each module will carry 25 % of total marks.The End Semester exam carries 25% of marks.

Title of the course : **Intro to Processor Architecture**
Faculty Name : Deepak Gangadharan
Course Code : EC2.204
L-T-P : 3-1-0
Credits : 2 (Half semester course)
(L=Lecture hours, T=Tutorial hours, P=Practical hours)

Name of the Academic Program: B-Tech in Computer Science and Engineering

1. Prerequisite Course/Knowledge
Digital Systems and Microcontrollers
2. Course Outcomes (COs)
After completion of this course successfully, the students will be able to

CO-1. Explain Instruction Set Architecture (ISA) and the different paradigms RISC and CISC.
CO-2. Employ the different instructions and addressing modes to write assembly programs.
CO-3. Describe the instruction encoding in an ISA.
CO-4. Design and Develop Sequential and Pipelined Implementation of a Processor.
CO-5. Explain the different types of cache memories in memory hierarchy and its impact.
CO-6. Explain the importance of virtual memory and associated concepts such as page table, page faults and address translation.
3. Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	-	1	-	-	-	-	-	2	-	3	-	-	1	1
CO2	2	1	-	2	3	-	-	-	2	2	-	3	1	1	-	-
CO3	1	1	-	1	-	-	-	-	-	2	-	3	-	-	1	1
CO4	3	2	-	2	3	-	-	2	3	2	-	3	3	2	1	3
CO5	1	1	-	1	-	-	-	-	-	2	-	3	-	-	1	1
CO6	1	1	-	1	-	-	-	-	-	2	-	3	-	-	1	1

Note: '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4. Detailed Syllabus

Unit 1: Introduction to Processor Architecture – Definition of Computer System, Models of Computer Architecture, Programming Abstractions, Definition of Instruction Set Architecture, ISA Design Paradigms: RISC vs CISC
Unit 2: Machine Level Representation of Programs – Accessing Information: Operand Specifiers, Addressing Modes, Data Movement Instructions, Push and Pop Instructions, Arithmetic and Logic Operations, Condition Codes, Accessing Condition Codes, Jump Instructions and Encoding, Conditional Branches, Loops, Switch Statements
Unit 3: Processor Architecture – Instruction Set Architecture, Sequential Implementation, Principles of Pipelining, Pipelined Implementation

Unit 4: Memory Hierarchy – Storage Technologies, Locality, Types of Cache Memories, Impact of Cache on Program Performance
Unit 5: Virtual Memory – Physical and Virtual Addressing, Page Tables, Page Hits, Page Faults, Address Translation

Reference Books:
Randal E. Bryant and David R. O'Hallaron. *Computer Systems : A Programmer's Perspective* – 3rd Global Edition.
2. David A. Patterson and John L. Hennessy. *Computer Organization and Design: The Hardware/Software Interface* – 5th Edition.

Teaching-Learning Strategies in brief

Weekly lectures cover the topics in the syllabus. Tutorials introduce the students to Verilog programming and general instructions on how to write Verilog program for various building blocks of a processor architecture – such as instruction decode, ALU, etc. There is one major project where each student designs and develops a HDL program for a pipelined processor architecture based on the theory covered in the lectures.

Assessment methods and weightages in brief

Type of Evaluation	Weightage (in %)
Quiz 1	**10**
End Sem Exam	**30**
Project	**60**

Title of the Course : Introduction to UAV Design

Faculty Name : Harikumar K
Course Code **:** EC4.402
L-T-P : 3-1-0,
Credits **:** 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)

1. Prerequisite Course /Knowledge:

BasicsofLinearAlgebra,LaplacetransformandVectorcalculus.

2. CourseOutcomes(COs)(5to8fora3or4creditcourse):

After completion of this course successfully, the students will be able to..

CO1 Determine the design specifications of the Unmanned Aerial Vehicle (UAV) used for a particular application.
CO-2 Explain the various design phases involved in the UAV design.
CO-3 Perform the conceptual design and preliminary design for multi-rotor, fixed-wing and hybrid UAVs.
CO-4 Perform the stability and flight performance analysis for the designed UAV.
CO-5 Able to manufacture a prototype UAV.
CO6 Performtheflightsimulationandflighttestingoftheprototype UAVandverify its stability and performance characteristics.

3. MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecificOutcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO 3	PSO 4
CO1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	3
CO2	2	2	3	1	1	1	1	1	1	1	1	1	1	1	1	3
CO3	3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	3
CO4	3	3	2	1	1	1	1	1	1	1	1	1	1	1	1	3
CO5	2	2	3	1	2	1	1	1	3	1	1	1	1	1	1	3
CO6	2	2	2	1	1	1	1	1	3	1	1	1	1	1	1	3

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs.
Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4. DetailedSyllabus:

Unit 1: Types of UAVs--- Multi-rotors, fixed wing (FWUAV), Hybrid VTOLs

Unit2: Multi-rotordesign---
Conceptofoperation(CONOPS),designspecifications,differentreferenceframes, axisconventions,forcesandmoments,sizingandassembly,sensorsandcontrol.
Unit3:FWUAVFlightmechanicsandcontrol---
wing,fuselage,stabilizerandcontrolsurfaces,propulsion

system,forces(lift,drag,thrust,sideforce),moments(roll,pitch,yaw),trimconditions,longitudinalstatic stability,lateralanddirectionalstability,PIDcontrolthroughsuccessiveloopclosure.
Unit 4: FWUAV design--- Concept of operation (CONOPS), design specifications, preliminary sizing, airfoil selection, wing planform selection, control surface sizing, stabilizer sizing, selection of propulsion system (battery, motor/engine, propeller), stability and performance analysis, design trade-offs.
Unit5: Differentconfigurations(tilt-rotor,tailsitter),transitiondynamics,designspecifications,sizing, stability andcontrol.

Reference Books:

DanielPRaymer,AircraftDesign:AConceptualApproach,secondedition,AIAAUSA,1992.
1. JohnD.Anderson,Introductiontoflight,thirdedition,McGraw HillUSA,1989.

2. R.W.BeardandT.M.McClain,SmallUnmannedAircraft:TheoryandPractice,firstedition,Princeton University Press USA,2012

5. Teaching-Learning Strategies in brief (4 to 5sentences):

Weekly lectures based on the course syllabus and based on the latest design technologies available in the literature and other industrial resources. Tutorials covering the use of software for UAV design and performanceanalysis.Detailedstudentassignmentforpracticingthedifferentelementsofconceptualdesign phase. Open book exam followed by detailed project submission including simulation studies, prototype development and flighttesting.

6. Assessment methods and weightages in brief (4 to 5sentences):

Type of Evaluation	Weightage (in %)
Quizzes	**10**
Assignments	**40**
Project	**50**

Title of the Course : Introduction to Algorithm Engineering
Faculty Name : Kishore Kothapalli
Course Code : CS1.305
Credits : 2
L- T -P :
(L-Lecture hours, T-Tutorial hours, P-Practicalhours)
Semester, Year : Spring 2025

Pre-Requisites : first course on algorithms, programming, computer architecture/ organization
CourseOutcomes :
(listabout 5to6outcomes forafull4creditcourse)

The action verbs to be used for writing the course outcomes can be found on slide 22 in thefollowing presentation. You may remove this line and the following link after the course outcomesareformulated.

https://iiitaphyd-my.sharepoint.com/:b:/r/personal/dyacad_iiit_ac_in/Documents/NBA-2020-21/Reference%20Documents/Curriculum%20Design%20in%20NBA%20Framework%20and%20Course%20design%20for%20all%20faculty%20IIIT%20Hyderabad%207th%20july%202021.pdf?csf=1&web=1&e=387W1k
Attheendofthecourse, a student willbe ableto:

CO–1: Demonstrate familiarity and scope of algorithm engineering
CO2: Explain the significance of algorithm engineering and analyze the practical performance of algorithms inconnection to the nature of input
CO–3: Apply algorithm engineering principles to implement avarietyofgraphand semi-numerical algorithms

CourseTopics :

(pleaselisttheorderinwhichtheywillbecovered,andpreferablyarrangetheseasfivetosix modules.)

1. Introduction to algorithm engineering, its scope, andits importance–1
2. Cache-AwareDesign: Algorithms and Techniques–1
3. Cache-Oblivious Design: Algorithms and Techniques-1
4. APrimer on Parallel Algorithms –3
5. Graph connectivity –2
6. Eccentricity and Diameter –2
7. Centrality MeasuresonGraphs–2

Preferred TextBooks:

Reference Books : Reference papers that are used for some of the course topics will be posted astheyarediscussedinclass.

E-bookLinks : Book beingdeveloped by the instructor available at http://cstar.iiit.ac.in/~kkishore/pgae.pdf

Grading Plan: Since the courseisahalf-course, we will have one quiz evaluation and one finalevaluation.

Type of Evaluation	Weightage(in%)
Quiz-1	**20%**
MidSem Exam	
Quiz-2	
EndSemExam	**30%**
Assignments	**25%**

Project	**25%**

MappingofCourseOutcomestoProgramObjectives:(1–Lowest,2—Medium,3–Highest, ora'-'dashmarkifnotat allrelevant).Programoutcomes are postedat

	PO1	PO 2	PO3	PO 4	PO5	PO 6	PO7	PO 8	PO 9	PO1 0	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	1	2	2	2	1	1	1	1	1	2	1	1	2	1	1	2
CO2	1	2	2	2	1	1	1	1	2	2	1	1	2	1	1	2
CO3	1	2	3	3	1	1	1	1	2	2	1	1	2	1	1	2

Teaching-LearningStrategiesinbrief(4-5sentences):
The course will have hands-on exercises that help students understand themechanisms available for algorithm engineering. The course project also equipsthem to explore an existing algorithm and a problem in depth and gain usefulpractical knowledge. The material used in the course is not part of standard text book as yet, so lecture slides and referencepapers will be made available for reading.

Title of the Course : **INTRODUCTION TO BRAIN AND COGNITION**
Faculty Name : Kavita Vemuri
Course Code : CS9.311
Credits : 2
L - T - P :2-0-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring 2025 (H2)
Name of the Program : BTech CSE

Pre-Requisites : NONE
Course Outcomes :
(list about 5 to 6 outcomes for a full 4 credit course)

After completion of this course successfully, the students willbeable to:
CO-1:develop understanding and familiarity with seminal research findings in brain and cognition.
CO-2:read, interpret, critique, and evaluate research explaining brain/mind/behavior.
CO-3:critically think about the relationship between diverse fields such neuroscience, cognitive psychology, and cognitive science

CO-4:critical understanding and evaluation of the experiments, methods and practices for empirical and computational investigation of cognition utilizing various instruments by different teams in Cognitive Science Lab in order to make informed decision about the Lab to work for further research in the Dual Degree Program

Course Topics :

(please list the order in which they will be covered, and preferably arrange these as five to six modules.)

Module 1: Introduction

Brain Anatomy basics; Spatial and temporal aspects of the Brain and Cognition; Methods of Investigation of the Brain and Cognition

Module 2: Vision

Visual Perception; Recognizing Objects; Attention

Module 3:Memory

Acquisition; Relation between Acquisition and Retrieval; Memory of Complex Events

Module 4: Knowledge

Concepts; Language

Module 5: Thinking

Problem Solving and Intelligence; Conscious and Unconscious Thought

Preferred Text Books :

- Daniel Reisberg (2019). Cognition: exploring the science of the mind. 7th Edition. W. W. Norton & Company, NY, USA
- V. Srinivasa Chakravarthy (2019). Demystifying the Brain: A Computational Approach. Springer, Singapore (1st Edition).

Reference Books :

- Eric Kandel, James H. Schwartz, and Thomas Jessell (2012). Principles of Neural Science. McGraw Hill Education (5th Edition).
- John R. Anderson (2009). Cognitive Psychology and its Implications. Worth Publishers (7th Edition).

E-book Links :

Grading Plan :(The table is only indicative)

Type of Evaluation	Weightage (in %)
Quizzes (3 out of 4: each 20%)	**60%**
End Sem Exam	**30%**
Term Paper	**10%**

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant).Program outcomes are posted at

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	1	1	2	1	1	2	1	1	1	1	1	2	1	1	1	1
CO 2	3	1	2	3	1	3	3	1	1	1	1	2	2	2	3	2

CO 3	2	1	2	2	1	3	2	2	1	1	1	2	1	2	3	1
CO 4	1	1	1	1	1	1	1	1	2	3	1	2	1	1	1	1

Teaching-Learning Strategies in brief (4-5 sentences) :
The IBC course is primarily lecture and discussion-based learning course. Students will be introduced to undergraduate-level introductory topics and issues in brain and cognition. Reading material will be assigned. Students will be required to engage in discussions, and to write a term paper on related topics. Students will be encouraged to relate the theory topicsto everyday experiences and will be asked to evaluate the event/phenomenon/ processes critically and scientifically. They will be encouraged to interact with various research teams in Cognitive Science Lab to familiarize themselves with the research projects so that they can start thinking about a future lab to conduct their research work.

TitleoftheCourse : Introduction to Coding Theory
Faculty Name : Lalitha Vadlamani
CourseCode : EC5.205
L-T-P : 1.5-0.5-0
Credits : 2
(L=Lecture hours, T=Tutorial hours,P=Practical hours)
Name of the Academic Program: B.Tech in ECE, B.Tech in CSE
Semester, Year : Spring 2025

Pre-Requisites : Linear Algebra
Course Outcomes :

After completion of this course successfully, the students will be able to:

CO-1: Explain the importance of redundancy and block codes as well as their parameters

CO-2: Discuss the characteristics of linear codes including generator matrix, parity-check matrix and dualcode

CO-3: Apply encoding and decoding algorithms to linear codes

CO-4: Analyze the dependence between various parameters of the codes

CO-5: Construct Reed Solomon codes, BCH Codes and RM Codes, given the specifications of the problem.

Course Topics :
Unit 1: Noisy channels, Shannon's Channel Capacity Theorem, block codes, encoding and decoding, maximum-likelihood decoding, minimum- distance decoding, Error detection and correction

Unit 2: Bounds on Codes, **Linear Codes,** Minimum distance, generator and parity-check matrices, dual codes, syndrome decoding.

Unit 3: Repetition codes, Hamming codes, Finite field basics, RS Codes.

Unit 4: Reed Muller Codes, BCH Codes and Convolutional Codes (as time permits).

Preferred Textbooks:

1.Todd K Moon, Error Correction Coding, Mathematical Methods and Algorithms.
2.Essential Coding Theory , V. Guruswami, A. Rudra, M. Sudan
3.W.C. Huffman and V. Pless, Fundamentals of Error Correcting Codes, Cambridge University Press, 2003.

Reference Books :

1. S. Lin and D.J. Costello, Error Control Coding, Pearson, 2011

2. R.E. Blahut, Algebraic Codes for Data Transmission, Cambridge University Press, 2003

E-book Links : https://cse.buffalo.edu/faculty/atri/courses/coding-theory/book/

Grading Plan : (The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz	**20%**
Scribing	**10%**
Assignments/Problem Sets	**15%**
End Sem Exam	**40%**
Viva based on Problem Sets	**15%**

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	1	1	2	1	1	1	1	2	1	2	2	3	2
CO2	3	3	3	1	1	1	1	1	1	1	1	1	2	3	2	1
CO3	3	3	3	1	1	2	1	2	1	1	2	1	2	3	2	1
CO4	3	3	3	1	1	1	1	1	2	1	1	1	1	3	1	1

CO5	3	3	3	1	2	1	2	1	1	1	2	2	1	3	1	1

Teaching-Learning Strategies in brief (4-5 sentences):

The course has lectures supported by assignments. Via the assignments, problems related to the concepts presented in the class are solved by teaching assistants. Problem Sets will be provided for students to apply the concepts learned in the class (some of them could be programming assignments). Exams are conducted periodically so that students can actively engage with the course material.

Title of the Course : Introduction to Game Theory

Faculty Name : Sujit Gujar
Course Code :CS1.408
L-T-P : 3-1-0
Credits : 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)

1.Prerequisite Course / Knowledge:
Basic Knowledge in Linear Algebra, Probability Theory and comfortable in basic maths

2.Course Outcomes (COs) (5 to 8 for a 3 or 4 credit course):
After completion of this course successfully, the students will be able to
CO-1understand how to define a game and strategies in a game
CO-2demonstrate familiarity with different solution concepts in game theory
CO-3write algorithms to solve many game theoretic problems
CO-4understand the concept of mechanism design (incentive engineering)
CO-5analyze given autonomous system for any strategic behavior of the agents

CO-6design mechanism for autonomous agent systems to make them game theoretically sound
CO-7 design agents to patriciate in auction-based competition

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1		PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1		1	3	1	1	1	1	1	1	1	1	3	3	1	1	3
CO2	1		1	3	1	1	1	1	1	1	1	1	3	3	1	1	3
CO3	1		3	3	1	3	1	1	1	1	2	1	3	3	1	1	3
CO4	1		2	3	1	2	2	1	1	1	1	1	3	3	1	1	3

CO5	2		3	3	3	2	2	1	1	1	1	1	3	3	2	2	3
CO6	3		3	3	2	2	2	1	1	1	1	1	3	3	3	2	3
CO7	3		2	3	2	3	3	1	1	3	3	1	3	3	3	2	3

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4.Detailed Syllabus:

(a) What is game? Extensive form games vs strategic form games, two player zero sum games, mini-max theorem, dominant strategy equilibrium, Nash equilibrium and its existence. Co-operative game theory, core, imputations, Shapley value, Nash bargaining solution.
(b) Mini-max Theorem, Nash Theorem, Shapley's Theorem for core and algorithmic aspects of these theorems.
(c) Game with incomplete information, introduction to mechanism design, revelation principle, voting schemes.
(d) Application of the above concepts will be illustrated with use cases in wireless communication, e-Commerce, social networking, crowdsourcing and, cloud management.

Reference Books:

1. "Game Theory and Mechanism Design" by Y Narahari.
2."Game Theory: Analysis of Conflict", by Roger B. Myerson.

5.Teaching-Learning Strategies in brief (4 to 5 sentences):

The course is designed mix of theory and practice. The theory part is planned to be taught with posing questions to the students to make them think how intelligent agents should behave in the give situation. The students are evaluated regularly with quizzes. To expose students to deep research aspects there are reading assignments. To enable learning practical aspects, there are programming assignment and tournament where they write their strategic agents. The the assignments are done in teams to enable peer learning. To further enhance the knowledge further, the reading assignments are peer-evaluated.

6.Assessment methods and weightages in brief (4 to 5 sentences):

Type of Evaluation	Weightage (in %)
End Sem Exam	25
Quizzes/Reading Assignment	15
Programming/Reading Assignments	15
Scribes	5
Course Participation	5
Project (Competition)	10

Title of the Course : Introduction to Information Security

Faculty Name : Ankit Gangwal
Course Code : CS8.301
L-T-P : 3-1-0
Credits :2 (Half semester course)
(L= Lecture hours, T=Tutorial hours, P=Practical hours)

Name of the Academic Program B.Tech. In CSE / M.Tech. in CSE/CSIS

1.Prerequisite Course / Knowledge:
Discrete Structures, Programming Languages

2.Course Outcomes (COs) :
After completion of this course successfully, the students will be able to
CO-1: Demonstrate problem solving skills related **to** security
CO-2: Demonstrate critical thinking skills
CO-3: Demonstrate security protocolspractically
CO-4: Demonstrate knowledge of Blockchain technology and its security aspects
CO-5: Demonstrate knowledge ofDesign and analysis of Internet of Things (IoT)-related security protocols

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	2	2	3	2	2	2	2	2	2	2	2	2	2	3
CO2	1	1	2	2	2	2	2	2	2	2	2	2	2	2	3	3
CO3	1	1	2	2	3	2	2	2	1	2	2	2	2	2	3	3
CO4	1	1	2	2	3	2	2	2	1	1	2	2	2	2	3	3
CO5	1	1	2	2	3	2	3	2	1	1	2	2	2	2	2	3

Note '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4. Detailed Syllabus:

- **Unit 1:** Basics of Cryptography: Cryptographic goals and objectives; Types of attacks, passive and active attacks;Introduction to Number Theory; Complexity Theoretic Connections; Overview of symmetric and public key cryptography
- **Unit 2:** Basics of System Security: Overview of intrusion detection: Types of intruders, intrusion
  detection and prevention mechanisms; Overview of software vulnerabilities: Overview of phishing,
  Buffer Overflow (BOF), heap overflow, and SQL injection attacks
- **Unit 3:** Basics of Network Security: Overview of encrypting communication channels
- **Unit 4:** Introduction to Internet of Things (IoT) security: IoT architecture; various IoT applications; security requirements, security attacks, threat model for the IoT ecosystem; taxonomy of security protocols
- **Unit 5:** Introduction to Blockchain technology: Various applications of Blockchain of Things (BCoT); centralized versus decentralized models; types of blockchain; brief overview of various consensus algorithms; block formation and addition in a blockchain

Reference Books:
1. William Stallings, "Cryptography and Network Security: Principles and Practices," Pearson Education, 6th Edition, 2014.

2. Bernard Menezes, "Network Security and Cryptography," Cengage Learning, 2010.
3. Behrouz A. Forouzan, "Cryptography and Network Security," Special Indian Edition, 2010.

5.Teaching-Learning Strategies in brief (4 to 5 sentences):

* Design of efficient and secure symmetric/public key cryptosystems
* Design of efficient intrusion detection systems
* Understanding various system related attacks and their remedies
* Understanding security aspects of IoT-related applications
* Understanding Blockchain technology and its usage in various real-life applications

6. Assessment methods and weightages in brief (4 to 5 sentences):

- In-Class Tests: 20%
- Assignments: 20%
- Mid Semester Examination: 20%
- End Semester Examination: 40%

Title of the Course : Introduction to IoT

Faculty Name : Kavita Vemuri + Suresh Purini
Course Code : CS3.303
L-T-P :1-0-3
Credits :3
(L=Lecture hours, T=Tutorial hours, P=Practicalhours)

Name of the Academic Program:B-Tech in Computer Science and Engineering

1. PrerequisiteCourse/Knowledge

Basic knowledge of C/C++ programming, Digital Systems and Microcontrollers

2. Course Outcomes(COs)

After completion of this course successfully, the students will be able to

CO-1. Explain the definition of IoT and the various IoT architectures.

CO-2. Explain the types and characteristics of commonly used sensors, actuators and microcontrollers.

CO-3. Explain the communication and application layer IoT protocols.

CO-4. Explain the concepts of Cloud+Fog Computing, IoT Interoperability, data handling and analytics.

CO-5. Employ the Arduino Programming concepts to program microcontrollers.

CO-6. Employ the interfacing of sensors and actuators with microcontroller.

CO-7. Employ a few communication and application layer protocols.

CO-8. Employ an Interoperability standard called oneM2M.

3. Mapping of Course Outcomes (COs) with Program Outcomes (POs) andProgram Specific Outcomes (PSOs) – Course ArticulationMatrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4

CO1	1	1	1	1	-	1	-	-	-	2	-	3	1	1	-	-
CO2	1	1	1	1	-	1	-	-	-	2	-	3	1	1	-	-
CO3	1	1	1	1	-	1	-	-	-	2	-	3	1	1	-	-
CO4	1	1	1	1	-	1	-	-	-	2	-	3	1	1	-	-
CO5	2	1	-	2	3	1	-	-	3	1	-	3	1	1	-	-
CO6	2	1	-	2	3	1	-	-	3	1	-	3	1	1	-	-
CO7	2	1	-	2	3	1	-	-	3	1	-	3	1	1	-	-
CO8	2	1	-	2	3	1	-	-	3	1	-	3	1	1	-	-

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs.

Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4. DetailedSyllabus

Unit 1: Introduction – Definition, Architectures and Use Cases

Unit 2: Sensor and Actuators – Definition, features, classification, characteristics,physicsoffewbasicandimportantsensorsandactuators

Unit 3: Microcontroller and Programming –

- Basics of a controller, popularmicrocontrollers
- Microcontroller programming(Arduino/ESP32)
- Overview of different peripherals: ADC, DAC, Memory, GPIO,Timers
- Interfacing of Sensors and Actuators to microcontrollers: UART, SPI,I2C

Unit 4: Communication Protocols –

- Basics of communication network
- Overview of different communication technologies for IoT: LoRaWAN, Cellular (3G/4G/5G), WLAN, Bluetooth,Zigbee
- Overview of application/middleware protocols: MQTT, HTTP,CoAP
- Connecting the sensor node tointernet

Unit 5: Cloud + Fog Computing – Characteristics, Types of Cloud, Challenges in Cloud Computing, Fog Computing Architecture, Advantages of Fog Computing, Case Study

Unit 6: Interoperability –

- Concepts and Types of Interoperability

- Interoperability Standards andoneM2M

Unit 7: Data Handling and Analytics –

- Handling - Definition, Data Types, Characteristics of Big Data, Data Flow (Generation, Acquisition, Storage,Analysis)
- Analytics - Definition, Types of Analytics (Descriptive, Diagnostic, Predictive, Prescriptive), Qualitative and QuantitativeAnalysis

Reference Books:

1) Perry Lea, (2018) Internet of Things for Architects: Architecting IoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security, Packt Publishing

5. Teaching-Learning Strategies in brief

Weekly lectures cover the theory in the syllabus and the labs will deliver the hands-on experience in building IoT systems. The comprehensive quizzes and end semester examwill test the students on the relevant theory taught for IoT systems. The project will give the students an end-to-end IoT system development covering all the concepts learned in the labs.

6. Assessment methods and weightages inbrief

Type of Evaluation	Weightage (in %)
Quizzes	**15**
End Sem Exam	**30**
Labs	**30**
Project	**25**

Title of the Course : Introduction to NLP

Faculty Name : Manish Srivastava
Course Code : CS7.401
Credits : **4**
L - T - P : 3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring, 2025
Name of the Program : B.Tech. in Computer Science and Engineering
Pre-Requisites : None
Course Outcomes :

After completion of this course successfully, the students will be able to –

CO-1. Demonstrate the knowledge of stages and fundamental building blocks of NLP
CO-2. Apply NLP machine learning algorithms for classification, representation, and parsing
CO-3. Demonstrate the knowledge of Dense vector representation for NLP
CO-4. Explain the concepts behind distributed semantics
CO-5. Discuss the approaches to global and contextual semantic representation
CO-6. Apply the above concepts for fundamental NLP tasks.

Course Topics :
Unit 1: Stages of NLP: from lexical to semantic. Fundamental Language processing: Tokenization, Language modeling, Text classification,
Unit 2: Morphology, POS Tagging, Chunking, Discriminative vs generative modes, HMM and CRF
Unit 3: Syntax parsing: Constituency and Dependency, PCFG, projectivity Arc-eager
Unit 4: Distributed semantics: SVD, Word2Vec, RNN, LSTM,
Unit 5: Contextual Distributed semantics: ElMO, BERT
Preferred Text Books : Christopher D. Manning and Hinrich Schütze. 1999. Foundations of Statistical Natural Language Processing. MITPress.
Reference Books :
Jurafsky, Dan, and James H. Martin. *Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition*. Upper Saddle River, N.J.: Prentice Hall, 2000.
E-book Links :
Grading Plan : (The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz	**10**
Mid SemExam	**10**
End Sem Exam	**20**
Assignments	**20**
Project	**40**

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant).Program outcomes are posted at

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	1	3	3	2	2	2	1	-	1	1	1	3	3	3	3	2
CO2	3	3	3	3	3	1	1	1	3	3	3	3	3	3	2	3
CO3	3	3	3	3	3	-	-	-	2	2	2	3	3	3	2	3
CO 4	3	3	3	3	3	-	-	-	2	2	2	3	3	3	2	3
CO5	3	3	3	3	3	-	-	-	2	2	2	3	3	3	2	3
CO 6	3	3	3	3	3	1	1	1	3	3	3	3	3	3	3	3

Teaching-Learning Strategies in brief (4-5 sentences) :
Lectures by integrating ICT into classroom teaching, weekly tutorials involving problem solving and active learning by students and Project-based Learning by doing fourassignments and a project. Evaluation based on personal viva to judge deeper understanding.

Title of the Course : Introduction to Linguistics 2:
Semantics, Pragmatics and Discourse

Faculty Name : Aditi Mukherjee
Credits : 3-0-1-4
Code : CL1-102
Type when : Spring 2025
Prerequisite : Introduction to Linguistics 1.

COURSE OUTCOME:

CO-1: Students will have a good understanding of semantic and contextual analysis of texts
CO-2: Students will be introduced to different semantic and pragmatic theories
CO-3: It will enable them in building text processing tools and systems
CO-4: Other than English, they will explore different languages in class working in teams.
CO-5: Using real examples, they will analyse conversational data to understand the concepts.

COURSE TOPICS:

SEMANTICS

Semantics as a discipline. Types of meaning: Connotation, denotation, affective etc. Sentence meaning and proposition. Reference and sense. Word meaning and sentence meaning. Entailment, contradiction, transitivity and reflexivity. Predicates. Diexis and definiteness. Lexical semantics: sense relations among words: Synonymy, antonymy, hyponymy, meronimy, lexical ambiguity. Components and contrasts of meaning: componential analysis. Semantic Universals: colour and kinship terms.

PRAGMATICS

Speech act theory: language as action, performative verbs, perlocution and illocutions, direct and indirect illocutions, propositions and illocutions, felicity conditions. Conversational implicature. Entailment, inference and presupposition. Gricean maxims: cooperative principles.

DISCOURSE

Structure of text and coherence. Local coherence and global structure. Conversation analysis. Coreference. Anaphora, Cataphora, Endophora. Discourse connectives and relations.

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant).Program outcomes are posted at

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2													2	2
CO2	2	2													2	2
CO3	2	2													2	2
CO4									3	3						
CO5									2	2						

SEMINARS: Students will be expected to read research papers on various topics and make presentations in the class.

TEXT BOOKS:
John Saeed (2009) *Semantics*
Geoffrey Leech (1983) *Semantics: the Study of Meaning*

SUGGESTED READINGS:
JohnLyons (1995). *Linguistic Semantics.*

Cruse Alan (2004). Meaning in Language: *An Introduction to Semantics and Pragmatics*. Part 2 and Part 4.
Levinson, Stephen C. (1983). *Pragmatics.*
Brown, G and Yule, G. (1983). *Discourse Analysis.*
Cutting Joan (2002). *Pragmatics and Discourse: A resource book for students. ''*

GRADING:
Assignments: 15%,
Mid Sem: 30%,
End Sem: 35%
Seminar: 20%

Title of the Course : Introduction to Particle Physics

NAME OF FACULTY : Subhadip Mitra
Name of the Academic Program : CND
Course Code : SC1.420
L-T-P : 3-1-0.
Credits : 4
(L= Lecture hours, T=Tutorial hours,
P=Practical hours)

1.Prerequisite Course / Knowledge:
Some exposure to Quantum Mechanics & basic Mathematics (i.e., some linear algebra & complex analysis, basic group theory etc.) and most importantly, interest about the subject.

2.Course Outcomes (COs):
After completing this course successfully, the students will be able to

CO-1 **Describe** the particle content of the Standard Model.
CO-2 **Discover** the various types of interactions among the elementary particles/antiparticles and the role of various symmetries and **classify** the particles according to their quantum numbers.
CO-3 **Discover** the representation of elementary processes with Feynman diagrams.
CO-4 **Recognize** the relativistic generalization of Quantum Mechanics through the Klein-Gordon and Dirac equations and **outline** the basic workings of Quantum Electrodynamics.
CO-5 **Apply** their knowledge and **calculate** simple processes (like two-body decay or two-going-to-two scattering, etc.).

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1											2		1		3
CO2	2	2										2		2		3
CO3	3	2										2		2		3
CO4	3	3	1											1	1	3
CO5	3	3	2											1	2	3

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4.Detailed Syllabus:

Unit 1: Introduction: developments throughout the 19th century as the backdrop. From abstract atoms to the Large Hadron Collider, Elementary particles and forces, the Standard Model.
Unit 2: Relativistic kinematics and Symmetries of nature: the SU(2) & SU(3) groups and their connections with the elementary particles, discrete symmetries, antiparticles.
Unit 3: The Klein Gordon equation & the basics of the perturbation theory.
Unit 4: Core Concepts: Electrodynamics of spin-less particles, Feynman diagrams and rules, Dirac equation, Quantum Electrodynamics
Unit 5: Advanced Topics: Parton model and a little QCD, collider physics – a (very) quick tour, introduction to HEP computing – Monte Carlo tools, some basic simulations, challenges in modern particle physics, role of modern computing
Reference Books:

1. D J Griffiths, Introduction to Elementary Particles, John Wiley & Sons.
2. F Halzen and A D Martin, Quarks and Leptons, John Wiley & Sons.
3. D H Perkins, Introduction to High Energy Physics, Cambridge U.

5.Teaching-Learning Strategies in brief:

This is an introductory (elective) course on Particle Physics designed to give the students who have no prior exposure to Quantum Field Theory a broad overview and some taste of the exciting world of Particle Physics. The approach would be somewhat intuitive. The design is for students with diverse backgrounds. The focus would be on concepts, simple explanations, and intuition building.

6.Assessment methods and weights in brief:

Assignments + Quizzes – (30%), Mid-term evaluation (30%), Final exam (40%)

Title of the Course : Introduction to Philosophy of Technology

Faculty Name : Ashwin Jayanti
Name of the Academic Programs :B.Tech. in CSE, B.Tech in ECE
Course Code : HS0.204
L-T-P :3-0-0
CREDITS :4
(L = Lecture hours, T = Tutorial hours,
P = Practical hours)

1. Prerequisite Course /Knowledge:

None

2. Course Outcomes (COs):

After completion of this course successfully, the students will be able to:

CO-1: Identify and recognize various conceptions of technology implicit in arguments for/against technology

CO-2: Classify and describe various theories and interpretations of technological change through history

CO-3: Compareanalytical and continental approaches to technology and its relation to science and examine the limitations and advantages of both the approaches

CO-4: Assess the moral significance of technical artefacts within particular social contexts

CO-5: Develop philosophical frameworks in orderto understand and assess the impact of contemporary technologies to society at large

3. Mapping of Course Outcomes (COs) with Program Outcomes (POs) andProgram Specific Outcomes (PSOs) – Course ArticulationMatrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS O1	PS O2	PS O3	PS O4
CO1	-	-	2	-	-	3	2	3	2	3	1	3	-	-	-	-
CO2	-	-	1	-	-	3	2	2	-	-	-	3	-	-	-	-
CO3	-	-	1	-	-	3	2	2	-	1	-	3	-	-	-	-
CO4	-	-	2	1	-	3	3	3	1	2	-	3	-	-	1	-
CO5	1	1	3	3	-	3	3	3	1	2	-	3	-	-	-	-

3 in the table denotes high level mapping, 2 denotes moderate level and 1 denotes low level

DetailedSyllabus:

Unit I –Introduction: What is Philosophy of Technology? Engineering and Humanities Philosophies of Technology; Classical and Contemporary Philosophy of Technology

Unit II: Encountering Technological Artefacts –Conceptual history of 'technology'; What is 'technology'? Continental and Analytic Perspectives

Unit III: Epistemological Aspects to Technologies –Science, Technology, and Engineering; Philosophy of science and philosophy of technology; Knowing-how and knowing-that

Unit IV: Moral Status of Technologies –Norms, Values, and Technologies; Debates Concerning Moral Significance of Artefacts; Role of Design in Moral Status

Unit V: Philosophical Debates in Artificial Intelligence –Philosophical background to Artificial Intelligence; Philosophical and ethical issues within Artificial Intelligence

REFERENCE BOOKS:

- Hans Achterhuis (ed.),*American Philosophy of Technology: The Empirical Turn*, translated by Robert Crease, Indiana University Press:2001.
- Carl Mitcham,*Thinking Through Technology: The Path Between Engineeringand Philosophy*, The University of Chicago Press:1994

- Robert C. Scharff and Val Dusek (eds.),*The Technological Condition: AnAnthology (Second Edition)*, John Wiley& Sons:2014
- Peter-Paul Verbeek,*What Things Do: Philosophical Reflections on Technology,Agency, and Design*, translated by Robert Crease, The Pennsylvania State University Press, 2005
- Peter Kroes and Peter-Paul Verbeek (eds.),*The Moral Status of TechnicalArtefacts*, Dordrecht: Springer,2014.
- StuartJ.RussellandPeterNorvig,*ArtificialIntelligence:AModernApproach* (Second Edition), Pearson, 2003
- John Searle,*Mind: A Brief Introduction*, Oxford University Press:2004

4. Teaching-Learning Strategies inBrief

This course aims at reading, critically evaluating, and thinking through contemporary debates in philosophy of technology. For this purposes, the main strategy is to share the readings and resource material beforehand for the students to acquaint themselves with the topics and use the class time to discuss and evaluate the implications of the various positions respective to each topic. Continuous assessment methods will be employed to make sure the students have acquired the requisite conceptual understanding to explicate and argue for their position with greater nuance and logical rigor.

5. Assessment Methods and Weightages inBrief

Continuous assessment in the form of written assignments will carry the major weightage of the evaluation, with the rest of the weightage assigned to class participation in the ensuing discussions.

The assigned weightage is as follows: Assignments: 40 marks, class participation: 10 marks, Mid semester exam: 20 marks, End semester exam: 30marks.

Title of the Course : **Introduction to Quantum Information and Computation**
Faculty Name : Uttam Singh
Course Code : CS9.312
LTP : 3-1-0.
Credits : 2
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Academic Program: **B.Tech. in Computer Science and Engineering**

Prerequisite Course / Knowledge:

Knowledge of Advanced Linear Algebra, Quantum Mechanics, Classical information Theory

Course Outcomes (COs):

After completion of this course successfully, the students will be able to..
CO-1. Explainthe basic idea of Qubits (Quantum States), Pure and Mixed States, Quantum Measurements, Entanglement, Quantum Gates and the idea of extension of Entropy from Classical to Quantum. Learning Dirac Algebra to solve problems of Quantum Computing and Information
CO-2. Demonstrate familiarity with process like Quantum Measurement, Information processing tasks like Teleportation, Superdense Coding, Entanglement Swapping, s Quantum Circuits.
CO-3: Synthesize proofs of theorems related to Quantum Entropy using the mathematical and logical arguments.
CO-4. Design Quantum Circuits with Universal Gates,

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	1	1	1	2	1	-	-	-	-	-	-	3	3	3	3	3
CO2	2	2	1	3	1	-	-	-	-	-	-	3	3	2	3	3
CO3	1	2	-	3	-	-	-	-	-	-	-	2	3	2	2	3
CO 4	1	2	-	3	2	-	-	-	-	-	2	2	3	3	3	3

'3' in the box denotes 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

Detailed Syllabus:

Unit 1. Introduction and Overview: Transition from Classical to Quantum (2L)
Unit 2. Foundations of Quantum Theory I: States, Ensembles, Qubits, Pure and Mixed states, Multi-qubit states, Tensor Products, Unitary transformations, Spectral Decomposition theorem, Singular value Decomposition, Generalized Measurement, Projective Measurement, POVM (4L)
Unit 3. Quantum Entropy and Entanglement: Quantum Entropy, EPR Paradox, Schmidt Decomposition. (2L)
Unit 4. Basic Quantum Information Processing Protocols: Teleportation, Super Dense Coding, Entanglement Swapping. (2L)
Unit 5 Quantum Computation : Introduction to quantum computing, Pauli Gates, Hadamard Gates, Universal Gates, Quantum algorithms . (2L)

Reference Books:

Preferred Text Books: 1. Quantum Computation and Quantum Information –M. A. Nielsen, I. L. Chuang. Cambridge University Press.
Other Books: 1. Quantum Computer Science: An Introduction --- N. D. Mermin, Cambridge University Press. 2. Quantum Computing: From Linear Algebra to Physical Realizations---M. Nakahara, T. Ohmi, Taylor and Franchis Group. 3. Lectures on Quantum Information (Physics Textbook)---D. Brub, G. Leuchs, WILEYVCH.

Teaching-Learning Strategies in brief (4 to 5 sentences):

First of all there will be lectures which will introduce the motivations, concepts, definitions along with simpler examples. After that there are going to be assignments and quizzes that will make sure that the students have understood the concepts. These will be followed by deeper lectures and assignments as the area is interdisciplinary and new. These will also be supplemented with innovative problems so that they can apply the concepts learned by them.

Assessment methods and weightages in brief (4 to 5 sentences):

Mid semester exam- 20%
End SemExam- 30%
Assignment- 15%
Quizz- 15%
Project -20%

Title of the Course : **Introduction to Software Systems**
Faculty Name : Sai Anirudh Karre
Course Code : CS6.201

LTP : 3-1-0.
Credits : 2
(L= Lecture hours, T=Tutorial hours, P=Practical hours)

1. **Prerequisite Course / Knowledge:** Not applicable.

2. **Course Outcomes (COs) (5 to 8 for a 3 or 4 credit course):**

After completion of this course successfully, the students will be able to…

CO-1: Demonstrate familiarity with various OS Concepts, Shell programming, Web Technologies, Database Systems, Python Programming, software engineering principles.

CO-2: Understand the different types of tools and technologies that are suitable for solving different software problems

CO-3: Apply tools and technologies to implement simple software solutions

3. **Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2								2							
CO2	3		2		2				2	2		1				
CO3	3			1	3				3		1					

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4. **Detailed Syllabus:**

Unit 1: Software and Systems overview - SHELL: OS concepts, Kernel, Memory, Shell basics, Advance Linux commands including file management and schedulers, Control flows, Regex, Awk,

Unit 2: Developing web applications- Introduction to HTML, CSS and Javascript concepts, Data types, variables, operators, conditions, loops, functions, function expressions, events, form controls, data structures, java script libraries, AFrame, Three.js

Unit 3: Programming with Python – Functions, Exceptions, Error Handling, Sequences, scoping rules, closures, higher order functions, mutability, object model and inheritance, modules and packages, variable args, decorators, usage of libraries including SOAP and REST API, Flask based server set up.

Unit 4: SDLC and Databases – SDLC concepts, Version Control Systems, Editors, Bug trackers, Basics of SQL, CRUD;

Reference Material/Books:

1. Mastering Linux Shell Scripting : A practical guide to Linux command-line, Bash scripting, and Shell programming, by Mokhtar Ebrahim, Andrew Mallett. 2nd Edition, 2018. ISBN-13 : 978-1788990554
2. Learning Python: Powerful Object-Oriented Programming, by Mark Lutz. 5th Edition, 2013. ISBN-13 : 978-1449355739
3. JavaScript: The Definitive Guide, by David Flanagan. 7thEdition, 2020. ISBN-13: 978-1491952023
4. Workbook/Gitbook created by the course instructors (https://serciiit.gitbook.io/introduction-to- software-systems/)

5. Teaching-Learning Strategies in brief (4 to 5 sentences):

The course is delivered using problem based learning methodology. The major goal of the course is to introduce the students to various software and systems technologies and tools that can facilitate them to develop simple software systems. To achieve this goal, the course is delivered as a combination of lectures and tutorial sessions that provide students with hands-on experience in understanding the problem and implementing solutions using the corresponding software technologies and tools.

6. Assessment methods and weightages in brief (4 to 5 sentences):

Mid Exam – 15%
Final Exam – 20%
Assignments (3) – 25 %
Labs (4) – 20%
Others– 20% (In-class Activities, Surprise quiz/test)

Title of the Course : **Introduction to Spatial Sciences**
Name of the Faculty : RC Prasad & K.S Rajan
L-T-P : **3-0-1.**
Credits : **2**
Course Code : GS0.301

1. Prerequisite Course / Knowledge:

Basic Physics and computational knowledge.

2.Course Outcomes (COs)

After completion of this course successfully, the students will be able to

CO-1: Describe the characteristics of satellite imagery

CO-2: Comprehend different techniques of satellite data processing

CO-3: Apply conventional and advanced computational techniques for feature extraction

CO-4: Understand how to Capture, handle and store spatial data

CO-5: Visualize and anlayze Spatial data

CO-6: Learn the concepts of Web GIS

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	2	1	2	1	1	1	1	-1	1	1	2	2	2	2
CO2	2	1	2	2	2	2	2	2	2	1	2	2	3	2	2	2
CO3	2	2	2	2	3	2	1	1	1	1	2	2	2	2	2	2
CO4	2	2	2	2	2	1	1	1	1	1	2	2	2	2	2	2
CO5	2	2	2	2	3	2	2	2	2	1	2	3	3	2	2	2
CO6	1	2	2	1	2	1	1	1	1	1	1	2	2	2	2	1

4. Syllabus:

Unit-1: Characteristics of Satellite imagery

Unit-2: Satellite data processing

Unit-3: Case studies and challenges in satellite data processing

Unit-4: Spatial data handling and Processing including Global Navigational Satellite Systems

Unit-5: Spatial data analysis and its Challenges

Unit-6:Geovisulaization and Web GIS

References:

1.https://www.oreilly.com/library/view/deep-learning-for/9781788295628/f6335652-83ed-490c-8912-5e1f3ef0b8ad.xhtml

2. Remote sensing Digital Image Analysis by J.A Richards and Xiuping Tia

3. https://webgispro.ir/Files/getting-know-web-gis-3rd.pdf

4.https://d1.amobbs.com/bbs_upload782111/files_33/ourdev_584835O21W59.pdf

5.Teaching-Learning Strategies in brief:

Teaching, discussing current approaches of information extraction, challenges, and limitations with spatial data; Research papers presentations by students on chosen topic and written assignments, periodical evaluation of course project implemented with open data and tools.

6.Assessment methods and weightages in brief:

1. Quiz (1 and 2) - (**30%**)

2. Project **- (40%)**

3. End Semester Exam **- (30%)**

Title of the Course : Introduction to Statistical Signal Processing

Name of the Faculty : Santosh Nannuru
Name of the Program **:** Introduction to Statistical Signal Processing
Course Code **: EC5.206**
Credits **:** 2
L - T - P **:** 3-1-0 (L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year **:** Spring 2025 (H2)
Pre-Requisites **:** Signal Processing, Probability & Random Processes

Course Outcomes :

1. Apply concepts from signal processing and probability to study autoregressive (AR),moving average (MA), and ARMA random processes.
2. Analyze stationary signals using optimum linear filters like Wiener filter.
3. Analyze non-stationary signals using adaptive filters such as least mean squares (LMS)filter, recursive least squares (RLS) filter, and their variants.
4. Estimate and track evolving state space using Kalman filter and its variants.
5. Design adaptive filters for applications such as prediction, tracking, filtering, and noisecancellation.

Course Topics :

Introduction to Statistical Signal Processing combines ideas from signals processing and probability to process stochastic signals.

Overview of random processes – stationary process, power spectral density, white noise. Linear time-invariant (LTI) systems and stationarity - autoregressive (AR), moving average (MA), and ARMA processes, Yule-Walker equations.

Optimal linear filters – Wiener filter and its applications to stationary signal processing including filtering, prediction, noise cancellation, and deconvolution.

Adaptive filters – gradient descent, stochastic gradient descent, least mean squares (LMS) filter, convergence of LMS; recursive least squares (RLS) filter, applications of adaptive filters.

State space model – Kalman filter, extended Kalman filter, object tracking and other applications.

Preferred Text Books : "Statistical Digital Signal Processing and Modeling" by Monson H. Hayes

Reference Books **:** "Digital Signal Processing" by Proakis & Manolakis, 4th Edition

E-book Links **:**

Grading Plan **:** The table is only indicative.

Type of Evaluation	Weigh t
Quiz	30%
Assignments	30%
Final Exam	40%

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant).

	PO1	PO2	PO3	PO 4	PO5	PO 6	PO7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO 2	PSO3	PSO 4
CO1	3	3	3	3	3	1	1	1	1	1	1	3	1	3	2	2
CO2	3	3	3	3	3	1	1	1	1	1	1	3	1	3	2	2
CO3	3	3	3	3	3	1	1	1	1	1	1	3	1	3	2	2

CO 4	3	3	3	3	3	1	1	1	1	1	1	3	1	3	2	2
CO5	3	3	3	3	3	1	1	1	1	1	1	3	1	3	2	2

Teaching-Learning Strategies in brief (4-5 sentences) :

Class lectures will focus on explaining the theory concepts. Tutorials will be used for doubt clarifications and problem solving. Assignments are given to promote the application of theory concepts for problem solving.

Title of the Course : Language and Power
Name of the Faculty : Priya Prithiviraj
Name of the Program : BTech in CSE and BTech in ECE
Course Code : HS0.220
Credits : 2
L - T - P : 3-1-0 (L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring 2025
Pre-Requisites :
Course Description:

What does language do? What do we do with language? Language plays a multifaceted role, extending beyond communication to influence our cognitive development, conceptual frameworks, and perception of reality. It is a tool that can be used to both maintain and disrupt existing hierarchies and inequalities. Given its profound role in shaping society, this course will explore the complex relationship between language, power, and identity by analysing language attitudes and ideologies that influence language policies, which regulate language use and status. Students will evaluate case studies of language conflict from India and other global contexts to understand the core issues in language policy and engage with critical questions on the ethical dilemmas in resolving these.

Course Outcomes:

By the end of this course, students will be able to:
CO1: Demonstrate an understanding of the key concepts related to the sociocultural dimensions of language, such as linguistic imperialism, linguistic human rights, and language ideologies. **[Apply]**
CO2: Analyse the relations between language, power, and identity, and how these affect language policies. **[Analyse]**

CO3: Critique different language policies by engaging with case studies of language conflict from other countries. **[Evaluate]**

CO4: Construct arguments on the ethical challenges in multilingual education and policymaking, particularly within the Indian context. **[Create]**

Course Topics:

Module 1: Multilingualism and Education

What is a Mother Tongue? Need-based and Choice-based Bilingualism, Monolingual Bias and Subtractive Views of Bilingualism, Multilingualism and Linguistic Diversity, Plurilingualism and Translanguaging, Mother Tongue Maintenance, Home-School Language Gap, Mother Tongue Based Multilingual Education (MTB-MLE), Child Language Assessment in Multilingual Contexts.

Module 2: Language, Identity, and Ethical Dilemmas

Language Use and Regulation, Language Attitudes and Linguistic Imperialism, Minority and Endangered Languages, Linguistic Human Rights and Linguistic Social Justice, Language Policy and Language Planning.

Module 3: Language Policy in Multilingual India

Constitutional Provisions on Language Use, Linguistic Reorganisation of States, Official Languages Commission, Official Languages Act, Three-Language Formula, National Policy on Education (NPE 1968; 1986), National Curriculum Framework – Foundational Stage (NCF-FS 2022), National Education Policy (NEP 2020).

Recommended Reading:

1. Mohanty, A. (2006). Multilingualism of the unequals and predicaments of education in India: Mother tongue or other tongue? In O. García, T. Skutnabb-Kangas, & M. Torres-Guzmán (Eds.), *Imagining multilingual schools: Languages in education and glocalisation* (pp. 262–283). Multilingual Matters. https://doi.org/10.21832/9781853598968-014
2. Mohanty, A. (2010). Languages, inequality and marginalisation: Implications of the double divide in Indian multilingualism. *International Journal of the Sociology of Language, 2010* (205), pp. 131–154. https://doi.org/10.1515/ijsl.2010.042
3. Pattanayak, D. P. (Ed.). (1990). *Multilingualism in India* (Vol. 61). Multilingual Matters.
4. Sharma, A. (2022). Reconceptualising power in language policy. In *Language policy* (Vol. 30, pp. 85–110). Springer. https://doi.org/10.1007/978-3-031-09461-3_5
5. Skutnabb-Kangas, T. (1981). *Bilingualism or not: The education of minorities*. Multilingual Matters.
6. Skutnabb-Kangas, T. (2012). Linguistic human rights. In L. Solan & P. Tiersma (Eds.), *The Oxford handbook of language and law* (pp. 235–247). Oxford University Press.
7. Skutnabb-Kangas, T., & Phillipson, R. (1994). Linguistic human rights, past and present. In T. Skutnabb-Kangas & R. Phillipson (Eds.), *Linguistic human rights: Overcoming linguistic discrimination* (pp. 71–110). De Gruyter Mouton. https://doi.org/10.1515/9783110866391.71
8. UNESCO. (2001). *Language education in multilingual India* (C. J. Daswani, Ed.). UNESCO.

Additional Reading:

1. Daudet, A. (2024). The last lesson. In *Flamingo: A Textbook in English for Class XII* (pp. 2-11). New Delhi: NCERT. https://ncert.nic.in/textbook.php?lefl1=1-14
2. Kernell, A. (Dir.). (2016). *Sami Blood* (Swedish/Saami: Sameblod) [Film]. Sweden, Norway, and Denmark: Nordisk Film Production Sverige AB, Bautafilm AB, Digipilot A/S, Nordisk Film Production A/S, and Sveriges Television AB.
3. Noyce, P. (Director). (2002). Rabbit-Proof Fence [Film]. Australia: Rumbalara Films, The Australian Film Commission, and the Australian Film Finance Corporation (AFFC).

4. Shetty, R. (Dir.). (2018). *Government Higher Primary School, Kasaragodu, Donated by: Raamanna Rai* (Kannada: Sarkaari Hiriya Praathamika Shaale, Kaasaragodu, Kodugé: Raamanna Rai) [Film]. India: Rishab Shetty Films.
5. Sombogaart, B. (Dir.). (1996). *The Boy Who Stopped Talking* (Dutch: De Jongen Die niet meer Praatte) [Film]. Netherlands: Bos Bros. Film & TV Productions.

Grading Plan:

The assessment for this course will comprise three formative assessments (one for each module) with a weightage of 10% each (totaling 30%) and a mid-semester exam (30%). The remaining 40% will be allocated to a summative assessment in the form of a term paper or presentation.

Type of Evaluation	Weightage (in %)
Mid Sem Exam	**30%**
Assignments	**30% (3 x 10%)**
Term Paper/Presentation	**40%**

Mapping of Course Outcomes to Program Objectives:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	2	2	1	2	1	2	1	2	1	2	-	3	2	3
CO2	1	2	2	2	2	2	1	2	1	2	1	2	-	3	2	3
CO3	1	2	2	2	2	2	1	2	1	2	1	2	-	3	2	3
CO4	1	2	2	2	2	2	1	3	1	2	1	2	-	3	2	3

Note: The COs are mapped to the POs and PSOs of the 'B.Tech in Computer Science and Master of Science in Computing & Human Sciences by Research' programme. (Scale: 1 – Lowest, 2— Medium, 3 – Highest, and a '-' dash indicates it is not relevant.)

Teaching-Learning Strategies:

This course comprises interactive lectures supplemented by debates and discussions that critically examine issues in language policy. Students will engage in active learning through individual and pair/group tasks, including writing reflections on their bilingual experiences and presenting case

studies of language conflict from their own contexts. In addition to critically reading the recommended academic texts, students will engage with short stories and films from the additional reading list. They will also prepare a glossary of key terms to enhance their understanding of course topics and develop proficiency in discourse-specific language. By the end of the course, each student will have identified research questions related to the ethical issues discussed for further engagement beyond the course, while also cultivating a critical stance on these topics.

Title of the Course :**Language Typology and Universals**

Faculty Name : Radhika Mamidi
Course Code : CL2.204
LTP : 3-1-0.
Credits : 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Academic Program: CLD

1.Prerequisite Course / Knowledge:

Introduction to Linguistics-1 and 2

2.Course Outcomes (COs) (5 to 8 for a 3 or 4 credit course):

After completion of this course successfully, the students will be able to:

CO-1 Analyse language at morpho-syntactic and semantic levels
CO-2 Discussthe similarities and differences between languages
CO-3 Demonstrate understanding of language development and language loss in humans
CO-4 Demonstrate understanding of different language families
CO-5 Build knowledge and do research and be able to build NLP applications in mother tongue

3.Mappingof Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1		3		2					3						2	2
CO2		2		3					3						3	3
CO3		2		2			3								2	2
CO4		2		2					3						2	2
CO5		2		2											3	3

Note: '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4.Detailed Syllabus:

Unit 1: INTRODUCTION: Nature of human language and its design features and comparison with animal communication systems - Duality of patterning, creativity, displacement etc; Levels of language organization- Phonological, Morphological; Grammatical and Discourse; **LANGUAGE CHANGE:** Concepts from Historical linguistics; language families

and subfamilies; Comparative methods: spelling changes, types of sound changes, morphological changes, syntactic and semantic changes; Analogical change; Borrowing; the Great Vowel Shift; Grimm's law; Lexical comparisons

Unit 2: COMPARISION AND CLASSIFICATION OF UNIVERSALS: Historic-generic method and typological method; Language contact and convergence and areal typological study; South Asian language area and common areal features – experience subject, echo-formation, reduplication, retroflexion; Approaches to language universals: structural approach and generative approach – their assumptions about sampling, methodology and nature of linguistic elements.

Unit 3:GREENBERG'S BASIC WORD ORDER TYPOLOGY: Implicational universals and their role in restricting

possible language types; absolute universals and tendencies; Post-Greenbergian research and reformulation

of word order typology. **CHOMSKYAN APPROACH TO LANGUAGE UNIVERSALS:** Language learnability,

poverty of stimulus and innateness hypothesis; Concepts of universal grammar; Principles and parameters –

head parameter, pro-drop parameter and X-bar theory of phrase structure.

Unit 3: PHONOLOGICAL STRUCTURE: Vowels and Consonants across languages; Distinctive features and

phonological oppositions; Syllable types; Phonotactic constraints; Phonological Processes; Language

acquisition and dissolution. Phonological universals. **MORPHOLOGICAL STRUCTURE:** Language types-

Analytic, Agglutinative, Synthetic and Polysynthetic: derivational and inflectional categories and types of

affixes; Morphological encoding of number, person, gender, tense, aspect and modal features, agreement

and case marking; Parts of speech categories.

Unit 4: CLAUSE STRUCTURE: Grammatical relations – Nominative-Accusative and Ergative-Absolutive

language types; Dative and other Nominative subjects; Relative clause types; Causative construction;

Complement structure; Conjuctive Participles. **SEMANTIC STRUCTURE:** Case Grammar; Predicate argument

structure and thematic roles and their realization; Paninian grammar and Karaka relations.

Reference Books:

1. Campbell, Lyle. 1998. Historical Linguistics. MIT Press.

2. Comrie, Bernard. 1981. Language Universals and Linguistic Typology. Oxford : Basil Blackwell.

3. Aitchison Jean. 1976. The Articulate Mammal. London: Hutchinson. Chapters 1-5.

4. Subbarao K.V. 2012. South Asian Languages: A Syntactic Typology. Cambridge University Press. Chapters 1,2,5,6 and 8.

5. Masica, Colin P.1979. Defining a Linguistic Area. Chicago and London: The University of Chicago Press.

6. Emeneau, Murray (1956), "India as a Linguistic Area", *Language***32** (1): 3–16.

7. Jakobson, Roman. 1968. Child Language, Aphasia and Phonological Universals. The Hauge: Muoton.

5.Teaching-Learning Strategies in brief (4 to 5 sentences):

The teaching process is a mix of theory and activity based. The focus is on using the concepts taught in class to extend to mother tongue. Translation method to compare the languages they know will be done individually, as pairwork and in groups

6.Assessment methods and weightages in brief (4 to 5 sentences):

Type of Evaluation	**Weightage (in %)**
Assignments	20%,
Seminar	10%

Graded Exercises	10%,
Midsem Exam	20%,
Endsem Exam	40%

Title of the Course : Linear Algebra

Course Code : MA2.101
Name of the Faculty : Sidharatha Das and Indranil Chakrabarty
L-T-P : 3-1-0
Credits : 4
Name of the Academic Programme: B.Tech

Prerequisite Course / Knowledge:

This is one of the first math courses and only assumes school knowledge of maths.

Course Outcomes (COs):

After completion of this course successfully, the students will be able to...

CO-1: Understanding the basic mathematical concepts like vector space, Basis, Linear Transformation, Rank Nullity Theorem, Matrix Representation of Linear Transformations, System of Equations, Determinants.
CO-2: Demonstrate familiarity with Eigenvalues, Eigenvectors, Orthogonality and Matrix Decomposition theorems.
CO-3: Synthesize proofs of theorems related to Matrices and Vector Spaces using clear mathematical and logical arguments.
CO-4: Apply principles of Spectral Decomposition and Singular Value Decompositions to real world problems in Image Compression, Principal Component Analysis etc.
CO-5: Design dimension reduction techniques with approximation guarantees using Best Fit Subspaces.
CO-6: Create mathematical models using principles of Linear Algebra and analyze them.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	PSO1	PSO2	PSO3	PSO4
CO1	2	3	1	3	1	1	1	1	2	2	1	3	1	1	1	2

CO2	1	2	2	2	1	1	1	1	2	2	1	1	3	1	1	2
CO3	2	3	1	3	1	1	1	1	2	2	1	3	2	1	1	2
CO4	1	3	2	2	1	1	1	1	2	2	1	1	3	1	2	2
CO5	1	3	2	3	1	1	1	1	2	2	1	1	3	1	1	3
CO6	1	2	1	2	2	1	1	1	2	2	1	2	3	2	2	2

'3' for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping.

Detailed Syllabus:

Unit 1: Vector spaces, subspaces, Linear dependence, Span, Basis, Dimension, Finite dimension vector spaces Linear transformation, Range and Null space of linear transformation, Rank Nullity Theorem, Sylvester's Law, Matrix representation of a linear transformation for finite dimensional linear spaces, Matrix operations, change of basis, Rank of a Matrix, Range and Null Space of a matrix representing a linear transformation. Linear spaces with inner product [inner product example over space of functions: orthogonality and orthogonal functions in L_2], Orthogonality, Gram-schmidt orthonormalization.

Unit 2: System of Linear Equations, Row-echelon form, reduced row-echelon form. Gauss-Jordon elimination, Solution of linear systems using Gauss-Jordon elimination, matrix inversion by Gauss Jordon elimination, Understanding Range Space and Solution Space using Rank-Nullity Theorem.

Unit 3: Matrices, Matrix operations, Matrix Algebra, Inverse of a Matrix, Fundamental Theorem of Invertible Matrices, Determinants, Elementary Matrices, Cramer's Rule.

Unit 4: Eigenvalues and Inner product: Eigenvalues & Eigenvectors, Norms, Inner Products and Projections, QR Factorization, Orthogonal Matrices, Orthogonal Diagonalization of Symmetric Matrices, Spectral Theorem.

Unit 5: Advanced Topics: Singular Value Decomposition Theorems, Quadratic Form. Applications of SVD, Best Fit Subspaces

Reference Books:

1. Linear Algebra, 2nd edition, K. Hoffman and R. Kunze.
2. Finite Dimensional Vector Spaces, P. Halmos.
3. Introduction to Linear Algebra, Gilbert Strang.
4. Linear Algebra Done Wrong, Sergei Treil.
5. Linear Algebra, A Modern Introduction, David Poole

Teaching-Learning Strategies in brief (4 to 5 sentences):

Lectures will initially introduce the motivations, concepts, definitions along with simpler examples. This will be followed by assignments and quizzes that will make sure that the students have understood the concepts. These will be followed by deeper lectures and assignments which lead the students to the bigger questions in the area. These will also be supplemented with real world engineering problems so that they can apply the concepts learned by them.

Assessment methods and weightages in brief (4 to 5 sentences):

– Tutorial Quizes: 15%

- Assignments: 15%
- Quiz 1: 10%
- Quiz 2: 10%
- Mid Exam: 20%
- End Exam: 30%

Title of the Course : Linear partial differential equations and variational calculus
Faculty Name : Samyadeb Bhattacharya
Course Code : MA4.303
Credits : 4
L - T - P :
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring 2025

Pre-Requisites **:** Basic knowledge of ordinary differential equations

Course Outcomes :
a) Getting students equipped with skills to solve practical physical problems.
b) Basic ideas on partial differentiation, state functions, path functions etc.
c) Introductory ideas on thermodynamics, wave propagation and heat conduction in connection to partial differential equations.
d) Solid idea on the basics of partial differential equations and their uses.
e) Basic idea about constructing boundary value problems.

Course Topics :
1. Basic concepts and definitions.
2. Mathematical problems.
3. Linear operators.
4. Superposition principle.
5. First order quasi-linear equations and method of charecteristics.
6. Mathematical models: a) Vibrating strings and membranes, b) Heat conduction, c) Schroedinger equation
7. Classification of second order linear equations.
8. Method of separation of variables.
9. Introduction to eigenvalue problems.
10. Introduction to boundary value problems.
11. Variational calculus. a. Application: Least action principle, brachistochrone and related problems. b. Application:Euler-Lagrange's equation and related problems. c. Hamilton's principle and related problems.

Preferred Text Books **:**K.T. Tang, Mathematical methods Engineers and scientists 3.

Reference Books **:**TynMyint-U and Lokenath Debnath, Linear partial differential equations for scientists and engineers. (other references will be given during the course)

E-book Links **: Will be shared during the course**

Grading Plan :
(The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz-1	**10%**
Mid SemExam	**10%**
Quiz-2	**10%**
End Sem Exam	**20%**
Assignments	**25%**
Project	**25%**

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant).Program outcomes are posted at

https://iiitaphyd-my.sharepoint.com/:w:/r/personal/dyacad_iiit_ac_in/Documents/NBA-2020-21/Course%20Content/IIIT-CSE-ECE.docx?d=w111f0effcaea41b3a4d1e8a3fbc6332d&csf=1&web=1&e=z1Khby

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	3	3	2	3	2	3	2	2	3	2	3	3	3
CO2	3	2	2	3	3	2	2	3	3	3	3	2	2	3	2	2
CO3	2	2	3	3	3	2	2	3	3	3	2	2	3	3	2	3
CO4	3	3	3	2	3	3	3	3	2	3	2	3	2	3	2	3
CO5	3	3	3	3	2	3	2	3	3	3	3	2	3	3	2	3

Teaching-Learning Strategies in brief (4-5 sentences) :
In this course, the main objective is to help the student understand the fundamental aspects of partial differential equations and their usage in practical problems. The course is of two aspects. First is the technical and mathematical aspect, which will be taught meticulously. Second is that of physical and practical, where student will be taught to construct a physical problem.

Title of the course **: Machine Learning for Natural Sciences**
Name of the Faculty : Prabhakar Bhimalapuram + Vinod PK

Name of the Academic Program : MS in Computer Science
Course Code : SC4.411
L-T-P : 4-0-0.
Credits : 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)

Prerequisite Course / Knowledge:

Probability & Statistics, Linear Algebra, Statistical Models in AI

Course Outcomes (COs):

After completion of this course successfully, the students will be able to...

CO-1: Learn and demonstrate understanding the basic concepts in machine learning

CO-2: Demonstrate use of machine learning algorithms on simple problems

CO-3: For a selected problem, apply the understanding of the principles, to formulate a problem statement

CO-4: Build Models based on requirements of the problem statement

CO-5: Analyze the constructed models for their usefulness, find deficiencies and identify possible improvements.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	1	3	1	1	1	1	2	2	1	3	1	1	1	2
CO2	1	2	2	2	1	1	1	1	2	2	1	1	3	1	1	2
CO3	2	3	1	3	1	1	1	1	2	2	1	3	2	1	1	2
CO4	1	3	2	2	1	1	1	1	2	2	1	1	3	1	2	2
CO5	1	3	2	3	1	1	1	1	2	2	1	1	3	1	1	3
CO6	1	2	1	2	2	1	1	1	2	2	1	2	3	2	2	2
CO7																

'3' for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping.

Detailed Syllabus:

Unit 1: Overview: Types of problems: regression, classification. Types of machine learning: (a) supervised, (b) unsupervised, (c) semi-supervised and (d) reinforcement learning

Unit 2: Problem specific issues:

(a) representation: how to decide on a model that can solve the problem at hand?
(b) evaluation: Construction of a loss function to evaluate the
(c) Optimization: methods to use to iteratively improve the model from a starting guess?

Unit 3: Review of prominent current literature in ML as applied to natural sciences

Unit 4: Project discussion and implementation: Selection of a problem in natural sciences and developing a solution using ML techniques

Reference Books:

1. "Probabilistic Machine Learning", Kevin Murphy, MIT Press 2022
2. Other material (websites, technical articles) will be given to the students, based on need.

Teaching-Learning Strategies in brief (4 to 5 sentences):

Lectures will initially introduce the motivations, concepts, definitions along with simpler examples. This will be followed by assignments and quizzes that will make sure that the

students have understood the concepts. These will be followed by deeper lectures and assignments which lead the students to the bigger questions in the area. These will also be supplemented with real world engineering problems so that they can apply the concepts learned by them.

Assessment methods and weightages in brief (4 to 5 sentences):

- Light In-class Quizes: 15%
- Assignments: 15%
- Mini Project: 20%
- Major Project: 50%

Title of the Course : **Machine, Data and Learning**
Faculty Name : Praveen Paruchuri + Sujit Gujar
CourseCode : CS7.301
L-T-P : **3-1-0**
Credits : **4**
(L=Lecture hours,T=Tutorialhours,P=Practicalhours)

Name of the Academic Program: **B.Tech. in Computer Science and Engineering**

1. **PrerequisiteCourse/Knowledge:**
Data Structures, Computer Programming

2. **Course Outcomes (COs)**
After completion of this course successfully, the students will be able to:
CO-1. Understand basicMLconcepts suchas Underfitting, Overfitting and Bias-Variance tradeoff

CO-2. Gainhands-onexperienceofapplyingtheseconceptstoexampleproblems

CO3.Understand local search techniques with focus on Genetic algorithms

CO-4. Understand the basics of Probability and Utility theory

CO-5. Usage of these concepts in the context offormalmodels such as Decision theoretic model sand Bayesiannet works

CO-6.Understand Decision tree learning and notion of Information Gain

3. **MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecific Outcomes(PSOs)–CourseArticulationMatrix**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO 4
CO1	3	3	3	2	2	3	-	-	3	2	2	2	1	2	2	1
CO2	2	2	3	1	1	3	-	-	3	2	1	2	1	2	2	1
CO3	2	1	3	1	1	3	-	-	3	2	1	2	1	2	2	1
CO4	2	2	3	2	2	3	-	-	3	2	2	2	1	2	2	1
CO5	3	3	3	2	1	3	-	-	3	2	1	2	1	2	2	1
CO6	3	2	3	2	1	3	-	-	3	2	1	2	1	2	2	1

'3'in the box denotes 'High-level'mapping,2 for 'Medium-level'mapping,1 for 'Low'-level'mapping

4. DetailedSyllabus:

Unit1: Overview of AI and ML
Unit2: Basic MLconceptsincludingData and generalization, Overfitting, Underfitting, Bias-variancetradeoff
Unit3: Local Search Techniques, Genetic AlgorithmsUnit5: Basics of Probability and Utility Theory
Unit6: Decision Theory, MarkovDecision Process, Modeling observation errors
Unit7: Decision TreeLearning,Constructdecisiontreesfromexamples,Notion of information gain
Unit8:Bayesian networks

References:

- PythonMLbyExamplebyYuxi(Hayden)Liu,PacktPublishing,2017
- Stuart Russell andPeter Norvig, Artificial Intelligence A ModernApproach,PearsonEducationInc.,2009

5. Teaching-LearningStrategiesinbrief:

Thecourselectureswillcoverthecoreconceptswhileassignmentswillprovideamplescopetoimplementandunderstandmanyoftheconceptsinmoredetail.Learningoftheoretical

conceptsandproblemsolvingwillbeenabledviaquizzes,midandfinalexams.

6. Assessmentmethodsandweightagesinbrief:

Assignments:35marks,Quizzes:15marks,MidExam:20marks,EndExam:30marks

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Title of the Course: **Making of the Contemporary World**

Name of the Faculty: Anirban Dasgupta and Isha Dubey

Name of the Program: B.Tech in Computer Science and M.S. in Computing and Human Sciences by Research

Course Code: HS8.101

Credits: 4 (four)

L - T - P: **3-1-0**

(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring 2025

Pre-Requisites : Admission to the Human Sciences Dual Degree Programme

Course Outcomes : This course will inform the student about the world in which they live. Rather than taking a chronological order, it will look at a few landmark events and processes which marked and produced our world. It is meant to fill in the information gap which students will have about the world we live in, but also give them a sense of how different disciplines and scholars look at the world, how the same processes often play out in different "fields" and how one influences the other. The objective is to both inform the students about the contemporary world and how it came to be, and to appreciate the various strands, the diversity of ideas and practices, which constitute it. The objective is also to teach the student how to analyse social, economic, political and intellectual trends in the world in which they will work and live. It will bring them up-to-speed to the moment of digital transformations they are living through.

CO1:Identifythe main events of world history over the last fewcenturies

CO2: **Describe**and**Explain**theimportance of the scientific revolution, capitalism, colonialism, industrial revolution, etc

CO3: **Employ** one or more theories of social sciences used to interpret the modern world

CO4: **Compare** the trends and processes in different parts of the world

CO5:Evaluatethe influence of different world events and trends on present times

Course Topics :

1. The temporal and spatial understanding of the world- What is global history; what does modern mean and where is the world? The 'global turn' in world history, conceptualising modernity, Enlightenment

2. The evolution of knowledge systems- Religious to secular ways of knowing the world. Science and scientificity. Different ways of doing science- classical vs Baconian

3. Explorations and expansion of the European world- Mercantilism, trade routes and nodes of entanglement; Economic and cultural dimensions of capitalism; Resources, surplus repatriation, slavery, Orientalism

4. Production, Technology and Resources- The advent of capitalism, industrial revolution, demographic transition; Environmental History: use and abuse of nature

5. Ruptures to status quo and Revolutions- French, American, Russian Revolutions; The World Wars; Do revolutions happen anymore?

6. Representations of the human condition - The evolution of cultural production; class and culture; capitalism, materialism, and the politics of leisure.

7. Nations, nationalism, and postcolonial world–The post-WW2 world, the Cold War, NAM, nationalism, and nation-making in the Global South

8. Globalization and its aftermath- the great divergence, post-world development project and possibility of catching up.

Text Book:

1. Robert Tignor et.al.: Worlds Together, Worlds Apart. Vol 2
2. C.A. Bayly: *The Birth of the Modern World, 1780-1914*

Reference Books :

1. Michael Spence: *The Next Convergence: The Future of Economic Growth in a Multispeed World*
2. Jurgen Osterhammel: *The Transformation of the World: A Global History of the 19th Century*
3. Clifford Connor: *A People's History of Science*
4. Ellen Meiksins Wood: Agrarian Origins of Capitalism
5. Francois Furet: *Interpreting the French Revolution*
6. Eric Hobsbawm: *The Age of Revolution: Europe 1789-1848*
7. Priya Setia: *Time's Monster: How History Makes History*

E-book Links:

Grading Plan:

Type of Evaluation	Weightage (in %)
Term paper and presentation	30%
Midsemester Exam	30%
End Sem Exam	40%

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2	2	3	2	2	3	1	1	1	3	1	3	3	3
CO2	2	3	1	3	3	2	2	3	1	2	1	3	1	3	3	3
CO3	2	3	3	3	3	2	3	3	2	2	1	3	1	3	3	3
CO4	2	3	3	3	3	3	2	3	3	2	1	3	1	3	3	3
CO5	2	3	3	3	3	2	2	3	2	3	1	3	1	3	3	3

Teaching-Learning Strategies in brief (4-5 sentences):

The course will be held in the workshop mode with student engagement in the topics discussed in each class. Readings will be given out before the class and students will be expected to read and come, and then engage with the topic under discussion.
Each of the different modules will be taught using research papers and books from different disciplines of the Human Sciences.

Students will be asked to submit a written term-paper and make presentation on this paper. Students will be expected to read between 1,200 to 1,500 pages of academic texts, as well as write about 3000 words for their assignment.

Title of the Course : Mathematical Foundations of Data Science

Name of the Faculty : Suryajith Chillara, Girish Varma

Course Code : CS1.503

Credits 4

L -T – P : 3 - 1 – 0

(L - Lecture hours, T-Tutorial hours, P - Practical hours)

Semester, Year : Spring 2025

Name of the Program: BTech/MS/MTech/PhD in Computer Science

Pre-Requisites : Linear Algebra, Probability, Discrete Mathematics, Algorithms

Course Outcomes :

CO1: Understand how probability, statistics and graph theory can be used to model data science problems

CO2: Design efficient algorithms for Data Science problems with provable guarantees on runtime and accuracy

CO3: Study how to draw good samples efficiently and how to estimate statistical and linear algebra quantities, with such samples

CO4: Enable students to analyse higher dimensional data using abstract methods

CO5: Learn the theory for understanding when optimization over training samples can be expected to lead to good performance on new, unseen data

Course Topics :

Foundations:

Estimation from Random Samples and Confidence Intervals, Random Walks in Graphs and PageRank, Best fit subspace or PCA using SVD.

Algorithms for Large Datasets:

Streaming Algorithms, Property testing, Hashing, Approximate Nearest Neighbours using Locality Sensitive Hashing

Theory of Supervised Learning:

PAC Learning, Sample Complexity, VC Dimension, Learning Half spaces, Juntas

Preferred Textbooks :

1. **Foundations of Data Science** by Avrim Blum, John Hopcroft, and Ravindran Kannan https://www.cs.cornell.edu/jeh/book.pdf
2. **Data Streams: Algorithms and Applications** by S. Muthukrishnan https://www.cs.princeton.edu/courses/archive/spr04/cos598B/bib/Muthu-Survey.pdf
3. **Graphical Models, Exponential Families, and Variational Inference** by Martin J. Wainwright and Michael I. Jordan https://people.eecs.berkeley.edu/~wainwrig/Papers/WaiJor08_FTML.pdf

Reference Books :

1. Algorithms for Big Data by Moran Feldman https://www.worldscientific.com/worldscibooks/10.1142/11398#t=toc

2. Understanding Machine Learning: From theory to Algorithms by Shai Shalev- Schwartz and Shai Ben David https://www.cs.huji.ac.il/~shais/UnderstandingMachineLearning/understanding-machine-learning-theory-algorithms.pdf

Grading Plan : (The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz-1	**10%**
Mid Sem Exam	**20%**
Quiz-2	**10%**
End Sem Exam	**35%**
Assignments	**25%**

Mapping of Course Outcomes to Program Objectives:

(1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant).

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	-	3	1	3	1	2	2	-	-	1	-	-	2	2	2	3
CO 2	-	3	1	3	1	2	2	-	-	1	-	-	2	2	2	3

CO 3	-	3	1	3	1	2	2	-	-	1	-	-	2	2	2	3
CO 4	-	3	1	3	1	2	2	-	-	1	-	-	2	2	2	3
CO 5	-	3	1	3	1	2	2	-	-	1	-	-	2	2	2	3

Teaching-Learning Strategies:

The course lectures will include activities that promote the understanding of the lecture content by using small examples that students work out during the class itself and promote active and participatory learning. A good part of the lecture will involve problem solving and finding solutions to problems rather than expositing known material. In class tests that are held periodically are useful as summative assessments. Homework assignments are designed to reiterate the material covered in class lectures and also solve problems that are based on simple extensions of concepts described in the lectures.

Fundamentals of Data Science

Table of Contents

1. Estimation from Random Samples

Use Linearity of Expectation, Tail bounds, Confidence Intervals

Examples in Vote Share surveys, Medical Tests etc.
Mathematical Formulation in terms of Random Vari

Linearity of Expectation & Tail Bounds

Gaussian & Confidence Intervals

Predictions, Precision/Recall Curve

2. WWW Graph, Page Rank & Eigenvalues

Matrices, Eigenvalues, Convergence, Page Rank

World Wide Web Graph and Ranking Problem

Random Walks and Eigenvalues

Stationery Distributions and Degree

Convergence and Second Largest Eigen Value

3. Dimensionality Reduction

SVD, PCA and Best fit subspaces

- Dimension Reduction Problem
- Examples: Spiral Galaxy, Recommender Systems
- Singular Value Decomposition
- Best fit subspaces from SVD
- Low Rank Assumption and Applications
- Projection to Random Subspace (Johnson-Lindenstrauss)

4. Data Streaming Algorithms
   - Finding missing numbers and duplicates
   - Streaming algorithms
   - Fingerprinting Method
   - Frequency Moments and k-wise Independence
   - Limits of Streaming Algorithms

5. Nearest Neighbor Search, Hashing and Clustering
   - Nearest Neighbor Classifier
   - Hashing
   - Appropriate NN from Locally Sensitive Hashing
   - Clustering

6. Sublinear time algorithms
   - Property testing
   - Sublinear time algorithms for graphs
   - Subliner time algorithms for boolean functions
   - Distribution testing

7. Decision Trees
   - Sample complexity
   - Decision Tree algorithms
   - Random Forests

8 . Sample Complexity and VC Dimension

9 . Supervised Learning

PAC Learning. Learning Linear functions using gradient updates. Overfitting

10. Neural Network Learning

Neural Networks

Gradient Descent and Backpropagation

Convolutional Neural Networks for Images

Recurrent Neural Networks for Time Series

Regularization and Dropouts

Title of the Course : Mathematical Methods in Biology

Name of the Faculty : Abhishek Deshpande

Course Code : SC3.316

L-T-P : 3-1-0

(L= Lecture hours, T=Tutorial hours, P=Practical hours)

Credits : 4

1.Prerequisite Course / Knowledge: NA

2.Course Outcomes (COs):

After completion of this course successfully, the students will be able to

CO-1 State and prove theorems related to dynamical systems arising from biological interaction networks.

CO-2 Apply modeling techniques to complex biological problems.

CO-3 Demonstrate the familiarity in operating softwares like pplane, MATLAB commonly used in simulating trajectories of dynamical systems.

CO-4 Explain the basic concepts in reaction network theory.

CO-5 Analyze properties of models, such as various forms of stability and long-term behaviour.

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation MatriX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	1	1								2	2	1	1
CO2	2	2	2	2	2								1	1	1	1
CO3	2	2	1	2	2								1	1	1	1
CO4	2	2	2	2	2								1	1	1	1

CO5	2	2	1	2	2								1	1	1	1

Note: '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4.Detailed Syllabus:

1) Short treatise on Differential Equations: Existence and uniqueness of solutions, System of differential equations, Eigenvalues and eigenvectors. Application to population dynamics models.
2) Introduction to dynamical systems: Flows, Fixed points and linearization.
3) Introduction to reaction networks: Persistence, Permanence, Globally Attracting sets, Deficiency and Multistability (Species-Reaction graphs).
4) Absolute concentration robustness, Network translation, Deficiency zero and Deficiency one theorems.
5) Applications to biological signal transduction pathways, phosporylation-dephosphorylation cycles and MAPK cascades.
6) Numerical simulations and analysis of dynamical systems using pplane and MATLAB.

Reference Books:

1) Nonlinear Dynamics And Chaos: With Applications to Physics, Biology, Chemistry, And Engineering, by Steven Strogatz.
2) Foundations of chemical reaction network theory by Martin Feinberg.
3) Martin Feinberg's lecture notes: https://crnt.osu.edu/LecturesOnReactionNetworks
3) Jeremy Gunawardena's lecture notes: https://vcp.med.harvard.edu/papers/crnt.pdf
4) An introduction to systems biology: design principles of biological circuits, by Uri Alon.

5.Teaching-Learning Strategies in brief (4 to 5 sentences):

The objective of the course is to give the students a flavor of mathematical techniques used in modeling biological systems. In particular, the focus will be on analyzing biological systems from a dynamical systems point of view. Applications include analysis of enzymatic pathways, reaction networks, epidemic models and stability of steady states. The course will familiarize students with state-of-the-art softwares like pplane for simulating dynamical systems arising from biological networks.

6.Assessment methods and weightages in brief (4 to 5 sentences):

Assignments (25%), Midterm Iexam (20%), Midterm II exam(20%), End semesterexam (35%)

Title of the Course : Mechatronics System Design

Faculty Name : Nagamanikandan +Harikumar K
Course code : EC4.404
L-T-P : 3-1-0
Credits : 4
(L=Lecturehours,T=Tutorialhours,P=Practicalhours)

1. Prerequisite Course / Knowledge:

Basic programming (Python, C++), LinearAlgebra, Numerical methods, Basicmicrocontroller knowledge.

2. Course Outcomes (COs):

After completion of this course successfully, the students will be able to

CO-1 Describeimportant elementsofmechatronics system
CO2Apply the previous knowledge ofmicrocontroller programming for controlling multidisciplinary mechatronic systems.
CO-3 Describe and design basic mechanical elements and their feedback control.
CO-4 Synthesizeandanalyzea rangeofmechanisms.
CO-5Designandexecuteamultidisciplinary projectbasedonthegiven specificationsas partof ateam.

3. Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)–CourseArticulationMatrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	1	1	1	2	2	1	2	1	3	3	2	2	2
CO2	3	3	2	1	3	1	1	1	3	1	2	3	3	2	2	3
CO3	3	2	2	1	2	1	1	1	1	2	1	2	1	1	1	3
CO4	3	3	3	1	2	1	1	1	1	2	1	3	1	1	1	3
CO5	3	3	3	2	3	2	2	1	3	3	2	3	1	2	3	3

4. DetailedSyllabus:

Unit1: SensorsandActuators:
Sensors for robotics application - position, speed, acceleration, orientation, range.Actuators-generalcharacteristics,motors,controlvalves.
Unit2: Computer based feedback control:
Sampled data control, sampling and hold, PID control implementation, stability, bilinear transformation.
Unit 3: Introduction to mechanical elements and transformations, basic concepts of kinematics anddynamics.
Unit4:Designandanalysisofmechanisms.
Unit5:Programmingandhardwareexperiments.

ReferenceBooks:

1. Bentley,JohnP.“Principlesofmeasurementsystems,”Pearsoneducation,2005.
2. D.R.Coughanowr,"Processsystemanalysisandcontrol,"McGrawHill,1991
3. G.F. Franklin,J.D. Powell and M.L. Workman, “Digital control of dynamic systems”,AddisonWesley,3rdedition,1998.

4. Hartenberg,R.,&Danavit,J, "Kinematicsynthesisof linkages,"McGrawHill,1964.
5. http://wiki.ros.org/
6. Usermanualofmicrocontrolleranddata sheetsofsensors andactuators

5. Teaching-LearningStrategiesinbrief:

This course aims to teach the students about designing and developing a mechatronics system by providingthem with essential hardware and software. Part of the class is devoted to a learn-by-doing lesson where thestudentswill learntheory andget hands-onexperience withvarious aspectsofthemechatronicssystem.
The goal for the students is to design, build, and debug the electromechanical system for a given task as apart ofthecourseproject.

6. Assessmentmethodsandweightagesinbrief:

Midsemesterexam20%
Assignments40%
Theclassworkassignmentswillbebasedontheapplicationofastep-by-stepengineeringdesignprocesstoaproblemassigned inthe course.

Project 40%
Proposal (5%)
Projectdemonstration (25%)
Final report (10%)

Title of the Course : Mechatronics System Design - 1
Faculty Name : Nagamanikandan +Harikumar K
Course Code : EC4.201
L-T-P : 3-1-0
Credits : 2 (H1)
(L= Lecture hours, T=Tutorial hours, P=Practical hours)

1. Prerequisite Course / Knowledge:
No prerequisite is required.

2. Course Outcomes (COs):
After completion of this course successfully, the students will e able to

CO-1 Describe important elements of the mechatronic system.

CO-2 Identify and describe various types of sensors and actuators essential for a mechatronic system.

CO-3 Describe and design basic mechanical elements.

CO-4 Apply kinematic concepts to analyze the motion of simple mechanisms.

3. Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes(PSOs) – Course Articulation Matrix

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	3	2	3	1	1	1	2	2	1	2	1	3	3	2	2	2
CO 2	3	3	2	1	3	1	1	1	3	1	2	3	3	2	2	3
CO 3	3	2	2	1	2	1	1	1	1	2	1	2	1	1	1	3
CO 4	3	3	3	1	2	1	1	1	1	2	1	2	1	1	1	3

4. Detailed Syllabus:

PART A

Unit 1: Sensors: Sensors for robotics application - position, speed, acceleration, orientation, range.Unit 2: Actuators: general characteristics, motors, control valves.

Unit 3: Introduction to mechanical elements and transformations, basic concepts of kinematics, Devisemodels for rotational, translational, electromechanical, and mechanical systems.

Reference Books:

1. Bentley, John P. "Principles of measurement systems," Pearson education, 2005.
2. D.R. Coughanowr, "Process system analysis and control," McGraw Hill, 1991
3. Robert L. Norton, "DESIGN OF MACHINERY", McGraw-Hill, 6th edition, 2019
4. William Bolton, "Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering,"Pearson, 6th edition, 2015.
5. User manual of microcontroller and data sheets of sensors and actuators
6.

5. Teaching-Learning Strategies in brief:

This course is designed to provide foundational knowledge for students, enabling them to develop a holistic understanding of integrating sensors, actuators, and mechanical elements within the framework of a mechatronic system. The goal is to equip students with the skills necessary to apply this knowledge effectivelyin solving real-world problems and engaging in system modeling activities.

6. Assessment methods and weightages in brief:

Assignments	40%
Quiz	20%
Final exam	40%

Title of the Course : Migrants and Migrations in Modern South Asia

Faculty Name : Isha Dubey

Name of the Program : B. Tech in Computer Science and Engineering

Course Code : HS3.305
Credits : 4
L - T - P : 3-0-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring 2025

Pre-Requisites : Intro to Human Sciences, CHD 3rd and 4th year students

Course Outcomes:
After completion of the course successfully students should be able to:
CO1: Define various terms and concepts related to the topic, such as –migrant, immigrant, refugee, stateless, IDP, diaspora, etc.
CO2: Explain the academic theories and conceptual frameworks relating to human migrations in the modern world.
CO3: Analysethe nature and impact of some of the most important internal, cross-border and transnational migrations which have shaped modern and contemporary South Asia
CO4: Evaluate the different methods used for understanding how, why, and when people move from one place to another.
CO5: Examine what tools can be used to narrate, document and curate the lived experience of migrating under diverse circumstances in historical and present-day South Asia.
CO6: Develop a small-scale case-study aimed at understanding a specific kind of migration and its impact using any of the methodological tools covered in the course.

Course Topics:

1) **Migration, mobility, and motivation:** This module will introduce the basic concepts in migration studies, the different categories of people on the move, the possibilities for overlaps among them, and the various theoretical frameworks developed across disciplines for studying different kinds of migrations that have shaped the modern world. Students will be encouraged to develop critical understanding of t these theories and their relevance for South Asia.
2) **Empire, colonialism, global histories of migration from South Asia:** This module will focus on bringing out the complex entanglements between the workings of colonialism and the transnational movement of people for meeting the needs of empire from South Asia. This module has two objectives: First, familiarise students with the nature and history of migrations spawned by 19th century indenturedlabour, the inter-generational traumaand the creolization of cultures it resulted in. Second, discuss the various migrations from this period with their linkages to colonialism, race, and the compulsory global passport regime which decides who gets to travel where and with what conditions.
3) **Borders boundaries and frontiers in South Asia:**Students will study the processes and politics of defining borders, borderlands, and frontiers in South Asia historically in this module. What are the physical limits of the nation? Have they always remained the same or do they change over time? Who draws these boundaries of belonging? Is the border only confined to the actual line on a map of is it constituted by a larger fluid space at the margins? Who are the people who populate these margins and how do they navigate these geographies of flux? These are some of the questions that the module will pose and address.
4) **Nation-making, citizenship, and displacement:** Carrying forward the discussion from the previous one, this module is structured around the idea of the nation state and its centrality to questions of belonging and exclusion. How are these mitigated through the choice (of

lack thereof) of 'migration' within and without it? This module will study certain colossal moments of rupture resulting in the breakup, creation, reorganization or reorientation of nations and national belonging in postcolonial South Asia. What impact have these had on mobility and movement across and within borders?

5) **South Asian diasporas:** This module will introduce students to the study of various kinds and contexts of diasporic migration extending outwards from the Indian subcontinent. What are the ways in which they widen the ambits of migration research? Using literature, film and memoire, the module will discuss the meanings attached to home and homeland, and the notions of return, nostalgia and assimilation, as well as their inter-generational transmission.
6) **Tools and methods of research in migration history:** This module will familiarise students with the major trends in qualitative migration research; more specifically historical research on varied experiences of migration. The objective is to prompt the class to engage with different methods for collecting and analysing data – archival, ethnographic, oral history etc. – for capturing narratives of people on the move and the possibilities offered by computational social science in broadening the scope of these methodological tools. Finally, the module shall also take up the questions related to the storing, documenting, curating, and disseminating of migration histories from South Asia and the role that technology plays/can play in these processes.

Preferred Textbooks:

- Ranabir Samaddar: *The Postcolonial Age of Migration*
- Lucy Mayblin and Joe Turner: *Migration Studies and Colonialism*
- Ian Goldin, Geoffrey Cameron, and Meera Balarajan: *Exceptional People: How migration shaped our world and will define our future*
- Neilesh Bose: *South Asian Migrations in Global History: Labour, Law and Wayward Lives*
- Ainslie T. Embree and Mark Juergensmeyer (ed.): *Frontiers into Borders: Defining South Asian States, 1757-1857*
- Vizira Fazila-Yacoobali Zamindar: *The Long Partition and the Making of Modern South Asia: Refugees, Boundaries, Histories*

Reference Books

- Sunil S. Amrith: *Crossing the Bay of Bengal: The Furies of Nature and the Fortunes of Migrants*
- Urvashi Butalia: *The Other Side of Silence: Voices from the Partition of India*
- Willem van Schendel: *The Bengal Borderland: Beyond State and nation in South Asia*
- Steven Vertovec: *The Hindu Diaspora: Comparative Patterns*
- Papiya Ghosh: *Partition and the South Asian Diaspora: Extending the Subcontinent*
- Amitav Ghosh: *Sea of Poppies*
- Arjun Appadurai: *Modernity at Large: Cultural Dimensions of Globalisation*
- Vivek Bald: Bengali *Harlem and the Lost Histories of South Asian America*
- Gaitura Bahadur: *Coolie Woman: The Odyssey of Indenture*
- RanabirSammadar (Ed.): *Borders of an Epidemic: COVID 19 and Migrant Workers*

Articles

- Md. Mahbubar Rahman and Willem van Schendel: " 'I Am Not a Refugee' : Rethinking Partition Migration."
- David Ludden: "Presidential Address: Maps in the Mind and the Mobility of Asia."

- Radhika Singha: " The Great War and a 'Proper' Passport for the Colony: Border Crossing in British India, c. 1882-1922."
- Willem van Schendel: "Working Through Partition: Making a Living in the Bengal Borderlands."
- Joya Chatterjee: "Dispositions and Destinations: Refugee Agency and 'Mobility Capital' in the Bengal Diaspora."
- Alison Blunt: "Cultural Geographies of Migration: Mobility, Transnationality and Diaspora,"
- Lucas G. Drouhot, Emanuel Deutschmann, Carolina V. Zuccotti & Emilio Zagheni: "Computational Approaches to Migration and Integration Research: Promises and challenges."
- Thompson: "Moving Stories: Oral History and Migration Studies."
- Sucheta Mazumdar: "Localities of the Global: Asian migrations between Slavery and Citizenship."
- Leslie Page Moch: " From Regional to Global Repertoires of Migration."
- Lynn Hollen Lees: "Studying Migration on a Global Scale."
- Ravi Ahuja: "Mobility and Containment: The voyages of South Asian Seamen, 1900-1960."

E-book Links :

Grading Plan : (The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz-1	**8%**
Mid SemExam	**20%**
Quiz-2	**7%**
End Sem Exam	**35%**
Assignments	**(15x2) 30%**

Mapping of Course Outcomes to Program Objectives:
(1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	-	1	2	1	-	1	1	1	1	2	-	3	1	1	2	1
CO2	-	-	2	1	-	1	1	1	1	2	-	2	1	1	2	1
CO3	-	-	2	1	-	3	1	1	1	2	-	2	1	1	1	-
CO4	-	-	2	1	-	2	1	3	1	-	-	3	1	2	3	2
CO5	1	1	2	1	1	2	1	3	2	-	1	3	-	1	3	2

CO6	1	1	2	2	2	2	1	3	3	-	1	3	-	1	2	3

Teaching-Learning Strategies in brief (4-5 sentences):

The course will be based on classroom lectures and will require intensive reading, writing and active participation during the class. On an average, each student will be required to read between 500 to 800 pages of books and articles, and submit written work between 3,000 to 4,000 words, cumulatively.
Classroom discussions will be structured around certain pre-circulated question based on the larger thematic focus of that lecture and broad ideas emanating from prescribed readings for it. Students are expected to not only be able to grasp and articulate the arguments presented in the course literature but also to engage critically with how they speak to the more free-flowing discussion taking shape in the classroom based on these readings and the lecture.
Pictures, Extracts from primary sources, audio and video resources will be used to illustrate the points being taught.
The assignments and exams will focus on training students to develop their own ideas, and apply computer science tools, to the topics on hand.

Title of the Course : Philosophy of Mind and Cognition

Faculty Name : Saurabh Todariya
Name of the Academic Programs : B.Tech. in CSE, B.Tech in ECE
Course Code : **HS0.304**
Credits : 4
L - T - P : 3-0-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring 2025

1. **Prerequisite: Nil**
2. **Course Outcomes (COs):**

After completion of this course successfully, the students will be able to:

- CO1: define the process leading to cognition and the formation of epistemic states.
- CO2: explain the difference between the brain and mind.
- CO3: Analyze the fundamental process and structures which led to the situated knowledge.
- C04: Examine and distinguish the first-person perspective from the third-person perspective
- CO5: Evaluate the debates in the realm of philosophy of mind and able to apply its implications in cognitive science and artificial intelligence.

3. Mapping of Course Outcomes (COs) with Program Outcomes (POs) and ProgramSpecific Outcomes (PSOs) – Course Articulation Matrix for CSE and ECE

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	-	-	2	-	-	3	2	3	2	3	1	3	-	-	-	-
CO2	-	-	1	-	-	3	2	2	-	-	-	3	-	-	-	-
CO3	-	-	1	-	-	3	2	2	-	1	-	3	-	-	-	-
CO4	-	-	2	1	-	3	3	3	1	2	-	3	-	-	1	-
CO5	1	1	3	3	-	3	3	3	1	2	-	3	-	-	-	-

Course Topics

Unit 1: What is Philosophy?

The Myth of the Cave: Plato

Unit 2: What is Science?

Objectivity, Theory Choice and Value Judgement: Thoams Kuhn

Unit 3: What is Cognitive Science?

Why Cognitive Science Needs Philosophy and Vice Versa: Thagard

What Is It Like to Be a Bat: Nagel

What is it like to be boring and myopic? Katheleen Akins

Unit 4: Categories and Knowledge

Categories: Aristotle

Transcendental Philosophy: Kant

Myth of the given: Sellars

Unit 5: Intentionality

Brentano's concept of Intentionality: Dale Jacquette

Subjectivity and the First-Person Perspective: Dan Zahavi

The Phenomenological Mind (selections): Gallagher and Dan Zahavi

Intentionality as the mark of the mental: Tim Crane

Unit 5: Body and Cognition

Motor Intentionality and the Cognitive Science of Skilled Behavior: Sean D. Kelly

Space and Orientation: Merleau-Ponty

The concept of mind: Gilbert Ryle

Unit 6: Self-consciousness

Pre-reflective cogito: Sartre and Zahavi

Reflective Self-consciousness: Peacocke and Shoemaker

References:

Gaarder, Jostien (1997). *Sophie's World: A Novel about the History of Philosophy*. New York: Berkeley

Nagel, Thomas (1986). *The View from Nowhere*. Oxford: Oxford University Press

Nagel, Thomas (1987). *What does it all Mean? A Very Short Introduction to Philosophy.* Oxford: Oxford University Press

Russell, Bertrand (1912). *The Problems of Philosophy*. New Delhi: Prabhat Publications

Zahavi, D. (2003). *Husserl's Phenomenology*. California: Stanford University Press.

Heidegger, M. (1962). *Being and Time* (trans: Macquarie and Robinson). New York: Harper and Row.

Wittgenstein, L (1960). *Tractatus: Logico-Philosophicus***.** London: Routledge

Assessment Methods and Weightages in Brief

Type	Weight
Quizzes	20%
Class Participation	10%
Mid-term	30%
End term	40%

Teaching- Learning strategy in Brief

The course aims at introducing the students to the fundamental debates in philosophy of mind through the classroom lectures and discussion. There would be emphasis on the perspective building of the students through intense reading, debates and continuous assessment. The students are expected to develop logical reasoning for the conceptual development which will be assessed through the ongoing evaluation and class participation.

Title of the Course : Molecular Modeling and Simulations

Name of the Faculty : U Deva Priyakumar + Marimuthu Krishnan

Course Code : SC2.316
L-T-P : 3-1-0
Credits : 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Academic Program : BTech &BTech+MS dual degree programs

1.Prerequisite Course / Knowledge:

None

2.Course Outcomes (COs):

After completion of this course successfully, the students will be able to

CO-1: Describe the different aspects of molecular modeling techniques

CO-2: Describe the fundamental methods of quantum chemistry, molecular mechanics, molecular dynamics in the context of modelling molecular systems

CO-3: Examine properties of molecules using quantum chemical methods

CO-4: Evaluate the dynamic characteristics of biomolecules such as protein, DNA and RNA using molecular dynamics simulations.

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	2	1	1	1	1	1	1	1	3	1	2	1	2
CO2	2	2	1	2	1	1	1	1	1	1	1	2	1	2	1	2
CO3	2	3	2	1	2	2	1	1	1	2	1	2	2	2	2	1
CO4	2	3	2	2	3	2	1	1	2	1	1	2	2	2	3	1

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4.Detailed Syllabus:

Unit 1: Potential energy surface: Concepts of minima, transition states and higher order saddle points. Optimization methods: gradient descent, conjugate gradient and Newton-Raphson methods

Unit 2: Basics of Quantum mechanics: Particle in a box, Hydrogen atom problem, two-body problem, molecular orbital theory

Unit 3: Practicals of quantum chemistry: Optimization of molecules, Understanding of the different components of the outputs, calculation of properties like the IR spectrum

Unit 4: Molecular mechanics: Force field equations, Additive forcefields, polarizable and machine learning forcefields

Unit 5: Molecular dynamics simulations: Integrating Newton's laws of motion with force derived from force fields, replica exchange simulations, umbrella sampling simulations

Unit 6: Practicals of molecular dynamics: Set up necessary requirements for MD simulations, perform short simulations, calculation of thermodynamic properties.

Reference Books:

1. Molecular Modeling by Andrew Leach
2. Molecular Modeling and Simulations by Tamar Schlick

5.Teaching-Learning Strategies in brief (4 to 5 sentences):

The course aims to enable students to model a given chemical or biological molecular process. Lectures followed by practicals on the same aspects will be done in tandem. A bird's eye view will be followed where the emphasis is more on the philosophical understanding of the methods than elaborate derivations of all concepts. The evaluations will be continuous and will test the students' understanding of concepts and their implementations in performing a given task.

6.Assessment methods and weightages in brief (4 to 5 sentences):

- Assignments - 20%
- Quiz - 30%
- Exams - 50%

Title of the Course : **Molecular Symmetry and Quantum Mechanics**
Name of the Faculty : Harjinder Singh
Course Code : SC2.315
L-T-P : 3-1-0
Credits : 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)

Name of the Academic Program: B Tech (CSE/ECE), B Tech (CSD, CXD, ECD)

1.Prerequisite Course / Knowledge: Linear Algebra, Basic (High school) physics/chemistry

2.Course Outcomes (COs) (5 to 8 for a 3 or 4 credit course):

After completion of this course successfully, the students will be able to..

CO-1 State and prove theorems of group theory relevant to physics
CO-2 Apply group theory in molecular physics
CO-3 Derive molecular wavefunctions using symmetry behaviour of molecules
CO-4 Explain molecular properties using symmetry behaviour of molecules
CO-5 Demonstrate aspects of scientific methodology as used in abstract thinking

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1		PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3		3		3						1	3			3	1	3
CO2	3		3		3						1	3			3	1	3
CO3	3		3		3						1	3			3	1	3
CO4	3		3		3						1	3			3	1	3

CO5	3		3		3						1	3			3	1	3

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4.Detailed Syllabus:

Unit 1: Symmetry of objects, point groups, calculus of symmetry, reduced and irreducible representations,Great and Little orthogonality theorems(6L)

Unit 2: Group Theory and Quantum Mechanics, LCAO-SALC approach in MO theory, applications. (6.5L)

Unit 3: Special topics: Applications to Ligand field theory, Pericyclic reactions, Normal mode analysis of vibrational motion, etc. (9L)

Unit 4: Continuous (Lie) groups and applications (1.5L)

Reference Books:

1. F A Cotton (2008), Chemical Applications of Group Theory, 3rd Ed., Wiley, London
2. M Tinkham (2003), Group Theory and Quantum Mechanics, Dover, USA
3. P W Atkins and R S Friedman (2012), Molecular Quantum Mechanics, Oxford University Press, London

5.Teaching-Learning Strategies in brief (4 to 5 sentences):

Regular classes will be supplemented with weekly Tutorials. Class exercises and assignment problems will be discussed as and when necessary.
Assignments are open for discussion before submission, though submission must be original. Instructor is available 24X7 for discussions over the net either by a meeting or over email. This interactive process has helped the students to develop clarity on the learning material.

6.Assessment methods and weightages in brief (4 to 5 sentences):

Two Quizzes : 20%
Mid sem Exam 25%
Assignments (8) 20%
Final exam 35%

Title of the Course: **Music-Language-Creativity**

Name of the Faculty: Saroja T K
Course Code: HS1.209
L-T-P: 3-0-1
Credits: 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)

1.**Prerequisite** Course / Knowledge:… Faculty Consent

2.**Course Outcomes (COs)** (5 to 8 for a 3 or 4 credit course):
After completion of this course successfully, the students will be able to

CO-1Understand the significance of language in music
CO-2 Delineate music as a powerful mode of imagination

CO-3Realise the importance of music as an aesthetic means to communicate, mingle with each other and express oneself.
CO-4Appreciate the heights of creativity in Indian music in specific and music in general
CO-5Comprehend the inter disciplinary approach in music with respect to various spheres of knowledge..

3.**Mapping of Course Outcomes** (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO 1	1	-	1	1	-	2	1	2	2	2	-	2	-	2	1	2
CO 2	1	-	1	1	-	1	1	2	2	2	-	2	-	2	1	2
CO 3	1	-	1	1	-	1	1	2	2	2	-	2	-	2	1	2
CO 4	1	-	1	1	-	1	1	2	2	2	-	2	-	2	1	2
CO 5	1	-	1	1	-	1	1	2	2	2	-	2	-	2	1	2

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4.Detailed Syllabus:

Chapter 1: Basics of musicand Language

a. Notes, semitones, microtones, octave, ornamentations, rhythm, patterns, speeds, linear structures.
b. Basic concepts of Indian music:

Sruthi, Swara, Raga, Laya, Tala, Alankaras, Gamaka, Naad, compositional forms

c. Language:

Letters, words, idea of grammar, expressions, poetic ideas.

d. Musical concepts synonymous to the words:

Indian music has so many concepts named after their content nature and behavior. A discussion on such terms which are concepts by themselves is studied.

Unit 2: Study of songs of various composers in different languages:

Songs are the hubs of creativity, linguistic beauty, information, expression and communication. Study of all those features and practice to sing various such songs to experience the same.

Unit 3: Music ideas based on language

Musical concepts that took their birth from language perspective are discussed. Lot of musical exercises that help in understanding the relevance of those concepts would be practiced.

Unit 4: Music as language vs Spoken language

Melodic and rhythmic features of music based on language are discussed.

Unit 5: Experiments

Attempt to conduct simple experiments with music and language.

Discussing various experiments (compositions) by different composers who have worked on new ideas in the combination of music and language.

Reference Books:

1. The Hindu Speaks on Music - compilation of 232 selective music

articles by The Hindu --- Publishers: Kasturi and Sons ltd, December 1999.

2.. A Southern Music (The karnatic story) by T.M. Krishna, Published by Harper Collins, January 2013

3 South Indian Music(volumes I to VI) by P.Sambamurthy, The Indian Music Publishing House, 1994

4.. Nuances of Hindustanu Classical Music by Hema Hirlekar, Unicorn books Pvt ltd, 2010

5.. Videos and audios on the Youtube and other platforms.

5.Teaching-Learning Strategies in brief (4 to 5 sentences):

This is a course which is designed with 60percent practical and 40 percent theoretical approach.

The students would be taught a good number of songs that enable them to understand the role of creativity in binding music and language together to generate aesthetics. Personal demonstrations and you tube videos would be the main resources. Various experiments in music based on creative ideas would be discussed. At least one or two lecture demonstrations by experienced artists and professionals. ……

6.Assessment methods and weightages in brief (4 to 5 sentences):

…Assignments: 20%
…Mid term exams: 20%
Quizzes: 10%
Class participation 10%
Project: 40%

Title of the Course : Music, Mind, and Technology

Course Code : CG4.401
Faculty : Vinoo Alluri
Technology L-T-P : 3-1-0
Credits : 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Academic Program: **Open Elective**

1.Prerequisite Course / Knowledge: None

2.Course Outcomes (COs):

After completion of this course successfully, the students will be able to
CO-1 appreciate the fundamental concepts of the field of Music Cognition and Technology
CO-2 understand the role of the individual in musical experiences in relation to music experience including music consumption, music industry, mental well-being, and critically think about the relationship between diverse fields that comprise music cognition such as psychology, music information retrieval, and neuroscience.
CO-3 understand the relation between physical aspects of sound and perceptual processes including sensation and perception

CO-4 understand sound synthesis and analysis in addition to application of machine learning to various music information retrieval tasks (eg: music genre classification, mood detection, recommendation)
CO-5 understand music processing in the brain, and effect of individual differences thereof (eg: musical expertise, empathy, gender). Analyze brain responses to music which includes an interdisciplinary approach combining sound- and brain-signal processing, statistical methods, and perceptual experimentation to analyze experimental data from human neurological experiments
CO-6 combine knowledge gained from CO-1-4 to formulate own research idea and go about solving it.

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and ProgramSpecific Outcomes (PSOs) –Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO 3	PSO 4
CO1	1	1	1	3	1	1	1	1	1	2	-	1	2	1	1	1
CO2	1	1	1	1	2	2	2	1	1	1	-	1	1	1	2	2
CO3	3	1	1	1	1	1	1	2	1	1	-	1	1	1	1	1

CO4	3	2	1	2	3	2	1	1	3	1	-	2	2	2	1	2
CO5	2	1	2	2	3	1	1	1	2	1	-	1	2	1	1	2
CO6	3	3	3	3	2	1	1	1	3	2	-	1	2	2	2	2

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4. DetailedSyllabus:

Unit 1: Introduction to Music cognition, Evolutionary and Biological significance of music, Embodied music cognition, evolution of the field of psychology of music
Unit 2: Music experience and Individual differences, Music Emotion
Unit 3: Auditory Processing, Sensation, Perception, Auditory stream segregation Unit 4: Sound synthesis and analysis
Unit 5: Music information retrieval Unit 6: Neuromusicology

Reference Material:

Lecture slides and supplementary reading materials (journal articles, review articles) will be uploaded on the course page on Moodle.

5. Teaching-Learning Strategies inbrief:

Students will be introduced to the broad field of music cognition. The objective of the course is to give an appreciation of the main concepts of the field of Music Cognition and Technology. Students will learn about topics in music psychology (from perception to cognition), familiarize yourselves with music signal analysis and music information retrieval (MIR), ending with the interdisciplinary field of cognitive neurosciences of music (with a focus on functional magnetic resonance imaging (fMRI) studies). Apart from this, the course provides an overview of main areas of contemporary research of music perception and cognition such as musical preferences and personality, music and movement, music and emotion, music and mental well-being, and music processing in the brain.
By attending lectures, in addition to a few guest lectures by leading music researchers from around the world, students will be exposed to this interdisciplinary field and open questions. Students learn by working in groups to solve existing open problems in addition to creating their own research problem and addressing it to the best of their abilities.
Lectures are highly interactive as the course requires a student to actively participate and think and be creative. Students learn by doing assignments designed to achieve course outcomes and collaboratively working on a final project. The final project wherein students learn by working in teams, especially to devise a research question, identify hypotheses, operationalize it, deploy it, collect (if necessary) and analyze data and present the results thereby promoting collaboration, which is very much needed in interdisciplinary research.

6. Assessment methods and weightages inbrief:

Quiz 1 =10%
Quiz 2 =10%
Assignments = 30%
Final Project = 40%
Class participation = 10%

Title of the Course : **Neural Natural Language Generation**
Faculty Name : Manish Shrivastava

Name of the Program : CLD/Open Elective
Course Code : CL3.407
Credits : 2
L - T - P :2-1-2
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring 2025
Pre-Requisites : CL1 or NLP1

Course Outcomes:

CO-1: *Understand* Natural Language Generation (NLG) from Linguistic and Machine/Deep Learning perspectives
CO-2: *Analyze* classical and Deep Learning based Natural Language Generation model design principles for Monolingual, Multilingual and Multi-Modal uses cases
CO-3: Understand and evaluate state-of-the-art Prompt and query-based NLG methods
CO-4: Develop specialized NLG systems

Course Topics :

(please list the order in which they will be covered, and preferably arrange these as five to six modules.)

1. Background (4 Lectures): Introduction to NLG, Traditional Models for NLG
    a. Information Extraction perspective on Natural Language Generation (NLG)
    b. Linguistic perspective on Natural Language Generation
    c. Template-based NL generation,
    d. Statistical NLG
    e. Language Modeling (LM) and sequence to sequence models for NLG
    f. Merits and failures of traditional methods

2. Basic models for Neural NLG (2 lectures):
    a. Large Language Models (LLMs)
        i. Exploring major LLMs including BERT, GPT etc,
    b. Transfer models
        i. T5, BART etc
3. Controlled Generation(2 Lectures):
    a. Controlled generation paradigm
    b. Prompt based NLG
    c. Prompt finetuning using foundational models
    d. Evaluation of language generation models
4. Multilingual NLG(2 Lectures):
    a. Multilinguality and Multilingual models
        i. mT5, mBART
    b. Cross Lingual Generation
        i. Cross Lingual summarization
        ii. ML Question Answering
5. Multimodal NLG (2 Lectures:
    a. Modeling Image and Text modalities
    b. Image Captioning
    c. Scene Graph based description generation

Preferred Text Books : No text books

Reference Books :

1. *Speech and Language Processing*, Daniel Jurafsky and James Martin, Prentice-Hall (second edition).
2. Christopher D. Manning and Hinrich Schutze. *Foundations of Statistical Natural Language Processing.* MIT Press.
3. Ian Goodfellow and YoshuaBengio and Aaron Courville. *Deep Learning.* MIT Press.

E-book Links (indicative papers)**:**

1. The GEM Benchmark: Natural Language Generation, its Evaluation and Metrics
2. Wenhao Yu, Chenguang Zhu, Zaitang Li, Zhiting Hu, Qingyun Wang, Heng Ji and Meng Jiang. 2022. A Survey of Knowledge-Enhanced Text Generation. ACM Computing Survey.
3. BLEURT: Learning Robust Metrics for Text Generation
4. Leiter et al., Towards Explainable Evaluation Metrics for Natural Language Generation
5. Li and Liang, Prefix-Tuning: Optimizing Continuous Prompts for Generation
6. Krause et al., GeDi: Generative Discriminator Guided Sequence Generation
7. *Ramesh, Aditya et al. "*Zero-Shot Text-to-Image Generation*." ICML2019*
8. others

Grading Plan :

Type of Evaluation	**Weightage (in %)**
End Sem Exam	**20**
Assignments	**40**
Project	**40**

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant). Program outcomes are posted at

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	1	1	3	3	2	2
CO2	3	3	3	2	1	1	1	3	3	3	2
CO3	1	3	3	3	2	1	1	3	3	3	3
CO4	1	1	1	1	1	2	3	3	2	2	2

'3' in the box denotes 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

Teaching-Learning Strategies in brief :

This course is an advanced and research level course where each topic is being discussed in a flipped classroom model after necessary background is given. Students are expected to come to the class after reading/understanding given material for each session and share their understanding, analyze and synthesize the knowledge. This approach not only enhances the students' understanding of the state of the art but also encourages them to push the knowledge boundaries by applying them to a given problem setting such as Indian languages.

Title of the Course : Numerical Algorithms

Name of the Faculty : Pawan Kumar
Course Code : **CS1.306**
Name of the Programme : BTech in Computer Science
L-T-P : 2-1-0
Credits: : 2 (Breadth: Theory/Algorithms)
Prerequisite Course / Knowledge:

This requires Linear Algebra and Basic Calculus (Integration, Differentiation)

Course Outcomes (COs):

After completion of this course successfully, the students will be ableto...

CO-1: Enhance and learn theoretical concepts and tools for numerical analysis.

CO-2: Demonstrate understanding of basic numerical methods.

CO-3: Derive algorithmic approaches to develop numerical algorithms and their complexity.

CO-4: Learn to evaluate and quantify numerical accuracy for numerical algorithms.

CO-5: Write efficient and structured Python code for numerical algorithms.

DetailedSyllabus:

Unit0: Numerical Analysis Tools: Review of Metric spaces and Basic Topology, Norms, Convergence, Contraction Maps, Quantifying Numerical Errors. (Lectures:02)

Unit1: Polynomialinterpolation. Numerical differentiation nandintegration. (Lectures:03)

Unit2: Numerical Linear Algebra: Algorithms for LU,QR, SVD, Iterativemethodsforlargesparsematrices,Tensor Decompositions. Applications to quantization and image processing. (Lectures:04)

Unit 4: Basic Optimization Problems: Convex Sets, Convex Functions, Linear, Quadratic, Semi-definite, and Conic Program.Introduction to Min-Max problems. Applications to planning, finance, image completion. (Lectures:02)

Unit5: Numerical Solutionsto Differential Equations: Finite Difference Method for Diffusion Equation.Preconditioning. Applications. (Lectures:02)

TextbookBooks:

1. Numerical Algorithms, Justin Solomon,Link:numerical_book.pdf(mit.edu)
2. Matrix Computations, Golub, et. Al. Link:(U.John Hopkins) Matrix Computations (3rd Ed.)[rippedby sabbanji](cern.ch)(ForUnit-2, andsome Unit-5)

ReferenceBooks:

1. A.Greenbaum &T.P.Chartier,Numericalmethods,Princeton UniversityPress,2012.
2. Numerica lOptimization, J.Nocedal,S.J.Wright,S.Wright,1999.
3. Introduction to Linear Algebra, GilbertStrang.

Teaching-LearningStrategiesinbrief(4to5sentences):

This course aims to bridge the gap between various linear algebra, calculus concepts, and howtheyareimplementedinpracticekeepinginmindnumericalissuesandinstabilityofnumerical schemes.

Lectures will initially introduce the motivations, concepts, definitions alongwith simpler examples. Lectures will develop numerical analysistoolstokeeptrack of numerical accuracy of the numerical algorithms learnt.

Tutorials will be held every week to clarify doubts and to discuss solutions to assignment and exam problems. The assessment involves assignments and quizzes every week that will make sure thatthe students haveunderstoodthe concepts.

The lectures also motivate some real-world applications of numerical techniques and optimizationintheareaofimageprocessingandindustrialproblemsofplanningorschedulingviaoptimization.

Assessmentmethodsandweightagesinbrief(4to5sentences):

- Assignments: 30%
- Class Test1:30%
- MidExam:40%

Title of the Course	**: Optical Remote Sensing**
Faculty Name	: Ramachandra Prasad
Course Code	**: GS1.401**
L-T-P	**: 3-0-1.**
Credits	**: 4**

(L= Lecture hours, T=Tutorial hours, P=Practical hours)

Type -When : Spring 2025

Open Elective (Spring) (UG and PG)

1. Prerequisite Course / Knowledge:

Basic Physics and computational knowledge.

2.Course Outcomes (COs)

After completion of this course successfully, the students will be able to

CO-1: Explain the processes of optical remote sensing

CO-2: Describe various sensors and their image characteristics

CO-3: Extract information from satellite imagery using conventional methods

CO-4: Apply advanced computational techniques for feature extraction

CO-5: Discuss satellite imagery applications (ex. Forest, Urban, Agriculture)

CO-6: Explain the basics of advanced remote sensing technologies

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	2	1	2	1	1	1	1	1	1	1	2	2	2	2
CO2	2	1	2	2	2	2	2	2	2	1	2	2	3	2	2	2
CO3	2	2	2	2	3	2	1	1	1	1	2	2	2	2	2	2
CO4	2	2	2	2	2	1	1	1	1	1	2	2	2	2	2	2
CO5	2	2	2	2	3	2	2	2	2	1	2	3	3	2	2	2
CO6	1	2	2	1	2	1	1	1	1	1	1	2	2	2	2	1

4. Detailed Syllabus:

Unit-1: Introduction to Remote sensing: What is remote sensing? Earth Observation Satellites and Platforms

Unit-2: Physics of Electro Magnetic Radiation (EMR) Radiation laws applicable to remote sensing: EMR interaction with Atmosphere and Earth materials.

Unit-3: Data acquisition and image characteristics, Image pre-processing, Image Enhancement

Unit-4: Information extraction- Multispectral classification – Visual Interpretation- Digital classification. Object based image classification, Stereo Imagery.

Unit-5: Major applications in Vegetation /wildlife; Hydrology/Agriculture, Disaster management:

Unit-6: Overview of Advanced topics: Drone, Hyperspectral and thermal, Microwave/Radar

References:

1. Introduction to Remote Sensing by James B. Campbell

2. Remote Sensing and Image Interpretation by Thomas.M.Lillesand

3. Remote sensing Digital Image Analysis by J.A Richards and Xiuping Tia

4. Fundamental of Remote Sensing by CCRS (Online)

5. Principles of Remote sensing by ITC (online)

5.Teaching-Learning Strategies in brief:

Teaching, discussing current approaches of information extraction, challenges and limitations with satellite data; Current research papers presentations by students on chosen topic, writing assignments, periodical evaluation of course project implemented with open data and tools.

6.Assessment methods and weightages in brief:

1. Assignments [written, lab and presentations]	**- (30%)**
2. Theory [Mid exams-2]	**- (20%)**
3. Project	- (**35%**)
4. End Semester Exam in Theory	**- (15%)**

Title of the Course : Optimization Methods

FACULTY NAME : Naresh Manwani
Course Code : CS1.404
CREDITS : 4 Credits
L-T-P : 3-1-0
TYPE-WHEN : Spring 2025

PRE-REQUISITE **:** Strict Prerequisites: NIL

EXPECTED BACKGROUND:

To follow this course, some level of familiarity with linear algebra (specially, vectors and matrices) is expected. In addition, student is expected to know the fundamentals of algorithms and some of the popular problems (eg. shortest path.)

OBJECTIVE:

1. To enable students to formulate and solve problems in an optimization framework.
2. To expose a set of powerful tools and techniques to the students. To demonstrate how these tools (i.e. optimization methods) can be used in practice.
3. To visualize the optimization algorithms and know the numerical and practical issues in their implementation.
4. To relate the optimization methods to applications in diverse areas.

COURSE TOPICS :

1. CO-1: Linear Programming, Geometric Interpretation, SimplexMethod, Duality, primal dual method, Interior point methods, Ellipsoidal methods, Computational Issues.
2. CO-2: Integer programming, LP relaxation, Examples from combinatorial optimization. Shortest paths, network flows and matchings.
3. CO-3: Convex sets and functions. Need for constrained methods in solving constrained problems.
4. CO-4: Unconstrained optimization, Optimality conditions, Gradient Descent, Newton Method, Quasi- Newton Methods, Trust Region Methods. Conjugate Gradient Methods. Least Squares Problems.
5. CO-5: Constrained Optimization, Optimality Conditions and Duality. Convex Programming Problem. Quadratic Programming. Dual Methods, Penalty and Barrier Methods, Interior Point Methods.
6. CO-6: Linear Equations, Solutions based Matrix Factorization, Singular Value Decomposition,
7. CO-7: **Additional topics** (if time permits) related to
    1. Specific Algorithms (eg. Cutting plane algorithms, Stochastic gradients)
    2. Applications in Approximate Algorithms
    3. Computational issues in large scale optimization
    4. Heuristic methods for optimization

PREFERRED TEXT BOOKS:

1. S. Boyd and L Vandenberghe, ``Convex Optimization'', Cambridge University Press (Online Copy available at: http://www.stanford.edu/~boyd/cvxbook/).
2. L Vandenberghe, Lecture Notes for Applied Numerical Computing, (Online available at: http://www.ee.ucla.edu/~vandenbe/103/reader.pdf).
3. Edwin K. P. Chong, Stanislaw H. Żak, Introduction to Optimization, Fourth Edition, Wiley-Interscience Series in Discrete Mathematics and Optimization, John Wiley & Sons.

REFERENCE BOOKS:

1. M T Heath, ``Scientific Computing'', TMH (Most of First six chapters)
2. C H Papadimitriou and K Steiglitz,Combinatorial Optimization: Algorithms andComplexity'' (Most of First seven chapters), Dover.
3. D Bertisimas and J N Tsitsiklis, ``Introduction to Linear Optimization'', Athena Scientific.
4. J Matousek and B. Gartner, ``Understanding and Using Linear Programming'', Springer, 2007.

OUTCOME:

This course will help in sharpen the problem solving skills of students. Students will have experience

informally stating problems with the associated constraints, and solving them with computer friendly algorithms.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	-	-	-	2	2	2	2	3	3	3	3
CO2	3	3	3	3	3	-	-	-	2	2	2	2	3	3	3	3
CO3	3	3	3	3	3	-	-	-	2	2	2	2	3	3	3	3
CO4	3	3	3	3	3	-	-	-	2	2	2	2	3	3	3	3
CO5	3	3	3	3	3	-	-	-	2	2	2	2	3	3	3	3
CO6	3	3	3	3	3	-	-	-	2	2	2	2	3	3	3	3
CO7	3	3	3	3	3	-	-	-	2	2	2	2	3	3	3	3

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Small Quizzes (10 quizzes)	10%
Mid-Sem Exams (2)	30%
End Sem Exam	20%
Assignments	25%
Term Paper/Project	10%
Scribe	5%

Title of the Course : Organic Chemistry

Name of the Faculty : Prabhakar Bhimalapuram
Name of the Academic Program : CND
Course Code : SC2.202
L-T-P :3-1-0
(L= Lecture hours, T=Tutorial hours, P=Practical hours)

Credits :2

1.Prerequisite Course / Knowledge: NA

2.Course Outcomes (COs) (2 credit course):

CO1: Explain various mechanisms of structural stability of organic compounds and their reactivities

CO2: Apply the mechanisms to describe types of reactions using stability of reaction intermediates

CO3: Analyze the outcomes of different organic reactions using the principles of structure and stability of reactants and intermediate compounds

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	1									1	1	2	3
CO2	3	3	2	1									1	1	2	3
CO3	3	3	2	1									1	1	2	3
CO4																

4. Detailed syllabus

Concepts on structures, stabilities and reactivities

Unit 1: Reactive intermediates: Formation, structure, stability and fate of various reactive intermediates (Carbanion, carbocation, carbenes, nitrenes, benzynes, free radicals) – Reactive intermediates in biology and environment

Unit 2: Concepts of aromaticity

Unit3: Molecular symmetry and chirality, Stereoisomerism, Classification of stereoisomerism, configuration, chiral centre, Axial chirality, planar chirality, helicity, Racemization and methods of optical resolution, Determination of configuration, Conformation of acyclic and monocyclic molecules-conformation and reactivity, Prochirality and prostereoisomerism, Stereochemistry of alkene, Chirality in molecules devoid of chiral centers, Chirooptical properties. Some reactions and their mechanisms

Unit 4: Methods for determining structures and reaction mechanisms

Unit 5: Types of reactions and their mechanisms Radical substitution Electrophilic addition to alkenes and alkynes – stereochemical considerations – Markonikov rule Nucleophilic Substitution at saturated carbons (SN1, SN2 and SNi): Types, stereochemical considerations, Role of solvent Nucleophilic addition to the Carbonyl group Elimination reactions: Types (E1, E2 and E1cB) - stereochemical consideration, Role of solventHofmann rules- Zaytsev Rules Nucleophilic substitution at the carbonyl group Electrophilic Aromatic Substitution: Benzene and its reaction with electrophiles- Effect of functional groups Nucleophilic Aromatic substitution: Diazonium compounds-benzyne mechanism Pericyclic reactions: Electrocyclic reactions, Cycloadditions, Sigmatropic rearrangements and Group transfer reactions Important name

reactions involving rearrangements Functional group wise reactions Conversions and Identifications.

5.Teaching-Learning Strategies in brief (4 to 5 sentences):

The objective of the course is to familiarize the CND students with basic concepts of organic reaction mechanisms. Since organic reactions are wide spread in natural biological systems as well as their applications in various industries, understanding the mechanisms is crucial. The course would provide the students with tools to analyze outcomes of organic reactions. It will further help them to learn the numerical analysis of molecular reactions later.

6.**Assessment methods and weightages in brief(4 to 5 sentences):**
Assignments – (20%), Class Quizzes + Mid-term evaluation (40%), Final exam (40%)

Reference book

A Guidebook to Mechanism in Organic Chemistry by by Peter Sykes

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Title of the Course : Organizational Operations

Faculty Name : Santanu Mandal
Name of the Program : M. Tech in Product Design and Management program
Course Code : PD2.423
Credits : 2 Credits
L - T - P : 1.5 -0- 3
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year **:** Spring 2025 (2nd Sem – Year 1)

Pre-Requisites : None

Course Objective :
Operations are the work of managing the inner workings of your business so it runs as efficiently as possible. Whether you make products, sell products, or provide services, every small business owner has to oversee the design and management of behind-the-scenes work. Organizational operations management involves converting input into efficient outputs to achieve desired results for an entrepreneur. The course contains various operations models, tools, and techniques for supply chain management, quality control systems, and streamlining workflows. You will learn how to innovate business operations to improve productivity and capacity with the resources. You will develop skills that will empower you to configure business processes to channel operations and reduce bottlenecks.

Course Outcomes :
CO-1 Understand key functional areas of operations with the type of decisions they are typically involved in to run a business efficiently.
CO-2 Identify key differences between service and manufacturing organizations and the business operations in the two sectors of the businesses.
CO-3 Understand and map each process phase to formulate an organizational strategy with actions typically performed at that phase.
CO-4 Identify and categorize different transformation characteristics of manufacturing and service operations strategies.

CO-5 Understand the concept of organizational strategy, the four-phase process for formulating this strategy, and how the strategy should be aligned with operations strategy in the manufacturing and services context.

Course Topics :

Operations Management: Basics of production systems, Planning, Scheduling, Sequencing, Workplace Layouts, Locational problems of warehouses. **Four sessions**

Basics of Lean Operations: Classification of wastes, 5S, Kaizen, Jidoka, Kanban, Kaizen, Value Stream Mapping, Total Productive Maintenance. **Three sessions**

Service Operations - Service strategy, service enterprise design, service operations, service blueprint, Capacity planning, queueing models, forecasting demand, and managing service inventory. **Three sessions**

Supply Chain Management - Measuring supply chain performance, drivers and metrics, planning and managing inventories in the supply chain, managing economies of scale, uncertainty, optimal product availability, sourcing decisions, **Three sessions**

Basics of Information Systems and Impact on Operations - Basics of Business Analytics and Business Intelligence, Enterprise Management Systems, necessity, functions of ERP systems **Four sessions**

Modern Technology interventions - Impact of technology interventions like IoT, Blockchain, Artificial Intelligence, and Robotics on Manufacturing and service applications of the future**Four sessions**

Preferred Text Books :

Operations Management (McGraw-Hill Series in Operations and Decision Sciences) 12th Edition, by William J Stevenson

Reference Books :

- Operations Management: Processes and Supply Chains 11th Edition, by Lee Krajewski (Author), Manoj Malhotra (Author), Larry Ritzman (Author)
- Operations Management (11thEdition) by Heizer, Jay, Render, Barry

Grading Plan :(The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz-1	**10**
Mid SemExam	**20**
Quiz-2	**10**
End Sem Exam	**40**
Assignments	**20**

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not relevant).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	3	2	3			
CO2	3	3	2	2	3	1		1
CO3	3	2	3	3	3	2		3
CO4	3	2	3	2	3			3
CO5		2		1	1			

Teaching-Learning Strategies in brief (4-5 sentences) :
I believe in inclusive teaching with involvement from the class as much as possible. I tend to keep the teaching and learning hand in hand and ensure we teach, learn and evaluate as we go. This helps students to pace the subject well and also makes them accustomed to the subject in a better way. I keep quizzes and assignments to include them in the classes as much as possible. We keep the Case studies and hands-on culture intact.

Title of the Course : Performance modeling of computer systems

Faculty Name : Tejas Bodas
Course Code : CS3.307
Credits : 2
L- T -P:
(L-Lecturehours,T-Tutorialhours,P-Practicalhours) 2-0-0
Semester, Year : Spring2025

Name of the Program : CSE and or ECE
Pre-Requisites : MA6.101 Probability an Statistics

Course Outcomes :

Course outcomes (CO's): After completion of the course, the students will able to

1. Explain and identify the role of performance modeling indifferent computer systems such as data networks, server farms andcloudcomputingplatforms.
2. Apply Markovchainstomodelanda variety of computer systems and analyze their performance metric slikeresponse time, waiting time or jobloss probability.
3. Derive expressions for the average delay or average number of jobs waiting for service in a variety of queueing systems.
4. Design and analyze the performance of multi-server queueing systems that have applications to cloud computing
5. Analyze and understand the impact of scheduling policies like FIFO, LIFO, processor sharing and random routing on the performance of queues.
6. Identifycausesforperformancedegradation(largelatencyproblem)inqueueingsyste msand offereasy scalablesolutions

CourseTopics :

Followingisthetentativelistoftopicstobecoveredinthiscourseinabout12 lectures.(Eachlectureis of90 mins.)

Module1:(2lectures)

- MotivationtoPerformancemodeling(Modeling=Design+analysis)
- Probabilityrefresher
- BasicsofStochasticprocesses

Module2:(2lectures)

- DiscretetimeMarkovchains
- ContinuoustimeMarkovchains

Module3 : Elementary Queues(2lectures)

- M/M/1queue
- Lossqueues
- Little'slawandPASTAproperty

Module4;Server-farmsandnetworks(3lectures)

- Multi-serverqueues
- Networkofqueues
- loadbalancingsystems
- Applications to data centers, cloudcomputing and distributed systems

Module5: Scheduling and resource allocation in computer systems (3lectures)

- M/G/1queues
- Performance analysis of FIFO, round-robin, processor sharing, LCFS
- SMART scheduling policies

Preferred Textbooks: Performance modelling and design of computer systems (Cambridgepress) by MorHarchol-Balter (Professor, CMU)

ReferenceBooks :1) Probabilistic modeling by Isi Mitrani

2)QueueingSystems(vol1and2) by Klienrock

E-bookLinks :NA

GradingPlan :

(Thetableisonlyindicative)

TypeofEvaluation	Weightage(in%)
Quiz-1	15
MidSemExam	30
Quiz-2	15
EndSemExam	40

MappingofCourseOutcomestoProgramObjectives:(1–Lowest,2—Medium,3–Highest,ora'-'dashmarkifnotatallrelevant).Programoutcomesare posted at

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O 4
CO1	3	3	3	2	1	1	2	1	1	1	1	2	3	2	3	3
CO2	3	3	3	2	2	1	2	1	1	1	1	2	3	2	3	3
CO3	3	3	3	2	2	1	2	1	1	1	1	2	3	2	3	3
CO 4	3	3	3	2	1	1	2	1	1	1	1	2	3	2	3	3

CO5	3	3	3	2	1	1	2	1	1	1	1	2	3	2	3	3
C06	3	3	3	2	2	1	2	1	1	1	1	2	3	2	3	3

Teaching-LearningStrategiesinbrief(4-5sentences):

- Thecourseisplannedto beafinebalancebetweentheoryandpractice.
- Traditionally,thiscoursehasbeenatheoryintensivecoursewithlittleemphasisonp racticalapplications.Wewillhoweverflipthisaround.
- Wewillintroducetheoreticalmathematicalconceptsonaneedtoknowbasisor asand when required.
- Theemphasiswillbeto lookatplentyofpracticalexamplesofqueueingsystems that we encounter not just in our daily lives but also see inadvancedcomputing systems.
- The goal isnot only to design queueing systems that offer betterperformanceguaranteesbutalsotobeabletoanalyzesuchsystemssoastofinet une or control them.
- The12lecturesaremeanttobeveryinteractive,therewouldbelotofdiscussion and exchange of ideas on the design aspect of queueingsystems.
- As for the analysis, ample practice problems and practice assignmentswouldbe providedtogain analytical expertise.

Title of the Course : Physics of Soft Condensed Matter
Faculty Name : Marimuthu Krishnan
Course Code : SC2.301
L-T-P : 3-1-0
Credits : 4

1.Prerequisite Course / Knowledge:
Science-I and Science-II (for non-CND students); thermodynamics and basic statistical mechanics (for CND students)

2.Course Outcomes (COs) (5 to 8 for a 3 or 4 credit course):

After completion of this course successfully, the students will be able to

CO-1 Apply theoretical and numerical methods to analyze the structure and dynamics of soft condensed matter
CO-2 Analyze the time evolution of phase space probability density functions for many-body systems
CO-3 Calculate radial distribution functions and structure factors for condensed systems
CO-4 Explain density fluctuations and fluctuation dissipation theorem
CO-5 Calculate time correlation functions and mean-square displacement for condensed systems
CO-6 Explain fluctuation theorems for non-equilibrium systems

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2											1	1	1	2
CO2	3	3											2	2	2	2
CO3	3	2											1	1	1	2
CO4	3	2											1	1	2	2
CO5	3	3											1	1	1	2
CO6	3	2											1	1	2	1

4.Detailed Syllabus:

Unit 1: Introduction to soft condensed matter
Unit 2: Phase space probability density functions (PDFs) and their time evolution, Liouville equation and Liouville theorem
Unit 3: Particle densities and distribution functions, Radial distribution function and pair correlation functions
Unit 4: Statistical properties of liquids: thermodynamics and structure, static and dynamic structure factors
Unit 5: Density fluctuations and fluctuation-dissipation theorem

Unit 6: Fluctuation theorems
Unit 7: Mechanics of biomembranes, molecular transport through nanopores, single-molecule kinetics
Reference Books:
1. Theory of Simple Liquids: With Applications to Soft Matter by I. R. McDonald and J. P. Hansen
2. Principles of Condensed Matter Physics by P. M. Chaikin and T. C. Lubensky
3. Relevant research articles will be provided as additional reading material

5.Teaching-Learning Strategies in brief (4 to 5 sentences):
Lectures will introduce the basic concepts and recent advances in soft condensed matter physics, with particular emphasis on the equilibrium and non-equilibrium properties of simple liquids, biopolymers, and macromolecular assemblies. This will be followed by lectures on theoretical tools needed to understand many-body systems and some discussion on experimental techniques commonly used to probe soft condensed matter. The course will also have hands-on sessions on computational analyses of condensed matter systems. As part of reading assignments, students will be asked to read and present some research articles on some interesting soft condensed matter systems. Class assignments and mid-term exams will be used evaluate students' understanding of concepts covered in the course. Computational projects will be given at the end of the course, which will enable students to apply the concepts to some real-world problems.
6.Assessment methods and weightages in brief (4 to 5 sentences):
Mid-term exams (20%), Assignments (20%), Final Exam (30%), Projects (30%)

Title of the Course : **Principles of Information Security**
Faculty Name : Kannan Srinathan
Course Code : CS8.401
Credits : 4
L-T-P : 3-1-0
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Academic Program :B.Tech. in Computer Science and Engineering

1. Prerequisite Course / Knowledge:

Basic principles of algorithms.

2. Course Outcomes (COs) :

After completion of this course successfully, the students will be able to..

CO-1 Discuss mathematical concepts of cryptographic primitives

CO-2 Describe fundamental concepts and algorithms of cryptography, including encryption/decryption and hash functions

CO-3 Summarize different authentication techniques and describe programs like PGP & S/MIME

CO-4 Discuss network security principles, applications, and practices

CO-5 Analyse protocols for various system security objectives using cryptographic tools

CO-6 Evaluate the role of different security mechanisms like passwords, access control mechanisms, firewalls, etc.

2. **Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	2	1	1									2	1		2
CO2	3	2	2	2									3	2	2	3
CO3	1	1	2	1									2	1	1	2
CO 4	2	2	2	2									2	1	2	2
CO5	2	3	2	3									3	2	2	2
CO 6	1	1	2	1									1	1	2	1

Note: '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4. Detailed Syllabus:

Unit 1: **Introduction:** Security Trends, Security attacks, Security services, Security Mechanisms, A Model for Network Security Model, Classical Encryption Techniques, Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor Machines, Steganography.

Unit 2: **Block Ciphers and Data Encryption Standard:** Block Cipher Principles, Data Encryption Standard, Strength of DES, Differential and Linear Cryptanalysis, Block Cipher Design Principles, Advanced Encryption Standard, Evaluation Criteria of AES,AES Cipher, Multiple encryption and Triple DES, Block Cipher Modes of Operation, RC4.

Unit 3: **Public-key Encryption and Hash Functions:** Principles of Public Key Cryptosystems, RSA Algorithm, Key Management, Message Authentication and Hash Functions, Authentication Requirements, Authentication Functions, Message Authentication, Hash Functions, Security of Hash Functions and MACs, Digital Signatures, Authentication Protocols, Digital Signature Standard.

Unit 4: **Network Security Applications:** Kerberos, X.509Authentication Service, Public Key Infrastructure, Pretty Good Privacy, S/MIME , IP Security Overview, IP Security architecture, Authentication Header, Encapsulating Security Payload, Combining Security associations, Key Management.

Unit 5: **System Security:** Secure Socket Layer and Transport Layer Security, Secure Electronic Transaction, Intruders, Intrusion Detection, Password Management, Malicious Software, Firewalls, Trusted Systems

Reference Books:

1. W. Stallings, Cryptography and Network Security Principles & Practices, 4th edition, Prentice Hall, 2005
2. J. Katz and Y. Lindell, Introduction to Modern Cryptography, CRC Press, 2007
3. B. Schneier, Applied Cryptography, 2nd edition, John Wiley & Sons, Inc, 2001
4. Research papers

5. Teaching-Learning Strategies in brief (4 to 5 sentences):

Lectures by integrating ICT into classroom teaching; tutorials involving problem solving; being a fundamental course, it requires critical thinking and active learning by the students to solve problems.

5. Assessment methods and weightages in brief (4 to 5 sentences):

Assignments	30 marks
Mid Semester Examination	30 marks
End Semester Examination	40 marks

Title of the Course : Product Design Workshop

Faculty Name : Prakash Yalla+Raghu Reddy

Course Code : PD1.411

Credits : 2 Credits

L - T - P :1.5 -0- 3

(L - Lecture hours, T-Tutorial hours, P - Practical hours)

Semester, Year : 2nd Sem – Year 1 (Spring 2025)

Name of the Program : M. Tech in Product Design and Management program

Pre-Requisites : Basic principles of, Software programming, Design thinking and Product design. Basics of workshop tools and equipment operations (lathe, cnc, 3d printing , laser cutter &pcb maker). Else tutorials need to be taken). Basics of rapid prototyping CAD software for mechanical and electronics design (else tutorial to be taken)

Course Objective & Overview:

This course module intends to equip students with tools and techniques to rapid prototype a physical product that solve real life problems. Some of the most impactful systems interact with physical world. All of these have software driven intelligence. The objective of this learning module is to empower students with tools and techniques and to design real world physical systems.

Mode: Hands on workshop and project-based delivery. The course will involve a series of micro level projects that add up-to a larger project leading to a physical system (s).

2. Course Outcomes (COs)

After completion of this course successfully, the students will be able to:

CO-1. Apply Product design & rapid prototyping tools in development of physical systems/products.
CO-2: Re-engineer/Design products based on end user needs
CO-3. Integrate and create an end to end physical system (SW, Mechanicals and Electronics).
CO-4. Deploy in live setting and capture usable information from physical world.

3. Detailed Syllabus:

#	Topics
1	Rapid Prototyping Techniques & Tools
2	Shapes, Cuts and Joints : Usage and realise using RPT tools
3	Materials and selection depend upon their applications.
4	Product aesthetics : Materials Texture, Feel, and colour.
5	Embedded Intelligence
6	System Integration & Live deployment

The course has four parts to it with each part naturally dove tailing into the other

Part 1: Understanding Physical Objects & Rapid Prototyping:
In this module students get introduced to basics of rapid prototyping and usage of equipment like 3d printers, laser cutters, CNC machines etc. The students replicate everyday objects as is using these tools (builds an understanding on the right tool for right job).

Part 2: Problem Solving – understanding user need, usage scenario and re-imagining:
In this module students are given design problems that makes one re-imagine know systems based on user needs e.g. How could the everyday object manifest in the context of say r a Parkinson's patient.

Part 3: Embedding Intelligence:
In this module students are taught how to capture physical world information and how to embed smarts in a seamless manner into the physical system. This module brings into focus the behavior of software systems while engaging with real world parameters.

Part4: Putting it all Together: Final project
This part of the course assembles all the learning in the form of a end to end system/object that students showcase. The end semester exam for this is an end use feedback: the usability, the aesthetics , the functionality, the smarts etc.

4.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	2	3	3	2	2	2	2	3	3	3	3	3
CO2	3	3	3	3	3	3	2	2	3	3	3	3	3	3
CO3	3	3	2	2	3	3	2	2	3	3	3	3	3	3
CO 4	3	3	2	2	3	3	3	3	2	3	3	3	3	3

'3' in the box denotes 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

5.Teaching-Learning Strategies in brief:

The course is experiential in nature. It is workshops and discussions-based methodology to discover solutions to problems and projects that enables students to see their designs work in real world.
Lectures by integrating ICT into classroom teaching, weekly tutorials involving problem solving and active learning by students and Project-based Learning by doing 4 mini-projects & one major project in laboratory by the students

6. **Assessment methods and weightages in brief :**

In-class activities and Quizzes	20%
Weekly Lab assignments	30%
Main Project	40%
End Semester Exam	10%

Title of the Course : Product Lifecycle Management
Name of the Faculty : Ravi Warrier
Course Code : **PD2.502**
Credits : 4
L-T-P : 3-0-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring 2025
Pre-Requisites : NONE

Course Description

The Product Lifecycle Management (PLM) course is designed to equip participants with the skills and knowledge needed to develop comprehensive and functional strategies for bringing a product or service to the market. Throughout the course, participants will gain a deep understanding of the various stages involved in the lifecycle of a product, including the unique characteristics and challenges associated with each stage. They will learn how to accurately identify and differentiate these stages, allowing them to effectively strategize and mitigate risks at every step of the lifecycle. By mastering the ability to adapt to changes, manage product development across stages, and prepare for seamless transitions, participants will develop the expertise needed to navigate the complexities of the product lifecycle.

Course Outcomes

1. **Understand and Identify Product Lifecycle Stages:** Students will gain a clear understanding of what a product lifecycle is, its various stages, and the unique characteristics and

challenges of each stage. They will be able to accurately identify and differentiate these stages.

2. **Strategize and Mitigate Risks Across the Product Lifecycle:** Students will learn how to develop effective product, marketing, and customer engagement strategies for each stage of the product lifecycle. This will include assessing potential risks at each stage and creating mitigation strategies to minimize their impact.
3. **Adapt to Changes in the Product Lifecycle:** Students will learn how to effectively anticipate, adapt, and respond to changes and fluctuations within the product lifecycle, including adjusting the product roadmap when necessary.
4. **Manage Product Development Across Stages:** Students will gain a thorough understanding of the strategies and approaches needed to manage product development efficiently and effectively at each stage of the lifecycle.
5. **Prepare for Lifecycle Transitions:** Students will learn to predict and prepare for transitions to the next stage of a product lifecycle before they occur, minimizing disruption and facilitating smooth progression.
6. **Apply Lifecycle Concepts to Real-world Scenarios:** Students will demonstrate the ability to apply their knowledge of product lifecycle management to real-world scenarios, making sound decisions based on their understanding of the principles and strategies of lifecycle management.

Mapping of Course Outcomes to Program Objectives

(1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant).

	PO1	PO2	PO3	PO 4	PO5	PO 6	PO7	PO 8	PO 9	PO1 0	PO1 1	PS O1	PS O2	PS O3	PS O4
CO1	1	2	2		3	3	2	2		3	3	3	3	2	2
CO2	2	3	2	1	3	3	2	1	1	3	3	3	3	3	2
CO3	2	2	2	1	3	3	2	2		3	3	2	2	3	2
CO 4	2	2	2		3	2	2	2	1	3	3	2	3	3	3
CO5	3	3	2		2	3	2	1		3	3	2	2	2	3

CO 6	1	2	2	1	3	3	2		2	3	3	3	3	3	2

Proposed Course Outline

Week 1 - Introduction to Product Lifecycle Management (PLM)

Learning Objectives

- Remember the definition of PLM and its importance in product management.
- Understand the role of PLM in the product development process.

Topics Covered

- Defining PLM: Importance and benefits
- Overview of the product lifecycle stages
- Role of PLM in product development and management

Assessments

- Short quiz on the basics of PLM and its role in product development and management (Remembering, Understanding)

Instructional Methodology

- Lecture with presentation

Learning Activities

- Guided discussion about the role of PLM in the product development process.

Week 2 - Detailed Overview of Product Lifecycle Stages

Learning Objectives

- Understand the characteristics and challenges of each stage of the product lifecycle.
- Apply this understanding to identify the stages of a product's lifecycle.

Topics Covered

- Stage 1: Introduction – Market research, product development, and launch
- Stage 2: Growth – Scaling production, customer engagement, and marketing strategies
- Stage 3: Maturity – Market saturation, competition, and adaptation
- Stage 4: Decline – Market contraction, end-of-life strategies

Assessments

- Written submission identifying and describing the stages of a product's lifecycle using real or hypothetical products (Understanding, Applying)

Instructional Methodology

- Lecture with presentation

Learning Activities

- Guided discussion about the characteristics and challenges of each stage of the product lifecycle.

Week 3 - Strategy Development in PLM - Part 1

Learning Objectives

- Analyze the unique requirements for product, marketing, and customer engagement strategies in the Introduction and Growth stages.
- Create effective strategies for these stages.

Topics Covered

- Product strategy for Introduction stage: Innovation, positioning, pricing
- Marketing strategy for Introduction stage: Promotion, distribution
- Customer Engagement strategy for Introduction stage: Early adopter engagement, feedback mechanisms
- Product strategy for Growth stage: Improvements, diversification, scaling
- Marketing strategy for Growth stage: Expansion, competitive advantage
- Customer Engagement strategy for Growth stage: Customer retention, loyalty programs, community building

Assessments

- Group activity: Develop a product, marketing, and customer engagement strategy for a product in the Introduction or Growth stage (Analyzing, Creating)

Instructional Methodology

- Lecture with presentation

Learning Activities

- Group activity: Develop a product, marketing, and customer engagement strategy for a product in the Introduction or Growth stage

Week 4 - Strategy Development in PLM - Part 2

Learning Objectives

- Evaluate the effectiveness of different product, marketing, and customer engagement strategies in the Maturity and Decline stages.
- Create and adjust strategies based on risk assessment.

Topics Covered

- Product strategy for Maturity stage: Differentiation, cost optimization
- Marketing strategy for Maturity stage: Brand loyalty, market segmentation
- Customer Engagement strategy for Maturity stage: Customer retention programs, personalized customer experiences
- Product strategy for Decline stage: Discontinuation, pivoting

- Marketing strategy for Decline stage: Retention, clearance
- Customer Engagement strategy for Decline stage: Support and services, managing customer expectations
- Risk identification and mitigation strategies across stages

Assessments

- Individual assignment: Write a brief product, marketing, and customer engagement strategy for a product in the Maturity or Decline stage (Evaluating, Creating)

Instructional Methodology

- Lecture with presentation

Learning Activities

- Individual activity: Develop a product, marketing, and customer engagement strategy for a product in the Maturity or Decline stage

Week 5 - Adapting to Changes in the Product Lifecycle

Learning Objectives

- Analyze the factors that can cause changes in the product lifecycle.
- Create plans to adapt the product roadmap based on these changes.

Topics Covered

- Anticipating changes: Market trends, technology evolution, customer needs
- Adapting strategies: Changing product roadmap, altering marketing strategies
- Responding to changes: Agile decision-making, rapid prototyping

Assessments

- Group activity: Develop a contingency plan for a hypothetical product facing significant market changes (Analyzing, Creating)

Instructional Methodology

- Lecture with presentation

Learning Activities

- Group activity: Develop a contingency plan for a hypothetical product facing significant market changes

Week 6 - Managing Product Development Across Lifecycle Stages

Learning Objectives

- Understand how to manage product development at each stage.
- Apply this understanding to create a product development plan for a hypothetical product.

Topics Covered

- Product development in the Introduction stage: Ideation, prototyping, testing
- Product development in the Growth stage: Scaling, quality assurance

- Product development in the Maturity stage: Incremental improvements, cost reduction
- Product development in the Decline stage: Maintenance, end-of-life planning

Assessments

- Individual assignment: Create a product development plan for a hypothetical product (Understanding, Applying)

Instructional Methodology

- Lecture with presentation

Learning Activities

- Individual activity: Create a product development plan for a hypothetical product

Week 7 - Preparing for Lifecycle Transitions

Learning Objectives

- Analyze the signs of transition between stages.
- Create a plan to prepare for this transition.

Topics Covered

- Identifying signs of stage transition: Sales trends, customer feedback, market dynamics
- Preparing for transition: Strategic planning, resource allocation, stakeholder communication

Assessments

- Class discussion and short quiz to assess understanding of lifecycle transition signals and preparation strategies (Analyzing, Creating)

Instructional Methodology

- Lecture with presentation

Learning Activities

- Individual activity: Develop a transition plan for a hypothetical product moving from one lifecycle stage to another

Week 8 - Application of PLM in Other Industries

Learning Objectives

- Understand how PLM applies to various industries, including manufacturing and services.
- Analyze the potential benefits and challenges of implementing PLM in these industries.

Topics Covered

- Understanding PLM in the manufacturing industry: Lifecycle management for physical products, dealing with production processes
- Understanding PLM in the service industry: Lifecycle management for services, dealing with service delivery processes

- Comparison of PLM implementation in manufacturing vs services: Similarities, differences, and potential cross-industry learnings

Assessments

- Group activity: Analyze a case study of PLM implementation in a manufacturing or service company, and present the key findings (Understanding, Analyzing)

Instructional Methodology

- Lecture with presentation
- Case study analysis

Learning Activities

- Group activity: Analyze a case study of PLM implementation in a selected industry

Week 9 - Application of PLM to Real-World Scenarios

Learning Objectives

- Understand the application of PLM concepts in real-world scenarios.
- Evaluate the effectiveness of these applications.

Topics Covered

- Case studies: Review of real-world examples of successful PLM application
- Group discussion: Lessons learned and insights from case studies

Assessments

- Case study analysis and discussion: Evaluate real-world applications of PLM principles (Understanding, Evaluating)

Instructional Methodology

- Case study analysis

Learning Activities

- Class discussion about the unique PLM considerations for different products

Week 10 - The Role of Data in PLM

Learning Objectives

- Understand the role of data in Product Lifecycle Management (PLM).
- Develop strategies to collect, analyze, and use data effectively in PLM.

Topics Covered

- Importance of data in PLM: Informed decision-making, trend prediction
- Data collection in PLM: Methods and best practices
- Data analysis in PLM: Turning data into insights
- Data-driven decision making in PLM: Case studies and exercises

Assessments

- Individual assignment: Develop a data collection and analysis plan for a hypothetical product (Understanding, Creating)

Instructional Methodology

- Lecture with presentation
- Case studies

Learning Activities

- Individual activity: Develop a data collection and analysis plan for a hypothetical product

Week 11 - Role of Innovation and R&D in PLM

Learning Objectives

- Understand the role of innovation and R&D in Product Lifecycle Management (PLM).
- Develop strategies to foster innovation and effectively manage R&D processes in PLM.

Topics Covered

- Importance of innovation in PLM: Staying competitive, meeting changing customer needs
- The role of R&D in PLM: Product development, quality improvement
- Fostering innovation in PLM: Creativity techniques, innovation management
- R&D management in PLM: R&D planning, risk management

Assessments

- Group activity: Develop an R&D and innovation strategy for a hypothetical product OR
- Case study analysis with a written report on their evaluation of the R&D and Innovation strategy for the hypothetical product discussed in the case study (Understanding, Creating)

Instructional Methodology

- Lecture with presentation OR
- Guest Lecture OR
- Panel discussion with R&D and Innovation heads/managers of product companies

Learning Activities

- Group activity: Develop an R&D and innovation strategy for a hypothetical product

Week 12 - Technology and Trends in PLM

Learning Objectives

- Understand the impact of technology and current trends on Product Lifecycle Management (PLM).
- Analyze these trends and their implications for PLM.

Topics Covered

- Current technology in PLM: PLM software, automation, AI in PLM

- Trends in PLM: Sustainability, servitization, customer-centric PLM
- Impact of technology and trends on PLM: Case studies and exercises

Assessments

- Report submission: Assess their understanding of the impact of tech and current trends on PLM for a specific industry. (A choice of 2-3 industries will be provided.) (Understanding, Analyzing)

Instructional Methodology

- Lecture with presentation
- Case studies OR
- Panel discussion with industry experts on technology trends in PLM

Learning Activities

- Report writing on the impact of technology and current trends on PLM for a specific industry

Week 13 - Course Review and Recap

Learning Objectives

- Remember key concepts and strategies learned throughout the course.
- Evaluate personal growth and understanding of the course materials.

Topics Covered

- Course recap: Review of major concepts and strategies
- Student reflections: Assessment of personal learning and growth

Assessments

- N/A

Instructional Methodology

- Course recap and review
- Self-assessment and reflection

Learning Activities

- Review and group discussion: Students revisit the course materials and discuss the key points.
- Individual reflection activity: Students assess their learning journey and how their understanding of the topics has evolved over the course.

Week 14 – Course Evaluation

Learning Objectives

- N/A

Topics Covered

- N/A

Assessments

- Final Exams –Q&A or Case Studies Based

Instructional Methodology

- N/A

Learning Activities

- N/A

Title of the Course **: Quantum Algorithms**
Faculty Name : **Shantanav Chakraborty**
Course Code **: CS1.409**
Credits **: 4**
L - T - P **: 3-1-0**
(L - Lecture hours, T-Tutorial hours, P - Practical hours)

Name of the Program: Computer Science Elective (UG3, UG4, Dual degree)

Semester, Year **:** Spring 2025

Pre-Requisites : Familiarity with basic Linear Algebra, probability theory, discrete math, algorithms

Desirable: Knowledge of elementary quantum mechanics.

Course Outcomes: After the completion of this course, the students will be able to:

CO.1 (Understand level) – Demonstrate familiarity with the basic postulates of quantum mechanics, quantum circuits, quantum algorithmic primitives, various basic and advanced quantum algorithms and their running times, different quantum computational models

CO.2 (Analyze level) – Analyze the behavior of basic and advanced quantum algorithms

CO.3 (Evaluate level) – Review literature on the state-of-the-art quantum algorithms

CO.4 (Evaluate level) – Evaluate the complexity of quantum algorithms in various computational models

Course Topics :

Unit 1: Introduction to quantum mechanics, qubits, quantum circuits, Deutsch Deutsch-Jozsa algorithm

Unit 2: Quantum Fourier Transform, Simon's algorithm, Quantum phase estimation, Shor's Factoring Algorithm.

Unit 3: Grover's search algorithm, Quantum amplitude amplification, Analog quantum search

Unit 4: Quantum walks, Quantum walk search, Element distinctness problem, Glued trees algorithm, Adiabatic quantum computing

Unit 5: Hamiltonian simulation, Linear combination of unitaries, The block-encoding framework

Unit 6: Quantum algorithms for solving linear systems and least squares, Quantum machine learning: reading the fine print

Preferred Text Books:

There is no required text book for this course. Good introductory material:

- A Nielsen and IL Chuang, Introduction to Quantum Information and Computation,Cambridge University Press (2010)
- P. Kaye, R. Laflamme and M. Mosca, An Introduction to Quantum Computing, OxfordUniversity Press (2007)

These two books contain almost all the topics to be covered in Unit 1, Unit 2 and Unit 3.

Reference Books:

The following lecture notes are also recommended reading material:

- Lecture notes on Quantum Computation by John Preskill (Caltech)
- Lecture notes on Quantum Algorithms by Andrew Childs (U. Maryland)
- Lectures notes on Quantum Computation by Ronald de Wolf (CWI)

These lecture notes are updated periodically and covers some of the more recent topics on thesubject (Unit 4, Unit 5, Unit 6).

A great self-learning material for beginners is "Why now is the right time to study quantumcomputing", by Aram Harrow.

Additionally, we will be using various research articles throughout the course.

Grading Plan:

Type of Evaluation	Weightage (in %)
Assignments	20
Quiz	15
Course project	35
Final Exam	30

Course project details:

Students have to submit a course project where they have to work on a topic related to quantum algorithms. While a list of suggested topics will be made available, students are free to choose theirown topic. Along with surveying prior art, the students are strongly encouraged to identify or propose new research directions in that area.

The students can work on their own or form small groups of 2-3 students. The course project evaluation will have the following components:

- Project proposal (*5% of project grade*) – to be submitted by the end of Lecture 12
- Project presentation (*40% of project grade*) – to be made to the class (mandatory 10 minsallocated for questions)
- Paper (*55% of project grade*) – to be submitted by the end of the course

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest,or a '-' dash mark if not at all relevant). Program outcomes are posted at

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	1	1	1	-	-	2	2	1	2	3	2	3	3
CO2	2	2	3	1	2	-	-	-	2	2	1	2	3	2	3	3
CO3	2	2	3	1	1	-	-	-	2	2	1	2	3	2	3	3
CO4	2	2	3	1	1	1	-	-	2	2	2	1	3	2	3	3

Teaching-Learning Strategies in brief (4-5 sentences):

The lectures will facilitate inter-student and faculty-student discussions by incorporating small in-class exercises. There will be homework assignments that

would help the student to re-engagewith the essential components of the lecture and will test the student's ability to apply key conceptslearnt, and also inform the faculty of the progress being made by the students in acquiring them. Given the advanced nature of the course, there will be a significant exploratory component:students will have to submit a course project on a topic related to quantum algorithms, wherein thestudents will be encouraged to not only review existing literature on the topic but also explore thepossibility of identifying new possible research directions. Project presentations will facilitate inter-student discussions and exchange of new ideas.

Title of the Course **: Radio Frequency Based Sensors design: Principles and Applications [HALF COURSE]**

Faculty Name : Andleep
Course Code **: EC2.205**
Credits **: 2**
L - T - P **: 3-1-0**
(L - Lecture hours, T-Tutorial hours, P - Practical hours)

Name of the Academic Program: B. Tech. in ECE
Semester, Year **: Spring 2025**

Prerequisite Course / Knowledge:

Basic knowledge of Electromagnetic waves.

Course Outcomes (COs):

After completion of this course successfully, the students will be able to.

CO-1: Understand the background that drives the development of Radio Frequency (RF) based Sensors.

CO-2: The type of RF sensors and their applications.

CO-3: Design and simulation of RF circuits using CAD tools (e.g., HFSS, CST Microwave Studio)

CO-4: Hands-on experience in RF sensor design, fabrication, and RF sensor data analysis.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO11	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	2	1	1	1	1	2	2	2	1	1	2	3	2	2	2
CO2	3	3	2	2	2	1	1	2	1	1	1	1	3	1	1	1
CO3	3	3	2	2	2	1	1	2	2	2	1	2	3	1	1	1
CO4	3	2	3	3	3	1	1	2	2	2	1	3	3	1	1	1

Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs). Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level'mapping.

Mapping with PSOs, where applicable.

Detailed Syllabus:

Unit 1: Definition and classification of sensors, sensor components: receptor, transducer, andsignal processor, Applications of RF sensors (medical, environmental, and industrial).

Fundamentals of Electromagnetic Theory: Maxwell's equations, Wave propagation, Transmission line theory, Interaction of electromagnetic waves with matter, RF signal reflection, absorption, and scattering, S parameters.

Unit 2: RF and microwave principles, RF spectrum and frequency bands, Key components of RF circuits (resistors, capacitors, inductors, and antennas).

RF-sensing methods: Resonant, Non-resonant and their types, Key performance parameters: sensitivity, specificity, and resolution, Materials and Fabrication Techniques, Substrate materials for RF sensors (e.g., FR4, Rogers), Thin-film technologies and microfabrication processes, Integration of materials into RF systems for sensing.

Unit 3: Impedance matching and network analysis, Design and simulation of RF circuits usingCAD tools (e.g., HFSS, CST Microwave Studio), Miniaturization and optimization of RF sensors, Challenges and Future Directions.

Unit 4: Hands-on Projects and Laboratory Work: Design, simulation, and fabrication of a RFsensor: measurements, and analysis of RF sensor data.

Reference Books:

1. Introduction to Electrodynamics, 4th EDITION by David J. Griffiths
2. Fundamentals of RF and Microwave Electronics" by Matthew Radmanesh
3. Microwave Engineering 4th Edition by David M. Pozar
4. RF Microelectronics by Behzad Razavi

Assessment methods and weightages:

- Assignments: 20%
- Quiz: 20%
- Mid or End Semester Exam: 30%
- Project: 30%

Title of the Course : Research Methods in the Human Sciences

Faculty Name : Isha Dubey + Anirban Dasgupta
Course Code : HS0.302
Credits : 4 (four)
L - T - P : 3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring 2025
Name of the Program : B.Tech in Computer Science and M.S. in Computing and Human Sciences by Research
Pre-Requisites : Thinking and Knowing in the Human Sciences One and Two

Course Outcomes :
CO1:Identifythe main concepts of research method, and of methodology, in the human sciences
CO2: **Explain**the different qualitative and quantitative tools used in human sciences research
CO3: **Apply** one or many tools of research to specific given problems
CO4: **Differentiate** the different sources of evidence and data: textual, material, human; and **Analyse**the common errors which occur during research
CO5: Critically**Evaluate** existing research papers and books along different research methods
CO6:Develop their own research method and methodology; **Design** their own research problem

Course Topics :
1) **What all does Research Methods encompass?**
Explain the importance of research methods in making of a good research project. List and

describe the different components of it. Introduction to Zotero (open-source reference management).

2) **Textual Sources of Research: Literary, Historical**.
The different categories of textual sources; how to read them in context; the distinction and similarity between literary and historical textual sources. The function of the archive and library.

3) **Material Sources of Research: Artefacts, Built Environments, Nature; Pictures, Photographs, Audio sources of these**.
How to "read" material objects for information and evidence. Audio and Visual evidence as artefacts.

4) **Human Sources of Research: Relationships, Social Processes, Emotions, Ideas, Visual, Oral**.
How to conduct ethnographic research; special emphasis on surveys and questionaires, participant observation, focus group, ethics of conducting research. Placing audio-visual material in context.

5) **Data Sources of Research: Numbers; Turning textual, material and human sources into computational data**.
Importance of numbers and data; their limitations. The fraught relation between correlations and causation. The possibilities of using NLP tools and data analytic tools.

6) **Placing Research in Space (and Time)**
Importance of space and time in building context of information/evidence. Introduction to GIS and SNA

7) **Common Errors in Research**
Cherry-Picking data; strong determinism; generalizing/theorizing on insufficient evidence; conceptual stretching; methodological nationalism; lack of originality, and/or following fashion; Straw-man.

8) **Research Design and Presentation**
How to design a research project: identifying the research gap/debate, identifying methods/approach/theories, collecting evidence, analysis. Writing out the research: how to write abstract, literature review, citation and references, plagiarism, other components of writing.

Preferred Text Books :

1. AnolBhattacherjee (2012), *Social Science Research: Principles, Methods, Practices*, Textbook Collection 3. http://scholarcommons.usf.edu/oa_textbooks/3

2. Paul S. Gray, et al (2007), *The Research Imagination*, Cambridge University Press.

3. Shawn Graham, et al (2015), *Exploring Big Historical Data: The Historian's Macroscope*, Imprerial College Press, http://www.themacroscope.org/2.0/

Reference Books :

8. Peter J Carrington et al (ed) (2005), *Models and Methods in Social Network Analysis*, Cambridge University Press.

9. Mathew W Wilson, (2017), *New Lines: Critical GIS and the Trouble of the Map*, University of Minnesota Press.
10. Gabe Ignatow, Rada Mihalcea (2016), *Text Mining: A Guidebook for the Social Sciences*. Sage.

11. Andrew Piper (2020), *Can We Be Wrong? The Problem of Textual Evidence in a Time of Data*, Cambridge Elements – Digital Literary Studies, Cambridge University Press, https://www.cambridge.org/core/elements/can-we-be-wrong-the-problem-of-textual-evidence-in-a-time-of-data/86A68A9A055DE5815F29AAE66F2AFF9A
12. Johny Saldana (2016), *The Coding Manual for Qualitative Researchers*, Sage.
13. Bonita Aleaz, ParthaPratimBasu (eds) (2019), *Revisiting Qualitative Methods in Social Science Research*, Orient Blackswan.
14. Cliffford Geertz (1973),"Deep Play – notes on the Balinese Cockfight", *Interpretation of Cultures: Selected Essays*, Basic Books.
15. Clifford Geertz (1973),"Thick Description – towards an interpretive theory of culture", *Interpretation of Cultures: Selected Essays*, Basic Books.
16. Akhil Gupta, and James Ferguson (1997), "Discipline and Practice: 'The Field' as Site", Method, and Location in Anthropology", In *Anthropological Locations: Boundaries and Grounds of a Field Science*. A. Gupta, J. Ferguson, eds. Berkeley: University of California Press. Pp 1-46.
17. George Orwell (1984), *The Road to Wigan Pier*, HarperCollins.
18. Aman Sethi (2012), *A Free Man*, Random House India.
19. Rukmini S. (2021), *Whole Numbers and Half Truths: What Data Can and Cannot Tell Us About Modern India*, Context Publishers.
20. Carl E. Pletsch (1981) "The Three Worlds, or the Division of Social Scientific Labor, Circa 1950-1975", *Comparative Studies in Society and History,* 23(4), pp. 565-590.
21. D. D. Kosambi (1956), *Introduction to the Study of Indian History*, "Chapter 1: Scope and Methods", Popular Prakashan.
22. Carlo Ginzberg (2002), *Wooden Eyes: Nine Reflections on Distance*, Verso. (Chapter 1: Making it Strange – Prehistory of a Literary Device; Chapter II: Myth – Distance and Deceit; Chapter III: Representation – The World, The Idea, The Thing)
23. Jean-Claude Carriere, Umberto Eco (2012), *This is not the end of the book;* Vintage Books
24. James Hoopes (1979), *Oral History: An Introduction for Students*, University of North Carolina Press.
25. David L. Ransel (2010), "The Ability to Recognise a Good Source", *Perspectives on History*. https://www.historians.org/publications-and-directories/perspectives-on-history/october-2010/the-ability-to-recognize-a-good-source
26. Lynn Hunt (2010), "How Writing Leads to Thinking", *Perspectives on History*. https://www.historians.org/publications-and-directories/perspectives-on-history/february-2010/how-writing-leads-to-thinking
27. Giovanni Sartori (1970), "Concept Misinformation in Comparative Politics", *American Political Science Review*.
28. Andreas Wimmer, Nina Glick Schiller (2003), "Methodological Nationalism, the Social Sciences, and the Study of Migration: An Essay in Historical Epistemology", *International Migration Review*.
29. Stephen Kern (2004), *Cultural History of Causality : science, murder novels, and systems of thought*, Princeton University Press
30. Arthur Conon Doyle (1892), Sherlock Holmes – Silver Blaze.
31. Arthur Conon Doyle (1887), Sherlock Holmes – A Study in Scarlet.

E-book Links :

Grading Plan :

Type of Evaluation	Weightage (in %)
Assignments	**(3x15) 45%**
Project	**35%**
Other Evaluation: Class Participation	**20%**

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2	2	3	2	2	3	1	1	1	3	1	3	3	3
CO2	2	3	1	3	3	2	2	3	1	2	1	3	1	3	3	3
CO3	2	3	3	3	3	2	3	3	2	2	1	3	1	3	3	3
CO4	2	3	3	3	3	3	2	3	3	2	1	3	1	3	3	3
CO5	2	3	3	3	3	2	2	3	2	3	1	3	1	3	3	3
CO6	2	3	3	3	3	2	2	3	2	3	1	3	1	3	3	3

Teaching-Learning Strategies in brief (4-5 sentences) :

The course will be held in the workshop mode with student engagement in the topics discussed in each class. Readings will be given out before the class and students will be expected to read and come, and then engage with the topic under discussion.
Each of the different modules will be taught through two or more examples and illustrations from existing research papers and books from different disciplines of the Human Sciences.
Students will be asked to make presentations for their assignments, and will be made to work in teams of three or four for their project.
Students will be expected to read about 1,500 pages of academic texts, as well as write about 8000 to 10000 words.

Title of the Course : Responsible & Safe AI Systems

Name of the Faculty : Ponnurangam Kumaraguru
Name of the Program : Applicable to all UG, MS & PhD Programs on campus
Course Code : CS7.405
Credits : 4
L - T - P **:**3-0-1
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year **: Spring, 2025**
Preferred pre-requisites: Any of these courses: MDL, Intro to NLP, Advanced NLP, Topics in DL, SMAI, NNLG, Maths in gen models, Topics in RL, Deep learning. Familiarity in PyTorch will be added advantage.

Recommended courses: SMAI/Intro to NLP/CV

Course Outcomes :

- C0-1: Students will recognize possible harms that can be caused by modern AI capabilities
- C0-2: Students will learn to reason about various perspectives on the trajectory of AI development and proliferation
- C0-3: Students will learn about latest research agendas towards making AI systems safer
- C0-4:Students will be able to design and run experiments for understanding capabilities of current AI systems.
- C0-5: Students will conduct, develop, and practice the techniques needed to make AI systems safer through course project.

Course Topics :

(please list the order in which they will be covered, and preferably arrange these as five to six modules.)

Module 1: Introduction to AI Capabilities and Risks

- AI Capabilities Improvement in last 5-10 years
- Recap of Deep Learning Techniques, Language/Vision Models (through Tutorials)
- Imminent risks from AI Models: Toxicity, bias, goal misspecification, adversarial examples etc.
- Long-termrisks from AI Models: Misuse, Misgeneralization, Rogue AGI
- Overview of Techniques covered in course: Interpretability, Fairness, Robustness etc.
- Why study this course? Impact, Career Opportunities etc.
- Boosting Productivity with ChatGPT/Bard (Tutorial)
- Primer on instruction tuning, prompt fine-tuning and RLHF (Tutorial)

Module 2: Adversarial Robustness

- Tail risks
- Adversarial Attacks – Vision, NLP, Superhuman Go agents
- ML Poisoning Attacks like Trojans
- Implications for current and future AI safety
- Tutorials + Assignment on implementing adversarial attacks and defenses

Module 3: Transparency

- Imminent and Long-term potential for transparency techniques
- Mechanistic Interpretability
- Representation Engineering, model editing and probing
- Critiques of Transparency for AI Safety
- Tutorials + Assignment on applying various techniques

Module 4: Artificial General Intelligence

- What is AGI? When could it be achieved?
- Emergent capabilities
- Instrumental Convergence: Power Seeking, Deception etc.

- Goal misgeneralization
- Scalable Oversight

Module 5: AI Governance and Career Opportunities

- Risks from AI Misuse
- Technical Solutions for Governance
- AI taking over jobs
- Difficulties in Designing and Enforcing AI regulation
- Next steps for getting involved with Safety Research, Career Opportunities
- Visions for a post-AGI society

Inspired from the following courses:

1. **https://course.aisafetyfundamentals.com/alignment**
2. **https://course.mlsafety.org/**
3. Princeton AI Safety - https://sites.google.com/view/cos598aisafety/?pli=1

Textbook: All content (slides, papers, reports) for the course will be shared during the course.

Grading Plan :
(The table is only indicative)

Type of Evaluation	Weightage (in %)
Quizzes	20.0
Assignments + Activities	30.0
Project report + Blog + Video	20.0 [12 + 4 + 4]
Project	30.0
Total	**100**

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	-	-	-	3	3	-	-	3	-	1	3	-	-	3
CO2	3	1	-	1	-	3	-	-	-	3	-	1	3	-	-	3
CO3	3	3	-	-	-	3	1	-	-	3	-	1	3	-	-	3
CO4	3	3	-	-	3	3	-	-	-	3	-	1	3	1	-	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Teaching-Learning Strategies in brief (4-5 sentences):

Learning

- Lectures
- Reading research papers and blogs
- Class participation: questions, discussions
- Online discussion: Teams
- Guest lectures

Learning by doing

- Course project
- Real world implementation

POTENTIAL GUEST LECTURES:

1. Neel Nanda, Google DeepMind
2. Arun Jose, Independent Researcher
3. Prof. Ravi Balaraman, IIT Madras
4. Daniel Paleka, PhD Student, ETH Zurich
5. Dr. Adam Gleave, CEO FAR AI
6. Dr. Dan Hendrycks, Director of Center for AI Safety
7. Dr. Ethan Perez, Research Scientist, Anthropic
8. Prof. Vincent Conitzer, Carnegie Mellon University

RELATION TO EXISTING IIIT COURSES:

1. Fairness, Privacy and Ethics by Prof. Sujit Gujar – Our course is about potentially catastrophic harms from modern AI like misuse, deception, toxicity etc. We will not cover fairness, privacy, inequity concerns.
2. Values, Ethics and AI by Prof. Shatrunjay Rawat – This course focuses on human values and how they should be kept in mind while designing technology like AI. Our course will only explore this in the inverse sense, how can we make sure future AIdon't violate human values.

Title of the Course : Robotics: Planning and Navigation

Faculty Name : Madhava Krishna K
Course Code : EC4.403
L-T-P : 3-1-0
Credits : 4
Name of the Academic Program:B. Tech. in ECE, BTech in CSE

Prerequisite Course / Knowledge:

Computer Programming, Data Structures and Algorithms. Knowledge of Functional Optimization is a plus.

Course Outcomes (COs):

After completion of this course successfully, the students will be able to..

CO-1 :Demonstrate familiarity with different paradigms in robotic motion planning
CO-2: Analyze robotic planning algorithms in the context of navigating in an environment to accomplish a goal
CO-3: Explain the significance of mathematical frameworks of functional optimization as well as robot kinematics in robotic planning and navigation tasks.
CO-4: Apply principles of functional optimization and robot kinematics to propose analytical frameworks, algorithms for solving real world problems in robotic motion planning, navigation.
CO-5: Create and Simulate the algorithms using state of the art software and libraries and evaluate its performance on specified tasks

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

	PO1	PO2	PO3	PO 4	PO5	PO 6	PO7	PO 8	PO 9	PO 10	PO1 1	PO1 2	PS O1	PS O2	PS O3	PS O4
CO1	3	2	1	1	1	1	1	2	2	1	1	2	1	1	1	2
CO2	3	3	1	2	1	1	1	2	2	1	1	1	1	1	1	2
CO3	2	3	1	2	1	1	1	2	2	2	1	2	1	1	1	3
CO 4	3	2	3	2	2	1	1	2	2	2	1	3	1	1	1	3
CO5	2	2	3	2	3	1	1	2	3	3	3	3	1	1	1	3

Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs). Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping Mapping with PSOs, where applicable.

Detailed Syllabus:

Unit 1: Classical AI Based Planning and its Limitations
Unit 2: Sampling Based Kinematic Planners, Trajectory Optimization
Unit 3: Model Predictive Control and Velocity Obstacles for Dynamic Scenes
Unit 4: Uncertainty Modelling, Planning under Uncertainty

Reference Books:

1. Trajectory Planning for Automatic Machines and Robots by Luigi Biagiotti · Claudio Melchiorri
2. Introduction to Robotics: Mechanics and Control by John J Craig

Teaching-Learning Strategies in brief (4 to 5 sentences):

Classes invoke rich graphical content in the form of images, representations, videos to elucidate difficult concepts in robotic motion planning. Code walkthroughs, simulation of algorithms used to enhance understanding. Learning by doing, coding and simulation is highly promoted and encouraged. Students understand difficult mathematical concepts and abstraction by coding it using state of the art software, simulation frameworks, libraries and solvers.

Assessment methods and weightages in brief (4 to 5 sentences):

- Programming Assignments: 50%
- Mid Sem : 20%
- End Exam: 30%

Title of the Course : Science &Technology: Critical perspectives

Name of the Faculty : Yusuf Indorewala
Course Code : HS0.207
L-T-P : 3-1-0.
Credits : 2
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Academic Program: CHD

1.Prerequisite Course / Knowledge:

None

2.Course Outcomes (COs) :

After completing this course successfully, the students will be able to

CO-1 **Explain** diverse perspectives on **Science & Technology with an ethical scrutiny.**

CO-2 **Demonstrate** understandingof how science and technology have differential effects on different sections of society.

CO-3 **Apply** their knowledge to critically and ethically evaluate applications of science and technology to social problems.

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	-	2	-	-	-	2	2	3	-	1	-	1	1	1	-	1
CO2	-	1	1	-	-	2	2	2	-	1	-	1	1	1	1	1
CO3	-	1	1	1	-	2	2	3	-	1	-	2	1	1	-	1

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4.Detailed Syllabus:
Unit-1: The problem of knowledge and science as an episteme; the nature of technology
Unit-2: Deterministic nature versus social construction of science and technology; differential effects on different sections of society

Unit-3: General critique of science - feminist critique, post-modern critique, etc.

Unit-4: Specific instances of ethical violations - abuse of science and technology, illustrations from biotechnology, technology of war, etc.

Reference Books:

1. **Maurizio Iaccarino, Science and ethics, EMBO Rep. 2001 Sep 15; 2(9): 747–750** https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1084045/ **(and references therein)**
2. **R. Volti, Society and Technological Change, Worth Publishers, NY, USA, 2009**

5.Teaching-Learning Strategies in brief :

Interactive class room teaching, multiple quizzes; enciuragement for brief student presentations.

6.Assessment methods and weightages in brief :

Assignments: 30%,
Class Quizzes : 20%,
End Semester: 40%
Class Participation: 10%

A jump in grade will be awarded for an exceptional term paper. Plagiarism of any degree will invite a 'F' grade with no discussion.

Title of the Course : Science II
Faculty Name : **Nita Parekh + Chittaranjan Hens**
Course Code : SC1.111
L-T-P : 3-1-0
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Credits : 4
Name of the Academic Program:B. Tech. (CSE)

1.Prerequisite Course / Knowledge:NA
2.Course Outcomes (COs) (5 to 8 for a 3 or 4 credit course):
The course is divided into two halves:
First Half: Computing in Sciences
Second Half: Introduction to Biology
Outcomes of the First Half (Computing in Sciences):

After completion of the first half of this course successfully, the students will be able to

CO-1: Outline the uses of Monte Carlo to evaluate multidimensional integrals that appear in theoretical natural sciences
CO-2: Describe numerical algorithms and pseudocodes to solve ordinary and partial differential equations that appear in theoretical natural sciences
CO-3: Apply computational methods to find numerical solutions to scientific problems

Outcomes of the Second Half (Introduction to Biology):
After completion of this course successfully, the students will be able to
CO-4: Familiarize themselves with basic terms and terminology in biology, various biological entities and their function, DNA, RNA, proteins, and enzymes, cell and its functionality,

CO-5: appreciate that biology is very quantitative and how sequence analysis using algorithms can help in understanding the evolution, function of genes and proteins
CO-6: carry out a mini-project to learn how to go from sequence to structure, function and disease association

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix
FortheFirst Half (Computing in Sciences):

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	1	2	3	2	2	2	2	2	2	2	3	3	3	3
CO 2	3	3	1	2	3	2	2	2	2	2	2	2	3	3	3	3
CO 3	3	3	1	2	3	2	2	2	2	2	2	2	3	3	3	3

.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix
Forthe Second Half (Introduction to Biology):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO4	1	1														
CO5	1	1		1									1		1	1
CO6	1	1	1	1				1	1	1					1	1

4.Detailed Syllabus:
Syllabus of the First Half (Computing in Sciences):

Unit 1: Monte Carlo method: Its application in solving large dimensional integrals seen in statistical mechanics and quantum mechanics
Unit 2: Solving linear systems: Huckel molecular orbital approximation for band structure in metallic bonding
Unit 3: Algebra of matrices: Singular-Value Decomposition (SVD), Hessian matrix in normal mode analysis, and spectral decomposition

Unit 4: Differential equations in sciences: Prey predator model, dynamics from Newton Laws, molecular dynamics simulation
Unit 5: Stochastic differential equations: Diffusion, bistability of cellular processes
Unit 6: Partial Differential equations in sciences: Heat equation and wave equation

Syllabus of the Second Half (Introduction to Biology):
Unit 1: Introduction: Classification of Living Organisms, Origin of Life and Evolution, Biomolecules – Nucleotides, Amino Acids, Proteins, Enzymes
Unit 2: Cell Biology: Structure and Function - Prokaryotic and Eukaryotic Cells, Cell Cycle – Cell division – Mitosis, Meiosis, DNA Replication, Transition, Translation – Central dogma, DNA amplification, sequencing, cloning, restriction enzymes
Unit 3: Genetics: Mendelian Genetics – Genetic Disorders, Mendelian Inheritance Principles, Non-Mendelian Inheritance, Clinical Perspective
Unit 4: Macromolecules: DNA, Proteins – Structure, Function, Analysis, Carbohydrates – Features, Structure, Metabolism, Kreb cycle
Unit 5: Biological data analysis: Biological Data – sequence, structure, expression, etc., Sequence Data Analysis – alignment, database search, phylogeny, Applications
Reference Books:
1. Molecular Biology of the Cell by Alberts, Johnson, Lewis, Morgan, Raff, Roberts, Walter
2.Lehninger Principles of Biochemistry by David L. Nelson and Michael M. Cox
3.Reading the Story in DNA: A Beginners Guide to Molecular Evolution by Lindell Bromham
4. An Introduction to Computational Physics by Tao Pang
5. Molecular Modelling – Principles and Applications by A. R. Leach

5.Teaching-Learning Strategies in brief (4 to 5 sentences):

The objective of the course is to give the CSE students a flavour of biological sciences and scientific computing. To familiarize the students with available web-based resources (databases and tools) for biological sequence analysis and extract meaningful information. Whenever possible, after a theory lecture to follow up with analysis of real sequence data. Give the student small programming tasks in biological data analysis to be able to appreciate the role of computing in biological data analysis. Applications of computational and mathematical models in natural sciences are also discussed.

6.Assessment methods and weightages in brief (4 to 5 sentences):
Assignments – (10%), Class Quizzes + Mid-term evaluation (20%), Final exam (20%)

Title of the Course : Science Lab II

Faculty Name : Tapan K. Sau + Chittaranjan Hens
Course Code : SC4.111
L-T-P : 0.0.3
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Credits : 2
Name of the Academic Program: Dual Degree CNS…

1. **Prerequisite Course / Knowledge:**None

2. **Course Outcomes (COs):**

After completing this course successfully, the students will be able to

CO-1: Setup and perform physics experiments to measure properties of materials like polarization, thermal conductance, natural frequency, energy band gap, etc.
CO-2: Setup and perform chemistry experiments to synthesize and characterize materials.
CO-3: Perform chemistry experiments to measure properties like absorbance/transmittance, pH, solubility, conductance, etc.

3. **Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2	2	1	1	1	2	1	3	1	3	1	2	1	2
CO2	2	1	2	2	1	1	1	2	1	3	1	2	1	2	1	2
CO3	2	1	2	2	2	2	1	2	1	3	1	2	2	2	2	1

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4.Detailed Syllabus:

1. Unit-1: To Determine the Frequency of Tuning Fork by using Melde's Apparatus
2. Unit-2:To Determine the thermal conductance of bad conductor(s) by Lee-Charlotte's Experiment
3. Unit-3: Determination of Polarising angle and refractive index of prism using Brewster's Law
4. Unit-4:Determine the numerical value of Planck's constant using the photoelectric effect setup.
5. Unit-5: Determination of Band Gap of a Semiconductor
6. Unit-6: Extraction of DNA from Onion/Pea and Checking its Presence
7. Unit-7: Synthesis & polymer: Synthesis of a polymer
8. Unit-8: Chromatography: To separate the mixture of over-the-counter analgesics by Thin Layer Chromatography
9. Unit-9: Biophysical analysis: Determination of isoelectric pH of a protein.
10. Unit-10: Synthesis and Characterisation of Nanoparticles

Reference Books:
1. Introduction to Protein by Branden and Tooze
2. Fundamentals of Biochemistry by Voet, Voet, and Pratt
3. B.SC. PRACTICAL PHYSICS, S Chand EdutechPvt. Ltd.

5.Teaching-Learning Strategies in brief (4 to 5 sentences):

The course is a hands-on laboratory course requiringstudents to perform experiments after showing some prerequisite preparation. Then, the student's setup of the experiment is checked, before allowing to proceed to experimental measurements. After completion of all measurements, students will perform the required calculations for drawing the conclusions. Finally, a viva voice examination is conducted for the experiment to check a broad level of knowledge of the experiment.

6.Assessment methods and weightages in brief (4 to 5 sentences):

· Laboratory record- 40%
· Viva – 10%
·Quiz - 15%
·Exams - 35%

Title of the Course : Science, Technology and Society

Faculty Name **: Radhika Krishnan**
Course Code **:** HS7.301
L-T-P **:** 3-0-0
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Credits **:**4

Name of the Program **:**B.Tech in Computer Science and M.S. in Computing and Human Sciences by Research

1.Prerequisite Course / Knowledge: Thinking and Knowing in the Human Sciences I and II (For students in the CHD program); or Intro to Sociology, Intro to Politics, Intro to Philosophy.

2.Course Outcomes (COs)

After completion of this course successfully, the students will be able to:

CO-1:
Students will have a working knowledge of the key methodological and theoretical frameworks,key debates and contributions of scholarswithin STS.

CO-2:
Students will understand the various approaches within the broad domain of the social construction of science.

CO-3:
Students will learn about how technology shapes and in turn shaped by social, economic, political and cultural factors. They will understand various theories and methods under the broad rubric of the social construction of technology, and will be exposed to the debates between technological determinism and social construction of technology.

CO-4:
Students will be encouraged to identify values embedded in technical systems, and the potential as well as limitations of human and non-human agency.Students will have the conceptual ability to analyse various aspects of the society-technology interface.

CO-5:
CHD students will be able to think more deeply about confluence between the social sciences and the digital world of computing. This will help them think about possible research approaches and questions which they can later pursue.

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO 1		PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	1		3	3	3	1	3	3	3	1	1	1	3	1	1	3	3
CO 2	1		3	3	3	1	3	3	3	1	1	1	3	1	1	3	3
CO 3	1		3	3	3	1	3	3	3	1	1	1	3	1	1	3	3
CO 4	1		3	3	3	1	3	3	3	1	1	1	3	1	1	3	3
CO 5	1		3	3	3	1	3	3	3	1	1	1	3	1	1	3	3

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4.Detailed Syllabus:

Unit 1:

Structure and functioning of the scientific community (rules, norms, values). Social construction of scientific knowledge (controversies and the problem of replication, science as a negotiated process, role of interests). Strong Programme, Sociology of Scientific Knowledge, Empirical Programme of Relativism

Unit 2:

Introduction to Technology Studies: Understanding the technological visions of Jacques Ellul and Lewis Mumford.

Unit 3:

Social construction of Technology (SCOT): Introduction to the ideas of Michael Callon, Trevor Pinch, Wiebe Bijker, Bruno Latour, Thomas Hughes.

Unit 4:

Technological determinism and its debates with Social Construction of Technology: Introduction to the ideas of David Noble, Langdon Winner, Robert Heilbroner, David Harvey, Nathan Rosenberg.

Unit 5:

Digital Technologies in society: Discussion of recent research and case studies related to digital technologies.

Reference Books:

Harry M Collins and Trevor Pinch, *The Golem: What You Should Know About Science* (Cambridge: Cambridge University Press, 1998 [2nd edition]).

Jacques Ellul, *The Technological Society* (London: Vintage Books, 1954).

Langdon Winner, *Autonomous Technology: Technics-out-of-control as a Theme in Political Thought* (Cambridge, Massachusetts and London: MIT Press, 1978).

Lewis Mumford, *Myth of the Machine: Technics and Human Development* (London: Harcourt Brace Jovanovich, 1967).

Lewis Mumford, *Technics and Civilization* (London: Routledge, 1934).

Manuel Castells, *The Rise of Network Society* (London: Wiley, 2009).

Merritt Roe Smith and Leo Marx (eds.), *Does Technology Drive History: The Dilemma of Technological Determinism* (Cambridge, Massachusetts and London: MIT Press, 1994).
Robert Merton, *The Sociology of Science* (London: The University of Chicago Press, 1973).
Sergio Sismondi, *An Introduction to Science and Technology Studies* (Sussex: Wiley –Blackwell, 2009).
Wiebe Bijker and Trevor Pinch, *The Social Construction of Technological Systems* (Cambridge, Massachusetts and London: MIT Press, 2012).

5.Teaching-Learning Strategies in brief (4 to 5 sentences):

Students are introduced to theories and concepts through lectures. Discussions and interventions in the classroom are highly encouraged. Case studies will be used extensively to explain theoretical concepts. This course involves 1 project (which will involve studying digital technologies using theories and methods in STS). The idea behind this project is to bring together theory and practice. In addition, students are given 4 reading-based assignments through the course, which will help them to understand the concepts in some depth.

6.Assessment methods and weightages in brief (4 to 5 sentences):

Type of Evaluation	Weightage (in %)
Project	**25%. Related to analysis of the society-technology interface using STS concepts and theories**
Assignment 1	**15%. Related to Unit I, II, III**
Assignment 2	**15%. Related to Unit IV, V**
Mid Sem	**15% Questions designed to evaluate understanding of basic concepts.**
End Sem	**30%. Questions designed to evaluate understanding of basic concepts.**

Title of the Course : Sociology of Platform Economies

Faculty Name : Rajorshi Ray
Course Code : **HS2.304**
L-T-P : 3-0-0
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Credits :4
Name of the Academic Program :

1.Prerequisite Course / Knowledge: Students should have completed their Introduction to Human Sciences (IHS) credits

2.Course Outcomes (COs) (5 to 8 for a 3 or 4 credit course):

After completion of this course successfully, the students will be able to.

CO-1
Students will develop a foundational understanding of issues, definitions, and processes related to platforms and platformisation.

CO-2
Students will be able to acknowledge the panoply forms of work and entrepreneurship that marks the platform landscape. They would be introduced to platforms across sectors: on-demand,

marketplace, infrastructural. Subsequently, the students would have a sound knowledge of how the local structural specificities and platforms shape each other .

CO-3

Students will be able to distinguish how social processes unfold within the platform space. The act of being an intermediary gives the platform unrestricted authority through which interactions, communication and exchanges are shaped. Thus the students would be able to appreciate the myriad implications of platforms when it comes to ongoing social processes.

CO-4

Students will be able to analyze how economic forces such as neoliberalism and financialization creates an opportunity for platforms to survive and grow. The students will be introduced to concepts of social mobility, network effects and innovation that shape the economic nature of platforms

CO-5

Students will understand how Nation States try to regulate platforms within their geographical boundary. The question power would be discussed, as to how platforms exercise control and surveillance over users. Students will develop a critical outlook on how the debate on privacy has to ends one being absolute idea of privacy and on the other end is the idea of contextual privacy.

CO-6

In addition to the above objectives, the course would give an opportunity for students to interrogate the "cloud" nature of these platforms. Thus focusing on the human and material infrastructures that support these technological behemoths

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

Matrix for CSE

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1			1	1		3	3	3				2				
CO2			1	1		3	3	3				2				
CO3			1	1		3	3	3				2				
CO4			1	1		3	3	3				2				
CO5			1	1		3	3	3				2				

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

Matrix for ECE

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1			1	1		3	3	3				2				
CO2			1	1		3	3	3				2				
CO3			1	1		3	3	3				2				
CO4			1	1		3	3	3				2				
CO5			1	1		3	3	3				2				

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4.Detailed Syllabus:

Unit-1

Platform Societies: An introduction

- Theories and basic concepts of platformisation
- Historical discourses around digital capitalism (Digitization, digitalization and Digital transformation) and rise of platforms
- Platforms as novel economic institution or a disruptor within an old market
- Platforms as an intermediary vs platform as a mediator
- Sharing economy and its geographical variations

Unit-2

Platforms a contested economic terrain

- Debates around digital entrepreneurship and creation of a new laboring class,
- Labour process within platform
- Production and accumulation in a platformed market
- Contingent workforce and creative labour
- Complementor theory and digital innovations within platform space

Unit-3

Platforms and social processes

- Trust within a platform space and beyond
- Role of platforms in shaping interactions and intimacy between various users within a platform
- Geographical mobility platforms and role of maps in contemporary urban life
- Social mobility and platforms acting as an aspirational space
- Neoliberal subjectivity and communities of practice within platform ecosystems
- Financializing platforms and finance chains within the platforms

Unit-4

Transactions and Infrastructures of Platforms

- Digital Payments and Hub economy
- Exchange and Monetization of assets over platforms
- Financial Inclusion and Fintech platforms
- Cloud Computing and Infrastructures up in the air
- Platform Boundary Resources and Off-platform infrastructures on ground
- Socialization of Network effects within the informal economy

Unit-5

Platforms and Power

- Governance of Indian platform sector
- Same platforms and its heterogenous avatars depending State policies
- Data privacy and data harvesting within platform economy
- Contextual privacy within platform space
- Legal debacles and social movements faced by platforms

Reference books:

Athique, A., & Parthasarathi, V. (Eds.). (2020). *Platform capitalism in India*. Cham: Palgrave Macmillan.

Guyer, J. I. (2016). *Legacies, logics, logistics: Essays in the anthropology of the platform economy*. University of Chicago Press.

Lehdonvirta, V. (2022). *Cloud empires: How digital platforms are overtaking the state and how we can regain control*. Mit Press.

Metrick, A., & Yasuda, A. (2021). *Venture capital and the finance of innovation*. John Wiley & Sons.

Ravenelle, A. J. (2019). *Hustle and gig: Struggling and surviving in the sharing economy*. Univ of California Press.

Rosenblat, A. (2018). *Uberland: How algorithms are rewriting the rules of work*. Univ of California Press.

Shestakofsky, B. (2024). *Behind the startup: How venture capital shapes work, innovation, and inequality*. Univ of California Press.

Srnicek, N. (2017). Platform capitalism. *Polity*.

Van Dijck, J., Poell, T., & De Waal, M. (2018). *The platform society: Public values in a connective world*. Oxford university press.

In addition there would be journal articles that would be used to supplement the primary texts.

5.Teaching-Learning Strategies in brief (4 to 5 sentences):

This course aims to gives an immersive social science introduction to the 'platform' phenomena: network effects, venture capital and cloud infrastructures. The lectures will include videos, interviews, and popular articles to foster active learning. The quiz would include a writing exercise to evaluate the understanding of basic concepts. The first assignment would be a sociological film review, where the students use sociological concepts to dissect the film's narrative. In the second assignment, the students are expected present a contemporary journal article, where they engage with a state-of-the-art journal article to illustrate their sociological understanding of the paper and present a critique on it. Each assignment requires the students to read 30-50 pages of scholarly material.

6.Assessment methods and weightages in brief (4 to 5 sentences):

Type of Evaluation	Weightage (in %)
Mid Sem- Exam	**20%. Questions designed to evaluate understanding of basic concepts.**
End Sem Exam	**30%. Questions designed to evaluate understanding of basic concepts.**
Assignment 1	**20%. Related to Unit I, II, III (Sociological film review)**
Assignment 2	**20%. Related to Units III, IV and V (Project presentation)**
Quiz 1	**10% Related to Unit I and II**

Title of the Course **: Software Engineering**
Faculty Name : Karthik Vaidhyanathan
CourseCode :CS6.401
L-T-P :3-0-1
Credits :4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)

1. Prerequisite Course / Knowledge:
Students must have taken Intro to Software Systems, Design and Analysis of Software Systems or Equivalent courses

2. Course Outcomes (COs) (5 to 8 for a 3 or 4 credit course):

After completion of this course successfully, the students will be able to…
CO-1: Demonstrate familiarity with various process models, design patterns, architecture patterns and the characteristics of good software architectures

CO-2 Apply principles of user interface design, sub-system design and analyze the designs for good Software Engineering principles
CO-3: Demonstrate the use of tools to quantitatively measure and refactor existing software systems
CO-4: Compare design trade-offs between different patterns and/or different implementations of the same pattern
CO-5: Design the major components and user interface for a small-scale software system using modeling approaches such as UML class diagrams, and sequence diagrams
CO-6: Critique the quality of a software design and use product quality metrics to assess the quality of delivered software

3. Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO 3	PSO 4
CO1	1	2	1	1	1	1	1	1	2	2	1	1	1	1	1	1
CO2	1	2	2	2	2	2	2	1	3	3	2	2	1	1	2	1
CO3	2	1	2	3	3	1	1	1	2	2	2	2	2	2	1	2
CO4	2	1	2	2	2	1	1	1	3	3	2	2	1	1	2	2
CO5	1	1	2	2	2	1	1	1	3	3	1	1	2	1	2	2
CO6	1	2	3	3	3	1	1	2	3	3	1	2	2	2	2	2

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4. Detailed Syllabus:

Unit 1: Software Development Lifecyle and importance of architecture and design in the lifecycle, Process models; Modeling using UML.
Unit 2: Anti-patterns; Metrics and Measurement; Reverse Engineering and Refactoring.

Unit 3: Design Principles and Classification of Patterns

- Structural patterns: Adapter, Composite, Façade, Proxy, Decorator
- Behavioral patterns: Iterator, Observer, Mediator, Command, Memento, State, Strategy,
  Chain of Responsibility

- Creational patterns: Abstract Factory, Builder, Singleton, Factory Method

Unit 4: Software architecture and Architectural business cycle; Quality attributes and Tactics for achieving attributes; Architectural styles and Techniques; Designing Architectures, Case studies.

Reference Books:

1. Design Patterns: Elements of Reusable Object- Oriented Software. E. Gamma, R. Helm, R. Johnson, and J. Vlissides. Pearson, 2015, ISBN-13 : 978-9332555402
2. Refactoring: Improving the Design of Existing Code. Martin Fowler. Addison-Wesley, 2018. ISBN-13 : 978-0134757599
3. Software Architecture in Practice, 3rd edition by Len Bass, Paul Clements and Rick Kazman, Addison- Wesley, 2012. ISBN-13 : 978-9332502307

5. Teaching-Learning Strategies in brief (4 to 5 sentences):

The course is delivered using project based learning methodology. Topics like software subsystems modeling, design analysis, design trade-offs, language agnostic designs and component-based software development are taught and reinforced via unit level projects. The lectures emphasize the study and development of software sub-systems, comprehension and analysis of design quality attributes. The focus is on application of these concepts to concrete design problems through in-class design exercises and analysis of existing designs of currently implemented software systems. Entire class is run in a studio mode to facilitate discussion between student teams and discuss design trade-offs among students within student teams. Students present their designs and implementations to other students who are expected critique the designs.

6. Assessment methods and weightages in brief (4 to 5 sentences):

Final Exam	22 %
Mid-term Quiz	12 %
Unit Questions	12 %
3 Unit Projects (2 * 17) + (1 * 10)	44 %
Other In-class Activities	10 %

Title of the Course : **Software Programming for Performance**
Faculty Name : Suresh Purini
Course Code : CS3.302
L-T-P : 3-1-0
Credits : 2(Half semester course)
(L=Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Academic Program: B-Tech in Computer Science and Engineering

1. Prerequisite Course/Knowledge

Basics of Algorithm Analysis, Computer Architecture

2. Course Outcomes (COs)

After completion of this course successfully, the students will be able to

CO-1. Explain the algorithmic optimizations necessary to improve the performance of a software on a uniprocessor.
CO-2. Analyze cache dependent performance of algorithms
CO-3. Employ cache-aware (such as tiling)/cache oblivious (such as recursive multiplication) optimizations to improve program performance
CO-4. Analyze the software performance improvement using SIMD Array Processing and Vector Processing Architectures
CO-5. Explain different concurrency platforms such as Pthreads, Threading Building Blocks.
CO-6. Develop multicore programs using OpenMP pragmas
CO-7. Explain the basics of GPU architecture

4. **Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	-	1	-	-	-	-	-	2	-	3	1	1	1	1
CO2	3	3	-	3	1	-	-	-	-	1	-	3	3	3	1	3
CO3	3	1	-	2	-	-	-	-	3	1	-	3	3	1	1	1
CO4	3	3	-	3	1	-	-	-	-	1	-	3	3	3	1	3
CO5	1	1	-	1	-	-	-	-	-	2	-	3	1	1	1	1
CO6	3	2	-	2	3	-	-	1	3	1	-	3	3	2	2	3
CO7	1	1	-	1	-	-	-	-	-	2	-	3	1	1	1	1

Note 3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4. Detailed Syllabus

Unit 1: Algorithmic optimizations – Introduction to optimization of matrix multiplication: Language dependent performance, Loop ordering, compiler optimization, loop parallelization, tiling, vectorization

Unit 2: Memory Hierarchy aware Optimizations – Review on Caches, Conflict misses, Ideal Cache Model and cache misses, Cache analysis of matrix multiplication, Tiling, Recursive Matrix Multiplication

Unit 3: Using SIMD units – Flynn's Taxonomy, Data Parallelism, SIMD Array Processing, Vector Processing – Vector Registers, Vector Functional Units, Memory Banking, Basic Vector Code Performance, Vector Chaining, Multiple Memory Ports, Masked Vector Instructions

Unit 4: Programming Multi-cores – Shared Memory Hardware, Concurrency Platforms – Pthreads, Threading Building Blocks, OpenMP – Creating Threads, Synchronization: critical, barrier, Parallel loops, Data Sharing, Memory model

Unit 5: Acceleration using Hardware Accelerators (GPU)

Reference Books:
No specific text book, but the material would be taken from different books such as:

1) Cormen, Thomas H., et al. *Introduction to algorithms*.
2) Hennessy, John L., and David A. Patterson. *Computer architecture: a quantitative approach*.

5. Teaching-Learning Strategies in brief

Weekly lectures cover the topics in the syllabus. Tutorials cover how to use some tools for measuring performance of software implementations. There are couple of assignments that will provide the students experience in programming some functions and improve the performance employing the techniques learned in theory. Firstly they would learn how to improve cache performance and then exploit parallelism in code by employing multicore programming using OpenMP.

6. Assessment methods and weightages in brief

Type of Evaluation	Weightage (in %)
Quizzes	**40**
Assignments	**30**
Project (End semester)	**30**

Comment: Please revisit the Assessment and provide weightage for end semester exam for at least 30% marks

Title of the Course : Spatial Data Science

Faculty Name : K S Rajan
Course Code : CS4.410
Credits : 4
L - T – P : 3-1-0
(L - Lecture hours, T-Tutorial hours,
P - Practical hours)
Semester, Year : Spring 2025

Name of the Program : Open to All Programs on Campus at UG, PG/PhD Level

Pre-Requisites : Basic understanding of Locational Data and Computing – Any UG3,UG4, M.Tech., MS, and Ph.D. student should be able to take it.
Prior course work in Spatial Informatics may help.

Course Outcomes :

CO-1: Describe how Spatial Data Science helps uncover patterns
CO-2: Apply Geospatial techniques to Prepare the data for analysis
CO-3: Analyze the spatial and temporal data and interpret its outcomes
CO-4: Assessment of application of Spatial data science in key domain areas
CO-5: Design research projects that helps synthesize the learning into an application

Course Topics :

Module 1: Introduction to Spatial Data Science
- What is special about Spatial Data and Geo-AI?
- How Spatial and Spatio-temporal Big Data helps uncover patterns?
- Spatial Data Handling including spatial data models, data formats
- Challenges to computing approaches when applied to Spatial Data – Effectsof Topology

Module 2: Geospatial Data Analysis and Modelling
- Vector Data Spatial Analysis
- Raster Data Spatial Analysis
- How to use temporal data in conjunction with Spatial data
- GeoSpatial Data

ModellingModule 3: Spatial Sciences
- Spatial Statistics including Spatial auto-correlation, Spatial tessellation
  - o Data Mining applications on Spatial data including Spatio-temporalData Mining
- Network Analysis and Graph theory
- Few relevant topics from Computational Geometry
- Geovisualization – Maps to

WebGISModule 4: Spatial Classification and Prediction
- Spatial decision trees

- Machine learning as applied to Spatial Data including Spatial-aware NeuralNetworks
- Hotspot Analysis
- Spatial Outliers detection

Module 5: Applications of Spatial Data Science

- Public Health – monitoring and mapping diseases, risk analysis and diseasespread modelling
- Agriculture – crop growth monitoring, crop yield patterns and resourceconstraints
- Location based services – routing applications, ride-sharing algorithms,optimal location

Preferred Text Books :

1. Spatial Computing, By Shashi Shekar and Pamela Vold. The MIT Press. 2020
2. GIS – A computing perspective. By Micheal Worboys and Matt Duckham. CRC Press;2nd edition 2004
3. Spatial Databases: A Tour. By S. Shekhar and S. Chawla, Prentice Hall, 2003, ISBN013-017480-7 .
4. Selected Research Papers and Articles (will be shared with the topics taught on thecourse portal)

Reference Books :

1. Geographical Data Science and Spatial Data Analysis - An Introduction in R. By LexComber and Chris Brunsdon. SAGE Publications Ltd. 2020

E-book Links : Will be provided in Class as appropriate

Grading Plan :

Type of Evaluation	Weightage (in %)
Class Quizzes	**15.0**
Mid Sem Exams – 2	**20.0**
End Sem Exam	**30.0**
Paper reviews and Presentations byeach Student in Class	**10.0**
Project/Term paper demonstrating thePractical applications	**25.0**

Mapping of Course Outcomes to Program Objectives:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	3	-	-	-	1	2	-	-	3	2	-	-	-
CO2	2	-	-	-	3	-	-	-	2	-	-	-	2	-	2	2
CO3	3	2	-	-	3	-	-	-	2	-	-	-	2	2	3	2
CO4	3	2	3	3	2	2	-	3	2	3	-	3	3	2	2	3
CO5	3	3	3	3	2	3	1	3	3	3	2	3	2	3	2	3

Teaching-Learning Strategies in brief (4-5 sentences) :

Teaching - Learning
- Lectures Guest
- Lectures
- Reading research papers
- Class participation in Q&A, discussions
- Online discussions over MS Teams

Learning by doing
- Short Presentation and Discussion led by Student
- Course project on conceptualization and implementationReal world applications
- Multi-disciplinary approach

Title of the Course : Speech Signal Processing

Course Code : EC5.408
Name of the Faculty : Anil Kumar Vuppala
L-T-P 3-1-0
Credits 4
Name of the Academic Program B.Tech. in ECE

Prerequisite Course / Knowledge:
Suggested to have a Signal Processing course or DSA course.

Course Outcomes (COs):
After completion of this course successfully, the students will be able to..
CO-1: Explaining the speech production and modeling of it.
CO-2: Analyzing the algorithms for speech events extraction.
CO-3: Applying mathematical foundations of signal analysis for speech feature extraction.
CO-4: Analyzing the speech signals using excitation source and prosody.
CO-5: Explaining the basics of speech applications.

CO-6: Designing the algorithms for speech events detection and speech applications building.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO 1	2	2	1	1	1	1	1	1	2	1	1	2	-	3	-	-
CO 2	3	2	1	1	1	1	1	1	2	1	1	2	-	3	-	-
CO 3	3	2	2	1	1	1	1	1	2	1	1	2	-	3	-	-
CO 4	3	2	2	1	1	2	1	1	2	1	1	2	-	3	-	-
CO 5	2	3	2	2	1	2	2	1	2	1	1	3	-	3	-	-
CO 6	2	3	3	3	2	2	2	1	3	2	2	3	-	3	-	-

Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs). Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mappin Mapping with PSOs, where applicable.

Detailed Syllabus:

Unit 1: Overview of signal processing, speech production, speech perception, types of speech, and LTI model of speech production.
Unit 2: Pitch, formants, epochs and vowel region extraction.
Unit 3: Speech analysis: STFT analysis, Linear prediction analysis and cepstral analysis.
Unit 4: Prosody analysis and excitation source analysis of speech.
Unit-5: Applications of speech processing such as speech recognition, speaker recognition and speech synthesis.

Reference Books:

1. Introduction to Digital Speech Processing by Lawrence R. Rabiner and Ronald W. Schafer, now Publishers Inc. Hanover, USA, 2007.
2. Discrete Time Speech Signal Processing: Principles and Practice-Thomas F. Quateri, Ed., PE, 2004.
3. Speech Communications Human and Machine by Douglas O Shaughnessy, 2nd Edition, IEEE Press, 2000.
4. Speech and Audio Signal Processing, Processing and Perception of Speech and Music- Ben Gold and Nelson Morgan, Wiley- India Edition, 2006.

Teaching-Learning Strategies in brief (4 to 5 sentences):

It is an introduction to speech processing course, so regular software-oriented assignments are given to understand the concepts. Surprise class tests are conducted based on assignments to test the seriousness in assignment solving. As a part of teaching, practical systems like speech recognition, speaker recognition etc are demonstrated in the class. Course projects are given on the concepts learned to design speech applications.

Assessment methods and weightages in brief (4 to 5 sentences):

Quizzes	30%
Assignments	25%
Project	20%
End Viva	25%

Title of the Course : Statistical Mechanics

Name of the Faculty : Harjinder Singh

Course Code : SCI. 205

L-T-P : 2(90mins)-1-0

Credits : 2

(L= Lecture hours, T=Tutorial hours, P=Practical hours)

Name of the Academic Program: B Tech (CND)

1.Prerequisite Course / Knowledge: Thermodynamics, elementary classical and quantum mechanics

2.Course Outcomes (COs) (5 to 8 for a 3 or 4 credit course):

After completion of this course successfully, the students will be able to

CO-1 State principles of ensemble theory applied to statistical physics
CO-2 Apply statistical mechanics to investigate natural systems
CO-3 Apply scientific methodology to problems in allied disciplines.

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1		PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3		3		3						1	3			3	1	3
CO2	3		3		3	1					1	3			3	1	3
CO3	3		3		3						1	3			3	1	3
CO4																	
CO5																	

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4.Detailed Syllabus:
Unit 1: 1. The purpose of statistics: Bridging the micro and the macro, random walk, binomial distribution and the Gaussian limit: 1L
2. Ensemble, micro-canonical, canonical and grand canonical; Partition function, Lagrange multiplier technique to obtain the Boltzmann distribution: 2L
Unit 2: 3. Statistical expressions for thermodynamic functions for monatomic, diatomic and polyatomic perfect gases, equilibrium constant using partition function: 2L
4. Classical statistical mechanics, Liouville equation, Equipartition of energy: 1L
Unit 3: 5. Identical particles, Quantum statistics - Fermi-Dirac and Bose-Einstein statistics: 2L
6. Special topics (Real gases, Liquids, Lattice dynamics, Ising spins, etc.): 3L

Reference Books:
1. D. A. McQuarrie (2000), Statistical Mechanics, University Science Books, Paris
2. P W Atkins (2018), 11th Ed.Physical Chemistry, Oxford University Press, London
3. F Reif (2017), Fundamentals of Statistical and thermal Physics,(Berkeley Physics, vol. 5), McGraw Hill Education, NY

5.Teaching-Learning Strategies in brief (4 to 5 sentences):

Teaching currently is on line. Along with prepared slides, tools are used to write material extempore and draw pictures to explain the material.
Assignments are open for discussion before submission, though submission must be original. Class exercises are used for effective learning.
Instructor is available 24X7 for discussions over the net either by a meeting or over email. This interactive process has helped the students to develop clarity on the learning material.

6.Assessment methods and weightages in brief (4 to 5 sentences):

Quiz	**25%**
Final Exam	**55%**
Assignments (4)	**20%**

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Title of the Course : Statistical Methods in Artificial Intelligence
Faculty Name : Vineet Gandhi + CV Jawahar
Course Code : CS7.403
L-T-P : 3:1:0
Credits : 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Academic Program: Btech in CSE and Btech in ECE

1.Prerequisite Course / Knowledge:
Basic probability theory
Basic Linear Algebra
Good programming skills in Python
2.Course Outcomes (COs) (5 to 8 for a 3 or 4 credit course):

After completion of this course successfully, the students will be able to..
CO-1: Data processing: process raw data and convert it into machine exploitable format
CO-2: Problem formulation: formulate a practical problem as a machine learning problem (classification, clustering etc.)
CO-3: Classical algorithms: In depth investigation of theory and practice of classical algorithms in supervised and unsupervised learning (e.g. SVM, Kmeans, decision trees).
CO-4 Deep Learning: Introduction to theory and practice of deep learning and recent advances
CO-5 System building: design practical systems incorporating basic machine learning

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	2	2	1	3	2	2	3	2	2	2	2	2	2	1	2
CO2	3	3	3	3	1	3	2	3	1	2	2	3	1	3	2	2
CO3	1	2	2	2	2	1	2	1	1	1	2	3	3	2	2	3
CO 4	2	2	2	3	3	1	1	1	1	1	2	3	3	2	2	3
CO5	3	1	1	2	3	3	3	2	3	2	2	2	2	3	3	3

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4.Detailed Syllabus:

Unit 1:Review of basic statistics, linear algebra, probability
Unit 2: Problem formulation in ML, Decision Trees, Nearest Neighbours
Unit 3: Supervised Machine Learning (SVM, Random Forest, Boosting etc.)
Unit 4: Unsupervised Machine Learning (kmeans, recommendation, anomaly detection, PCA, LDF etc.)
Unit 5: Deep Learning

Reference Books:

1. Richard O. Duda, Peter E. Hart, David G. Stork, *Pattern Classification*, 2nd Edition, John Wiley and Sons, October 2000
2. Christopher M. Bishop, *Pattern Recognition and Machine Learning*, 2nd Edition, Springer, 2011
3. Ian Goodfellow and Yoshua Bengio and Aaron Courville, *Deep Learning*, 1st Edition, MIT Press, 2016

5.Teaching-Learning Strategies in brief (4 to 5 sentences):

The course involves heavy theory and programming components. The strategy is to first discuss a problem statement, introduce an algorithms and work out the details of the algorithm, and then use the algorithm to solve the problem. A lot of teaching on black board to discuss theory, large assignments are given for covering practical aspects and a large project is given mid-way of the course to cover the system building aspect.

6.Assessment methods and weightages in brief (4 to 5 sentences):

Programming Assignments: 25%

Quiz1: 10%
Quiz2 : 15%
Final exam: 25%
Course Project: 25%

Title of the Course : System and Network Security
Faculty Name : Ashok Kumar Das
Course Code : CS8.403
Credits : 4
L - T - P : 3-1-0

(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Name of the Program : MTech. in CSIS and Open Elective for B.Tech. in CSE
Semester, Year **:** Spring, 2025

Pre-Requisites **:** Data Structures and Algorithms and Principles of Information Security
Course Outcomes **:**
After completion of this course successfully, the students will be able to..
CO-1 Demonstrate a familiarity with concepts of computer attacks and core defense techniques
CO-2 Discuss various vulnerability testing schemes
CO-3 Apply the knowledge of cryptography to build secure and efficient communication channels
CO-4 Analyze and compare mobile platform security architecture of iOS and Android
CO-5 Design security modules against web and network attacks
CO-6 Develop a framework to test web applications' security

Course Topics **:**
Unit 1: Attacks and Vulnerabilities: Exploits and defenses in control hijacking attacks; principle of least privilege, access control, and operating systems security; isolation and sandboxing; vulnerability testing using fuzzing, static, and dynamic analysis; brief overview of cryptography.

Unit 2: Web Security: Basic web security mode; web application security; web session management; goals and pitfalls for HTTPS.

Unit 3: Network Security: Internet Protocol security; DoS and DDoS attacks; network defenses.

Unit 4: Security of Mobile Platforms: Mobile platform security architecture; Android and iOS security models; topics in Android security.

Unit 5: Low-level Architectural Security and Misc. Topics: Processor and microarchitecture security; Intel SGX and the Specter attack; privacy, anonymity, and censorship.

Preferred Text Books **:**
1. J. R. Vacca. "Network and System Security."
2. B. Menezes. "Network Security and Cryptography."

Reference Books **:**

1. W. Stallings. "Cryptography and Network Security: Principles and Practice." Research papers.

E-book Links :
Grading Plan :

Type of Evaluation	Weightage (in %)
Mid-term exams, quizzes	**20**
End-term exam	**30**
Assignments and projects	**50**

Mapping of Course Outcomes to Program Objectives:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	3	1	1	1	1	3	2	1	2	3	3	2	2
CO2	3	3	3	2	2	1	1	1	2	2	1	3	3	3	2	2
CO3	3	2	3	3	2	1	1	2	2	3	1	2	3	3	2	2
CO4	2	2	2	3	1	3	1	2	3	2	1	1	3	3	2	2
CO5	3	2	3	3	2	1	1	3	2	2	1	2	3	3	2	2
CO6	2	3	3	3	3	3	1	3	2	3	1	2	3	3	2	2

Teaching-Learning Strategies in brief (4-5 sentences):
The main objective of this course is to enable students to have a good understanding of the fundamental principles of computer systems and network security. It is designed to help the students understand various attack and defense techniques. The course is especially useful for students who plan to do research and/or product development in the area of system building.

Title of the Course : Technology Product Entrepreneurship

Faculty Name : Ramesh Loganathan, Prakash Yalla
Course Code : **CS9.424**
Credits : 4
L - T - P :3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Name of the Program : Technology product entrepreneurship-
Pre-Requisites : No prerequisites
Course Outcomes :

This course introduces the fundamentals of technology product entrepreneurship. You will learn the process of building a technology enterprise in a workshop format. Starting from a technology

idea, mapping the idea to a high-potential commercial opportunity, defining/designing/validating the product, figuring out the market avenues & how to sell the product, and planning/managing rapid growth.

The class will apply the learning to their tech product ideas and create a venture able product & plan; in a workshop mode thru extensive hands-on assignments concurrent with course modules.

CO1-Understand how to evaluate product ideas and assess the market opportunity in real-time, along with learning from current scenarios.

CO2-Connect products with markets and identify market & customer segments with the help of frameworks and business models.

CO3-Assess competition and evolve Value proposition for the product in cognisance of the current market trends and ever-evolving customer needs.

CO4-Be able to put a complete business plan for a technology product, after analysing the markets and building a GTM strategy.

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant).Program outcomes are posted at

https://iiitaphyd-my.sharepoint.com/:w:/r/personal/dyacad_iiit_ac_in/Documents/NBA-2020-21/Course%20Content/IIIT-CSE-ECE.docx?d=w111f0effcaea41b3a4d1e8a3fbc6332d&csf=1&web=1&e=z1Khby

PreferredTextBooks:
High Tech Start Up, Revised and Updated: The Complete Handbook For Creating Successful New High Tech Companies by John L. Nesheim
The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses by Eric Ries

Reference Books:
Technology Entrepreneurship: Overview, Definition, and Distinctive Aspects

1. http://timreview.ca/sites/default/files/article_PDF/Bailetti_TIMReview_February2012.pdf
2. Toward a General Modular Systems Theory and Its Application to Interfirm Product Modularity
3. http://amr.aom.org/content/25/2/312.abstract
4. Harvard: Why Lean Startup Changes everything
5. http://host.uniroma3.it/facolta/economia/db/materiali/insegnamenti/611_8959.pdf
6. The Power of Integrality: Linkages between Product Architecture, Innovation, and Industry Structure
7. http://www.sciencedirect.com/science/article/pii/S0048733308001091

E-book Links:

The Art of the Start by Guy Kawasaki

1. Demand: Creating What People Love Before They Know They Want It by Adrian J. Slywotzky with Karl Weber
2. The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business by Clayton M. Christensen
3. Running Lean: Iterate From Plan A to a Plan That Works by Ash Maurya
4. Positioning: The Battle for Your Mind by Al Ries and Jack Trout
5. Venture Deals by Brad Feld and Jason Mendelson
6. Lean Analytics by Alistair Croll and Benjamin Yoskovitz
7. Crossing the Chasm by Geoffrey A. Moore

Grading Plan:

Type of Evaluation	**Weightage (in %)**
Quiz-1	**20%**
Labs	**20%**
Tech Product Quiz-2	**20%**
Demo and Presentation	**10%**
Final submission	**30%**

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant). Program outcomes are posted at

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2	3	3	3	2	3	3	3	2	3	2
CO2	2	3	3	2	2	3	3	3	2	3	2	2	2	3
CO3	2	3	2	2	3	3	3	2	2	3	3	2	2	2
CO4	3	3	3	2	2	3	3	2	2	3	3	3	3	2

Teaching-Learning Strategies in brief (4-5 sentences) :

- Introduction: Assignment: Create startup website; Vision; Basic Positioning statement;
- Creativity & Innovation: Assignment: Based on team's tech idea considered, list 3 product possibilities, applying Idea hexagon framework.
- Frameworks & Models: Assignment: Assess opportunity for the ideas. And pick the "venturable business."
- Customer Discovery/Opportunity mapping: Assignment: Apply Lean Startup Methodology, and Validate customer interest, need &… ; Assignment: First cut of Musiness Model Canvass filled in
- Design Thinking: Assignment: Rapidly create and refine the product functionality for the teams product using design thinking process
- Customer Development: Assignment: Competitive Positioning; Assignment: Update Product functionality capturing the competitive proposition
- Sales & Market Strategy: Assignment: Evolve the GTM plans
- Business Plans: Assignment: Completed, defensible, business model canvass; Assignment: Product roadmap- market & technical, GTM plans, revenue projections

- Technical Architecture considerations: Assignment: Study 2 similar solutions in market and compare/contrast tech architecture used by your product
- Corporate Technology Innovation : TBD
- Tech Product Pitch/Plan presentations

Title of the Course : The Universe Across Scales

Name of the Faculty : Subhadip Mitra + Chittaranjan Hens + Diganta Das

Course Code : SC1.308

L-T-P : 3-1-0.

(L= Lecture hours, T=Tutorial hours, P=Practical hours)

Credits : 4

Name of the Academic Program:

1. Prerequisite Course / Knowledge:

High school-level physics and calculus, basic exposure to classical mechanics

2. Course Outcomes (COs):

After completing this course successfully, the students will be able to

- **CO-1 Discover** the physics at the scales of atoms and elementary particles
- **CO-2 Familiarize** with the basics of relativity theory
- **CO-3 Demonstrate** how patterns at the macroscopic level emerge from physics at the microscopic scale
- **CO-4 Explain** the large-scale structure of the universe, including the essential evolutionary stages, like the inflationary stage, hot big-bang stage, nucleosynthesis, recombination, etc.
- **CO-5Recognize** how physics at vastly different scales come together to shape the present universe

2. **Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1									2	1	3	1	1
CO2	3	1	1									2	1	3	1	1
CO3	3	1	2									2	1	3	1	1
CO4	3	2	2									2	1	3	1	1
CO5	3	2	2									2	1	3	1	1

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4. Detailed Syllabus:

The aim of the course is to present a broad overview of physics across different scales—from the quantum mechanical world of the elementary particles to gravity-controlled large-scale structures through physics at the everyday scales. To teach the students simple calculations and estimations to appreciate the beautiful rules that nature seems to follow at different scales and the emerging patterns.

Unit-1: Fast and small

1. Special Theory of Relativity: time dilation, length contraction, Lorentz transformation, and the mass-energy relation [2]
2. A brief introduction to the core ideas of Quantum Mechanics: the double-slit experiment, the Schroedinger equation, wave-function, the basic postulates, and the particle-in-a-box problem [3]
3. Elementary particles, fundamental interactions, composite states: nucleons, atoms, molecules [3]

Unit-2: The patterns in the middle

4. Statistical Physics in Brief [2]
5. Universal scaling in networks, Fractals in nature—from the sub-cellular level to social interactions (analysis with real networks) [4]
6. Collective motion of self-propelled particles/swarmmalators: Flocking of birds and bacterial clusters. Scale-invariance property under different scales: from microorganisms to large ecological systems [2]

Unit-3: Slow and big

7. Large-scale structure of the Universe, a brief history [1]
8. Olber's paradox, Isotropy and homogeneity, Hubble's law [1]
9. The Universe: according to Newton and Einstein [2]
10. Dynamics of the expanding Universe: Friedmann equations [2]
11. Cosmic Microwave Background, Big Band Nucleosynthesis and inflation [2]

Reference Books:

1. Introduction to Quantum Mechanics by David J Griffiths

2. Introduction to Elementary Particles by David J Griffiths

3. Dynamical Processes on Complex Networks by Alain Barrat, Marc Barthelemy, Alessandro Vespignani

4. Introduction to Computational Physics, Lecture of Prof. H. J. Herrmann

5. Introduction to Cosmology by Andrew Liddle

6. Introduction to Cosmology by Barbara Ryden

5. Teaching-Learning Strategies in brief:

The objective is to present a broad overview of some of the advanced theories of physics that describe the universe at different length scales. Lectures are designed to keep the in-depth technical details at a minimum level. Instead, focus is given more on intuitive understanding. Lessons are augmented by additional study materials including YouTube videos and not-too-technical scientific articles.

6. Assessment methods and weights in brief:

Assignments + Quizzes – (30%), Mid-term evaluation (30%), Final exam (40%)

Title of the Course : Thermodynamics

Name of the Faculty : Harjinder Singh
Course Code : SC1.204
L-T-P : 2(90mins)-1-0
Credits: 2 (L= Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Academic Program : B Tech (CND)

1.Prerequisite Course / Knowledge: Basic (High school) physics/chemistry

2.Course Outcomes (COs) (5 to 8 for a 3 or 4 credit course):

After completion of this course successfully, the students will be able to..

CO-1 State principles and laws of Thermodynamics
CO-2 Apply thermodynamics to investigate natural phenomena
CO-3 Apply thermodynamic principles to allied disciplines like information processing.

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1		PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3		3		3						1	3			3	1	3
CO2	3		3		3						1	3			3	1	3
CO3	3		3		3						1	3			3	1	3
CO4																	
CO5																	

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs. Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4.Detailed Syllabus:

Unit 1: 1. Thermodynamic space, system and surroundings, variable, function, Thermodynamic process and energy transaction: Work, Heat; Walls: Diathermal, Adiabatic, (im)permeable 1L
2. Properties of Gases: Perfect and real: 1L
3. Zeroth law and temperature, first law and internal energy, enthalpy, thermochemistry, Hess's law :1L
4. Expansion Work, Isothermal and Adiabatic Changes, Heat capacity :1L

Unit 2: 5. Second law and equivalence of different ways of stating it, Clausius inequality The Joule-Thomson Effect, Entropy, Heat Engine, Refrigerator, Carnot Cycle: 2L
6. Helmholtz and Gibbs Free Energies, thermodynamic equation of state, criteria for spontaneity, chemical potential, variation with temperature and pressure, Maxwell relations :2L
7. Fugacity and activity :1L

Unit 3: 8. Thermodynamics of mixing, Phase Diagrams and Phase Transitions: 2L
9. Chemical equilibrium, Equilibrium constant and standard free energy :1L
10: Equilibrium electrochemistry

Reference Books:

1. M W Zemansky and R H Dittman (1997), Heat and Thermodynamics, 7th Ed., McGraw-Hill Education,NY
2. P W Atkins (2018), 11th Ed.Physical Chemistry, Oxford University Press, London

5.Teaching-Learning Strategies in brief (4 to 5 sentences):

Along with prepared slides, tools are used to write material extempore and draw pictures to explain the material.

Class exercises are used to ensure effective learning.

Assignments are open for discussion before submission, though submission must be original. Instructor is available 24X7 for discussions over the net either by a meeting or over email. This interactive process has helped the students to develop clarity on the learning material.

6.Assessment methods and weightages in brief (4 to 5 sentences):

Quiz	*25%*
Final Exam	*55%*
Assignments (4)	*20%*

Title of the Course : **Thinking and Knowing in the Human Sciences – I**
Name of the Faculty : Saurabh Todariya + Subha Chakraburtty
Course code : HS0.201
L-T-P : 3-1-0
Credits : 4
Name of the Academic Program: CHD
1. Prerequisite Course / Knowledge: Nil

2. Course Outcomes (COs)

After completion of this course successfully students will be able to:

CO1: Explainthe basics of philosophical discourse and develop interpretative skills

CO2: Demonstrate knowledge of conceptual challenges involved in philosophical analysis

CO3: Discuss philosophical questions about the nature of thought, knowledge and understanding

CO4: Analyzethe ways in which literary practices imagine and express our relation to the world.

CO5: Survey sets of concepts and intellectual assumptions that constitute historical, cultural, textual, and critical methods of literary analyses

CO6: Consider specific moments of intersection between "meta-inquiry" and questions of representation.

3. Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	2	3	1	3	1	2	1	3	1	3	2	3	3	2
CO2	2	2	1	1	1	2	2	3	1	2	1	3	1	2	3	3
CO3	1	2	2	2	2	2	1	2	1	2	1	3	1	2	2	3
CO4																
CO5																
CO6																

'3' in the box denotes 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

Pl. map the COs 4, 5 and 6 also to the POs.

4. Detailed Syllabus:

Section A: Philosophy

Unit I – Philosophical tools (5 hours): conceptual distinctions, argument analysis, definition, evidence, belief, knowledge, justification, confirmation, and inference to best explanation.

Unit II – Knowledge and its limits (6.5 hours): kinds of knowledge and its sources, the problem of induction, scepticism about our senses regarding the external world, and skepticism about reflection regarding the internal world.

Unit III – Cognition and its nature (6.5 hours): dualism and the mind-body problem, functionalism and the computational account of thinking, physicalism and qualia, subjective experience and the hard problem of consciousness.

Reference books:

1) Baggini, J. and Fosl, P. 2010. *The Philosopher's Toolkit: A Compendium of Philosophical Concepts and Methods*. Wiley-Blackwell.

2) Stich, S. and Donaldson. T. 2019. *Philosophy: Asking Questions, Seeking Answers*. Oxford University Press.

3) Rosen, G., Byrne, A., Cohen, J., Harman, E., and Shiffrin, S. 2018. *The Norton Introduction to Philosophy.* W.W. Norton and Co.

4) Williamson, T. 2018. *Doing Philosophy: From Common Curiosity to Logical Reasoning*. Oxford University Press.

Section B: Literature

PREFERRED TEXT BOOKS FOR SECTION B

Unit 1. Dickens, Charles. *A Tale of two Cities.* 1859.

Wilde, Oscar. *The Picture of Dorian Gray.* 1890.

Unit 2. Lee, Harper. *To Kill a Mockingbird.* 1960

Morrison Toni. *Beloved*. 1987

Unit 3. Rushdie, Salman. *Haroun and the Sea of Stories*. 1990.

Shahid Ali, Agha. *The Country Without a Post Office.* 1997

REFERENCE BOOKS FOR SECTION B

1. Leitch, Cain, Finke, Johnson, McGowan, and Williams, eds. *The Norton Anthology of Theory and Criticism*. 2nd ed. New York: W.W. Norton & Co., 2010.

2. Eagleton, Terry. *Literary Theory*. 3rd ed. Minneapolis: University of Minnesota Press, 2008. The Norton Anthology of Poetry (6th ed.)

3. Rivkin, J. and Ryan, M., ed: *Literary Theory: An Anthology* (Blackwell, Oxford, 2nd ed.)

5.Teaching-Learning Strategies in brief:

Section A: Philosophy – the general teaching strategy employed is the use of conceptual puzzles to introduce course topics. Lectures make use of this strategy to impress upon students the need to critically reflect on problems and the relevance of doing a careful, philosophical investigation of those issues. Students are taught effective reasoning skills to engage with abstract ideas without spoon feeding them any settled philosophical truths. They are trained to think for themselves in a

clear and organized manner and encouraged to ask meaningful questions that enrich debates about what we take for granted in thinking and knowing about the world and ourselves.

Section B: Literature– Plays, novels and poetry have given their authors and their readers an opportunity to consider what it is to be human. This course looks at some the ways in which literary practices imagine and express our relation to the world. The module will survey sets of concepts and intellectual assumptions that constitute historical, cultural, textual, and critical methods of literary analyses. We shall look at specific texts to see how the field of literary studies has evolved to reformulate its primary concerns and moved beyond canon formation to questions of epistemology and subjectivity.

Students are expected to read six full texts in the course of the module.

6. Assessment methods and weightages in brief:

Section A: Philosophy – questions are carefully designed to make students reflect critically on what they read. Students are assessed for abilities like logically dissecting issues, questioning assumptions, clarifying distinctions, and bringing out nuances. In assignments and exams, students are expected to demonstrate these abilities by presenting their views clearly, assessing competing positions systematically, anticipating possible objections to a reasoned conclusion and composing cogent responses to those objections. The assessment components and their weightages are as follows. Assignments: 35%, Essay 10%, and class participation: 10%.?

Section A: Literature

Type of Evaluation	**Weightage (in %)**
In-Class assignments (Due every week)	**20%**
Term Paper 1	**10%**
Term Paper 2	**15%**
Participation	**5%**

Title of theCourse : Time FrequencyAnalysis

Faculty Name : Anil Kumar Vuppala +Chiranjeevi Yerra
Course Code : EC5.402
L-T-P : 3-1-0
Credits : 4
NameoftheAcademicProgramB.Tech. in ECE

Prerequisite Course/Knowledge:

ShouldhavetakenSignalProcessingcourse.

Course Outcomes (COs):

After completion of this course successfully, the students will be able to..

CO-1 : Demonstrate usability of joint time-frequency transforms and distributions insignal processing.
CO-2: Apply principles of time & frequency fundamentals to understand uncertaintiesin joint time-frequency representation.

CO-3: Developing mathematical foundation for joint time-frequency representation.
CO-4: AnalyzingsignalswithWavelettheoryofsignalprocessing.
CO-5: Explaining the application of advanced transforms for signal analysis.
CO-6: Designing the algorithms for modeling non-stationary signals.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) andProgram Specific Outcomes (PSOs)

	PO1	PO2	PO 3	PO4	PO 5	PO6	PO7	PO 8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O 3	PS O 4
CO1	2	2	1	1	1	1	1	1	2	1	1	2	-	3	-	-
CO2	3	2	1	1	1	1	1	1	2	1	1	2	-	3	-	-
CO3	3	2	2	1	1	1	1	1	2	1	1	2	-	3	-	-
CO 4	3	2	2	1	1	2	1	1	2	1	1	2	-	3	-	-
CO5	2	3	2	2	1	2	2	1	2	1	1	3	-	3	-	-
CO 6	2	3	3	3	2	2	2	1	3	2	2	3	-	3	-	-

EachCourseOutcome(CO)maybemappedwithoneormoreProgramOutcomes(POs).Write‘3’intheboxfor‘High-level’mapping,2for‘Medium-level’mapping, 1 for ‘Low’-level’mapping
Mapping with PSOs, where applicable.

DetailedSyllabus:

Unit1: IntroductiontoVectorSpace,BasisFunctions,Basis,Frames.ReviewofFourier series and transform.
Unit2: Fundamentalsoftimeandfrequency.Time-bandwidthproduct.Uncertaintyprinciple.
Unit3:STFT,Wavelettheoryofsignalprocessing,multi-resolutionanalysis.
Unit4: Wigner Villedistribution,HHTandS-transform.
Unit-5: Applications in signal and image processing.

ReferenceBooks:

1. Time-Frequency Analysis,L.Cohen,PrenticeHall,1997.
2. Awavelettour of signal processing,S.Mallat,Thirdedition,AcademicPress,2009.
3. Fourier and wavelet signal processing, Kovacevic,J.,Goyal,V.K.andVetterli,M., 2013.

Teaching-LearningStrategiesinbrief(4to5sentences):

It is a mathematical oriented signal processing course, so regular problem-solving assignments are given to understand the concepts. Surprise class tests are conducted based on assignments to test the seriousness in assignment solving. As apart of teaching, practical examples like speech and images are used for demonstration of mathematical concepts learned. Advanced concepts applications are studied by doing course projects.

Assessmentmethodsandweightagesinbrief(4to5sentences):

Assignments -- 20%Mid exams-- 30%End Project -- 15%Endexam--35%

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Title of the Course: Topics in Information-Theoretic Privacy

Name of the Faculty : Gowtham Raghunath Kurri + Prasad Krishnan
Course Code : CS8.502
Credits : 4
L - T - P : 3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring, 2025

Pre-Requisites : Mathematical maturity and basics of discrete probability theory. No background in Information Theory is assumed for the course.

Course Outcomes : After successful completion of the course, the students will be able to

1. Demonstrate a familiarity with information-theoretic approaches to various problems in privacy.
2. Articulate the axioms of a privacy leakage measure.
3. Illustrate the applications of information-theoretic tools in operationally quantifying privacy leakage.
4. Model differential privacyin terms of an information-theoretic channel highlighting the connection betweenprivacy and utility.
5. Describe the algorithms for achieving privacy and correctness simultaneously for the problems in private information retrieval.

Course Topics :

Module 0: Review of discrete probability theory (1 Lecture)

Module 1: Information-Theoretic Tools– Entropy, mutual Information, chain rule for entropy and mutual information, relative entropy, Fano's inequality, Han's inequality, data-processing inequality,Rényi entropy and divergence, Sibson's Mutual Information (approx. 5 Lectures)

Module 2: Information/Privacy Leakage – Operational approach to information leakage,axioms of a leakage measure,types of leakage measures and their properties - mutual information,min-entropy leakage, and maximal leakage, introduction to applications in this course (approx. 8 Lectures)

Module 3: Information Theoretic Privacy Approach to Information Retrieval, Computation and Learning: Information Theoretic PIR and Computational PIR, IT-PIR Capacity with Multiple Servers and Replicated Storage, Weakly/Leaky PIR under various Loss Metrics, PIR under Coded Storage, PIR-like approaches to other problems: Secure Distributed Matrix Multiplication, Secure Aggregation, Federated Learning) (approx. 6 Lectures)

Module 4: Information Leakage with Differential Privacy – Differential privacy (DP) and its properties (composition and post-processing), relation between DP and information flow, bounds on information leakage of DP mechanisms, privacy-utility tradeoff in the information-theory framework (approx. 6 Lectures)

Preferred Textbooks/Reference Material: There is no preferred textbook for the course. The course broadly covers topics and material from various textbooks and research articles. Some of them are listed below.

- Cover and Thomas. *Elements of Information Theory.* John Wily and Sons.
- Issa, Wagner, and Kamath, "An Operational Approach to Information Leakage," IEEE Transactions on Information Theory, 2020.
- Geoffrey Smith, "Recent Developments in Quantitative Information Flow," ACM/IEEE Symposium on Logic in Computer Science, 2015.
- Sun and Jaffar, "The Capacity of Private Information Retrieval," IEEE Transactions on Information Theory, 2017.
- "Private Information Retrieval and Its Applications: An Introduction, Open Problems, Future Directions" , Sajani Vithana and Zhusheng Wang and SennurUlukus, Available at - https://arxiv.org/abs/2304.14397
- S. Vithana and S. Ulukus, "Private Read Update Write (PRUW) with Storage Constrained Databases," 2022 IEEE International Symposium on Information Theory (ISIT), Espoo, Finland, 2022, pp. 2391-2396, doi: 10.1109/ISIT50566.2022.9834439.
- K. Banawan and S. Ulukus, "The Capacity of Private Information Retrieval From Coded Databases," in IEEE Transactions on Information Theory, vol. 64, no. 3, pp. 1945-1956, March 2018, doi: 10.1109/TIT.2018.2791994.
- H. -Y. Lin, S. Kumar, E. Rosnes, A. Graell i Amat and E. Yaakobi, "The Capacity of Single-Server Weakly-Private Information Retrieval," in IEEE Journal on Selected Areas in Information Theory, vol. 2, no. 1, pp. 415-427, March 2021, doi: 10.1109/JSAIT.2021.3056327.
- R. Freij-Hollanti, O. W. Gnilke, C. Hollanti, A. -L. Horlemann-Trautmann, D. Karpuk and I. Kubjas, "t-private information retrieval schemes using transitive codes," in IEEE Transactions on Information Theory, vol. 65, no. 4, pp. 2107-2118, April 2019, doi: 10.1109/TIT.2018.2871050.
- O. Makkonen and C. Hollanti, "General Framework for Linear Secure Distributed Matrix Multiplication with Byzantine Servers," *IEEE Information Theory Workshop (ITW)*, Mumbai, India, 2022, pp. 143-148, doi: 10.1109/ITW54588.2022.9965828.
- Benny Chor, Eyal Kushilevitz, Oded Goldreich, and Madhu Sudan. 1998. Private information retrieval. J. ACM 45, 6 (Nov. 1998), 965–981. https://doi.org/10.1145/293347.293350
- Alvim *et al.,* "Differential Privacy: On the Trade-off Between Utility and Information Leakage," International Workshop on Formal Aspects of Security and Trust, 2012.
- Barthe and Kopf, "Information-Theoretic Bounds for Differentially Private Mechanisms," Computer Security Foundations Symposium.

Grading Plan :
(The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz	10 %
Mid SemExam	20 %
End Sem Exam	30 %
Assignments/Scribes	15 %
Project	25 %

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant).

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2	1	1	2	1	1	1	2	2	2	2	1	1	2
CO2	3	2	1	2	1	2	1	2	1	3	1	2	3	2	1	3
CO3	3	2	2	1	2	1	3	1	1	2	2	2	2	1	2	2
CO4	2	3	2	2	1	2	1	3	1	3	2	2	2	2	2	2
CO5	3	2	3	2	1	2	1	2	1	2	1	2	3	2	2	3

Teaching-Learning Strategies in brief (4-5 sentences):

Even though basic probability theory is a prerequisite for the course, there will be a refresher lecture reviewing all the concepts from it to ensure all the students are on the same page. All the concepts and the theoretical results in the course are illustrated through examples and/or applications whenever possible so that the students can comprehend them easily.

Title of the Course : Topics in Reinforcement learning

Faculty Name : Tejas Bodas & Harikumar Kandath
Course Code : **CS7.603**
Credits : 4
L - T - P :
(L - Lecture hours, T-Tutorial hours,
P - Practical hours) 2-2-0
Semester, Year : Spring 2025
(Ex: Spring, 2022)
Name of the Program : CSE /ECE

Pre-Requisites : MA6.101 Probability and Statistics or Equivalent (Compulsory), MDL, Stochastic processes, or equivalent (desirable)

Course Outcomes :

Course outcomes
(CO's): After completion of the course, the students will be able to

1. ~ Analyze, understand and apply the theory of Markov Decision processes
2. ~ Analyze, understand and apply the theory of Reinforcement learning
3. ~ Implement reinforcement learning algorithms using Python
4. ~ Implement RL projects in group demonstrating use cases for topics learnt.

Course Topics **:** Following is the tentative list of topics to be covered in this course in about 12 lectures. (Each lecture is of 90 mins.)

Module 1: (3 lectures)

- Review of Probability and Stochastic Processes
- Markov Chains
- Introduction to Optimization
- Introduction to Dynamic programming and Markov Decision Processes

Module 2: (5 lectures)

- Infinite horizon discounted MDP
- Bellman Optimality Criteria
- Value Iteration & Policy Iteration
- Average cost criteria

Module 3; (6 lectures)

- Introduction to RL
- Monte Carlo methods
- TD Learning, Q-learning and Bootstrapping

Module 4: (5 lectures)

- Systems with continuous state-action space, Controllability and stability
- Linear Quadratic Regulator (LQR)
- Policy Iteration (PI) and Value Iteration (VI) methods

Module 5: (5 lectures)

- Function approximation techniques – DQN
- Actor-Critic methods
- Integral reinforcement learning
- Policy gradient methods

Preferred Text Book : Reinforcement learning: An Introduction by Sutton and Barto

Reference Books **:**

1) Applied probability models with Optimization Applications by Sheldon Ross
2) Approximate Dynamic programming by Warren Powell
3) Simulation based optimization: Parametric optimization techniques and Reinforcement learning. Abhijit Gosavi, 2015
4) Optimal Adaptive Control and Differential Games by Reinforcement Learning Principles. D. Vrabie, Kyriakos G. Vamvoudakis, Frank L. Lewis, 2013.

E-book Links **: NA**

Grading Plan **:**
(The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz-1	**10**
Mid SemExam	**20**
Quiz-2	**10**
End Sem Exam	**20**
Assignments	**20**
Project	**20**
Term Paper	**0**
Other Evaluation	**0**

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant). Program outcomes are posted at

	PO1	PO2	PO3	PO 4	PO5	PO 6	PO7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O1	PS O2	PS O3	PS O4
CO1	3	3	3	2	2	2	-	-	2	1	1	2	3	2	2	3
CO2	3	3	3	2	2	2	-	-	2	1	1	2	3	2	2	3
CO3	3	3	3	2	2	2	-	-	2	1	1	2	3	2	3	3
CO 4	3	3	3	2	1	1	2	1	1	1	1	2	3	2	3	3
CO5																

Teaching-Learning Strategies in brief (4-5 sentences) :

- The course is planned to be a balance between theory and practice.
- Traditionally, this course has been a theory intensive course with little emphasis on implementation and applications. We will however flip this around.
- We will introduce theoretical mathematical concepts on a need to know basis or as and when required.
- The emphasis will be to look at a lot of examples of MDP's and RL algorithms and possible be able to use them in real world examples.

Title of the Course : Topics in Speech-to-Speech Translation (SSMT)
Faculty Name : Chiranjeevi Yerra + Parameswari Krishnamurthy
Course Code : CL5.401
L-T-P : 3-1-0
Credits : 4
Name of the Academic Program B. Tech. in CSE and ECE

Prerequisite Course / Knowledge:
Suggested to have a Speech Signal Processing course or NLP course.

Course Outcomes (COs):
After completion of this course successfully, the students will be able to..

CO-1 :Explaining the need for speech to speech translation
CO-2: Explaining ASR, MT and TTS systems.
CO-3: Applying AI models for ASR, MT and TTS.
CO-4: Analyzing the discourse role in SSMT.
CO-5: Explaining the issues in speech to speech translation.
CO-6: Designing speech to speech translation systems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	1	1	1	1	1	2	1	1	2	-	3	-	-
CO2	3	2	1	1	1	1	1	1	2	1	1	2	-	3	-	-
CO3	3	2	2	1	1	1	1	1	2	1	1	2	-	3	-	-
CO4	3	2	2	1	1	2	1	1	2	1	1	2	-	3	-	-
CO5	2	3	2	2	1	2	2	1	2	1	1	3	-	3	-	-
CO6	2	3	3	3	2	2	2	1	3	2	2	3	-	3	-	-

Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs). Write '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping Mapping with PSOs, where applicable.

Detailed Syllabus:
Unit 1: Introduction to SSMT with demos. Automatic speech recognition introduction and state of the art approaches.
Unit 2: Machine translation introduction and state of the art approaches.
Unit 3: TTS introduction and state of the art approaches.
Unit 4: Role of discourse and prosody in SSMT.
Unit-5: Corpus standards. Need for human in the loop of SSMT and research issues in SSMT.

Reference Books:

1. **Speech and Language Processing (3rd ed. draft) by Dan Jurafsky and James H. Martin**
2. Machine Translation by Bonnie Jean Dorr, MIT press.

Teaching-Learning Strategies in brief (4 to 5 sentences):

It is topics course in speech to speech translation. Indian government has taken Speech to speech translation in Indian languages as mission project. There is a need to generate manpower in this new are which is combination of NLP and Speech domains. This is mainly project oriented course. After demonstration of necessary topics like Machine translation, ASR and TTS projects will be given.

Assessment methods and weightages in brief (4 to 5 sentences):

Quiz 20%
Assignments 30%
Project 50%

Title of the Course : User Interaction and Usability of Digital Products

Faculty : Raman Saxena
Course Code : CS5.401
No. of Credits : 4
Format: Lecture; Tutorial; Labs/Studio: 1.5 -1- 3

Target Students: Open elective for UG, DD and PG Humanities, and across CS and EC programme
Pre-requisite: No
Class size: 30 Students max.

Course Objectives & Outcomes

A Positive and Delightful User Experience and High Usability is critical for the succesful acceptance and adoption of any software and digital products by their targeted users. This course focuses on the principles and techniques in the design of an easy to use, safe, trustworthy, efficient and comfortable interaction between human and computers under the overall goal of delivering a delightful user experience, which is the key successfactor for any software and digital products.

This course introduces the fields of Interaction Design, User Experience (UX) Research, UX Design, and Usability of software and digital products & systems. Students will learn about the Human-Centered SoftwareDevelopment Lifecycle including gaining an understanding of what is involved in Designing Interactions and User Experience (Human-computer Interaction-HCI, Human-Centered Design - HCD, Digital Anthropology,Cognitive/Mental Models, Human-Action Cycle, Perception, Attention and Memory, Gestalt Principles/laws, Information Architecture, Task/User Flows, etc.), UX Research (understanding User Needs & Requirements, Ethnography Research, Contextual Inquiries, Interviews, Qualitative and Quantitive Research, User Personas, Use Cases diagrams, etc.), Software Usability (Including Low Fidelity and High-Fidelity Prototyping, Heuristic Review, Usability Matrix, Usability Evaluation/Testing in the development cycle, etc.) using principles of interaction design, user experience, and usability engineering. The course will also investigate technology trends such as AI influence on User Interfaces and UX, Conversational User Interfaces (Chatbots.),etc., and their influence on the interactions between users and computers.

A significant number of students graduating from the CS and ECE backgrounds serve as software engineers and developers in the IT, Software and other industry working on designing and developing software and digital products and systems. This course will not only help them better prepare to design and develop human-centered, easy to use & usable software and digital

products and system leading to higher acceptance and adoption of those products but also to work with the product managers and designers more collaboratively andeffectively.

Learning Outcomes

LO-1: Demonstrate good understanding and implementation of User-centered design, HCI. Software interaction Design, Principles of User Experience and Software Usability in software development lifecycles.

LO-2: Demonstrate good understanding of Interaction design and user experience from the perspectives of human- centered design and human/social sciences including digital anthropology and cognitive sciences, Cognitive Modeling, Human-Action Cycle (HAC), Designer Models, User Workflows, Task analysis and Modelling and System Images.

LO-3: Demonstrate good understanding and skills to conduct User Experience Research, collect User Requirements, UserPersonas, Use Cases, and evaluate acceptance and adoption of software and digital products and services amongst the targeted user group.

LO-4: Demonstrate the ability and skills for Information and Data Visualization, Information Architecture, Interaction Models, User Interface Elements, Wireframes and Rapid Prototyping and to articulate new trends in HCI/UX and UI - including AI Influence on UI/UX, Conversational UI or chatbot interfaces

LO-5: Demonstrate good understanding of software usability, usability matrix and skills to conduct usability evaluations including heuristics reviews, usability testing of the software and digital products along with documenting deliverables and communicating course project outcomes

LO- 6: Exhibit aptitude for working in teams and deliver task outcomes effectively.

LO	PO1	PO 2	PO3	PO4	PO 5	PO 6	PO7	PO8	PO9	PO1 0	PO 11	PO 12	PS O1	PS O2	PSO 3	PSO 4
LO1	1	1	3	3												2
LO2				3		3										2
LO3							1	3				3				
LO4					3								3	3		
LO5										3				3	3	
LO6									3		2	3			2	

Teaching-Learning Strategies

To enhance the learning and making it interesting and motivating, other than lecture sessions this course will include lotsof interactive and hands-on activities, quizzes, classroom, fieldwork, and studio assignments and experiments both individual and group. Accordingly in the beginning, this course will run like a lecture and tutorial format but later it willtransform into a studio format with students working on a project exploring Human-centered Software Design and Development Lifecycle, User Experience and UX in domain of their interest including, software/IT products including Mobility, Healthcare, Learning, E-commerce, and Utility etc. to experience the full HCI /UX cycle. The course will introduce and discuss a few case studies to HCI, User Experience and UI Design of software/IT/digital products, applications, and services. Other than attending lectures and doing classroom exercises & assignments, students need to spend 4 hours per week on home/field assignments.

Lesson Plans

- The Course will be divided into lectures (around 24, around 12 in each part) and hands-on work includingassignments, classroom exercises and homework.

- The course will also include fieldwork, hand on activities, learning by doing, to practice the learning from thelectures.
- Introduce and discuss a couple of case studies including cases related to the new product development and ICTdomain.
- It will introduce and discuss a couple of case studies including cases related to HCI, User Experience and UIDesign of software products.
- Design Project covering Interaction Design, User Experience Design and =project to practice HCI, UX, UI andUsability learnings.
- Other than attending lectures and doing classroom exercises & assignments students need to spend around fourto five hours per week on home/field assignments.

This course will consist of the following units.

UNIT 1: Introduction to User Experience	**UNIT 2: Understanding Human-Machine System**
• What is User Experience and UX Design? • How User interact with outside world? • Human Conceptual/Mental models • Conflict between Mental Models andDesign Models.	• Understanding Human-Machine System • Human-Action Cycle (HAC) • 7 stages of Human-action cycle • User Experience Research
UNIT 3: Social and Human Science inInteraction, UX and Usability	**UNIT 4: User-Centered approach to Software Design**
• Digital Anthropology • Ethnographic Design • Attention and Memory • Gestalt theory and principles • UI Elements including color andinteraction models.	• Perceived Usefulness & Ease of Use • Understanding User Persona • Why user person is important • Use cases, User stories • Task Flows & Task Analysis • Human-centered software Design Workflow • UXUI Qualitative Research
UNIT 5: User Experience and UI Design	**UNIT 6: New Trends and Project Documentation**
• Information Architecture • Wireframes and Storyboards • Interaction Design and UX Project	• AI influence on User Interface/Intelligent Interfaces • Chat Bots - Conversational User Interfaces • Project Work-in-progress Document
UNIT 7: Software/Digital Product Usability	**UNIT 8: Prototyping**
• Introduction to Software Usability? • Why should we evaluate usability? • Usability Goals	• Why prototype • Low Fidelity prototypes • High Fidelity Prototypes • Rapid Prototyping tools
UNIT 9: Usability Evaluation	**UNIT 10: Planning for Usability Evaluation**

• Types of Usability Evaluation • Usability Reviews, • Heuristic Evaluation • Usability Testing	• Usability Testing Process • Usability Matrix • Defining Test Cases and usability goals and matrix • Test user screener and recruiting test users
UNIT 11: Conducting Usability Evaluation	**UNIT 12: Project document and submission**
• Usability evaluation protocol includingtest questioner and data sheets. • Briefing and debriefing questioner • How to run the usability test? • Test data collection and analysis • Identifying usability problems	• Redesign recommendation based on usabilityevaluation • Usability Testing Documentation including testfindings • Project Document/Project Report • Submission and Evaluation

Reference Books & Case Studies

1. Human-Computer Interaction in the New Millennium, by Carroll, John
2. Learn Human-Computer interaction: Solve human problems and focus on rapid prototyping and validatingsolutions through user testing., by Christopher Reid Becker
3. Lean UX: Designing Great Products with Agile Teams, by Jeff Gothelf & Josh Seiden
4. Sketching User Experiences: Getting the Design Right and the Right Design, by Bill Buxton
5. Interaction Design: Beyond Human-Computer Interaction, By Helen Sharp, Jennifer Preece & Yvonnes Roger
6. Designing User Interfaces: Exploring User Interfaces, UI Elements, Design Prototypes and the Figma UI DesignTool, Dario Calonaki
7. Designing Interfaces: Patterns for Effective Interaction Design, By Jennifer Tidwell, Charles Brewer and AyneeValencia
8. UX for XR: User Experience Design and Strategies for Immersive Technologies (Design Thinking), by CornelHillmann
9. AI and UX: Why Artificial Intelligence Needs User Experience, by Gavin Lew, Robert M. Schumacher Jr.
10. Information Visualization: Design for Interaction, by Prof. Robert Spence
11. Moderating Usability Test: Principles and Practices for Interacting, by Dumas, Joseph
12. Ethnography and Virtual Worlds: *A Handbook of Method* Tom Boellstorff, Bonnie Nardi, Celia Pearce, and T.L. Taylor
13. Rethinking Users: The Design Guide to User Ecosystem Thinking, Mike Youngblood & Benjamin Chesluk
14. Designing with Data: Improving the User Experience with A/B Testing, Rochelle King, Elizabeth Churchill &Caitlin Tan
15. Design + Anthropology, Christine Miller
16. Quantified: Biosensing Technologies in Everyday Life, edited by Dawn Nafus
17. Case study: Design of a complex software system- CMS of a media organization
18. Case study: Defining a Mainframe System
19. Case Example: Conversational UI's.
20. Case Study: Designing Everyday Mobility

Assessment methods and weightage

	Assessment Methods	Weightage
1	Classroom /Home activities & assignments	30%
2	Project Individual/Group	50%
3	Final Exam	20%
	Total	100%

Title of the Course : VALUE EDUCATION – 2
Faculty Name : Shatrunjay Rawat
Course Code : OC3.102
L-T-P :12-6-0 (Total hours)
Credits : 2
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Academic Program: B. Tech. in ECE, BTech in CSE

1.Prerequisite Course / Knowledge: -NIL-
2.Course Outcomes (COs) :
After completion of this course successfully, the students will be able to:
CO-1: Apply the basic framework of universal human values to understand oneself
CO-2: Explain the relation of self with family, society and nature
CO-3:Explain the concept of living in harmony at all the levels
CO-4: Demonstrate theright understanding of relationships and Right utilization of physical facilities
CO-5: Realise the long-term goal of being happy and prosperous

3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	-	-	-	-	-	3	2	3	2	-	-	-	-	-	-	-
CO2	-	-	-	-	-	3	3	3	3	-	-	-	-	-	-	-
CO3	-	-	-	-	-	3	3	3	2	-	-	-	-	-	-	-
CO 4	-	-	-	-	-	2	3	3	3	-	-	-	-	-	-	-
CO5	-	-	-	-	-	3	3	3	2	-	-	-	-	-	-	-

Note: '3' in the box for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping

4.Detailed Syllabus:
Unit 1: Revisiting goal in life - short term and long term goals; Basic aspirations - Happiness and Prosperity; Role of education and human conduct; Self-exploration; Developing a holistic view
Unit 2: Self-reflection and reflecting on relationships; understanding value-based life

Unit 3: Living in harmony at 4 levels: self-self, self-family, self-society, self-nature
Unit 4:Harmony in Society; Broadening one's perceptions;
Unit5: Nature and Sustainability; Our role in protecting Nature;

Reference Books:

1. R.R. Gaur, R. Sangal, G. P. Bagaria. 2009. A Foundation course in Human Values and Professional Ethics. Excel books, New Delhi.
2. Randy Pausch. 2008. The Last Lecture. Hachette Books.
3. E. F. Schumacher. 1973. Small is beautiful: a study of economics as if people mattered. Blond & Briggs, Britain.
4. P. L. Dhar, R. R. Gaur. 1990. Science and Humanism. Commonwealth Publishers.

5.Teaching-Learning Strategies in brief (4 to 5 sentences):

This is a discussed based course. The instructor shares information on a topic and guides the discussion in the class by asking the right questions. By keeping the objectives in mind, the instructor adopts different techniques including smaller group discussions, role-play/skit, use of video clips/films or images to analyse and some activities to keep the students engaged in class throughout. Talks by experts who made a difference are also organised for the batch.

6.Assessment methods and weightages in brief (4 to 5 sentences):

This is a Pass/Fail course. The assessment methods include submissions of assignments and term papers. Critical thinking is expected from watching relevant short films or by reading assigned books. The classroom participation is also taken into consideration for evaluation. There are a few community-based activities and projects also. Participation in them is also important.