INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY
HYDERABAD

Syllabus for Courses of Spring 2024

Date: 06. 12.2023 **Ver.1**

S.No.	Code No.	Course Name	Credits	Faculty Name(s)
1.	CS1.406	Advanced Algorithms	3-1-0-4	Suryajith Ch
2.	CE1.603	Advanced Structural Analysis	3-1-0-4	Pravin Kumar Venkat Rao
3.	EC4.501	Advances in Robotics & Control	3-1-0-4	Spandan Roy
4.	HS0.215	AI and Human Rights **(H2)**	3-0-0-2	Aakansha Natani
5.	EC2.103	Analog Electronic Circuits	3-1-3-5	Abhishek Srivastava
6.	CE1.608	Analysis & Design of Precast and Prestressed Structures	3-1-0-4	Shubham Singhal
7.	CE1.609	Analysis and Design of Bridge Structures	3-1-0-4	Jofin George
8.	CS9.422	Behavioral Research: Statistical Methods	3-0-1-4	Vinoo Alluri + Vishnu Sreekumar
9.	EC1.202	Bioinstrumentation and Devices	3-1-0-4	Anshu Sarje
10.	SC2.203	Biomolecular Structures **(H2)**	3-1-0-2	U Deva Priyakumar
11.	PD2.422	Business Finance (H1)	3-1-0-2	TBA
12.	SC1.102	Classical Mechanics **(H1)**	3-1-0-2	Diganta Das
13.	CS9.430	Cognitive Neuroscience	3-1-0-4	Bhaktee Dongaonkar
14.	CS9.432	Cognitive Science and AI	3-1-0-4	Bapi Raju S
15.	EC5.203	Communication Theory	3-1-0-4	Praful Mankar
16.	EC5.204	Communicaton and Controls in IoT **(H2)**	3-1-0-2	Sachin Chaudari + Aftab Hussain
17.	CS1.403	Compilers	3-1-0-4	Venkatesh Choppella
18.	CL3.101	Computational Linguistics 1	3-1-0-4	Parameswari Krishnamurthy
19.	CL2.404	Computational Psycholinguistics	3-1-0-4	Rajakrishnan
20.	CS7.302	Computer Graphics **(H1)**	3-1-0-2	K T Aakash Ajit + P J Narayanan
21.	CS2.201a	Computer System Organization	3-1-0-4	Praveen Paruchuri + Deepak Gangadharan
22.	CS2.201	Computer Systems Organization	3-1-0-4	Praveen Paruchuri + Deepak Gangadharan
23.	CS7.505	Computer Vision	3-1-0-4	Makarand Tapaswi + Anoop Namboodiri
24.	SC4.102	Computing in Sciences II **(H2)**	3-1-0-2	Prabhakar Bhimalapuram

25.	CS0.302	Computing Tools	3-1-3-4	Sriranjani K
26.	MA7.501	Continuous Variable Quantum Information Theory and Computation	3-1-0-4	UttamSingh
27.	HS1.208	Critical Viewing and Reading	3-1-0-4	Sushmita Banerjee
28.	CS1.201	Data Structures and Algorithms	3-1-3-5	Sujit Gujar + Manish Shrivastava + Gowtham Kurri
29.	CS4.302	Data Visualisation **(H2)**	2-0-1-2	Kamal Karlapalem
30.	CS6.301	Design and Analysis of Software Systems	3-1-0-4	Ramesh Lognathan + Raghu Reddy
31.	CE5.501	Design of Hydraulic Structures	3-1-0-4	Shaik Rehana
32.	PD1.502	Design of Wearable Systems **(H)**	3-1-0-2	Raghu Reddy
33.	CS7.303	Digital Signal Analysis **(H2)**	3-1-0-2	Anil Kumar V
34.	EC2.408	Digital VLSI Design	3-1-0-4	Zia Abbas
35.	CE8.401	Disaster Management	3-1-0-4	Jofin George + Shubham Singhal
36.	CS3.401	Distributed Systems Prerequisite: Operating Systems. Networks desirable	3-1-0-4	Lini Thomas
37.	SC1.440	Dynamical Processes in Complex Networks	3-1-0-4	Chittaranjan Hens
38.	CE1.601	Earthquake Engineering	3-1-0-4	Sunitha P
39.	SC1.101	Electrodynamics **(H2)**	3-1-0-2	Diganta Das
40.	EC2.202	Electronics Workshop II	0-1-3-4	Anshu Sarje + Spandan Roy
41.	HS8.303	Environmental & Social Governance in Mineral Extraction	3-1-0-4	Radhika Krishnan
42.	HS0.209	Exploring Masculinities **(H1)**	3-0-0-2	Vindhya Undurti
43.	EC2.502	Flexible Electronics	3-1-0-4	Aftab Hussain
44.	HS8.202	Gender, Culture and Representatio	3-1-0-4	Subha Chakraburtty
45.	SC2.101	General and Structural Chemistry	3-1-0-4	Tapan Kumar Sau
46.	HS5.201	Growth and Development	3-1-0-4	Anirban Dasgupta
47.	PD1.501	Human Computer Interaction**(H1)**	3-1-0-2	Raman Saxena
48.	EC5.102	Information and Communication	3-1-0-4	Prasad Krishnan + Arti Yardi
49.	CS8.402	Information Security Audit and Assurance	3-1-0-4	Shatrunjay Rawat
50.	CS3.404	Internals of Application Servers	3-1-0-4	Ramesh Loganathan
51.	HS4.302	Internet and Democracy	3-1-0-4	Aakansha Natani
52.	HS8.102	Intro to Human Sciences	3-1-0-4	Nazia Akhtar + Aakansha Natani
53.	EC2.204	Intro to Processor Architecture **(H1)**	3-1-0-2	Deepak Gangadharan
54.	EC4.402	Intro to UAV Design	3-1-0-4	Harikumar K

55.	CS1.305	Introduction to Algorithms Engineering **(H2)**	3-1-0-2	Kishore Kothapalli
56.	CS9.311	Introduction to Brain and Cognition **(H2)**	3-1-0-2	Kavita Vemuri
57.	EC5.205	Introduction to Coding Theory **(H1)**	3-1-0-2	Arti Yardi + Prasad Krishnan
58.	CS1.408	Introduction to Game Theory	3-1-0-4	Sujit Gujar
59.	CS8.301	Introduction to Information Security **(H1)**	3-1-0-2	Ashok Kumar Das
60.	CS3.303	Introduction to IoT	1-0-3-3	Suresh Purini + Kavita Vemuri
61.	CL1.102	Introduction to Linguistics II	3-1-0-4	Aditi Mukherjee + Rajakrishnan
62.	CS7.401	Introduction to NLP	3-1-0-4	Manish Shrivastava + Rahul Mishra
63.	SC1.420	Introduction to Particle Physics	3-1-0-4	Subhadip Mitra
64.	HS0.204	Introduction to Philosophy of Technology	3-1-0-4	Ashwin Jayanti
65.	CS9.312	Introduction to Quantum Information and Computation **(H1)**	3-1-0-2	Uttam Singh
66.	CS6.201	Introduction to Software Systems **(H1)**	1-0-3-2	Anoop Namboodiri + Prakash Yalla
67.	CS9.315	Introduction to Spatial Science and Technology **(H1)**	3-1-0-2	RC Prasad + KS Rajan
68.	CL2.204	Language Typology and Universals	3-1-0-4	Radhika Mamidi
69.	MA2.101	Linear Algebra	3-1-0-4	Siddharatha Das + Indranil Chakraborthy
70.	MA4.303	Linear Partial Differential Equations and Variational Calculus	3-1-0-4	Samyadeb Bhattacharya
71.	CL3.406	Linguistic Data 3: Data Modelling in ILs **(H2)**	3-1-0-2	Parameswari Krishnamurthy
72.	HS0.210	Literature and the Ethics of telling a Story **(H1)**	3-0-0-2	Sushmita Banerji
73.	SC4.411	Machine Learning for Natural Sciences	3-1-0-4	Prabhakar B + Vinod PK
74.	CS7.301	Machine, Data and Learning	3-1-0-4	Vikram Pudi + Praveen P
75.	HS8.101	Making of the Contemporary World	3-1-0-4	Anirban Dasgupta + Isha Dubey
76.	SC3.316	Mathematical Methods in Biology	3-1-0-4	Abhishek Deshpande
77.	CS7.508	Mathematics of Generative Models	3-1-0-4	Pawan Kumar
78.	EC4.404	Mechatronics System Design	3-1-0-4	Nagamanikandan + Harikumar K
79.	HS3.305	Migrants and Migrations in Modern South Asia	3-1-0-4	Isha Dubey
80.	SC2.316	Molecular Modeling and	3-1-0-4	Deva Priyakumar + Marimuthu

		Simulations		Krishnan
81.	SC2.315	Molecular Symmetry and Quantum Mechanics	3-1-0-4	Harjinder Singh
82.	HS1.210	Music Workshop (30)	3-1-0-4	TK Saroja
83.	CS9.434	Music, Mind, and Technology **(Open Elective)**	3-1-0-4	Vinoo Alluri
84.	CL3.407	Neural Natural Language Generation **(H1)**	3-1-0-2	Manish Shrivastava + Rahul Mishra
85.	CS3.502	Neuroinformatics	3-1-0-4	Vishnu Sreekumar
86.	SC3.410	NGS Data Analysis	3-1-0-4	Nita Parekh
87.	CS1.306	Numerical Algorithms **(H2)**	3-1-0-2	Pawan Kumar
88.	CS1.404	Optimization Methods	3-1-0-4	Naresh Manwani
89.	SC2.202	Organic Chemistry **(H1)**	3-1-0-2	Prabhakar Bhimalapuram
90.	PD2.423	Organizational Operations **(H2)**	3-1-0-2	Santanu Mandal
91.	CS3.307	Performance Modeling of Computer Systems **(H1)**	3-1-0-2	Tejas Bodas
92.	SC2.301	Physics of Soft Condensed Matter	3-1-0-4	Marimuthu Krishnan
93.	CS8.401	Principles of Information Security	3-1-0-4	Kannan Srinathan
94.	PD1.411	Product Design Workshop **(H)**	3-1-0-2	Prakash Yalla
95.	PD2.502	Product Lifecycle Management	3-1-0-4	Ravi Warrier
96.	CS1.409	Quantum Algorithms	3-1-0-4	Shantanav Chakraborty
97.	HS1.302	Readings in Russian Literature: The Nineteenth Century	3-1-0-4	Nazia Akhtar
98.	CS9.314	Remote Sensing	3-1-0-4	RC Prasad
99.	HS0.302	Research Methods in Human Sciences	3-1-0-4	Anirban Dasgupta + Isha Dubey
100.	CS7.405	Responsible & Safe AI Systems	3-1-0-4	Ponnurangam Kumaraguru
101.	EC4.403	Robotics: Planning and Navigation	3-1-0-4	Madhava Krishna K
102.	HS0.207	Science and Technology: Critical Perspectives **(H2)**	3-0-0-2	Saurabh Todariya
103.	SC1.111	Science II	3-1-0-4	Nita Parekh + Chittaranjan Hens
104.	**SC4.111**	**Science Lab II (H)**	**0-0-3-2**	**Tapan Kumar Sau + Chittaranjan Hens**
105.	HS7.301	Science, Technology and Society	3-1-0-4	Radhika Krishnan
106.	CS6.401	Software Engineering	3-1-0-4	Karthik Vaidhyanathan
107.	CS3.302	Software Programming for Performance **(H2)**	3-1-0-2	Suresh Purini
108.	CS4.410	Spatial Data Sciences	3-1-0-4	KS Rajan
109.	SC1.205	Statistical Mechanics **(H2)**	3-1-0-2	Bhaswar Gosh
110.	CS7.403	Statistical Methods in AI	3-1-0-4	Vineet Gandhi

111.	CS8.403	System and Network Security	3-1-0-4	Ankit Gangwal
112.	CS9.424	Technology Product Entrepreneurship	3-1-0-4	Ramesh Loganathan + Prakash Yalla
113.	SC1.308	The Universe Across Scales	3-1-0-4	Subhadip Mitra+Chittaranjan Hens+Diganta Das
114.	SC1.204	Thermodynamics **(H1)**	3-1-0-2	Harjinder Singh
115.	HS0.201	Thinking and Knowing in the Human Sciences-I	3-1-0-4	Saurabh Todariya + Nazia Akhtar
116.	HS0.206	Thinking through moral problems **(H1)**	3-0-0-2	Ashwin Jayanti
117.	EC5.402	Time Frequency Analysis	3-1-0-4	Anil Kumar V + Chiranjeevi Yerra
118.	CS7.602	Topics in Deep Learning	3-1-0-4	Charu Sharma
119.	CS8.502	Topics in Information-Theoretic Privacy	3-1-0-4	Prasad Krishnan + Gowtham Kurri
120.	CS7.603	Topics in Reinforcement Learning	3-1-0-4	Tejas Bodas + Harikumar K
121.	CS6.502	Topics in Software Foundations	3-1-0-4	Venkatesh Choppella
122.	CL5.401	Topics in SSMT	3-1-0-4	Anil Kumar V + Chiranjeevi Yerra
123.	HS4.202	Understanding Political Theory **(H1)**	3-1-0-2	Aakansha Natani
124.	CS5.402	Usability of Software and Digital Products **(H2)**	3-1-0-2	Raman Saxena + Nimmi Rangaswamy
125.	CS5.401	User Interaction and Usability of Digital Products **(Open Elective)**	3-1-0-4	Raman Saxena + Nimmi Rangaswamy
126.	OC3.102	Value Education II **(H)**	0-2-0-2	Shatrunjay Rawat (Coordinator)
127.	HS0.211	Values, Ethics and AI **(H2)**	3-0-0-2	Shatrunjay Rawat + Rajeev Sangal

Note: The above courses highlighted in the RED color will be updated soon.

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

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	PO 11	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 : 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

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
Course Code : EC4.501
Name of the Academic Program : B. Tech. in ECE
L-T-P : 3-1-0
Credits : 4

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
CO-5: Design inverse dynamics based robust controller to address uncertainty in robot dynamics
CO-6: Design adaptive-robust controller for robotic systems to address unmodelled dynamics

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

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

Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs). Write '3' 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 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, Prentice Hall.
3) Applied Nonlinear Control by Slotine and Lee, Prentice Hall.

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. 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 scientific publications.

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 2024

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 Mid SemExam Quiz-2	20%
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 : Abhishek Srivastava
Course Code : 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)

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

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

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

CO-1 Describe the devices: diode, transistors and their operation.

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

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

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

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

4.Detailed Syllabus:
Unit 1: Semiconductor Basics & P-N junction
Unit 2: MOSFET Operation & Biasing
Unit 3: Single stage Amplifiers
Unit 4: Differential Amplifier & Operational Amp
Unit 5:BJT
Unit6: Misc Topics

Unit7 (Laboratory): Super position theorem, transistor biasing etc.

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

5.Teaching-Learning Strategies in brief (4 to 5 sentences):
Students will be applying the lecture discussion to solved examples shared with them in the class. The assignments given will reinforce the concepts. Class room learning will be done in interactive method as much as possible. Occasionally self assessment test (1minute paper) will be given. In lab class, students will make simple circuits using simple basic components.

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

Type of Evaluation [3 credit-lecture]	**Weightage (in %)**
Mid Sem Exam 1	**15***
Mid Sem Exam 2	**15***
End Exam	**15***
Assignments	**25**
Mini Project	**25**
1 minute paper (in class) [weekly prescheduled]	**5**

Title of the Course : 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, 2024

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 : Design and Assessment of Bridge Infrastructure
Faculty Name :Jofin George
Name of the Program : Computer Aided Structural Engineering (CASE)
Course Code :
Credits : 4
L - T - P : 3-1-0
Semester, Year : Spring 2024

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	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PSO1	PSO 2	PSO 3	PSO 4
CO1	3	1	-	-	-	2	-	1	-	1	1	-	2	1
CO 2	3	2	1	-	2	2	-	1	-	2	3	2	2	2
CO 3	3	3	2	-	2	1	-	1	-	2	2	2	3	3
CO 4	3	3	3	-	2	-	-	1	1	2	3	1	2	3
CO 5	3	3	3	-	3	2	-	1	2	3	3	3	3	3
CO 6	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 : Behavioral Research: Statistical Methods
Course Code : CS9.422
Faculty Name : Vishnu Sreekumar + Vinoo Alluri
L-T-P : 3-1-0
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: 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

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

CO4	2	3	2	3	3	3	1	1	3	1	-	-	-	-	-	-
CO5	1	1	1	1	1	3	1	1	2	1	-	-	-	-	-	-
CO6	2	2	3	3	3	1	1	1	2	2	-	2	1	1	2	3

4. Detailed Syllabus:

Module 1: Introduction to Experimental Design; Foundations of Inferential Statistics
Experimental Design: Literature review, Hypothesis Testing, Type I and II errors, Hypothesis-based vs Exploratory Research, Types of variables and levels of Measurements, Different types of experimental designs: Between-subject and within-subject factors in an experiment; Factorial designs, Simple repeated measures design, Randomized blocks design, Latin square type designs, Foundations of Inferential Statistics, Standardized Distributions, Probability.
Module 2: Parametric tests of difference and association
Parametric tests of difference: Multivariate Analysis, Linear Models (GLM) and Mixed models; Multivariate Regression Techniques, Multi-level tests (ANOVA), MANOVA, ANCOVA, MANCOVA. Main effects and interaction.
Module 3: Non-parametric tests of difference and association
Nonparametric tests of association – chi-square test, Mann Whitney U test, Binomial Sign test, Wilcoxon's T test,
Related and Unrelated t tests; correlation, regression; Power Analysis
Module 4: Multivariate Methods

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

Reference Material:

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

5. Teaching-Learning Strategies in brief:

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

6. Assessment methods and weightages in brief:

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

Title of the Course : **Bio-instrumentation and Devices**
Course Code : EC1.202

Faculty Name : Anshu Sarje
L-T-P : 3-1-0
Credits : 4
(L - Lecture hours, T-Tutorial hours, P - Practical hours)

Semester, Year : Spring, 2024 (second half)

Pre-Requisites : 1. Basic Sciences, 2. Analog Electronics & Digital VLSI; 3. Basic Electronics

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 electrophysiological signal 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); other signals.

Understanding various biological system and the electrical signal they generate. Capturing the signals 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 for specific 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 and working 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.

3. Analysis and Design of Analog IC by Meyer Grey, Hrust, Lewis
4. 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

	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.

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

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 : TBD
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
(Ex: Spring, 2022)

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,

1.Prerequisite Course / Knowledge:
None

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

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

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

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

CO1	3	2	2	3								1		1		
CO2	2	3	2	3												
CO3	1	3		2										1		1

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

4.Detailed Syllabus:

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

Unit 2: Lagrangian formulation. Calculus of variations, Conserved quantities,

Unit 3: Central force motion. Conversion of a 2-body problem to c.m. and relative coordinates, elastic collisions, Rutherford scattering

Unit 4: Small oscillations & rigid body dynamics. Geometric description of mechanics, nonlinear oscillations

Unit 5: Hamiltonian formulation. Liouville Theorem. Virial Theorem

Unit 6: Special theory of relativity

Reference Books:

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

5.Teaching-Learning Strategies in brief:

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

6.Assessment methods and weights in brief:

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

Title of the Course	**: Cognitive Neuroscience**
Faculty Name	: Bhaktee Dongaonkar
Course Code	: CS9.430
L-T-P	: 3-0 -1.
Credits	: 4

1.Prerequisite Course / Knowledge:

1. Intro to psychology
2. Cognitive Science

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

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 Articulation Matrix

	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 cognitive processing.

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.

COURSE TOPICS :

(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 and action
4. Language
5. Memory
6. Decision making
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 by Gazzaniga
2. Required research papers.

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

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 5 sentences):

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 : CS9.432
L - T – P **: 3-1-0**
Credits **: 4**
(L - Lecture hours, T-Tutorial hours, P - Practical hours)

Semester, Year : Spring 2024

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.

Course Outcomes :

(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

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 cognitive science and neuroscience. A brief tour of the principles of 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 with a focus on their applications in neuroscience. Debates on the strengths and limitations of deep neural networks as models of information processing in the brain as well as models for artificial general intelligence (AGI).

Module 2: Vision. Brief tour of recent developments of application of deep neural networks (DNN) in computer vision. Introduction to human perceptual processing (with emphasis on vision) and the neural correlates of the perceptual function. The relation between the representation of information 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 these phenomena.

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 mammalian brain, in AI systems and their relationship. Application of the concepts of reinforcement 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.

Module 5: Predictive (Bayesian) Brain. Predictive coding and the related ideas of Bayesian Brain and Free Energy Principle -- theoretical frameworks of brain function. Generate-compare-update process of a mental model of the environment. Debates about the Predictive Brain and Free Energy Principle.

Tutorials: Special tutorials will be conducted to familiarize with fMRI experiments, Neuroimaging data and preprocessing, ML/DL tools and how to set up these to complete assignments and 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).

Reference Books :

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 in visual 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 #106 https://www.youtube.com/watch?v=3t06ajvBtl0&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 learning systems do intelligent agents need? Complementary learning systems theory updated." Trends in 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-book Links :

Grading Plan :

(The table is only indicative)

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

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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
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):

Lectures will initially introduce the motivations and concepts, illustrated with simpler examples. 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 project are expected to lead the students to a broader but more concrete understanding of the issues in 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 cognitive neuroscience.

Title of the Course : **Communication Theory**
Faculty Name : Praful Kumar
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**

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

2.Course Outcomes (COs)

After completion of this course successfully, the students will be able to
CO-1.Explain the basic elements of a communication system.
CO-2. Interpret the complex baseband representation of passband signals and systems and its critical role in modeling, design, and implementation.
CO-3. Explainthe basic concepts and implementations of analog modulation and demodulation techniques.
CO4: Explain different linear digital modulation techniques using constellations such as PAM, QAM, PSK, orthogonal modulation and its variants.

CO-5: Apply the concepts of power spectral density, energy spectral density and bandwidth occupancy, Nyquist pulse shaping criterion for avoidance of intersymbol interference.

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

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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO1	1	1	1	1	1	-	-	-	-	1	-	3	1	3	2	1
CO2	3	3	-	3	3	-	-	-	-	1	-	3	1	3	-	-
CO3	3	3	-	3	3	-	-	-	-	1	-	3	1	3	2	1
CO4	3	3	-	3	3	-	-	-	-	1	-	3	1	3	2	1
CO5	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 : **Communications and Controls in IoT**
Faculty Name : Sachin Chaudhari + Aftab Hussain
Course Code : EC5.204
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 Electronics and CommunicationsEngineering**

1. Prerequisite Course / Knowledge:

Basic computer programming (C, C++), 10+2 level physics.

2. Course Outcomes (COs)

After completion of this course successfully, the students will be able
toCO-1. Explain the basic elements of a communication system.
CO-2. Describe the working principle of commonly available sensors and actuators.
CO-3: Design an embedded system using advanced concepts such as timers and interrupts.
CO-4. Explain the basics concepts of communication networks on physical and MAC layer.
CO-5. Assess different communication technologies from IoT application point of view.
CO-6. Develop and implement an IoT-based solution for a real-life problem.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO 4
CO1	1	-	2	2	3	1	2	-	1	2	-	3	1	1	3	1
CO2	3	3	3	1	3	1	2	-	1	2	-	2	3	-	3	1
CO3	3	2	2	1	3	1	2	-	1	2	-	2	3	-	3	1
CO4	3	2	2	1	3	1	2	-	1	2	-	2	-	3	3	1
CO5	3	2	2	1	3	1	2	-	1	2	-	2	-	3	3	1
CO6	3	3	3	3	3	1	2	-	3	2	3	3	3	3	3	1

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

4. Detailed Syllabus:

Unit 1: Introduction to IoT (1 lecture)
Unit 2: Sensor physics, sensor characteristics and properties, sensor read-out circuitry, actuatorphysics, actuator drive circuits (3 lectures)
Unit 3: Interfacing of sensors and actuators, wired communication protocols – SPI, I2C, UART, timers and interrupts, analog-to-digital and digital-to-analog convertors. (3 lectures)
Unit 4. Basics of Networking (2 lectures)

Unit 5. Communication Protocols: WiFi/Bluetooth/Zigbee/LoRaWAN/NB-IoT; Data Protocols: MQTT/CoAP (4 lectures)

Reference:

1. Raj Kamal, Internet of Things, McGraw Hill, 2018
2. P. Lea, Internet of Things for Architects, 2018
3. O. Hersent, D. Boswarthick, O. Elloumi, The Internet of Things, Wiley, 2016
4. D. Norris, The Internet of Things, McGraw Hill, 2015
5. A. Bahga and V. Madisetti, Internet of Things, University Press, 2016

5. Teaching-Learning Strategies in brief:

Lectures will be integrating ICT into classroom teaching, active learning by students, and project-based learning by doing an IoT-based project.

6. Assessment methods and weightages in brief :

Quizzes: 20
MidSem: 20
Final Exam: 20
Project: 20

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)

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 + Radhika Mamidi
Course Code : **CL3.101**
L-T-P : 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

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

	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	3	1	2	2	1	1	2	3	1	2	3
CO 2	3	3	2	3	3	3	1	2	2	1	1	2	3	1	2	3
CO 3	3	2	2	3	3	3	3	2	2	3	1	1	3	1	3	3
CO 4	3	2	2	3	3	3	1	2	2	1	1	2	3	1	3	3
CO 5	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
Name of the Program : MS by Research in Computational Linguistics (LTRC)
Course Code : CL2.404
Credits : 4 credits
L - T - P : 3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring, 2024

Pre-Requisites : None

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

Course Outcomes :

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

CO1: Describe the psychological and neural basis of language processing (Cognitive Level:

Understand; Unit 1)

CO2. Describe how information-theoretic methods can be used to model typologically diverselanguages (Cognitive Level: *Understand*; Units 2,3)

CO3: Explain influential computational theories of language processing (Cognitive Level:

Understand and Apply; Unit 4)

CO4: Develop hypotheses about language comprehension and production phenomena using computational theories of language processing (Cognitive Levels: *Understand, Apply, Analyze and Create*; Unit 4)

CO5. Apply standard NLP tools and techniques on language datasets for hypothesis testing (Cognitive Levels: *Understand, Apply and Analyze*; Unit 5)

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

Course Topics :

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

Unit 1: Introduction: Language Mind and the Brain

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

Unit 2: Mathematical foundations

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

Unit 3: Processing of Linguistic structure

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

Unit 4: Computational theories of Language Processing

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

Unit 5: Computational Methods for hypotheses testing

- *Language models: Lexical and syntactic models for modelling human behavioralmeasures (like reading time and spoken word duration)*
- *Surprisal/information density estimates using language models (starting from simplelexical and syntactic language models to neural models like LSTMs, RNNs etc).*
- *Eye tracking corpora for sentence comprehension research (basics of eye movements)*
- *Analyzing behavioural data using computational models*

Preferred Text Books :

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

Speech and Language Processing: An Introduction to Natural Language Processing,Computational Linguistics and Speech Recognition (Prentice Hall

Series in Articial Intelligence). Daniel Jurafsky and James H. Martin. Prentice Hall, 2 nd Edition 2013.

Reference Books :

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

Example Readings/Viewings:

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

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

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

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

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

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

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

E-book Links : None

Grading Plan :

(The table is only indicative)

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

Assignments	**10**
Project	**20**
Term Paper	**-**
Other Evaluation	**-**

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

	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 : P.J.Narayanan + K T Aakah Ajit
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 2024
Name of the Program : Introduction to Computer Graphics

Pre-Requisites : C Programming

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

- CO-1 Understand & implement basic graphics pipeline for game design.

- CO-2 Understand various geometric transformations and projections for graphics.
- CO-3 Implement rasterization pipeline features using OpenGL library.
- CO-4 Design virtual environments using popular libraries like Unity and Unreal Engine.

Course Topics :

1. Geometry Module:Graphics Primitives, Geometric Transformations.
2. Pipeline Module: Hierarchical Modeling and Viewing Transforms.
3. Projection Module: Perspective and Orthographic Projection.
4. Rasterization Module:Clipping Points and Lines, Polygon Filling, Visibility.
5. Intro to Unity& Unreal Engine based virtual world design.

Preferred Text Books : ComputerGraphicswithOpenGLbyHearnand Baker

Reference Books :

- Fundamentals of Computer Graphics by Peter Shirley.
- Computer Graphics: Principles & Practice by Foley, van Dam, Feiner, Hughes. Indian Edition available.
- Interactive Computer Graphics: ATop-Down Approach Using OpenGL, Fifth edition by Edward Angel.
- OpenGL Programming Guide by Neider,et.al.

E-book Links :

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) : The course is designed to introduce the fundamentals of Computer Graphics. The objective of this course is to familiarize the audience with the theoretical as well as practical aspects of computer graphics and imaging process. The expected outcome is to give good familiarity of computer graphics pipeline to students so that

they can design virtual world using OpenGL or Unity/Unreal kind of public libraries for gaming and AR/VR type of applications.

Title of the Course : **Computer Systems Organization**
Faculty Name : Praveen Paruchuri + Deepak Gangadharan
Course Code : CS2.201 a
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:

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

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**)

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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	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	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:**
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  - 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:

4. Computer Systems: A Programmer's Perspective. Randal Bryant and David O'Hallaron
5. Computer Organization and Design. The Hardware/Software Interface. David A. Patterson and John L. Hennessy.
6. 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

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

Title of the Course : Computer Vision
Faculty Name : Makarand Tapaswi + Anoop Namboodiri
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 2024**

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

After completion of this course successfully, the students will be able to.
CO-1 Introduce the image formation process and camera modelling.
CO-2 Introduce multi-view geometry methods in computer vision.
CO-3 Introduce classical computer vision techniques for semantic segmentation, retrieval, 3d reconstruction.
CO-4 Explain modern computer vision techniques with focus on deep learning architectures.
CO-5 Introduce 3D computer vision research problems and latest deep learning solutions.

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

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

Module 4: Modern Computer Vision

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

Module 5: 3D Computer Vision Applications

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

Preferred Text Books : Forsytn and Ponce' Computer Vision: a modern approach, Pearson Education Inc.

Reference Books : Multi-view Geometry by Hartley & Zisserman, Computer Vision by Rick Szeliski

E-book Links :https://szeliski.org/Book/

Grading Plan : (The table is only indicative)

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

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

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

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

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

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

Title of the Course **: Computing in Sciences-2**

Faculty Name **:** Prabhakar Bhimalapuram

Course Code **: SC4.102**
Credits **: 2**
Name of the Academic Program CND

L-T-P 3-1-0 (L= Lecture hours, T=Tutorial hours, P=Practical hours)
1.Prerequisite Course / Knowledge:

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

2.Course Outcomes (COs) (5 to 8 for a 3 or 4 credit course):
After completion of this course successfully, the students will be able to..
CO-1 Demonstrate skill of **converting** a word statement of a problem to a mathematical problem statement
CO-2 Formulate a solution by application of learned concepts (in other Math coures) and employ computer to solve the problem
CO-3 Demonstrate skills in computer visualization of data, solution.
3.Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs) – Course Articulation Matrix

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

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

4.Detailed Syllabus:

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

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

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

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

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

Title of the Course : Computing Tools
Name of the Faculty : Sriranjani K
Course Code : CS0.302
L-T-P : 3-1-3
Credits : 4
Name of the Academic Program: M.Tech. in CASE, Bioinformatics (1st year, 2nd semester)

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

Course Outcomes (COs):

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

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

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

	PO1	PO2	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	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
CO4	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
CO6	2	3	3	1	1	1	2	1	3	3	2	3	2	2	2	3

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

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

Reference Books:

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

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

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

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

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

Faculty Name **: Uttam Singh**
Name of the Program: PhD
Course Code **:**
Credits **:**
L - T - P **: 24 – 6 - 0**
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year **:** Spring, 2024

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

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																
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 **: Critical Viewing and Reading**
Name of the Faculty : Sushmita Banerjee
Course Code **: HS1.208**
L-T-P **: 3-1-0**
Credits : 4
Name of the Academic Program: Elective

1.Prerequisite Course / Knowledge:

None

2.Course Outcomes (COs):

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

CO-1: Discuss the information in thetexts – literary and cinematic – that engage with the Partition of British India into present day India and Pakistan

CO-2: Explain thekey historical moments to contextualize the texts they read

CO-3: Discuss thekey historical moments to contextualize the films they view

CO-4: Interpretcultural expression in light of ethical, cultural, and historical trauma

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												
CO2						2										

CO3								2								
CO4												1				

Note: 3 in the box for high level mapping, 2 for medium level mapping and 1 for low level mapping)

4.Detailed Syllabus:

Unit 1: History and its ghosts – Political moves, Gandhi, Nehru and the INC; Jinnah and the Muslim League, the state of the people and the State and its people

Unit 2: What were people writing – short stories from Urdu, Hindi and Bangla

Unit 3: Cinema – Popular cinema and its tendencies, the new Nation in the popular imagination, the Partition's afterlives on celluloid.

Reference Books:

Bhalla, Alok.ed. *Stories About the Partition of India. Vol.1,2,3.*New Delhi: Indus, 1994.

Bose, Sugata and Ayesha Jalal. *Modern South Asia: History, Culture, Political Economy.* Routledge: London, 1997.

Butalia, Urvashi. *The Other Side of Silence: Voices from the Partition of India.* Delhi: Penguin, 1998.

Caruth, Cathy. *Unclaimed Experience: Trauma and the Possibility of History.*Baltimore: Johns Hopkins University Press, 1996.

Das Veena, Arthur Kleinman, Margaret Lock, MamphelaRamphele and Pamela Reynolds. eds. *Remaking a World: Violence, Social Suffering, and Recovery.* Berkeley: University of California Press, 2001.

Didur Jill. *Unsettling Partition: Literature, Gender, Memory.* Toronto: University of Toronto Press, 2006.

Pandey, Gyanendra. *Remembering Partition: Violence, Nationalism and History in India.* Cambridge: Cambridge University Press, 2001.

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.

5.Teaching-Learning Strategies

Students are expected to read up to 30 pages a week, watch any video lectures made available, and view films and read literature when required. Lectures will be based on class readings and will assume that students will have read the required materials. Discussions in class, on chat and via emails shall be encouraged. Students are expected to write at least two, perhaps three papers that will be designed to encourage interpretative and creative writing.

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.

6.Assessment methods and weightages:

	Percentage of Grade
Mid semesterQuiz 1	10%
Mid semesterQuiz 2	10%
Mid semesterQuiz 3	10%
End semester exam	20%
Term Paper 1	20%
Term Paper 2	20%

Title of the Course : **Data Structures and Algorithms**
Faculty Name : Sujit P Gujar+Manish Srivastava+Gowtham K
Course Code : CS1.201
L-T-P : **3-1.5-3.**
Credits : **4**
(L = Lecture Hours, T = Tutorial Hours, P = Practical Hours)
Name of the Academic Program: **B.Tech in Computer Science and Engineering**

1. Prerequisite Course / Knowledge:

CS1.302 - Computer Programming

2. Course Outcomes (COs)

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

CO-1: Explain the design and implementation details of fundamental data structures and sorting/searching algorithms. (Cognitive Level: Understand)

CO-2: Write programs involving fundamental data structures and sorting/searching algorithms (Cognitive Levels: Apply and Analyze)

CO-3: Compare and contrast the performance of different data structures and sorting/searching algorithms with respect to time and memory. (Cognitive Levels: Analyze and Evaluate)

CO-4: Discover the algorithmic logic and new composite data structures required to solve well-defined computational problems while following specified compute constraints. (Cognitive Levels: Apply and Analyze)

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

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

4. Detailed Syllabus

- Unit-1
  - Recap: Array, Pointers, Structures, Asymptotic Complexity
  - Abstract Data Types
- Unit-2: Linear Data Structures
  - Linked Lists
  - Stacks
  - Queues
- Unit-3: Non-linear Data Structures
  - Binary Trees and Search Trees
  - Hash Tables, Sets, Maps
- Unit-4: Sorting Algorithms
  - Sorting – Insertion
  - Sorting – Selection, Merge, Quicksort
  - Heapsort
  - Counting Sorts
  - Radix Sort, External Sorting
  - Sorting – External, Selection Algorithms
  - Selection Algorithms
- Unit-5: Graph Algorithms
  - Graphs – Representation and Algorithms
  - Graphs – Representation and Algorithms (DFS, Dijkstra, Bellman)
  - Graphs – Representation and Algorithms (MST)
  - Graphs - Strongly Connected Components
- Unit-6: Advanced Data Structures

- AVL Trees
- Suffix Trees

Reference Books:

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

5. Teaching-Learning Strategies in brief

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

6. Assessment methods and weightages in brief

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

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

Title of the Course : Data 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 2024

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

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

Course Topics :

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

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

Preferred Text Books :

Visualization Analysis and Design Tamara Munzner 2014 CRC.

Reference Books :

TheVisualDisplayof QuantitativeInformation(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 : Ramesh Loganathan + Raghu Reddy
Course Code : CS6.301
L-T-P:
Credits : 4
(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

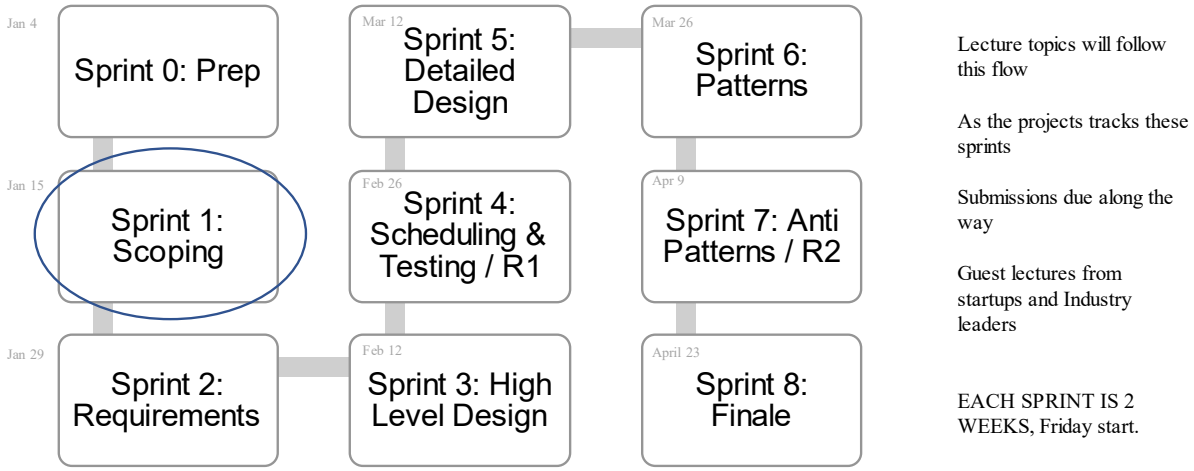
	PO 1		PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	2			2	1					2		1	1		1		
CO 2	3			1		2						1		1	3		
CO3	2		1	1								1		1	2		1
CO 4	2		2	2						3				2		1	
CO5											3						

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

4.Detailed Syllabus:

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

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



Reference Books:

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

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

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

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

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

Title of the Course **: Design of Hydraulic Structures**
Faculty Name **: Shaik Rehana**
Name of the Program **:** M.Tech in CASE
Course Code **: CE5.501**
Credits **: 4**
L - T - P **: 3-1-0**
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year **:** Spring, 2024

Pre-Requisites **:** Basics of fluid mechanics and hydraulics

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

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

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

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

Preferred Text Books :

- *Hydraulic Structures*, P. Novak, A. I. B. Moffat, C. Nalluri and R. Narayanan, Taylor and Francis, U. K
- Irrigation Engineering and Hydraulic Structures- Garg S.K- Khanna Publishers N.D.13th ed, 1998.

- Irrigation and Water Resources Engineering by G. L. Asawa, New Age International Publishers, 2008.

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

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

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

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

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

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

Title of the Course **:** Design of Wearable Systems

Faculty Name : Raghu Reddy

Course Code **: PD1.502**

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

Credits **:** 2 (Half Course)
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Academic Program: Master of Technology in Product Design and Management

1.Prerequisite Course / Knowledge:
Students must have knowledge of basic electronics or seek permission from instructor.
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: Understand the design and construction of a bare-minimum wearable system
CO2: Demonstrate the ability to explore and identify feature requirements for building a wearable system
CO3: Apply engineering principles and practices from existing use-cases of wearable systems
CO4: Demonstrate use of tools required to design and prototype a wearable system
CO5: Practice social ethics and human values while building wearable system for the targeted audience
CO6: Exhibit aptitude for working in teams and deliver task outcomes effectively

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	PSO1	PSO2	PSO3	PSO4
CO1	2		3	2	2	2	1	1	2	1	2	3	3	3	2
CO2	3		3	2	2	2	2	1	2	2	2	2	3	3	2
CO3	2		3	1	1	3	1	1	1	2	2	3	3	3	2
CO4	2		2	1	3	2	2	1	1	2	2	2	3	2	2
CO5	2		2	2	2	3	2	2	1	3	2	2	3	2	2
CO6	2		2	2	2	3	2	2	3	2	3	2	3	2	2

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

- Wearable systems Fundamentals – Attributes, challenges and opportunities.
- Applications of wearable device technology such as Healthcare, Sports, Fitness, Entertainment, Connected cars, etc.
- Wearable systems design and architecture

UNIT 2:

- User Experience of Wearable Technology
- Social Aspects of Wearable Technology

UNIT 3

- Wearable Technologies - Energy Expenditure and Energy Harvesting.

- Technology of Connected Devices – Energy Considerations
- Recommend appropriate process steps for a device based on size, cost, operating conditions, and capabilities.

UNIT 4

- Analyze performance; including sensitivity, noise, bandwidth, and dynamic range for common wearable and implantable systems a variety of applications.
- Evaluate the methods, results, and conclusions from case studies and extract relevant details for a performance comparison.
- Describe design tradeoffs in selecting, developing or redesigning wearable and implantable solutions.

Reference Books:

1. Edward Sazonov (Eds), Wearable Sensors: Fundamentals, Implementations and Applications, 2014, Academic Press, ISBN 978-0124186620
2. Scott Sullivan, Designing for Wearables: Effective UX for current and future devices, 2017, O' Reilly Media, Inc, ISBN 978-14911944158
3. Claire Rowland, Elizabeth Goodman, Martin Chalier, Ann Light, Alfred Lui, Designing Connected Products: UX for the Consumer Internet of Things, 2015, O'Reilly Media, Inc, ISBN 978-1449372569
4. Kate Hartman, Wearable Electronics – Design, prototype, and wear your own interactive garments, Shroff/Maker Media, 2015, ISBN 978-9352131983
5. Yangsheng Xu, Intelligent wearable interfaces, Wiley-Interscience, 2008, ISBN 978-0470179277

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

The course is delivered using a combination of project based and case based learning methodology. Design and architecture of wearable systems from different domain is reinforced through various case studies. The lectures emphasize on the fundaments as wells as applications of wearable systems. Focus is on understanding and analyzing various attributes like performance, bandwidth, noise, energy consumption, latency, etc. to build a wearable system by the end of the class.

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

Course Project	40%
Case study presentation	10 %
Case study report	15 %
Assignments	25 %
Other In-class Activities	10 %

Title of the Course: Digital Signal Analysis
Faculty Name : Anil Kumar Vuppala
Course Code : CS7.303
L-T-P :3-1-0
Credits :2
Name of the Academic Program B. Tech. in CSE
Prerequisite Course / 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 to undergraduate students of CLD/CS/CSD.
CO-2: Introduce the advantage of a transformed domain representation.
CO-3: Application of basic signal processing to speech signals.

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

	PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
CO 1	3	2	1	1	1	1	1	1	2	1	1	2	-	3	-	-
CO 2	3	2	1	1	1	1	1	1	2	1	1	2	-	3	-	-
CO 3	3	2	2	1	1	1	1	1	2	1	1	2	-	3	-	-

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: Basics of Fourier series and transform, sampling and quantisation, 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.

Reference Books:

1. Digital signal processing by John G. Proakis and Dimitris K Manolakis.
2. Digital signal processing by Alan V. Oppenheim and Ronald W. Schafer.
3. Introduction to Digital Speech Processing by Lawrence R. Rabiner andRonald W. Schafer, now Publishers Inc. Hanover, USA, 2007

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

It is a mathematical oriented signal processing course, so regular problem solving assignments are given to understand the concepts. Surprise class tests are conducted based on assignments to test the seriousness in assignment solving. As a part of teaching practical examples like speech signal is used for demonstration of mathematical concepts learned.

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

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

Title of the Course **: Digital VLSI Design**
Faculty Name **: Zia Abbas**
Course Code **: EC2.408**
L-T-P **: 3-1-0**
Credits : 4

Prerequisite Course / Knowledge:
Basic knowledge of digital design.

Course Outcomes (COs):
After completion of this course successfully, the students will be able to.
CO-1: Understand the background that drive to the development of state-of-the-art VLSI digital circuits, the importance of low power, high-performance and power-delay optimal designs, state of the art design issues in digital circuits, understand the CMOS digital IC design process.
CO-2: Design and Synthesis of Verilog/VHDL codes, test benches to meet specifications, to synthesise Verilog/VHDL onto hardware using required EDA tools.
CO-3: design and analyze CMOS circuits using both analytically and SPICE tools, derive analytical circuit equations to estimate performances (e.g., power) of a VLSI design. Able to identify the impact of Process, Voltage and Temperature on circuit's performance.
CO-4: Analyze the design flow to design complex CMOS digital circuit using required CAD tools. Create a cell library to be used in other designs.

CO-5: Create a low-power digital design, estimate static and dynamic power dissipation in CMOS circuits. Impact of CMOS technology scaling. Low power design methodologies.
CO-6: Design of high-performance circuits, and power-delay optimal designs.

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	PSO 4
CO1	3	2	1	1	1	1	2	2	2	1	1	2	3	2	2	2
CO2	3	3	2	2	2	1	1	2	1	1	1	1	3	1	1	1
CO3	3	3	2	2	2	1	1	2	2	2	1	2	3	1	1	1
CO4	3	2	3	3	3	1	1	2	2	2	1	3	3	1	1	1
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

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 digital design, Digital design metrics (Performance, Power, Functionality, Robustness, etc.) and their discussion in general, why low power, why high performance, Power-delay optimal designs, why technology scaling, issues in state-of-the-art digital designs i.e., making modern digital circuits, corner-based nanoscale design, statistical circuit design.

Unit 2: Combinational IC design, Sequential IC design, Role of CAD tools, RTL design, Logic Synthesis, Logic Simulations, Static Timing Analysis.

MOS Capacitor, Electrical Characteristics of MOS Transistors, Threshold Voltage, Transconductance (g_m), Body Effect, Channel-Length Modulation, MOS Transistors as a Switch, MOS Inverter, Switching Characteristics, Driving Large Capacitive Loads, CMOS Realization, Switching Characteristics, CMOS NAND, NOR and other basic combinational/sequential circuits, CMOS Complex circuits, CMOS technology scaling, CMOS Gate sizing-logical effort, Complementary CMOS, Pass transistor logic, Dynamic CMOS design, Transmission gate, Layout basics, Floor Planning, Introduction to FinFET technology.

Unit 3: Digital Design - From Power perspective: Introduction, Dynamic power dissipation (Short-Circuit and Switching), Dynamic Power in the Complex Gate, Switching Activity, Switching Activity of Static CMOS Gates, Transition Probability in Dynamic Gates, Power Dissipation due to Charge Sharing, Static i.e. Leakage Power Dissipation (leakage mechanism): p–n Junction Reverse-Biased Current, Band-to-Band Tunnelling Current, Tunnelling through and into gate oxide, Injection of hot carriers from substrate to gate oxide, GIDL, Punch- through, Subthreshold Leakage Current including DIBL. Impact of technology scaling on leakage currents/power, need for technology scaling, factors effecting the leakage current especially in scaled technology nodes (input pattern dependency, stacking effect, loading effect, etc.), Impact of process, temperature and supply voltage variations on leakage currents. Internal node voltage impact.

Unit 4: Digital Design - From Performance (i.e., delay) perspective: Computing the Capacitances, Propagation delays, Factors affecting the propagation delays, Mathematical formulation of the delays in CMOS circuits, Technology scaling impact on propagation delays, Mean and variance of the delays in a gate, Impact of process variations on delays in CMOS circuits, Impact of operating (temperature and supply voltage) variations on delays.

FinFET technology will also be discussed in parallel. Such delay/leakage estimation techniques will also be applied to FinFET circuits.

Reference Books:

1. Jan M. Rabaey, A. Chandrakasan, B. Nikolic "Digital Integrated Circuits - A Design Perspective, PHI.
2. Douglas A. Pucknell, K. Eshraghian, "Basic VLSI Design", 3rd Edition, Prentice Hall of India.
3. Neil H. E. Weste, K. Eshraghian, "Principles of CMOS VLSI Design", A Systems Perspective, 2nd Edition, Pearson Education Pvt. Ltd.

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

The course will start with the background that drive us to the development of state-of-the-art digital VLSI designs, then fundamental and core topics of the course will be discussed in detail broadly at logic and transistor level with hands-on with related CAD tools. Circuit simulations, layout, RTL coding, synthesis, etc. will be highly encouraged throughout the course. The broad approach of the course is to discuss the digital VLSI design from three perspectives; power, performance, and power-delay optimal designs to understand the different design approaches. Students will be exposed to state-of-the-art scaled technology node to better understand the

issues related to scaled nodes. Regular assignments will be given to reinforce the concepts. Weekly tutorials will involve students in active learning by applying the lecture discussion. Quizzes will be designed to test student's understandings on the discussed concepts. Projects will be carried out in groups, thereby developing the students' abilities to work in teams.

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

- Home Assignments: 20%
- Quiz: 10%
- Mid Semester Exam: 15%
- End Semester Exam: 30%
- Project: 25%

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 Articulation Matrix

	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. Detailed Syllabus:

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 (7 hours);

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, New Delhi
3. Bryant,E., (1995), *Natural Hazards*, Cambridge University Press, New York
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, New York
10. Sinha, P.C., (2006), *Disaster Vulnerabilities and Risks: Trends, Concepts, Classification & Approaches*, SBS Publishers & Distributors, New Delhi, India

5. eaching-Learning Strategies in brief:

Lectures by integrating ICT into classroom teaching, tutorials involving simulation modelling, analysing GIS data for predicting disasters, critical and active learning, and project-based learning by doing term-projects which involves hands-on use of computer programming skills and software/hardware tools applications.

6. Assessment methods and weightages in brief:

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

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Title of the Course: Distributed Systems

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

1.Prerequisite Course / Knowledge:

An understanding of operating systems, networks, and algorithms

2.Course Outcomes (COs):

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

CO-1 : Explain the challenges faced by distributed systems in terms of lack of global time, synchrony, faults, programming support, etc.

CO-2 :Employ standard distributed programming frameworks to write distributed programs for problem solving

CO-3 : Explain the properties and design principles of various real-world and practical distributed systems

CO-4 :Interpret the impact of faults in distributed systems in the context of important problems such as distributed agreement, distributed consensus, and distributed transaction processing

CO-5 :Analyze distributed algorithms for graphs with respect to correctness, round complexity, and message complexity.

CO-6 : Analyze the limitations of distributed systems and assess the operational scope of large scale distributed systems

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

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

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

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

4.Detailed Syllabus:

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

Reference Books:

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

5.Teaching-Learning Strategies in brief:

Lectures of the class use the active learning methodology and allow students to learn concepts thoroughly in class along with practising small examples. Homeworks assigned as part of the course are useful to impart knowledge of using practical distributed programming tools and libraries. To promote team work, some of the homeworks are done in a team of two students. The overall learning from the course is enhanced by doing

a substantial practice-based project – usually in a team of two students. The course will also have a summative assessment in the form of a final/end-semester exam.

6.Assessment methods and weightages in brief :

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

Title of the course **: Dynamical processes in complex networks**
Faculty Name : Chittaranjan hens, CCNSB
Name of the Program :
Course Code **: SC1.440**
Credits : 4
L - T - P **: L=2, T+P=1**
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring 2023(Ex:Spring,2023)
Pre-Requisites: Linear Algebra, Differential Equations, Basic of Statistical Physics

Course Outcomes

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

1. *Interpret and quantify* the connectivity patterns of real-world systems.
2. *Model* how the infection spreads in a well-mixed population setup and how chaos develops in the double pendulum.
3. *Identify* how structure influences synchronization and the spread of disease in metapopulation networks.
4. *Implement* the use of various appropriate pharmaceutical or non-pharmaceutical intervention strategies for reducing the severity of infectious diseases in actual circumstances.
5. *Design* cutting-edge problems regarding the diverse dynamical process incomplex networks.

Course Topics :

A. **Networks:** A general introduction. Dynamical processes in networks (1 Lecture)
B. **Fundamentals of Network theory:** Mathematics of networks, Measures and metrics(*3 Lectures*)
C. **Network Models:** Erdos-Renyi, Scale-free networks, and small-world model. Statistical properties and degree distribution. Random graphs with general degreedistributions. Percolation Process in complex networks. (*4 Lectures*)
D. **Nonlinear Dynamics:** From fixed points to chaos theory. Application: Epidemics(SIR/SIS dynamics) and double pendulum (*4 Lectures*).
E. **Dynamical Processes in Networks:** Epidemics in complex networks, Role heterogeneity in disease spreading. Pharmaceutical and nonpharmaceutical intervention strategy. Epidemics in metapopulation networks, epidemics in time- varying networks, and epidemics in multiplex networks, Activity-driven networks (*4 Lectures*).
Synchronization in coupled nonlinear oscillators (*2 lectures*).
F. **Recent literature survey, and problem design** (*4 lectures*).

Preferred Text Books :

1. Barrat, Alain, Marc Barthelemy, and Alessandro Vespignani. *Dynamical processes oncomplex networks*. Cambridge university press, 2008.
2. Networks: An Introduction, Mark Newman

Reference Books :

E-book/ review paper Links:

1. Boccaletti, Stefano, et al. "Complex networks: Structure anddynamics."*Phyics reports, 424.4-5 (2006): 175-308.*
2. Arenas, Alex, et al. "Synchronization in complex networks." *Physics reports* 469.3(2008): 93-153.
3. Pastor-Satorras, Romualdo, et al. "Epidemic processes in complexnetworks." *Reviews of modern physics* 87.3 (2015): 925.
4. Perra, Nicola. "Non-pharmaceutical interventions during the COVID-19 pandemic: Areview." *Physics Reports* 913 (2021): 1-52.

Grading Plan :

(The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz-1	**10**
Mid SemExam	**20**
Quiz-2	**10**
End Sem Exam	**0**
Assignments	
Project	**30**
Term Paper	**20**
Other Evaluation	**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	3	3	2	2	3	2	2	1	2	-	-	3	2	2	3	1
CO2	2	2	2	2	3	2	2	1	2	-	-	3	2	1	3	1
CO3	3	3	2	2	3	3	3	1	2	-	-	3	3	2	2	3
CO4	3	2	3	2	2	3	2	3	1	-	-	3	3	3	2	1

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

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

This course is specially tailored for students who are eager to learn and gain access to cutting- edge information on complex networks and disease propagation. This curriculum requires active participation from the students, who must come up with fresh ideas, present them by forming small groups, and examine related research. Comprehensive computer simulation isa requirement.

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 forstructural design;
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 of the faculty : Anshu Sarje, Spandon Roy
Course Code : EC2.202
L-T-P : 0-0-6
Credits : 4
Name of the Academic Program: B. Tech. in ECE
Prerequisite Course / Knowledge:
Basic knowledge of Electronics design (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 practicalimplementations of theoretical knowledge e.g., p-n junction diode, need of rectifiers,understanding of filters, understanding the working of transistors in various configuration;understanding of MOSFET, amplification, conversion, processing, etc. Practicalimplementations 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 of various devices (MOS, transistors, Diodes, SCR, etc.), Op-amp, Use of electronic instruments (multi-meter, signal generator, power supply, oscilloscope), etc.

CO-3: At the end of the course students are expected to be able to design and analyse electronic circuits, which involve many discrete active and passive components.

CO-4: Able to articulate the functionality of such circuits as well as be proficient in implementing the same in various domains.

CO-5: Posed with a non-obvious design problem the student should feel adequately confident to come up with the design, implement, debug and get it to work.

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	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.

Detailed Syllabus:

EW-II is a project intensive course focused on Electronics (analog, digital, mixed) design and application while elements of microcontroller programming that aids this design is anoption. The course is broadly divided in two projects;

Project-1 (e.g., Design of an Audio Amplifier) is common to all students (in a group of 2 students with the following specifications (for illustration only)

- Supply: 5V
- Input: 10-20 mV peak to peak
- Gain: G1 x G2 ≥ 500 (Pre amp and Gain stage)
- Frequency: Audible range (20 Hz - 20KHz)
- Power: P ≥ 1.5 W
- Filter should not attenuate the gain; Power amp shouldn't be used for gain.
- Load: 10 Ω

Project-2 is an individual project (in a group of 2 students), which are very applied test the students' mettle in the following areas broadly-

- Filter Design
- Amplifier and Rectifier Design
- Regulator Design
- ADC
- Sensor Integration to Controllers and Calibration
- Signal Processing
- Robotics
- IoT, etc.

Reference Books:

No preferred text book as this is a project course. Indicative textbook include Microelectronic Circuits by Sedra and Smith.

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

Projects are the best way to open student minds to learning electronics practically. Making projects that do an exciting real-world task will make students curious to understand electronics better. The aim of this subject is to provide the knowledge of the fundamental concepts related to Electronics. The learning will involve handling wide variety of instruments while testing, trouble shooting, calibration etc. The study of EW-II will help students to gain the knowledge of working principles and operation of different instruments. During EW-II practical sessions, they will acquire the requisite skills.

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

- Project 1: 40%
- Project 2: 60%

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

Faculty Name : **Radhika Krishnan**

Name of the Program: HumanitiesElective offered to UG3/UG4

Course Code : HS8.303

Credits : 4

L - T - P :3-0-0

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

Semester, Year :Spring 2024

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

Course Outcomes:

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

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

CO-3: Students willunderstand the continuities and disruptions in the history of mineral extraction in India.

CO-4: Students will be able to critically analysepolicy conundrums within mineral resource governance, with a specific focus on India.

CO-5: Students will have an understanding of the various impacts of mineral extraction in the Global South, with a specific focus on coal mining.

CO-6: Students will be encouraged to think through and critically analyse ideas around the future(s) of existing mineral extractive industries.

Course Topics:

Unit 1:

Impacts of mineral extraction: Social (displacement, loss of land/associated status and familiar spaces), economic (loss of livelihoods, access to resources such as water and forests) and ecological (forest destruction, water table, loss of agricultural land). Case studies, exploring socio-cultural, economic and ecological disruptions and responses from the state as well as local communities and non-state actors.

Unit 2:

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

Unit 3:

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

Unit 4:

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

Unit5:

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

Unit 6:

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

Preferred Textbooks:

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

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

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

Reference Books/articles:

Impacts of mineral extraction

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

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

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

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

Conundrums in Mineral Resource Governance

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

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

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

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

History of Mineral Extraction in India

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

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

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

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

Political Economy of Mineral Extraction

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

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

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

Narratives around Mineral Extraction

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

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

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

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

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

Future(s) of Mineral Extraction

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

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

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

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

Grading Plan:

Type of Evaluation	Weightage (in %)

Quiz-1	**7.5 (Questions related to Unit I)**
Mid SemExam	**20 (Questions related to Units 2-3)**
Quiz-2	**7.5 (Questions related to Unit 4)**
End Sem Exam	**35 (Emphasis on Units 5-6, some questions from 1-4)**
Group Project	**30 (Designed to use frameworks discussed in the course)**

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

Applicable for CSE

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

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

Applicable for ECE

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

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

Teaching-Learning Strategies in brief (4-5 sentences):
Students will be introduced to theories and concepts through lectures, and will be encouraged to read specific papers that are central to the ideas being discussed in class. Photographs, short 4-5 minutes videos, posters and pamphlets will be used during the lectures. Discussions and interventions in the classroom are highly encouraged. The Mid Semester as well as the End Semester exams will be designed to test the grasp over specific issues and concepts discussed in the course, and the quizzes will require to apply concepts to specific case studies. The group project will involve students working together to analyse the socio-political and economic dynamics of the extraction of a specific mineral in a specific region.

Title of the Course : Exploring Masculinities

Faculty Name : Vindhya Undurti, TISS, Hyd
Name of the Program : Humanities Elective
Course Code : HS0.209
Credits : 2 credits
L - T - P : 18Lecture hours (12 classes)
Semester, Year : Spring 2024
Pre-Requisites : Introduction to Human Sciences, Ethics 1 (Basics)

Course Description :
This course explores the construction and meaning of masculinities and examines in particular the linkages between the social construction of masculinities and power and violence.The course will provide an overview of the key discussions and perspectives from different disciplines such as psychology, sociology, and gender studies, on the connections between the construction of masculinities, their intersections with markers such as class, ethnicity, caste, sexual orientation,and the many forms of power and violence. While the theoretical understanding of masculinities and their connections with power and violence will form the bedrock of the course, a distinctive feature will be the experiential component – the opportunity the course aims to provide for students to reflect and imagine the possibility of ethical masculinities that is transformative, based on ideals of mutuality, care and respect, and awareness of gendered vulnerabilities. This course will thus enable students to be familiar with the key concepts in

relation to the social construction of masculinities in different disciplines, unravel the links between masculinities and violence, and to facilitate engagement, through self-reflection of behaviors, norms and values, with the transformative potential of ethical masculinities.

Course Outcomes :

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

1. Explain how masculinities are socially constructed
2. Understand the connections between harmful masculinites and perpetration of violence
3. Critically reflect on their own individual behavior, socialization patterns and identity development in order to contextualize the understanding of masculinities in the 'personal'.

Course Topics :

Module I:

- Introduction: Origins of scholarly interest and research in masculinities
- How are power, violence and the social construction of masculinities connected?

Module II:

- Gender stereotypes, construction of male identity: An intersectional approach
- Social psychology of sexism: hostile and benevolent sexism and links with violence perpetration

Module III:

- Ethical masculinities

Readings:

Bowker, L. (1998/2013). *Masculinities and violence.* Newbury Park, CA: Sage
https://sk.sagepub.com/books/masculinities-and-violence/n11.xml
Connell, R.W. (2005). *Masculinities*. University of California Press.
Sharma, A., & Das, A. (2016). Men, Masculinities and Violence. *Graduate Journal of Social Science.*

Grading Plan :

Type of Evaluation	Weightage (in %)
Quiz-1 (3-5 questions; answers of 200-300 words)	**20%**
Assignment 1/Reflective piece (1000-word essay)	**30%**
Quiz-2 (3-5 questions; answers of 200-300 words)	**20%**
Assignment 2 (1000-word essay)	**30%**

Mapping of Course Outcomes to Program Objectives:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 12	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1						3		2									3

CO2						2				3							3
CO3						3		3		3							3

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

The teaching-learning strategy will consist of a combination of powerpoint-based lectures,and discussions on the selected readings. In addition, there will be classroom activities designed to encourage students to take an experiential stance and critically reflect on their own socialization patterns and construction of identities for a critical appraisal of the concepts learnt in class. The participatory methodology of pedagogy will be supplemented with assessments aimed to test comprehension of students' knowledge, as well as their abilities of critical reflection, interpretative reading and structured writing.

Title of the Course : Flexible Electronics

Faculty Name : Aftab Hussain
Course Code :EC2.502
L-T-P :3-1-0
Credits :4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)

1.Prerequisite Course / Knowledge:
Understanding of basic concepts of Physics and Chemistry taught up to the 10+2 level

2.Course Outcomes (COs) (5 to 8 for a 3 or 4 credit course):
After completion of this course successfully, the students will be able to..
CO-1: Describe the physical reason for flexibility in various material systems.
CO-2: Explain the various processes, such as lithography, etching, deposition etc., that are involved in silicon semiconductor fabrication.
CO-3: Compare the fabrication and functioning of flexible electronic systems with their rigid counterparts.
CO-4: Employ various microfabrication techniques to obtain flexible electronic systems.
CO-5: Choose the correct approach for designing and fabricating a fully flexible system including, flexible memory, processor, display, power source and so on.
CO-6: Create a report of the various advances in the state-of-the-art of a specific topic in flexible electronic systems.

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

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

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs.

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

4. Detailed Syllabus:

Unit 1: Physics of silicon electronics, silicon band structure, flexible materials
Unit 2: VLSI fabrication: silicon wafer, deposition, lithography, etching
Unit 3: Flexible electronic systems, flexible PCBs, interconnects, flexible silicon processes Unit 4: Flexible displays, flexible TFTs, OLEDs, flexible memory
Unit 5: Flexible energy harvesters, photovoltaics, flexible interconnects

Reference Books:

1. Sami Franssila, *Introduction to Microfabrication*, Wiley VCH, 2010
2. Mario Caironi, Yong-Young Noh, *Large Area and Flexible Electronics*, Wiley VCH, 2015
3. Takao Someya, *Stretchable Electronics*, Wiley VCH, 2013

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

The course instruction is delivered through lectures slides explained by the instructor. The slides include theoretical concepts with examples of real-world applications of flexible electronic systems to foster student understanding and interest. Assignments are designed to encourage students to critically think about the concepts discussed in the class and to learn to independently solve problems. The students are asked to create a literature survey report detailing the advances in the state-of-the-art of one of the topics in flexible electronic systems.

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

Continuous evaluations:
Assignments – 20% MCQ
Quizzes – 20%
Comprehensive exams:
End semester exam – 35%
Term-paper report – 25%

Title of the Course: **Gender, Culture and Representation**
Name of the Faculty: **Subha Chakraburtty**
Course Code:
Credits: 4
L - T – P: **3-0-0**
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Name of the Academic Program: Humanities Elective
Semester, Year: Spring, 2024

Pre-Requisites: Nil

Course Outcomes :

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

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 upon both primary and secondary sources.

CO-4: Apply concepts and theories of Gender Studies to life experiences and historical events and processes.
CO-5: Communicate effectively about gender issues in both writing and speech, drawing upon Gender Studies scholarship and addressing a public audience.

Course Topics:

Unit 1:

Introduction to Gender Studies – Understanding the definitions, concepts and theories
Historical perspectives – The Evolution of Gender Roles

Unit 2:

Social Construction of Gender

Gender as a social construct: Deconstructing strategies
Language and Discourse: how words shape gender The
impact of socialization on gender

Unit 3:

Gender and Inequality

Gender inequality and gender pay gap Gender
and education: access and outcomes

Unit 4:

Non-normative gender identities and experiences

Intersectionality and marginalization within transgender and non-binary identities

Unit 5:

Applying Gender Studies

Gender in the workplace: bias, leadership Gender
and politics: Representation and policy

Preferred Textbooks:

Bateson, Mary Catherine. *Composing a Life.* Plume, 1990.

Beauvoir, Simone de. *The Second Sex*. Translated by Constance Borde and Sheila Malovany Chevallier, Vintage Books, 2011.

Bornstein, Kate, and S. Bear Bergman, editors. *Gender Outlaws: The Next Generation.* Seal Press, 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, Geoff Eley and Sherry B. Ortner, Princeton University Press, 1994, pp. 155-59.

Butalia, Urvashi. *The Other Side of Silence.* Penguin, 1998.

Butler, Judith. *Gender Trouble: Feminism and the Subversion of Identity*. Routledge, 1990.

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

Fincher, Ruth. "Space, Gender and Institutions in Processes Creating Difference", *Gender, Place and Culture,* vol. 14, 2007, pp. 5-27.

Hall, Stuart. "The Work of Representation." *Representation: Cultural Representation and Signifying Practices*, edited by Stuart Hall, Sage Publications, 1997.

Hermans, Theo. *The Conference of the Tongues.* St. Jerome, 2007.

Hochschild, Arlie. *The Second Shift: Working Parents and the Revolution at Home.*

Penguin Books, 2003.

hooks, bell. *The Will to Change: Men, Masculinity, and Love.* Washington Square Press, 2004.

Kimmel, Michael S. *The Gendered Society.* 4th ed., Oxford University Press, 2018.

Lefebvre, Henri. *The Production of Space.* Verso, 1991.

Lorber, Judith. *The Social Construction of Gender.* Sage Publications, 1991.

Serano, Julia. Whipping Girl: A Transsexual Woman on Sexism and the Scapegoating of Femininity. Seal Press, 2007.

Reference Books:

Arnold, David, and Stuart Blackburn. "Introduction: Life Histories in India." *Telling Livesin India: Biography, Autobiography, and Life History,* edited by David Arnold and Stuart Blackburn, Permanent Black, 2004, pp. 1-28.

Athens, L.H. *Violent Criminal Acts and Actors: A Symbolic Interactionist Study.* London, Routledge and Kegan Paul, 1980.

Becker, G. *Disrupted Lives: How People Create Meaning in a Chaotic World.* Universityof California Press, 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,* edited by Jonathan Rutherford, Lawrence and Wishart, 1990, pp. 207-211.

Bhabha, Homi.K. *The Location of Culture.* Routledge, 2006.
Cixous, Helen. "The Laugh of the Medusa." Translated by Keith Cohen and Paula Cohen, *Signs*, vol.1, no.4, 1976, pp. 875-93.
Halberstam, Judith. *The Queer Art of Failure.* Duke University Press, 2011.
hooks, bell. *Feminist Theory: From Margin to Center.* South End Press, 1984.
Derrida, Jacques. "Structure, Sign and Play in the Discourse of the Human Sciences." *Writing and Difference*, translated by Alan Bass, London, Routledge, 1978.
Schaffer, Kay, and Sidonie Smith. Human Rights and Narrated Lives: The Ethics of Recognition. Palgrave-Macmillan, 2004.

Grading Plan:

Type of Evaluation	Weightage (in %)
2 major Writing Assignments overthe course of the semester	**40** (typed essays of 1000 - 1500 words, double spaced, Times New Roman, 12 font size. One pageequals 250 words)
End Sem Exam	**40** (2 – 3 subjective questions; in-class writingexercises)
Class Participation	**20** (Active participation in class discussion is necessary to receive full credit for the participationcomponent)

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

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

Teaching-Learning Strategies:

This course is structured in a format that blends lectures and discussions. It is crucial that students come to class on time, with required texts, well prepared to offer insightful responses to the assigned readings. To be effective as class participants, students need to complete reading and writing tasks by the assigned dates.

A vital ongoing intellectual conversation – which actively questions the meaning of genderin places and spaces is at the heart of the course. Many issues that we address in the course are controversial and students may have or voice different viewpoints. It is crucial that we acknowledge and respect one another's experiences and perspectives so that our classroomis a safe and supportive space to converse productively across our 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 2024**

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.

Title of the Course : Human-Computer Interaction

Faculty Name : Raman Saxena
Course Code : PD1.501
L-T-P : 1.5 -0- 3
Credits : 2
(L= Lecture hours, T=Tutorial hours,
P=Pracocal hours)
Semester, Year : 2nd Semester – Year 1 (Monsoon, 2022)

1. Prerequisite Course / Knowledge:

No prerequisites are required

2. Course Objecoves & Outcomes (COs)

This course provides knowledge about the interac?on between human(user), computer(machine) and environment. The course will examines the HCI from the science, technology and human-centered design perspec?ve.

Lecture topics are aimed at guiding the students through analysing and discussing the interac?on between products and people based on cogni?ve, physical and emo?onal factors. It will introduce fundamentals of interac?on design such as mental models, human ac?on cycles and difference between User Experience, User Interface and Interac?on Design. It will look at the various types of human-computer interac?on and how it affects the people intended goals and objec?ves. How a good HCI design delivers higher perceive usefulness, usability or ease of use leading to posi?ve and delighPul user experience. It will build understanding the factors that influence the interac?on between people and products in a desired direc?on. The course will explain the process of User-centered soRware design and development and the deliverables within the same such as user cases, user stories, work flow, task analysis, informa?on architecture, wireframes, storyboards and low fidelity and high fidelity prototypes. The course will also introduce the concept and prac?ce of usability tes?ng and evalua?on. The course will also looks into the technology trends such as AI, Chatbots. etc. and their influence on the interac?ons between human and computers. The course will also cover User Experience, The Course will divide into lectures including classroom exercises, quizzes, a short project and home assignments.

The students of this course will be able to apply the knowledge/learning's from this course to their own professional work as HCI Designer, Interac?on designer, UX Designer and design interac?on layer of the soRware/IT products including Mobility, Healthcare, Learning, E-commerce and U?lity etc. The course will include a short project to offer opportunity to the students to experience the full HCI cycle.

ALer compleoon of this course successfully, the students will be able to…

CO-1 Demonstrate good understanding of Human-Computer Interac?on and How it influences the User Experience of digital products, systems, solu?ons and services.

CO-2 Demonstrate good understanding of methods and tools used to understand the HCI from the perspec?ves of technology, human-centered design and human/social sciences such as cogni?ve, and digital anthropology perspec?ve.

CO-3 Demonstrate good understanding of incorpora?ng human-centered approach in HCI to deliver useful and easy to use soRware and IT products including Mobility, Healthcare, Learning, E-commerce and U?lity etc.

CO-4 Demonstrate the ability to create, document and present the various deliverables and communica?ons related to HCI, UX and UI Design including Human-Ac?on Cycle, Personas, Use

Cases, Task Flow and Analysis, Informa?on Architecture diagram, Wireframes, UI Design, and Usability Tes?ng etc.

CO-5 Demonstrate the ability to plan and execute usability tes?ng including crea?ng test cases, usability matrix, performs tes?ng, record test data and analyse the same to iden?fy usability issues and report the same for upda?ng the design.

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

	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	3	3			3
CO5	3	3	3	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. Detailed Syllabus:

UNIT 1. Introducoon to Human-Computer Interacoon *(Week 1 - Lecture 1)*

- Introduc?on to HCI?
- History of HCI
- How Human interact with outside world?
- Human Conceptual/Mental models
- Conflict between Mental Models and Design Models.

UNIT 2. UNDERSTANDING Human-Machine System *(Week 1 - Lecture 2)*

- Understanding Human-Machine System
- Human-Ac?on Cycle (HAC)
- 7 stages of Human-ac?on cycle.
- Classroom exercise on HAC
- User Experience

UNIT 3. Art and Science of User Experience and UI Design *(Week 2 - Lecture 3 & 4)*

- Aaen?on and Memory
- Gestalt theory and principles
- UI Elements including colour and interac?on model
- Informa?on and Interac?on Design principles

UNIT 4. User-Centered approach to the SoLware Design *(Week 3 - Lecture 5 & 6)*

- Perceived Usefulness and Perceived Ease of Use
- Understanding User Persona
- Why user person is important
- Use cases, User stories
- Task Flows & Task Analysis

- Human-centered soRware Design Workflow.

UNIT 5. User Experience and UI Design *(Week 4 - Lecture 7 & 8)*

- Informa?on Architecture
- Wireframes and Storyboards
- Low and High Fidelity prototypes

UNIT 6. Usability Engineering and Tesong (*Week 5 - Lecture 9 & 10)*

- What is Usability, usability requirements and how to measure it?
- Heuris?cs evalua?on
- Usability Test planning and conduc?ng usability test.
- Usability matrix and test repor?ng

UNIT 7. Usability Engineering and Tesong *(Week 6 - Lecture 11 & 12)*

- Short term project
- Project comple?on, documenta?on and submission

Reference Books & Case Studies:

1. Book: Human-Computer Interac?on in the New Millennium, by Carroll, John
2. Book: Learn Human-Computer interac?on: Solve human problems and focus on rapid prototyping and valida?ng solu?ons through user tes?ng., by Christopher Reid Becker
3. Book: Lean UX: Designing Great Products with Agile Teams, by Jeff Gothelf & Josh Seiden
4. Book: Designing with Mind in Mind: Simple guide to understanding User Interface Guidelines, by Jeff Johnson
5. Book: Sketching User Experiences: Ge ng the Design Right and the Right Design, by Bill Buxton
6. Book: Human-Computer Interac?on: Solve human problems and focus on rapid prototyping and valida?ng solu?ons through user tes?ng, by Christopher Reid Becker
7. Book: Interac?on Design: Beyond Human-Computer Interac?on, By Helen Sharp, Jennifer Preece & Yvonnes Roger
8. Book: Designing User Interfaces: Exploring User Interfaces, UI Elements, Design Prototypes and the Figma UI Design Tool , Dario Calonaki
9. Book: Designing Interfaces: Paaerns for Effec?ve Interac?on Design , By Jennifer Tidwell, Charles Brewer and Aynee Valencia
10. Book: UX for XR: User Experience Design and Strategies for Immersive Technologies (Design Thinking), by Cornel Hillmann
11. Book: AI and UX: Why Ar?ficial Intelligence Needs User Experience , by Gavin Lew , Robert M. Schumacher Jr.
12. Book: Informa?on Visualiza?on: Design for Interac?on, by Prof. Robert Spence
13. Book: Modera?ng Usability Test: Principles and Prac?ces for Interac?ng, by Dumas, Joseph
14. Case study : Design of a complex soRware system- CMS of a media organisa?on
15. Case study : Defining a Mainframe System
16. Case Example: Conversa?onal UI's

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

- The Course will divide into lectures (around 12 nos.) and hands-on work including assignments, classroom exercises and home work.
- The course will also include fieldwork, hand on activities, learning by doing, to practice the learning from the lectures.
- Introduce and discuss couple of case studies including cases related to HCI, User

Experience and UI Design of software products.

- A short term project to practice HCI, UX, UI and Usability learnings.
- Other than attending the lectures and doing classroom exercises & assignments, students need to spend 4 hours per week on home/field assignments.

5.

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

1.	Class/Home activities		40%
2.	Short-term project		50%
3.	Viva		10%
		TOTAL	**100%**

Title of the Course : **Information and Communication**

Faculty Name : Prasad Krishnan + Arti Yardi

Course Code : EC5.102

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

Credits : 4

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

Name of the Academic Program: B. Tech in Electronics and Communication Engineering

1.Prerequisite Course / Knowledge:

Basic idea of communication system, analog modulation and demodulation, basics of signals in time and frequency, basics of probability, basic understanding of binary number system.

2. Course Outcomes (COs) :

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.

CO-4: 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-5: 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-6: Evaluate the essential information and communication theoretic quantities in a wide variety of communication systems used in 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	3	2	-	-	-	-	-	-	-	-	-	2	-	3	1	-
CO2	2	2	-	2	-	-	-	-	-	-	-	2	-	3	1	-
CO3	3	2	-	-	-	-	-	-	-	-	-	2	-	3	2	-
CO4	3	1	-	-	-	-	-	-	-	-	-	2	-	3	2	-
CO5	3	2	-	-	-	-	-	-	-	-	-	2	-	3	2	-
CO6	3	2	-	-	-	-	-	-	-	-	-	3	-	3	2	-

4.etailed Syllabus:

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

Reference Books:

1. McEliece, R. (2002). The Theory of Information and Coding (2nd ed., Encyclopedia of Mathematics and its Applications). Cambridge: Cambridge University Press. doi:10.1017/CBO9780511606267.
2. Gallager, R. (2008). Principles of Digital Communication. Cambridge: Cambridge

University Press. doi:10.1017/CBO9780511813498.
3. Venkatesan Guruswami, Atri Rudra, Madhu Sudan, "Essential Coding Theory", Publisher: University of Buffalo, Available online at https://cse.buffalo.edu/faculty/atri/courses/coding-theory/book/web- coding-book.pdf.
4. Thomas M. Cover, Joy A. Thomas, "Elements of Information Theory", 2nd Edition, ISBN: 978-0-471- 24195-9, June 2006,.

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

The course is conducted through systematically prepared lectures and tutorial sessions. The lecture sessions are held in an interactive manner with short pop-quizzes for 1-2 minutes at appropriate junctures through which the instructor can understand the pulse of the classroom and whether the students are able to follow the class or otherwise. Based on these the lectures are fine-tuned (increase/decrease in pace or complexity of material covered). Further, the students are divided into groups of 4 or 5 each, and each group presents their understanding of the lectures in a short 10 minute presentation video per week as home assignment group wise. We call these as *course summaries*. Programming assignments are also given as home assignments which promote implementation-level understanding of theoretical topics taught in the class. In the tutorial sessions conducted with the help of teaching assistants, students learn to solve problems associated with the material covered in the lectures. These sessions are generally highly interactive and offer a platform for students to correct their understanding and also serve as a launching pad for students to pursue further directions of learning in Information and Communication theory advanced material that is not usually part of the regular lectures.

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

Type of Evaluation	Weightage (in %)
2 Mid Semester Exams	2 x 15 = 30%
Home assignment (Course Summaries and Programming assignments – group wise)	30%
End Semester Exam	40%

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 **:**3-0-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year **:**Spring, 2024

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

Teaching-Learning Strategies in brief:
Course will be primarily driven by classroom discussions, readings, surveys, exploratory practical assignments. It will involve a lot of critical thinking and active learning by the students to solve practical problems. Students will be asked to make presentations on topics assigned to them for exploration/experiment.

Title of the Course : **Internals of Application Servers**
Faculty Name : Ramesh Loganathan
Course Code : CS3.404
Credits : 4
L - T - P : (3-1-0)
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring 2024

Pre-Requisites : None

Course Outcomes :
A systems level understanding of distributed application platforms through building a contemporary platform.Key objectives of the course:

CO1: Understand Middleware systems concepts:
CO2: Understand Distributed Application Platforms through a project-based system building course structure.
CO3: Understand Key aspects of distributed applications, and the requirements from an underlying applications' platform
CO4:Understand the design of key subsystems of a contemporary application platform, and the same to be built as part of the course project

Course Topics :
Following topics will be covered in the context of the course project. Specific to the course project.

Lectures – 4 or 5 3-hour classes per Module

- *M1- Understand essence of middlewares and distributed object technology*
- *M2- App Server architecture*
- *M3- Lifecycle of a Web Service request*
- *M4- Things "in" the Internet*
- *M5- Project problems Discussions*
- *M6- Project problems Discussions*
- *M7- Project problems Discussions*
- *M7- Project problems Discussions*

Labs – L1 to L8 (16 hrs)
Seminars – 6 hrs (6 groups, 1 hr each)
Mini Project review – 3-4 hrs
Various topics that will be covered in the lectures:

- **Middleware/ App Server concepts**
  - Understanding concepts related to CMS, Application server, web server, message oriented middleware etc.
- **Distributed App Platforms components**
  - Understanding distributed applications tools, architecture and workings
  - RPC, servlets, stubs, Messaging services.
- **Project Overview and Understanding**
  - Project Idea discussion and idea finalization.
  - Blackbox overview of project from view points of various actors.
  - Idea Hackathon
- **Project Platform Deep dive (concepts)**
  - Discussion on major platform components.
  - Functionality finalization and designing major components
  - Project Documentation.
- **System Building Experience**
  - A full distributed app platform will be built.
  - Endpoint for each microservice.
  - Hackathon.
- **Integration of Platform Components.**
  - Designing endpoints for each component & integration with other components.
  - Testing use case for each component.

Preferred Text Books **:**None. Reading references will be provided in class.
Reference Books : -
E-book Links : -
Grading Plan :

Type of Evaluation	Weightage (in %)
Class quizzes	**5**
Lab submissions	**15**
Hackathons	**10**
Projects	**40**
- Reqts& Design docs	15
- Pre Demos	10

- Final Demos	15
End Sem Exam	**30**

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P2O9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2	1	1	1	1	1	2	2	1	2	3	1	2	2
CO2	1	2	2	1	2	1	1	1	2	2	2	2	2	3	2	1
CO3	3	2	2	3	2	1	1	1	3	3	2	2	2	2	2	1
CO4	3	1	2	3	2	1	1	1	3	3	3	2	2	2	3	1

Teaching-Learning Strategies in brief (4-5 sentences) :
Project problems Discussions; Project architecture & design reviews; Guest lectures from Industry (Projects built in previous years- JMS Server. Distributed web services platform (SOA). MiroServices Platforms. Ai on the Edge. Fog computing (IOT) platform)

There will be labs to understand basic concepts and then hackathons to help build susbsystems. And through the course projects understand the various elemensot and subsystems of a distributed applications erver platforms.

Title of the Course : Internet and Democracy

Faculty Name : Aakansha Natani
Name of the Program : B.Tech in Computer Science and Engineering
Course Code : HS4.302
Credits : 4
L - T - P : 3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring 2024
Pre-Requisites : Completed one of the following courses: Intro to Politics, Intro to Sociology, Intro to History; CHD 3rd and 4th year students

Course Outcomes :
After completion of this course successfully students will be able to
CO1: Understand and describe the impact of scientific developments on society and political systems.
CO2: Explain theoretical concepts and substantive issues in digital democracy.
CO3: Analyse and elaborate on emerging debates and concerns on privacy and data ownership.
CO4: Explain what factors lead to efficient digital transformation of governance.
CO5: Assess the impact of tech-policy initiatives in advanced and developing societies.
CO6: Develop one's own understanding of emerging challenges in information society and the need for new digital rights paradigm from both citizen and institution centric perspectives.

Course Topics:

The course is divided into five modules
(i) **Internet and Democracy**: Role of science and technology in evolution of Political systems; Impact of ICT on Democracy
(ii) **Theory and Substantive issues in Digital Democracy**: Defining Digital Democracy, Debates on Right to Privacy, Data Ownership, New Digital Rights Paradigm
(iii) **Tech-Policy Initiatives in Advanced Democracies**: Case Study of Right to High-Speed Internet Access in Finland, French Digital Republic Act, M5S (Italy) and Pirate Party (Germany), E-Voting in Estonia, Digital Inclusion Policy of Germany
(iv) **Digital Democracy in Developing Societies:** Major issues and challenges; Digital India and National E-Governance Program; Judicial Interventions and Legislative Proposals on Privacy and Data Protection
(v) **Towards Information Society in India:** Contemporary concerns and Need for New Public Policy Frameworks; Digital Divide and Inclusion

Course Modules:
Module 1: Role of Scientific and Technological Inventions in Evolution of Political Systems; New Information and Communication Technologies and its impact on Social Structures and Functioning of Democracy; Democratic Potential of Internet: Early Projection and Realities; Can the internet strengthen Democracy?
Module 2: Digital Democracy: Theory and Substantive issues, Global Concerns on Right to Privacy and Major Policy Initiatives, Key Debates on Data Ownership, Accessibility and Protection; New Digital Rights Paradigm: General Data Protection Regulation, Digital Service Act and Digital Market Act of the European Union.
Module 3: Tech-Policy Initiatives in Advanced Democracies, Case Study of Right to High-Speed Internet Access in Finland; Public Policy Frameworks for Digital Transformation of Governance, Case Study of French Digital Republic Act; Transitions in Political Culture and Civic Engagement, Emergence of New Public Sphere and e-Identities, Case Study of M5S (Italy) and Pirate Party (Germany); Democratic Credentials of e-Voting and e-Deliberation systems, Contradictions between Anonymity and Transparency on Digital Media Platforms, Case Study of Estonia; Digital Divide and Public Policy for Digital Inclusion, Case Study of Digital Inclusion Policy of Germany.
Module 4: Digital Democracy in Developing Societies: major concerns and challenges, Digital Governance Models in India, Policy Framework and Objectives of Digital India Program, National E-Governance plan of India; Important Judgments of Supreme Court and Legislative Proposals on Privacy and Data Protection in India.
Module 5: Towards Information Society:Challenges and Prospects in India; Concerns on uneven distribution of technology; Democratisation of Digital Spaces: Need for New Comprehensive Policies in India.

Preferred Text Books:
Selected Chapters from-

1. Andrew Chadwick and Philip N Howard (2009): *Routledge Handbook of Internet Politics*, Routledge Publications
2. Coleman, Stephen (2017), *Can the Internet Strengthen Democracy,* Cambridge*:* Polity Press
3. Andrew Chadwick (2006): *Internet Politics: States, Citizens, and New Communication Technologies,* Oxford University Press

4. Hacker, Kenneth L. & Dijk, Jan van (2000), *Digital Democracy: Issues of Theory and Practice*, London: SAGE.
5. Banerjee, Indrajit (2003), *Rhetoric and Reality: The Internet Challenge for Democracy in Asia*, Singapore: Eastern Universities Press

Reference Books and Policy Papers:

- Cynthia Alexander and Leslie A Pal (1998): *Digital Democracy: Politics and Policy in the Wired World*, Oxford University Press
- Dahl, R. A. (1989), *On Democracy,* London: Yale University Press.
- European Commission (2016), *General Data Protection Regulation*, Eur-lex: Brussels
- Feather, John (2013), *The Information Society: A Study of Continuity and Change, UK: Cambridge University Press*
- Goldstein, Keith et al (2018), *The Right to Privacy in Digital Age*, Online: OHCHR
- 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.
- Hippel, Eric Von (2005), *Democratising Innovation,* Cambridge, MA: MIT Press.
- Huang, Wayne et al. (2005), *Electronic Government Strategies and Implementation,* PA: Idea Group Pub.
- Huntington, Samuel P. (1991), *The Third Wave: Democratization in the Late Twentieth Century*, Norman: University of Oklahoma Press.
- Isakhan B. and Stockwell S. (eds) (2012), *The Edinburg Companion to the History of Democracy,* Edinburg: Edinburg University Press.
- Kersting, Norbert and Baldersheim, Harald (2005), *Electronic Voting and Democracy: A Comparative Analysis,* New York: Palgrave Macmillan.
- Kies, Raphaël (2010), *Promises and Limits of Web-deliberation*, New York: Palgrave Macmillan.
- Levitsky, Steven and Ziblatt, Daniel (2018), *How Democracies Die: What History Reveals about Our Future,* Audiobook: Penguin Books Ltd.
- 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.
- Mattelart, Armand (2003), *The Information Society: An Introduction*, UK: Sage
- 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.
- Toffler, Alvin (1980), *The Third Wave: The Classic Study of Tomorrow*, US: William Morrow.
- Van der Ploeg, I. (2012), "The body as data in the age of information", Kirstie Ball, Kevin Haggerty and David Lyon (eds.), *Routledge Handbook of Surveillance Studies*, New York: Routledge.
- Van Dijk J. A. G. M., (2005), *The Deepening Divide: Inequality in the Information Society*, UK: Sage.

Journal and Web Articles

- Albrakht, K. (2014), "The Information Revolutions' Broken Promises', *The Futurist,* 48(2).
- Bailey, R. & Parsheera, S. (2018), *Data Localisation in India: Questioning the Means and Ends. New Delhi, National Institute of Public Finance and Policy,* Working Paper No. 242.
- Becker, M (2019) "Privacy in the Digital Age: Comparing and Contrasting Individual vs Social Approaches towards Privac'y, *Ethics Inf Technol* 21, pp 307-317
- Bolleyer, N, Little, C, Von Nostitz, FC (2015), "Implementing democratic equality in political parties: Organisational consequences in the Swedish and the German pirate parties", *Scandinavian Political Studies*, 38(2): 158–178.
- Devanesan , V. Vijay and Chandrasekaran, P. Kingsley Alfred (2011), "E-Democracy In India-Implications and Imperative",*The Indian Journal of Political Science, 72 (2):395-401*
- Dhont, Jan et al. (2016), *"The French Digital Republic Act gives new Powers to the French DPA",* [Online: web]
- G.L.A. van der Meer, Toni et al. (2015) "E-Democracy: Exploring the Current Stage of E-Government",*Journal of Information Policy*, 5: 589-506.
- Kovacs, Anja and Ranganathan, Nayantara (2019), *Data sovereignty of whom? Limits and suitability of sovereignty frameworks for data in India,* Delhi: Internet Democracy Project. [Online: web]
- Loucaides, Darren (2019), "What happens when techno-utopians actually run a country", [Online: web]
- M. Castells (2008), "The New Public Sphere: Global Civil Society, Communication Networks and Global Governance", *The Annals of the American Academy of Political and Social Science*, 616, 78-94.
- Nyst, Carl & Falchetta, Tomaso (2017),"The Right to Privacy in the Digital Age", *Journal of Human Rights Practice, 9(1): 104–118.*

Grading Plan:

Type of Evaluation	Weightage (in %)
Quiz-1	**10%**
Mid SemExam	**20%**
End Sem Exam	**30%**
Assignments	**20% x 2= 40%**

Mapping of Course Outcomes to Program Objectives:

(1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant).

Matrix for CSE

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

Name of the faculty : **Nazia Akhtar, Akanksha Natani**
Course code : **HS8.102**
L-T-P : **3-1-0**
Credits : **4**
Name of the Academic Programs: **B.Tech. inCSE, B.Tech in ECE**
Course: UG2 Humanities core for CSE, ECE

1.Prerequisite Course / Knowledge: Nil

2.Course Outcomes (COs)

After completion of this course successfullystudents will be able to:

CO1: Discuss the origin and development of key disciplines in the human sciences

CO2: Identify some of the fundamental questions that shape and drive inquiry in human sciences

CO3: Demonstrate knowledge of concepts related to theorizing about reflection, society, and culture

CO4: Analyzecrucial normative elements and descriptive frameworks in human sciences inquiry

CO5: Develop skills to formulate nuances involved in problems concerning humans and societies

CO6: Write clear and well thought out short essays on topics in humanities and social sciences

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

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

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

4.Syllabus:

The course will be divided into fourmodules, each of which will introduce students to a particulardiscipline in the human sciences. The various disciplines that constitute human sciences are:

1. Philosophy
2. Psychology
3. Literature
4. History
5. Sociology
6. Anthropology

Each module will offer a systematic worldview, tools of enquiry to study and analytical frameworks tomake sense of topics taken up for discussion. Detailed list of topics under a module will be provided by the faculty teaching that module when the lectures begin. The overarching theme for the topics are the fundamentals of human sciences so that students grasp what humans sciences are all about.

Reference books:

Readings for each of the modules will be given with thecommencement of the lectures. There is no single textbook as such for all four modules.

5.Teaching-Learning Strategies in brief:

Each module will have one faculty giving six lectures of 90 mins each Through discipline specific modes of understanding and everyday examples, class lectures will enablestudents to connect and ponder about themselves, the society and cultures that surrounds them. The teaching-learning strategy emphasises the merits of avoiding simplistic solutions to complex problems and instead ask meaningful questions that enrich debates about how we produce, distribute,

consume, reflect, represent, and governourselves.Lectures impress upon students the need to critically reflect on issues that are impacted by technology, the historical and social context of the world they live in, the literary and philosophical ideas that permeate human thought and psychological principles of human behaviour.

6.Assessment methods and weightages in brief:

This is mainly a writing-driven course, and the evaluation questions are carefully designed to make students think independently. Students are assessed for abilities likecritically assessing issues, questioning assumptions,clarifying distinctions, and bringing out nuances. In assignments and exams, students are expected to demonstrate these abilities by presenting their views clearly and systematically. Students will be evaluated for each of the four modules and the pattern of evaluation will be decidedby the respective faculty.

Evaluation pattern can include weekly assignments, quizzes and term papers. Each module will carry 25 % of total marks. The End Semester exam carries 25% of marks.

Title of the course : **Intro to Processor Architecture**

Faculty Name : Deepak Gangadharan

Course Code : EC2.204

L-T-P : 3-1-0

Credits : 2 (Half semester course)

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

Name of the Academic Program: B-Tech in Computer Science and Engineering

1. Prerequisite Course/Knowledge

Digital Systems and Microcontrollers

2. Course Outcomes (COs)

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

CO-1. Explain Instruction Set Architecture (ISA) and the different paradigms RISC and CISC.
CO-2. Employ the different instructions and addressing modes to write assembly programs.
CO-3. Describe the instruction encoding in an ISA.
CO-4. Design and Develop Sequential and Pipelined Implementation of a Processor.
CO-5. Explain the different types of cache memories in memory hierarchy and its impact.
CO-6. Explain the importance of virtual memory and associated concepts such as page table, page faults and address translation.

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

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

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

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

4. Detailed Syllabus

Unit 1: Introduction to Processor Architecture – Definition of Computer System, Models of Computer Architecture, Programming Abstractions, Definition of Instruction Set Architecture, ISA Design Paradigms: RISC vs CISC

Unit 2: Machine Level Representation of Programs – Accessing Information: Operand Specifiers, Addressing Modes, Data Movement Instructions, Push and Pop Instructions, Arithmetic and Logic Operations, Condition Codes, Accessing Condition Codes, Jump Instructions and Encoding, Conditional Branches, Loops, Switch Statements

Unit 3: Processor Architecture – Instruction Set Architecture, Sequential Implementation, Principles of Pipelining, Pipelined Implementation

Unit 4: Memory Hierarchy – Storage Technologies, Locality, Types of Cache Memories, Impact of Cache on Program Performance

Unit 5: Virtual Memory – Physical and Virtual Addressing, Page Tables, Page Hits, Page Faults, Address Translation

Reference Books:

Randal E. Bryant and David R. O'Hallaron. *Computer Systems : A Programmer's Perspective* – 3rd Global Edition.

2. David A. Patterson and John L. Hennessy. *Computer Organization and Design: The Hardware/Software Interface* – 5th Edition.

6. 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.

7. Assessment methods and weightages in brief

Type of Evaluation	Weightage (in %)
Quiz 1	**10**
End Sem Exam	**30**
Project	**60**

Title of the Course : **Introduction to UAV Design**
Faculty Name : Harikumar K
Course Code : EC4.402
L-T-P : 3-1-0,
Credits : 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)

1.Prerequisite Course / Knowledge:
Basics of Linear Algebra, Laplace transform and Vector calculus.

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 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.
CO-6 Perform the flight simulation and flight testing of the prototype UAV and verify its stability and performance characteristics.

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

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

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

4.Detailed Syllabus:
Unit 1: Types of UAVs--- Multi-rotors, fixed wing (FWUAV), Hybrid VTOLs

Unit 2: Multi-rotor design--- Concept of operation (CONOPS), design specifications, different reference frames, axis conventions, forces and moments, sizing and assembly, sensors and control.

Unit 3: FWUAV Flight mechanics and control--- wing, fuselage, stabilizer and control surfaces, propulsion system, forces (lift, drag, thrust, side force), moments (roll, pitch, yaw), trim conditions, longitudinal static stability, lateral and directional stability, PID control through successive loop closure.

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.

Unit 5: Different configurations (tilt-rotor, tail sitter), transition dynamics, design specifications, sizing, stability and control.

Reference Books:

Daniel P Raymer, Aircraft Design: A Conceptual Approach, second edition, AIAA USA, 1992.

1. John D. Anderson, Introduction to flight, third edition, McGraw Hill USA, 1989.

2. R. W. Beard and T. M. McClain, Small Unmanned Aircraft: Theory and Practice, first edition, Princeton University Press USA, 2012

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

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 performance analysis. Detailed student assignment for practicing the different elements of conceptual design phase. Open book exam followed by detailed project submission including simulation studies, prototype development and flight testing.

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

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 - Practical hours)
Semester, Year : Spring 2024

Pre-Requisites : first course on algorithms, programming, computer architecture/ organization

Course Outcomes :

(list about 5 to 6 outcomes for a full 4 credit course)
The action verbs to be used for writing the course outcomes can be found on slide 22 in the following presentation. You may remove this line and the following link after the course outcomes are formulated.

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

At the end of the course, a student will be able to:
CO – 1: Demonstrate familiarity and scope of algorithm engineering
CO – 2: Explain the significance of algorithm engineering and analyze the practical performance ofalgorithms in connection to the nature of input
CO – 3: Apply algorithm engineering principles to implement a variety of graph and semi-numericalalgorithms

Course Topics :

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

1. Introduction to algorithm engineering, its scope, and its importance – 1
2. Cache-Aware Design: Algorithms and Techniques – 1
3. Cache-Oblivious Design: Algorithms and Techniques -1
4. A Primer on Parallel Algorithms – 3
5. Graph connectivity – 2
6. Eccentricity and Diameter – 2
7. Centrality Measures on Graphs – 2

Preferred Text Books :

Reference Books : Reference papers that are used for some of the course topics willbe posted as they are discussed in class.
E-book Links : Book being developed by the instructor available athttp://cstar.iiit.ac.in/~kkishore/pgae.pdf

Grading Plan : Since the course is a half-course, we will have one quiz evaluation andone final evaluation.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	1	2	2	2	1	1	1	1	1	2	1	1	2	1	1	2
CO 2	1	2	2	2	1	1	1	1	2	2	1	1	2	1	1	2
CO 3	1	2	3	3	1	1	1	1	2	2	1	1	2	1	1	2

Teaching-Learning Strategies in brief (4-5 sentences) :
The course will have hands-on exercises that help students understand the mechanisms available for algorithm engineering. The course project also equips them to explore an existing algorithm and a problem in depth and gain useful practical knowledge. The material used in the course is not part of standard textbook as yet, so lecture slides and reference papers will be made available forreading.

Title of the Course : **INTRODUCTION TO BRAIN AND COGNITION**
Faculty Name : Kavita Vemuri
Course Code : CS9.311
Credits : 2
L - T - P : 2-0-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring 2024 (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 will beable 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 (7^{th} Edition).

E-book Links :
Grading Plan : (The table is only indicative)

Type of Evaluation	Weightage (in %)
Quizzes (3 out of 4: each 20%)	**60%**
End Sem Exam	**30%**
Term Paper	**10%**

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

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O1	PS O2	PS O3	PS O4
CO1	1	1	2	1	1	2	1	1	1	1	1	2	1	1	1	1
CO 2	3	1	2	3	1	3	3	1	1	1	1	2	2	2	3	2
CO 3	2	1	2	2	1	3	2	2	1	1	1	2	1	2	3	1
CO 4	1	1	1	1	1	1	1	1	2	3	1	2	1	1	1	1

Teaching-Learning Strategies in brief (4-5 sentences) :
The IBC course is primarily lecture and discussion-based learning course. Students will be introduced to undergraduate-level introductory topics and issues in brain and cognition. Reading material will be assigned. Students will be required to engage in discussions, and to write a term paper on related topics. Students will be encouraged to relate the theory topicsto everyday experiences and will be asked to evaluate the event/phenomenon/ processes critically and scientifically. They will be encouraged to interact with various research teams in Cognitive Science Lab to familiarize themselves with the research projects so that they can start thinking about a future lab to conduct their research work.

Title of the Course : Introduction to Coding Theory
Faculty Name : Arti Yardi + Prasad Krishnan
Course Code : 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

1. **Prerequisite Course / Knowledge: Linear Algebra**
2. **Course Outcomes (COs) :**

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: Deduce the additive, multiplicative and vector space structure of finite fields
CO-6: Construct BCH and Reed Solomon codes, given the specifications of the problem.

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

	PO1	PO2	PO3	PO4	PO 5	PO 6	PO 7	PO 8	PO9	PO 10	PO 11	PO12	PSO1	PS O2	PS O3	PS O4
CO1	3	3	2	-	-	-	-	-	-	-	-	2	1	3	1	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-	1	3	1	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-	1	3	1	-
CO4	3	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO6	3	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-

4. Detailed Syllabus:

Unit 1: Noisy channels, block codes, encoding and decoding, maximum-likelihood decoding, minimum- distance decoding, error detection and correction.
Unit 2: Minimum distance, generator and parity-check matrices, dual codes, standard array decoding,
syndrome decoding. Repetition codes, Hamming codes.
Unit 3: Hamming bound, Singleton bound, Gilbert-Varshamov bound, Plotkin bound.
Unit 4: Definitions, prime fields, construction of prime power fields via irreducible polynomials, existence ofprimitive elements, minimal polynomials.
Unit 5: Bose-Choudhury-Hocquenghem (BCH) codes, Reed-Solomon codes. Applications of Reed-Solomoncodes in digital communications and storage.

Reference Books:

1. R. Roth, Introduction to Coding Theory, Cambridge University Press, 2007.
2. W.C. Huffman and V. Pless, Fundamentals of Error Correcting Codes, Cambridge University Press,2003.
3. S. Lin and D.J. Costello, Error Control Coding, Pearson, 2011
4. R.E. Blahut, Algebraic Codes for Data Transmission, Cambridge University Press, 2003

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

The course has lectures supported by tutorials. In tutorials, problems related to the concepts presented in the class are solved by teaching assistants. Exams are conducted periodically so that students can actively engage with the course material. Viva is conducted at the end of the course to assess how students are ableto apply concepts learnt in the class to new problems. A project is given towards the end of the course, which requires the students to present a research paper in the area of coding theory in detail.

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

Type of Evaluation	Weightage (in %)
2 Mid Semester Exams	2 X 10 = 20%
Assignments	30%

Viva	10%
Project	20%
End Semester Exam	20%

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-1 understand how to define a game and strategies in a game
CO-2 demonstrate familiarity with different solution concepts in game theory
CO-3 write algorithms to solve many game theoretic problems
CO-4 understand the concept of mechanism design (incentive engineering)
CO-5 analyze given autonomous system for any strategic behavior of the agents

CO-6 design 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

	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	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
CO 3	1		3	3	1	3	1	1	1	1	2	1	3	3	1	1	3
CO 4	1		2	3	1	2	2	1	1	1	1	1	3	3	1	1	3
CO 5	2		3	3	3	2	2	1	1	1	1	1	3	3	2	2	3
CO 6	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 %)
Mid Sem Exam	-
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 : Ashok Kumar Das
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 of Design 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 : Suresh Purini + Kavita Vemuri

Course Code : CS3.303

L-T-P : 2-0-3

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**

	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	1	1	1	-	1	-	-	-	2	-	3	1	1	-	-
CO 2	1	1	1	1	-	1	-	-	-	2	-	3	1	1	-	-
CO 3	1	1	1	1	-	1	-	-	-	2	-	3	1	1	-	-
CO 4	1	1	1	1	-	1	-	-	-	2	-	3	1	1	-	-
CO 5	2	1	-	2	3	1	-	-	3	1	-	3	1	1	-	-
CO 6	2	1	-	2	3	1	-	-	3	1	-	3	1	1	-	-
CO 7	2	1	-	2	3	1	-	-	3	1	-	3	1	1	-	-
CO 8	2	1	-	2	3	1	-	-	3	1	-	3	1	1	-	-

Note: Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs) and PSOs.

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

4. DetailedSyllabus

Unit 1: Introduction – Definition, Architectures and Use Cases

Unit 2: Sensor and Actuators – Definition, features, classification, characteristics,physicsoffewbasicandimportantsensorsandactuators

Unit 3: Microcontroller and Programming –

- Basics of a controller, popularmicrocontrollers
- Microcontroller programming(Arduino/ESP32)
- Overview of different peripherals: ADC, DAC, Memory, GPIO,Timers
- Interfacing of Sensors and Actuators to microcontrollers: UART, SPI,I2C

Unit 4: Communication Protocols –

- Basics of communication network
- Overview of different communication technologies for IoT: LoRaWAN, Cellular (3G/4G/5G), WLAN, Bluetooth,Zigbee
- Overview of application/middleware protocols: MQTT, HTTP,CoAP
- Connecting the sensor node tointernet

Unit 5: Cloud + Fog Computing – Characteristics, Types of Cloud, Challenges in Cloud Computing, Fog Computing Architecture, Advantages of Fog Computing, Case Study

Unit 6: Interoperability –

- Concepts and Types of Interoperability
- Interoperability Standards andoneM2M

Unit 7: Data Handling and Analytics –

- Handling - Definition, Data Types, Characteristics of Big Data, Data Flow (Generation, Acquisition, Storage,Analysis)
- Analytics - Definition, Types of Analytics (Descriptive, Diagnostic, Predictive, Prescriptive), Qualitative and QuantitativeAnalysis

Reference Books:

1) Perry Lea, (2018) Internet of Things for Architects: Architecting IoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security, Packt Publishing

5. Teaching-Learning Strategies in brief

Weekly lectures cover the theory in the syllabus and the labs will deliver the hands-on experience in building IoT systems. The comprehensive quizzes and end semester exam will 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 + Rahul Mishra
Course Code : CS7.401
Credits : **4**
L - T - P : 3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring, 2024
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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
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
CO4	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
CO6	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 + Rajakrishnan
Credits : 3-0-1-4
Type when : Spring 2024
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

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

SEMINARS: Students will be expected to read research papers on various topics and make presentations in the class.

TEXT BOOKS:
John Saeed (2009) *Semantics*
Geoffrey Leech (1983) *Semantics: the Study of Meaning*

SUGGESTED READINGS:
JohnLyons (1995). *Linguistic Semantics.*

Cruse Alan (2004). Meaning in Language: *An Introduction to Semantics and Pragmatics*. Part 2 and Part 4.
Levinson, Stephen C. (1983). *Pragmatics.*
Brown, G and Yule, G. (1983). *Discourse Analysis.*
Cutting Joan (2002). *Pragmatics and Discourse: A resource book for students.*

GRADING:

Assignments: 15%,

Mid Sem: 30%,

End Sem: 35%

Seminar: 20%

Title of the Course : Introduction to Particle Physics

NAME OF FACULTY : Subhadip Mitra
Name of the Academic Program : CND
Course Code : SC1.420
L-T-P : 3-1-0.
Credits : 4
(L= Lecture hours, T=Tutorial hours,
P=Practical hours)

1.Prerequisite Course / Knowledge:

Some exposure to Quantum Mechanics & basic Mathematics (i.e., some linear algebra & complex analysis, basic group theory etc.) and most importantly, interest about the subject.

2.Course Outcomes (COs):

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

CO-1 **Describe** the particle content of the Standard Model.

CO-2 **Discover** the various types of interactions among the elementary particles/antiparticles and the role of various symmetries and **classify** the particles according to their quantum numbers.

CO-3 **Discover** the representation of elementary processes with Feynman diagrams.

CO-4 **Recognize** the relativistic generalization of Quantum Mechanics through the Klein-Gordon and Dirac equations and **outline** the basic workings of Quantum Electrodynamics.

CO-5 **Apply** their knowledge and **calculate** simple processes (like two-body decay or two-going-to-two scattering, etc.).

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

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

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

4.Detailed Syllabus:

Unit 1: Introduction: developments throughout the 19th century as the backdrop. From abstract atoms to the Large Hadron Collider, Elementary particles and forces, the Standard Model.

Unit 2: Relativistic kinematics and Symmetries of nature: the SU(2) & SU(3) groups and their connections with the elementary particles, discrete symmetries, antiparticles.

Unit 3: The Klein Gordon equation & the basics of the perturbation theory.

Unit 4: Core Concepts: Electrodynamics of spin-less particles, Feynman diagrams and rules, Dirac equation, Quantum Electrodynamics

Unit 5: Advanced Topics: Parton model and a little QCD, collider physics – a (very) quick tour, introduction to HEP computing – Monte Carlo tools, some basic simulations, challenges in modern particle physics, role of modern computing

Reference Books:

1. D J Griffiths, Introduction to Elementary Particles, John Wiley & Sons.
2. F Halzen and A D Martin, Quarks and Leptons, John Wiley & Sons.
3. D H Perkins, Introduction to High Energy Physics, Cambridge U.

5.Teaching-Learning Strategies in brief:

This is an introductory (elective) course on Particle Physics designed to give the students who have no prior exposure to Quantum Field Theory a broad overview and some taste of the exciting

world of Particle Physics. The approach would be somewhat intuitive. The design is for students with diverse backgrounds. The focus would be on concepts, simple explanations, and intuition building.

6.Assessment methods and weights in brief:

Assignments + Quizzes – (30%), Mid-term evaluation (30%), Final exam (40%)

Title of the Course : Introduction to Philosophy of Technology

Faculty Name : Ashwin Jayanti

Name of the Academic Programs :B.Tech. in CSE, B.Tech in ECE

Course Code : HS0.204

L-T-P : 3-0-0

CREDITS : 4

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

1. Prerequisite Course /Knowledge:

None

2. Course Outcomes (COs):

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

CO-1: Identify and recognize various conceptions of technology implicit in arguments for/against technology

CO-2: Classify and describe various theories and interpretations of technological change through history

CO-3: Compareanalytical and continental approaches to technology and its relation to science and examine the limitations and advantages of both the approaches

CO-4: Assess the moral significance of technical artefacts within particular social contexts

CO-5: Develop philosophical frameworks in orderto understand and assess the impact of contemporary technologies to society at large

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS O1	PS O2	PS O3	PS O4
CO1	-	-	2	-	-	3	2	3	2	3	1	3	-	-	-	-
CO2	-	-	1	-	-	3	2	2	-	-	-	3	-	-	-	-
CO3	-	-	1	-	-	3	2	2	-	1	-	3	-	-	-	-
CO4	-	-	2	1	-	3	3	3	1	2	-	3	-	-	1	-
CO5	1	1	3	3	-	3	3	3	1	2	-	3	-	-	-	-

3 in the table denotes high level mapping, 2 denotes moderate level and 1 denotes low level

DetailedSyllabus:

Unit I –Introduction: What is Philosophy of Technology? Engineering and Humanities Philosophies of Technology; Classical and Contemporary Philosophy of Technology

Unit II: Encountering Technological Artefacts –Conceptual history of 'technology'; What is 'technology'? Continental and Analytic Perspectives
Unit III: Epistemological Aspects to Technologies –Science, Technology, and Engineering; Philosophy of science and philosophy of technology; Knowing-how and knowing-that
Unit IV: Moral Status of Technologies –Norms, Values, and Technologies; Debates Concerning Moral Significance of Artefacts; Role of Design in Moral Status
Unit V: Philosophical Debates in Artificial Intelligence –Philosophical background to Artificial Intelligence; Philosophical and ethical issues within Artificial Intelligence

REFERENCE BOOKS:

- Hans Achterhuis (ed.),*American Philosophy of Technology: The Empirical Turn*, translated by Robert Crease, Indiana University Press:2001.
- Carl Mitcham,*Thinking Through Technology: The Path Between Engineeringand Philosophy*, The University of Chicago Press:1994
- Robert C. Scharff and Val Dusek (eds.),*The Technological Condition: AnAnthology (Second Edition)*, John Wiley& Sons:2014
- Peter-Paul Verbeek,*What Things Do: Philosophical Reflections on Technology,Agency, and Design*, translated by Robert Crease, The Pennsylvania State University Press, 2005
- Peter Kroes and Peter-Paul Verbeek (eds.),*The Moral Status of TechnicalArtefacts*, Dordrecht: Springer,2014.
- StuartJ.RussellandPeterNorvig,*ArtificialIntelligence:AModernApproach*
  (Second Edition), Pearson, 2003
- John Searle,*Mind: A Brief Introduction*, Oxford University Press:2004

4. Teaching-Learning Strategies inBrief

This course aims at reading, critically evaluating, and thinking through contemporary debates in philosophy of technology. For this purposes, the main strategy is to share the readings and resource material beforehand for the students to acquaint themselves with the topics and use the class time to discuss and evaluate the implications of the various positions respective to each topic. Continuous assessment methods will be employed to make sure the students have acquired the requisite conceptual understanding to explicate and argue for their position with greater nuance and logical rigor.

5. Assessment Methods and Weightages inBrief

Continuous assessment in the form of written assignments will carry the major weightage of the evaluation, with the rest of the weightage assigned to class participation in the ensuing discussions.

The assigned weightage is as follows: Assignments: 40 marks, class participation: 10 marks, Mid semester exam: 20 marks, End semester exam: 30marks.

Title of the Course	**: Introduction to Quantum Information and Computation**
Faculty Name	: Uttam Singh
Course Code	**: CS9.312**
LTP	**: 3-1-0.**
Credits	**: 2**

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

Prerequisite Course / Knowledge:
Knowledge of Advanced Linear Algebra, Quantum Mechanics, Classical information Theory

Course Outcomes (COs):
After completion of this course successfully, the students will be able to..
CO-1. Explain the 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)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
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
CO4	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 : Anoop Namboodiri + Prakash Yalla
Course Code : **CS6.201**
LTP : **3-1-0.**
Credits : **2**
(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:** Not applicable.
2. **Course Outcomes (COs) (5 to 8 for a 3 or 4 credit course):**

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

CO-1: Demonstrate familiarity with various OS Concepts, Shell programming, Web Technologies, Database Systems, Python Programming, software engineering principles.

CO-2: Understand the different types of tools and technologies that are suitable for solving different software problems

CO-3: Apply tools and technologies to implement simple software solutions

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

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

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

4. Detailed Syllabus:

Unit 1: Software and Systems overview - SHELL: OS concepts, Kernel, Memory, Shell basics, Advance Linux commands including file management and schedulers, Control flows, Regex, Awk,

Unit 2: Developing web applications- Introduction to HTML, CSS and Javascript concepts, Data types, variables, operators, conditions, loops, functions, function expressions, events, form controls, data structures, java script libraries, AFrame, Three.js

Unit 3: Programming with Python – Functions, Exceptions, Error Handling, Sequences, scoping rules, closures, higher order functions, mutability, object model and inheritance, modules and packages, variable args, decorators, usage of libraries including SOAP and REST API, Flask based server set up.

Unit 4: SDLC and Databases – SDLC concepts, Version Control Systems, Editors, Bug trackers, Basics of SQL, CRUD;

Reference Material/Books:

1. Mastering Linux Shell Scripting : A practical guide to Linux command-line, Bash scripting, and Shell programming, by Mokhtar Ebrahim, Andrew Mallett. 2nd Edition, 2018. ISBN-13 : 978-1788990554
2. Learning Python: Powerful Object-Oriented Programming, by Mark Lutz. 5th Edition, 2013. ISBN-13 : 978-1449355739
3. JavaScript: The Definitive Guide, by David Flanagan. 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 Science and Technology (ISSAT)**
Name of the Faculty : Rama Chandra Prasad Pillutla and K.S Rajan
L-T-P : **3-0-1.**
Credits : **2**

1. <u>Prerequisite Course / Knowledge</u>:

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

CO 4	2	2	2	2	2	1	1	1	1	1	2	2	2	2	2	2
CO 5	2	2	2	2	3	2	2	2	2	1	2	3	3	2	2	2
CO 6	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 : **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

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

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

4.Detailed Syllabus:

Unit 1: INTRODUCTION: Nature of human language and its design features and comparison with animal communication systems - Duality of patterning, creativity, displacement etc; Levels of language organization- Phonological, Morphological; Grammatical and Discourse; **LANGUAGE CHANGE:** Concepts from Historical linguistics; language families and subfamilies; Comparative methods: spelling changes, types of sound changes, morphological changes, syntactic and semantic changes; Analogical change; Borrowing; the Great Vowel Shift; Grimm's law; Lexical comparisons

Unit 2: COMPARISION AND CLASSIFICATION OF UNIVERSALS: Historic-generic method and typological method; Language contact and convergence and areal typological study; South Asian language area and common areal features – experience subject, echo-formation, reduplication, retroflexion; Approaches to language universals: structural approach and generative approach – their assumptions about sampling, methodology and nature of linguistic elements.

Unit 3:GREENBERG'S BASIC WORD ORDER TYPOLOGY: Implicational universals and their role in restricting

possible language types; absolute universals and tendencies; Post-Greenbergian research and reformulation

of word order typology. **CHOMSKYAN APPROACH TO LANGUAGE UNIVERSALS:** Language learnability,

poverty of stimulus and innateness hypothesis; Concepts of universal grammar; Principles and parameters –

head parameter, pro-drop parameter and X-bar theory of phrase structure.

Unit 3: PHONOLOGICAL STRUCTURE: Vowels and Consonants across languages; Distinctive features and

phonological oppositions; Syllable types; Phonotactic constraints; Phonological Processes; Language

acquisition and dissolution. Phonological universals. **MORPHOLOGICAL STRUCTURE:** Language types-

Analytic, Agglutinative, Synthetic and Polysynthetic: derivational and inflectional categories and types of

affixes; Morphological encoding of number, person, gender, tense, aspect and modal features, agreement

and case marking; Parts of speech categories.

Unit 4: CLAUSE STRUCTURE: Grammatical relations – Nominative-Accusative and Ergative-Absolutive

language types; Dative and other Nominative subjects; Relative clause types; Causative construction;

Complement structure; Conjuctive Participles. **SEMANTIC STRUCTURE:** Case Grammar; Predicate argument

structure and thematic roles and their realization; Paninian grammar and Karaka relations.

Reference Books:

1. Campbell, Lyle. 1998. Historical Linguistics. MIT Press.

2. Comrie, Bernard. 1981. Language Universals and Linguistic Typology. Oxford : Basil Blackwell.

3. Aitchison Jean. 1976. The Articulate Mammal. London: Hutchinson. Chapters 1-5.

4. Subbarao K.V. 2012. South Asian Languages: A Syntactic Typology. Cambridge University Press. Chapters 1,2,5,6 and 8.

5. Masica, Colin P.1979. Defining a Linguistic Area. Chicago and London: The University of Chicago Press.

6. Emeneau, Murray (1956), "India as a Linguistic Area", *Language***32** (1): 3–16.

7. Jakobson, Roman. 1968. Child Language, Aphasia and Phonological Universals. The Hauge: Muoton.

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

The teaching process is a mix of theory and activity based. The focus is on using the concepts taught in class to extend to mother tongue. Translation method to compare the languages they know will be done individually, as pairwork and in groups

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

Type of Evaluation	Weightage (in %)
Assignments	20%,
Seminar	10%
Graded Exercises	10%,

Midsem Exam	20%,
Endsem Exam	40%

Title of the Course : Linear Algebra
Course Code : MA2.101
Name of the Faculty : Sidharatha Das _ Indranil Chakraborthy
L-T-P : 3-1-0
Credits :4
Name of the Academic Programme: B.Tech in Computer Science

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.

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: Eigenvalues and Inner product: Eigenvalues & Eigenvectors, Norms, Inner Products and Projections, Applications like Analysis of Random Walks.

Unit 4: Advanced Topics: Spectral & Singular Value Decomposition Theorems, Applications of SVD and 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.

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%
- Class Test 1: 10%
- Class Test 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 2024

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 : Parameswari Krishnamurthy
Course Code : CL3.406
Credits : 2
L - T - P : 3-1-0 (L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring, 2024 [H2]

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 2024
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 how prominent 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

Title of the course : **Machine Learning for Natural Sciences**

Name of the Faculty : Prabhakar Bhimalapuram + Vinod PK

Name of the Academic Program : MS in Computer Science

Course Code : SC4.411

L-T-P : 4-0-0.

Credits : 4

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

Prerequisite Course / Knowledge:

Probability & Statistics, Linear Algebra, Statistical Models in AI

Course Outcomes (COs):

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

CO-1: Learn and demonstrate understanding the basic concepts in machine learning

CO-2: Demonstrate use of machine learning algorithms on simple problems

CO-3: For a selected problem, apply the understanding of the principles, to formulate a problem statement

CO-4: Build Models based on requirements of the problem statement

CO-5: Analyze the constructed models for their usefulness, find deficiencies and identify possible improvements.

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

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

'3' for 'High-level' mapping, 2 for 'Medium-level' mapping, 1 for 'Low'-level' mapping.

Detailed Syllabus:

Unit 1: Overview: Types of problems: regression, classification. Types of machine learning: (a) supervised, (b) unsupervised, (c) semi-supervised and (d) reinforcement learning

Unit 2: Problem specific issues:

(a) representation: how to decide on a model that can solve the problem at hand?

(b) evaluation: Construction of a loss function to evaluate the

(c) Optimization: methods to use to iteratively improve the model from a starting guess?

Unit 3: Review of prominent current literature in ML as applied to natural sciences

Unit 4: Project discussion and implementation: Selection of a problem in natural sciences and developing a solution using ML techniques

Reference Books:

1. "Probabilistic Machine Learning", Kevin Murphy, MIT Press 2022
2. Other material (websites, technical articles) will be given to the students, based on need.

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

Lectures will initially introduce the motivations, concepts, definitions along with simpler examples. This will be followed by assignments and quizzes that will make sure that the

students have understood the concepts. These will be followed by deeper lectures and assignments which lead the students to the bigger questions in the area. These will also be supplemented with real world engineering problems so that they can apply the concepts learned by them.

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

- Light In-class Quizes: 15%
- Assignments: 15%
- Mini Project: 20%
- Major Project: 50%

Title of the Course : **Machine, Data and Learning**
Faculty Name **: Vikram Pudi + Praveen P**
Course Code : CS7.301
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:**

Data Structures, Computer Programming

2. **Course Outcomes (COs)**

After completion of this course successfully, the students will be able to:
CO-1. Understand basic ML concepts such as Underfitting, Overfitting and Bias-Variance tradeoff
CO-2. Gain hands-on experience of applying these concepts to example problems
CO-3. 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 of formal models such as Decision theoretic modelsand Bayesian networks
CO-6. Understand Decision tree learning and notion of Information Gain

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	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. Detailed Syllabus:

Unit 1: Overview of AI and ML
Unit 2: Basic ML concepts including Data and generalization, Overfitting, Underfitting, Bias-variance tradeoff
Unit 3: Local Search Techniques, Genetic
AlgorithmsUnit 5: Basics of Probability and Utility
Theory
Unit 6: Decision Theory, Markov Decision Process, Modeling observation errors

Unit 7: Decision Tree Learning, Construct decision trees from examples, Notion of information gainUnit 8: Bayesian networks
References :

- Python ML by Example by Yuxi (Hayden) Liu, Packt Publishing, 2017
- Stuart Russell and Peter Norvig, Artificial Intelligence A Modern Approach, PearsonEducation Inc., 2009

5. Teaching-Learning Strategies in brief:

The course lectures will cover the core concepts while assignments will provide ample scope to implement and understand many of the concepts in more detail. Learning of theoretical

conceptsand problem solving will be enabled via quizzes, mid and final exams.

6. Assessment methods and weightages in brief :

Assignments: 35 marks, Quizzes: 15 marks, Mid Exam: 20 marks , End Exam: 30 marks

Title of the Course: **Making of the Contemporary World**

Name of the Faculty: Anirban Dasgupta and Isha Dubey

Name of the Program: B.Tech in Computer Science and M.S. in Computing and Human Sciences by Research

Course Code: HS8.101

Credits: 4 (four)

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

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

Semester, Year : Spring 2024

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 Methods in Biology
Name of the Faculty : Abhishek Deshpande
Course Code : SC3.316
L-T-P : 3-1-0
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Credits : 4

1.Prerequisite Course / Knowledge: NA
2.Course Outcomes (COs):
After completion of this course successfully, the students will be able to
CO-1 State and prove theorems related to dynamical systems arising from biological interaction networks.
CO-2 Apply modeling techniques to complex biological problems.
CO-3 Demonstrate the familiarity in operating softwares like pplane, MATLAB commonly used in simulating trajectories of dynamical systems.
CO-4 Explain the basic concepts in reaction network theory.
CO-5 Analyze properties of models, such as various forms of stability and long-term behaviour.

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

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

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

4.Detailed Syllabus:

1) Short treatise on Differential Equations: Existence and uniqueness of solutions, System of differential equations, Eigenvalues and eigenvectors. Application to population dynamics models.
2) Introduction to dynamical systems: Flows, Fixed points and linearization.
3) Introduction to reaction networks: Persistence, Permanence, Globally Attracting sets, Deficiency and Multistability (Species-Reaction graphs).
4) Absolute concentration robustness, Network translation, Deficiency zero and Deficiency one theorems.
5) Applications to biological signal transduction pathways, phosporylation-dephosphorylation cycles and MAPK cascades.
6) Numerical simulations and analysis of dynamical systems using pplane and MATLAB.

Reference Books:

1) Nonlinear Dynamics And Chaos: With Applications to Physics, Biology, Chemistry, And Engineering, by Steven Strogatz.
2) Foundations of chemical reaction network theory by Martin Feinberg.
3) Martin Feinberg's lecture notes: https://crnt.osu.edu/LecturesOnReactionNetworks
3) Jeremy Gunawardena's lecture notes: https://vcp.med.harvard.edu/papers/crnt.pdf
4) An introduction to systems biology: design principles of biological circuits, by Uri Alon.

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

The objective of the course is to give the students a flavor of mathematical techniques used in modeling biological systems. In particular, the focus will be on analyzing biological systems from a dynamical systems point of view. Applications include analysis of enzymatic pathways, reaction networks, epidemic models and stability of steady states. The course will familiarize students with state-of-the-art softwares like pplane for simulating dynamical systems arising from biological networks.

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

Assignments (25%), Midterm Iexam (20%), Midterm II exam(20%), End semesterexam (35%)

Title of the Course : Mathematics of Generative Models

Faculy Name : Pawan Kumar
Name of the Program : CSE Elective
Course Code : CS7.508
Credits : 3-1-0-4
L - T - P:
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring, 2024

Pre-Requisites : Multivariable Calculus, LinearAlgebra, Probability and Statistics, Optimization Methods, SMAI

Course Outcomes:

1. Learn extensive mathematical foundations required for generative models.
2. Learn to build mathematical modelsfor a generative task.
3. Analyze and solve complex optimization models and solvers.
4. Analyze the obtained results with various benchmarks and scores.
5. Learn to programbasicgenerative model applications.

Course Topics:

1. Brief review of Probability and Random processes, Ordinary differential equations, and optimization methods. (*5 lectures*)
2. Variational Autoencoders: The Gaussian VAE, ConvNets and ResNets, Posterior collapse, Discrete VAEs. (*4 lectures*)
3. Generative Adversarial Networks: f-GANs, Wasserstein GANs, Solvers for min-max, Generative Sinkhorn Modeling: KR-duality, Optimal Transport,Sinkhorn algorithm. (*4 lectures*)
4. Generative Flow: Autoregressive flows, Invertible networks, Neural Ordinary Differential Equations. (*3 lectures*)
5. Energy based Models: Stein's method and score matching, Langevin dynamics.(*3 lectures*)
6. Diffusion Models: Stochastic calculus, Diffusion Process, Stochastic differential equations, Simulated Annealing, Denoising diffusion models. (*6 lectures*)

Preferred Textbooks:

1. Class Lecture Slides and Notes (created from papers, see below!)
2. Machine Learning: A Probabilistic Perspective by Kevin P. Murphy.
3. Computational Optimal Transport, arXiv:1803.00567
4. Tutorial on Deep Generative Models. Aditya Grover and Stefano Ermon. International Joint Conference on Artificial Intelligence, July 2018.
5. Tutorial on Generative Adversarial Networks. Ian Goodfellow. Neural Information Processing Systems, December 2016.

Reference Books:

1. Score-Based Generative Modeling through Stochastic Differential Equations, arXiv:2011.13456
2. Sliced Score Matching: A Scalable Approach toDensity and Score Estimation, arXiv:1905.07088
3. Backprop through Sinkhorn's algorithm for generative modeling, AISTATS 2018
4. Entropy, convexity, and matrix scaling, Lecture notes
5. Denoising Diffusion Probabilistic Models, arXiv:2006.11239
6. Wasserstein GAN, arXiv:1701.07875
7. Improved Training of Wasserstein GANs, arXiv:1704.00028

8. The Usual Suspects? Reassessing Blame for VAE Posterior Collapse, arXiv:1912.10702
9. NVAE: A Deep Hierarchical Variational Autoencoder, arXiv:2007.03898

E-book Links:

1. **https://optimaltransport.github.io/slides/**
2. **https://openai.com/blog/jukebox/**
3. **https://optimaltransport.github.io/book/**
4. **https://people.math.wisc.edu/~kurtz/m735.htm**
5. **https://ethz.ch/content/dam/ethz/special-interest/mavt/dynamic-systems-n-control/idsc-dam/Lectures/Stochastic-Systems/SDE.pdf**
6. **https://www.probabilitycourse.com/**

Grading Plan:

(The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz-1	**10%**
Mid SemExam	**20%**
Quiz-2	**10%**
End Sem Exam	**30%**
Assignments	**20%**
Project	**None**
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).

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

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

Title of the Course : Mechatronics System Design

Faculty Name : Nagamanikandan +Harikumar K

Course code : EC4.404

L-T-P : 3-1-0

Credits : 4

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

1. Prerequisite Course / Knowledge:

Basic programming (Python, C++), Linear Algebra, Numerical methods, Basic microcontroller knowledge.

2. Course Outcomes (COs):

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

CO-1 Describe important elements of mechatronics system

CO-2 Apply the previous knowledge of microcontroller programming for controlling multidisciplinarymechatronic systems.

CO-3 Describe and design basic mechanical elements and their feedback control.

CO-4 Synthesize and analyze a range of mechanisms.

CO-5 Design and execute a multidisciplinary project based on the given specifications as part of a team.

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	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. Detailed Syllabus:

Unit 1: Sensors and Actuators:

Sensors for robotics application - position, speed, acceleration, orientation, range.Actuators - general characteristics, motors, control valves.

Unit 2: 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.

Unit 4: Design and analysis of mechanisms.
Unit 5: Programming and hardware experiments.

Reference Books:

1. Bentley, John P. "Principles of measurement systems," Pearson education, 2005.
2. D.R. Coughanowr, "Process system analysis and control," McGraw Hill, 1991
3. G.F. Franklin, J.D. Powell and M.L. Workman, "Digital control of dynamic systems", AddisonWesley, 3rd edition, 1998.
4. Hartenberg, R., & Danavit, J, "Kinematic synthesis of linkages," McGraw Hill, 1964.
5. http://wiki.ros.org/
6. User manual of microcontroller and data sheets of sensors and actuators

5. Teaching-Learning Strategies in brief:

This course aims to teach the students about designing and developing a mechatronics system by providing them with essential hardware and software. Part of the class is devoted to a learn-by-doing lesson where thestudents will learn theory and get hands-on experience with various aspects of the mechatronics system.
The goal for the students is to design, build, and debug the electromechanical system for a given task as apart of the course project.

6. Assessment methods and weightages in brief:

Mid semester exam 20%
Assignments 40%
The class work assignments will be based on the application of a step-by-step engineering design process to aproblem assigned in the course.

Project 40%
Proposal (5%)
Project demonstration (25%)
Final report (10%)

Title of the Course : Migrants and Migrations in Modern South Asia
Faculty Name : Isha Dubey
Name of the Program : B. Tech in Computer Science and Engineering
Course Code : HS3.305
Credits : 4
L - T - P : 3-0-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring 2024

Pre-Requisites : Intro to Human Sciences, CHD 3rd and 4th year students

Course Outcomes:
After completion of the course successfully students should be able to:
CO1: Define various terms and concepts related to the topic, such as –migrant, immigrant, refugee, stateless, IDP, diaspora, etc.

CO2: Explain the academic theories and conceptual frameworks relating to human migrations in the modern world.
CO3: Analysethe nature and impact of some of the most important internal, cross-border and transnational migrations which have shaped modern and contemporary South Asia
CO4: Evaluate the different methods used for understanding how, why, and when people move from one place to another.
CO5: Examine what tools can be used to narrate, document and curate the lived experience of migrating under diverse circumstances in historical and present-day South Asia.
CO6: Develop a small-scale case-study aimed at understanding a specific kind of migration and its impact using any of the methodological tools covered in the course.

Course Topics:

1) **Migration, mobility, and motivation:** This module will introduce the basic concepts in migration studies, the different categories of people on the move, the possibilities for overlaps among them, and the various theoretical frameworks developed across disciplines for studying different kinds of migrations that have shaped the modern world. Students will be encouraged to develop critical understanding of t these theories and their relevance for South Asia.
2) **Empire, colonialism, global histories of migration from South Asia:** This module will focus on bringing out the complex entanglements between the workings of colonialism and the transnational movement of people for meeting the needs of empire from South Asia. This module has two objectives: First, familiarise students with the nature and history of migrations spawned by 19th century indenturedlabour, the inter-generational traumaand the creolization of cultures it resulted in. Second, discuss the various migrations from this period with their linkages to colonialism, race, and the compulsory global passport regime which decides who gets to travel where and with what conditions.
3) **Borders boundaries and frontiers in South Asia:**Students will study the processes and politics of defining borders, borderlands, and frontiers in South Asia historically in this module. What are the physical limits of the nation? Have they always remained the same or do they change over time? Who draws these boundaries of belonging? Is the border only confined to the actual line on a map of is it constituted by a larger fluid space at the margins? Who are the people who populate these margins and how do they navigate these geographies of flux? These are some of the questions that the module will pose and address.
4) **Nation-making, citizenship, and displacement:**Carrying forward the discussion from the previous one, this module is structured around the idea of the nation state and its centrality to questions of belonging and exclusion. How are these mitigated through the choice (of lack thereof) of 'migration' within and without it? This module will study certain colossal moments of rupture resulting in the breakup, creation, reorganization or reorientation of nations and national belonging in postcolonial South Asia. What impact have these had on mobility and movement across and within borders?
5) **South Asian diasporas:** This module will introduce students to the study of various kinds and contexts of diasporic migration extending outwards from the Indian subcontinent. What are the ways in which they widen the ambits of migration research? Using literature, film and memoire, the module will discuss the meanings attached to home and homeland, and the notions of return, nostalgia and assimilation, as well as their inter-generational transmission.

6) **Tools and methods of research in migration history:** This module will familiarise students with the major trends in qualitative migration research; more specifically historical research on varied experiences of migration. The objective is to prompt the class to engage with different methods for collecting and analysing data – archival, ethnographic, oral history etc. – for capturing narratives of people on the move and the possibilities offered by computational social science in broadening the scope of these methodological tools. Finally, the module shall also take up the questions related to the storing, documenting, curating, and disseminating of migration histories from South Asia and the role that technology plays/can play in these processes.

Preferred Textbooks:

- Ranabir Samaddar: *The Postcolonial Age of Migration*
- Lucy Mayblin and Joe Turner: *Migration Studies and Colonialism*
- Ian Goldin, Geoffrey Cameron, and Meera Balarajan: *Exceptional People: How migration shaped our world and will define our future*
- Neilesh Bose: *South Asian Migrations in Global History: Labour, Law and Wayward Lives*
- Ainslie T. Embree and Mark Juergensmeyer (ed.): *Frontiers into Borders: Defining South Asian States, 1757-1857*
- Vizira Fazila-Yacoobali Zamindar: *The Long Partition and the Making of Modern South Asia: Refugees, Boundaries, Histories*

Reference Books

- Sunil S. Amrith: *Crossing the Bay of Bengal: The Furies of Nature and the Fortunes of Migrants*
- Urvashi Butalia: *The Other Side of Silence: Voices from the Partition of India*
- Willem van Schendel: *The Bengal Borderland: Beyond State and nation in South Asia*
- Steven Vertovec: *The Hindu Diaspora: Comparative Patterns*
- Papiya Ghosh: *Partition and the South Asian Diaspora: Extending the Subcontinent*
- Amitav Ghosh: *Sea of Poppies*
- Arjun Appadurai: *Modernity at Large: Cultural Dimensions of Globalisation*
- Vivek Bald: Bengali *Harlem and the Lost Histories of South Asian America*
- Gaitura Bahadur: *Coolie Woman: The Odyssey of Indenture*
- RanabirSammadar (Ed.): *Borders of an Epidemic: COVID 19 and Migrant Workers*

Articles

- Md. Mahbubar Rahman and Willem van Schendel: " 'I Am Not a Refugee' : Rethinking Partition Migration."
- David Ludden: "Presidential Address: Maps in the Mind and the Mobility of Asia."
- Radhika Singha: " The Great War and a 'Proper' Passport for the Colony: Border Crossing in British India, c. 1882-1922."
- Willem van Schendel: "Working Through Partition: Making a Living in the Bengal Borderlands."
- Joya Chatterjee: "Dispositions and Destinations: Refugee Agency and 'Mobility Capital' in the Bengal Diaspora."
- Alison Blunt: "Cultural Geographies of Migration: Mobility, Transnationality and Diaspora,"
- Lucas G. Drouhot, Emanuel Deutschmann, Carolina V. Zuccotti & Emilio Zagheni: "Computational Approaches to Migration and Integration Research: Promises and challenges."

- Thompson: "Moving Stories: Oral History and Migration Studies."
- Sucheta Mazumdar: "Localities of the Global: Asian migrations between Slavery and Citizenship."
- Leslie Page Moch: " From Regional to Global Repertoires of Migration."
- Lynn Hollen Lees: "Studying Migration on a Global Scale."
- Ravi Ahuja: "Mobility and Containment: The voyages of South Asian Seamen, 1900-1960."

E-book Links :
Grading Plan :
(The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz-1	**8%**
Mid SemExam	**20%**
Quiz-2	**7%**
End Sem Exam	**35%**
Assignments	**(15x2) 30%**

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

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

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

The course will be based on classroom lectures and will require intensive reading, writing and active participation during the class. On an average, each student will be required to read between 500 to 800 pages of books and articles, and submit written work between 3,000 to 4,000 words, cumulatively.

Classroom discussions will be structured around certain pre-circulated question based on the larger thematic focus of that lecture and broad ideas emanating from prescribed readings for it. Students are expected to not only be able to grasp and articulate the arguments presented in the course literature but also to engage critically with how they speak to the more free-flowing discussion taking shape in the classroom based on these readings and the lecture.
Pictures, Extracts from primary sources, audio and video resources will be used to illustrate the points being taught.
The assignments and exams will focus on training students to develop their own ideas, and apply computer science tools, to the topics on hand.

Title of the Course : Molecular Modeling and Simulations
Name of the Faculty : U Deva Priyakumar + Marimuthu Krishnan
Course Code : SC2.316
L-T-P : 3-1-0
Credits : 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Academic Program : BTech & BTech+MS dual degree programs

1.Prerequisite Course / Knowledge:

None

2.Course Outcomes (COs):

After completion of this course successfully, the students will be able to
CO-1: Describe the different aspects of molecular modeling techniques
CO-2: Describe the fundamental methods of quantum chemistry, molecular mechanics, molecular dynamics in the context of modelling molecular systems
CO-3: Examine properties of molecules using quantum chemical methods
CO-4: Evaluate the dynamic characteristics of biomolecules such as protein, DNA and RNA using molecular dynamics simulations.

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

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

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

4.Detailed Syllabus:

Unit 1: Potential energy surface: Concepts of minima, transition states and higher order saddle points. Optimization methods: gradient descent, conjugate gradient and Newton-Raphson methods

Unit 2: Basics of Quantum mechanics: Particle in a box, Hydrogen atom problem, two-body problem, molecular orbital theory
Unit 3: Practicals of quantum chemistry: Optimization of molecules, Understanding of the different components of the outputs, calculation of properties like the IR spectrum
Unit 4: Molecular mechanics: Force field equations, Additive forcefields, polarizable and machine learning forcefields
Unit 5: Molecular dynamics simulations: Integrating Newton's laws of motion with force derived from force fields, replica exchange simulations, umbrella sampling simulations
Unit 6: Practicals of molecular dynamics: Set up necessary requirements for MD simulations, perform short simulations, calculation of thermodynamic properties.

Reference Books:

1. Molecular Modeling by Andrew Leach
2. Molecular Modeling and Simulations by Tamar Schlick

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

The course aims to enable students to model a given chemical or biological molecular process. Lectures followed by practicals on the same aspects will be done in tandem. A bird's eye view will be followed where the emphasis is more on the philosophical understanding of the methods than elaborate derivations of all concepts. The evaluations will be continuous and will test the students' understanding of concepts and their implementations in performing a given task.

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

- Assignments - 20%
- Quiz - 30%
- Exams - 50%

Title of the Course : **Molecular Symmetry and Quantum Mechanics**
Name of the Faculty : Harjinder Singh
Course Code : SC2.315
L-T-P : 3-1-0
Credits : 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)

Name of the Academic Program: B Tech (CSE/ECE), B Tech (CSD, CXD, ECD)

1.Prerequisite Course / Knowledge: Linear Algebra, Basic (High school) physics/chemistry

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

After completion of this course successfully, the students will be able to..
CO-1 State and prove theorems of group theory relevant to physics
CO-2 Apply group theory in molecular physics
CO-3 Derive molecular wavefunctions using symmetry behaviour of molecules
CO-4 Explain molecular properties using symmetry behaviour of molecules
CO-5 Demonstrate aspects of scientific methodology as used in abstract thinking

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

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

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

4.Detailed Syllabus:

Unit 1: Symmetry of objects, point groups, calculus of symmetry, reduced and irreducible representations,Great and Little orthogonality theorems(6L)

Unit 2: Group Theory and Quantum Mechanics, LCAO-SALC approach in MO theory, applications. (6.5L)

Unit 3: Special topics: Applications to Ligand field theory, Pericyclic reactions, Normal mode analysis of vibrational motion, etc. (9L)

Unit 4: Continuous (Lie) groups and applications (1.5L)

Reference Books:

1. F A Cotton (2008), Chemical Applications of Group Theory, 3rd Ed., Wiley, London
2. M Tinkham (2003), Group Theory and Quantum Mechanics, Dover, USA
3. P W Atkins and R S Friedman (2012), Molecular Quantum Mechanics, Oxford University Press, London

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

Teaching in this semester is on line. Along with prepared slides, tools are used to write material extempore and draw pictures to explain the material.
The class begins with a 5-minute quiz on concepts learned in the previous class. Students can interrupt any time with queries during the class. They can use speakers or write comments in the chat box. The instructor stops every few minutes to inquire if there are queries. Class exercises – a few in every class, are used to ensure that learning is effective.
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):

Quizzes (23 - 5-minute quiz every class)	30%
Final Exam	35%
Assignments (8)	35%

Title of the Course: Music Workshop
Name of the Faculty: T K Saroja
Course Code:
L-T-P: 3-0-1
Credits:4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)

1.Prerequisite Course / Knowledge:

Maximum students: 30

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

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

CO-1Understand the scope of research in music

CO-2Realise the potential of a thought as a seed to a productive work

CO-3 Understand the relevance of music as an integral part of human life

CO-4Develop an inter disciplinary perspective onmusic

CO-5 Come up with a work of their own, related to music

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

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

1. Text reading: The students will be introduced to a wide range of topics through the writings of different musicians, musicologists and music rasikas
2. Introduction to all the basic concepts of music with special focus on Indian music
3. Music listening: Music of different genres will be played for the students to observe and understand the importance of 'Sadhana' in music
4. Practical exercises: Various exercises based on notes, rhythm, scales, ragas and language
5. Discussions on topics that students want to take up as their course project (individual sessions relevant to their topic)

Reference Books:

As this course is a research/project oriented one, the references are not limited to the given list.

The list given below is to cite a few books that cover broad areas.

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. The two faces of Beauty Science and Art by The Quest for Music DivinePushpa Mittra Bhargava, Chandana Chakrabarti, mapin Publishing, 2014
6. The Quest for Music Divine by Suresh Chandra Dey, Ashish Publishing House, 1990

7. History of South Indian Music (Carnatic) Music, R. rangaramanujaAyyangar, JAK Printers, 1972
8. Hindustani Music- A tradition in transition by Deepak Raja, D.K.Print World Ltd, 2005
9. Indian Aesthetics and musicology- The Art and Science of Indian music by Prof. Prem latha Sharma, AmnayaPrakasana, Bharatha Nidhi, Varanasi, 2000
10. Elements of Western music for the students of Indian music by Prof. P.Sambamoorthy,KMBC, 1961
11. Ragacikitsa (Music Therapy) by Suvarna Nalapat, Readworthy publications Pvt ltd, 2008

Videos and audios on the Youtube and other platforms.

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

This is a course designed to encourage researchrelated to music. The students would identify some research topic to work on throughout the semester and work in groups of three or four. There would be four to five common classes to all the students to equip them with the basic knowledge of music and direct them towards diverse prospects. Suggesting relevant resources, monitoring the projects regularly, encouraging projects in the confluence of music, science and technology would be the strategy of the course. There would be individual and group wise attention onstudents to make them complete a project successfully. The students would thoroughly learn the topic of their interest and finally submit a project related to it.

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

Assignments: 40%

Class participation 10%

Project: 50%

Title of the Course : Music, Mind, and Technology

Course Code : CS9.434
Faculty : Vinoo Alluri
Technology L-T-P : 3-1-0
Credits : 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Academic Program: **Open Elective**

1.Prerequisite Course / Knowledge: None

2.Course Outcomes (COs):

After completion of this course successfully, the students will be able to
CO-1 appreciate the fundamental concepts of the field of Music Cognition and Technology
CO-2 understand the role of the individual in musical experiences in relation to music experience including music consumption, music industry, mental well-being, and critically think about the relationship between diverse fields that comprise music cognition such as psychology, music information retrieval, and neuroscience.

CO-3 understand the relation between physical aspects of sound and perceptual processes including sensation and perception
CO-4 understand sound synthesis and analysis in addition to application of machine learning to various music information retrieval tasks (eg: music genre classification, mood detection, recommendation)
CO-5 understand music processing in the brain, and effect of individual differences thereof (eg: musical expertise, empathy, gender). Analyze brain responses to music which includes an interdisciplinary approach combining sound- and brain-signal processing, statistical methods, and perceptual experimentation to analyze experimental data from human neurological experiments
CO-6 combine knowledge gained from CO-1-4 to formulate own research idea and go about solving it.

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

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

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

4. Detailed Syllabus:

Unit 1: Introduction to Music cognition, Evolutionary and Biological significance of music, Embodied music cognition, evolution of the field of psychology of music
Unit 2: Music experience and Individual differences, Music Emotion
Unit 3: Auditory Processing, Sensation, Perception, Auditory stream segregation Unit 4: Sound synthesis and analysis
Unit 5: Music information retrieval Unit 6: Neuromusicology

Reference Material:

Lecture slides and supplementary reading materials (journal articles, review articles) will be uploaded on the course page on Moodle.

5. Teaching-Learning Strategies in brief:

Students will be introduced to the broad field of music cognition. The objective of the course is to give an appreciation of the main concepts of the field of Music Cognition and Technology. Students will learn about topics in music psychology (from perception to cognition), familiarize yourselves with music signal analysis and music information retrieval (MIR), ending with the interdisciplinary field of cognitive neurosciences of music (with a focus on functional magnetic resonance imaging (fMRI) studies). Apart from this, the course

provides an overview of main areas of contemporary research of music perception and cognition such as musical preferences and personality, music and movement, music and emotion, music and mental well-being, and music processing in the brain.
By attending lectures, in addition to a few guest lectures by leading music researchers from around the world, students will be exposed to this interdisciplinary field and open questions. Students learn by working in groups to solve existing open problems in addition to creating their own research problem and addressing it to the best of their abilities.
Lectures are highly interactive as the course requires a student to actively participate and think and be creative. Students learn by doing assignments designed to achieve course outcomes and collaboratively working on a final project. The final project wherein students learn by working in teams, especially to devise a research question, identify hypotheses, operationalize it, deploy it, collect (if necessary) and analyze data and present the results thereby promoting collaboration, which is very much needed in interdisciplinary research.

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

Quiz 1 = 10%
Quiz 2 = 10%
Assignments = 30%
Final Project = 40%
Class participation = 10%

Title of the Course : Neural Natural Language Generation
Faculty Name : Manish Shrivastava + Rahul Mishra
Name of the Program : CLD/Open Elective
Course Code : CL3.407
Credits : 2
L - T - P :2-1-2
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring 2024
Pre-Requisites : CL1 or NLP1
Course Outcomes :
CO-1: *Understand* Natural Language Generation (NLG) from Linguistic and Machine/Deep Learning perspectives (
CO-2: *Analyze* classical and Deep Learning based Natural Language Generation model design principles for Monolingual, Multilingual and Multi-Modal uses cases
CO-3: Understand and evaluate state-of-the-art Prompt and query-based NLG methods
CO-4: Develop specialized NLG systems
Course Topics :
(please list the order in which they will be covered, and preferably arrange these as five to six modules.)

1. Background (4 Lectures): Introduction to NLG, Traditional Models for NLG
    a. Information Extraction perspective on Natural Language Generation (NLG)
    b. Linguistic perspective on Natural Language Generation
    c. Template-based NL generation,
    d. Statistical NLG
    e. Language Modeling (LM) and sequence to sequence models for NLG
    f. Merits and failures of traditional methods
2. Basic models for Neural NLG (2 lectures):
    a. Large Language Models (LLMs)

        i. Exploring major LLMs including BERT, GPT etc,
    b. Transfer models
        i. T5, BART etc
3. Controlled Generation(2 Lectures):
    a. Controlled generation paradigm
    b. Prompt based NLG
    c. Prompt finetuning using foundational models
    d. Evaluation of language generation models
4. Multilingual NLG(2 Lectures):
    a. Multilinguality and Multilingual models
        i. mT5, mBART
    b. Cross Lingual Generation
        i. Cross Lingual summarization
        ii. ML Question Answering
5. Multimodal NLG (2 Lectures:
    a. Modeling Image and Text modalities
    b. Image Captioning
    c. Scene Graph based description generation

Preferred Text Books : No text books

Reference Books :

1. *Speech and Language Processing*, Daniel Jurafsky and James Martin, Prentice-Hall (second edition).
2. Christopher D. Manning and Hinrich Schutze. *Foundations of Statistical Natural Language Processing.* MIT Press.
3. Ian Goodfellow and YoshuaBengio and Aaron Courville. *Deep Learning.* MIT Press.

E-book Links (indicative papers)**:**

1. The GEM Benchmark: Natural Language Generation, its Evaluation and Metrics
2. Wenhao Yu, Chenguang Zhu, Zaitang Li, Zhiting Hu, Qingyun Wang, Heng Ji and Meng Jiang. 2022. A Survey of Knowledge-Enhanced Text Generation. ACM Computing Survey.
3. BLEURT: Learning Robust Metrics for Text Generation
4. Leiter et al., Towards Explainable Evaluation Metrics for Natural Language Generation
5. Li and Liang, Prefix-Tuning: Optimizing Continuous Prompts for Generation
6. Krause et al., GeDi: Generative Discriminator Guided Sequence Generation
7. *Ramesh, Aditya et al. "*Zero-Shot Text-to-Image Generation*." ICML2019*
8. others

Grading Plan :

Type of Evaluation	**Weightage (in %)**
End Sem Exam	**20**
Assignments	**40**
Project	**40**

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

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

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

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

Teaching-Learning Strategies in brief :

This course is an advanced and research level course where each topic is being discussed in a flipped classroom model after necessary background is given. Students are expected to come to the class after reading/understanding given material for each session and share their understanding, analyze and synthesize the knowledge. This approach not only enhances the students' understanding of the state of the art but also encourages them to push the knowledge boundaries by applying them to a given problem setting such as Indian languages.

Title of the Course: Neuroinformatics

Name of the Faculty : Vishnu Sreekumar

Name of the Program: Computer Science

Course Code : CS3.502

Credits 4

L - T - P : 3-1-0

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

Semester, Year : Spring, 2024

Pre-Requisites : Linear Algebra, MATLAB/Python programming, BRED/BRSM. Desirable (but not required) also is any cognitive science elective such as Introduction to cognitive science, Introduction to psychology, Introduction to brain and cognition, etc. Instructor permission is required if you do not have the prerequisites on your transcript.

NOTE: The course will provide code in MATLAB. A willingness to work in MATLAB ishighly encouraged. If you wish to use Python, you will be entirely responsible for code translation and using the right toolboxes such as https://mne.tools/stable/index.html

Course Outcomes :

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

- CO-1: demonstrate an understanding of Signal Processing methods.
- CO-2: perform hands-on analyses of time series data using both frequency and time-domain methods.
- CO-3: perform non-parametric statistics on the measures obtained from applying the techniques above to time series data.
- CO-4: identify flaws and pitfalls in time series data analysis and critically evaluate neuroscience findings based on time series data analysis.
- CO-5: write technical reports with an appropriate description of the data and methods.

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

- Attend lectures and participate in class discussions (CO-1, CO-2, CO-3, CO-4)
- Data analysis project (CO-1, CO-2, CO-3, CO-4, CO-5)
- In-class and take-home assignments (CO-1, CO-2, CO-3, CO-4)
- Quiz 1, Quiz 2, and mini-quizzes (CO-1, CO-2, CO-3, CO-4)

Course Topics :

- **Unit 1: Introduction; understanding the origin of the data**
  - Introduction and origin of EEG/LFP/fMRI signals
  - Preprocessing (e.g. referencing schemes) and signal artifacts
  - Simulating time series and noise
- **Unit 2: Decomposing the signals for further analysis**
  - Time-domain analyses
  - Frequency-domain analyses
  - Choices of baselining
  - Time-frequency analysis
- **Unit 3: Neuronal synchronization**
  - Phase synchronization
  - Lagged-phase synchronization
  - Power-based connectivity
  - Graph theoretic analysis
- **Unit 4: Non-parametric statistics**
  - Permutation and shuffling procedures
  - Cluster-based multiple comparisons correction
  - Subject-level and group-level statistics
  - Visualizing statistically significant neural patterns
- **Unit 5: Advanced and special topics**
  - Multivariate neural analysis
  - Periodic and aperiodic neural activity
  - Dynamics (optic flow and linear stability analysis)

Preferred Textbooks :

- Mike X Cohen. Analyzing neural time series data: Theory and practice. MIT Press,2014.

Reference Books :

- Assigned journal and review articles (compulsory readings or videos to watch will be assigned every week and there will be mini-quizzes in class to check for progress and understanding).
- Videos will be assigned to supplement in-class lectures. So, some classes may be flipped where students will be required to watch lecture videos before class, and we willuse the class to discuss and clear doubts about the methods.
- Other digital resources: https://github.com/openlists/DSPResources
- Lecture slides and supplementary readings will be posted to Moodle.
- Buzsáki, G. (2006). *Rhythms of the brain.* Oxford University Press. https://doi.org/10.1093/acprof:oso/9780195301069.001.0001

Sample Readings:

- Buzsáki, G., Anastassiou, C. A., & Koch, C. (2012). The origin of extracellular fieldsand currents—EEG, ECoG, LFP and spikes. *Nature reviews neuroscience*, *13*(6), 407-420.
- Greene, A. S., Horien, C., Barson, D., Scheinost, D., & Constable, R. T. (2023). Why iseveryone talking about brain state?. *Trends in Neurosciences*.
- Perrenoud, Q., & Cardin, J. A. (2023). Beyond rhythm–A framework for understandingthe frequency spectrum of neural activity. *bioRxiv*, 2023-05.
- Donoghue, T., Haller, M., Peterson, E. J., Varma, P., Sebastian, P., Gao, R., ... & Voytek, B. (2020). Parameterizing neural power spectra into periodic and aperiodic components. *Nature neuroscience*, *23*(12), 1655-1665.
- Kriegeskorte, N., Simmons, W. K., Bellgowan, P. S., & Baker, C. I. (2009). Circularanalysis in systems neuroscience: the dangers of double dipping. *Nature neuroscience*, *12*(5), 535-540.
- Noble, W. S. (2009). How does multiple testing correction work?. *Nature biotechnology*, *27*(12), 1135-1137.
- Maris, E., & Oostenveld, R. (2007). Nonparametric statistical testing of EEG-and MEG-data. *Journal of neuroscience methods*, *164*(1), 177-190.

E-book Links : NA

Grading Plan :

Type of Evaluation	Weightage (in %)
Quiz-1	**10**
Quiz-2	**10**
Mini-quizzes	**10**
Assignments	**30**
Project	**40**

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

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

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

The lectures and assigned videos will introduce the students to signal processing and other quantitative approaches relevant to neural data (particularly EEG) analysis. Students will be taught to simulate data to better understand the structure of the data and to test the validity of the methods for themselves. Every topic will be accompanied by a hands-on analysis of a sample dataset or simulated data. Code snippets will be provided to support student learning. While the quizzes will check for a basic understanding of the concepts, the assignments will provide practice in applying the concepts by writing custom code.

Furthermore, the project forms a major component of the course and is designed to take the quantitatively trained novice to an intermediate level of expertise in neural time seriesanalysis. Students interested in neuroscience research or those seeking practical expertisewith signal processing techniques as applied to time series data (we just so happen to use brain data for this purpose) should take this course.

Title of the Course **:** Next Generation Sequence Data Analysis
Faculty Name : Nita Parekh
Name of the Academic Program: CND
Course Code **: SC3.410**
Credits **: 4**
L - T - P **:3-1-0**
(L - Lecture hours, T-Tutorial hours, P - Practical hours)

1. Prerequisite Course / Knowledge: Bioinformatics 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: Handle confidently different types of next generation sequencing data.
CO-2: Appreciate mathematical and algorithmic concepts for whole genome and exome assembly, both reference-based and de novo and learn to carry out the analysis on real data.

CO-3: Identify different types of variations in NGS data, viz., small sequence variations, copy number variations, insertions and deletions, inversions and translocations, and annotate the variants.
CO-4: Perform differential gene expression analysis using NGS data
CO-5: Use judiciously different tools and databases for end-to-end analysis of NGS data.

The course provides in-depth hands-on analysis of NGS data using various publicly available resources and prepares the student for his research.

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

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

4.Detailed Syllabus:

Unit 1: Workflow of NGS data analysis, Types of reads - single-end, paired-end, mate-pairs Sequencing technologies – Illumina, SOLiD, 454 - read lengths, accuracy, biases introduced, etc. Applications of NGS sequencing - RNA-Seq, De novo sequencing, non-coding RNA sequencing, bisulphite sequencing, metagenomics by NGS, etc.

Unit 2: Introduction to some basic Unix/Linux/R commands, NGS Data Formats - FASTA, FASTQ, SFF, VCF, SAM/BAM, etc., Parsing NGS Files (Accessing, Querying, Comparing, etc.)

Unit 3: Algorithms in Short Read Alignments. Alignment based assembly – Bowtie, BWA, De novo assembly – de Brujin graph. Tools for alignment based assembly - Bowtie (genome), BWA (genome), HISSAT (transcriptome)

Unit 4: Downstream analysis of alignment based assembly. Methods for identification of variants (genome-level), Data-preprocessing, Data pretreatment, Data analysis for Single nucleotide variations (SNVs), Structural variations (SVs) - CNVs, indels, inversions and translocations,

Visualization and Annotation of variants, Differential gene expression analysis (CuffDiff) – (transcriptome-level)

Unit 5: Tools for de novo assembly - Velvet (genome), Soapdenovo (genome), Cufflinks (transcriptome). Downstream analysis of de novo assembly - Genome annotation, Enrichment analysis

Unit 6: Small RNA analysis

Reference Books:

1. Research Papers (to be uploaded on course website)
2. Algorithms for Next Generation Sequencing, Wing-Kin Sun
3. https://en.wikibooks.org/wiki/Next_Generation_Sequencing_(NGS)

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

The course will provide the skills to perform comprehensive genome analysis using next generation sequencing data, both at the whole-genome level (WGS) and transcriptome-level (RNAseq). A major component of the course is hands-on-sessions, wherein various publicly available resources will be used to carry out the analysis on real genome/transcriptome data to address biological problems. The course structure will be one theory lecture followed by one lab session. The course also has a project component wherein the students will carry an end-to-end

genome analysis using NGS data for a biological problem and submit a term paper on some recent application of NGS data analysis.

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

Assignment - 15%
Term paper + Project - 15%,
Mid semester exams - 20%
End semester exam - 50%

Title of the Course: Numerical Algorithms

Name of the Faculty : Pawan Kumar

Course Code:

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 able to...

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: 02)

Unit 1: Polynomial interpolation. Numerical differentiation and integration. (Lectures: 03)

Unit 2: Numerical Linear Algebra: Algorithms for LU, QR, SVD, Iterative methods for large sparsematrices, Tensor Decompositions. Applications to quantization and image processing. (Lectures:04)

Unit 4: Basic Optimization Problems: Convex Sets, Convex Functions, Linear, Quadratic, Semi-definite, and Conic Program. Introduction to Min-Max problems. Applications to planning, finance, image completion. (Lectures: 02)

Unit 5: Numerical Solutions to Differential Equations: Finite Difference Method for Diffusion Equation. Preconditioning. Applications. (Lectures: 02)

Textbook Books:

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.)[ripped by sabbanji] (cern.ch) (For Unit-2, and some Unit-5)

Reference Books:

1. A. Greenbaum & T. P. Chartier, Numerical methods, Princeton University Press, 2012.
2. Numerical Optimization, J. Nocedal, S. J. Wright, S. Wright, 1999.
3. Introduction to Linear Algebra, Gilbert Strang.

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

This course aims to bridge the gap between various linear algebra, calculus concepts, and how they are implemented in practice keeping in mind numerical issues and instability of numericalschemes.

Lectures will initially introduce the motivations, concepts, definitions along with simpler examples. Lectures will develop numerical analysis tools to keep track of numerical accuracy of the numericalalgorithms learnt.

Tutorials will be held every week to clarify doubts and to discuss solutions to assignment and examproblems. The assessment involves assignments and quizzes every week that will make sure that the students have understood the concepts.

The lectures also motivate some real-world applications of numerical techniques and optimizationin the area of image processing and industrial problems of planning or scheduling via optimization.

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

- Assignments: 30%
- Class Test 1: 30%
- Mid Exam: 40%

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 2024

PRE-REQUISITE **:** Strict Prerequisites: NIL

EXPECTED BACKGROUND:

To follow this course, some level of familiarity with linear algebra (specially, vectors and matrices) is expected. In addition, student is expected to know the fundamentals of algorithms and some of the popular problems (eg. shortest path.)

OBJECTIVE:

1. To enable students to formulate and solve problems in an optimization framework.
2. To expose a set of powerful tools and techniques to the students. To demonstrate how these tools (i.e. optimization methods) can be used in practice.
3. To visualize the optimization algorithms and know the numerical and practical issues in their implementation.
4. To relate the optimization methods to applications in diverse areas.

COURSE TOPICS :

1. CO-1: Linear Programming, Geometric Interpretation, SimplexMethod, Duality, primal dual method, Interior point methods, Ellipsoidal methods, Computational Issues.
2. CO-2: Integer programming, LP relaxation, Examples from combinatorial optimization. Shortest paths, network flows and matchings.
3. CO-3: Convex sets and functions. Need for constrained methods in solving constrained problems.
4. CO-4: Unconstrained optimization, Optimality conditions, Gradient Descent, Newton Method, Quasi- Newton Methods, Trust Region Methods. Conjugate Gradient Methods. Least Squares Problems.
5. CO-5: Constrained Optimization, Optimality Conditions and Duality. Convex Programming Problem. Quadratic Programming. Dual Methods, Penalty and Barrier Methods, Interior Point Methods.
6. CO-6: Linear Equations, Solutions based Matrix Factorization, Singular Value Decomposition,
7. CO-7: **Additional topics** (if time permits) related to
    1. Specific Algorithms (eg. Cutting plane algorithms, Stochastic gradients)
    2. Applications in Approximate Algorithms
    3. Computational issues in large scale optimization
    4. Heuristic methods for optimization

PREFERRED TEXT BOOKS:

1. S. Boyd and L Vandenberghe, ``Convex Optimization'', Cambridge University Press (Online Copy available at: http://www.stanford.edu/~boyd/cvxbook/).
2. L Vandenberghe, Lecture Notes for Applied Numerical Computing, (Online available at: http://www.ee.ucla.edu/~vandenbe/103/reader.pdf).
3. Edwin K. P. Chong, Stanislaw H. Żak, Introduction to Optimization, Fourth Edition, Wiley-Interscience Series in Discrete Mathematics and Optimization, John Wiley & Sons.

REFERENCE BOOKS:

1. M T Heath, ``Scientific Computing'', TMH (Most of First six chapters)
2. C H Papadimitriou and K Steiglitz,Combinatorial Optimization: Algorithms andComplexity'' (Most of First seven chapters), Dover.
3. D Bertisimas and J N Tsitsiklis, ``Introduction to Linear Optimization'', Athena Scientific.
4. J Matousek and B. Gartner, ``Understanding and Using Linear Programming'', Springer, 2007.

OUTCOME:

This course will help in sharpen the problem solving skills of students. Students will have experience informally stating problems with the associated constraints, and solving them with computer friendly algorithms.

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

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

CO4	3	3	3	3	3	-	-	-	2	2	2	2	3	3	3	3
CO5	3	3	3	3	3	-	-	-	2	2	2	2	3	3	3	3
CO6	3	3	3	3	3	-	-	-	2	2	2	2	3	3	3	3
CO7	3	3	3	3	3	-	-	-	2	2	2	2	3	3	3	3

GRADING PLAN:

Type of Evaluation	Weightage (in %)
Small Quizzes (10 quizzes)	10%
Mid-Sem Exams (2)	30%
End Sem Exam	20%
Assignments	25%
Term Paper/Project	10%
Scribe	5%

Title of the Course : Organic Chemistry

Name of the Faculty : Prabhakar Bhimalapuram
Name of the Academic Program : CND
Course Code : SC2.202
L-T-P :3-1-0
(L= Lecture hours, T=Tutorial hours, P=Practical hours)

Credits : 2

1.Prerequisite Course / Knowledge: NA

2.Course Outcomes (COs) (2 credit course):

CO1: Explain various mechanisms of structural stability of organic compounds and their reactivities
CO2: Apply the mechanisms to describe types of reactions using stability of reaction intermediates
CO3: Analyze the outcomes of different organic reactions using the principles of structure and stability of reactants and intermediate compounds

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

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

4. Detailed syllabus

Concepts on structures, stabilities and reactivities

Unit 1: Reactive intermediates: Formation, structure, stability and fate of various reactive intermediates (Carbanion, carbocation, carbenes, nitrenes, benzynes, free radicals) – Reactive intermediates in biology and environment

Unit 2: Concepts of aromaticity

Unit3: Molecular symmetry and chirality, Stereoisomerism, Classification of stereoisomerism, configuration, chiral centre, Axial chirality, planar chirality, helicity, Racemization and methods of optical resolution, Determination of configuration, Conformation of acyclic and monocyclic molecules-conformation and reactivity, Prochirality and prostereoisomerism, Stereochemistry of alkene, Chirality in molecules devoid of chiral centers, Chirooptical properties. Some reactions and their mechanisms

Unit 4: Methods for determining structures and reaction mechanisms

Unit 5: Types of reactions and their mechanisms Radical substitution Electrophilic addition to alkenes and alkynes – stereochemical considerations – Markonikov rule Nucleophilic Substitution at saturated carbons (SN1, SN2 and SNi): Types, stereochemical considerations, Role of solvent Nucleophilic addition to the Carbonyl group Elimination reactions: Types (E1, E2 and E1cB) - stereochemical consideration, Role of solventHofmann rules- Zaytsev Rules Nucleophilic substitution at the carbonyl group Electrophilic Aromatic Substitution: Benzene and its reaction with electrophiles- Effect of functional groups Nucleophilic Aromatic substitution: Diazonium compounds-benzyne mechanism Pericyclic reactions: Electrocyclic reactions, Cycloadditions, Sigmatropic rearrangements and Group transfer reactions Important name reactions involving rearrangements Functional group wise reactions Conversions and Identifications.

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

The objective of the course is to familiarize the CND students with basic concepts of organic reaction mechanisms. Since organic reactions are wide spread in natural biological systems as well as their applications in various industries, understanding the mechanisms is crucial. The course would provide the students with tools to analyze outcomes of organic reactions. It will further help them to learn the numerical analysis of molecular reactions later.

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

Assignments – (20%), Class Quizzes + Mid-term evaluation (40%), Final exam (40%)

Reference book

A Guidebook to Mechanism in Organic Chemistry by by Peter Sykes

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Title of the Course : Organizational Operations

Faculty Name : Santanu Mandal

Name of the Program : M. Tech in Product Design and Management program

Course Code : PD2.423

Credits : 2 Credits

L - T - P : 1.5 -0- 3

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

Semester, Year : 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 - Lecture hours, T-Tutorial hours, P - Practical hours)
2-0-0
Semester, Yea : Spring 2024

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 in different computer systems suchas data networks, server farms and cloud computing platforms.
2. Apply Markov chains to model and a variety of computer systems and analyze theirperformance metrics like response time, waiting time or job loss probability.
3. Derive expressions for the average delay or average number of jobs waiting for service ina 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, processorsharing and random routing on the performance of queues.
6. Identify causes for performance degradation (large latency problem) in queueing systemsand offer easy scalable solutions

Course Topics : Following is the tentative list of topics to be covered in this coursein about 12 lectures. (Each lecture is of 90 mins.)

Module 1: (2 lectures)

- Motivation to Performance modeling (Modeling = Design + analysis)
- Probability refresher
- Basics of Stochastic processes

Module 2: (2 lectures)

- Discrete time Markov chains
- Continuous time Markov chains

Module 3: Elementary Queues (2 lectures)

- M/M/1 queue
- Loss queues
- Little's law and PASTA property

Module 4; Server-farms and networks (3 lectures)

- Multi-server queues
- Network of queues
- load balancing systems
- Applications to data centers, cloud computing and distributed systems

Module 5: Scheduling and resource allocation in computer systems (3 lectures)

- M/G/1 queues
- Performance analysis of FIFO,round-robin, processor sharing, LCFS
- SMART scheduling policies

Preferred Text Books : Performance modeling and design of computer systems (Cambridge press) by Mor Harchol-Balter (Professor, CMU)

Reference Books : 1) Probabilistic modeling by Isi Mitrani

2) Queueing Systems (vol 1 and 2) by Klienrock

E-book Links : NA

Grading Plan :

(The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz-1	15
Mid SemExam	30
Quiz-2	15
End Sem Exam	40
Assignments	0 0
Project	0
Term Paper	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

	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 O 4
C O1	3	3	3	2	1	1	2	1	1	1	1	2	3	2	3	3
C O2	3	3	3	2	2	1	2	1	1	1	1	2	3	2	3	3
C O3	3	3	3	2	2	1	2	1	1	1	1	2	3	2	3	3
C O4	3	3	3	2	1	1	2	1	1	1	1	2	3	2	3	3
C O5	3	3	3	2	1	1	2	1	1	1	1	2	3	2	3	3
Co6	3	3	3	2	2	1	2	1	1	1	1	2	3	2	3	3

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

- The course is planned to be a fine balance between theory and practice.
- Traditionally, this course has been a theory intensive course with little emphasis on practical applications. We will however flip this around.
- We will introduce theoretical mathematical concepts on a need to knowbasis or as and when required.
- The emphasis will be to look at plenty of practical examples of queueingsystems that we encounter not just in our daily lives but also see in advanced computing systems.
- The goal is not only to design queueing systems that offer better performance guarantees but also to be able to analyze such systems soas to fine tune or control them.
- The 12 lectures are meant to be very interactive, there would be lot of discussion and exchange of ideas on the design aspect of queueing systems.
- As for the analysis, ample practice problems and practice assignmentswould be provided to gain 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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
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
CO4	2	2	2	2									2	1	2	2
CO5	2	3	2	3									3	2	2	2
CO6	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. <u>Assessment methods and weightages in brief</u> (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

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 2024)

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).

<u>2. Course Outcomes (COs)</u>

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3	PSO4
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
CO4	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:
Credits **:** 4
L-T-P **:**3-0-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year **:** Spring 2024
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 2024

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:

- MA 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 their own 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	**: 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 2024

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 Vovchokand Maxim Gorky envisaged and pushed for a transformation of the entire social order, fighting more particularly for the rights of serfs and the workingclasses. Others such as Elena Gan, Maria Zhukova, Nadezhda Khvoshchinskaya, Karolina Pavlova, and Olga Shapirnot only engaged with and represented the concerns their male colleagues were preoccupied with, butalso 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 andmilieu; 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 philosophythrough 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 issuessuch 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. **ZinaidaVolkonskaya:**"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**	**PO1 0**	**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.

Title of the Course : Remote Sensing

Faculty Name : Ramachandra Prasad P
Course Code : HS1.302
Credits : 4 credits
L - T - P : 3 – 1 – 0
(L= Lecture hours, T=Tutorial hours, P=Practical hours)

Semester, Year : Spring 2024

1. <u>Prerequisite Course / Knowledge</u>:

Basic Physics and computational knowledge.

<u>2.Course Outcomes (COs)</u>

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

CO-1: Explain the processes of 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

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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O1	PSO 2	PSO 3	PSO 4
CO	1	1	2	1	2	1	1	1	1	1	1	1	2	2	2	2

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

4. <u>Syllabus</u>:

Unit-1: Introduction to Remote sensing

What is remote sensing? Earth Observation Satellites and Platforms (Evolution of platforms, sensors, satellites, national and international sensors) Sensor and its characteristics – Classification; Remote sensing instruments, passive-active, imaging-non imaging, OIR-Microwave, framing-scanning, mechanical-push broom; Aerial photographs-satellite image; types of resolutions and their trade-off

Unit-2: Physics of Electro Magnetic Radiation (EMR)

EMR properties/characteristics-wave model-particle model; Radiation laws applicable to remote sensing: EMR interaction with Atmosphere and Earth materials: EMR interactions with atmosphere, atmosphere structure, Atmosphere blinds – windows; Absorption-scattering mechanism- types; EMR interactions with earth surface material-Specular - Diffuse; Albedo

Unit-3: Data acquisition and image characteristics

Data creation at sensor level – telemetry- ground station acquisition: Data products: Special

Products –Processing software, Image characteristics, and FCC creation-types. Additional

ways of Acquiring data in Non-optical or near Optical Image processing

Unit-4: Image pre-processing

Image restoration- Atmosphere errors, correction-methods; Correcting geometric distortions – Types of errors, Spatial and pixel interpolation (types), map projections and types: Image Enhancement - Contrast and Spatial enhancement, Hue, Intensity, and Saturation transformations, Density slicing.

Unit-5: Information extraction

Multispectral classification – Visual Interpretation-Digital classification –Unsupervised, supervised; other classifiers –Deep learning methods, Fuzzy logic, Decision tree (basic level); post classification smoothing, Ground truth, accuracy assessment. Object based image classification, difference between per pixel and object-based classification. PCA; Image arithmetic, Change detection methods, State of the Art – Geo-AI.

Unit-6: Major applications of remote sensing

Vegetation / Terrestrial ecology/wildlife; Hydrology/Land, use / Land cover /Agriculture; Disaster management; Oceanography

Unit-7: Overview of Advanced topics

Drone imagery – Ultra high resolutions (cm level data); Hyperspectral and thermal (near optical); 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; Research papers presentations by students on chosen topic and written assignments, periodical evaluation of course project implemented with open data and tools; applying remote sensing satellite imagery in different domains, develop an open-source tool as part of project or revise algorithms for feature extraction or for any image processing method.

6.Assessment methods and weightages in brief:

1. Assignments **- (20%)**

2. Quiz and Mid exam - (**25%**)

3. Project **- (25%)**

4. End Semester Exam **- (30%)**

PROJECT: Development of open-source tools, replication of case studies or working on new problem using open geospatial data and algorithms or any application or improvement of existing algorithms in processing and feature extraction from satellite data

Title of the Course : Research Methods in the Human Sciences

Faculty Name : Anirban Dasgupta + Isha Dubey
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 2024
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 **: XXXXXXXX**
Credits **: 4**
L - T - P **:**3-0-1
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year **: Spring, 2024**
Pre-Requisites **:None**

Recommended courses: SMAI/Intro to NLP/CV

Course Outcomes :

- C0-1: Students will recognize possible harms that can be caused by modern AI capabilities
- C0-2: Students will learn to reason about various perspectives on the trajectory of AI development and proliferation
- C0-3: Students will learn about latest research agendas towards making AI systems safer
- C0-4:Students will be able to design and run experiments for understanding capabilities of current AI systems.
- C0-5: Students will conduct, develop, and practice the techniques needed to make AI systems safer through course project.

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

Module 1: Introduction to AI Capabilities and Risks

- AI Capabilities Improvement in last 5-10 years
- Recap of Deep Learning Techniques, Language/Vision Models (through Tutorials)
- Imminent risks from AI Models: Toxicity, bias, goal misspecification, adversarial examples etc.
- Long-termrisks from AI Models: Misuse, Misgeneralization, Rogue AGI
- Overview of Techniques covered in course: Interpretability, Fairness, Robustness etc.
- Why study this course? Impact, Career Opportunities etc.
- Boosting Productivity with ChatGPT/Bard (Tutorial)
- Primer on instruction tuning, prompt fine-tuning and RLHF (Tutorial)

Module 2: Adversarial Robustness

- Tail risks
- Adversarial Attacks – Vision, NLP, Superhuman Go agents
- ML Poisoning Attacks like Trojans
- Implications for current and future AI safety
- Tutorials + Assignment on implementing adversarial attacks and defenses

Module 3: Transparency

- Imminent and Long-term potential for transparency techniques
- Mechanistic Interpretability
- Representation Engineering, model editing and probing
- Critiques of Transparency for AI Safety
- Tutorials + Assignment on applying various techniques

Module 4: Artificial General Intelligence

- What is AGI? When could it be achieved?
- Emergent capabilities
- Instrumental Convergence: Power Seeking, Deception etc.
- Goal misgeneralization
- Scalable Oversight

Module 5: AI Governance and Career Opportunities

- Risks from AI Misuse
- Technical Solutions for Governance
- AI taking over jobs
- Difficulties in Designing and Enforcing AI regulation
- Next steps for getting involved with Safety Research, Career Opportunities
- Visions for a post-AGI society

Inspired from the following courses:

1. **https://course.aisafetyfundamentals.com/alignment**
2. **https://course.mlsafety.org/**
3. Princeton AI Safety - https://sites.google.com/view/cos598aisafety/?pli=1

Textbook: All content (slides, papers, reports) for the course will be shared during the course.

Grading Plan :
(The table is only indicative)

Type of Evaluation	Weightage (in %)
Quizzes	20.0
Assignments + Activities	30.0

Project report + Blog + Video	20.0 [12 + 4 + 4]
Project	30.0
Total	**100**

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

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

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

Learning

- Lectures
- Reading research papers and blogs
- Class participation: questions, discussions
- Online discussion: Teams
- Guest lectures

Learning by doing

- Course project
- Real world implementation

POTENTIAL GUEST LECTURES:

1. Neel Nanda, Google DeepMind
2. Arun Jose, Independent Researcher
3. Prof. Ravi Balaraman, IIT Madras
4. Daniel Paleka, PhD Student, ETH Zurich
5. Dr. Adam Gleave, CEO FAR AI
6. Dr. Dan Hendrycks, Director of Center for AI Safety
7. Dr. Ethan Perez, Research Scientist, Anthropic

8. Prof. Vincent Conitzer, Carnegie Mellon University

RELATION TO EXISTING IIIT COURSES:

1. Fairness, Privacy and Ethics by Prof. Sujit Gujar – Our course is about potentially catastrophic harms from modern AI like misuse, deception, toxicity etc. We will not cover fairness, privacy, inequity concerns.
2. Values, Ethics and AI by Prof. Shatrunjay Rawat – This course focuses on human values and how they should be kept in mind while designing technology like AI. Our course will only explore this in the inverse sense, how can we make sure future AIdon't violate human values.

Title of the Course : Robotics: Planning and Navigation

Faculty Name : Madhava Krishna K
Course Code : EC4.403
L-T-P : 3-1-0
Credits : 4
Name of the Academic Program:B. Tech. in ECE, BTech in CSE

Prerequisite Course / Knowledge:

Computer Programming, Data Structures and Algorithms. Knowledge of Functional Optimization is a plus.

Course Outcomes (COs):
After completion of this course successfully, the students will be able to..
CO-1 :Demonstrate familiarity with different paradigms in robotic motion planning
CO-2: Analyze robotic planning algorithms in the context of navigating in an environment to accomplish a goal
CO-3: Explain the significance of mathematical frameworks of functional optimization as well as robot kinematics in robotic planning and navigation tasks.
CO-4: Apply principles of functional optimization and robot kinematics to propose analytical frameworks, algorithms for solving real world problems in robotic motion planning, navigation.
CO-5: Create and Simulate the algorithms using state of the art software and libraries and evaluate its performance on specified tasks

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

	PO1	PO2	PO3	PO 4	PO5	PO 6	PO7	PO 8	PO 9	PO 10	PO1 1	PO1 2	PS O1	PS O2	PS O3	PS O4
CO1	3	2	1	1	1	1	1	2	2	1	1	2	1	1	1	2
CO2	3	3	1	2	1	1	1	2	2	1	1	1	1	1	1	2

CO3	2	3	1	2	1	1	1	2	2	2	1	2	1	1	1	3
CO 4	3	2	3	2	2	1	1	2	2	2	1	3	1	1	1	3
CO5	2	2	3	2	3	1	1	2	3	3	3	3	1	1	1	3

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

Detailed Syllabus:
Unit 1: Classical AI Based Planning and its Limitations
Unit 2: Sampling Based Kinematic Planners, Trajectory Optimization
Unit 3: Model Predictive Control and Velocity Obstacles for Dynamic Scenes
Unit 4: Uncertainty Modelling, Planning under Uncertainty
Reference Books:

1. Trajectory Planning for Automatic Machines and Robots by Luigi Biagiotti · Claudio Melchiorri
2. Introduction to Robotics: Mechanics and Control by John J Craig

Teaching-Learning Strategies in brief (4 to 5 sentences):
Classes invoke rich graphical content in the form of images, representations, videos to elucidate difficult concepts in robotic motion planning. Code walkthroughs, simulation of algorithms used to enhance understanding. Learning by doing, coding and simulation is highly promoted and encouraged. Students understand difficult mathematical concepts and abstraction by coding it using state of the art software, simulation frameworks, libraries and solvers.

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

- Programming Assignments: 50%
- Mid Sem : 20%
- End Exam: 30%

Title of the Course : Science &Technology : Critical perspectives

Name of the Faculty : Saurabh Todariya
Course Code : HS0.207
L-T-P : 3-1-0.
Credits : 2
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Academic Program: CHD

1.Prerequisite Course / Knowledge:
None
2.Course Outcomes (COs) :
After completing this course successfully, the students will be able to
CO-1 Explain diverse perspectives on **Science & Technology with an ethical scrutiny.**
CO-2 Demonstrate understandingof how science and technology have differential effects on different sections of society.
CO-3 Apply their knowledge to critically and ethically evaluate applications of science and technology to social problems.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1																
CO2																
CO3																
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: The problem of knowledge and science as an episteme; the nature of technology

Unit-2: Deterministic nature versus social construction of science and technology; differential effects on different sections of society

Unit-3: General critique of science - feminist critique, post-modern critique, etc.

Unit-4: Specific instances of ethical violations - abuse of science and technology, illustrations from biotechnology, technology of war, etc.

Reference Books:

1. **Maurizio Iaccarino, Science and ethics, EMBO Rep. 2001 Sep 15; 2(9): 747–750** https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1084045/ **(and references therein)**
2. **R. Volti, Society and Technological Change, Worth Publishers, NY, USA, 2009**

5.Teaching-Learning Strategies in brief :

Interactive class room teaching, multiple quizzes; enciuragement for brief student presentations.

6.Assessment methods and weightages in brief :

Assignments: 30%,
Class Quizzes : 20%,
End Semester: 40%
Term Paper : 10%

A jump in grade will be awarded for an exceptional term paper. Plagiarism of any degree will invite a 'F' grade with no discussion.

Title of the Course **:** Science II
Faculty Name : Chittaranjan Hens + Nita Parekh
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

Forthe First Half (Computing in Sciences):

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

CO2	3	3	1	2	3	2	2	2	2	2	2	2	3	3	3	3
CO3	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, Technology and Society**
Faculty Name	**: Radhika Krishnan**
Course Code	**:** HS7.301
L-T-P	**:** 3-0-0
(L= Lecture hours, T=Tutorial hours, P=Practical hours)	
Credits	**:** 4

Name of the Program **:**B.Tech in Computer Science and M.S. in Computing and Human Sciences by Research

1.Prerequisite Course / Knowledge: Thinking and Knowing in the Human Sciences I and II (For students in the CHD program); or Intro to Sociology, Intro to Politics, Intro to Philosophy.

2.Course Outcomes (COs)

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

CO-1:

Students will have a working knowledge of the key methodological and theoretical frameworks,key debates and contributions of scholarswithin STS.

CO-2:

Students will understand the various approaches within the broad domain of the social construction of science.

CO-3:

Students will learn about how technology shapes and in turn shaped by social, economic, political and cultural factors. They will understand various theories and methods under the broad rubric of the social construction of technology, and will be exposed to the debates between technological determinism and social construction of technology.

CO-4:

Students will be encouraged to identify values embedded in technical systems, and the potential as well as limitations of human and non-human agency.Students will have the conceptual ability to analyse various aspects of the society-technology interface.

CO-5:

CHD students will be able to think more deeply about confluence between the social sciences and the digital world of computing. This will help them think about possible research approaches and questions which they can later pursue.

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

	PO 1		PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	1		3	3	3	1	3	3	3	1	1	1	3	1	1	3	3
CO 2	1		3	3	3	1	3	3	3	1	1	1	3	1	1	3	3
CO3	1		3	3	3	1	3	3	3	1	1	1	3	1	1	3	3
CO 4	1		3	3	3	1	3	3	3	1	1	1	3	1	1	3	3
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 : Software Engineering
Faculty Name : Karthik Vaidhyanathan
CourseCode :CS6.401
L-T-P : 3-0-1
Credits : 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)

1. Prerequisite Course / Knowledge:

Students must have taken Intro to Software Systems, Design and Analysis of Software Systems or Equivalent courses

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

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

CO-1: Demonstrate familiarity with various process models, design patterns, architecture patterns and the characteristics of good software architectures

CO-2 Apply principles of user interface design, sub-system design and analyze the designs for good Software Engineering principles

CO-3: Demonstrate the use of tools to quantitatively measure and refactor existing software systems

CO-4: Compare design trade-offs between different patterns and/or different implementations of the same pattern

CO-5: Design the major components and user interface for a small-scale software system using modeling approaches such as UML class diagrams, and sequence diagrams

CO-6: Critique the quality of a software design and use product quality metrics to assess the quality of delivered software

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

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

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

4. Detailed Syllabus:

Unit 1: Software Development Lifecyle and importance of architecture and design in the lifecycle, Process models; Modeling using UML.

Unit 2: Anti-patterns; Metrics and Measurement; Reverse Engineering and Refactoring.

Unit 3: Design Principles and Classification of Patterns

- Structural patterns: Adapter, Composite, Façade, Proxy, Decorator
- Behavioral patterns: Iterator, Observer, Mediator, Command, Memento, State, Strategy,
  Chain of Responsibility
- Creational patterns: Abstract Factory, Builder, Singleton, Factory Method

Unit 4: Software architecture and Architectural business cycle; Quality attributes and Tactics for achieving attributes; Architectural styles and Techniques; Designing Architectures, Case studies.

Reference Books:

1. Design Patterns: Elements of Reusable Object- Oriented Software. E. Gamma, R. Helm, R. Johnson, and J. Vlissides. Pearson, 2015, ISBN-13 : 978-9332555402
2. Refactoring: Improving the Design of Existing Code. Martin Fowler. Addison-Wesley, 2018. ISBN-13 : 978-0134757599
3. Software Architecture in Practice, 3rd edition by Len Bass, Paul Clements and Rick Kazman, Addison- Wesley, 2012. ISBN-13 : 978-9332502307

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

The course is delivered using project based learning methodology. Topics like software subsystems modeling, design analysis, design trade-offs, language agnostic designs and component-based software development are taught and reinforced via unit level projects. The lectures emphasize the study and development of software sub-systems, comprehension and analysis of design quality attributes. The focus is on application of these concepts to concrete

design problems through in-class design exercises and analysis of existing designs of currently implemented software systems. Entire class is run in a studio mode to facilitate discussion between student teams and discuss design trade-offs among students within student teams. Students present their designs and implementations to other students who are expected critique the designs.

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

Final Exam	22 %
Mid-term Quiz	12 %
Unit Questions	12 %
3 Unit Projects (2 * 17) + (1 * 10)	44 %
Other In-class Activities	10 %

Title of the Course : **Software Programming for Performance**
Faculty Name : Suresh Purini
Course Code : CS3.302
L-T-P : 3-1-0
Credits : 2(Half semester course)
(L=Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Academic Program: B-Tech in Computer Science and Engineering

1. Prerequisite Course/Knowledge

Basics of Algorithm Analysis, Computer Architecture

2. Course Outcomes (COs)

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

CO-1. Explain the algorithmic optimizations necessary to improve the performance of a software on a uniprocessor.
CO-2. Analyze cache dependent performance of algorithms
CO-3. Employ cache-aware (such as tiling)/cache oblivious (such as recursive multiplication) optimizations to improve program performance
CO-4. Analyze the software performance improvement using SIMD Array Processing and Vector Processing Architectures
CO-5. Explain different concurrency platforms such as Pthreads, Threading Building Blocks.
CO-6. Develop multicore programs using OpenMP pragmas
CO-7. Explain the basics of GPU architecture

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	PSO1	PSO2	PSO3	PSO4

CO 1	1	1	-	1	-	-	-	-	-	2	-	3	1	1	1	1
CO 2	3	3	-	3	1	-	-	-	-	1	-	3	3	3	1	3
CO 3	3	1	-	2	-	-	-	-	3	1	-	3	3	1	1	1
CO 4	3	3	-	3	1	-	-	-	-	1	-	3	3	3	1	3
CO 5	1	1	-	1	-	-	-	-	-	2	-	3	1	1	1	1
CO 6	3	2	-	2	3	-	-	1	3	1	-	3	3	2	2	3
CO 7	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

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Title of the Course : Spatial Data Science

Faculty Name : K S Rajan
Course Code : CS4.410
Credits : 4
L - T – P : 3-1-0
(L - Lecture hours, T-Tutorial hours,
P - Practical hours)
Semester, Year : Spring 2022
(Ex: Spring, 2022)
Name of the Program : Open to All Programs on Campus at UG, PG/PhD Level

Pre-Requisites : Basic understanding of Locational Data and Computing – Any UG3,UG4, M.Tech., MS, and Ph.D. student should be able to take it.
Prior course work in Spatial Informatics may help.

Course Outcomes :

CO-1: Describe how Spatial Data Science helps uncover patterns
CO-2: Apply Geospatial techniques to Prepare the data for analysis
CO-3: Analyze the spatial and temporal data and interpret its outcomes
CO-4: Assessment of application of Spatial data science in key domain areas
CO-5: Design research projects that helps synthesize the learning into an application

Course Topics :

Module 1: Introduction to Spatial Data Science
- What is special about Spatial Data and Geo-AI?
- How Spatial and Spatio-temporal Big Data helps uncover patterns?
- Spatial Data Handling including spatial data models, data formats
- Challenges to computing approaches when applied to Spatial Data – Effectsof Topology

Module 2: Geospatial Data Analysis and Modelling
- Vector Data Spatial Analysis
- Raster Data Spatial Analysis

- How to use temporal data in conjunction with Spatial data
- GeoSpatial Data

ModellingModule 3: Spatial Sciences

- Spatial Statistics including Spatial auto-correlation, Spatial tessellation
  - o Data Mining applications on Spatial data including Spatio-temporalData Mining
- Network Analysis and Graph theory

- Few relevant topics from Computational Geometry
- Geovisualization – Maps to

WebGISModule 4: Spatial Classification and Prediction

- Spatial decision trees
- Machine learning as applied to Spatial Data including Spatial-aware NeuralNetworks
- Hotspot Analysis
- Spatial Outliers detection

Module 5: Applications of Spatial Data Science

- Public Health – monitoring and mapping diseases, risk analysis and diseasespread modelling
- Agriculture – crop growth monitoring, crop yield patterns and resourceconstraints
- Location based services – routing applications, ride-sharing algorithms,optimal location

Preferred Text Books :

1. Spatial Computing, By Shashi Shekar and Pamela Vold. The MIT Press. 2020
2. GIS – A computing perspective. By Micheal Worboys and Matt Duckham. CRC Press;2nd edition 2004
3. Spatial Databases: A Tour. By S. Shekhar and S. Chawla, Prentice Hall, 2003, ISBN013-017480-7 .
4. Selected Research Papers and Articles (will be shared with the topics taught on thecourse portal)

Reference Books :

1. Geographical Data Science and Spatial Data Analysis - An Introduction in R. By LexComber and Chris Brunsdon. SAGE Publications Ltd. 2020

E-book Links : Will be provided in Class as appropriate

Grading Plan :

Type of Evaluation	Weightage (in %)
Class Quizzes	**15.0**
Mid Sem Exams – 2	**20.0**
End Sem Exam	**30.0**
Paper reviews and	**10.0**

Presentations byeach Student in Class	
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 : Statistical Mechanics
Name of the Faculty : Bhaswar Ghosh
Course Code : SCI. 205
L-T-P : 2(90mins)-1-0
Credits : 2
(L= Lecture hours, T=Tutorial hours, P=Practical hours)

Name of the Academic Program: B Tech (CND)

1.Prerequisite Course / Knowledge: Thermodynamics, elementary classical and quantum mechanics

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

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

CO-1 State principles of ensemble theory applied to statistical physics
CO-2 Apply statistical mechanics to investigate natural systems
CO-3 Apply scientific methodology to problems in allied disciplines.

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

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

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

4.Detailed Syllabus:
Unit 1: 1. The purpose of statistics: Bridging the micro and the macro, random walk, binomial distribution and the Gaussian limit: 1L
2. Ensemble, micro-canonical, canonical and grand canonical; Partition function, Lagrange multiplier technique to obtain the Boltzmann distribution: 2L
Unit 2: 3. Statistical expressions for thermodynamic functions for monatomic, diatomic and polyatomic perfect gases, equilibrium constant using partition function: 2L
4. Classical statistical mechanics, Liouville equation, Equipartition of energy: 1L
Unit 3: 5. Identical particles, Quantum statistics - Fermi-Dirac and Bose-Einstein statistics: 2L
6. Special topics (Real gases, Liquids, Lattice dynamics, Ising spins, etc.): 3L

Reference Books:

1. D. A. McQuarrie (2000), Statistical Mechanics, University Science Books, Paris
2. P W Atkins (2018), 11th Ed.Physical Chemistry, Oxford University Press, London
3. F Reif (2017), Fundamentals of Statistical and thermal Physics,(Berkeley Physics, vol. 5), McGraw Hill Education, NY

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

Teaching currently is on line. Along with prepared slides, tools are used to write material extempore and draw pictures to explain the material.
Assignments are open for discussion before submission, though submission must be original. Class exercises are used for effective learning.
Instructor is available 24X7 for discussions over the net either by a meeting or over email. This interactive process has helped the students to develop clarity on the learning material.

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

Quiz	**25%**
Final Exam	**55%**
Assignments (4)	**20%**

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Title of the Course : Statistical Methods in Artificial Intelligence

Faculty Name : Vineet Gandhi
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 : System and Network Security

Faculty Name : Ankit Gangwal
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, 2024

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)
Semester, Year : Spring 2020 & S21
Name of the Program : Technology product entrepreneurship-
Pre-Requisites **: No prerequisites**
Course Outcomes :

This course introduces the fundamentals of technology product entrepreneurship. You will learn the process of building a technology enterprise in a workshop format. Starting from a technology idea, mapping the idea to a high-potential commercial opportunity, defining/designing/validating the product, figuring out the market avenues & how to sell the product, and planning/managing rapid growth.

The class will apply the learning to their tech product ideas and create a venture able product & plan; in a workshop mode thru extensive hands-on assignments concurrent with course modules.

CO1-Understand how to evaluate product ideas and assess the market opportunity in real-time, along with learning from current scenarios.

CO2-Connect products with markets and identify market & customer segments with the help of frameworks and business models.

CO3-Assess competition and evolve Value proposition for the product in cognisance of the current market trends and ever-evolving customer needs.

CO4-Be able to put a complete business plan for a technology product, after analysing the markets and building a GTM strategy.

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

https://iiitaphyd-my.sharepoint.com/:w:/r/personal/dyacad_iiit_ac_in/Documents/NBA-2020-21/Course%20Content/IIIT-CSE-ECE.docx?d=w111f0effcaea41b3a4d1e8a3fbc6332d&csf=1&web=1&e=z1Khby

PreferredTextBooks:
High Tech Start Up, Revised and Updated: The Complete Handbook For Creating Successful New High Tech Companies by John L. Nesheim
The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses by Eric Ries

Reference Books:
Technology Entrepreneurship: Overview, Definition, and Distinctive Aspects

1. http://timreview.ca/sites/default/files/article_PDF/Bailetti_TIMReview_February2012.pdf
2. Toward a General Modular Systems Theory and Its Application to Interfirm Product Modularity
3. http://amr.aom.org/content/25/2/312.abstract
4. Harvard: Why Lean Startup Changes everything
5. http://host.uniroma3.it/facolta/economia/db/materiali/insegnamenti/611_8959.pdf
6. The Power of Integrality: Linkages between Product Architecture, Innovation, and Industry Structure
7. http://www.sciencedirect.com/science/article/pii/S0048733308001091

E-book Links:
The Art of the Start by Guy Kawasaki

1. Demand: Creating What People Love Before They Know They Want It by Adrian J. Slywotzky with Karl Weber
2. The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business by Clayton M. Christensen
3. Running Lean: Iterate From Plan A to a Plan That Works by Ash Maurya
4. Positioning: The Battle for Your Mind by Al Ries and Jack Trout
5. Venture Deals by Brad Feld and Jason Mendelson
6. Lean Analytics by Alistair Croll and Benjamin Yoskovitz
7. Crossing the Chasm by Geoffrey A. Moore

Grading Plan:

Type of Evaluation	Weightage (in %)
Quiz-1	

	20%
Labs	**20%**
Tech Product Quiz-2	**20%**
Demo and Presentation	**10%**
Final submission	**30%**

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

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

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

- Introduction: Assignment: Create startup website; Vision; Basic Positioning statement;
- Creativity & Innovation: Assignment: Based on team's tech idea considered, list 3 product possibilities, applying Idea hexagon framework.
- Frameworks & Models: Assignment: Assess opportunity for the ideas. And pick the "venturable business."
- Customer Discovery/Opportunity mapping: Assignment: Apply Lean Startup Methodology, and Validate customer interest, need &… ; Assignment: First cut of Musiness Model Canvass filled in
- Design Thinking: Assignment: Rapidly create and refine the product functionality for the teams product using design thinking process
- Customer Development: Assignment: Competitive Positioning; Assignment: Update Product functionality capturing the competitive proposition

- Sales & Market Strategy: Assignment: Evolve the GTM plans
- Business Plans: Assignment: Completed, defensible, business model canvass; Assignment: Product roadmap- market & technical, GTM plans, revenue projections
- Technical Architecture considerations: Assignment: Study 2 similar solutions in market and compare/contrast tech architecture used by your product
- Corporate Technology Innovation : TBD
- Tech Product Pitch/Plan presentations

Title of the Course : The Universe Across Scales
Name of the Faculty : Subhadip Mitra + Chittaranjan Hens + Diganta Das
Course Code:
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**

	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	3	1	1									2	1	3	1	1

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

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

4. Detailed Syllabus:

The aim of the course is to present a broad overview of physics across different scales—from the quantum mechanical world of the elementary particles to gravity-controlled large-scale structures through physics at the everyday scales. To teach the students simple calculations and estimations to appreciate the beautiful rules that nature seems to follow at different scales and the emerging patterns.

Unit-1: Fast and small

1. Special Theory of Relativity: time dilation, length contraction, Lorentz transformation, and the mass-energy relation [2]
2. A brief introduction to the core ideas of Quantum Mechanics: the double-slit experiment, the Schroedinger equation, wave-function, the basic postulates, and the particle-in-a-box problem [3]
3. Elementary particles, fundamental interactions, composite states: nucleons, atoms, molecules [3]

Unit-2: The patterns in the middle

4. Statistical Physics in Brief [2]
5. Universal scaling in networks, Fractals in nature—from the sub-cellular level to social interactions (analysis with real networks) [4]
6. Collective motion of self-propelled particles/swarmmalators: Flocking of birds and bacterial clusters. Scale-invariance property under different scales: from microorganisms to large ecological systems [2]

Unit-3: Slow and big

7. Large-scale structure of the Universe, a brief history [1]
8. Olber's paradox, Isotropy and homogeneity, Hubble's law [1]
9. The Universe: according to Newton and Einstein [2]

10. Dynamics of the expanding Universe: Friedmann equations [2]
11. Cosmic Microwave Background, Big Band Nucleosynthesis and inflation [2]

Reference Books:

1. Introduction to Quantum Mechanics by David J Griffiths

2. Introduction to Elementary Particles by David J Griffiths

3. Dynamical Processes on Complex Networks by Alain Barrat, Marc Barthelemy, Alessandro Vespignani

4. Introduction to Computational Physics, Lecture of Prof. H. J. Herrmann

5. Introduction to Cosmology by Andrew Liddle

6. Introduction to Cosmology by Barbara Ryden

5. Teaching-Learning Strategies in brief:

The objective is to present a broad overview of some of the advanced theories of physics that describe the universe at different length scales. Lectures are designed to keep the in-depth technical details at a minimum level. Instead, focus is given more on intuitive understanding. Lessons are augmented by additional study materials including YouTube videos and not-too-technical scientific articles.

6. Assessment methods and weights in brief:

Assignments + Quizzes – (30%), Mid-term evaluation (30%), Final exam (40%)

Title of the Course : Thermodynamics

Name of the Faculty : Harjinder Singh
Course Code : SC1.204
L-T-P : 2(90mins)-1-0
Credits: 2 (L= Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Academic Program : B Tech (CND)

1.Prerequisite Course / Knowledge: Basic (High school) physics/chemistry

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

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

CO-1 State principles and laws of Thermodynamics
CO-2 Apply thermodynamics to investigate natural phenomena
CO-3 Apply thermodynamic principles to allied disciplines like information processing.

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

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

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

4.Detailed Syllabus:

Unit 1: 1. Thermodynamic space, system and surroundings, variable, function, Thermodynamic process and energy transaction: Work, Heat; Walls: Diathermal, Adiabatic, (im)permeable 1L
2. Properties of Gases: Perfect and real: 1L
3. Zeroth law and temperature, first law and internal energy, enthalpy, thermochemistry, Hess's law :1L
4. Expansion Work, Isothermal and Adiabatic Changes, Heat capacity :1L

Unit 2: 5. Second law and equivalence of different ways of stating it, Clausius inequality The Joule-Thomson Effect, Entropy, Heat Engine, Refrigerator, Carnot Cycle: 2L
6. Helmholtz and Gibbs Free Energies, thermodynamic equation of state, criteria for spontaneity, chemical potential, variation with temperature and pressure, Maxwell relations :2L
7. Fugacity and activity :1L

Unit 3: 8. Thermodynamics of mixing, Phase Diagrams and Phase Transitions: 2L
9. Chemical equilibrium, Equilibrium constant and standard free energy :1L
10: Equilibrium electrochemistry

Reference Books:

1. M W Zemansky and R H Dittman (1997), Heat and Thermodynamics, 7th Ed., McGraw-Hill Education,NY
2. P W Atkins (2018), 11th Ed.Physical Chemistry, Oxford University Press, London

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

Teaching currently is online. 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 : Ethics-2: Thinking through moral problems

Faculty Name : Ashwin Jayanti
Course Code : HS0.206
L-T-P : 3-0-0
CREDITS : 2
(L = Lecture hours, T = Tutorial hours, P = Practical hours)

Name of the Academic Programs:
1. Prerequisite Course / Knowledge: Basics of Ethics-1

2. Course Outcomes (COs):

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

CO-1: Identify and recognize normative standpoints in ethical arguments concerning pressing debates
CO-2: Analyze and evaluate the validity of arguments for and against each of these ethical debates
CO-3: Understand the significance of normative ethics as it applies to pressing ethical dilemmas and debates
CO-4: Evaluate the arguments from both sides of the debate and assess the limitations and implications of each of the positions
CO-5: Develop and synthesize arguments in the light of current evidence and considering multiple aspects of a particular course of action

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

4. Detailed Syllabus:

Unit I – Introduction to applied ethics; animal rights; animal rights and equality; Argument from marginal cases, unequal value thesis

Unit II: Environmental ethics;biocentric ethics; distributive and corrective justice, individual moral obligations
Unit III: Economic Justice and inequality; Rawls-Nozick debate
Unit IV: Genetic engineering; genetic engineering and perfection; genetic engineering and enhancement; GMOs

PREFERRED TEXTBOOK

Shafer-Landau, R. 2019. *Living Ethics: An Introduction with Readings*. Part 2: Moral Problems. Oxford University Press.

REFERENCE BOOKS

Cohen, Andrew I. And Wellman, Chrisopher Heath. 2005. *Contemporary Debates in Applied Ethics*. Blackwell Publishing

Vaughn, L. 2019. *Doing Ethics: Moral Reasoning, Theory and Contemporary Issues* 5th Edition. W W Norton and Co.

Singer, Peter. 1986. *Applied Ethics.* Oxford University Press

5. Teaching-Learning Strategies in Brief

This course aims at reading, critically evaluating, and thinking through contemporary debates in applied ethics. 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.

6. Assessment Methods and Weightages in Brief

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: 90 marks, class participation: 10 marks.

Type of Evaluation	Weightage (in %)
Class Participation	10
Assignments (1000 words)	60 (3 x 20)
Review Essay (1500 words)	30

Title of the Course : Time Frequency Analysis

Faculty Name : Anil Kumar Vuppala +Chiranjeevi Yerra
Course Code : EC5.402
L-T-P : 3-1-0
Credits : 4
Name of the Academic Program B. Tech. in ECE

Prerequisite Course / Knowledge:

Should have taken Signal Processing course.

Course Outcomes (COs):

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

CO-1 : Demonstrate usability of joint time-frequency transforms and distributions insignal processing.
CO-2: Apply principles of time & frequency fundamentals to understand uncertaintiesin joint time-frequency representation.
CO-3: Developing mathematical foundation for joint time-frequency representation.
CO-4: Analyzing signals with Wavelet theory of signal processing.
CO-5: Explaining the application of advanced transforms for signal analysis.
CO-6: Designing the algorithms for modeling non-stationary signals.

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

	PO1	PO2	PO 3	PO4	PO 5	PO6	PO7	PO 8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O 3	PS O 4
CO1	2	2	1	1	1	1	1	1	2	1	1	2	-	3	-	-
CO2	3	2	1	1	1	1	1	1	2	1	1	2	-	3	-	-
CO3	3	2	2	1	1	1	1	1	2	1	1	2	-	3	-	-
CO	3	2	2	1	1	2	1	1	2	1	1	2	-	3	-	-

4																
CO5	2	3	2	2	1	2	2	1	2	1	1	3	-	3	-	-
CO 6	2	3	3	3	2	2	2	1	3	2	2	3	-	3	-	-

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 Vector Space, Basis Functions, Basis, Frames. Review ofFourier series and transform.
Unit 2: Fundamentals of time and frequency. Time-bandwidth product. Uncertaintyprinciple.
Unit 3: STFT, Wavelet theory of signal processing, multi-resolution analysis.
Unit 4: Wigner Ville distribution, HHT and S-transform.
Unit-5: Applications in signal and image processing.

Reference Books:

1. Time - Frequency Analysis, L. Cohen, Prentice Hall, 1997.
2. A wavelet tour of signal processing, S. Mallat, Third edition, Academic Press,2009.
3. Fourier and wavelet signal processing, Kovacevic, J., Goyal, V.K. and Vetterli,M., 2013.

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

It is a mathematical oriented signal processing course, so regular problem solving assignments are given to understand the concepts. Surprise class tests are conducted based on assignments to test the seriousness in assignment solving. As apart of teaching, practical examples like speech and images are used for
demonstration of mathematical concepts learned. Advanced concepts applicationsare studied by doing course projects.

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

Assignments -- 20% Mid exams -- 30% End Project -- 15% End exam -- 35%

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Title of the Course : Topics in Deep Learning
Faculty Name : Charu Sharma
Course Code : CS7.602
Credits : 4
L - T - P : 3-1-0
(L - Lecture hours, T-Tutorial hours,
P - Practical hours)
Semester, Year : Spring, 2022
Name of the Program : Honors, DD, MTech, PhD

Max. no. of students: 50
Pre-Requisites :
Mandatory: SMAI course and linear algebra.

Nice to have basics of graph theory, computer vision, and natural language processing.

Course Outcomes:

Recently, graph representation learning has gained prominence in the area of Deep Learning in a wide variety of tasks as there is a lot of graph data available in different forms from several domains such as social network, biological network, chemical compounds, citation network, retail network, transaction network, drug network, etc. Machine learning for graphs aims to solve various problems such as graph classification, node classification, link prediction, relation prediction, graph/ node clustering, etc. This is a research-driven course that intends to describe variety of tasks, representation learning methods and its applications in the emerging field of machine learning for graphs.

The aim of the course is to make students understand the theoretical and research aspects of the topics (CO1)

so that they can analyze and evaluate the research ideas behind the existing methods

(CO2).

The students will also be able to look at the problem from different perspectives

(CO3) and extend or design a method/ algorithm for a real-worldproblem

(CO4). Students can relate to the real-world problem and apply the existing methods as well

(CO5).

Course Topics : Following topics are subject to minor changes.

1. Introduction, Fundamentals and Significance
   A. Introduction to ML for Graphs, Applications, Problem Definition
   B. Basics of Networks and Graphs
   C. Node and Graph Embeddings
2. Problems in Graph ML
   A. Node and Graph Classification
   B. Link Prediction and Relation Prediction
   C. Clustering and Community Detection
   D. Graph/Subgraph Matching
   E. Applications
3. Embedding Methods
   A. Heuristic Methods, Graph Kernel-based Methods
   B. Random Walk-based Methods: DeepWalk, Node2vec
   C. Graph Laplacian and Spectral Methods
   D. Applications
4. Graph Neural Networks
   A. Popular GNNS and its Variants: GCN, GraphSAGE, GIN, DGCNN, etc.
   B. Applications of GNNs
5. Knowledge Graphs
   A. KG Embeddings
   B. Applications of KG Embedding Methods
6. Other GNNs
   A. Attention Model: GAT
   B. Graph Transformers
   C. Graph Generation: Deep Generative Models

Preferred Text Books for machine learning and deep learning basics:

Christopher Bishop. Pattern Recognition and Machine Learning.

Ian Goodfellow and Yoshua Bengio and Aaron Courville. Deep Learning.

Reference Books : There is an e-book (Graph Representation Learning) that came recently by William Hamilton (link mentioned under e-book links). Useful links, class notes and/or references will be providedfor classes.

E-book Links:

https://www.cs.mcgill.ca/~wlh/grl_book/files/GRL_Book.pdf

Grading Plan **:** The evaluation below is subject to minor changes

Type of Evaluation	Weightage (in %)
Quiz-1	10
Assignment – 1	10
Assignment – 2	10
Project (proposal + presentation + report + work)	60 (10 + 10 + 10 + 30)
Others (class activity, surprise quiz, scribing, etc.)	10

Project evaluation:

- Teams of 3 members.
- 10 points: Proposal: 1 page + refs; Write about what you want to do, something achievable in 3months.
- 10 points: Final report: 2 pages + analysis figures + proofs + refs; Describe the main contribution.Reference previous work for everything else.
- 10 points: Final presentation (5 slides) / video (4 minutes) / poster (1 A0 size)
- Core research work, upto 30 points obtainable. If you do more, this may offset scoring in otherparts of the project evaluation.
    - (15 points max) Re-implementation of code + main experiment, or re-creation of severalexperiments using existing code
    - (5 points max) Additional interesting ablations, experiments, analysis
    - (10 points max) New ideas that unfortunately did not work
    - (15 points max) New working idea, publishable in a conference like ICVGIP, required forhighest grade.

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	PSO
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

Teaching-Learning Strategies in brief (4-5 sentences) :
The plan is to use the slides in general to explain the problem and methods. This would includethe handwritten notes or using white-board whenever required to describe the topics mathematically. The outline has quite a few topics from research papers and would be presented like a paper in detail. Coding sessions (using graph data) would be conducted to make the topics/papers easier to understand.

Title of the Course: Topics in Information-Theoretic Privacy

Name of the Faculty : Gowtham Raghunath Kurri and Prasad Krishnan
Course Code : CS1.502
Credits : 4
L - T - P :3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Spring, 2024

Pre-Requisites : Mathematical maturity and basics of discrete probability theory. No background in Information Theory is assumed for the course.

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

1. Demonstrate a familiarity with information-theoretic approaches to various problems in privacy.
2. Articulate the axioms of a privacy leakage measure.
3. Illustrate the applications of information-theoretic tools in operationally quantifying privacy leakage.
4. Model differential privacyin terms of an information-theoretic channel highlighting the connection betweenprivacy and utility.
5. Describe the algorithms for achieving privacy and correctness simultaneously for the problems in private information retrieval.

Course Topics :

Module 0: Review of discrete probability theory (1 Lecture)

Module 1: Information-Theoretic Tools– Entropy, mutual Information, chain rule for entropy and mutual information, relative entropy, Fano's inequality, Han's inequality, data-processing inequality,Rényi entropy and divergence, Sibson's Mutual Information (approx. 5 Lectures)

Module 2: Information/Privacy Leakage – Operational approach to information leakage,axioms of a leakage measure,types of leakage measures and their properties - mutual information,min-

entropy leakage, and maximal leakage, introduction to applications in this course (approx. 8 Lectures)

Module 3: Information Theoretic Privacy Approach to Information Retrieval, Computation and Learning: Information Theoretic PIR and Computational PIR, IT-PIR Capacity with Multiple Servers and Replicated Storage, Weakly/Leaky PIR under various Loss Metrics, PIR under Coded Storage, PIR-like approaches to other problems: Secure Distributed Matrix Multiplication, Secure Aggregation, Federated Learning) (approx. 6 Lectures)

Module 4: Information Leakage with Differential Privacy – Differential privacy (DP) and its properties (composition and post-processing), relation between DP and information flow, bounds on information leakage of DP mechanisms, privacy-utility tradeoff in the information-theory framework (approx. 6 Lectures)

Preferred Textbooks/Reference Material: There is no preferred textbook for the course. The course broadly covers topics and material from various textbooks and research articles. Some of them are listed below.

- Cover and Thomas. *Elements of Information Theory.* John Wily and Sons.
- Issa, Wagner, and Kamath, "An Operational Approach to Information Leakage," IEEE Transactions on Information Theory, 2020.
- Geoffrey Smith, "Recent Developments in Quantitative Information Flow," ACM/IEEE Symposium on Logic in Computer Science, 2015.
- Sun and Jaffar, "The Capacity of Private Information Retrieval," IEEE Transactions on Information Theory, 2017.
- "Private Information Retrieval and Its Applications: An Introduction, Open Problems, Future Directions" , Sajani Vithana and Zhusheng Wang and SennurUlukus, Available at - https://arxiv.org/abs/2304.14397
- S. Vithana and S. Ulukus, "Private Read Update Write (PRUW) with Storage Constrained Databases," 2022 IEEE International Symposium on Information Theory (ISIT), Espoo, Finland, 2022, pp. 2391-2396, doi: 10.1109/ISIT50566.2022.9834439.
- K. Banawan and S. Ulukus, "The Capacity of Private Information Retrieval From Coded Databases," in IEEE Transactions on Information Theory, vol. 64, no. 3, pp. 1945-1956, March 2018, doi: 10.1109/TIT.2018.2791994.
- H. -Y. Lin, S. Kumar, E. Rosnes, A. Graell i Amat and E. Yaakobi, "The Capacity of Single-Server Weakly-Private Information Retrieval," in IEEE Journal on Selected Areas in Information Theory, vol. 2, no. 1, pp. 415-427, March 2021, doi: 10.1109/JSAIT.2021.3056327.
- R. Freij-Hollanti, O. W. Gnilke, C. Hollanti, A. -L. Horlemann-Trautmann, D. Karpuk and I. Kubjas, "t-private information retrieval schemes using transitive codes," in IEEE Transactions on Information Theory, vol. 65, no. 4, pp. 2107-2118, April 2019, doi: 10.1109/TIT.2018.2871050.
- O. Makkonen and C. Hollanti, "General Framework for Linear Secure Distributed Matrix Multiplication with Byzantine Servers," *IEEE Information Theory Workshop (ITW)*, Mumbai, India, 2022, pp. 143-148, doi: 10.1109/ITW54588.2022.9965828.
- Benny Chor, Eyal Kushilevitz, Oded Goldreich, and Madhu Sudan. 1998. Private information retrieval. J. ACM 45, 6 (Nov. 1998), 965–981. https://doi.org/10.1145/293347.293350

- Alvim *et al.*, "Differential Privacy: On the Trade-off Between Utility and Information Leakage," International Workshop on Formal Aspects of Security and Trust, 2012.
- Barthe and Kopf, "Information-Theoretic Bounds for Differentially Private Mechanisms," Computer Security Foundations Symposium.

Grading Plan :
(The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz	10 %
Mid SemExam	20 %
End Sem Exam	30 %
Assignments/Scribes	15 %
Project	25 %

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

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

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

Even though basic probability theory is a prerequisite for the course, there will be a refresher lecture reviewing all the concepts from it to ensure all the students are on the same page. All the concepts and the theoretical results in the course are illustrated through examples and/or applications whenever possible so that the students can comprehend them easily.

Title of the Course : Topics in Reinforcement learning

Faculty Name : Tejas Bodas & Harikumar Kandath
Course Code : **CS7.603**
Credits : 4
L - T - P :
(L - Lecture hours, T-Tutorial hours,
P - Practical hours) 2-2-0
Semester, Year : Spring 2024

(Ex: Spring, 2022)
Name of the Program : CSE /ECE

Pre-Requisites : MA6.101 Probability and Statistics or Equivalent (Compulsory), MDL, Stochastic processes, or equivalent (desirable)

Course Outcomes :

Course outcomes
(CO's): After completion of the course, the students will be able to

1. ~ Analyze, understand and apply the theory of Markov Decision processes
2. ~ Analyze, understand and apply the theory of Reinforcement learning
3. ~ Implement reinforcement learning algorithms using Python
4. ~ Implement RL projects in group demonstrating use cases for topics learnt.

Course Topics : Following is the tentative list of topics to be covered in this course in about 12 lectures. (Each lecture is of 90 mins.)

Module 1: (3 lectures)
- Review of Probability and Stochastic Processes
- Markov Chains
- Introduction to Optimization
- Introduction to Dynamic programming and Markov Decision Processes

Module 2: (5 lectures)
- Infinite horizon discounted MDP
- Bellman Optimality Criteria
- Value Iteration & Policy Iteration
- Average cost criteria

Module 3; (6 lectures)
- Introduction to RL
- Monte Carlo methods
- TD Learning, Q-learning and Bootstrapping

Module 4: (5 lectures)
- Systems with continuous state-action space, Controllability and stability
- Linear Quadratic Regulator (LQR)
- Policy Iteration (PI) and Value Iteration (VI) methods

Module 5: (5 lectures)
- Function approximation techniques – DQN
- Actor-Critic methods

- Integral reinforcement learning
- Policy gradient methods

Preferred Text Book : Reinforcement learning: An Introduction by Sutton and Barto

Reference Books :

1) Applied probability models with Optimization Applications by Sheldon Ross
2) Approximate Dynamic programming by Warren Powell
3) Simulation based optimization: Parametric optimization techniques and Reinforcement learning. Abhijit Gosavi, 2015
4) Optimal Adaptive Control and Differential Games by Reinforcement Learning Principles. D. Vrabie, Kyriakos G. Vamvoudakis, Frank L. Lewis, 2013.

E-book Links : NA
Grading Plan :
(The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz-1	**10**
Mid SemExam	**20**
Quiz-2	**10**
End Sem Exam	**20**
Assignments	**20**
Project	**20**
Term Paper	**0**
Other Evaluation	**0**

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

	PO1	PO2	PO3	PO 4	PO5	PO 6	PO7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O1	PS O2	PS O3	PS O4
CO1	3	3	3	2	2	2	-	-	2	1	1	2	3	2	2	3
CO2	3	3	3	2	2	2	-	-	2	1	1	2	3	2	2	3
CO3	3	3	3	2	2	2	-	-	2	1	1	2	3	2	3	3
CO 4	3	3	3	2	1	1	2	1	1	1	1	2	3	2	3	3
CO5																

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

- The course is planned to be a balance between theory and practice.
- Traditionally, this course has been a theory intensive course with little emphasis on implementation and applications. We will however flip this around.
- We will introduce theoretical mathematical concepts on a need to know basis or as and when required.
- The emphasis will be to look at a lot of examples of MDP's and RL algorithms and possible be able to use them in real world examples.

Title of the Course **:Topics in Software Foundations**
Faculty Name **: Venkatesh Choppella**
Course Code **:** CS6.502
Credits **: 4 (Two 1.5 hour lectures per week)**

Prerequisites

Database systems, Distributed Systems (recommended, or can be taken concurrently in the same semester)

2 Objective

The objective of this course is to explore the modeling, architecture, and design of advanced software systems from the perspective of Systems Theory. The theory equips the student with a conceptual vocabulary for describing systems. The practical perspective provides an opportunity to analyze a software system and model its structure and behavior using the vocabulary of transition systems.

The course is in three parts. The first part (Unit 1) is an introduction to the notion of transition systems and applying a systems approach when designing or analyzing iterative, interactive, parallel or distributed systems. . The second part of the course (Unit 2) dives into the architecture and design of large systems, including a brief on Infrastructure as a Service. The third part (Unit 3) applies the principles learned in Unit 1. We will analyze an existing open-source system and use transition systems modeling and specific system comprehension techniques to understand the dynamics of the system.

The course will involve lectures from industry experts: Mrityunjay Kumar (Zenoti) and Dr. Sudhir G Rao (ex-IBM Raleigh USA).

3 Course specific outcomes

After completing the course, the student should be able to accomplish the following:

1. **CO1: Model simple to moderate interactive applications**

Using the formalism of interactive systems, model simple systems like an Automatic Teller Machine, Boom Barrier Controller, etc.

2. **Co2: Specify properties of systems**

Formally state correctness conditions of sequential, concurrent and distributed systems.

3. C03: Express Patterns of design formally

Write down formal descriptions of some basic and advanced design patterns, like Observer, State and Model-View-Controller.

4. C04: Understand the architectural principles behind large systems

Analyze a given system in terms of its architecture and be able to judge how well it uses the architectural principles and patterns

5. C05: Analyze the design of real-world systems

Take a real world system and model its dynamics in terms of patterns and express the patternsusing a formal notation.

4 Detailed Syllabus

Unit 1: Principles of interactive systems

Sequential Systems. Algorithmic Problem Solving. Transition Systems. Interactive problem solving. Composition of systems. Feedback composition. Actor models of distributed systems.

Unit 2: Building large systems

Software System Architecture & Design Methodologies, A Software Systems Algebra for Architecture & Design, Client-Server Systems, Distributed Systems, Distributed Communication Protocols, Virtualized Infrastructure & Infrastructure Clouds, [time permitting] Server System Design & Protocol Subsystem Design.

Unit 3: Analyzing Systems

A comprehension strategy for software systems, using models to capture system behavior, iteratively gather information about an existing system and refine mental and formal models.

5 References

There is no text book for the course. Material will be used from a variety of books, research papers and online websites. Some reference books and sites are listed below.

- An introduction to Mathematical Computer Science. Kasturi Viswanath.
- Verification and Control of Hybrid Systems. Pablo Tabuada. Springer 2009.
- Patterns of Enterprise Application Architecture. Martin Fowler. Addison Wesley 2002.
- ISO/IEC 25010:2011 System and software quality models https://www.iso.org/standard/35733.html
- Software Architecture in Practice, 4th Edition, 2021, Bass, Clements, Kazman

6 Teaching-Learning Strategies

The course will be lecture-driven. Students will need to complete assignments (including programming assignments) to demonstrate understanding of the material covered in class. In addition, there will be project presentations of case studies done by students. The project presentation will include a term paper and a talk.

7 Assessment Methods (Tentative)

Assignments	**40**			
Midsem	20			
Project	40			

8 Mapping of Course Outcomes to Programme and Programme Specific Outcomes

Programme Outcome (PO/PSO)	**CO1**	**Co2**	**Co3**	**Co4**	**Co5**	**Co6**
PO1	3	3	3	3	3	3
Engg. Knowledge						
Po2	3	3	1	1	2	3
Problem Analysis						
PO3	3	3	3	3	2	1
Design/Develop						
PO4	1	2	3	3	3	3
Complex Problems						
PO5	1	1	1	1	1	1
Modern tool usage						
PO6	1	2	2	3	1	1
Engr. & Society						
PO7	1	1	1	1	1	1

Environment & Sustainability						
PO8	1	2	2	2	2	2
Ethics						
PO9	1	1	1	2	1	3
Team work						
P10	3	3	3	3	3	3
Communication						
P11	1	1	1	1	1	1
Project Mgmt & Finance						
P12	2	2	2	2	1	2
Life learning						
PS01	3	3	3	3	3	2
Specialised knowledge						
PS02	2	2	2	2	2	2
Roadmap for technologies						
PS03	3	3	3	3	3	3
Research &						
Development Skills						
PS04	3	3	3	3	3	3
Potential for PG study						

Appendix: Programme and Programme Specific Outcomes

Programme Outcomes (POs)

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 life-long learning required to meet their professional and career goals.

Programme Specific Outcomes (PSOs)

PSO1

Exhibit specialized knowledge in some sub-areas of Computer Science and Engineering such as Theoretical Computer Science, Computer Systems, Artificial Intelligence, Cyber-physical Systems, Cyber-security and use this specialized knowledge base to solve advanced problems

PSO2

Perform gap analysis in terms of systems and technologies and prepare roadmaps for incorporating state-of-the-art technology into system analysis, design, implementation, and performance.

PSO3

Demonstrate research and development skills needed to define, scope, develop, and market futuristic software systems and products.

PSO4

Demonstrate knowledge and skills at the required depth and breadth to excel in post-graduateand research programs.

Title of the Course : **Topics in Speech to Speech Translation (SSMT)**
Faculty Name : **Anil Kumar Vuppala + Chiranjeevi Yerra**
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%

Course Title : Understanding Political Theory
Faculty Name : Aakansha Natani
Name of the Program :B.Tech in Computer Science and Engineering
Course Code : HS4.202
Credits : 2
Semester, Year : Spring 2024
Pre-Requisites : None
L- T – P : **3-0-0**
(L - Lecture hours, T-Tutorial hours, P - Practical hours)

Course Outcomes :

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

CO1: Describe the concept of politics and identify the general scope and methods of Political Science at an introductory level.

CO2: Understand the meaning and interpretation of key concepts in Political Science

CO3: Explain range of academic theories relating to key concepts in Political Science.

Course Topics :

The course is divided into three modules:

(i) Introduction to Political Science- Politics, State and Government

(ii) Defining the 'Political': Power, Authority, Legitimacy, Sovereignty, Citizenship

(iii) Key Concepts in Political Science: Liberty, Equality, Justice, Rights, Democracy

Module 1: Introduction to various perspectives on how we define politics and its domain; Nature and scope of Political Science as a field of knowledge; Meaning and origin of State: divine theory and social contract theory; Forms and functions of government

Module 2: Meaning, interpretation and classification of the concepts of Power, Authority and Legitimacy; Definitions and Characteristics of Sovereignty; Theory of Citizenship

Module 3: Brief introduction to key concepts of Political Science; Liberty: Negative and Positive; Equality: Equality of opportunity, outcome, welfare, resources, capabilities; Justice: Procedural, Substantive, Social Justice; Rights: Legal Rights and Human Rights; Democracy: Idea and Practice

Preferred Text Books :

Selected Chapters from-

- Andrew Heywood: *Politics (forth edition)*
- Andrew Heywood: *Political Theory: An Introduction*

- Kenneth Minogue: *Politics: A Very Short Introduction*
- Rajeev Bhargava and Ashok Acharya (eds)*: Political Theory: An Introduction*

Reference Books :

- Rand Dyck: Studying Politics: *An Introduction to Political Science, Third edition*
- Larry Johnston: *Politics: An Introduction to the Modern Democratic State*
- Eric Mintz, David Close, and Osvaldo Croci: *Politics, Power and the Common Good: An Introduction to Political Science*
- Jonathan Wolff: *An Introduction to Political Philosophy*
- Matt Zwolinski: *Arguing about Political Philosophy*

Grading Plan :

(The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz-1	20%
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		2		3				2
C O2				1		2	2	2		2		3				3
C O3						2		2				2				2

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		2		3				2
C O2				1		2	2	2		2		3				3
C O3						2		2				2				2

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: Usability of Software and Digital Products

Faculty **:** Raman Saxena and Nimmi Rangaswamy
Course Code **: CS5.402**
No. of Credits **: 2**
Format: Lecture; Tutorial; Labs/Studio: 1.5 -0- 3
Target Students **:** Open Elective for UG and PG
Pre-requisite: HCI Course for PDM Students and other UG and PG students

Course Objectives & Outcomes

Usability is critical for the successful acceptance and adoption of any software and digital products by their targeted users. This course introduces the usability of software and digital products & systems. Students will learn about the Software Usability, Prototyping, including Low Fidelity and High-Fidelity Prototypes, Usability Evaluation Methods (including Usability

Goals, Usability Test planning, Usability Matrix, Heuristic Review and Usability Testing, The course will also provide the understanding and skillsconducting the evaluation, data collection, documenting the test results and interpreting the test data to access the usability of any software and digital product. Product usability and its assessment is a critical milestone of any product launch and understanding it will be an important skill/attribute for any excellent product manager.
The students of this course will be able to apply the knowledge/learning's from this course to their own professional work as product designer and product managers of the software/IT products/industry including Mobility, Healthcare, Learning, E-commerce and Utility etc. The course will include a short project to offer opportunity to the students to experience the full HCI cycle. This course will also 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 and to work with the product managers and designers more collaboratively and effectively.

After completion of this course successfully, the students will be able to…
CO-1 Demonstrate good understanding of the full development life-cycle Human-Computer Interaction and How it influences the Usability of the digital products, systems, solutions, and services.
CO-2 Demonstrate good understanding about Software Usability in software development lifecycles and usability evaluation methods including heuristic review, expert review, usability testing etc.
CO-3 Demonstrate the understanding about the need for prototyping, types of prototypes including low fidelity & high fidelity and ability and skills for rapid prototyping.
CO-4 Demonstrate good understanding of usability evaluation process, protocols, usability matrix, and tools, and demonstrate the ability to conduct usability evaluation sessions, collect, and analyze test results,interpret test data to identify design changes, document and present the same.
CO-5 Demonstrate the ability to collaborate with end users (test users) and other stakeholders.

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	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2	3	2	1	2	3	2	3	2	2	2
CO2	3	3	3	3	3	2	1	3	3	2	3	2	2	2
CO3	3	3	3	3	3	2	1	3	3	2	3	2	2	2
CO4	3	2	3	3	3	2	1	3	3	3	3	2	2	2
CO5	2	2	2	2	2	2	1	2	3	3	3	2	2	2

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

Teaching-Learning Strategies

To enhance the learning and making it interesting and motivating, other than lecture sessions this course will include lots of 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 will transform into a studio format with students working on a project exploring Human-centered Software Design and Usability evaluation to experience the full HCI /UX/Usability cycle. The course will introduce and discuss a few case studies to HCI, Software Usability, 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 12) and hands-on work including assignments, classroomexercises and homework.
- The course will also include fieldwork, hand on activities, learning by doing, to practice the learning fromthe lectures.
- Introduce and discuss a couple of case studies including cases related to the new product development andICT/ digital domain.
- 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 Usabilitylearnings.
- Other than attending lectures and doing classroom exercises & assignments students need to spend aroundfour to five hours per week on home/field assignments.

This course will consist of the following units.

UNIT 1 : Software/Digital Product Usability	**UNIT 2: Prototyping**
• Introduction to Software Usability? • Why should we evaluate usability? • Usability Goals	• Why prototype • Low Fidelity prototypes • High Fidelity Prototypes • Rapid Prototyping tools
UNIT 3: Usability Evaluation	**UNIT 4: 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 5: Conducting Usability Evaluation	**UNIT 6: 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 & YvonnesRoger
6. Designing User Interfaces: Exploring User Interfaces, UI Elements, Design Prototypes and the Figma UIDesign Tool, Dario Calonaki
7. Moderating Usability Test: Principles and Practices for Interacting, by Dumas, Joseph
8. Ethnography and Virtual Worlds: *A Handbook of Method* Tom Boellstorff, Bonnie Nardi, Celia Pearce, andT. L. Taylor
9. Rethinking Users: The Design Guide to User Ecosystem Thinking, Mike Youngblood & Benjamin Chesluk
10. Designing with Data: Improving the User Experience with A/B Testing, Rochelle King, Elizabeth Churchill& Caitlin Tan
11. Design + Anthropology, Christine Miller
12. Quantified: Biosensing Technologies in Everyday Life, edited by Dawn Nafus
13. Case study: Design of a complex software system- CMS of a media organization
14. Case study: Defining a Mainframe System
15. Case Example: Conversational UI's.
16. 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 : User Interaction and Usability of Digital Products

Faculty : Raman Saxena and Nimmi Rangaswamy
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 success factor 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, User Personas, Use Cases, and evaluate acceptance and adoption of software and digital products and services amongst the targeted user group.

LO-4: Demonstrate the ability and skills for Information and Data Visualization, Information Architecture, Interaction Models, User Interface Elements, Wireframes and Rapid Prototyping and to articulate new trends in HCI/UX and UI - including AI Influence on UI/UX, Conversational UI or chatbot interfaces

LO-5: Demonstrate good understanding of software usability, usability matrix and skills to conduct usability evaluations including heuristics reviews, usability testing of the software and digital products along with documenting deliverables and communicating course project outcomes

LO- 6: Exhibit aptitude for working in teams and deliver task outcomes effectively.

LO	PO1	PO 2	PO3	PO4	PO 5	PO 6	PO7	PO8	PO9	PO1 0	PO 11	PO 12	PS O1	PS O2	PSO 3	PSO 4
LO1	1	1	3	3												2
LO2				3		3										2
LO3							1	3				3				
LO4					3								3	3		
LO5										3				3	3	
LO6									3		2	3			2	

Teaching-Learning Strategies

To enhance the learning and making it interesting and motivating, other than lecture sessions this course will include lots of 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 will transform 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 including assignments, classroom exercises and homework.
- The course will also include fieldwork, hand on activities, learning by doing, to practice the learning from the lectures.
- Introduce and discuss a couple of case studies including cases related to the new product development and ICT domain.
- It will introduce and discuss a couple of case studies including cases related to HCI, User Experience and UI Design of software products.
- Design Project covering Interaction Design, User Experience Design and =project to practice HCI, UX, UI and Usability learnings.
- Other than attending lectures and doing classroom exercises & assignments students need to spend around four to 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

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4. Sketching User Experiences: Getting the Design Right and the Right Design, by Bill Buxton
5. Interaction Design: Beyond Human-Computer Interaction, By Helen Sharp, Jennifer Preece & Yvonnes Roger
6. Designing User Interfaces: Exploring User Interfaces, UI Elements, Design Prototypes and the Figma UI DesignTool, Dario Calonaki
7. Designing Interfaces: Patterns for Effective Interaction Design, By Jennifer Tidwell, Charles Brewer and AyneeValencia
8. UX for XR: User Experience Design and Strategies for Immersive Technologies (Design Thinking), by CornelHillmann
9. AI and UX: Why Artificial Intelligence Needs User Experience, by Gavin Lew, Robert M. Schumacher Jr.
10. Information Visualization: Design for Interaction, by Prof. Robert Spence
11. Moderating Usability Test: Principles and Practices for Interacting, by Dumas, Joseph
12. Ethnography and Virtual Worlds: *A Handbook of Method* Tom Boellstorff, Bonnie Nardi, Celia Pearce, and T.L. Taylor
13. Rethinking Users: The Design Guide to User Ecosystem Thinking, Mike Youngblood & Benjamin Chesluk
14. Designing with Data: Improving the User Experience with A/B Testing, Rochelle King, Elizabeth Churchill &Caitlin Tan
15. Design + Anthropology, Christine Miller
16. Quantified: Biosensing Technologies in Everyday Life, edited by Dawn Nafus
17. Case study: Design of a complex software system- CMS of a media organization
18. Case study: Defining a Mainframe System
19. Case Example: Conversational UI's.
20. Case Study: Designing Everyday Mobility

Assessment methods and weightage

	Assessment Methods	**Weightage**
1	Classroom /Home activities & assignments	30%
2	Project Individual/Group	50%
3	Final Exam	20%
	Total	100%

Title of the Course : **VALUE EDUCATION – 2**
Faculty Name : Shatrunjay Rawat
Course Code : OC3.102
L-T-P :12-6-0 (Total hours)
Credits : 2

(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Academic Program: B. Tech. in ECE, BTech in CSE

1.Prerequisite Course / Knowledge: -NIL-
2.Course Outcomes (COs) :
After completion of this course successfully, the students will be able to:
CO-1: Apply the basic framework of universal human values to understand oneself
CO-2: Explain the relation of self with family, society and nature
CO-3:Explain the concept of living in harmony at all the levels
CO-4: Demonstrate theright understanding of relationships and Right utilization of physical facilities
CO-5: Realise the long-term goal of being happy and prosperous

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

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

Title of the Course : **Values, Ethics and AI**
Faculty Name : Shatrunjay Rawat + Rajeev Sangal
Course Code : HS0.211
CREDITS : 2
L - T - P :3-0-0
(L - Lecture hours, T-Tutorial hours,
P - Practical hours)
Name of the Program: B.Tech. and other programmes
Semester, Year :Spring 2023

Pre-Requisites : Basic Understanding of Ethics and IT Systems
Course Outcomes :

CO-1 Understanding of basic human values, its connect with ethics, and their application in the domain of IT systems, AI, Big Data.
CO-2 Develop the basic ability to identify whether an IT system is aligned to basic human values and adhere to ethical norms.
CO-3 Develop the ability to design systems that adhere to values and ethics.

Course Topics :

Unit 1 Universal Values (based on Co-Existential Philosophy): a) Values in individual, b) Values in relationship, c) Values in society
Unit 2 Relating Values with ethics: a) Relationship between values and ethics, b) Trusteeship principle
Unit 3 Ethics of technology – Dimensions: a) Development and empowerment of User, Family, Society, b) Sustainability with nature
Unit 4 AI and big data: a) Issues, b) Privacy of Individuals, c) Ownership of my personal data - Who? Exploitation, d) Explainability, e) Empowerment

Preferred Text Books :
No single text book. Required study material will be shared/identified as course progresses.
Reference Books :
Will be identified as course progresses

E-book Links :
Grading Plan :

Type of Evaluation	Weightage (in %)
Participation in Class Discussions	**20**
Quiz	**25**
Assignments	**20**
End of the Course Examination	**35**

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

Teaching-Learning Strategies in brief (4-5 sentences):
Course will be primarily driven by classroom discussions, readings, exploratory assignments. It will involve a lot of critical thinking and active learning by the students. Students will be asked to make presentations on topics assigned to them for exploration/experiment.