INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY
HYDERABAD

Syllabus for Courses of Spring 2026

Date: 04.12.2025 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	CE1.603	Advanced Structural Analysis	3-1-0-4	Pravin Kumar Venkat Rao
4	EC4.501	Advances in Robotics & Control	3-1-0-4	Spandan Roy
5	HS0.215	AI and Human Rights (H1)	3-0-0-2	Aakansha Natani
6	EC2.103	Analog Electronic Circuits	3-1-3-5	Zia Abbas
7	EC2.401	Analog IC Design	3-1-0-4	Abhishek Srivastava
8	CE1.608	Analysis & Design of Precast and Prestressed Structures	3-1-0-4	Shubham Singhal
9	CE1.609	Analysis and Design of Bridge Infrastructure	3-1-0-4	Jofin George
10	CL3.408	Applications of Language Models (H)	3-1-0-2	Vasudeva Varma
11	CG5.405	Art, Vision, & Feelings (H2)	3-1-0-2	Priyanka Srivastava + Shrikant Bharadwaj, LVPEI
12	OC2.102	Arts-2 (H1&H2)	2-0-0-2	Saroja TK (Coordinator)
13	HS0.203a	Basics of Ethics (H1 + H2)	3-0-0-2	Saurabh Todariya + Guest faculty
14	CG3.403	Behavioral Research: Statistical Methods	3-0-1-4	Vishnu Sreekumar + Bapi Raju S
15	Revised	Bioinstrumentation and Devices	3-1-0-4	Anshu Sarje
16	SC2.203	Biomolecular Structures (H1)	3-1-0-2	Deva Priyakumar
17	PD2.422	Business Finance	3-1-0-4	Dr. Sarath Babu A (Guest Faculty)
18	SC1.102	Classical Mechanics (H1)	3-1-0-2	Diganta Das

19	EC2.412	CMOS Oscillator Design	3-1-0-4	Abhishek Pullela
20	CG2.401	Cognitive Neuroscience (Max:80)	3-1-0-4	Bhaktee Dongaonkar
21	CG3.501	Cognitive Science and AI	3-1-0-4	Bapi Raju S
22	EC5.203	Communication Theory	3-1-0-4	Sachin Chaudhari
23	CS1.403	Compilers	3-1-0-4	Venkatesh Choppella
24	CL3.101	Computational Linguistics 1	3-1-0-4	Parameshwari Krishnamurthy + Manish Shrivastava
25	CL2.404	Computational Psycholinguistics	3-1-0-4	Rajakrishnan P Rajkumar
26	CS7.302	Computer Graphics (H2)	3-1-0-2	Raghavendra GS + PJ Narayanan
27	CS2.201	Computer Systems Organization	3-1-0-4	Deepak Gangadhar + Priyesh Shukla + Abhishek Kumar Singh
28	CS7.505	Computer Vision	3-1-0-4	Makarand Tapaswi + Charu Sharma
29	SC4.102	Computing in Sciences II (H2)	3-1-0-2	Abhishek Deshpande
30	CS0.302	Computing Tools	3-1-3-4	Vikram Pudi
31	HS0.221	Constitutional Ethics (H2)	3-0-0-2	Khaliq Parkar
32	MA7.501	Continuous Variable Quantum Information Theory and Computation	3-1-0-4	UttamSingh
33	HS1.301	Critical Viewing and Reading	3-1-0-4	Sushmita Banerji
34	CS1.201	Data Structures and Algorithms	3-1-3-5	Lini Thomas + Kshitij Gajjar + Raghavendra
35	CS4.401	Data Systems	3-1-0-4	Kamal Karlapalem
36	CS4.302	Data Visualisation (H1)	2-0-1-2	Kamal Karlapalem
37	CS6.301	Design and Analysis of Software Systems	3-1-0-4	Raghu Reddy
38	MA4.301	Differential Equations	3-1-0-4	Lakshmi Burra
39	HS4.303	Digital Democracy and Data Governance in the European Union (80)	3-1-0-4	Aakansha Natani
40	CS7.303	Digital Signal Analysis (H2)	3-1-0-2	Chiranjeevi Yarra

41	CE8.401	Disaster Management (40)	3-1-0-4	Jofin George + Shubham Singhal
42	CS3.401	Distributed Systems Prerequisite: Operating Systems. Networks desirable	3-1-0-4	Lini Thomas
43	CE1.601	Earthquake Engineering	3-1-0-4	Sunitha P
44	SC1.101	Electrodynamics (H2)	3-1-0-2	Diganta Das
45	EC2.202	Electronics Workshop II	0-1-3-4	Arti Yardi + Priyesh Shukla
46	CS6.402	Engineering Virtual Reality Systems (H2)	3-1-0-2	Sai Anirudh Karre+Raghu Reddy
47	HS0.217	Ethics and the Digital Society (H1)	3-0-0-2	Nimmi Rangaswamy
48	HS0.218a	Ethics in Research (H2)	3-0-0-2	Priyanka Srivastava + Bhaktee Dongaonkar
49	CL3.409	Evaluation Methods for NLP (H1)	3-1-0-2	Manish Shrivastava + Parameswari Krishnamurthy
50	EC2.206	Foundations of RF and Microwave Sensors (H2)	3-1-0-2	Andleeb Zahra
51	HS8.202	Gender, Culture and Representation (40)	3-1-0-4	Subha Chakraburtty
52	SC2.101	General and Structural Chemistry	3-1-0-4	Tapan K Sau
53	HS5.301	Growth and Development	3-1-0-4	Anirban Dasgupta
54	CS9.433	Hydro Informatics & Climate Sciences (Max:40) Open Elective	3-1-0-4	Shaik Rehana
55	EC5.102	Information and Communication	3-1-0-4	Arti Yardi + Lalitha V
56	CS8.402	Information Security Audit and Assurance	3-1-0-4	Shatrunjay Rawat
57	CS1.502	Information-Theoretic Methods in Computer Science	3-1-0-4	Gowtham Kurri
58	CS3.404	Internals of Application Servers	3-1-0-4	Ramesh Loganathan + Arjun Rajashekar
59	HS8.102	Intro to Human Sciences	3-1-0-4	Coordinated by Aniket Alam + Ashwin J (co-taught by 6 HSRC teachers)
60	EC2.204	Intro to Processor Architecture (H1)	3-1-0-2	Deepak Gangadharan
61	EC4.202	Intro to Robotics: Perception and Planning (H1)	3-1-0-2	K Madhava Krishna + Antony Thomas
62	EC4.402	Intro to UAV Design	3-1-0-4	Harikumar K

63	CS1.305	Introduction to Algorithms Engineering(H2)	3-1-0-2	Kishore Kothapalli
64	CS9.311	Introduction to Brain and Cognition (H2)	3-1-0-2	Bapi Raju S
65	EC5.205	Introduction to Coding Theory (H2)	3-1-0-2	Lalitha V
66	CS1.408	Introduction to Game Theory	3-1-0-4	Sujit Gujar
67	CS8.301	Introduction to Information Security (H1)	3-1-0-2	Ankit Gangwal
68	CS3.303	Introduction to IoT	1-0-3-3	Kavitha V + Suresh Purini
69	CL1.102	Introduction to Linguistics II	3-1-0-4	Aditi Mukherjee
70	CS7.401	Introduction to NLP	3-1-0-4	Manish Shrivastava + Parameshwari Krishnamurthy
71	SC1.420	Introduction to Particle Physics	3-1-0-4	Subhadip Mitra
72	HS0.304	Introduction to Philosophy of Technology	3-1-0-4	Ashwin Jayanti
73	CS9.312	Introduction to Quantum Information and Computation (H1)	3-1-0-2	Uttam Singh
74	CS6.201	Introduction to Software Systems (H)	1-0-3-2	Anil Nelakanti + Anoop Namboodiri
75	GS0.301	Introduction to Spatial Sciences & Technology (H2)	3-1-0-2	RC Prasad + Kuldeep K
76	EC5.206	Introduction to Statistical Signal Processing (H2)	3-1-0-2	Santosh Nannuru
77	HS8.305	Knowing India Through Data (H1)	3-1-0-2	Angarika Rakshit
78	HS0.220	Language and Power (H1)	3-0-0-2	Priya Prithiviraj
79	CL2.204	Language Typology and Universals	3-1-0-4	Radhika Mamidi
80	CS6.504	Law, Technology and Digital Governance	3-1-0-4	Raman Saxena + G.K. Goswami
81	CG1.403	Learning and Memory (Max 70)	3-1-0-4	Bhaktee Dongaonkar
82	MA2.101	Linear Algebra	3-1-0-4	Atul Singh Arora + Siddhartha Das + Gowtham Kurri
83	MA4.303	Linear Partial Differential Equations and Variational Calculus	3-1-0-4	Samyadeb Bhattacharya
84	CL3.406	Linguistic Data 3: Data Modeling in ILs (H1)	3-1-0-2	Rajakrishnan P Rajkumar

85	HS0.210	Literature and the Ethics of telling a Story (H2)	3-0-0-2	Sushmita Banerji
86	EC5.414	Machine Learning for Communication	3-1-0-4	Saikiran Bulusu
87	SC4.411	Machine Learning for Natural Sciences	3-1-0-4	Vinod PK + Deva Priyakumar + Prabhakar B
88	CS7.301	Machine, Data and Learning	3-1-0-4	Sujit Gujar + Praveen P
89	HS8.101	Making of Contemporary World	3-1-0-4	Khaliq Parkar + Angarika Rakshit
90	SC5.450	Mathematical Methods in Sciences	3-1-0-4	Monalisa Patra
91	SC3.316	Mathematical Models in Biology	3-1-0-4	Abhishek Deshpande
92	MA8.402	Mathematics for Finance - Max:25 - Selection by faculty	3-1-0-4	Sukrit Mittal
93	EC4.404	Mechatronics System Design	3-1-0-4	Harikumar K + Antony Thomas
94	SC2.316	Molecular Modeling and Simulations	3-1-0-4	Marimuthu Krishnan + Deva Priyakumar
95	SC2.315	Molecular Symmetry and Quantum Mechanics	3-1-0-4	Harjinder Singh
96	HS1.209	Music Language Creativity	3-1-0-4	TK Saroja
97	CS1.306	Numerical Algorithms (H1)	3-1-0-2	Pawan Kumar
98	GS1.401	Optical Remote Sensing	3-1-0-4	RC Prasad + Kiran Chand T
99	CS1.404	Optimization Methods	3-1-0-4	Naresh Manwani
100	SC2.202	Organic Chemistry (H2)	3-1-0-2	Prabhakar Bhimalpuram
101	PD2.423	Organizational Operations (H2)	3-1-0-2	TBD
102	CS3.307	Performance Modeling of Computer Systems (H1)	3-1-0-2	Tejas Bodas
103	SC2.301	Physics of Soft Condensed Matter	3-1-0-4	Marimuthu Krishnan
104	CS8.401	Principles of Information Security	3-1-0-4	Srinathan Kannan
105	PD1.411	Product Design Workshop	3-1-0-4	Prakash Yalla+Raghu Reddy
106	PD2.502	Product Lifecycle Management	3-1-0-4	Ravi Warrier

107	CS1.409	Quantum Algorithms	3-1-0-4	Shantanav Chakraborty
108	CS1.505	Quantum aspects of Cryptography	3-1-0-4	Atul Singh Arora
109	HS1.302	Readings in Russian Literature	3-1-0-4	Nazia Akhtar
110	HS0.302	Research Methods in Human Sciences	3-1-0-4	Anirban Dasgupa + Rajorshi Ray
111	CS7.405	Responsible & Safe AI Systems	3-1-0-4	Ponnurangam Kumaraguru
112	EC4.403	Robotics: Planning and Navigation	3-1-0-4	Madhava Krishna K + Antony thomas
113	SC1.111	Science II	3-1-0-4	Chittaranjan Hens and Prabhakar B
114	SC4.111	Science Lab II (H)	0-0-3-2	Tapan Kumar Sau + Chittaranjan Hens
115	HS7.301	Science, Technology and Society	3-1-0-4	Radhika Krishnan
116	HS2.304	Sociology of Platform Economies	3-1-0-4	Rajorshi Ray
117	CS6.401	Software Engineering	3-1-0-4	Karthik Vaidhyanathan
118	CS3.302	Software Programming for Performance (H1)	3-1-0-2	Suresh Purini
119	GS2.503	Spatial Data Sciences	3-1-0-4	Kuldeep Kurte + KS Rajan
120	EC5.408	Speech Signal Processing	3-1-0-4	Anil Kumar Vuppala
121	SC1.205	Statistical Mechanics (H2)	3-1-0-2	Marimutu Krishnan
122	CS7.403	Statistical Methods in AI	3-1-0-4	Vineet Gandhi + CV Jawahar
123	PD2.403	Sustainable Growth Strategy for Startup (H1)	3-1-0-2	Sridhar Kalyanasundaram
124	CS8.403	System and Network Security	3-1-0-4	Ashok Kumar Das
125	CS9.424	Technology Product Entrepreneurship	3-1-0-4	Ramesh Loganathan + Prakash Yalla
126	HS8.304	The Digital City	3-1-0-4	Khaliq Parkar
127	EC5.207	The Mathematics of Information: Theory & Application (H1)	3-1-0-2	Prasad Krishnan
128	SC1.308	The Universe Across Scales (150)	3-1-0-4	Subhadip Mitra+Chittaranjan Hens+Diganta Das

129	HS3.303	Theories and Practices of Nationalism	3-1-0-4	Aniket Alam
130	SC1.204	Thermodynamics (H1)	3-1-0-2	Harjinder Singh
131	HS0.201	Thinking and Knowing in the Human Sciences-I	3-1-0-4	Saurabh Todariya + Nazia Akhtar
132	MA5.501	Topics in Discrete Mathematics	3-1-0-4	Prasad Krishnan
133	CS7.603	Topics in Reinforcement Learning	3-1-0-4	Tejas Bodas + Harikumar K
134	CL5.401	Topics in SSMT	3-1-0-4	Chiranjeevi Yerra + Parameswari Krishnamurthy
135	CS5.401	User Interaction and Usability of Digital Products	3-1-0-4	Raman Saxena
136	OC3.102	Value Education II (H)	0-2-0-2	**TBD**

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 2026

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)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
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
CO4	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
CO6	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 2026

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 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 2026

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 2026

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	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
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):

Thecourselectureswillincludeactivitiesthatpromotetheunderstandingof thelecturecontentbyusingsmallexamplesthatstudentsworkoutduring theclass 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 : **AI and Human Rights**
Faculty Name : Aakansha Natani
Name of the Program : B.Tech. in Computer Science and Engineering
Course Code : **HS0.215**
Credits :2
L-T-P- :3-0-0

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

Semester, Year : Spring 2026

Pre-Requisites : None

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

CO1: Describe the concept of Human Rights and identify the historical background and principles of Human Rights in a comprehensive perspective.

CO2: Analyse the legal and human rights issues of AI with reference to emerging challenges, gaps and vulnerabilities.

CO3: Critically evaluate global negotiations and policy interventions to address the emerging challenges.

Course Topics: The course is divided into three modules:

(i) Understanding Human Rights

(ii) AI and Human Rights: Challenges and Vulnerabilities

(iii) Global Negotiations and Policy Interventions

Module 1- Understanding Human Rights, Historical background, Three Generation of Rights, Universal Declaration of Human Rights

Module 2- Challenges to Human Rights in the digital era; AI advancement and human vulnerabilities; Impact on underprivileged sections of society

Module 3- Global Negotiations and Policy Interventions; United Nations' Principles on AI; Artificial Intelligence Act of the European Union; India's National Strategy for AI

Suggested Reading-

J. Hoffman and P. Graham, (2006) '*Human Rights*', *Introduction to Political Theory*, Delhi, Pearson, pp. 436-458.

SAHRDC (2006) '*Introduction to Human Rights*'; '*Classification of Human Rights: An Overview of the First, Second, and Third Generational Rights*', Introducing Human Rights, New Delhi: Oxford University Press

D. O'Byrne, (2007) '*Theorizing Human Rights*', Human Rights: An Introduction, Delhi, Pearson, pp.26-70.

J. Morsink, (1999) *The Universal Declaration of Human Rights: Origins, Drafting and Intent*, Philadelphia: University of Pensylvania Press, pp. ix-xiv

J. Nickel, (1987) *Making Sense of Human Rights: Philosophical Reflections on the Universal Declaration of Human Rights,* Berkeley: University of California Press.

Kate Jones (2023), *AI Governance and Human Rights*, https://www.chathamhouse.org/2023/01/ai-governance-and-human-rights

Rowena Rodrigues (2020), *Legal and human rights issues of AI: Gaps, challenges and vulnerabilities, Journal of Responsible Technologies,* ScienceDirect, Vol 4

Access Now (2018) *Human rights in the age of artificial intelligence.* https://www.accessnow.org/cms/assets/uploads/2018/11/AI-and-Human-Rights.pdf

European Commission (2020). *White Paper on artificial intelligence - a European approach to excellence and trust.* Brussels, 19.2.2020 COM(2020) 65 final https://ec.europa.eu/info/sites/info/files/ commission-white-paper-artificial-intelligence-feb2020_en.pdf.

Forbes Insights Team (2019) *Rethinking Privacy For The AI Era.* https://www.forbes.com/sites/insights-intelai/2019/03/27/rethinking-privacy-for-the-ai-era/

Meyer, S (2018). *Artificial intelligence and the privacy challenge.* CPO Magazine. https://www.cpomagazine.com/data-privacy/ artificial-intelligence-and-the-privacy-challenge/.

Miailhe, N (2018). *AI & global governance: Why we need an intergovernmental panel for artificial intelligence. AI & Global Governance*. https://cpr.unu.edu/ai-globalgovernance-why-we-need-an-intergovernmental-panel-for-artificial-intelligence. html

L. Smith (2017), *Unfairness by algorithm: Distilling the harms of automated decision-making. Future of Privacy Forum.*. https://fpf.org/2017/12/11/ unfairness-by-algorithm-distilling-the-harms-of-automated-decision-making/.

United Nations (2019) *United Nations Activities on Artificial Intelligence (AI),* http://handle.itu.int/11.1002/pub/813bb49e-en

European Commission (2021), *EU Artificial Intelligence Act (Briefing)*, https://www.europarl.europa.eu/RegData/etudes/BRIE/2021/698792/EPRS_BRI(2021)698792_EN.pdf

Niti Aayog (2018), *National strategy for Artificial Intelligence*, https://www.niti.gov.in/sites/default/files/2021-02/Responsible-AI-22022021.pdf

Grading Plan :

(The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz-1	20%
Mid SemExam	
Quiz-2	
End Sem Exam	50%
Assignments	30%

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

	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

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

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

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 200 to 300 pages of books and articles and submit written work between 1500-2000 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 : 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 2026

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	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
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 2026

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, 2026

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 : Spring2026

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 2026
Designed for : Research students in CS/CL/Human Sciences (Max Students: 25)
Name of the Program : **B.Tech in CSE and Master of Science in Computer Science and Engineering by Research**
Pre-Requisites : At least one graduate level Introductory AI/ML course (Introduction to NLP, Statistical Methods in AI, Advanced NLP, Information Retrieval and Extraction)

Course Outcomes :
By the end of the course, students will be able to:

- **CO1:** Understand the core architectures and functionalities of Large Language Models (LLMs) and Small Language Models (SLMs) and their differences.
- **CO2:** Analyze the applications of LLMs and SLMs in domains such as Education and Healthcare and assess their potential impact.
- **CO3:** Design and implement agentic frameworks using language models to solve real-world problems in specific domains like Education and Healthcare.
- **CO4:** Critically evaluate the ethical challenges in deploying language models, including issues of bias, fairness, and data privacy.

Course Topics :

Module 1: Foundations of Language Models

- 1.1 Introduction to Language Models: Definition, evolution, and comparison between LLMs and SLMs.
- 1.2 Key Architectures: Understanding transformers, attention mechanisms, and training techniques.
- 1.3 Small Language Models (SLMs): Strengths, limitations, and specialized applications.
- 1.4 RAG and Tool Calling: Addressing the limitations of LLMs through integration with other technologies.
- 1.5 Introduction to Agentic Frameworks: Using language models for task-specific applications.

Module 2: Applications in Education and Healthcare

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

Module 3: Broader Applications of Language Models

- 3.1 Applications in other domains: Customer service, legal tech, and software development.

- 3.2 Emerging Trends: Combining language models with multi-modal systems and reinforcement learning agents.

Preferred Textbooks: Due to the flipped-classroom nature of the course, a lot of interactive material will be provided to the students every lecture, which will include blogs, video essays, and live lectures from distinguished members of academia as well as the industry.

Reference Books : NA

E-book Links : NA

Grading Plan :

Type of Evaluation	Weightage (in %)
Project (Proposal, Prototype, and Presentation)	**70%**
Class Participation and Activities	**30%**

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

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

This course employs activity-based and project-based learning to enhance the understanding of theoretical concepts through hands-on experience. Students will participate in workshops, group discussions, and case studies. A flipped classroom model will be adopted for specific topics, ensuring collaborative and self-driven learning. The project component allows students to address real-world challenges using language model applications in domains such as Education and Healthcare.

Title of the Course : **Art, Vision, & Feelings:** Psychological, Biological, and Computational Perspectives on Beholder's POV

Course coordinator : Priyanka Srivastava,

Co-Instructor : Shrikant Bharadwaj, LVPEI

CourseCode : CG5.405

Credits : **2**

L- T -P : 3-1-0

Semester, Year : Spring 2026

Name of the Academic Program: Open Electives (Applicable to UG 3, 4, MS & PhD Programs on Campus)

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..

CO1: Demonstrate an understanding and appreciation of diverse perspectives in perceiving and feeling visual art from the beholder's point of view (Understand)

CO2: Evaluate the relationship between emotion, visual art, and well-being (Understand)

CO3: Describe the functional architecture of the human visual system and how it processes the complex visual scene filled with details of form, color, depth and motion (Understand).

CO4: Apply and analyze computational models of visual perception to explain the processing and aesthetic appreciation of visual art (Apply and Analyze)

CO5: Design and conduct an eye tracking study to determine how humans explore a visual scene, particularly art forms of various genres (Create, Apply, Analyze, Presentation/ Communication).

CO6: Reflect upon personal emotional experiences of encountering art during their visit to an art gallery (Experiential, Evaluation, and Communication)

CO7: Effectively communicate ideas, reflections, and findings related to the major course assignment involving empirical observations about visual and emotional experience (Communication)

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

CO4	2	1	1	2	3	2	0	1	3	3	3	3	1	0	2	2
CO5	2	0	2	2	3	2	0	3	3	3	3	3	1	0	2	2
CO6	0	0	0	0	1	2	0	1	3	2	3	3	0	0	2	2
CO7	0	0	0	0	0	0	0	1	3	3	3	3	0	0	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:

Module 1	Module 2	Module 3	Module 4
Introduction	**Psychology, Biology, & Computational Perspectives on Beholder's POV**	**Art, Emotion, & Well-being**	**Project Component**
Art, Beauty and Pleasure from Artist and Beholder's perspectives [1]	Visual System and Other Components of Human Nervous System [3] • Visual perception and Bottom-up processing in Art [2] • The eye as an optical system [1] • The visual system as a Fourier analyzer [1]	The Anatomy of the Arts focusing at the world inside your head, neuroplasticity, the aesthetic triad, default mode network, and a space for being [1.5]	Major Assignment involving Theoretical and Empirical exploration of appreciating and experiencing visual art. [1]
	How brain processes and perceive faces and abstract images [2]	The nature and the recruitment of Emotion [2]	
Guest lecture / Interaction with the Artists [1]		Art, Mental health and Well-being [1.5]	

Hours: 3	**Hours: 9**	**Hours: 7.5**	**Hours: 4.5 hours**
Classes: 2	**Classes: 6**	**Classes: 5**	**Classes: 1**
CO: 1 & 5	**CO: 1, 2, 3 & 4**	**CO: 1, 2 & 6**	**CO: 4, 6 & 7**

Reference Books:

1. The Aesthetic Brain by Anjan Chatterjee
2. The Brain, Emotion, and Depression by Edmund T Rolls
3. Reductionism in art and brain science by Eric R. Kandel
4. Your brain on Art by Susan Magsamen and Ivy Ross
5. Seeing: The Computational Approach to Biological Vision by John Frisby and James Stone
6. Foundations of Vision: Behaviour, Neuroscience and Computation by Brain Wandell
7. https://www.guggenheim-bilbao.eus/en/activities/online-art-courses-art-and-neuroscience-beyond-beauty-the-creative-and- divergent-mind-of-the-artist
8. https://dana.org/resources/learning-arts-and-the-brain/

Journal Articles: Will be announced before a few key topics. 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/ assignments. 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 a presentation during project/ major assignment final presentation. Students will be assigned pre-planned assignments requiring them to explore the experiential, empirical, and computational perspectives of visual art. 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.

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

Assessment Scheme:

S No.	Component	Count	Weight	Course Outcomes
1.	Assignment	N = 2	30%	CO: 1-7
2.	Project	N = 1	30%	CO: 2-7
5.	Final Exam	N = 1	30%	CO: 1, 2, 3, & 4
6.	Others	-	5%	
7.	Class participation	-	5%	
		TOTAL	**100%**	

Grading Policy: Absolute grading policy scheme – Attendance is necessary

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 other students 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.

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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 2026

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	: Saurabh Todariya + Guest Faculty
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 2026

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**
Name of the faculty : Vishnu Sreekumar and Bapi Raju
Course code : CG3.403
L-T-P : 3-0-1
Credits : 4
Name of the Academic Programs : CSE/Open Elective
(L - Lecture hours, T-Tutorial hours, P - Practical hours)

Semester, Year **:** Spring, 2026

Prerequisite Course / Knowledge: : None

Course Outcomes:

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

- CO-1: develop an understanding of various experimental designs
- CO-2: recognize and employ appropriate statistical packages to analyze data
- 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

You will meet the outcomes listed above through a combination of the following activities in this course:

- Attend lectures and participate in class discussions (CO-1, CO-2, CO-3, CO- 4, CO-5)
- Quiz 1, Quiz 2, and Endsem (CO-1, CO-2, CO-5)
- Complete problem sets, assignments, and mini-project(s) (CO-2, CO-3, CO4, CO-5, CO-6)

Course Topics: **Tentative schedule -**

Week 1: Introduction: why do statistics, and basics of research designWeek 2: Installing R and basics of R

Week 3: Descriptive statistics and visualizing data

Week 4: Organizing, sorting, merging, and reading data in R Week 5: Probability and sampling distributions

Week 6: Null hypothesis testing

Week 7: Categorical data analysis, comparing two means, data reduction Week 8: Linear regression, regression diagnostics, and related hypothesis tests Week 9: One-way ANOVA

Week 10: Factorial ANOVA

Week 11: Generalized linear models (GLMs)

Week 12: Bayesian statistics and inference

Preferred Text Books : Learning Statistics with R by Danielle Navarro: https://learningstatisticswithr.com/lsr-0.6.pdf

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

Reference Books : NA

E-book Links : https://learningstatisticswithr.com/lsr-0.6.pdf

Grading Plan :
(The table is only indicative)

Description	Percentage
Assignments	30
Mini-project	20
2 Quizzes (10% each)	20
End sem exam	30
Total	100
Bonus	Max 5% (submission of in-class problem sets, mini-project presentations)

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

	O1	O2	O3	O4	O5	O6	O7	O8	O9	PO10	PO11	PO12 PS	O1P	O2 P	O3	PSO4
	1	3	1	1	1	2	1	1	1	1	-	-	-	-	-	-
O2	2	2	2	3	3	2	1	1	3	1	-	-	-	-	-	-
O3	2	3	2	3	3	3	1	1	3	1	-	-	-	-	-	-
O4	2	3	2	3	3	3	1	1	3	1	-	-	-	-	-	-
O5	1	1	1	1	1	3	1	1	2	1	-	-	-	-	-	-
O6	2	2	3	3	3	1	1	1	2	2	-	2	1	1	2	3

Teaching-Learning Strategies in brief (4-5 sentences) : Students will be introduced to the different statistical methods employed in the analysis of behavioral and other 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/mini-projects 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.

Title of the Course : Bio Instrumentation & Devices
Faculty Name : Anshu Sarje
Name of the Program : Electronics and Communication Engineering
Course Code :
Credits : 4
L - T – P :3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring, 2026 (second half)

Pre-Requisites : 1. Basic Sciences, 2. Analog Electronics & Digital VLSI;

3. BasicElectronics

Course Outcomes :

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

CO-1 Describe and explain the generation of action potentials in neurons and cardio-electrophysiology.
CO-2 They will be able to explain, and design system for picking up the electrophysiologicalsignal and amplify it.
CO-3 Design & analysis of circuit for processing electrophysiological system.
CO-4 Explain the basis of micro fabrication and micro fluidic based systems.
CO-5 Understand the fundamental operation of diagnostic devices.

Course Topics :

1. **Module 1 (**Lecture 1-4): Biological signals: electrophysiology (cardio, near, muscular); othersignals.

Understanding various biological system and the electrical signal they generate. Capturing thesignals for biomedical systems. Micro-electrode arrays and micro-electrode systems.
2. **Module 2** (Lecture 5, 6): Amplification & Signal Conditioning basics: Opamps; Instrumentation Amplifier; TIA: Review of analog circuits and amplifiers (AEC). Circuit system forspecific applications.
3. **Module 3** (Lecture 7, 8): CMOS VLSI circuit design, Potentiostat; switch cap amps: Discussion and analysis of specialised circuits and circuit design techniques for low power.
4. **Module 4** (Lecture 9-13): Diagnostic devices: uTAS & Lab-on-a-chip (RT PCR, On-chip-olfaction):

Introduction to Bio-MEMs, Micro-fluidics. Basics of device fabrication theory (non-semiconductor).Status quo and review of some cutting edge lab-on-chip applications. Introduction to smart systems.
5. **Module 5** (Lecture 13): JFET, ISFET, ChemFET; Non-electrical devices: Introduction to other semiconductor and non-semiconductor based devices. Discussion andworking of various devices. Current and future trends. Brief discussion on FinFETs.
6. **Module 6** (Lecture 14): Noise & noise efficient design:

Preferred Text Books :

1. Bio-instrumentation by Webster.

2 Analysis and Design of Analog IC by Meyer Grey, Hrust, Lewis
3. Select Journal Papers: Lab-on-Chip (RSC), IEEE, EMBS

Reference Books **: 1.** Medical Physiology by Guyton

2. Select Journal Papers: Lab-on-Chip (RSC), IEEE, EMBS

E-book Links **:**

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

Type of Evaluation	**Weightage (in %)**
Quiz-1	**NA***
Mid SemExam	**NA***
Quiz-2	**20**
End Sem Exam	**20**
Assignments	**30**
Project	**0**
Term Paper	**25**
Other Evaluation	**5**

NA*: Course offered only for second half semester.

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

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

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

1. Class room lecture (slide or board) for instructing on the topics.
2. Demonstration (live or videos) to show the operation, model of operation.
3. Simulation (MATLAB, Cadence, LT Spice) to model and/or analyse the concepts.
4. Reading and review of research publications on the topics.
5. Presentations by students to help them learn a specific topic.

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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 2026

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 2026
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, P - Practical hours)
Semester, Year : Spring 2026

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 : CMOS Oscillator Design

Faculty Name : Abhishek Pullela
Course Code : EC2.412
Credits : 4
L - T - P : 3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring 2026
Name of the Academic Program : B. Tech/MS in ECE

Prerequisite Course / Knowledge:

Analog Electronic Circuits, CMOS References and Regulators/Analog IC Design, Mandatory knowledge of cadence virtuoso tool.

Course Outcomes (COs):

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

CO-1: Understand different types of clock generating circuits and their applications.
CO-2: Understand the effect of Process/Supply/Temperature/Mismatch/Jitter/Phase Noise variations in oscillators.
CO-3: Design voltage and current mode relaxation oscillators from scratch for given specifications.
CO-4: Apply compensation techniques for different design constraints, for ex. Comparator delay cancellation schemes for low power and switch leakage compensations for high-temperature applications.
CO-5: Understand the challenges of integrating basic blocks like references, comparator, switching circuits, etc.
CO-6: Understand ring and crystal oscillators and advantages and limitations of relaxation oscillators in comparison to ring and crystal oscillators.
CO-7: Understand basic architecture of voltage-controlled oscillator which forms a part of Phase-locked loop.

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	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
CO5	2	3	3	3	3	1	1	2	3	3	3	3	3	1	2	1
CO6	2	3	3	3	3	1	1	2	3	3	3	3	3	2	1	1

Detailed Syllabus:

Unit 1: Introduction to oscillators (relaxation, ring, and crystal), applications of each oscillator, advantages, limitations and trade-offs, block level diagrams of all oscillators and basic understandings, evaluating performance of oscillators and definitions of metrics, short review of noise concepts in resistors, capacitors and MOSFETs.

Unit 2: Basic architecture of voltage mode relaxation oscillator with very less duty cycle, techniques to get 50% duty cycle, final architecture of voltage mode relaxation oscillator with 50% duty cycle, effect of comparator offset and delay on frequency, comparator offset cancellation scheme, different methods for reducing the effect of comparator delay, duty cycling approaches for extremely low power consumption, resistor-less architectures for area optimization, short review of current references and voltage references, analysis of PVT, mismatch and noise impact on frequency of relaxation oscillator.

Unit 3: Impact of switch leakage for high-temperature applications, subthreshold leakage compensation, drain/source bulk leakage compensation, bootstrapped switches for low voltage applications, comparator less architectures, current mode relaxation oscillators, advantages, and limitations, choosing the architectures of references, comparators, and other components based on different specifications.

Unit 4: Introduction to crystal oscillators, small signal model of the crystal, design of negative resistance to cancel the resistance of crystal, modes of operation of the crystal, Barkhausen's criterion for stability and positive feedback, basic crystal oscillator design, feedback circuits to rectify the variations in crystal oscillator, phase noise in crystal oscillators, final crystal oscillator design.

Unit 5: Introduction to ring oscillator, PVT variations impact on frequency of ring oscillator, advantages and disadvantages, small signal and large signal analysis of ring oscillator, stages of ring oscillator to get different frequencies and trade-offs, current starved ring oscillators and their frequency expressions, getting different frequencies using current starved ring oscillators, large impact of layout parasitic on ring oscillator frequency, compensation techniques to reduce impact of PVT variations on ring oscillator frequency, use of ring oscillator in voltage controlled oscillators.

Unit 6: Brief introduction to phase locked loops, introduction to voltage controlled oscillator and their functionality in phase locked loops, small signal model for VCO, deriving specs for VCO based on PLL specifications, calculating KVCO for ring oscillator, linearizing method for KVCO over frequency range, programmability for current starved ring oscillator to tune the frequency range, AC coupled inverter, use of PDAC and NDAC to control KVCO and output frequency variation, integrating ring oscillator, AC coupled inverter, PDAC and NDAC and running top level simulations. Trade-offs and architectures for each application.

Reference Books:

1. Behzad Razavi. Design of analog CMOS integrated circuits. , 2005.
2. P. E. Allen and D. R. Holberg, "CMOS Analog Circuit Design," 2nd Edition, Oxford University Press, New York, 2004.
3. Gray, Paul R. and Robert G. Meyer. "Analysis and Design of Analog Integrated Circuits." (1993).

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

The course will commence by introducing oscillators and their applications. Different architectures of oscillators like ring, crystal and relaxation will be discussed and choosing architectures based on specification sheet will be taught. During tutorial sessions, select circuits discussed in class will be practically implemented and simulated in different technology nodes using Cadence Virtuoso. This hands-on approach provides students with firsthand experience in circuit design under stringent constraints akin to those encountered in industry applications. Assignments will consist of small-scale analog blocks (based on industry specs) and the final project will be to integrate all these blocks. To encourage innovation in low-power circuit design, students will be tasked with reviewing research papers, preparing project reports, and delivering presentations to hone their research skills. Exams, will evaluate students' intuitive grasp of the concepts.

Assessment methods and weightages in brief:

- Assignments: 20%
- Quiz: 7.5%
- Mid Semester Exam: 10%
- End Semester Exam: 12.5%
- Mid Project: 20%
- End Project: 30%

Title of the Course : Cognitive Neuroscience

Faculty Name : BhakteeDongaonkar
Course Code : CG2.401
L-T-P : 3-0 -1.
Credits : 4
Semester, Year : Spring 2026

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 2026

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.Therelationbetweentherepresentationofinformation 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.Applicationoftheconceptsofreinforcement 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.** PredictivecodingandtherelatedideasofBayesianBrain 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=3to6ajvBtl0&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%**
Assignments / Term	**25%**

Paper / In-class Presentation / Peer Review	
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 10	PO11	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 2026

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	PO10	PO11	PO12	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 2026

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

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

CO4	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 + Manish Shrivastava
Course Code : **CL3.101**
L-T-P : 3-1-0.
Credits : 4
(L = Lecture Hours, T = Tutorial Hours, P = Practical Hours)
Semester, Year : Spring 2026
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,2026

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**

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	1	-	3	2	-	-	3
CO2	-	-	-	-	-	-	-	-	2	1	-	3	2	-	-	3
CO3	-	-	2	2	-	-	-	-	2	1	-	3	2	-	-	3
CO4	-	-	2	3	3	-	-	-	3	2	-	3	3	-	-	3
CO5	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 : **Raghavendra GS + P J Narayanan**
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 2026
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 : Deepak Gangadharan, Priyesh Shukla and Abhishek Kr. Singh
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 2026

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 + Charu Sharma
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 2026

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 : Abhishek Deshpande
Course Code : SC4.102
Credits : 2
Semester, Year : Spring 2026
L-T-P : 3-1-0
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Academic Program CND
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 : Vikram Pudi

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 **: Constitutional Ethics**
Name of the Faculty : Khaliq Parkar
Name of the Program : Ethics Elective
Course Code : HS0.221
Credits : 2
L - T - P : 3-0-0
Semester, Year : Spring, 2026.
Ethics Elective for UG4

Pre-Requisites **: None**

Course Description : This course provides a theoretical and conceptual understanding of ethical values enshrined in constitutions. Key values are introduced and interpreted through a political theory lens. Contemporary examples of court cases and judgments are also used to understand how these ethical values are interpreted in practice.

Course Outcomes :

CO1: Interpret specific values enshrined in contemporary constitutions
CO2: Evaluate contemporary issues in the light of constitutional values
CO2: Apply constitutional values to contemporary social and political debates

Course Topics :

1. **Justice and its Forms**

This module introduces justice as an ethical value. It identifies how it can be interpreted in four ways – procedural, restorative, retributive, and distributive. Using these interpretations, it is applied to an understanding of justice as understood in the Indian constitution – social, political and economic justice.

2. **Liberty and its Limitations**

Liberty or Freedom is introduced through key texts that establish why it is an inherently human ethical value. Furthermore, we understand how the restrictions or limitations on liberty are determined. We also study it in particular constitutional interpretations such as freedom of speech and expression.

3. **Reconciling Equality and Difference**

Regardless of various forms of differences that exist, contemporary constitutions enshrine equality as a core ethical value. This module explicates how equality is understood and interpreted in its application to differences that exist within societies. Special attention is drawn to how equality is 'distributed' to individuals and groups.

4. **The Rule of Law**

The Rule of Law is a fundamental principle that binds contemporary constitutions. This module understands how the principle determines the various ways in which the goals of Justice, Liberty and Equality can be met.

Reference Resources :

- The Stanford Encyclopedia of Philosophy
- Basu, Durga Das. (2024) *Introduction to the Constitution of India*. LexisNexis.
- Bellamy Richard, King Jeff; eds (2025). *The Cambridge Handbook of Constitutional Theory*. Cambridge University Press.
- Heywood, Andrew. (2015). *Political Theory: An Introduction*. New Delhi: Palgrave.
- Heywood, Andrew. (2015). *Key Concepts in Politics and International Relations*. Palgrave Macmillan

Grading Plan :
(The table is only indicative)

Type of Evaluation	**Weightage (in %)**
Quizzes	**30**
Class Activities/Assignments	**50**
End Sem Assignment	**20**

Mapping of Course Outcomes to Program Objectives (for BOTH CSE and ECE programs): (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	1	3	1	3		3	1		3	3		2		
CO2		1	2	3	1	3		3	1		2	2		2		
CO3		3	2	2	2	3		3	2		2	2		2		

Teaching-Learning Strategies in brief (4-5 sentences): The course follows a discussion-based approach to understanding constitutional ethics. Case studies utilized to understand contemporary constitutional debates. Specific court cases are also used towards understanding how constitutional values are interpreted. Short documentaries and articles are used to initiate debate and discussion.

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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, 2026

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+Raghavendra
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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO2	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO3	1	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO4	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
CO3	3	2	2	1	2	2	1	-	2	2	2	1	3	3	3	2
CO4	3	2	2	1	2	2	1	-	2	2	2	1	3	3	3	2
CO5	3	2	2	1	2	2	1	-	2	2	2	1	3	3	3	2
CO6	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 2026

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

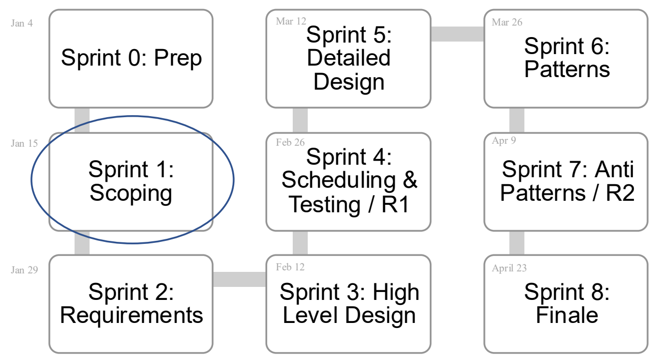
	PO1		PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2			2	1					2		1	1		1		
CO2	3			1		2						1		1	3		
CO3	2		1	1								1		1	2		1
CO4	2		2	2						3				2		1	
CO5											3						

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



Lecture topics will follow this flow

As the projects tracks these sprints

Submissions due along the way

Guest lectures from startups and Industry leaders

EACH SPRINT IS 2 WEEKS, Friday start.

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

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 2026
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)

<u>Preferred Text Books:</u>

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.or g/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 : Chiranjeevi Yarra
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)

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

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

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 : Electronics Workshop-II
Name ofthe faculty : Arti Yardi + Priyesh Shukla
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	PSO 3	PSO 4
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:

NopreferredtextbookasthisisaprojectcourseIndicativetextbookincludeMicroelectronicCircuitsby 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 **: Engineering Virtual Reality Systems**

Name of the Faculty : Sai Anirudh Karre and Y. Raghu Reddy
Name of the Academic Program : CSE
Course Code : CS6.402
Credits : 2
L-T-P : 1-0-2

Anybody who is B. Tech 3rd year and beyond may register for the course.

1. Prerequisite Course / Knowledge: Programming knowledge in any OOPs (Python, C++, C#)

2. Course Outcomes (COs):

CO1: Understanding basics of VR Systems

CO2: Apply requirement elicitation and specification methods for VR Systems in practice CO3: Design and Implement VR Systems by selecting appropriate hardware and software CO4: Evaluate VR product quality by applying testing methods to VR Systems

CO5: Deploy VR Systems through systematic methods and learns collaborative coding practices

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

4. Detailed Syllabus:

- Unit 1: Intro to Virtual Reality – About VR, VR Experiences and Use-Cases, Hardware-Software, Human Physiology and Perception, Developer Ecosystem and Practices, VR Enterprise Software Products.
- Unit 2: Physics of Virtual Environments – Geometry, Position, Orientation, Axis-Angle of Rotation, View Transformations, Light, Camera, Shadow, Human Eye – Accommodation and Vergence, their conflict, Ray Casting, Shading, Latency, Frame Rates, Velocity and Acceleration, Tracking, Interaction, Audio etc.
- Unit 3: Requirement Engineering Practices for VR product development – Elicitation, Specification, Practices, Tools.
- Unit 4: Designing VR experiences – Tools, requirements for design, automated design generation tools, design guidelines, best practices.
- Unit 5: Game Engines and VR SDKs – development strategies for VR/AR products, Gameplay, interactions.
- Unit 6: Quality – Testing strategies for VR Products, guidelines, tools and approaches.
- Unit 7: Build C Release - deploying VR products at scale, usage analytics, tracking user adoption, continuous improvement.
- Tutorials: Covers concepts of Blender and UNITY tools in 4 lab sessions with graded activity.

5. Reference Books:

- Virtual Reality – Steven M LaValle - https://msl.cs.uiuc.edu/vr/vrbook.pdf
- Virtual Reality Technology and Applications – Matjaz, Domen, Samo - https://link.springer.com/book/10.1007/978-94-007-6910-6
- Virtual and Augmented Reality (VR/AR) - Foundations and Methods of Extended Realities – Doerner, Broll, Grimm, Jung - http://vr-ar-book.org/

6. Teaching-Learning Strategies in brief:

This is a project-based learning course, featuring highly interactive lectures that demand active participation, critical thinking, and creativity from students. Learning occurs through hands-on class activities, guided tutorials, and collaborative project work that directly addresses course outcomes. The centrepiece is a team-based course project where students develop a small-scale VR system from conception to deployment. Through this experience, students gain practical expertise in the full development lifecycle—including requirements gathering, system design, coding, deployment, and maintenance—skills that are essential in professional practice. *Considering hands-on learning, this course is offered with one lecture per week making it a semester-long course.*

7. Assessment methods and weightages in brief:

Class Activities (2) – 15%, QUIZ (1) – 20%, Lab (4) – 25%, Main Project (1) – 40%

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' ma ing, 2 for 'Medium-level' ma ing, 1 for 'Low'-level' ma ing

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 Ethics*, 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 of 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 : Priyanka Srivastava, Bhaktee Dongaonkar

Course Code : HS0.218a

Credits : 2

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 : **Evaluation Methods for NLP**

Faculty Name : Manish Shrivastava and Parameswari K
Course Code : CL3.409
Credits : 2
L - T - P : **3-1-0.**

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

Semester, Year : Spring 2026

1. Prerequisite Course / Knowledge:
Introduction to NLP

Course Outcomes :

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.

Course Topics :

- **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.

Preferred Text Books :

Reference Books :

- Jurafsky, D., & Martin, J. H. (2024). *Speech and Language Processing* (3rd ed.). Prentice-Hall.

- Manning, C. D., & Schütze, H. (1999). *Foundations of Statistical Natural Language Processing*. MIT Press.
- Gehrmann, S., Belz, A., & Berant, J. (2021). The GEM benchmark: Natural language generation, its evaluation, and metrics. *Transactions of the Association for Computational Linguistics, 9*, 165-184.
- Sellam, T., Das, D., & 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., & Lipton, Z. C. (2022). Towards explainable evaluation metrics for natural language generation. *arXiv preprint arXiv:2205.01961*.
- Papinenko, A., Roumi, P., Turunen, D., & 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., & 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., & 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

E-book Links :

Grading Plan :

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%

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

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

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.

Title of the Course : Foundations of RF and Microwave Sensors

Name of the Faculty : Dr. Andleeb Zahra

Name of the Program : B. Tech in ECE

Course Code : EC2.206

Credits **: 02**

L - T - P **: 3-1-0**

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

Semester, Year **: Spring, 2026**

Pre-Requisites : Electromagnetism and Fundamental Circuit Concepts

Course Outcomes :

(list about 5 to 6 outcomes for a full 4 credit course)

CO-1: Understand theoretical foundations of RF and microwave sensor technology.

CO-2: The type of RF sensors and their applications.

CO-3: Analyze sensor performance using S-parameters.

CO-4: Evaluate design trade-offs and challenges in RF/microwave sensor systems.

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

Unit 1: Electromagnetic Foundations for RF Sensing

- Introduction of sensors and some basic terms.
- Maxwell's equations (integral & differential forms), continuity equation, displacement current.
- Electromagnetic wave (EM wave) propagation: wave equation, plane waves in free space, dielectric, lossy media.
- Wave parameters: intrinsic impedance, phase velocity, wavelength, propagation constant.
- Interaction with materials: reflection, transmission, material effects, power flow (Poynting vector), attenuation.
- Relevance to RF sensing: effect of dielectric properties on resonant frequency, impedance, and attenuation.

Unit 2: Signal Propagation and Impedance in RF Sensors

- Transmission line structures: single wire, coaxial, strip line, and microstrip line. resistance (R), inductance (L), conductance (G), and capacitance (C).
- Transmission line equations, wave propagation, propagation constant (γ), characteristic impedance (Z_0); lossless line special case.
- Input and output impedance for open-circuited, short-circuited, matched, and terminated lines.
- Application to RF sensors: microstrip lines in resonator- and antenna-based sensors, impedance matching, and the effect of source/load impedance on sensor performance.

Unit 3: RF and Microwave Sensor Principles and Applications

- RF fundamentals: spectrum, frequency bands, key components (R, L, C, antennas, connectors, amplifiers).
- S-parameters (S11, S21, S12, S22): significance, reflection/transmission, sensor performance correlation.
- Sensor types: resonator-based, antenna-based, transmission-line, hybrid.
- Performance metrics: sensitivity, specificity, resolution, linearity, dynamic range, response time, Q-factor.
- Materials/fabrication: substrate selection (FR4, Rogers), thin-film, microfabrication, system integration.

- Design aspects: impedance matching, network analysis, CAD simulation (HFSS, CST), miniaturization, optimization.
- Applications: biosensing, chemical detection, dielectric/material characterization, environmental monitoring.

Challenges and future directions in RF/microwave sensors.

Preferred Textbooks:

- Introduction to Electrodynamics – David J. Griffiths
- Elements of Electromagnetics – M. N. O. Sadiku
- Microwave Engineering – David M. Pozar

Reference Books:

Fundamentals of RF and Microwave Electronics – Matthew Radmanesh

E-book Links / Additional Reading:

NOTE: Apart from these books, relevant research papers and additional reading materials will be provided during the course as needed.

Grading Plan :

Type of Evaluation	Weightage (in %)
Quiz-1	
Mid Sem Exam	
Quiz-2	**30%**
End Sem Exam	**70%**
Assignments	**Only for practice (0%)**
Project	
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

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

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

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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, 2026

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.Cresswell,Tim. *Place:A Short Introduction.*Blackwell Publishing. 2004.

Fincher,Ruth."Space,GenderandInstitutionsinProcessesCreatingDifference",*Gender,Placeand 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–which actively questionsthemeaningofgenderinplacesandspacesisattheheartofthecourse.Manyissuesthat weaddressinthecourseare controversial and students may have or voice different viewpoints.

It is crucial that weacknowledge and respect one another's experiences and perspectives so that our class roomisasafeandsupportive 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 : Growth and Development
Faculty Name : Anirban Dasgupta
Course Code : HS5.201
Credits : 4
L - T - P :3 – 1 – 0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring 2026

Pre-Requisites : BTech Students: Intro to Human Sciences, CHD Students: 3rd and 4th years

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

CO1: Apply the concept of development and economic growth from different perspectives
CO2: Examine the interrelationship between economic growth and development
CO3: Identify the role of technology in the development process
CO4: Compare cross-country data, including through computational tools
CO5. Analyze the alternative models of sustainable development in the face of looming climate crisis

Course Topics:

1. **'Growth' in History of Economic Thought:** The importance of economic growth from classical political economy to development economics.
2. **Growth vs. Development:**The ideas differentiating growth and development in early development economics. Growth as necessary but not sufficient for development.
3. **Theories of Economic growth:**Overview of main growth theories: classical, structuralist and neo-classical (including endogenous growth). Different conceptions of convergence. Fundamental causes of growth: history, geography and institutions.
4. **Development beyond growth:**Early critiques of growth centrism – social development, Basic Needs and employment generation. Capability theory and Human Development. Limits to growth and sustainable development.
5. **Development without growth:** The ecological critique and economics of steady state. Climate change and the debate between green growth and degrowth.

Please Note: Relevant statistical and computational tools will be used throughout the course wherever applicable.
Textbooks :

- Ujiro Hayami and YoshihishaGodo: *Development Economics: From the Poverty to Wealth of Nations* 3rd Edition. Oxford University Press.
- Michael Todaro and Stephen Smith: *Economic Development* 12th edition. Pearson.
- Gilbert Rist: *The History of Development: from Western Origins to Global Faith* 5th Edition. Zed Books
- Shahrukh Rafi Khan: *Development Economics: A Critical Introduction*. Routledge

Reference Books & Articles (indicative list, more will be added in the course of teaching):

- Herman E. Daly: *The Economics of Steady State*. *American Economic Review*
- Gerald Meier: *Development Economics: Biography of a Subject*. Oxford University Press
- Gerald Meier(ed.): *From Classical Economics to Development Economics*. Macmillan.
- Giorgos Kallis: *Degrowth.* Agenda Publishing
- Pulapre Balakrishnan: *Economic Growth in India: History and Prospect*. Oxford University Press.
- Amartya Sen: *Development as Freedom*. Oxford University Press.
- Bhaskar Vira: *Taking Natural Limits Seriously: Implications for Development Studies and the Environment*. *Development and Change*.
- Servaas Storm: *Structural Change*. *Development and Change*

Grading Plan :
(The table is Indicative)

Type of Evaluation	**Weightage (in %)**
Mid SemExam	**25%**
Class Presentation	**15%**
End Sem Exam	**40%**
Assignment	**20%**

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

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

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

In this course, teaching will be primarily based on lectures and will be supplemented with group discussions, class presentations and film screenings related to the class material.This will be a reading intensive course with multiple readings recommended for each lecture. A substantial writing assignment (3000- 4000 words) with the objective of constructing a cogent analytical argument based on academic literature will be a requirement for this class. The teaching tools including class discussion and presentation will be designed to train students in formulating their independent views on critical social and economic issues of the day.

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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, 2026

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 2026
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, 2026

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 : Information-Theoretic Methods in Computer Science

Faculty Name : Gowtham Kurii

Name of the Program : Elective for B.Tech. in CSE/ECE

Course Code : **CS1.502**

L-T-P : 3-1-0

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

Semester, Year : Spring, 2026

Prerequisites : Mathematical Maturity and Basics of Probability Theory - Random variable (RV), Joint and Conditional Probability Distributions, Expected Value of a RV, Linearity of Expectation, No Background on Entropy or Information Theory is assumed for the course.

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

1. Apply various Information Theoretic tools in the problems of Discrete Mathematics.
2. Demonstrate a familiarity with non-trivial proofs of combinatorial results like Shearer's lemma and Bregman's theorem using Entropy.
3. Articulate the underlying interconnections between the concepts of Information Theory and Computer Science.
4. Illustrate the applications of various statistical distances in theoretical computer science.
5. Explain the role of Information-Theoretic quantities in Machine Learning models like GANs.

Course Topics **:** A tentative list of topics to be covered in this course is below.

Module 0 : Review of Basics of Probability Theory.

Module 1 : Entropy and Its Properties: Entropy, Joint Entropy, Conditional Entropy, Sub-Additivity, Relative Entropy, Mutual Information, Chain Rules, Han's Inequality, Fano's Inequality, Source Coding

Module 2 : Applications of Entropy in Combinatorics, Graph Theory, Coding Theory, Shearer's lemma, and Bregman's theorem.

Module 3 : Pinsker's Inequality and Its Application to Distinguishing Coins.

Module 4 : Special Topics.

(i) Information-Theoretic Privacy - An Operational Approach to Information Leakage, Min-Entropy Leakage, Maximal Leakage.

(ii) Entropy and Guessing - Boltzmann Distribution, Guesswork, and Bounds via Entropy.

(iii) Generative Adversarial Networks (GANs) - Jensen-Shannon Divergence and Its Application in GANs.

Preferred Textbooks/Reference Material: There is no dedicated textbook for the course. The course broadly covers topics and material from various textbooks, research papers, and other similar courses. Some of them are listed below.

1. Cover and Thomas. *Elements of Information Theory.* John Wiley and Sons.
2. Jaikumar Radhakrishnan, "Entropy and Counting," Computational Mathematics Modelling and Algorithms, 2003.
3. 'Information and Coding Theory' by Madhur Tulsiani @ TTIC, 2021.
4. Issa, Wagner, and Kamath, "An Operational Approach to Information Leakage," IEEE Transactions on Information Theory, 2020.
5. I. J. Goodfellow *et al.,* "Generative Adversarial Networks," NIPS, 2014.

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

Type of Evaluation	Weightage (in %)
Assignments	15%
Quizzes	10%
Mid-Sem Exam	20%
End-Sem Exam	40%
Term Paper	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	3	3	2	1	1	2	2	3	2	3	2	3	3
CO2	2	3	2	3	3	3	3	2	3	3	2	3	3	3	3	2
CO3	3	3	3	3	3	3	3	1	2	3	2	2	3	3	3	2
CO4	3	3	2	3	2	2	3	2	3	3	2	2	3	2	3	3
CO5	2	2	3	2	2	3	3	1	2	3	2	3	2	2	3	3

Teaching-Learning Strategies in brief: Even though basic probability theory is a prerequisite, there will be a refresher lecture reviewing all the related concepts from it so as 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 wherever possible so that the students can comprehend them easily. Office hours are conducted with prior appointment via email where the students can interact with Teaching Assistant and/or Faculty to get their doubts on in-class discussion clarified and seek any extra help if required. Each assignment is associated with a short quiz primarily building upon the assignment so as to encourage the students to attempt and solve all the problems in the assignments on their own.

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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 2026
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 Textbooks: 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 : Aniket Alam + 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

Prerequisite Course / Knowledge: **Nil**

Course Outcomes (COs):

After completion of this course successfully, students 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: Analyze crucial 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.

Syllabus:
The course will be divided into five modules, each of which will introduce students to a particular discipline in the human sciences. The various disciplines that constitute human sciences are:

1. Political Science
2. History
3. Economics
4. Sociology
5. Philosophy

Each module will offer a systematic worldview, tools of enquiry to study, and analytical frameworks to make sense of topics taken up for discussion. A 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 human sciences are all about.

Reference books:
Readings for each of the modules will be given with the commencement of the lectures. There is no single textbook as such for all five modules.

Assessment methods and weightages in brief:
This is mainly a writing-driven course, and the evaluation questions in exams are carefully designed to make students think independently. Students are assessed for abilities like critically assessing

issues, questioning assumptions, clarifying distinctions, and bringing out nuances. Students are expected to demonstrate these abilities by presenting their views clearly and systematically.
Each module will have equal weightage of 20% each.

Quiz 1	20%
Mid-Sem	20%
Quiz 2	20%
End-Sem	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

Matrix for CSE

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

Matrix for ECE

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

Teaching-Learning Strategies in brief:
Each module will have one faculty delivering five lectures of 85 mins each. Through discipline-specific modes of understanding and everyday examples, class lectures will enable students to connect and ponder about themselves, the society and cultures that surround 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 govern ourselves. 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.

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 : Intro to Robotics: Perception and Planning

Name of the Faculty : K Madhava Krishna and Antony Thomas
Name of the Program : ECE
Course Code : EC4.202
Credits : 2
L - T - P :
(L - Lecture hours, T-Tutorial hours, P - Practical hours) 2-1-0
Semester, Year : Spring 2026
Pre-Requisites : Linear Algebra
Course Outcomes :
Course outcomes (CO's): After completion of the course, the students will be able to

1. Understand the fundamental principles and basic methods of robotic perception, localization, motion planning and feedback control.
2. Apply these methods to a robotic platform in a simulation environment

Course Topics:

Module 1: Perception and Localization: Introduction to the localization and perception problem, The need for perception and localization, The idea of error drift with time, Sensors used for perception and localization, introductory frameworks.

Module 2: Motion planning and Control: Configuration space, rotations and translations, sampling-based planning, Robot modeling, linearization, PID control design, state feedback control design.

Module 3: Introduction to robotic simulation: Robot Operating System (ROS), MuJoCo

Reference Books :

1) **Introduction to Autonomous Mobile Robots, R. Siegwart and I.R. Nourbaksh, MIT Press**
2) **Robot Modeling and Control, M.W. Spong, S. Hutchinson, M. Vidyasagar, Wiley India.**
3) **Springer Handbook of Robotics, Siciliano, B., Khatib, O. and Kröger, T**

Grading Plan :

Type of Evaluation	Weightage (in %)
Quiz-1	**10**
Mid Sem Exam	**30**
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

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	3	3	3	2	-	-	2	1	1	2	3	2	2	3
CO2	3	3	3	3	3	2	-	-	3	1	2	2	3	2	2	3

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

The key elements of robotic autonomy viz. localization and perception, motion planning, and feedback control will be covered with necessary mathematical details. Assignment problems will cover both theory and state of the art robotic simulations. The end project will enable the student to execute the complete pipeline of localization, perception, planning and control in high fidelity robotic simulation software.

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 PerformtheflightsimulationandflighttestingoftheprototypeUAVandverify its stability and performance characteristics.

3.

4.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

5.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 2026

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 :

(please list the order in which they will be covered, and preferably arrange these as five to six 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	P O 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**
aculty Name : Bapi Raju S
Course Code : CS9.311
Credits : 2
L - T - P :2-0-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring 2026 (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	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	2	1	1	2	1	1	1	1	1	2	1	1	1	1
CO2	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.

Title of the Course : Introduction to Coding Theory

Faculty Name : Lalitha Vadlamani V
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 2026

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,physics of few basic and important sensors and actuators

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 + Parameswari K
Course Code : CS7.401
Credits : **4**
L - T - P : 3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring, 2026
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 2026
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 : HS0.304
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	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	- - -	-

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	PO1 0	PO1 1	PO1 2	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 : Anil Nelakanti + Anoop Namboodi
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. **MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecific Outcomes (PSOs) – Course Articulation Matrix**

	PO1	PO2	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	2								2							

CO 2	3		2		2				2	2		1				
CO 3	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. 7th Edition, 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 & Technology
Name of the Faculty : RC Prasad & Kuldeep K
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 2026 (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, 4^{th} Edition

E-book Links :

Grading Plan : The table is only indicative.

Type of Evaluation	Weight
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 : Knowing India Through Data

Name of the Faculty : Angarika Rakshit
Name of the Program : CHD
Course Code : HS8.305
Credits : 2
L - T - P : 3 – 1 - 0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)

Semester, Year : Spring semester 2026.

Elective for CHD UG2 students

Pre-Requisites : Familiarity with any data analysis software – R, Stata, Python etc

Course Outcomes :

CO-1

Understand India's key data sources

Students will be able to critically read and analyse datasets such as the Census, NSS/PLFS, NFHS, ASI and administrative data, understanding their scope, limitations, and what they reveal about India's population, economy, and society.

CO-2

Evaluate Public Policy Using Data-Driven Reasoning

Students will learn to connect empirical patterns with real-world policy issues—such as unemployment, gender gaps, migration, or inequality—and use data-driven reasoning to support or critique policy positions.

CO-3

Identify how data shapes public narratives and recognise misleading uses of statistics.

Students will develop the ability to detect common forms of data misinterpretation or manipulation in media/policy discourse and produce more responsible, transparent, and context-aware data stories.

Course Description: This course introduces students to the major data sources used to understand India's economy and society. It provides hands-on exposure to publicly available datasets, builds familiarity with their scope and limitations, and uses them to explore key empirical features of the country. Students will learn how to interpret various types of data on the Indian economy and society, and engage with major empirical debates shaping contemporary India.

<u>Module I: Understanding India's Data Landscape</u>

- **Introduction to official data sources**
  – Types of datasets: surveys, administrative data, census data, and national accounts
  – Frequency, reliability, comparability, and data gaps
- **Key national data systems**
  – *Population & Demography:* Census, NFHS
  – *Industry & Production:* ASI, ASUSE, NSS
  – *Employment & Livelihoods:* PLFS, EUS
  – *Consumption & Living Standards:* CES, NFHS, IHDS
  – *Macroeconomic Indicators:* National Accounts Statistics, RBI data

– *Prices:* CPI, WPI
– *Government Schemes & Administrative Data:* MGNREGA, UDISE+

Module II: What India Looks Like Through Data

- **Who are the Indian people?**
  – Population structure, dependency ratios
- **How India works**
  – Employment arrangements (regular, casual, self-employment)
  – Sectoral distribution of work
  – Social Identity and occupations
- **What India earns**
  – Income measures and measurement challenges
  – Earning gaps
- **What India spends**
  – Consumption expenditure patterns
  – Food vs non-food spending, welfare implications
- **How India lives**
  – Access to basic services - water, sanitation, housing
  – Access to health and education services

Module III: Major Empirical Debates in Contemporary India

- **Is India an unequal society?**
  – Income, wealth, consumption, and social inequality
- **Are Indians becoming richer over time?**
  – Growth vs distribution, real incomes, poverty measurement
- **How many people are unemployed in India?**
  – Competing measures of unemployment
- **How *NOT* to use data**
  – Ethical concerns and misrepresentation

Preferred Readings :

1. Rukmini S. (2021), *Whole Numbers and Half Truths*
2. Handbook of Statistics on the Indian Economy 2023-24, Reserve Bank of India
3. Compendium of Datasets and Registries in India 2024, MoSPI, Government of India
4. State of Working India 2018, 2023, Azim Premji University

Students will be referred to other relevant journal articles during the course

Grading Plan :

(The table is only indicative)

Type of Evaluation	**Weightage (in %)**

Quiz	**30**
Assignment-1	**35**
Assignment-2	**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

https://intranet.iiit.ac.in/offices/static/files/PEOs%2CPOs%26PSOs-ofAllProgrammes-Jan2023.pdf

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

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

The course adopts a practice-oriented and exploratory pedagogy, where students engage directly with real Indian datasets such as the Census, NSS/PLFS, NFHS, ASI, ASUSE and other administrative sources. Each session blends brief conceptual discussions with guided, hands-on data exercises, allowing students to learn statistical reasoning by doing rather than by rote. Students work individually and in groups to clean, analyse, and visualise data, and to connect their findings to contemporary social and policy debates. Throughout the course, students are encouraged to reflect on ethical data use, developing the ability not only to analyse numbers but also to question how data is constructed, represented, and used in public discourse.

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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 2026
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%

Name of the Course : Law, Technology and Digital Governance

Name of the Faculty : Raman Saxena and Dr. G.K. Goswami, IPS, Director UP State Institute of Forensic Sciences (UPSIFS), Lucknow

Course Code : CS6.504

No. of Credits **: 4**

Lecture, Tutorial; Labs/Studio: 1.5 -0- 3

Target Students: Open Elective for B.Tech (2nd Year onward) and M.Tech

Course Duration: 14 Weeks

Semester, Year : Spring 2026

1. INTRODUCTORY STATEMENT

In today's era of Artificial Intelligence, Cloud Computing, and Data Analytics, engineering professionals face increasingly complex challenges around privacy, data protection, cyber ethics, and legal compliance. Understanding these dimensions is no longer optional—it is essential for driving responsible and sustainable innovation.

Legal frameworks such as the EU's General Data Protection Regulation (GDPR, 2018) and India's Digital Personal Data Protection Act (DPDP Act, 2023) have set new global standards for how technology must respect individual rights and organisational accountability. As a result, tomorrow's technology leaders must be equipped not only with technical expertise but also with a deep appreciation of the legal and ethical boundaries within which innovation thrives.

The joint elective course by IIIT Hyderabad and the Partner Institute (UPIFS), a leading authority in the integration of law, technology, and practice) is designed precisely to meet this need. It empowers engineering students with:

- Foundational legal literacy to navigate complex regulatory landscapes confidently.
- Ethical and compliance frameworks to design technologies that are both innovative and responsible.
- Global perspectives to ensure readiness for international data governance and cross-border compliance.

By bridging the worlds of law and technology, this course prepares future engineers to become trusted innovators—professionals who can build cutting-edge solutions while upholding the highest standards of ethics, privacy, and compliance.

2. COURSE OBJECTIVES

This interdisciplinary course has a vision to prepare future technocrats with a clear understanding of interfaces of technology with law which became a global new normal in the recent past. The legally compliant data protection landscape became an integral and mandatory component of cyber security. Brief objectives of the course are:

CO1- To introduce engineering students to the basic principles of law, jurisprudence, and governance.

CO2- To familiarise students with key legal frameworks such as the IT Act, 2000, and its amendments.

CO3- To develop understanding of global and Indian data protection regimes (GDPR, DPDP Act, 2023, HIPPA, 1996)

CO4- To equip students to identify legal, ethical, and compliance challenges in emerging technologies.

CO5- To encourage students to apply legal reasoning to real-world technological problems.

Mapping of Course Outcomes (COs) with M.Tech in Computer Science & Information Security Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

	PO1	PO2	PO3	PO 4	PO5	PO 6	PO7	PO 8	PO 9	PO10	PO11	PO12	PS O 1	PS O 2	PS O 3	PS O 4
CO1	3	1	1	2	1	2	1	2	1	1	1	3	1	1	1	1
CO2	3	2	2	2	1	3	1	3	1	1	1	2	3	1	2	3
CO3	3	2	3	2	1	3	1	3	1	2	2	2	3	1	3	3
CO4	2	3	2	3	1	3	1	3	1	2	1	3	2	3	3	2
CO5	2	3	3	3	1	3	1	3	2	2	2	3	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

3. EXPECTED LEARNING OUTCOMES

After completion of the course, students will be enabled to:

1. Understand fundamental legal concepts applicable to technology and data.
2. Interpret the relevance of IT laws and cyber regulations in practical engineering contexts.
3. Compare global data protection laws and their impact on business and design decisions.
4. Identify ethical and legal dilemmas in AI, IoT, and data-driven innovation.
5. Demonstrate ethical and legal dilemmas in AI, IoT, and data-driven innovation.
6. It will facilitate students becoming industry-fit and skilled as envisaged under T-model of skill development for better employability.

4. COURSE STRUCTURE AND EVALUATION

Course Credit: 3 (2 Lecture + 1 Tutorial/Practical per week) **Mode:**

Interactive Lectures, Case Studies and Simulation Exercises

Evaluation Scheme:

Assessment methods and weightage

	Assessment Methods	**Weightage**
1	Class Participation and Reflection Notes	10%
2	Mid-Term Test	20%
3	Case Study/Group Project	30%
4	Final Examination/Presentation	40%
	Total	100%

5. DETAILED WEEK-BY-WEEK COURSE CONTENT (SYLLABUS)

Week 1: Introduction to Law and Legal Systems – Concept of Law, Rights, Duties, and Governance

Week 2: Jurisprudence and the Role of Law in Technological Societies

Week 3: Overview of Indian Legal System – Constitution, Fundamental Rights, and Rule of Law

Week 4: IT Act, 2000 – Historical Background, Objectives, and Key Provisions

Week 5: Offences and Adjudication under IT Act; Cybercrime Case Studies**Week 6:** Cybersecurity and Digital Evidence – Legal Admissibility and Investigation

Week 7: Mid-Term Review and Discussion on Indian Cyber Law Practice

Week 8: Introduction to Data Protection – Concepts of Privacy, Consent, and Accountability

Week 9: The European GDPR (2018) – Principles, Rights, and Compliance Requirements

Week 10: The Digital Personal Data Protection Act (DPDP), 2023 – Indian Framework and Comparison with GDPR, 2018

Week 11: Cross-border Data Transfer and Corporate Compliance Obligations. Privacy Enhancing Technologies (PETs), focusing on how they facilitate international data sharing.

Week 12: AI, Ethics, and Algorithmic Accountability – Legal and Moral Dimensions

Week 13: Law, Technology, and Future Regulations – Metaverse, Blockchain, and Digital Identity. Open-Source Licensing and IP.

Week 14: Student Presentations and Final Assessment – Techno-Legal Case Analyses

6. SUGGESTED READINGS

- The Concept of Law – HLA Hart
- Information Technology Act, 2000 and its Amendments
- General Data Protection Regulations, 2018
- Digital Persona Data Protection Act, 2023
- Solove, D. J. (2021). Understanding Privacy. Harvard University Press
- Kuner, C. (2020). Transborder Data Flows and Data Privacy Law. Oxford University Press
- Shreya Singhal v. Union of India (2015) – Supreme Court of India
- Justice K.S. Puttaswamy (Retd.) v. Union of India (2017 SC) – Privacy Judgment
- Justice K.S. Puttaswamy (Retd.) v. Union of India (2018 SC) – Aadhaar Judgment

7. IMPLEMENTATION & PEDAGOGICAL APPROACH

This course will employ experiential pedagogy, integrating short videos, judicial decisions, live cybercrime examples, and policy debates. Guest lectures from legal experts, data protection officers, and technologists will enhance the applied understanding. The Partner Institute will assist in course delivery, providing access to Legal-Tech modules and case simulations.

8. CONCLUSION

This elective represents a pioneering initiative aligning legal reasoning with technological innovation. It will help IIIT Hyderabad students become not just skilled engineers but also responsible digital citizens capable of shaping ethical and lawful technological futures.

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Title of the Course : Learning and Memory

Name of the Faculty : Bhaktee Dongaonkar
Course Code : CG1.403

Credits : 4
L - T - P : 3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Name of the Program : Cognitive Science

Semester & Year : Spring 2026

Pre-Requisite : not applicable

Course Overview

This course is designed for students to learn the core concepts of learning and memory mechanisms in the brain. The course will go in-depth and discuss important scientific experiments and theories, and neural models that have helped to shape the understanding of learning and memory behaviour. The content is a mix of cognition, neuroscience, and neural network models.

Course Outcomes :

- CO1- Understand the basic principles of learning and memory in the brain
- CO2- Apply the fundamentals of behaviour to brain network models
- CO3- Examine the experimental results from research in the field of learning and memory
- CO4- Evaluate a chosen topic, understand its current status and propose new ideas
- CO5- Develop an experimental design that can propel the field ahead

Course Topics :

Introductory Module

- Psychology of Learning and Memory
- Neuroscience of

Learning and Memory

Learning Module

- Habituation, Sensitization, and Familiarization: Learning About Repeated Events
- Classical Conditioning: Learning to Predict Significant Events

- Operant Conditioning: Learning the Outcome of Behaviors
- Generalization, Discrimination Learning, and

Concept FormationMemory Module

- Episodic Memory and Semantic Memory
- Skill Memory
- Complementary learning systems in the brain /Memory network in the brain
- Working Memory

and Cognitive Control

Integrative Module

- Emotional/Stress Influences on Learning and Memory
- Social Learning and Memory: Observing, Interacting, and Reenacting
- Development and Aging: Learning and Memory Across the Lifespan

Preferred Text Books **:**Learning and Memory- From Brain to Behavior (3^{rd} edition, 2020)-Mark A. Gluck, Eduardo Mercado, Catherine E. Myers, Worth Publishers (Macmillan, New York)

Reference Books :

E-book Links :
https://www.macmillanlearning.com/college/ca/product/Learning-and-Memory/p/1319107389

If any changes in the Grading Plan, faculty will announce in the first class.

Grading Plan :

(The table is only indicative)

Type of Evaluation	Weightage (in %)
In class quizzes	**40% (8 quizzes x 5%)**
Mid Sem-Exam	**15%**
End Sem Exam	**30%**
In-class discussions& presentations	**15%**

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-'

dash mark if not at all relevant).

PO1- Demonstrate conceptual knowledge of cognition at brain and behaviour levelPO2 - Evaluate and analyze scientific work done in the field

PO3 – Apply the knowledge to address important unanswered questions in the fieldPO4 - Demonstrate ability to think of potential experiments

PO5 – Apply the scientific ability to work on real-world problems in the field of cognitive science

	PO1	PO2	PO3	PO4	PO5
CO1	2	1	1	1	1
CO2	1	2	2	1	1
CO3	1	3	3	2	1
CO4	1	3	3	3	3
CO5	1	2	2	3	3

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

The textbook will be used as a reference to cover the important topics and basicsin the field of learning and memory. Published experimental results will be discussed in class with students to understand how experimental work is conducted and analyzed. Students will then choose a topicof their interest, understand it in-depth, design a study that fills a gap and explain it to the class.

Title of the Course : Linear Algebra
Course Code : MA2.101
Name of the Faculty : Atul Singh Arora, Sidharatha Das and Gowtham K
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 2026

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 : Linguistic Data III-Data modelling in ILs

Name of the faculty : Rajakrishnan P Rajkumar
Course Code : CL3.406
Credits : 2
L - T - P : 3-1-0 (L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring, 2026 [H1]

Pre-requisite: Introduction to Linguistics 1
COURSE OUTCOME:
CO-1: Provide understanding of to the necessary concepts and methods for analyzing linguistic data at different levels of language organization.
CO-2: Acquire practical training in analyzing data, storing and modelling it for NLP applications
CO-3: Get training in general analytical thinking, practice and accountability with respect to linguistic data.
CO-4: They will explore data from different Indian Languages (ILs).

CO-5: The students will be exposed to different schemas necessary for future research. We focus simultaneously on language data and on the techniques used.

COURSE TOPICS:

Unit 1: Introduction to Linguistic analysis and Analytical techniques in Linguistics.

Unit 2: Basics of Data and Data Collection and Extraction; Crowd Sourcing; Structured Data acquisition and Pre-processing

Unit 3: Morphological Data Analysis and Compilation. Modelling morphological analysis and generation

REFERENCES BOOKS

Handel, Zev (Compiled and revised). 2009.Asian Linguistics Workbook. Seattle: University of Washington. Based on Hal Schiffman's Asian Linguistics Workbook, a Draft version.

Heine, Bernd and Heiko Narrog (Eds.). 2009. The Oxford Handbook of Linguistic Analysis. New York: OUP.

Langacker, Ronald Wayne. 1972. Fundamentals of Linguistic Analysis. New York: Harcourt Brace Jovanovich.

Nida, E. Nida.1949. Morphology: The Descriptive Analysis of Words (2nd edition). Ann Arbor, MI:University of Michigan Press.

Sylak-Glassman, J., 2016. The composition and use of the universal morphological feature schema (unimorph schema). Johns Hopkins University.

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

Grading Scheme:

Assignment: 40 points

Quiz: 20

End Semester Exam: 40 points

Title of the Course : Literature and the Ethics of telling a Story

Faculty Name : Sushmita Banerji

Course Code : HS0.210

Credits : 2 credits

L - T - P:

Semester, Year : Spring 2026

Name of the Program : Humanities Elective

Pre-Requisites:

Introduction to Human Sciences, Ethics 2 (Basics)

Course Description:

Theodore Adorno famously said, "to write poetry after Auschwitz is barbaric." He was clearly not talking about the act of writing poetry but rather the tension between ethics and aesthetics inherent in an act of artistic production that reproduces the cultural values of the society that generated the mass murder of Jews during WWII. How then does a writer presume to represent/re-present collective acts of extreme brutality while also not validating the culture that produces these violences?

This course shall look at key pieces of literature emerging from periods of extreme violence and orchestrated genocide in the 20th and 21st century to examine and interrogate models of remembering, testimony and representation. Readings shall include writings on the Holocaust, the Partition of India and Pakistan, and regional Indian Literatures.

Course Outcomes:
On successful completion of this course, students will be able to

1. Examine key ethical concepts and explain how they work or fail in the historical of war and genocide.
2. Examine howprominent writers have dealt with fundamental ethical questions, moral dilemmas and personal failures and successes in key pieces of writing.
3. Synthesize their knowledge of theories and concepts in ethics to critically examine the world they live in and the cultural production they encounter and produce.

Course Topics:
Unit I: Introduction
Ethics in the World
Literature and its dimensions, What is the value of representation?

Unit II:
Ethical Questions and World War II Literature
Ethics of Suffering
Unit III:
Indian Literatures of Strife

Preferred Text Books:

Adorno, Theodor W., 1997. *Can One Live After Auschwitz?: A Philosophical Reader*, ed. by Rolf Tiedemann, trans. by Rodney Livingstone et al, *Cultural Memory in the Present*. Stanford: Stanford University Press (2003)
Ali,Agha Shahid. *A Country Without a Post Office*. Delhi: Penguin, 2013.
Ao, Temsula, *These Hills Called Home: Stories from a War Zone.*Zubaan/Penguin, 2005.
Bhalla, Alok. ed. *Stories About the Partition of India. Vol.1,2,3.* New Delhi: Indus, 1994.
Levi, Primo, *The Truce*, 1963 trans. by Stuart Woolf. London: Abacus Books (1987).
Reference Books:
Caruth, Cathy. *Unclaimed Experience: Trauma and the Possibility of History.*Baltimore: Johns Hopkins University Press, 1996.
Das, Veena, "Language and Body: Transactions and the Construction of Pain." *Life and Words: Violence and the Descent into the Ordinary.* Berkeley: University of California Press, 2007.

Derrida, Jacques, *Demeure: Fiction and Testimony*, with Maurice Blanchot, *The Instant of My Death*, translated by Elizabeth Rottenberg. Stanford: Stanford University Press, 2000.
Lang, Berel, *Holocaust Representation: Art within the Limits of History and Ethics.* Baltimore: The Johns Hopkins University Press, 2000.
Talbot, Ian. "Literature and the Human Drama of the 1947 Partition." *Partition and Post-Colonial South Asia: A Reader, Vol. II. Eds. Tai Young Tan and GyaneshKudaisya*. London: Routledge, 2008.

Assessments:

Quiz 1	**10%**
Quiz 2	10%
Quiz 3	10%
End semester exam	20%
Term Paper 1	20%
Term Paper 2	20%

Teaching-Learning Strategies:

Students are expected to read prescribed texts in the course of the semester, watch any video lectures made available, and view films when required. This class is based on close reading of the texts prescribed and relies heavily on student participation and discussion.

This class shall deal with material students might disagree with. All informed disagreements, opinions, and discussions are encouraged. It shall however be the instructor's right to shut down any disrespectful behaviour.

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								3
CO2						2										3
CO3						3		3								3

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Title of the Course : Machine Learning for Communications
Name of the Faculty : Saikiran Bulusu
Name of the Program : ECE/CSE
Course Code : EC5.414
Credits : 4
L - T - P : 3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring, 2026

Pre-Requisites : Mathematical maturity, basics of probability theory, linear algebra, and digital communications. Background in wireless communication and machine learning will be helpful but should not be necessary.
Course Outcomes : After successful completion of the course, the students will be able to

1. Understand fundamental machine learning algorithms and their applications in wireless communication systems, including supervised, unsupervised, and reinforcement learning techniques.
2. Analyze and apply machine learning methods for channel estimation and signal detection in various wireless network scenarios.
3. Evaluate and implement federated learning framework in wireless networks, especially under resource constraints and privacy requirements.
4. Design and optimize wireless communication systems that effectively support machine learning tasks, including model training and inference at the network edge.
5. Conduct independent projects to explore advanced topics or emerging research areas in machine learning applied to wireless communications, demonstrating critical thinking and problem-solving skills.

Course Topics :

The course is organized into two parts. The first part deals with machine learning algorithms to solve various wireless communication problems. The second part focuses on the design and optimization of wireless network architectures to carry out machine learning tasks.

Module 0: Review of Wireless Communications – Channel modeling, Channel estimation, Digital modulation over wireless channels, Synchronization, OFDM, MIMO (5 Lectures)

Module 1: Introduction of Machine Learning – Supervised learning – k-nearest neighbor method, Perceptron, Unsupervised learning – clustering, EM algorithm, PCA, Reinforcement learning (4 Lectures)

Part 1: Machine Learning for Wireless Networks:

Module 1: Channel Prediction and Estimation based on Machine Learning – Learning-based reconstruction algorithms, Optimized sampling, Channel estimation in point-to-point systems, Deep learning-based channel estimation, Deep learning for massive MIMO CSI feedback (approx. 6 Lectures)

Module 2: Signal Detection – Modulation classification via machine learning, OFDM detection, MIMO detection, Specific emitter identification via machine learning (approx. 4 Lectures)

Part 2: Wireless Networks for Machine Learning:

Module 3: Federated Learning in Wireless Networks with Constrained Resources – Model training at the wireless edge, FedAvg, Resource-constrained federated learning, Quantization theory, Quantization methods for federated learning, Performance analysis (approx. 5 Lectures)

Module 4: Over-the-Air Computation for Distributed Learning: Federated learning with over-the-air computations, Federated learning with user scheduling, Model compression, Federated learning without CSI, Differentially private wireless federated learning (approx. 4 Lectures)

Preferred Textbooks/Reference Material: The following are the preferred textbooks for the course.

- Eldar, Goldsmith, Gunduz, and Poor, "Machine Learning and Wireless Communications," Cambridge University Press, 2022.
- He and Ding, "Application of Machine Learning in Wireless Communications," IET, 2019.
- F.-L. Luo, "Machine Learning for Future Wireless Communications," Wiley-IEEE Press, 2020.
- C.M. Bishop, "Pattern Recognition and Machine Learning," Springer, 2006.
- Goodfellow, Bengio, and Courville, "Deep Learning," MIT Press, 2016.

Grading Plan :

Type of Evaluation	Weightage (in %)
Scribes	10 %
Assignments	20 %
Mid Sem Exam	20 %
End Sem Exam	20 %
Project	30 %

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

Commented [PK1]: Most boxes could be filled here with 2-3, and remaining with 1. Best to not leave anything empty, was advice gn before.

	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 probability theory, linear algebra, digital communication, wireless communication, and machine learning are a prerequisite for the course, there will be refresher lectures reviewing the concepts from them 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.

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Title of the course : Machine Learning for Natural Sciences

Name of the Faculty : Vinod PK + Deva Priyakumar and Prabhakar B
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	: Sujit Gujar + Praveen Paruchuri
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 : Khaliq Parkar + Angarika Rakshit

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 2026

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 Models 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 : Mathematical Methods in Sciences

Name of the Faculty : Monalisa Patro
Course Code : SC5.450
Name of the Academic Program : CNS
Credits : 4
L-T-P : 3-1-0
(L= Lecture hours, T=Tutorial hours, P=Practical hours)

1.Prerequisite Course / Knowledge:

Basic knowledge of linear algebra and complex numbers.

2. Course Outcomes (COs):

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

CO-1 Discover the basic notion of n-dimensional complex vector space.

CO-2 Learn to **manipulate/calculate** abstract problems with modern notations (like index notations).

CO-3 Recognize the connections between the abstract notion of vector space, physical vectors and tensors, andmatrix manipulations.

CO-4 **Discover** the basics of discrete/continuous group theory.

CO-5 **Apply** their knowledge and **calculate** simple mathematical problems in 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	2	3	1	1								3			2	
CO 2	2	3	2	2						2		3			2	
CO 3	2	3	2	3						2		3			2	
CO 4	2	3	2	2								3			2	
CO 5	3	3	3	3						2		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: Introduction: (Linear vector space) Dirac notation and n-dim spaces, from vectors to matrices, their basicproperties, products, determinants, orthogonal/hermitian/unitary matrices, diagonalization etc..

Unit 2: Calculus of vector & tensor fields: gradient/divergence/curl, line/surface/volume integrals, Gauss's theorem, Stokes theorem, Dirac delta function, curvilinear coordinates, definition of tensors, properties: symmetric/anti-symmetric tensors, Kronecker delta/Levi-civita, non-Cartetian tensors: metric, Christoffel Symbols,covariant derivatives, geodesics, parallel transport. Special topics: special functions like Legendre functions, Fourier transformations etc.

Unit 3: Group theory/symmetries: representations, Lie algebra, rotational/Lorentz symmetries, Unitary group,Special Unitary group, angular momentum

Reference Books:

1. Mathematical Methods for Physicists - Arfken and Weber
2. Advanced Engineering Mathematics - Erwin, Kreyszig
3. A Physicists Introduction to Algebraic Structures – Palash Baran Pal
4. Mathematical Physics - S.D. Joglekar

5.Teaching-Learning Strategies in brief:

The course will build on basic ideas introduced in linear algebra, group theory and complex analysis. The starting point will be the complex linear vector space. It will connect to domains that, apparently, have very littlein common (like physical vectors and functions). The ideas will be extended to vector fields, their calculus and tensors to investigate multi-dimensional problems. The basics of discrete/continuous group theory and some Lie groups (like the Rotation groups SO(2) or SO(3), etc) will be discussed. 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%)

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Title of the Course : Mathematics for Finance

Name of the Faculty : Sukrit Mittal
Name of the Program : Mathematics of Finance
Course Code : MA8.402
Credits : 4
L - T - P : 2-0-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)

Semester, Year : Spring 2026

Pre-Requisites : MA6.101 Probability and Statistics or Equivalent
CS 7.403 Statistical methods in AI

Course Outcomes :

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

1. Understand and apply core concepts of financial markets, instruments, and pricing.
2. Model risk-free and risky assets using binomial trees and discrete-time frameworks.
3. Construct and evaluate portfolios using CAPM, diversification, and risk-return analysis.
4. Analyze and price derivatives and apply risk-neutral valuation in financial engineering.

Course Topics : Following is the tentative list of topics, broadly divided into 4 modules, to be covered in this course in 24 lectures. (Each lecture is 90 mins)

Module 1: Fundamentals of financial instruments (6 lectures)

- Overview of financial systems
- Market participants and historical evolution
- Annuities and perpetuities
- Zero-coupon and coupon bonds
- Forward contracts

Module 2: Portfolio management (6 lectures)

- Quantifying single asset risk and return
- Two-asset portfolios and diversification
- Minimum variance portfolio and Efficient Frontier
- Risk-free asset and capital market line
- Asset pricing model and systematic risk

Module 3: Options and options pricing (6 lectures)

- Introduction to options
- No-arbitrage principle and single option replication
- Binomial option pricing model
- American & European options, options greeks
- Black-Scholes-Merton model

Module 4: Continuous and discrete time models (6 lectures)

- Introduction to stochastic calculus
- Discrete-time models (beyond options)
- Continuous-time modeling: Geometric Brownian Motion
- Modeling interest rates

Preferred Textbooks:

- Mathematics for Finance: An Introduction to Financial Engineering, *by Marek Capinski & Tomasz Zastawniak*
- Portfolio Theory and Risk Management, *by Maciej J. Capinski & Ekkehard Kopp*

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	30
Project	30

	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	1	2	-	2	-	2	-	-	-	-	-	2	2	2	1	2
CO 2	3	2	-	2	2	2	-	-	2	1	-	2	2	2	3	2
CO 3	2	3	2	1	2	2	-	1	2	1	-	2	2	2	1	2
CO 4	3	3	2	1	2	2	-	1	2	1	-	2	2	2	2	2

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

- The course is designed to balance theoretical foundations with practical applications in quantitative finance.
- Theoretical concepts from the Capinski textbook will be introduced contextually, as needed to support modeling and analysis.
- Students will engage with numerous examples and exercises, including pricing models, portfolio construction, and risk management strategies.

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Title of the Course : Mechatronics System Design

Faculty Name : Harikumar K + Antony Thomas
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 : Molecular Modeling and Simulations
Name of the Faculty : Marimuthu Krishnan + U Deva Priyakumar
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 : 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.

Detailed Syllabus:

Unit 0: Numerical Analysis Tools: Review of Metric spaces and Basic Topology, Norms, Convergence, Contraction Maps, Quantifying Numerical Errors. (Lectures: 01)
Unit 1: Numerical Differentiation and Integration: Finite Difference. Numerical Integration (Riemann sum, Trapezoidal and Simpsons rule). Preconditioning. Monte Carlo. Applications. (Lectures: 01)
Unit 2: Numerical Interpolations: Polynomial interpolation. (Lectures: 02)
Unit 3: Numerical Linear Algebra: Algorithms for LU, QR, SVD, Iterative methods for sparse matrices, Tensor Decompositions. Applications to quantization and image processing. (Lectures: 02)
Unit 4: Numerical Optimization: Convex Sets, Convex Functions, Linear, Quadratic, Semi-definite, and Conic Program. Introduction to Min-Max problems. Dynamic Optimization. Applications to planning, finance, image
completion. (Lectures: 04)

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.

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

- **Assignments: 10%**
- **Quiz: 20%**
- **Mid Exam: 35%**
- **Projects: 35%**

Title of the Course : **Optical Remote Sensing**
Faculty Name : Ramachandra Prasad + Kiran Chand T
Course Code : **GS1.401**
L-T-P : **3-0-1.**
Credits : **4**
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Type -When : Spring 2026

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 2026

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. ak, 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 (S_N1, S_N2 and S_Ni): 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 : **TBD**
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 2026 (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 : Spring2026

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)inqueueingsystemsand 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 2026)

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 2026

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	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
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
CO4	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

CO6	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 2026

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 : Quantum aspects of cryptography

Faculty Name : **Atul Singh Arora**
Course Code : CS1.505
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 2026

Pre-Requisites: Mathematical maturity from courses like Discrete Structures or Linear Algebra course.

Desirable: Familiarity with the basics of (classical) cryptography, and quantum computation/information

Course Outcomes: The primary goal of this course is to enable students to perform research in this exciting newly emerging discipline. The students will be able to do the following:

CO.1 (Understand level) — Demonstrate familiarity with the basic security definitions in the area, including those of verification of quantum computations, homomorphic computation, including those based on complexity theoretic assumptions such as the hardness of the learning with errors problems.

CO.2 (Analyse) — Analyse whether a formal security definition is meaningfully capturing the relevant notion of security, and construct security proofs given explicit candidate constructions or show impossibility given a model of computation.

CO.3 (Evaluate level) — Review the literature at the frontier of quantum cryptography and related areas.

CO.4 (Evaluate level) — Evaluate the runtime/resource requirements of cryptographic protocols, derive reductions to show protocols satisfy appropriate security definitions.

Course Topics:

Depending on the maturity of the students, the course will be adapted. The following is an ambitious and therefore tentative course outline. The basic goal will be to cover Unit 1 and one key result from Units 2, 3 and 4. The remaining units will be covered, depending on the pace of the course and interest of the students.

Unit 1: Review:

Primer on quantum formalism. [VW '16] Lay of the land:

Impagliazzo's worlds: in particular MiniCrypt and Cryptomania Introduce the main directions:

(T1) post-quantum cryptography (make classical constructions secure against quantum adversaries), (T2) quantum analogues of classical functionalities,

(T3) functionalities impossible without quantum (excluding those in T2), (T4) basing cryptography on quantum complexity (T3) Information Theoretic: key distribution (BB84, Ekert), proof of security, secret sharing, impossibility of bit commitment, impossibility of strong coin flipping, achieving optimal strong coin flipping using weak coin flipping, self-testing CHSH, all bipartite states can be self- tested [VW '24]

Unit 2: (T2) Verification:

Regev's quantum reduction [Regev'09]

Weak quantum verifier: based on MBQC [GKK17]

Classical verifier: assuming LWE is hard, Mahadev [Mahadev 18, Vidick 22] Classical verifier: two non-communicating provers [RUV 12]

Unit 3: (T2) QFHE: construction and its applications: Mahadev's QFHE construction [Mahadev 17] Compiling non-local games [KLVY 23] Verification assuming QFHE [NZ 23]

Unit 4: (T4) Minimal assumptions: Minicrypt and below OT is in Miniqcrypt [GLSV 20, BCKM 20]

Crypto despite having NP=P or similar [Kre 21, KQST 23] Microcrypt Primitive Zoo [Or Sattah]

Unit 5: (T1/T2) Multi Party Computation

(T1) Post-quantum Commitments (collapse-binding commitments) [Unruh'16] (T1) Post-quantum MPC [HSS 11]

(T2) Quantum 2-PC [DNS '10 and '12]

(T2) Quantum MPC w/ quantum communication [Dulek, Grilo, Jeffery, Majenz, Schaffner] (T2) Quantum MPC w/ classical communication [Bartusek '21]

Unit 6: (T3) Quantum-only functionalities—I

Unclonable encryption: construction in the Random Oracle Model [AKLLZ '22] Certified deletion [BK '22]

Quantum Pseudorandom unitaries [MH '24]

Unit 7: (T3) Quantum-only functionalities—II
Quantum Money and Lightning [Zhandry '17]

iO for pseudo-deterministic functions [BKNY '23]

Unit 8: Bonus/extra reading (references will be provided later) Other key topics in

cryptography:

Interactive proofs Zero knowledge Quantum rewinding

Quantum Random Oracle Model Everlasting security

Connections to physics:

Self-testing using a single quantum device Non-locality = Proof of quantumness + rigidity

Black hole radiation decoding and commitments Cryptographic tests of python's lunch conjecture Computationally bounded theory of entanglement

References:

GKK 17: Verification of quantum computation: An overview of existing approaches VW 24: Introduction to Quantum Cryptography (book)

VW 16: Quantum Proofs (survey)

RUV 12: Classical command of quantum systems

Vidick 22: Course FSMP, Fall'20: Interactions with Quantum Devices Mahadev 18: Classical verification of quantum computations Mahadev 17: Classical Homomorphic Encryption for Quantum Circuits KLVY 23: Quantum Advantage from Any Non-Local Game

NZ 23: Bounding the Quantum Value of Compiled Nonlocal Games: From CHSH to BQP verification

BCKM: One-Way Functions imply Secure Computation in a Quantum World MH24: How to Construct Random Unitaries

Or Sattah: MicroCrypt Zoo

Kre21: Quantum pseudorandomness and classical complexity KQST21: Quantum cryptography in algorithmica

DNS '10: Secure two-party quantum evaluation of unitaries against specious adversaries DNS '12: Actively Secure Two-Party Evaluation of any Quantum Operation

DGJMS '19: Secure Multi-party Quantum Computation with a dishonest majority Bartusek '21: Secure Quantum Computation with Classical Communication

BK 22: Cryptography with Certified Deletion

HSS11: Classical Cryptographic Protocols in a Quantum World Unruh'16: Collapse-binding quantum commitments w/o random oracles AKLLZ '22: On the Feasibility of Unclonable Encryption and more Zhandry '17: Quantum Lightning Never Strikes the same state twice MH '24: How to Construct Random Unitaries

BKNY '23: Obfuscation of pseudo-deterministic quantum circuits

Regev '09: On Lattices, Learning with Errors, Random Linear Codes, and Cryptography

Video Tutorials:

Dakshita Khurana: Cryptography with certified deletion Mark Zhandry: Security Reductions (multi-part series)

Preferred/reference Textbooks:

There are no textbooks for this course as the material is at the frontier of current research in quantum cryptography. Relevant lecture notes/tutorials/survey articles have already been referenced above.

Resources to review basics of quantum info/computation

- Lecture notes on Quantum Computation by John Preskill (Caltech)
- Introduction to Quantum Information and Computation, MA Nielsen and IL Chuang

Resources to review classical cryptography

- Introduction to Modern Cryptography. Jonathan Katz and Yehuda Lindell.
- Foundations of Cryptography (Volumes 1 and 2). Oded Goldreich.

Other resources

- Zhandry's lecture notes on quantum cryptography

Grading Plan:

Type of Evaluation	Weight (%)
Assignments/Scribe	40
Term Paper	20
Two Exams (mid-semester and final)	40 (20 + 20)

Assignments. Approximately, every two lectures. Will largely consist of completing proofs that could not be carried out in class. Resources will be provided for finding the proofs. Deadlines for assignments will be decided by consensus. Every student is allowed to miss the deadline by at most 48 hours, at most once per month.

Exams. The final exam would not overlap (to the extent reasonable) with the material assessed in the mid-semester exam. Two previously assessed assignments can be resubmitted, one during the mid-term and one during the final, to improve one's score on those assignments. Depending on the need, one may also offer to scribe a lecture, to improve one's score on one of the assignments.

Term Paper.

The goal here is for each student to read and understand a related paper. To this end, the course requires each student to submit a short four-page summary of the paper (page limit is not strict) that also identifies one potential direction for further research, together with some ideas on how to make progress towards achieving it. The research aspect does not have to be anything too ambitious. The emphasis will be on understanding the main result. Depending on the number of students, there may be a presentation in addition/instead of the written report.

The choice of paper must be finalised before the mid-term. A list will be provided but students are welcome to submit papers they find interesting.

The term paper will be due at least one month after the mid-term. The exact date will be announced after the mid-term.

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 course will facilitate inter-student and faculty student interactions by periodic gaps for completing in-class exercises and discussing their solutions. Proofs will be broken down into smaller steps and some steps will be given as exercises after each class. Spaced repetition of exercises will be used to encourage retention of key ideas and concepts. The focus will primarily be on understanding and asking questions, preparing the students to conduct research. The course explicitly has an exploratory component that will allow students to study cutting edge research papers and formulate new research directions and crystalise ideas on how to make progress along these directions. Students will submit written reports and, time permitting, also present their work. Both being crucial skills for conducting effective research.

Title of the Course **: Readings in Russian Literature: The Nineteenth Century**
Faculty Name : Nazia Akhtar
Name of the Program : **Humanities Elective**

Course Code : HS1.302
Credits : 4 credits
L - T - P : **36 hours (24 lectures)**
Semester, Year : Spring 2026

Pre-Requisites : BTech Students: Passed Intro to Human Sciences and one other HSS elective (Introduction to Literature desirable); CHD 3rd and 4th Year students

Course Outcomes :

On successful completion of this course, students will be able to

1. critically interpret, analyze, and appreciate Russian literature (and by extension, other kinds of texts and narratives as well) and its contributions to art and thought of the modern world;
2. examine and discuss the literary merit of creative texts beyond casual impressions or value judgements, acquiring – in the process – fundamental skills in oral and written communication;
3. connect human, creative expression to the issues that make up and are made by the world in which we live;
4. apply this basic foundation in the study of creative writing to conduct further research on literature, including computational research on topics associated with literature; and
5. understand the socio-historical background and material foundation of modern Russia, whose geopolitics plays a crucial international role in our times.

Course Topics :

The nineteenth century in Russia saw the production of some of the greatest prose in the history of world literature. This was the century when Lev Tolstoy debated the question of non-violence through the prisms of philosophy and religion; when Fyodor Dostoevsky pondered over the psyche of human beings, pushing them to their extremes in his writings, and wrote one of the first creative texts of existentialism; and when Anton Chekhov wrote stories and plays that totally shifted paradigms and principles of representation on page and stage. Across the span of the century, writers of novels, novellas, and short stories grappled with fundamental questions about humanity: the eternal struggle between good and evil, the place of the individual in society and state, the conditions and rights of women, alienation and other discontents brought about by industrialization and urbanization, the uncanny in nature and folk, patriotism and the Russian soul and so on. Writers such as Marko Vovchok and Maxim Gorky envisaged and pushed for a transformation of the entire social order, fighting more particularly for the rights of serfs and the working classes. Others such as Elena Gan, Maria Zhukova, Nadezhda Khvoshchinskaya, Karolina

Pavlova, and Olga Shapir not only engaged with and represented the concerns their male colleagues were preoccupied with, but also challenged existing discourses about women and their place in the world, ushering in change in social thought through their deliberations on the "new woman" and her aspirations and world view.

The impact of nineteenth-century Russian literature far exceeds its specific time and milieu; this body of writing raises and addresses questions that remain relevant to our world today. It has inspired figures as diverse as Sigmund Freud, Friedrich Nietzsche, Mahatma Gandhi, Virginia Woolf, Martin Luther King Jr, and Anita Desai. This course will introduce students to the terrain and trajectory of the nineteenth-century Russian short story and provide them the opportunity to examine, interpret, and discuss the work of several writers from this period. It will equip them with a foundational understanding of major conceptual, theoretical, and methodological developments in Russian literature. Over the duration of this course, we will reflect on three key questions through our reading of nineteenth-century Russian short stories: what were the major moments and concerns of Russian literature during this period, and how are these still relevant today? How did the form of the Russian short story change over the course of the century, and what was the socio-cultural context for these developments? What was the long-term impact of these events for literature in general? The course will discuss issues fundamental to the study of literature, psychology, sociology, and philosophy through the lens of these texts and seek to understand their status as an indispensable and enduring body of writing in world literature.

To do so, it will cover the following topics:

1. **Defining the Literary, Socio-Historical, and Global Context of Nineteenth-Century Russian Literature:** the Russian Empire; the defeat of Napoleonic France in 1812; the Decembrist revolt of 1825; the court and country; the Crimean War of 1854-5; the annexation of the Caucasus; relations with the Ottomans, Persians, and the Chinese; urbanization and industrialization; 1861 Emancipation of the serfs; Nihilism and other political and intellectual developments.
2. **Mapping and Examining the Forms and Concerns of the Russian Short Story across the Nineteenth-Century through Close-Reading:** Romanticism (the Gothic and the uncanny, folklore, nature and human beings, patriotism and nationalism); Realism (psychological realism, social manners, structural inequalities, critique of the state, lyrical realism); Existentialism (nature of existence, sovereign vs. relational self); Socialist Realism (socialism; the advent of revolutionary writing).
3. **Tracing the Literary History and Method of the Russian Short Story across the Nineteenth-Century:** poetics of sensibility vs. poetics of rationality and pragmatism; political, didactic, and ideological writing; temporal, stylistic, and narrative structure; thematic shifts.
4. **Synthesizing an Understanding of Nineteenth-Century Russian Literature with Its Enduring Place in World Literature:** universal philosophical, political, and aesthetic questions; major issues such as class, gender, empire, totalitarianism, and power; accessing world literature in translation; possibilities of research on nineteenth-century Russian literature using computing.

Preferred Text Books :

1. **Aleksandr Pushkin:** "The Queen of Spades" (1834), selections from *The Tales of the Late Ivan Petrovich Belkin* (1831).
2. **Zinaida Volkonskaya:** "The Dream: A Letter" (1829).
3. **Mikhail Lermontov:** "Ashik-Kerib" (1837).
4. **Nikolai Gogol:** "The Nose" (1835-6), Selections from *Evenings on a Farm Near Dikanka* (1829-32).
5. **Ivan Turgenev:** Selections from *A Hunter's Sketches* (1852).
6. **Karolina Pavlova:** "At the Tea-Table" (1859).
7. **Marko Vovchok:** "After Finishing School" (1859).
8. **Lev Tolstoy:** "Quench the Spark" (1885), selections from *Sevastopol Sketches* (1855).
9. **Sofya Soboleva:** "Pros and Cons" (1863).
10. **Fyodor Dostoevsky:** "The Crocodile" (1865), "Notes from Underground" (1846).
11. **Anton Chekhov:** "Death of a Clerk" (1883), "Lady with the Dog" (1899).
12. **Olga Shapir:** "The Settlement" (1892).
13. **Maxim Gorky:** "Old Izergill" (1895).

Reference Books :

1. Martin Puchner, ed. *The Norton Anthology of World Literature*, vol. 2, fourth ed. (2019).
2. Catriona Kelly, ed. *An Anthology of Russian Women's Writing*, 1777-1992 (1994).
3. Nicholas Rzhevsky, ed. *An Anthology of Russian Literature from Earliest Writings to Modern Fiction: Introduction to a Culture* (1996).
4. Dominic Lieven, ed. *The Cambridge History of Russia*, vol. 2 (Imperial Russia, 1689-1917; 2008).

Grading Plan :

Type of Evaluation	**Weightage (in %)**
Quizzes	**20% (2 x 10%)**
In-Class Writing Assignments	**20% (2 x 10%)**
Mid-Semester Exam	**25%**
End-Semester Exam	**35%**

Mapping of Course Outcomes to Program Objectives:

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	-	-	1	3	-	3	2	3	3	1	-	3	-	1	1	3
CO 2	-	-	1	3	-	3	2	3	3	1	-	3	-	1	1	3
CO 3	-	-	1	3	-	3	2	3	3	3	-	3	-	1	1	3
CO 4	-	1	1	2	-	3	2	3	3	2	-	3	-	1	1	3
CO 5	-	-	1	3	-	3	2	3	3	1	-	3	-	1	1	3

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

The teaching-learning strategy in this course will consist of lectures based on set readings, which students are expected to complete in advance of the class. These lectures will incorporate prompts for classroom discussion and activities based on the readings to enable active learning and critical thinking. This learning will be further consolidated through assessments that will be designed to test and develop the student's knowledge and skills, especially interpretative reading and writing.

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Title of the Course : Research Methods in Human Sciences

Faculty Name : Anirban Dasgupta + Rajorshi Ray
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 2026
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: Explainthe 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, 2026
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 + Antony Thomas
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	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
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
CO4	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 II

Faculty Name : Chittaranjan Hens + Prabhakar Bhimalapuram
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

<u>4.Detailed Syllabus</u>:

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.

<u>5.Teaching-Learning Strategies in brief</u> (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

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

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

<u>Matrix for CSE</u>

	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				
CO6			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

<u>Matrix for ECE</u>

	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				
CO6			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

<u>4.Detailed Syllabus</u>:

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):

his 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. MappingofCourseOutcomes(COs)withProgramOutcomes(POs)andProgramSpecific 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:EachCourseOutcome(CO)maybemappedwithoneormoreProgramOutcomes(POs)andPSOs. 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 : Kuldeep Kurte + K S Rajan
Course Code : GS2.503
Credits : 4
L - T – P : 3-1-0
(L - Lecture hours, T-Tutorial hours,
P - Practical hours)
Semester, Year : Spring 2026
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
    - 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 : Marimutu Krishnan
Course Code **: SC1.205**
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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
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
CO4	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 : **Sustainable Growth Strategy for Startup**
Name of the Faculty : Sridhar Kalyanasundaram
Name of the Program : M.Tech – Product Design and Management
Course Code : PD2.403
Credits : 2
L-T-P (Lecture-Tutorial-Practical hours) : 2-1-0

1. **Prerequisites**: Exposure to business models and basic financial statements. Comfort with basic quantitative analysis (spreadsheets, ratios).

2. **Course Objectives**

This course aims to equip students with the financial and strategic tools to build a profitable, scalable startup. The key objectives are:

- To introduce frameworks for startup financial and operational strategy.
- To provide a deep, practical understanding of various revenue and pricing strategies across B2B and B2C models.
- To master the key performance metrics that inform strategic decision-making and measure a startup's health.
- To develop an actionable financial forecast and operational strategy focused on achieving profitability and extending runway.

3. **Course Outcomes (COs)**

Upon successful completion of this course, students will be able to:

- **CO1**: Evaluate how changes in key business variables (e.g., pricing, customer acquisition cost, churn rate) impact a startup's financial projections and sustainability.
- **CO2**: Design and evaluate various B2C and B2B revenue models and pricing strategies.
- **CO3**: Calculate, interpret, and make decisions based on key startup metrics like LTV, CAC, Churn, and ARPU.
- **CO4**: Develop a comprehensive financial forecast and operational strategy to manage cash flow and extend runway.

4. **Course Modules & Session Plan**

Sl.	Module	Optimized Session Topic
1	**M1: Foundations**	From Business Plan to Operational Strategy

2		Key Business Levers & Financial Statements
3	**M2: B2C Business: Revenue, Pricing & Metrics**	B2C Revenue Architecture
4		B2C Pricing & Go-to-Market (GTM) Strategy
5		B2C Metrics Deep Dive (CAC, LTV, Engagement)
6	**M3: B2B Business: Revenue, Pricing & Metrics**	B2B Revenue Architecture
7		B2B Pricing & Sales Strategy
8		B2B Metrics Deep Dive (MRR/ARR, NRR, Sales Efficiency)
9	**M4: Financial Management & Sustainable Operations**	Financial Modeling for Startups
10		Managing Burn, Runway & Cash Flow
11		Capital Efficiency & Bootstrapping Strategies
12	**M5: Project**	Presenting the Sustainable Growth Plan (Part 1)

13		Presenting the Sustainable Growth Plan (Part 2)

5. Reference Books

The reference books are organized as a guided tour through the startup journey:

Part 1: The Blueprint (Designing the Initial Plan)

- "Business Model Generation" by Alexander Osterwalder & Yves Pigneur
- "Running Lean" by Ash Maurya

Part 2: The Process (Testing and Iterating)

- "The Lean Startup" by Eric Ries

Part 3: The Ambition & Market (Defining a Unique Space)

- "Zero to One" by Peter Thiel
- "Blue Ocean Strategy" by W. Chan Kim and Renée Mauborgne

Part 4: The Execution (Making It Happen)

- "Playing to Win: How Strategy Really Works" by A.G. Lafley and Roger L. Martin
- "Measure What Matters" by John Doerr

6. Grading Plan

Type of Evaluation	Weightage (in %)
Ongoing Assignments (Mini-cases, Memos)	20%
End-Semester Exam	20%
Final Project & Presentation	60%

7. 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	2	3	3	2	2	1	1	1	2	2	2	3	3	2
CO2	1	3	3	2	2	2	1	1	2	2	3	3	3	3
CO3	2	3	2	2	2	1	1	1	2	2	2	3	3	2
CO4	1	2	3	2	2	2	2	2	3	3	3	3	3	3

8 . Teaching-Learning Strategies

The course will be delivered on a live, interactive basis. The delivery will involve lectures to introduce frameworks, presentations, videos, and class discussions centered on real-world case studies. There will be periodic assignments which will enable participants to reflect and respond to situations based on their learning in the program. The final project will bring all the learnings together, challenging students to develop an actionable financial and operational plan for a real-life startup situation.

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, 2026

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 Digital City: Problems, Policies, and Practices
Name of the Faculty : Khaliq Parkar
Name of the Program : Open Elective for UG and PG
Course Code : HS8.304
Credits : 4
L - T - P : 3-0-1
Semester, Year : HSS Elective for UG3/UG4. Spring 2026.

Pre-Requisites :

Course Description : Cities are at the forefront of technological innovation and are primary sites for deploying technologies towards improving governance. As cities see rapid growth, digital interventions are seen as solutions for concerns of infrastructure, the delivery of public services, quality of life, meeting sustainability goals and improving democratic participation. Contemporary public policies encourage urban governments to adopt digital technologies and data-driven governance towards addressing these concerns.

The course brings together lessons from national and global experiences to understand key issues of urbanization and interpret how government programs and initiatives encourage technological adoption for urban governance. Furthermore, it evaluates the varieties of digital tools employed by cities, how citizens and city administrators use these tools and assesses outcomes of digitalization on urbanization, governance and citizenship.

The course is ideal for students interested in understanding contemporary issues of urbanization and working at the intersection of governance and digitalization.

Course Outcomes :

CO 1: Identify key concerns of urbanization
CO 2: Compare and categorize public policies towards digital urban governance
CO 3: Analyze how digital tools are designed to address urban concerns
CO 4: Assess and evaluate functioning of digital technologies in urban governance
CO 5: Design possible technology interventions for key issues in governance

Course Topics :

Module 1: Introducing Urbanization and Digitalization

This foundational module introduces the social, political and economic processes of urbanization. It identifies the key issues of urbanization using comparative case studies and locates how public policies aim to address them. Policies related to digitalization, such as 'smart cities' are brought into focus.

1.1 Understanding the city

1.2 Contemporary concerns of urbanization

1.3 Decoding polices of urban digitalization

Module 2: Urban Governance Institutions, Processes and Citizenship

This module establishes the role of governance institutions and citizens in relation to the city. It identifies substantive processes by which cities are planned and governed. It also establishes how urban development is conceived through civic participation, improvement of infrastructures, and a focus on services. Here, we introduce how digitalization aims to transform conventional roles and processes of governance.

1.4 The role of municipalities and other urban agencies

1.5 Digital democracy, citizens' participation and access to the city

1.6 Urban planning, development, infrastructures and services

Module 3: Digital Tools for Urban Governance

The third module establishes the role of sector specific digital technologies for urban governance. It focuses on various platforms as key tools in reconfiguring governance, locates the varieties of digital infrastructures, and identifies how data is used towards governance. Specific digital interventions from global case studies are critically evaluated and assessed.

3.1 The 'government-as-a-platform' framework

3.2 The role of urban digital infrastructures

3.3 Reaching goals of data-driven governance

Module 4: Urban Futures

The final module focuses on future trajectories of urban governance. Using contemporary policy discourses and technologies which are deployed, it plots three broad trajectories to understand how digitalization can transform cities.

4.1 Digital literacy, the digital divide and democracy

4.2 Services, safety and surveillance

4.3 Sustainable development of cities

Reference Books :

- Ash, James, Rob Kitchin, and Agnieszka Leszczynski. 2018. *Digital Geographies*. London: Sage.
- Baud, Isa, and J. de Wit, eds. 2008. *New Forms of Urban Governance in India*. New Delhi: Sage.
- Douay, Nicolas. 2018. *Urban Planning in the Digital Age*. London: John Wiley & Sons.
- Hood, Christopher C., and Helen Margetts. 2007. *The Tools of Government in the Digital Age*. New York: Palgrave Macmillan.
- Karvonen, Andrew, Federico Cugurullo, and Federico Caprotti. 2018. *Inside Smart Cities*. London: Routledge
- Luque-Ayala, Andrés, and Simon Marvin. 2020. *Urban Operating Systems: Producing the Computational City*. Infrastructures Series. Cambridge, Massachusetts London: The MIT Press.
- Patel, Sujata, and Kushal Deb. 2006. *Urban Studies*. New Delhi: Oxford University Press.
- Picon, Antoine. 2015. *Smart Cities: A Spatialised Intelligence*. West Sussex: Wiley.
- Ruet, Joël, and Stéphanie Tawa Lama-Rewal, eds. 2012. *Governing India's Metropolises*. New Delhi: Routledge.

Grading Plan :
(The table is only indicative)

Type of Evaluation	Weightage (in %)
Essay	**20%**
Field Study	**20%**
Problem Statement for Group Project	**10%**
Mid-Semester Group Project (Stage I)	**20%**
End Semester Group Project (Stage II)	**30%**

Mapping of Course Outcomes to Program Objectives (for BOTH CSE and ECE): (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	-	3	-	3	3	2	-	2	2	2	1	3	2	2
CO2	1	2	1	3	1	3	3	2	1	2	2	2	1	3	2	3
CO3	2	2	3	3	2	3	1	2	1	1	1	2	3	2	3	3
CO4	2	2	2	3	2	3	2	2	1	2	1	2	3	3	3	3
CO5	3	3	3	3	3	3	2	2	3	2	1	3	3	3	3	3

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

The course will be taught by using global case studies to compare and contrast varying elements of urbanization. In addition, students will have to spend some of their practical hours doing field visits in Hyderabad to get a hands-on understanding of local urban issues. Guest lecturers from companies such as Vassar Labs, Pixelvide, startups at T-Hub and representatives from Hyderabad and Telangana governments will be invited to introduce students to contemporary urban technology initiatives. The final group project encourages students to apply their interdisciplinary training in crafting a potential technology solution aimed at urban governance.

Title of the Course **: The Mathematics of Information: Theory and Application**
Name of the Faculty : Prasad Krishnan
ECE Course Code : EC5.207
Credits : 2
L - T – P : 3:1:0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring 2026
Pre-Requisites : Probability basics, [Useful but not essential: Information theory basics]

Course Outcomes :

At the end of the course the learner is expected to be able to do the following.

1. Identify the main mathematical concepts of information theory.
2. Analyze Sources of Discrete Signals and Discrete Noisy Channels, and Design codes for signal representation and communication on noisy channels.
3. Apply information theoretic ideas to study the fundamental limits of communication/computation/sequence-generation in the context of various applications in security, privacy, DNA sequencing, Machine learning, etc.

Course Topics :

1. **Unit 1.** Probability Review and Basic Information Theoretic Quantities
2. **Unit 2.** Typicality, Source Coding Theorem (General Statement + proof for Discrete, via typicality), Channel Capacity Theorem (proof for DMC, via typicality)
3. **Unit 3.** Applications - Information-theoretic security, privacy, data-storage, DNA sequencing, Machine Learning ec.

Preferred Textbooks :

1. **Elements of Information Theory Author(s):Thomas M. Cover, Joy A. Thomas.**
2. Changho Suh. (2023). Information Theory for Data Science. Boston–Delft: Now Publishers
3. Information Theoretic Cryptography, Himanshu Tyagi and Shun Watanabe, Cambridge University Press, Online ISBN: 9781108670203, https://doi.org/10.1017/9781108670203

Reference Books :

1. **Information Theoretic Security, Foundations and Trends in Communications and Information Theory Vol. 5, 2009, Y. Liang, H. V. Poor and S. Shamai (Shitz) DOI: 10.1561/0100000036**
2. Ilan Shomorony and Reinhard Heckel (2022), "Information-Theoretic Foundations of DNA Data Storage", Foundations and Trends® in Communications and Information Theory: Vol. 19: No. 1, pp 1-106. http://dx.doi.org/10.1561/0100000117 (Available on ArXiv)
3. Motahari, Abolfazl S.; Bresler, Guy and Tse, David N. C. "Information Theory of DNA Shotgun Sequencing." IEEE Transactions on Information Theory 59, 10 (October 2013): 6273– 6289 © 2013 Institute of Electrical and Electronics Engineers (IEEE)
4. I. Shomorony and R. Heckel, "DNA-Based Storage: Models and Fundamental Limits," in IEEE Transactions on Information Theory, vol. 67, no. 6, pp. 3675-3689, June 2021, doi: 10.1109/TIT.2021.3058966.
5. M. Bloch et al., "An Overview of Information-Theoretic Security and Privacy: Metrics, Limits and Applications," in IEEE Journal on Selected Areas in Information Theory, vol. 2, no. 1, pp. 5-22, March 2021, doi: 10.1109/JSAIT.2021.3062755.
6. Cynthia Dwork and Aaron Roth (2014), "The Algorithmic Foundations of Differential Privacy", Foundations and Trends® in Theoretical Computer Science: Vol. 9: No. 3–4, pp 211-407. http://dx.doi.org/10.1561/0400000042
7. Real-World Cryptography, David Wong, ISBN 9781617296710, Manning Publications, 2021.

8. **Relevant papers for PIR:**
    a. 'Private information retrieval', Chor, Benny and Kushilevitz, Eyal and Goldreich, Oded and Sudan, Madhu, J. ACM, Nov 1998, https://doi.org/10.1145/293347.293350.

    b. **H. Sun and S. A. Jafar, "The Capacity of Private Information Retrieval," in IEEE Transactions on Information Theory, vol. 63, no. 7, pp. 4075-4088, July 2017, doi: 10.1109/TIT.2017.2689028.**

Grading Plan :

(The table is only indicative)

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

https://intranet.iiit.ac.in/offices/static/files/PEOs%2CPOs%26PSOs-ofAllProgrammes-Jan 2023.pdf

	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

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

The key goal of the course is to convey a spirit of excitement and grasp basic ideas regarding information-theory's role in various applications, including communications, data processing, storage, security and privacy, etc. Towards that end we will have worksheets (assignments) regularly to help students to grasp the material. Further, to give the students a taste of current research in these areas, a paper or a topic will be assigned to be presented at the end of course as a term paper presentation.

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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 **: Theories and Practices of Nationalism**
Faculty Name **: Aniket Alam**
Course Code **: HS3.303**
Credits **: 4**
L - T - P **:**
(L - Lecture hours, T-Tutorial hours,P -Practical hours)
Semester, Year **: Spring 2026**
Name of the Program **: B.Tech in Computer Science and Engineering& B.Tech in Electronics and Communications Engineering**

Pre-Requisites **:** Passed Introduction to Human Sciences (HS8.102)

Course Outcomes :
CO1: Define the concept of Nationalism.

CO2: Explain range of academic theories interpreting Nationalism.

CO3: Analyze the different characteristics which form Nationalism.

CO4: Evaluate the positive and negative attributes of Nationalism.

CO5: Develop their own understanding about the role of Nationalism in today's world.

Course Topics :

(1) Academic theories of Nationalism

a) Imagined Communities
b) Industrialised Societies
c) Colonial and Post-Colonial

(2) Brief history of the nation-state in the world

a) Latin America

b) Europe

c) Asia and Africa

(3) Nationalism in India

a) Cultural Nationalism

b) Anti-Colonial Nationalism

(4) Theories of Nationalism in India

a) Gandhi

b) Bankim

c) Nehru

d) Tagore

e) Iqbal

f) Savarkar, Golwalkar

g) Jinnah

Preferred Text Books :

1. John Hutchinson: *Nationalism*
2. S. Irfan Habib: *Indian Nationalism – The Essential Writings*

Reference Books :

1. Benedict Anderson: *Imagined Communities*.
2. Ernest Gellner: *Nations and Nationalisms*.
3. Eric Hobsbawm: *Nations and Nationalism since 1780*
4. Hans Kohn: *The Idea of Nationalism*
5. E. H. Carr: *Nationalism and After*
6. Partha Chatterjee: *Nationalist Thought and the Colonial World*
7. Javeed Alam: *India- Living With Modernity*
8. M.K. Gandhi: *Hind Swaraj*.
9. V. D. Savarkar: *Hindutva*.

10. Rabindranath Tagore: *Nationalism*.
11. M. S. Golwalkar: *We or Our Nationhood Defined*.
12. Jawaharlal Nehru: *Discovery of India*.
13. Bankim Chandra Chattopadhyay: *Anandamath.*
14. Rabindranath Tagore: *Gora*.
15. Bipan Chandra: *Colonialism and Nationalism in Modern India*.
16. Sumit Sarkar: *Modern India*.

E-book Links :

Grading Plan :
(The table is only indicative)

Type of Evaluation	Weightage (in %)
Mid SemExam	**20%**
End Sem Exam	**35%**
Assignments	**(15x3) 45%**

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

BTech in CSE

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

Grading Plan :
(The table is only indicative)

Type of Evaluation	Weightage (in %)
Mid SemExam	**20%**
End Sem Exam	**35%**
Assignments	**(15x3) 45%**

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

BTech in ECE

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	-	-	2	2	1	3	3	3	2	2	1	3	-	2	2	3
CO2	-	-	3	2	1	3	3	3	2	2	2	3	--	2	1	3
CO3	-	-	2	2	-	3	3	3	1	2	1	3	-	1	2	3
CO4	-	-	3	3	1	3	3	3	2	2	1	3	-	1	2	3
CO5	-	-	3	3	1	3	3	3	2	3	1	3	-	2	1	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 1,200 pages of books and articles and submit written work between 5,000 to 6,000 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 assignments and project will focus on training students to develop their own ideas, and apply them to real life conditions.

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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 + Nazia Akhtar
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 the Course : Topics in Discrete Mathematics
Name of the Faculty : Prasad Krishnan
Name of the Program : Math Elective
Course Code : MA5.501
Credits : 4
L - T – P : 3:1:0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester & Year : Spring 2026

Pre-Requisites : Linear Algebra, Discrete Maths (Preferable but not essential)

Course Outcomes :

CO-1: Construct finite fields using the theory of field extensions and minimal polynomials, and perform computations within them.

CO-2: Analyze the internal algebraic structure of finite fields (e.g., cyclic multiplicative groups, subfields) and apply this theory to problems in related areas such as coding theory.

CO-3: Define a matroid using its equivalent axiomatic systems (independent sets, bases, circuits, rank) and identify fundamental examples (graphic, vector, uniform).

CO-4: Analyze matroids using the fundamental operations of duality and minors, and classify them based on their linear representability over various fields.

CO-5: Apply matroid theory to prove the optimality of the greedy algorithm for optimization problems and relate matroids to the more general concept of submodular functions.

Course Topics :

Unit 1: Algebraic Essentials

Rings, Fields, Integral Domains, Prime Fields, Polynomial rings F[x], the division algorithm, irreducible polynomials. Ideals and the construction of Quotient Rings.

Unit 2: Field theory and Vector Spaces (focus on finite fields and finite dimensional vector spaces)

Finite extensions, their construction and structure: Extensions, degree, algebraic elements, and minimal polynomials. Splitting fields. Field automorphisms and the Galois Group Gal(K/F). The Frobenius automorphism as a generator for Gal(GF(p^n)/Z_p). The Fundamental Theorem of Galois Theory for finite fields and its application to proving the subfield structure. Vector spaces: Vector spaces, linear independence, basis, dimension. Matrices and rank over finite fields, Connections to coding theory.

Unit 3: Matroid Axioms

Motivation from graphs and vector spaces. Equivalent axiom systems: Independent Sets, Bases, Circuits, and the Rank Function, Uniform, Graphic, and Vector matroids. Duality, cocircuits, and minors (deletion and contraction).

Unit 4: Representability, Optimization, and Generalizations

F-representable matroids. Binary matroids, the Fano Matroid. Examples of matroids representable over some fields but not others. Non-representable matroids (e.g., Vámos). The greedy algorithm and the maximum-weight basis problem, Submodular functions and Polymatroids.

Preferred Textbooks:

1. Lidl, Rudolf, and Harald Niederreiter. Introduction to Finite Fields and Their Applications. Cambridge University Press.
2. Oxley, James. Matroid Theory. Oxford University Press, 2nd Edition.
3. Dummit, David S., and Richard M. Foote. Abstract Algebra. Wiley, 3rd Edition.

Reference Books :

1. Welsh, D. J. A., Matroid Theory. Dover Publications.
2. Wilson, Robin J. Introduction to Graph Theory. Pearson.
3. Fraleigh, John B. A First Course in Abstract Algebra. Pearson.

Grading Plan :

(The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz-1	**15**
Mid Sem Exam	
Quiz-2	
End Sem Exam	**35**
Assignments	**20**
Project/Term Paper	**30**
Other Evaluation	

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	1	1	1	1	2	3	3	1
CO5	3	3	3	1	1	1	1	1	1	1	1	1	3	3	2	1

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

This is a proof-based course driven by rigorous lectures that builds a theoretical narrative from algebra to combinatorics. Learning will be reinforced through challenging problem sets that require students to construct their own proofs and apply abstract concepts to concrete examples. The exams will test for a deep conceptual understanding of the theory and the ability to synthesize ideas from different parts of the course.

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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 2026
(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	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
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
CO4	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	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
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 : **TBD**
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	PO1 0	PO1 1	PO1 2	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.

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