INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY
HYDERABAD

Courses Syllabus – Monsoon 2024

Ver.3: 28-07-2024

S.No.	Course No	Course Name	Credits (L-T-P-C)	Faculty Name(s)
1	CS2.501	Advanced Computer Architecture	3-1-0-4	Suresh Purini
2	CS3.402	Advanced Computer Networks	3-1-0-4	Ankit Gangwal
3	CE1.604	Advanced Design of Steel Structures	3-1-0-4	Sunitha Palissery
4	CS7.501	Advanced NLP	3-1-0-4	Manish Shrivastava
5	CS3.304	Advanced Operating Systems	3-1-0-4	P. Krishna Reddy
6	CS1.301	Algorithm Analysis and Design	3-1-0-4	Suryajith Chillara
7	CS3.306	Algorithms and Operating Systems	3-1-0-4	Lini Teresa Thomas
8	HS0.303	Applied Ethics	3-1-0-4	Ashwin Jayanti
9	OC2.101	Arts-1 (H1)	2-0-0-2	Saroja T K (Coordinator)
10	CS1.302	Automata Theory (H1)	3-1-0-2	Shantanav Chakraborty
11	HS0.203	Basics of Ethics (H2)	3-1-0-2	Ashwin Jayanti + Guest Faculty
12	CG3.402	Behavioral Research & Experimental Design	3-1-0-4	Vinoo Alluri
13	SC3.202	Bioinformatics (H1)	3-1-0-2	Nita Parkeh
14	EC1.202	Bioinstrumentation and Devices	3-1-0-4	Anshu Sarje
15	SC3.321	Biomolecular Structure Interaction & Dynamics	3-1-0-4	B. Gopalakrishnan
16		Blockchain and Web3 Development	3-1-0-4	Ankit Gangwal
17	PD2.421	Business Fundamentals	3-1-0-4	Himanshu
18	SC2.305	Chemical Kinetics and Reaction Dynamics (H2)	3-1-0-2	Harjinder Singh
19	SC2.309	Chemistry Topics for Engineers	3-1-0-4	Tapan Kumar Sau + Prabhakar B
20		CMOS References and Regulators	3-1-0-4	Zia Abbas+Abhishek Pullela

21	CL3.202	Computational Linguistics II: Comp Semantics and Discourse parsing	3-1-0-4	Rajakrishnan P Rajkumar + Parameswari Krishnamurthy
22	CS0.301	Computer Problem Solving	3-1-0-4	Shatrunjay Rawat
23	CS0.101	Computer Programming	3-1-3-5	Girish Varma + Charu Sharma +TBD
24	SC4.101	Computing in Sciences-1(H2)	2-0-3-2	Deva Priyakumar
25	CS4.405	Data Analytics I	3-1-0-4	Krishna Reddy Polepalli
26	CS4.301	Data and Applications (H2)	3-1-0-2	Ponnurangam Kumaraguru
27	CS1.304	Data Structures & Algorithms for Problem Solving	3-0-2-6	Kshitij Gajjar + Lini Thomas
28	CS7.601	Deep Learning: Theory and Practices	3-1-0-4	Naresh Manwani
29	CS9.429	Design for Social Innovation	3-1-0-4	Ramesh Loganathan + Ramana Gogula
30	EC2.407	Design for Testability	3-1-0-4	Usha Gogineni (Guest Faculty)
31	PD1.401	Design Thinking - Idea to Evaluate (H2)	3-1-0-2	Raman Saxena
32	PD1.301	Design Thinking - Research to Define (H1)	3-1-0-2	Raman Saxena
33	CS7.404	Digital Image Processing	3-1-0-4	Anoop M Namboodiri
34	EC2.101	Digital Systems and Microcontrollers	3-1-3-5	Madhava Krishna + Harikumar K +Anil Kumar Vuppala
35	EC2.408	Digital VLSI Design	3-1-0-4	Zia Abbas
36	MA5.101	Discrete Structures	3-1-0-4	Srinathan K + Shantanav Chakraborty
37	CS3.401	Distributed Systems	3-1-0-4	Kishore Kothapalli
38	CE1.607	Earthquake Resistant Design of Masonry Structures	3-1-0-4	P Pravin Kumar Venkat Rao
39	EC2.102	Electronic Workshop-1 (H2)	2-0-3-2	Praful Mankar + Sachin Chaudhari
40	EC3.202	Embedded Systems Workshop (H)	1-0-3-3	Abhishek Srivastava + Zia Abbas
41	CS1.407	Entropy and Information	3-1-0-4	Indranil Chakrabarty
42	CS9.428	Environmental Science & Technology	3-1-0-4	Ramachandra Prasad Pillutla
43	CS7.504	Fairness, Privacy and Ethics in AI	3-1-0-4	Sujit P Gujar
44	CE4.501	Finite Element Methods	3-1-0-4	Jofin George
45	EC5.412	Foundations for Signal Processing and Communication	3-1-0-4	Praful Mankar + Arti Yardi

46	HS8.201	Gender and Society	3-1-0-4	Sushmita Banerji
47		Geospatial Technology for Disaster Risk Modelling	3-1-0-4	Kiran Chand Thumaty and Rehana Shaik
48	PD1.501	Human Computer Interaction (H2)	3-1-0-2	Raman Saxena
49	HS7.101	Human Sciences Lab-1 (H2)	3-1-0-2	Anirban Dasgupta
50	CE5.502	Hydrological modelling and Software Development	3-1-0-4	Rehana Shaik
51	CS4.406	Information Retrieval & Extraction	3-1-0-4	Rahul Mishra
52	EC5.410	Information Theory	3-1-0-4	Arti Yardi
53	CG1.402	Intro to Cognitive Science	3-1-0-4	Vishnu Sreekumar
54	HS2.202	Intro to Psychology	3-1-0-4	Priyanka Srivastava
55	SC3.101	Introduction to Biology	3-1-0-4	Vinod PK
56	HS5.202	Introduction to Economics	3-1-0-4	Anirban Dasgupta
57	HS1.208	Introduction to Film Studies	3-1-0-4	Sushmita Banerji
58	HS3.201	Introduction to History	3-1-0-4	Isha Dubey
59	CL1.101	Introduction to Linguistics-1	3-1-0-4	Rajakrishnan P Rajkumar
60	CG3.401	Introduction to Neural and Cognitive Modeling	3-1-0-4	Bapiraju Surampudi
61	HS0.214	Introduction to Philosophy	3-1-0-4	Saurabh Todariya
62	HS4.201	Introduction to Politics	3-1-0-4	Aakansha Natani
63	SC1.421	Introduction to Quantum Field Theory	3-1-0-4	Diganta Das + Monalisa Patra
64	CS9.440	Introduction to Remote Sensing	3-1-0-4	RC Prasad
65	CE9.609	IoT Workshop	3-1-0-4	Sachin Chaudhari + Nagamanikandan Govindan +TBD
66	CL2.203	Language and Society	3-1-0-4	Aditi Mukherjee
67	CG1.403	Learning and Memory	3-1-0-4	Bhaktee Dongaonkar
68	HS4.102	Making of the Contemporary India	3-1-0-4	Aniket Alam
69	MA6.301	Maths for Computer Science 1- Probability and Statistics (H1)	3-1-0-2	Naresh Manwani
70	MA6.302	Maths for Computer Science 2 - Linear Algebra (H2)	3-1-0-2	Pawan Kumar

71	CS7.503	Mobile Robotics	3-1-0-4	K Madhava Krishna
72	EC5.411	Modern Coding Theory	3-1-0-4	Prasad Krishnan
73	CS1.405	Modern Complexity Theory	3-1-0-4	Ashok Kumar Das
74	HS1.210	Music Workshop	3-1-0-4	Saroja T K
75	EC5.101	Networks, Signals and Systems	3-1-0-4	Prasad Krishnan + Aftab Hussain
76	SC1.310	Open Quantum Systems and Quantum Thermodynamics	3-1-0-4	Samyadeb Bhattacharya
77	CS3.301	Operating Systems and Networks	3-1-0-4	Karthik Vaidhyanathan
78	SC1.415	Physics of Early Universe	3-1-0-4	Diganta Das
79	CS1.402	Principles of Programming Languages	3-1-0-4	Mrityunjay + Venkatesh Choppella
80	EC2.409	Principles of Semiconductor Devices	3-1-0-4	Aftab Hussain
81	MA6.102	Probability and Random Processes	3-1-0-4	Gowtham Kurri
82	MA6.101	Probability and Statistics	3-1-0-4	Tejas Bodas
83	PD2.401	Product Management 101 (H1)	3-1-0-2	Ramesh Swaminathan
84	PD2.501	Product Marketing	3-1-0-4	Ravi Warrior
85		Quantum Information Theory	3-1-0-4	Siddhartha Das
86	SC1.203	Quantum Mechanics	3-1-0-4	Subhadip Mitra
87	HS1.303	Readings from Hindi Literature	3-1-0-4	Harjinder Singh
88	MA4.101	Real Analysis	3-1-0-4	Samyadeb Bhattacharya + Abhishek Deshpande
89	CS3.502	Real-Time Embedded Systems	3-1-0-4	Deepak Gangadharan
90	CS8.501	Research in Information Security	3-1-0-4	Ashok Kumar Das + Srinathan K
91		Retrofit of Existing Infrastructure	0-2-0-2	Shubham Singhal
92	EC4.401	Robotics: Dynamics and Control	3-1-0-4	Nagamanikandan Govindan
93	SC1.110	Science 1	3-1-0-4	Prabhakar B (Harjinder Singh)
94	SC4.110	Science Lab I (H1)	0-0-3-2	Tapan Sau + Prabhakar B
95	EC5.406	Signal Detection and Estimation Theory	3-1-0-4	Santosh Nannuru
96	EC5.201	Signal Processing	3-1-3-5	Chiranjeevi Yarra + Santosh Nannuru
97		Software Quality Engineering	3-1-0-4	Raghu Reddy Y
98	CS6.302	Software Systems Development	3-0-2-4	Deepak Gangadharan + Rahul Mishra

99	CS4.408	Spatial Informatics	3-1-0-4	Rajan Krishnan Sundara
100		Spatial Thinking and Practice	3-1-0-4	KS Rajan
101	SC2.304	Spectroscopy(H1)	3-1-0-2	M Krishnan
102	CL2.405	Speech Analysis and Linguistics	3-1-0-4	Chiranjeevi Yarra
103	EC5.408	Speech Signal Processing	3-1-0-4	Anil Kumar Vuppala
104	CS7.403	Statistical Methods in AI	3-1-0-4	Ravi Kiran S
105	CE1.501	Structural Dynamics	3-1-0-4	Sunitha Palissery
106	CE1.502	Structural Engineering Design Studio	3-1-0-4	Shubham Singhal
107		Structural Safety of Built Infrastructure (H1)	3-1-0-2	Jofin George
108	SC3.203	Systems Biology (H2)	3-1-0-2	Vinod PK
109	EC5.202	Systems Thinking	3-1-0-4	Spandan Roy + Vinod PK
110	CE0.501	Theory of Elasticity	3-1-0-4	Pravin Kumar Venkat Rao
111	HS0.202	Thinking and Knowing in the Human Sciences - II	3-1-0-4	Aniket Alam
112		Thinking and Knowing in the Human Sciences - III	3-1-0-4	Anirban Dasgupta + Aakansha Natani
113	MA8.401	Topics in Applied Optimization	3-1-0-4	Pawan Kumar
114	SC2.401	Topics in Nanosciences	3-1-0-4	Tapan Kumar Sau
115	CS9.501	User Research Methods (H2)	3-1-0-2	Priynaka Srivastava
116	OC3.101	Value Education-1 (H)	0-2-0-2	Shatrunjay Rawat (Coordinator)
117	EC2.201	VLSI Design	3-1-0-4	Abhishek Srivastava
118	HS2.303	Work, Entrepreneurship and Technology in Contemporary Societies	3-0-0	Rajorshi Ray
119	EC5.407	Wireless Communications	3-1-0-4	Praful Mankar

Title of the Course : **Advanced Computer Architecture**

Name of the Faculty : Suresh Purini
Course Code : CS2.501
L-T-P : 3-1-0.
Credits : 4
(L = Lecture Hours, T = Tutorial Hours, P = Practical Hours)
Name of the Academic Program: B.Tech in Computer Science and Engineering

Prerequisite Course / Knowledge:

Computer Programming. Computer Systems Organization or Introduction to Processor Architecture.

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

CO-1: Explain the principles and practices underlying the design of modern processors (Cognitive Level: **Understand**)
CO-2: Explain the principles and practices underlying the design of memory hierarchies (Cognitive Level: **Understand**)
CO-3: Be able to analyze the different aspects of a processor/memory architecture qualitatively and quantitively, and further develop strategies to mitigate any observed bottlenecks. (Cognitive Leve: **Apply, Analyze, Evaluate and Create**)
CO-4: Explain and identify security vulnerabilities in modern computing systems. Be able to propose techniques to circumvent the identified threats. (Cognitive Levels: **Understand**)

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

4.Detailed Syllabus

- **Unit 1: Instruction Level Parallelism and Superscalar Processors**
  - What is Instruction Level Parallelism?
  - Microarchitecture design and analysis of Out-of-Order processors.
  - Compiler and Architecture Interactions
- **Unit 2: Data Level Parallelism and SIMD/GPU Architectures**
  - Vector Architectures
  - GPUs
  - Compiler and Architecture Interactions
- **Unit 3: Memory Hierarchy Design and Emerging Memory Technologies**
  - Design of Cache Memory
  - Distributed Shared Memory
  - Memory Consistency Models
  - Non-volatile memories
- **Unit 4: Emerging and Domain Specific Accelerators**
  - Hardware accelerators for deep neural networks and Genomics
  - AMD AI/ML Engine
  - TPUs
  - Near
- **Unit 5:AI/ML Techniques in Architecture**
  - Reinforcement Learning Techniques in Cache Optimization, Branch Prediction etc.
  - Power Management
- **Unit 6: Security**
  - Side Channel Attacks such as Spectre and Meltdown

Reference Books:

1. Computer Architecture: A Quantitative Approach, Sixth Edition, Johnl L. Hennessy and David A. Patterson.

5.Teaching-Learning Strategies in brief

This is an advanced course which prepares students to read state-of-the-art research papers in computer architecture from conferences such as ISCA, MICRO, HPCA, etc. Tools such as PIN, and other memory hierarchy simulators will be used to facilitate deeper understanding of the concepts.

6.Assessment methods and weightages in brief

1. HomeWorks: 20 percent
2. Quiz 1: 10 percent
3. Quiz 2: 10 percent
4. Midterm: 20 percent
5. Final Exam: 25 percent
6. Course Project: 15 percent

Title of the Course : **Advanced Computer Networks**

Name of the Faculty : Ankit Gangwal
Course Code: : CS3.402
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 computer networks and algorithms.

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 a familiarity with concepts of network management, standards, and protocols
CO-2 Discuss various privacy-enhancing techniques used in modern computer networks
CO-3 Apply the knowledge of distance-vector (RIP and IGRP) and link-state (OSPF and IS-IS) routing protocols to find routing paths for a variety of networks
CO-4 Analyze wireless LAN technologies including IEEE 802.11
CO-5 Design efficient routing protocols for advanced computer networks (e.g., SDN and ICN)
CO-6 Develop a framework for building a large-scale enterprise network

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

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

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

4.Detailed Syllabus:

Unit 1: Modeling and measurement: Network traffic modeling, network measurement, simulation issues, network coding techniques
Unit 2: Flow and congestion control, TCP variants, TCP modeling, active queue management
Unit 3: Routing: Router design, scheduling, QoS, integrated and differentiated services

Unit 4: Wireless networks: Mobility supports, MAC, multicast
Unit 5: Overlay networks and Emerging applications: SDN, ICN, P2P, CDN, Web caching, cross-layer optimizations, VoIP, SIP, video over P2P

Reference Books:

1. Larry L. Peterson and Bruce S. Davie, Computer Networks: A Systems Approach, 5th edition, Elsevier, 2012
2. James F. Kurose and Keith W. Ross, Computer Networking: A Top-Down Approach, 6th edition, Pearson Education, 2013
3. Jean Walrand and Pravin Varaiya, High-Performance Communication Networks, 2nd edition, Elsevier, 2000
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 systems course, it requires hands-on working as well as critical thinking and active learning by the students to solve practical problems; and finally, project-based learning by implementing semester-long project(s) to solve real-world issues.

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

Assignments	20 marks
One at home project	30 marks
Mid Semester Examination	20 marks
End Semester Examination	30 marks

Title of the Course : Advanced Design of Steel Structures

Faculty : Sunitha Palissery
Course Code : CE1.604
Name of the Program: M.Tech CASE
Credits : 4
L - T - P : 3-1-0
Semester, Year : Monsoon 2024

Pre-Requisites : Design of Steel Structures (Undergraduate course content)

Course Outcomes

After completion of this course successfully, the students will be able to:
CO-1. Develop knowledge and skills to numerically model, analyze and design steel members and low-rise steel frame buildings
CO-2. Employ computer application skills in developing structural behavior intuition and predict structural response to dynamic loading and buckling
CO-3. Demonstrate problem solving skills for various scenarios of structural design and work towards a research-based approach to stability design and seismic design of steel structures

CO-4: Develop critical thinking to help improve and control structural behavior, with focus on seismic loading effects on steel buildings

CO-5. Analyze ethical and effective structural design practices to preclude instability failure and earthquake loading failure of steel structures

CO-6. Reorganize inter-personal skills required to manage possible negotiations with structural engineering design practitioners and promote a safe built environment

Course Topics

Unit 1: Design for Stability- Fundamentals

Compression Members, Flexural Members, Systems/Beam-Columns-Behaviour and Design-Key Definitions-Stability, Bifurcation, Instability; Limit States-Yielding, Buckling, flexural buckling, bending; Column Curves; Euler Buckling, Inelastic Buckling, Imperfections, Amplification of loads; Residual Stresses- Stub-columns, Column Curves for Design

Unit 2: Design for Stability- Design & Behaviour

Behaviour of Flexural Members- Laterally Restrained and unrestrained beams, Effective Length of Columns- AISC Alignment Charts; stability index; Design of Beam Columns-Interaction equations, Design for combined axial and bending effects Introduction to Lateral Torsional Buckling, Governing Differential Equations for Plate Buckling, Plates Subjected Loading Actions, Post-buckling Behaviour of Plates

Unit 3: Earthquake Resistant Design- Codes of Practice

Code recommendations in IS1893:2016, IS800:2007, IS18168:2023; ASCE07-10, AISC documents.

Unit 4: Earthquake Resistant Design- Design & Behaviour

Design of steel members, connections-Joint panel zones, prequalified connections; Design of Column Bases; Nonlinear Static Analysis and Behaviour: Lateral Stiffness, Lateral Strength, Ductility Capacity, Collapse Mechanism and Energy Dissipation Capacity of Designed Steel Building

Preferred Textbooks

1. Alexander, C., *Principles of Structural Stability Theory*, Prentice-Hall Inc, New Jersey
2. Chen, W.F., and Lui,E.M., (1987), Structural Stability: Theory and Implementation, Elsevier Science Publishing Co., New York
3. Elnashai,A.S., and Di Sarno,L., (2008), *Fundamentals of Earthquake Engineering*, John Wiley and Sons, UK
4. Gioncu,V., and Mazzolani,M., (2002), *Ductility of Seismic Resistant Steel Structures*, SPON Press, Taylor and Francis, New York
5. Park,R., and Paulay,T., (1975b), *Reinforced Concrete Structures*, John Wiley & Sons, UK
6. Paulay,T., and Priestley,M.J.N., (1992), *Seismic Design of Reinforced Concrete and Masonry Buildings*, John Wiley and Sons, New York
7. Salmon, C.G., and Johnson,J.E., (1996), *Steel Structures Design and Behaviour*, Prentice Hall, NJ

Reference Books

1. American Institute of Steel Construction (AISC), (2016), Seismic Provisions for Structural Steel Buildings, (ANSI/AISC341-16), Chicago, Illinois, USA
2. American Institute of Steel Construction (AISC), (2016), Specifications for Structural Steel Buildings, (ANSI/AISC360-16), Chicago, Illinois, USA
3. American Society of Civil Engineers (ASCE), (2022), Minimum Design Loads for Buildings and Other Structures (ASCE 7-10), USA
4. American Society of Civil Engineers (ASCE), (2013), Seismic Rehabilitation ofExisting Buildings, (ASCE/SEI 41-13), Virginia, USA
5. Bureau of Indian Standards (BIS), (2007), Indian Standard Code of Practice for General Construction in Steel, IS800;2007, New Delhi, India
6. Bureau of Indian Standards (BIS), (2016), Indian Standard Criteria for Earthquake Resistant Design of Structures, IS:1893;2016-Part 1, New Delhi, India
7. Bureau of Indian Standards (BIS), (2023), Earthquake Resistant Design and Detailing of Steel Buildings — Code of Practice, IS:18168, New Delhi, India
8. Bažant,Z.P., and Cedolin,L., (2010), Stability of Structures- Elastic, Inelastic, Fracture and Damage Theories, World Scientific Publishing Co. Pvt. Ltd., Singapore
9. Booth,E., (2014), *Earthquake Design Practice for Buildings*, ICE Publishing, London
10. Chen,W.F., and Lui,E.M., (2005), *Earthquake Engineering for Structural Design*, CRC Press, Taylor and Francis, Boca Raton
11. Galambos,T.V., and Surovek,A.E., (2008), Structural Stability of Steel: Concepts and Applications for Structural Engineers, John Wiley & Sons, New Jersey
12. Gambhir,M.L., (2004), Stability Analysis and Design of Structures, Springer, New York
13. Guide to Stability Design Criteria for Metal Structures, Edited by Ziemian, R.D., (2010)
14. Murty,C.V.R., Goswami,R., Vijayanarayana,A.R., and Mehta,V.V., (2012), *Earthquake Behaviour of Buildings,* GSDMA, Gujrat
15. Timoshenko,S.P., and Gere,J.M., (1985), Theory of Elastic Stability, McGraw Hill International Book Company
16. Varghese,P.C., (2010), *Design of Reinforced Concrete Foundation*, PHI Learning Pvt Ltd, New Delhi

E-book/software Links

https://www.mastan2.com/

Grading Plan

Type of Evaluation	Weightage (in %)
Quiz-1	**5**
Mid Sem Exam	**20**
Quiz-2	**5**
End Sem Exam	**30**
Assignments	**20**
Project	**20**

Mapping of Course Outcomes to Program Objectives

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

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

1. Lectures by integrating ICT into classroom teaching
2. Tutorials involving numerical modelling of and steel members and moment frame buildings to reinforce linear and nonlinear structural analysis concepts and design methods commonly used in design practice
3. Assignments involving analysing structural data to understand linear and nonlinear responses
4. Critical and active learning through projects, and project-based learning by doing term-projects which involves hands-on use of software tools to investigate and predict behaviour of steel members and buildings.

Title of the Course : Advanced Natural Language Processing (NLP)
Name of the Faculty : Manish Shrivastava
Course Code : CS7.501
Credits : 4
L - T - P :3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Monsoon, 2024
Name of the Program: B. Tech III year, Computational Linguistics Dual Degree III year

Pre-Requisites : None

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

CO-1. Demonstrate the knowledge of Advanced building blocks of NLP
CO-2. Apply NLP machine learning algorithms for Machine Translation, Summarization
CO-3. Demonstrate the knowledge of Dense and contextual representation for NLP
CO-4. Explain the concepts behind Deep Learning models
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. Distributed Semantics
- Contextual Distributed Semantics

Unit 2. Models such as ELMO, BERT, ERNIE and their derivatives

Unit 3. Statistical Machine Translation methods
- Early Neural Machine Translation models

Unit 4. Extractive and Abstractive Summarization
- Neural Summarization Methods

Unit 5. Reinforcement learning for NLP

Preferred Textbooks: None. Mostly research papers.

Reference Books : Statistical Machine Translation by Philip Koehn Deep Learning by Ian Goodfellow

E-book Links :

1. https://www.deeplearningbook.org/
2. **http://www.cs.cmu.edu/~tom/mlbook.html**

Grading Plan : (The table is only indicative)

Type of Evaluation	**Weightage (in %)**
Quiz-1	2.5
Mid Sem Exam	10
Quiz-2	2.5
End Sem Exam	20
Assignments	15
Project	40
Term Paper	10

Mapping of Course Outcomes to Program Objectives:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	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 four assignments and a project. Evaluation based on personal viva to judge deeper understanding.

Title of the Course : Advanced Operating Systems

Name of the Faculty : Krishna Reddy Polepalli
Course Code : CS3.304
Credits : 4
L - T - P : 3-1-1
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Name of the Program : MTech in CSE
Semester, Year : Monsoon, 2024

1.Prerequisite Course / Knowledge

Digital Logic Design, Computer Organization, Knowledge of a programming language, Introduction to operating systems

2. Course Outcomes (COs)

Objective: The operating system abstracts the machine part of the given computer system in terms of simple services (system calls) by hiding the details of the machine (hardware). Traditionally, operating system concepts were developed for single processor (machine). Currently, shared memory, shared disk and shared-nothing architectures (computer network) are being employed for building cloud computing systems by exploiting multiple processor cores and commodity machines to manage diverse computing loads, such as search engine, weather forecasting and mobile-based services. The objectives of this course to study the key concepts, which were evolved for building modern operating systems.

The course Outcomes (COs) are as follows.

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

CO-1. Explain the concepts of several modern computer operating systems (SOLARIS, LINUX, WINDOWS, MAC, Adroid,…)
CO-2: Implement the task on the top of given operating system, in an efficient manner, based on process and thread framework.
CO-3. Prescribe the appropriate scheduling/synchronization/memory management/virtual memory/protection module for a given application.

CO-4. Architect the new application by selecting the appropriate system calls of the given operating system services.
CO-5. Develop a distributed application on multi-processor machine or multiple commodity processors connected through a network.

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	2	-	-	-	3	2	2	3	3	2	1	2
CO2	3	3	3	2	2	-	1	-	2	2	2	3	2	1	2	2
CO3	3	3	3	2	2	2	1	-	3	2	2	3	3	2	1	2
CO4	2	2	3	2	2	3	2	-	3	2	2	2	3	3	2	3
CO5	3	2	1	1	2	-	-	-	3	2	2	3	3	2	1	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: Introduction, Computer System Hardware Review, Networking (9 hours)

Unit 2: Operating System Structures, Virtual machines, Process and thread management (9 hours);

Unit 3: CPU scheduling, Process Synchronization, Deadlocks (10 hours);

Unit 4: Memory management, Virtual memory (10 hours);

Unit 5: File systems, Hadoop, Map Reduce, Overview of Protection, Security, Multi-media systems, Cloud Computing (6 hours);

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

References:

1. Silberschatz, A, Galvin, P, Gagne, G. Operating system concepts, Addison-Wesley, 2018
2. Computer Networks (5th Edition) Andrew S. Tanenbaum, David J. Wetherall Prentice Hall, 2013
3. Distributed and Cloud Computing: From Parallel Processing to the Internet of Things Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra, Elsevier, 2012

4. Wlliam Stallings, Operating Systems, Prentice-Hall, 2018.
5. Charles Crowley, Operating systems: A design oriented approach, Tata McGraw-Hill, 2017.
6. Tanenbaum, A., Modern Operating Systems, Prentice-Hall, Second Edition (latest edition, 2015.
7. Key research papers related to UNIX, Virtual machines, smart phone OSs, distributed OSs.

5. Teaching-Learning Strategies in brief

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

6.Assessment methods and weightages in brief

Two Class Room tests: 10 marks; Mid Semester Examination in theory: 20 marks, End Semester Examination in Theory: 40 marks, Assessment of 5 mini projects in Laboratory: 30 marks

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Title of the Course : Algorithms and Operating Systems

Name of the Faculty : Lini Teresa Thomas
Course Code : CS3.306
Credits : 4
L - T - P : 3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Monsoon 2024
Name of the Academic Program: B. Tech. in Electronics and Communication Engineering

1.**Prerequisite Course / Knowledge:**

A comfortable understanding of data structures, basic algorithm complexity and beginner level algorithms like sorting and searching.

2.**Course Outcomes (COs):**
The course has two parts – Algorithms and Operating Systems. After completion of this course successfully, the students will be able to understand the basic components of a computer operating system, and the interactions among the various components.
Also, from the topics in algorithms, the students will be able to determine the best most suited data structures and method to solve a problem while also being able to conduct a proper complexity analysis of the same.

CO-1 :Learn the components of an Operating system, its requirement and how the Operating System handles memory management, files, process synchronization and deadlocks.
CO-2 : Apply the concepts taught to create and evaluate algorithms that allow process synchronization, solve problems to evaluate how an Operating system manages a given memory requirement, determine whether a particular scenario leads to a deadlock and how to avoid it.

CO-3 : Implement an application on the top of given operating system in an efficient manner based on process and thread framework available in the given operating system.
CO-4: Familiarize students with algorithmic thinking, design and evaluating the complexity of the algorithm. Students should be able to compare between different data structures and possible algorithms and pick an appropriate one for a design requirement.
CO-5: Apply principles of dynamic programming, divide and conquer and greedy algorithms. Design and analyze them when required. Argue the correctness of algorithms using proofs.
CO-6: Introduce graph algorithms. Students should be able to model a problem into a graph structure when required and use graph concepts to solve the 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	1	1	1	1	1	2	2	2	1	2	1	1				
CO2	2	3	2	2	1	2	1	2	2	3	1	3				
CO3	1	1	3	2	3	1	1	1	3	2	1	3				
CO4	1	2	2	2	1	1	1	1	1	3	1	1				
CO5	2	2	2	2	1	2	1	2	2	2	1	3				
CO6	2	2	2	2	1	2	1	2	2	2	1	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 to Operating Systems
  - Introduction to Algorithms and Complexity
  - Introduction to Process, multithreading and process scheduling
- Unit 2
  - Process Synchronization
  - Greedy Algorithms
  - Divide and Conquer Algorithms
- Unit 3
  - Dynamic Programming
  - Memory Management
- Unit 4
  - Deadlocks
  - Graph Algorithms

Reference Books:

1. Galvin, Peter B., Greg Gagne, and Abraham Silberschatz. Operating system concepts. Vol. 10. John Wiley & Sons, 2003.
2. Cormen, Thomas H., et al. Introduction to algorithms. MIT press, 2009.

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 practicing small examples. Assignments are given to reassert and practice topics done in class. Periodical quizzes support summative assessments.

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

- In-class objective tests: 25%
- Homework: 20%
- Midsemester Examination: 20%
- End Semester Exam: 35%

Title of the Course : Algorithm Analysis and Design

Name of the Faculty : Suryajith Chillara
Course Code : CS1.301
Credits : 4
L - T - P : 3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Monsoon 2024
Name of the Program : B.Tech
Pre-Requisites : Discrete Mathematics, and Data Structures and Algorithms

Course Outcomes : After completion of this course successfully, the students will be able to...
CO-1: Demonstrate the ability to fully understand the analysis of various knownalgorithms.
CO-2: Identify problems where various algorithm design paradigms can possibly be applied.
CO-3: Understand the notions of computational intractability and learn how to copewith hardness.
CO-4: Understand the notion of approximation and randomized algorithms. If timepermits, intro to quantum algorithms.

Detailed syllabus:

1. Basic graph algorithms
2. Greedy algorithms
3. Divide and Conquer
4. Dynamic Programming
5. Network flows
6. NP and computational intractability
7. Intro to Approximation and Randomized algorithms
8. Intro to Quantum algorithms

Assessment method and Grading scheme:

- Deep quizzes 1 and 2: 10 + 10 = 20%

- Mid-semester exam = 20%
- End-semester exam = 30%
- In-class quizzes (unannounced) = 15%
- Assignments = 15%

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

	PO1	PO2	PO 3	PO 4	PO5	PO6	PO7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O 2	PS O 3	PS O 4
CO1	1	2	2	2	1	1	1	2	1	1	1	2	3	1	1	3
CO2	2	3	2	2	1	1	1	2	2	2	1	3	3	2	2	3
CO3	2	3	1	2	1	1	1	2	2	2	1	3	3	2	2	3
CO4	2	3	1	2	2	1	1	2	2	1	1	3	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

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

The course lectures will include activities that promote the understanding of the lecturecontent 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 inthe lectures.

Title of the Course : Applied Ethics

Name of the Faculty : Ashwin Jayanti
Course code : HS0.303
L-T-P : 3-1-0
Credits : 4
Name of the Academic Program CHD

1. Prerequisite Course / Knowledge: Philosophy section of Thinking and Knowing in the Human Sciences – I

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

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

CO6. Discuss the major tenets of normative ethical theories and their scope of application

1. 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

2. Detailed Syllabus:

Unit I – Introduction: Distinction between conventional and critical ethics, philosophical tools for argument analysis, intuition, evidence, justification, and explanation.

Unit II – Skepticism: Intrinsic vs Instrumental value, challenge of egoism, problem of cultural relativity and subjectivism, error theory and nihilism, distinction between being ethical and seeming ethical.

Unit III – Goodness: the problem of defining 'good', naturalistic fallacy and the open question argument, implications of the experience machine thought experiment.

Unit IV – Responsibility: challenge of attributing moral responsibility to agents, the control, competence and epistemic conditions of responsibility, moral luck.

Unit V – Normative theories: Consequentialism, deontology, and virtue ethics

Unit VI – Practical ethics: discussion of specific moral problems

Reference books:

1) Shafer-Landau, R. 2019. *Living Ethics: An Introduction with Readings*. Oxford University Press**.**

2) Shafer-Landau, R. 2013. *Ethical Theory: An Anthology 2nd Edition*. Wiley-Blackwell.

3) Cahn, S. M. (ed). 2020. *Exploring Ethics: An Introductory Anthology* 5th Edition. Oxford University Press.

4) Singer, P. 1986. *Applied Ethics*. Oxford University Press.

5) Cohen, A. et al. 2005. *Contemporary Debates in Applied Ethics*. Wiley-Blackwell.

6) Jackson, E. et al 2021. *Applied Ethics: An Impartial Introduction.* Hackett Publishing.

5.Teaching-Learning Strategies in brief:

The general teaching strategy employed is the use of moral dilemmas and conceptual puzzles to introduce course topics. Lectures make use of this strategy to impress upon students the need to critically reflect on ethical issues and the relevance of doing a careful, philosophical investigation of those issues. Student interaction at this stage is aimed at bringing out conflicting ethical intuitions. This is followed up by introducing proper vocabulary to map out the problems involved

in normative moral assessment. Using case studies and toy examples, ethical principles and methods of inquiry are taught so that students develop effective reasoning skills to engage with any real-world ethical matter. Student interaction and discussion at this stage is aimed to give flesh to the intuitions identified in the previous stage. The teaching-learning strategy emphasizes the merits of avoiding simplistic solutions to complex ethical problems and instead ask meaningful questions that enrich moral debates. The second half of the course is done in a seminar style where students choose a moral problem and present it to the class for group discussion. Based on feedback from the instructor and peers, students modify their initial draft essay and refine their arguments about the topic culminating in the final presentation at the end of the semester.

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

This is mainly a writing-driven course, and the exercise questions are carefully designed to make students think independently in ethical contexts. Students are assessed for abilities like logically dissecting issues, questioning assumptions, clarifying distinctions, and bringing out nuances. In assignments and exams, students are expected to demonstrate these abilities by presenting their views clearly, assessing competing positions systematically, anticipating possible objections to a reasoned conclusion and composing cogent responses to those objections. For the term paper, students are first asked to submit an essay where they survey a topic of their choice and identify the question they want to explore in detail for the term paper. The assessment components and their weightages are as follows. Assignments: 40%, class participation: 10%, Essay: 20%, Term paper: 30%.

Title of the Course : Arts 1 and 2

Name of the Faculty : **Saroja T K**
Course code : OC2. 101
L-T-P : 3 Hour a week
Credits : 2-0-0-2
(L= Lecture hours, T=Tutorial hours, P=Practical hours)

Name of the Academic Program**:** **Arts**

1.Prerequisite Course / Knowledge: None

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

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

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

CO-2 Enhances Imagination and aesthetic sensibility

CO-3 Imparts humanities and artistic skills

CO-4 Understands Art as a system of knowledge

CO-5 Understands the effectiveness of informed Art practice

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	1	1	1	1	0	2	1	2	3	1	0	3	0	0	0	0
CO2	1	1	1	1	0	2	1	2	3	1	0	3	0	0	0	0
CO3	1	1	1	1	0	2	1	2	3	1	0	3	0	0	0	0
CO4	1	1	1	1	0	2	1	2	3	1	0	3	0	0	0	0
CO5	1	1	1	1	0	2	1	2	3	1	0	3	0	0	0	0

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

4.Detailed Syllabus:

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

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

Unit 3: Dance: The course informs the students about the significance of dance, and the training involved to perform the dance movements. The course instructs about basic stretches and fundamental movements of the dance of various Indian dance forms. The knowledge about various dance forms of India and the significance of the dance forms in the past and present is discussed. The course helps the students to compose movements and dance their individual units of movements they create out of the instructions and assistance received. In the course, the emphasis point on evaluation is not based on the dancing skills of the students but on their participation in the session in progress.

Unit 4: Sculpture: The course deals with understanding three-dimensional form and creativity. Clay modelling is a great activity that helps students develop in many ways, like self-expression and creativity. In this course, students are taught to make sculptures out of clay. Through this, I try to connect them to nature. The students get a personal experience of the texture of clay, which is an important part of understanding nature. In this course, they will learn how to use different materials to make art.

Unit 5 Collage: Collage is not just a compilation of photos that we create to share on social media. It's an art form where one assembles images from a magazine or newspapers or photographic images, maps, diagrams by cutting pasting or painting or drawing over it to create a unique composition. Artists have manipulated mass produced images to comment on or question body images and narrow beauty standards, gender stereotypes, consumerism, racism and much more. The aim of this course is to equip students with visual tools to explore the possibility this medium offers through a set of exercises. Students will learn to express their ideas or imagination through the process of selection and deduction and addition.

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

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

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

It is a 2-credit course The semester evaluations are based on the participation of students in the sessions.

Title of the Course : Automata Theory

Name of the Faculty : Shantanav Chakraborty
Course Code : CS1.302
Credits : 2
L-T-P : 3-1-0
(L=Lecturehours, T=Tutorialhours, P=Practicalhours)
Name of the Academic Program : B.Tech in Computer Science and Engineering

1. Prerequisite Course / Knowledge: Data structures, Elementary Formal Logic

2.Course Outcomes (COs)

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

CO-1. Develop an understanding of the core concepts of Automata theory such as Deterministic Finite Automata, Non-deterministic Finite Automata, Regular Languages, Context Free Languages, Push down Automata, the basics of Turing Machines
CO-2. Design grammar sand automata for different languages
CO-3. Identify formal language classes and prove language member ship properties
CO-4. Describe the limitations of the different computation al models

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

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

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

4. Detailed Syllabus:

Unit1: Introduction, Finite State Machines, Deterministic Finite Automata (DFA), Nondeterministic Finite Automata (NFA), Equivalence of NFA and DFA, Regular Expressions, Regular Languages, Closure
Properties of regular languages, Pumping Lemma, Grammars, Left and Right-linear grammars

Unit2: Context Free Grammar (CFG), Chomsky Normal Form, Push Down Automata (PDA), Equivalence of CFG and PDA, Context Free Languages (CFL), Deterministic PDA and Deterministic CFL, Pumping Lemma for context free languages

Unit 3: Introduction to Turing machines, Total Turing Machines, Recursive languages, Recursively enumerable languages, The Halting problem.

References:

- M. Sipser, Introduction to the Theory of Computation, Third Edition, Cengage Learning2012.
- J.E. Hopcroft, R. Motwani and J. Ullman, Introduction to Automata Theory, Languages and Computation, Third Edition, Pearson, 2006.

5. Teaching-Learning Strategies in brief:
Thelectureswillbearrangedinamannerthatfacilitatesinter-studentandfaculty-studentdiscussions. Additionally, the lectures will have small exercises that will ensure that the students actively participate in the learning activity and think out of the box. There will be more emphasis on ideas and reproduction of textbook material. There will be small homework problems that would help the student to re-engage with the essential components of the

lecture. Assignments will test the student's ability to apply key concepts learnt, and also inform the faculty of the progress being made by the students in acquiring them.

6. Assessment methods and weightages in brief:

Homework:25%
Quiz 1: 20%
Quiz 2: 20%
Finalexam:35%

Title of the Course : **Basics of Ethics**

Name of the faculty : Ashwin Jayanti + Guest Faculty
Course code : HS0.203
L-T-P : 3-1-0
Credits : 2
Name of the Academic Programs : B.Tech. in CSE, B.Tech in ECE

1.Prerequisite Course / Knowledge: : Nil

2.Course Outcomes (COs)

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

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

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

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

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

4.Detailed Syllabus:

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

Reference books:

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

5.Teaching-Learning Strategies in brief:

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

6.Assessment methods and weightages in brief:

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

Title of the Course **: Behavioral Research & Experimental Design**

Course Code : CG3.402
Faculty Name : Vinoo A R
L-T-P : 3-1-0
Credits : 4
Name of the Academic Program : B. Tech.in CSE

Prerequisite Course / Knowledge:

Interest in conducting behavioral experiments is desirable. Open only for DD, MS, and PhD students. BTech and MTech students can be admitted based on specific requirements and instructor permission.

Course Outcomes (COs):

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

CO-1: To develop understanding of the basic framework of behavioral research process.
CO-2: To identify various sources of information for literature review for operationalizationand data collection.
CO-3: To develop an understanding of various experimental designs and analyses techniques and apply in their own final projects.
CO-4: To operationalize a research question and design, deploy behavioral experiments and analyze the data collected thereof using appropriate statistical tests.
CO-5: To develop an understanding and evaluate the ethical dimensions of conducting applied research.
CO-6: Appreciate the components of scholarly writing and evaluate its quality. Create and develop their unique way of writing and presenting their work whilst balancing scientific standards to effective communication

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

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

Detailed Syllabus:

1. Introduction to Research Methods: Qualitative and Quantitative Approaches; Conducting Behavioural Research; Ethics in Research; Institute Review Board (IRB) Process

2. Starting on Research, Experimental Design: Hypothesis Testing, Type I and II errors, Hypothesis-based vs Exploratory Research, Operationalizing Research, Literature Review; Sampling, Types of variables and levels of Measurements, Designing an Experiment; Validity, Reliability and Cross-validation in Research

3. Types of Experimental design: Non-Experimental Designs, Pilot Testing; 4. Data Collection: Surveys Questionnaires; Data Representation: Levels of Measurement, Human Annotation, Different types of design: Simple randomized design, Factorial designs, Simple repeated measures design, Randomized blocks design, Latin squaretype designs, Between-subject and within-subject factors in an experiment; Scaling Behavioural Experiments: web and mobile experiments, crowdsourcing, big data, large-scale experiments, citizen science, online data collection (PsiTurk, Mechanical Turk, etc).

4. Data Visualization and Analysis: Descriptive Statistics, Tests of Normality and Data Transformation, Outliers, Collinearity in Data, Data Summarization vs Data Reduction Techniques: Exploratory Factor Analysis, Principal Component Analysis, Discriminant Factor Analysis

5. Introduction to Statistical Analysis: Inferential Statistics-Tests of Difference and Tests of Association: Multi-level tests (ANOVA): nonparametric and parametric testsof difference – chi-square test, Mann Whitney U test, Binomial Sign test, Wilcoxon'sT test, Related and Unrelated t tests; nonparametric and parametric tests of association – correlation, regression; Significance testing [*NOTE: While this course emphasizes basic descriptive and inferential statistical analysis, the Second part of the course to be offered in Spring would cover Statistical Analysis of Behavioural andNeuroimaging data in more detail*].

6. Communicating and Assessing Research: Writing, Poster and generalPresentations (formatting of the research paper using APA and IEEE journal/conference formats)

Reference Books:

- Howell, D.C. (1997). Statistical Methods for Psychology (4th ed). Belmont, CA: Duxbury.
- Salkind, N.J. (2009). Exploring Research (8th Ed.). Upper Saddle River, NJ: Prentice Hall.
- Cozby, P. & Bates, S. (2011). Methods in Behavioural Research (11th Ed.), McGraw Hill.
- Coolican, H. (2014). *Research Methods and Statistics in Psychology*. London: Hodder &Stoughton.
- Passer, M. W. (2017). Research Methods: Concepts and Connections, 2nd ed. New York: MacMillan.

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

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 and analyze data and present, promotes collaboration, which is very much needed in research. Deploying their experiment and collecting data allows them to appreciate real-world problems that are faced while creating reliable databases.

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

Assignments: 30%

Quizzes (2): 20% (10 + 10)

Class Participation & Hand-Written Summary notes: 10%
Final Project (teams of two or individual – apply, design, runexperiments, analyze with appropriate statistics): 40%

Title of the Course : Bioinformatics

Name of the Faculty : Nita Parekh
Course Code : SC3.202
L-T-P : 3-1-0
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Credits : 2
Name of the Academic Program : CND

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

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

CO-1: Use various web-based bioinformatic resources (databases and tools) judiciously
CO-2: Understand and implement methods for various biological sequence analysis, viz., pattern search and sequence comparison (pairwise and multiple sequence alignments), and phylogenetic reconstruction, gene prediction
CO-3: Familiarize with the probabilistic models in biological sequence analysis

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			1										3	1
CO3	2														1	

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

4.Detailed Syllabus:

Unit 1: Overview – Bioinformatics, Gene and Genome structure, Gene Technology – Restriction Endonucleases, Cloning vectors, DNA sequencing – PCR, cDNA and Whole Genome sequencing, NGS and third generation sequencing technologies

Unit 2: Bio Databases**:** Major Bioinformatics Resources – NCBI, EBI, PubMed, Primary Nucleotide and Proteins Databases - GenBank, Uniport, PDB, Genome Browsers – Ensemble, UCSC, k-mer analysis and their significance in biological sequences

Unit 3: Sequence Alignment: Pairwise Alignment – Types of pairwise alignments – Global, Local and Overlap alignments, Dot Plots, dynamic programming (DP) algorithm, Scoring matrices for nucleotides and proteins and gap penalties, Sequence-based Database Search algorithms – BLAST, FASTA, Multiple Alignment, Algorithms for Global and Local MSA – DP, Progressive based (ClustalX), Iterative methods, motif search-based methods

Unit 4: Modeling Molecular Evolution – Phylogeny: Markov models of base substitution, Computing Phylogenetic Distances, Phylogenetic Tree Construction Methods, PHYLIP

Unit 5: Gene Prediction: Gene Prediction approaches - Open Reading Frames, Homology search, Content-based methods, Markov models

Reference Books:

1. Bioinformatics Sequence and Genome Analysis, David W. Mount, Cold Spring Harbor Laboratory Press, 2001.

2. Biological Sequence Analysis, Probabilistic Models of Proteins and Nucleic Acids, Richard Durbin, Sean R. Eddy, Anders Kroghs and G. Mitchison, Cambridge University Press 1998.

3. Computational Genome Analysis – An Introduction, Richard C. Deonier, Simon Tavae and Michael S. Waterman, Springer 2005.

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

The objective of the course is to familiarize the students with available web-based bioinformatics resources (databases and tools), how to use them for analysis, extract information from them, and learn to build such tools. First by taking an example of an unknown sample, what information about the sample can be obtained starting with DNA sequence by searching through available resources is provided. Next each one is given a gene sequence, and they extract information about it, perform functional annotation, disease association, etc. To get a clear understanding of the methods learned for biological sequence analysis, the students implement algorithms for

performing various tasks such as finding k-mers, restriction recognition sites, pairwise alignment, and gene prediction.

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

1. Assignments – written, a mini-project using online resources, implementation of algorithms (30%), Class Quizzes + Mid-term evaluation (30%), Final exam (40%).

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 : Monsoon, 2024

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 systems 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 specialized 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 Textbooks:

1. Bioinstrumentation 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 Sem Exam	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	PO1 0	PO1 1	PO1 2	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. Classroom 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 Structure Interactions and Dynamics

Name of the Faculty : B. Gopalakrishnan
Course Code : SC3.321
Credits : 3-1-0- 4
L - T - P : Each week has 2 lectures and 1 Tutorials [28 L + 14 T]
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Monsoon, 2024
Name of the Program: Science Stream Elective, Odd semester

Pre-Requisites : Molecular Architecture, Advanced Biomolecular Architecture or equivalent

Course Outcomes :

1. Review of physicochemical principles at the molecular level
2. From molecules to biochemical systems – appreciation of principles of kinetics and thermodynamics for understanding mechanisms of interactions and reactions of biomolecules
3. Appreciation of the experimental methods used for exploring structures of biomolecules

3. Understanding of important structural concepts used for the analysis of protein and nucleic acid structures
4. Learning to use and understanding the principles of molecular modeling, docking and molecular dynamics simulations for inferring structures, functions and interactions from sequences –
5. Familiarity with important structural and functional databases and their usefulness in biological contexts (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.

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

Preferred Textbooks: [e-books are available]

1. *Biochemistry – Voet, Voet and Pratt*
2. *Bio-Chemistry – L. Stryer*
3. *Modeling & Simulations – Tamar Schlick*

Reference Books :

1. **Introduction to Protein Structure by Branden & J Tooze [ISBN-10 : 9780815323051]**
2. **Proteins: Structures and Molecular Properties by TM Creighton [ISBN-10 : 071677030X]**
3. **Molecular Modelling: Principles and Applications by AR Leach [ISBN-10 : 0582382106]**

E-book Links:
https://iiitaphyd-my.sharepoint.com/:f:/g/personal/shweta_kumari_research_iiit_ac_in/EldcZ_Lqj3JBlCDryuvU5z4B8twcGifr3I4ovKjixUVqSg?e=LpyvBS
Active links are also available in Moodle.

Grading Plan : (The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz-1	5
Mid SemExam	10
Quiz-2	5
End Sem Exam	30
Assignments	30
Project	10
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	2	2	3	1	3	1	2	-	-	-	-	-	3	2	2	2
CO2	2	2	3	1	3	1	2	-	-	-	-	-	3	2	2	2
CO3	2	2	3	1	3	1	2	-	-	-	-	-	3	2	2	2
CO4	2	2	3	1	3	1	2	-	-	-	-	-	3	2	2	2
CO5	2	2	3	1	3	1	2	-	-	-	-	-	3	2	2	2

Teaching-Learning Strategies in brief (4-5 sentences):
Navigating the 'Sequence – Structure – Function' Space for Biomolecules.
Understanding the 'physicochemical' principles underlying the 'structure-interaction-dynamics-function' of biomolecular machines.
Application of the above principles to analyze the relationship of few molecular systems.

Title of the course : **Blockchain and Web3 Development**
Name of the Faculty : Ankit Gangwal
Course Code : **TBD**
Credits : 4
L - T - P : 3-1-0 (L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Monsoon, 2024
Name of the Program : B Tech, MTech, MS, PhD – (MAX 40)

Pre-Requisites

1. Basic knowledge of cryptography.
2. Basic understanding of programming constructs.

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

CO-1 Demonstrate a familiarity with the knowledge of distributed ledger technology.
(Cognitive levels: *Remember*)
CO-2 Discuss different blockchain consensus mechanisms.
(Cognitive levels: *Understand*)
CO-3 Discuss various building blocks in the Solidity programming language.
(Cognitive levels: *Understand*)
CO-4 Apply the knowledge of smart contracts development to build DApps.
(Cognitive levels: *Apply*)
CO-5 Experiment and assess security, scalability, and storage requirements of smart contracts.
(Cognitive levels: *Analyze, Evaluate*)

Course Topics:

Unit 1: Introduction to decentralization and distributed consensus, Bitcoin blockchain, transactions and scripting, addresses and wallets, crypto mining, security attacks and anonymity in blockchain.

Unit 2: Bitcoin vs. Ethereum, the need for smart contracts, tokens vs. coins, Ethereum Virtual Machine (EVM), isolation and security in EVM execution model, gas system, PoS consensus.

Unit 3: Solidity, Remix IDE, basic variable types (integers, Boolean, strings, address), functions (constructor, fallback function, view/pure functions, visibility), arrays, structs, and mappings, handling errors, imports, modifiers, inheritance, events and return variables, interacting with contract Application Binary Interface (ABI), memory modifiers (memory and storage) and cost concerns, token standards (ERC-20, ERC-721, and ERC-1155).

Unit 4: DApps, backend languages, development frameworks (Truffle vs. Hardhat vs. Foundry), integrating frontend, backend, and smart contracts, unit tests, interacting with the outside world using Oracles, decentralized storage (temporarily on IPFS, permanently on Arweave), secure development using Open Zeppelin, upgradable smart contracts.

Unit 5: Scaling solutions, state channels, payment channels (PCN and PCH), side/child chains (custodial vs. non-custodial), commit and Plasma chains, Rollups (zk and Optimistic), cross chains (blockchain of blockchains), hybrid solutions (TEE-based and bisection).

Reference Books

1. A. Narayanan, J. Bonneau, E. Felten, A. Miller, and S. Goldfeder. "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction." Princeton University Press, 2016.
2. Andreas M Antonopoulos and Gavin Wood. "Mastering Ethereum: Building Smart Contracts and DApps." O'Reilly Media, 2018.
3. Huawei Huang, Jiajing Wu, and Zibin Zheng. "From Blockchain to Web3 and Metaverse." Springer, 2023.
4. Research papers.

Grading Plan: (The table is only indicative)

Type of Evaluation	Weightage (in %)
Mid-term exam, quizzes	**20**
End-term exam	**30**
Assignments and projects	**50**

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	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	2	2	1	2	1	1	1	2	2	1	3	3	3	2	2
CO2	3	3	3	3	2	1	1	1	2	2	2	3	3	3	2	2
CO3	3	3	3	2	2	1	1	1	2	2	1	3	3	3	2	3
CO 4	3	3	3	2	1	1	1	1	3	2	1	3	3	3	3	3
CO5	3	1	2	3	3	1	1	2	1	2	1	3	2	2	1	1

Teaching-Learning Strategies in brief (4-5 sentences):
The main objective of this course is to provide students with the knowledge of developments in the blockchain world. It is designed to help the students understand the fundamental concepts, state-of-the-art technologies, and frameworks used in Web3 development. The course is beneficial for students who plan to do product development and/or research in the blockchain domain. The course will be driven by classroom lectures and discussions, tutorials to supplement lectures, and hands-on assignments and projects.

Title of the Course **: Business Fundamentals**

Name of the Faculty : Himanshu
Course Code : PD2.421
Name of the Program : M.Tech – Product Design and Management
Credits : 4
L - T - P : 3-0-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Monsoon 2024

Pre-Requisites **:** None

Course Objectives:
The course introduces business fundamentals, processes and terminology to non-business students. An understanding of the legal structures (incorporation models), business models, marketing methods and practices, principles of accounting and finance. The students are introduced to the process of business model development through case studies. The methods and approaches offered in this Business Fundamentals course are aimed at improving the capacity of cross-functional teams to collaborate and create excellent products. Students who successfully complete the Business Fundamentals course will have a solid understanding of the critical skills needed for success in product management jobs.

Course Outcomes:

CO1: Demonstrate a clear comprehension of basic concepts of management.
CO2: Exhibit ability to understand the different strategic initiatives adopted by a firm to provide more value to its customers.
CO3: Develop capabilities for demonstrating leadership in decision making in product management roles.
CO4: Develop capabilities to undertake appropriate decision-making to optimize cost in developing a product by appropriately managing resources.
CO5: Develop overall capability required for product development and product marketing.

Course Topics:

- Introduction to Foundations of Business
- Forms of Business Ownership
- Business and Economics
- Organization Structure
- Fundamental areas of Management: Operations Management, HR, Marketing, Accounting and Finance, Information Systems, Strategy Management
- Ethics and Social Responsibility
- Total Quality Management
- Product Development Process and Value Creation
- Managing Teams, Leadership and Global Business

Preferred Textbook :

1. Skripak, Stephen J. 2018. Fundamentals of Business, 2nd Edition, Blacksburg, VA: VT Publishing. http://hdl.handle.net/10919/84848. Licensed with CC BY-NC-SA 4.0 https://creativecommons.org/licenses/by-nc-sa/4.0

Reference Books/Links :

- Introduction to Business, Gitman et al. An Open tax Publication. https://d3bxy9euw4e147.cloudfront.net/oscmsqa/media/documents/IntroductionToBusiness-OP.pdf
- Fundamentals of business organization and management, 2nd Edition, Y K Bhusan, ISBN: 9789351610618.
- Business Fundamentals: How to Become a Successful Businessman, First Edition, Roger W. Babson.

https://vtechworks.lib.vt.edu/bitstream/handle/10919/111385/Fundamentals_of_Business_4e.pdf?sequence=4&isAllowed=y

Grading Plan:(The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz-1	10
Mid Sem Exam	20
End Sem Exam	30
Assignments	25
Project	15

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

Teaching-Learning Strategies in brief (4-5 sentences):
The sessions would be held in a mix of online and offline classes. The course would involve class lectures, power point presentations, videos, and case study discussions. The students will be required to go through the materials before coming to the class. For each session, every student is expected to go through the suggested topic to facilitate classroom discussion. Furthermore, every student is encouraged to participate in class discussions as the course would adopt an integrative pedagogical approach. Periodic assignments would be given that would require students to reflect and respond based on learning.

Title of the Course : Chemistry Topics for Engineers

Name of the Faculty : Tapan K Sau + Prabhakar B
Course Code : SC2.309
L-T-P : 3-1-0.
Credits : 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
PROGRAM : CSE

1.Prerequisite Course / Knowledge: NONE

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

CO-1 Demonstrate understanding of the chemical principles behind spectroscopy.
CO-2 Apply the various spectroscopies to solve for chemical identity of system under study.
CO-3 Provide students with a conceptual understanding of electronic properties in solid materials.
CO-4 Define terminology used in the fields of modern materials chemistry.
CO-5 Learn and identify various applications of modern materials and their future potential.
CO-6 Learn the importance and various methods of green synthesis.

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

Detailed Syllabus:

Unit 1: Introduction to modern atomic theory and its application to explain the atomic spectra and molecular spectra. Origin of electronic, vibrational and rotational levels, and their signatures in spectra. (3L)

Unit 2: Excited states of atom and molecules. Lasers. Fluorescence, phosphorescence, and Froster energy transfer(2L)

Unit 3: Introduction to Nuclear Magnetic Resonance Spectroscopy, and Electron Spin Resonance Spectroscopy (2L)

Unit 4: Modern Electrochemistry. Butler-Volmer equation. Biosensing using electrochemical principles (4L)

UNIT 5: Molecular Orbital Theory (Polar and Ionic compounds, Conductors, Semiconductor); Inorganic Pigments and Phosphors; and Superconductors Chemistry. (5L)

UNIT 6: Modern and Futuristic Materials: Hydrides and Hydrogen Storage Materials; Molecular Materials; Liquid Crystals; Conducting Polymers; Supramolecular and Nanostructured Materials. (6L)

UNIT 7: Green Synthesis: Principles and methods of synthesis with examples. (1L)

Reference Books:

1. Physical Chemistry by Atkins and De Paula
2. Principles of Molecular Spectroscopy by Barnwell
3. Chemical Principles: The Quest for Insight (5e) by P. Atkins and L. Jones
4. Principles of Modern Chemistry (8e) by D.W. Oxtoby, H.P. Gillis, and L. J. Butler

5.Teaching-Learning Strategies in brief:

This is a course covering (a) spectroscopy and their use in determining composition and other properties in system, and (b) chemical principles behind various materials and devices seen in modern life.

6.Assessment methods and weights in brief:

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

Title of the Course **: CMOS References and Regulators**
Name of the Faculty : Zia Abbas + Abhishek Pullela
Course Code : TBD
L-T-P : 3-1-0.
Credits : 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Academic Program: B. Tech/MS in ECE

Prerequisite Course / Knowledge: Circuit theorems, basics of MOS amplifiers, analog circuits

Course Outcomes (COs):

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

CO-1: Understand the how power supply is generated in real world applications and trade-offs between power, area, and other parameters.

CO-2: Understand Process/Supply/Temperature/Mismatch/Noise variations in circuits.

CO-3: Design voltage and current references for micro-watt/nano-watt/pico-watt power range applications.

CO-4: Perform stability analyses in complex loops and understand compensation techniques.

CO-5: Design a low drop-out voltage regulator by integrating references and op-amps and understand challenges in integration.

CO-6: Design oscillator circuits like ring oscillator, relaxation oscillator and crystal oscillator.

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

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

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 Internet-of-Things, Various analog systems in IoT, review of important concepts like op-amp design.

Unit 2: PVT variations, resistor and BJT based PTAT and CTAT generating elements, temperature compensation, defining specifications of voltage reference line regulation, PSRR, accuracy, process-spread, etc., Brokaw bandgap reference, variations of Brokaw bandgap reference, op-amp based bandgap references, op-amp less bandgap references, design procedure for bandgap references, sub-bandgap references, PSRR analysis in bandgap references, applications of micro-watt bandgap references, start-up circuits, capacitor based and non-capacitor based start-up circuits, switched capacitor bandgap references.

Unit 3: Sub-threshold region of operation, need for MOS based and BJT-MOS hybrid voltage references, MOS only PTAT and CTAT generating cells, 2-transistor based voltage references, process spread comparison between bandgap and MOS based voltage references, trimming circuits for voltage references, BJT and MOS hybrid voltage reference architectures, nano-watt and pico-watt design considerations for IoT applications, 2-transistor PTAT cells, analog temperature sensor, constant gm-bias circuitry, resistor-less and op-amp less reference design, extending analog temperature sensor to digital output sensor using saw-tooth generators, current reference design, op-amp considerations in current references, introduction to gate-leakages in lower technology nodes, gate-leakage based reference architectures.

Unit 4: Integrating bandgap reference, two-stage/folded-cascode op-amps and pass transistor stage in LDO, defining LDO specs like accuracy, line regulation, load regulation, PSRR, loop gain, offset, phase margin, start-up time, undershoot, overshoot, etc., different trade-offs for various industrial applications, NMOS and PMOS LDOs, performance comparison between NMOS and PMOS LDOs, stability compensation techniques, feedforward compensation, DC-DC converter, efficiency comparison between LDOs and DC-DC converters, buck regulator, small-signal model for type-1, type-2, type-3 buck regulator.

Unit 5: Design procedure for LDO, other LDO architectures, comparison between different LDOs, introduction to frequency references, deriving relaxation oscillator from scratch, replacing resistors with references in relaxation oscillators, introduction to ring oscillators, 3-stage and multi-stage ring oscillator design trade-offs, introduction to crystal oscillator and design procedure for crystal oscillator, introduction to voltage-controlled oscillators and their design procedure.

Reference Books:

1. Behzad Razavi. Design of analog CMOS integrated circuits. , 2005.
2. P. E. Allen and D. R. Holberg, "CMOS Analog Circuit Design," 2nd Edition, Oxford University Press, New York, 2004.
3. Power Management Techniques for Integrated Circuit Design By Ke-Horng Chen, Wiley-Blackwell, 2016.
4. Gray, Paul R. and Robert G. Meyer. "Analysis and Design of Analog Integrated Circuits." (1993).

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

The course will commence by exploring the motivations behind analog circuit design, delving into its real-world applications and the utilization of power management circuits within these contexts. Then, fundamental and core topics of the course will be discussed in detail both at block level and transistor level with hands-on with Cadence Virtuoso tool. During tutorial sessions, select circuits discussed in class will be practically implemented and simulated in different technology nodes using Cadence Virtuoso. This hands-on approach provides students with firsthand experience in circuit design under stringent constraints akin to those encountered in industry applications. Assignments will encompass a blend of equation-solving exercises and analytical questions. Mini projects will consist of small-scale analog blocks (based on industry specs) and the final project will be to integrated all these blocks. To encourage innovation in low-power circuit design, students will be tasked with reviewing research papers, preparing project reports, and delivering presentations to hone their research skills. Assignments, including quizzes and exams, will evaluate students' intuitive grasp of the concepts.

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

- Assignments: 20%
- Mid Semester Exam: 10%
- End Semester Exam: 30%
- Mini Projects – 20%
- Project: 20%

Title of the Course : **Chemical Kinetics and Reaction Dynamics**

Course Code : SC2.305
Name of the Faculty : Harjinder Singh
L-T-P : 3-1-0
Credits : 2
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. Determine the rate law for a reaction, the overall order of reaction, the integrated rate laws, the rate constants of the reactions and temperature dependence, and the order of the reaction from concentration/time plots and apply the rate equations to determine the concentration of chemical species and order of the chemical reactions.
CO-2. Explain a reaction mechanism, identify the reaction intermediates and catalysts, determine the molecularity of each step, write the overall reaction, and explain how enzymes act as biological catalysts and why enzymatic reactions respond differently to temperature changes.
CO-3. Interpret a potential energy diagram and a reaction coordinate diagram, potential energy profiles and use them to determine the activation energy and potential energy changes for a reaction.
CO-4. Use Collision Theory to explain how reactions occur at the molecular level, the concept of activation energy and how the collision frequency, kinetic energy, temperature, and orientation of colliding reactant molecules affect the rate of a chemical reaction.
CO-5. Apply transition state theory to explain the roles of various physical factors that govern chemical reactivity.
CO-6. Describe the physical principles that govern electron transfer reactions and explain Marcus theory.
CO-7. Solve problems on chemical kinetics and reaction dynamics of unimolecular, bimolecular, and complex reactions
CO-8. Relate experimental observations to theoretical aspects of chemical kinetics and identify applications of chemical kinetics in everyday life and industry.

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		2														3
CO4	3															3
CO5				3												3
CO6	3															
CO7				3												3
CO8			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: Empirical chemical kinetics: Experimental techniques; The rates of reactions; Integrated rate laws; Reactions approaching equilibrium; The temperature dependence of reaction rates; Accounting for the rate laws; Elementary reactions; Consecutive elementary reactions; Impact on biochemistry: The kinetics of the helix-coil transition in polypeptides; Unimolecular reactions. (2L)

Unit 2: Chain reactions; The rate laws of chain reactions; Explosions; Polymerization kinetics; Stepwise polymerization; Chain polymerization; Homogeneous catalysis; Features of homogeneous catalysis; Enzymes. (2L)

Unit 3: Photochemistry, Kinetics of photophysical and photochemical processes; Impact on: The chemistry of stratospheric ozone; Applications: Impact on environmental sciences, biochemistry, and other areas. (1L)

Unit 4: Molecular Reaction Dynamics: Reactive encounters; Collision theory; Diffusion-controlled reactions; The material balance equation. (2L)

Unit 5: Transition state theory; The Eyring equation; Thermodynamic aspects; The dynamics of molecular collisions; Reactive collisions; Potential energy surfaces; Some results from experiments and calculations. (2L)

Unit 6: The investigation of reaction dynamics with ultrafast laser techniques; Electron transfer in homogeneous systems; The rates of electron transfer processes; Theory of electron transfer processes; Experimental results; Impact on biochemistry: Electron transfer in and between proteins. (2L)

Unit 7: Special topics (oscillating reactions, etc.). (1L)

Reference Books:

1. P. Atkins and J. Paula (2014), *Physical Chemistry*, 10th edition, Oxford University Press, Oxford.
2. D. A. McQuarrie and J. D. Simon (1997), *Physical chemistry: a molecular approach*, 1st edition, University Science Books, California.
3. J. Laidler (1998), *Chemical Kinetics*, 3rd edition, Harper & Row, New York.
4. S. Berry, S. A. Rice and J. Ross (2007), *Physical Chemistry*, 2nd edition, Oxford University Press, Oxford.

5. K. Rohatgi-Mukherjee (2014), *Fundamentals of Photochemistry*, 3rd edition, New Age International Pvt. Ltd., New Delhi.
6. I. Steindeld, J. S. Francisco, W. L. Hase (1989), *Chemical Kinetics and Dynamics*, 2nd edition, Prentice Hall International Inc., New York.

5.Teaching-Learning Strategies in brief (4 to 5 sentences):
The course involves formal lectures, quizzes, assignments and tutorials.

6.Assessment methods and weightages in brief (4 to 5 sentences):
Students' assessment will be on the basis of:

1. Assignments: 30%
2. Quizzes: 20%
3. End-Sem Exam (*WHOLE Syllabus*): 50%

Title of the Course : Computational Linguistics 2

Name of the Faculty : Rajakrishnan P Rajkumar + Parameswari K
Course Code : CL3.202
L-T-P : 3-1-0
Credits : 4
Name of the Academic Program: : CLD

1.Prerequisite Course / Knowledge : Introduction to Linguistics-1 and 2; Computational 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 analyze language at semantic and pragmatic levels
CO-2 Develop requisite skills for problem solving at discourse and conversation levels
CO-3 Develop computational resources and tools for handling text, contextual interpretation of text and representation of meaning in context.
CO-4 Perform theoretical research in computational semantics and computational discourse analysis
CO-5 Apply CL/NLP techniques for real world applications by using real time dialog and discourse data

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	1	1	3	1	2	2	1	1	2	3	1	2	3
CO2	3	3	3	3	3	3	1	2	2	1	1	2	3	1	2	3
CO3	3	2	3	3	3	3	3	2	2	3	1	1	3	1	3	3
CO4	3	2	3	3	3	3	1	2	2	1	1	2	3	1	3	3
CO5	2	2	3	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: *Background for studying word meaning and sentence meaning, sentence meaning and propositional content; sense and reference; referent, extension, prototype, stereotype; deixis and definiteness; predicates, referring expressions, universe of discourse; properties of sentences - analytic, contradiction, entailment; properties of predicates - reflexive, symmetry, transitive. Word meaning and sentence meaning, content word and grammatical word, contextual variation; Speaker meaning vs Sentence meaning. Building resources using Lexical semantic relations - Synonymy, Antonymy, Hyponymy, Troponymy, Meronymy; Metaphor and Metonymy; Polysemy and Homonymy; Semantic fields; Lexical ambiguity; Building dictionaries; Ontologies.*

Unit 2: Formal Semantics: *Formal representation of natural language - semantic features, case frames, semantic primitives. Logic, notation for simple propositions; connectives – and, or, but, if etc.; Logical expressions for ambiguous sentences*

Unit 3: Pragmatics and Discourse: *Pragmatics and Discourse analysis as a study of context dependent aspects of meaning; text, co-text, context and relevance. Computational Discourse analysis: Studying Structure of text and coherence; exchange structure and conversational analysis; turn taking; adjacency pairs; preference organization; deixis; anaphora; ellipsis; discourse connectives and relations; Structural analysis of different kinds of texts.*

Unit 4: Text classification and generation: Memory and knowledge representation as schemas - frames, scripts and story grammar; Generation and processing of texts: Sentiment Analysis. Humour Analysis.

Unit 5: Computational Pragmatics: *Language Understanding; Meaning beyond textual context; speaker's intention and hearer's inference; inference - bridging inferences, causal and spatial inferences, elaborative and restrictive inferences; Application of pragmatic concepts in Dialogue Systems: conversational implicature, conventional implicature, entailment and presupposition; co-operative interaction and Gricean maxims; speech act theory; language as action, performatives, direct and indirect speech acts and felicity conditions; politeness maxims; Austin and Searle's speech acts; Dialogue data annotation: Dialog Acts, Rhetorical Structure Theory*

Reference Books:

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

2. James R. Hurford& Brendan Heasley (1983). SEMANTICS - a course book. Cambridge University Press.
3. Judith Greene (1986). Language Understanding - a cognitive approach. Open University Press.
4. Lyons, John. (1977). Semantics. Cambridge University Press.
5. Levinson, Stephen C. (1983). Pragmatics. Cambridge University Press. Leech, Geoffrey. (1983). Principles of Pragmatics. Longman.
6. Brown, G and Yule, G. (1983). Discourse Analysis. Cambridge University Press. Cutting, Joan (2002). Pragmatics and Discourse: A resource book for students.
7. Allen, James. (1994). Natural Language Understanding. Pearson.

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 real time situations and uses.

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 analyze and generate data at the level of semantics and pragmatics. 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 : Computer Problem Solving

Name of the Faculty : Shatrunjay Rawat
Course Code : CS0.301
Name of the Academic Program : MTech CASE
L-T-P : 3-1-0
Credits : 4

1.Prerequisite Course / Knowledge:
None
2.Course Outcomes (COs) (5 to 8 for a 3 or 4 credit course):
After completion of this course successfully, the students will be able to..

CO-1: Demonstrate an understanding of computer programming language concepts.
CO-2: Ability to design and develop C programs, implement the concept of pointers, declarations, initialization, operations on pointers and their usage, arrays, functions. Able to define data types and use them.
CO-3: Ability to define and manage data structures based on problem subject domain.
CO-4: Ability to analyze the complexity of the solution offered.

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	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	3	1	-	-	-	-	-	-	-	-	-	-	3	3
CO2	1	2	3	1	-	-	-	-	-	-	-	-	-	-	3	3
CO3	1	2	3	1	-	-	-	-	-	-	-	-	-	-	3	3
CO4	1	2	3	1	-	-	-	-	-	-	-	-	-	3	3	3

4.Detailed Syllabus:

Unit 1: Basics of C Programming, Variables declaration, Input-Output, Operators
Unit 2: Arrays and Strings and Control Statements
Unit 3: Functions, Pointers
Unit 4: File Handling, Memory management
Unit 5: Stacks, queues, Linked Lists
Unit 6: Sorting Algorithms
Unit 7: Understanding Algorithm Complexity
Unit 8: Problem Solving and Computations Thinking

Reference Books:

1. The C Programming Language -Brian Kernighan and Dennis Ritchie
2. Art of Computer Programming, Vol. I, II, III, D. E. Knuth, Addison Wesley.
3. How to solve it by computer, R. Dromey, Prentice-Hall India

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

Any concept introduced in the lecture is followed by implementation in the lab session and further discussion and practice on the same in the tutorial. Assignments help students to think about implementing the most efficient solution. Project is to be chosen from the domain the student is from. This brings in a practical application of programming to the field of work.

6.Assessment methods and weightages in brief (4 to 5 sentences)
Term Papers (2): 15% + 20 %
Quizzes:20 %
Lab Exams: 10%
Project and assignments: 35%

Title of the Course : Computer Programming

Faculty Name : Girish Varma + Charu Sharma +TBD
Course Code : CS0.101
L-T-P : 3-1-3
Credits : 5
(L = Lecture Hours, T = Tutorial Hours, P = Practical Hours)
Name of the Academic Program: B.Tech

Prerequisite Course / Knowledge:
Basic high school mathematics.
Course Outcomes (COs):
After completion of this course successfully, the students will be able to...
CO-1: Demonstrate an understanding of computer programming language concepts like variables, data types, conditional, loop, print statements and functions.
CO-2: Ability to use pointers, arrays, initialization, dynamic memory allocation and use gdb to debug issues with the code.
CO-3: Design and implement algorithms using recursing, iteration with specific use cases like sorting.
CO-4: Design structured data storage using structs, and read/write them to hard disk using file I/O
CO-5: Ability to analyze the complexity of the solution offered in terms of memory and runtime and choose efficient alternatives.
CO-6: Develop large scale programs using multiple files, header files and make.
Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
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: Basic computer organization, High level programming languages, assemble code, binary instructions, compilers. Program editing, compilation and execution cycle. Basic data types and their representation, Expressions, Operators and precedence levels, Basic I/O functions, Writing straight-line sequence of code, Conditional Statements (if-then-else, switch case). Functions

Unit 2: Loops (for, while etc.), Arrays, Multidimensional Arrays, Parameter passing mechanisms, Pointers, Strings, Pointer Arithmetic.

Unit 3: Recursion, Program stack, scope and lifetime of variables., heap memory, dynamic memory management, linked lists and memory leaks.

Unit 4: Structures, and Enumerations, Standard libraries for string manipulation, disk file access etc. Preprocessor directives, multi-file programming and Make files.

Reference Books:

1. Computer Science: A Structured Programming Approach Using C, 3rd Edition by Behrouz A. Forouzan, Richard F. Gilberg.
2. The C Programming Language -Brian Kernighan and Dennis Ritchie.
3. Let Us C by Kanetkar Yashavant P.

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

Lectures are conducted in a highly interactive fashion. At the end of every class, a small practice problem which helps in enhancing the concepts discussed in the class will be released. Tutorial sessions are used to teach the utilization of tools such as Visual Studio Code, GCC, GDB, GIT, Make files, perf, valgrind 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. On the rest of the days, 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.

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

- Labs: 20%
- Assignments: 30%
- Mid Sem: 20%
- End Exam: 30%

Title of the Course : **Computing in Sciences-1**

Name of the Faculty : U Deva Priyakumar
Course Code : SC4.101
L-T-P : 2-0-3
Credits : 2

1.Prerequisite Course / Knowledge:

Familiarity with running programs in BASH shell.

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

CO-1 Demonstrate understanding of basic concepts of molecular modelling
CO-2 **Demonstrate the familiarity in operating** prepackaged software commonly used in molecular mechanics, quantum chemistry, and visualization of molecular systems
CO-3 Compute (a) simple thermodynamic properties using quantum chemistry software for small molecules (b) thermodynamic properties using molecular dynamics 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	PSO2	PSO3	PSO4
CO1	2	1	1	1	1	2	1	1	2	1	2	2	2	2	1	1
CO2	2	2	2	2	2	3	2	1	1	2	1	2	1	1	1	1
CO3	2	2	1	2	2	3	2	1	2	2	1	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:
Unit 1: Basic outline of application of quantum mechanics to molecule/s. Variational Theorem, and introduction to density functional theory. Basis sets. Geometry Optimization and Frequency calculation. And other 'simple' properties from output of Quantum Chemistry software
Unit 2: Motivation for Classical mechanical models of molecules. Use of Newtonian equations of motion to model dynamics of molecular systems. Motivation for ergodic hypothesis, and calculation of thermodynamic properties.

Reference Books:
1. Molecular Modeling by Andrew Leach
2. Molecular Modeling for beginners by Alan Hinchliffe
3. Software user manual for the following: GAUSSIAN, MOLDEN, NAMD and VMD.

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

A lecture on a theory concept will be immediately followed by on-hands-practice using appropriate scientific software. Students will be encouraged to read carefully all the log files and become familiar with technical language, in addition to homework and assignments which will be mini projects with specific task.

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

The course will rely heavily on the submission of work done using scientific software like setting up input files, preparing initial molecular structures; this work will be in-class or tutorial submissions, homework etc.
End semester will carry 40% weightage of which 75% component will be based on demonstrating familiarity with scientific software taught in the course.
Homework and assignments will carry a weightage of 25%, while the in-class and tutorial submission will be another 10%. Finally, the remainder 15% will be theory part.

Title of the course : Data Analytics-I

Name of the Faculty : Krishna Reddy Polepalli
Course Code : CS4.405
L-T-P : 3-1-0
Credits : 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
TYPE-WHEN Fifth semester and onwards

1. Prerequisite Course / Knowledge:

(i) Data and Applications*, or equivalent courses that cover Data modelling, normalization, SQL*
(ii) First courses on programming, data-structures and algorithms
(iii) Basics of Python language, to be able to use relevant libraries and toolkits for data analytics

2.Course Outcomes (COs)
Objective: In a computerized and networked society, vast amount of data is being collected every dayin multiple domains. We are drowning in data but starving for knowledge or actionable insights. Datamining or data analytics constitute a collection of concepts and algorithms, which are being developedto answer "how" questions by extracting interesting and useful knowledge of from large data. Data analytics-based platforms are being operated in multiple domains to extract valuable and actionable insights from the data to improve the business performance. The objective of this first level course is tolearn the important concepts and algorithms related to data mining functionalities such as summarization, pattern mining, classification, clustering and outlier analysis.

The Course Outcomes (COs) are as follows:

- After completing the course successfully, the students are able to
  - CO-1. describe the concepts of data summarization, data warehousing, pattern mining,classification and clustering approaches
  - CO-2. perform the task of data summarization, pattern mining, classification and clustering based on the requirement.

- CO-3. prescribe a single or a combination of data summarization, pattern mining, classification and clustering approaches for the problem scenario of a business/organization.
- CO-4. construct the improved data analytics methods for existing services.
- CO-5. formulate new data mining problems for creating new services and design thecorresponding solutions
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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	PO 10	PO1 1	PO 12	PS O1	PS O2	PS O3	PS O4
CO1	3	2	3	3	3	3	2	2	3	2	2	3	2	2	2	3
CO2	3	1	3	1	3	2	1	1	3	3	2	3	2	1	2	3
CO3	1	3	1	3	1	1	1	1	1	1	1	3	3	1	2	3
CO4	1	2	1	3	3	1	1	1	3	1	2	3	3	1	2	3
CO5	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.

4. Detailed Syllabus

(please list the order in which they will be covered)
Unit 1: Introduction, data summarization through characterization, discrimination and datawarehousing techniques (9 hours)
Unit 2: Concepts and algorithms for mining patterns and associations (9 hours) Unit 3: Concepts and algorithms related to classification and regression (9 hours)Unit 4: Concepts and algorithms for clustering the data (9 hours)
Unit 5: Outlier analysis and future trends. (3 hours)

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

Reference Books and materials:

1. Book: Jiawei Han and Micheline Kamber, Data Mining: Concepts and Techniques, Thirdedition, 2012, Elseiver Inc.
2. Book: Pang-Nong Tan, Michael Steinbach and Vipin Kumar, Introduction to Data Mining,2006, Pearson Education.
3. Research Papers: About 25 research papers from the proceeding of the conferences and journals related to data summarization, data warehousing, pattern mining, classification,clustering, outlier detection.

5. Teaching-Learning Strategies in brief

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

6. Assessment methods and weightages in brief

Two Classroom tests: 10 marks; Mid Semester Examination in theory: 20 marks, End Semester Examination in Theory: 40 marks, Assessment of 5 mini projects in Laboratory:30 marks

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Title of the Course : Data and Applications [Half]

Name of the Faculty : Ponnurangam Kumaraguru
Course Code : CS4.301
L-T-P : 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

1.Prerequisite Course / Knowledge: Data Structures

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

CO-1. State data requirements for an application.
CO-2. Develop a conceptual model (such as, Entity Relationship Model and Diagram) for a set of data requirements.
CO-3: Comprehend relational data model and integrity constraints, and relational database design with normalization.
CO-4. Map the conceptual model to a relational data model and create and populate its corresponding relational database
CO-5. Map user queries into correct relational algebra, Structured Query Language (SQL), and tuple relational calculus expressions/statements. And updates using SQL.
CO-6. Implement an application to access, query and update a relational database.

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

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

4.Detailed Syllabus:

Unit 1: Data, Database, Database System (3 hours)
Unit 2: Data models, Conceptual Data Modeling, ER Models (5 hours)
Unit 3: Relational Data Model, Relational Algebra, Tuple Relational Calculus (6 hours)
Unit 4: SQL, Constraints, Triggers, Database Connectivity, Applications (3 hours)
Unit 5: Normalization, Relational Database Design (4 hours)

1. Four mini projects related to the above syllabus will be done by students. References:
2. Elmasri & Navathe, Fundamentals of Database Systems, 6th Edition, Pearson Education, 2013
3. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, Database system concepts, fifth edition, Mc Graw Hill, 2006

5.Teaching-Learning Strategies in brief:
Lectures by integrating ICT into classroom teaching, weekly tutorials involving problem solving and active learning by students and Project-based Learning by doing four mini-projects.

6.Assessment methods and weightages in brief:
Assignments in theory: 10 marks, Quizzes in theory: 10 marks, Mid Semester Examination in theory: 20 marks, End Semester Examination in Theory: 30 marks, Assessment of four mini projects: 30 marks

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Title of the Course : Data Structures & Algorithms for Problem Solving

Name of the Faculty : Kshitij Gajjar + Lini Thomas
Course Code : CS1.304
Credits : 6
L - T – P :3–0 -2
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Monsoon 2024

Name of the Program: M. Tech in CSE/CSIS

Pre-Requisites : Basic computer programming
Basic Mathematics

Course Outcomes :

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

CO-1: Understanding of fundamental and advanced Data Structures including linked-lists, trees, binary search trees, AVL trees, stacks, queues, heaps, hash-table, tries and suffix tree.
CO-2: Ability to program data structures and use them in implementations of abstract data types.
CO-3: Ability to devise novel solutions to small scale programming challenges involving data structures and recursion.
CO-4: Understand basic algorithms including recursion, searching, hashing, dynamic programming, and traversal.
CO-5: Understanding of basic algorithmic complexity. Ability to perform simple inductive proofs and proofs by contradiction and reason about program correctness and invariants.

CO-6: Given a real-world problem have ability to sensibly select appropriate data structures and algorithms for solving the problem and be able to implement the solution.

Course Topics :

(Please list the order in which they will be covered, and preferably arrange these as five to six modules.)
Unit 1: Review of basic data structures and algorithms (Linked list, stack, queue, 2D arrays, dynamic programming, recursion etc.)
Unit 2: Algorithms on Trees and Graphs (Binary Search Tree, AVL Tree, Heaps, Graph Traversal, shortest path algorithms etc.)
Unit 3: Problem solving with other data structures and algorithms (Hashing, Tries, Splay Trees, Range Trees, sorting etc.)

Reference Books: Introduction to Algorithms, 3rd Edition (The MIT Press) 3rd Edition
by Thomas H. Cormen , Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein

Grading Plan : (The table is only indicative)

Type of Evaluation	**Weightage (in %)**
Quiz-1	**5**
Mid Sem Exam	**10**
Quiz-2	**5**
End Sem Exam	**25**
Assignments	**20**
Weekly Labs	**10**
Mid Lab exam	**10**
Final Lab exam	**15**

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

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

The course involves heavy theory and programming components. The strategy is to first thoroughly cover all the basics, with board-work-based teaching. The basics will be covered by solving examples problems, analyzing complexity, writing pseudo codes on board. In second stage, each class will introduce a problem statement, discuss solutions which go beyond the already covered topics. Introduce the novel algorithm or data structure, solve the problem in class and cement the idea and use case. Give them ideas on other problems where the discussed algorithm or data structure can be applied. The course will also have weekly labs, which will allow students to practice and code problems related to the topics covered in the class. There will be regular assignments with focus on the problem-solving aspect.

Title of the Course : Deep Learning: Theory and Practices

Name of the Faculty : Naresh Manwani
Course Code : CS7.601
CREDITS : 4 Credits
L-T-P : 3-0-1
TYPE-WHEN : Monsoon 2024

PRE-REQUISITE : Good background in Linear Algebra and Probability theory, Statistical Methods in AI (Mandatory), Optimization Methods (Optional)

OBJECTIVE: The course is designed to cover the fundamentals of Deep Learning in depth. The objective of this course is to familiarize the audience with the theoretical as well as practical aspects of deep learning.

COURSE TOPICS:

CO-1: Representation power of feedforward neural network, limitations of shallow networks, why and when can deep networks avoid curse of dimensionality.
CO-2: Perceptron, convergence proof. Feedforward neural network, back propagation, loss surfaces, learning rates, optimization for deep networks: gradient descent (GD), momentum-based GD, Nesterov accelerated GD, stochastic GD, AdaGrad, RMSProp, Adam.
CO-3: Bias variance tradeoff: overfitting and under-fitting. L2 regularization, early stopping, dataset augmentation, parameter sharing and tying, injecting noise at input, ensemble methods, dropout. Greedy layerwise pre-training, better activation functions, better weight initialization methods, batch normalization
CO-4: Auto-encoders and relation to PCA, regularization in auto-encoders, denoising auto-encoders, sparse auto-encoders, contractive auto-encoders, variational auto-encoders (VAEs), Word2vec and its relationship to latent semantic indexing (LSI).
CO-5: Convolutional neural networks (CNNs), backpropagation in CNNs, LeNet, AlexNet, Inception, VGG, GoogLeNet, ResNet, Densenet.
CO-6: Recurrent neural networks, backpropagation through time (BPTT), vanishing and exploding gradients, truncated BPTT, stability, bidirectional RNNs, gated recurrent units (GRUs), long short-term memory (LSTM), solving the vanishing gradient problem with LSTMs.
CO-7: Encoder Decoder Models, Attention Mechanism, Hierarchical Attention, Transformers, Generative Adversarial Networks (GANs), Diffusion Models, Graph Neural Networks.

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

PREFERRED TEXT BOOKS:

1. Simon Haykin. 1998. Neural Networks: A Comprehensive Foundation (2nd ed.). Prentice Hall PTR, Upper Saddle River, NJ, USA.
2. Ian Goodfellow and Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016.
3. R. Rojas: Neural Networks, Springer-Verlag, Berlin, 1996.
4. Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, Dive into Deep Learning, 2021

REFERENCE BOOKS: Recent research papers in deep learning (papers published in ICLR, ICML and NIPS)

GRADING PLAN:

Type of Evaluation	**Weightage (in %)**
Quiz-1	7.5 %
Quiz-2	7.5 %
End Sem Exam	30 %
Assignments	40 %
Mid-Sem	15%

OUTCOME : By the end of the course, it is expected that students will have very good familiarity with the topics in deep learning, and they should be able to apply deep learning to a variety of problems. They will also be in a position to understand the current literature in deep learning and extend their knowledge through further study (research).

Title of the Course : Design for Social Innovation

Name of the Faculty : Ramesh Loganathan & Ramana Gogula
Course Code : CS9.429
L-T-P : 3-1-0
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: None specific.

General understanding of systems & design. Any UG3, UG4, M.Tech.& MS/Ph.D. student can take.

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

The course will provide a rigorous overview of social sector and the need for technology led innovations in addressing the same. Leading to insights, concepts, and tools for designing solutions for social impact.

A social immersion led course to understand the problems and needs of the grassroots and solve them in creative ways leveraging technology. Work with social organizations or NGOs to get a first-person view of the ground reality, and understand problems that need to be solved.

Understand the tools and frameworks they need to define and design technology for social impact. Explore creative solutions to address these social problems, leveraging emerging technologies. Inspire social enterprises through the technology led journey.

Course Outcomes:

CO1-Understand how to evaluate social needs and solution opportunities
Social Immersion: A social immersion led course to understand the problems and needs of the grassroots and solve them in creative ways leveraging technology.

CO2-Connect solutions with markets and identify requirements & target user segments.
Societal Challenge Identification: Work with social organizations or NGOs to get a first-person view of the ground reality, and understand problems that need to be solved.

CO3-Assess alternatives and evolve unique Value proposition. Define and design the solution.
Design For Change: Understand the tools and frameworks they need to define and design technology for social impact.

CO4-Engineer & Build the solution for the real world. As part of the course project
Technology For Social Innovation: Explore creative solutions to address these social problems, leveraging emerging technologies. Inspire social enterprises through the technology led journey.

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

Mapping to the POs of the **PDM** program.

	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

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

PEDAGOGY

Design For Social Innovation (DFSI) is a project-based course that will enable students to do a deep dive into societal challenges being addressed by NGO(s), social enterprises & the government and build solutions to alleviate these complex social problems through immersion, design & technology.

The pedagogy will include interactive lectures, inspiring guest talks, field visits, social immersion and a course project. Applying and synthesizing information from these sources to define the social problem to address and take up the solution as the course project, with your group. Social immersions with NGOs/social sector will be a key part of the course. Will all lead to the course project that will address needs of the social sector.

COURSE TOPICS

The course will introduce social context and various players in the social space, present approaches to discover and understand social needs. Social immersion and inspiring conversations that will culminate in developing an actual, idea for problem-based intervention, based on an in-depth understanding of a key social problem.

The course will comprise of four modules, one in each month. Each module will address few topics through lectures, chance to meet the social change makers through guest lectures, upclose work with NGOs and in parallel work on the course project.

MODULE [I] ***Social Immersion***

- What Is Social Innovation
- Interaction With Leading Changemakers
- Identifying Core Developmental Sectors [Agri, Fintech, Healthcare, Edu etc] & Field Visits
- Student Paper [I] Case Study On A Social Innovation Of Choice
- Hackathon #1: Needs Identification (maybe, during a field immersion/at an NGO)

MODULE [II] ***Societal Challenge Identification***

- Deep Dive Into Defining The Problem
- Market Research/Competitive Landscape
- Circular Validation From Stakeholders [Organizations/Customers/End Users]
- Student Paper [II] White Paper On The Chosen Social Innovation
- Hackathon #2: Design thinking/Problem definition

MODULE [III] ***Design For Change***

- Ideation/Design Thinking On Problem Breakdown
- Build An SRS Document
- Identify Technology Components For Social Innovation
- Project Design & Execution Plan.
- Hackathon #3: Solution design, Design thinking & Prototypes

MODULE [IV] ***Technology For Social Innovation***

- Updates On Building The Technology
- Examples of technology used in social innovation
- Teams to build in the use of emerging technology/research.
- Hackathon #4: Final hackathon. Complete the solution

Finale

- Deploy Solution In Stakeholder/End User Environment. Measure Impact
- 15 Minute Presentation *Structure To Be Designed*
- Term Paper *Technology For Social Innovation*

PREFERRED TEXT BOOKS: Course material and reference/prescribed reading will be shared.

GRADING PLAN: Type of Evaluation	**Weightage (in %)**
Quizzes	**10**
Assignments [Paper [I/II]	**15**
Hackathons (2)	**30**
Technology Demonstration	**15**
Stake Holder Presentation	**15**
Final demos & Term paper (based on social immersion)	**15**

Reference courses

- Stanford: Center for Social Innovation offers Design for Extreme Affordability (OIT333 link)
- LSE: Social Innovation design (MG4G2-link)
- UPenn impact immersion week program (NPLD 585 link)
- Columbia- Design for social innovation (link)

Title of the Course : Design for Testability

Name of the Faculty : Usha Gogineni (Guest Faculty)
Course Code : EC2.407
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:
1. Should have taken VLSI Design or equivalent course. Knowledge of Combinational and Sequential Circuits, VLSI Design Flow. **(Mandatory)**
2. Familiarity with Verilog HDL **(Highly preferable but not mandatory)**

2. Course Outcomes (COs): After completion of this course successfully, the students will be able to:
CO-1: Understand the role of testing in VLSI design flow and apply the concepts of testing in IC Design for better yield.
CO-2: Apply various test pattern generation methods for automatic test pattern generation in production testing.
CO-3: Identify the design for testability methods used in combinational & sequential CMOS circuits.
CO-4: Tackle the problems associated with testing of semiconductor circuits at an early design stage, thus significantly reducing testing costs.
CO-5: Apply Built-in Self-Test (BIST) techniques for improving testability.

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

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

4.Detailed Syllabus:

1) Introduction: Role of testing in VLSI design flow, testing at different levels of abstraction, automatic test equipment.
2) Faults and fault modeling, detection of faults, fault simulation and its applications, test pattern generation, automatic testing procedures.
3) Design for testability: Various features incorporated for carrying out testing from input & output pins, scan architecture, test interface and boundary scan.
4) Built-in Self-Test (BIST), BIST concepts, test pattern generation, BIST architectures.
5) Testing of Analog and mixed signal ICs, testing of system on chip.

Reference Books

1. M. Bushnell and V. Agrawal, "Essentials of Electronic Testing for Digital, Memory & Mixed-Signal VLSI Circuits", Kluwer Academic Publishers, 2000.
2. L.T. Wang, C.W. Wu, and X. Wen, "VLSI Test Principles and Architectures", Morgan Kaufmann, 2006.
3. M. Abramovici, M. Breuer, and A. Friedman, "Digital Systems Testing and Testable Design, IEEE Press, 1994.
4. Z. Navabi, "Digital System Test and Testable Design using HDL Models and Architectures", Springer, 2010.

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

The course is on learning the basics of VLSI testing and design for testability. The course material is covered through lectures that are systematically prepared and delivered, considering the prerequisite knowledge of the students. The students will work out small examples during the lecture, thus promoting active and participatory learning. The evaluation plan of the course involves written exams, home assignments and a term paper. The homework includes lab assignments, using Verilog HDL, that will clarify the concepts covered in the lectures and will prepare the students for working in the industry. The term paper will expose the students to recent research activities in the "Design for Testability" area.

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

Type of Evaluation	**Weightage (in %)**
Home Assignments (Problem Sets 3-4)	15%
Quizzes (2)	20%
Midterm (1)	20%
End Semester Examination	30%
Final paper / project	15%

Title of the Course : Design Thinking 101 – Research to Define

Name of the Faculty : Raman Saxena
Course Code : PD1.301
L-T-P : 3 -1-0- 2
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Semester, Year : 1st Sem – Year 1 (Monsoon, 2024)

1.Prerequisite Course / Knowledge: No prerequisites are required

2.Course Objectives & Outcomes (COs)

The overall goal of design thinking course is to help design better solutions, products, services, systems, processes, strategies, and experiences. This course is aimed at guiding through the Design Thinking Process and will help developing a solid understanding of the overall process, phases and methods in design thinking. Introduce the concept of Human-centred approach, empathy, collaboration, co-creation and product-user & product-market fit. It will provide the theory and operational skills to follow Human (User)-Centred approach and how to implement this knowledge in professional work life.

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

CO-1 Understand the Human-Centered (HCD) led Empathy (end user advocacy) &Creative Thinking based approach for Problem solving and designing/delivering new products, solutions and services
CO-2 Demonstrate good understanding of various methods and tools used to understand the user's socio-cultural-economic context during the research/empathies and define stages of the Design Thinking Process.
CO-3 Apply hands-on skills, methods and tools for user research including User Research, Empathy, Contextual Inquiries, Shadowing, User Personas, Use and User Journey mapping, etc.
CO-4 Create, document and present the various deliverables and communications including Stakeholder Mapping, User Personas, Use Case Scenarios, User Journey Maps, Empathy Maps etc. related to the Design Thinking process and deliverables.
CO-5 Demonstrate the ability to collaborate and co-create the design solution and integrate the DT process within the overall product development and management life cycle.

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

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

3.Detailed Syllabus:

UNIT 1. UNLEARNING *(Week 1 - Lecture 1 & 2)*
Initial part of the course will emphasize on unlearning and to cultivate a knack for design thinking, and creative problem solving among the students that will work as a good foundation before introducing them to detailed process, methods and tools of DESIGN THINKING.

UNIT 2. UNDERSTANDING DESIGN AND DESIGN DOMAIN *(Week 2 - Lecture 3 & 4)*

- Understanding Design
- Role & Functions of design and designers.
- Design Elements – (Function, Ergonomics & Aesthetics) + Desirability, Feasibility & Viability)
- Understanding Design Domains and perspectives – Product Design, HCI, Visual Communication, Service Design and User Experience

UNIT 3. INTRODUCTION TO DESIGN THINKING *(Week 3 - Lecture 5 & 6)*

- What is Design Thinking?
- Why Design Thinking?
- Design Thinking approach in new product development & innovative solutions

UNIT 4. DESIGN THINKING PROCESS *(Week 4 - Lecture 7 & 8)*

- Design Thinking Process – human-focused, empathy, research, ideation and prototype-driven, innovative design approach.
- User-Centred Design / Double Diamond Process explaining stage of Discovery, Define, Design, Prototype & Test and Implement.
- Introduce/Initiate Design Thinking Pilot Project which is built into course structure and will run parallel to the course content in the DT-Part1 and will conclude in DT-Part 2.

UNIT 5. DISCOVERY PHASE (*Week 5 - Lecture 9 & 10)*

- What is Discovery and Validation phase and why?
- Understanding User Context? – Why & How to Empathies?
- Understanding the User Needs and Goals through empathy by observing their behavior and drawing conclusions based on qualitative information
- Understanding Business Goals
- Tools and Methods and Deliverables

UNIT 6. DEFINE PHASE *(Week 6 - Lecture 11 & 12)*

- Analysis and Synthesis of Data and Information.
- Driving Insights (both user and business) and solution directions
- Tools and Deliverables of the Define phase

UNIT 7. DRIVING ACTIONABLE BRIEF *(Week 7 - Lecture 13 & 14)*

- Through the process of analysis and synthesis, identifying user-business insights, arriving at an actional brief in form of HMW statement.
- Debriefing and briefing on upcoming course "Design Thinking 101 – Research to Define"

Reference Books:

1. Case1: Design Thinking and Innovation at Apple, Stefan T. & Barbara F. (HBS 9-609-066)
2. Case2: Defining Innovative Mobile Strategies: How Design Thinking Offers an Effective Way to Address the "Wicked Problem" of Enterprise Mobility by SAP
3. Case3: Good Kitchen- Public service delivery Innovation
4. Book: HBR's 10 Must Reads on Design Thinking, by Harvard Business Review
5. Book: Design Thinking for Strategic Innovation by Idris Mootee
6. Book: Design Thinking by Tim Brown (HBR – R0806E)
7. Book: Innovation Through Design by Bill Moggridge
8. Book: 101 Design Methods: A structured app roach for driving innovation in your organization by Vijay Kumar
9. Book: Design Thinking and Social Innovation by Tim Brown and Jocelyn Wyatt in Stanford Social Innovation review

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

- The Course will be divided into lectures (around 12 nos.) 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.
- I will also introduce and discuss a couple of case studies including cases related to the new product development and ICT domain.
- It is supported by the design thinking and research approaches of various design, technology and business schools including Stanford, NID, IIM Bangalore etc. and also prestigious design consulting's including IDEO, FROG Design, Nokia Research, Nokia Design and Siemens etc. to bring both academic and industrial flavor in the content and learning.
- Other than attending lectures and doing classroom exercises & assignments, students need to spend 4 to 6 hours per week on home/field assignments.

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

1.	Classroom /Home activities & assignments		20%
2.	Project Individual/Group		50%
4.	Final Exam		20%
		TOTAL	**100%**

Title of the Course : Design Thinking – Idea to Evaluate/Implement

Name of the Faculty : Raman Saxena
Course Code : PD1.401
L-T-P : 3-1-0- 2
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Semester, Year : 1st Sem – Year 1 (Monsoon, 2024)

1.Prerequisite Course / Knowledge:
Design Thinking 101 – Research to Define Course

2.Course Objectives & Outcomes (COs)
This course is the extension of the earlier course "Design Thinking101-Research to Define" and will introduce the knowledge and skills required for the second diamond of the overall design thinking process. This course is aimed at guiding the students to work through the Ideation & Prototyping (Diversion) and Test/Evaluate (Convergence) phases of the second diamond of the overall Design Thinking Process. This course will help the student appreciating the criticality and value of generating lots of ideas, early prototyping and user testing/validation of the ideas at the early stage of design development for delivering solution which has higher fit between the products and the user needs and business model.
This course is core knowledge/skill and will also serves as a foundation for further learning for any student irrespective of their specific domain such as product design, product management, user experience design, service design, software & IT, technology design and business.

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

CO-1 Understand the Human-Centered (HCD led Empathy (end user advocacy) &Creative Thinking based approach for Problem solving and designing/delivering new products, solutions and services
CO-2 Demonstrate good understanding of various methods and tools used to understand the user's socio-cultural-economic context during the research/empathies and define stages of the Design Thinking Process.
CO-3 Apply hands-on skills, methods and tools for user research including User Research, Empathy, Contextual Inquiries, Shadowing, User Personas, Use and User Journey mapping, etc.
CO-4 Create, document and present the various deliverables and communications including Stakeholder Mapping, User Personas, Use Case Scenarios, User Journey Maps, Empathy Maps etc. related to the Design Thinking process and deliverables.
CO-5 Demonstrate the ability to collaborate and co-create the design solution and integrate the DT process within the overall product development and management life cycle.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1	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

3.Detailed Syllabus:

UNIT 1. REVIST THE PREVIOUS LEARNINGS AND ACTIONABLE BRIEF (Week 1 - Lecture 1 & 2)

- Revise the understandings and learnings of the earlier course.
- Revisit and deliberate on the actionable brief and tweak the same if needed.
- The process of divergence and convergence.

UNIT 2. IDEATION (DIVERGENCE) PHASE (Week 2 - Lecture 3 & 4)

- Power and Value of Ideation process
- Process and techniques of Ideation to generate many ideas.
- Case study- Mainframe- Design for next generation.
- Project continue from H1

UNIT 3. PROTOTYPING (DIVERGENCE) PHASE (Week 3 - Lecture 5 & 6)

- Why prototyping?
- Types of Prototypes – Low fidelity & high fidelity
- Creation of prototypes.
- Case study of Embrace – The Baby Warmer and deliberation/discussion.
- Project continue from H1

UNIT 4. USER TESTING AND VALIDATION (Week 4 - Lecture 7 & 8)

- Why Test?
- Types of user testing and evaluation.
- Process of user testing/validation using prototypes.
- Use case of user testing/validation
- Project continue from H1

UNIT 5. PPROJECT WORK- IDEA GENERATION FOR THE PROJECT WORK (Week 5 - Idea Generation and design)

This week will be dedicated to a generation of ideas against the actionable brief. The students will require working on generating more and more ideas and lecture hours will be used for work in progress presentation by the students, discussions and feedback.

UNIT 6. PROJECT WORK - PROTOTYPE CREATION AND TESTING (Week 6- Hands-on Prototyping & testing) Students will be required to develop several prototypes based on the ideas generated during the ideation phase and validate the ideas for shortlisting,

UNIT 7. PROJECT WORK – TWEAKING IDEAS AND FINANLISING THE SOLUTION (Week 7- Project Completion)

- Tweaking the ideas and further development of the same.
- Final presentation of the work.

Reference Books:

- Case1: Design Thinking and Innovation at Apple, Stefan T. & Barbara F. (HBS 9-609-066)
- Case2: Embrace- A Baby Warmer, Project by Stanford University.
- Case3: TALA- Democratizing the Credit delivery
- Book: HBR's 10 Must Reads on Design Thinking, by Harvard Business Review
- Book: Design Thinking for Strategic Innovation by Idris Mootee
- Book: Change by Design by Tim Brown
- Book: Design Thinking: A Culture of Innovation by Sean Koh
- Book: Design Thinking, by Nigel Cross
- Book: The Design of Everyday Things by Donald A. Norman

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

- The Course will be divided into lectures (around 12 nos.) 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.
- I will also introduce and discuss a couple of case studies including cases related to the new product development and ICT domain.
- It is supported by the design thinking and research approaches of various design, technology and business schools including Stanford, NID, IIM Bangalore etc. and also prestigious design consulting's including IDEO, FROG Design, Nokia Research, Nokia Design and Siemens etc. to bring both academic and industrial flavor in the content and learning.
- Other than attending lectures and doing classroom exercises & assignments, students need to spend 4t to 6 hours per week on home/field assignments.

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

1.	Classroom /Home activities & assignments		20%
2.	Project Individual/Group		50%
4.	Final Exam		20%
		TOTAL	**100%**

Title of the Course : Digital Image Processing

Name of the Faculty : Anoop M Namboodiri
Course Code : CS7.404
L-T-P : 3-0-1.
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:**
Programming, Data Structures, Algorithms

2. **Course Outcomes (COs)**
After completion of this course successfully, the students will be able to:
CO-1. Give examples of how images are stored and represented in digital machines.
CO-2. Apply basic techniques for improving subjective perception of images.
CO-3. Apply basic techniques for filtering images in spatial and frequency domain.
CO-4. Apply basic techniques for morphological and geometric transformations of images.
CO-5. Apply techniques for color image processing.
CO-6. Apply basic techniques for high-level image processing (Image Segmentation, ImageRestoration, Image Compression)

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

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

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

3. **Detailed Syllabus:**

Unit 1: Introduction and Digital Image Fundamentals (3 hours)
Unit 2: Methods for Improving Subjective Perception of Images (4.5 hours)
Unit 3: Spatial and Transform Domain Image Processing (9hours)
Unit 4: Morphological and Geometric Image Processing (4.5 hours)Unit 5: Color Image Processing (3 hours)

Unit 6: High-level Image Processing and Advanced Approaches (15 hours)

References:

- Gonzalez and Woods, Digital Image Processing, Pearson Education, 2003

4. Teaching-Learning Strategies in brief:

Lectures are dominated by pictorial content (images, animations, videos) to explain concepts in image processing. Simulation of algorithms are used to enhance understanding. Learning by writing code is highly promoted and encouraged. Students understand difficult mathematical concepts and abstraction by coding using state of the art software, simulation frameworks, libraries and solvers. More concretely, students also learn by doing assignments designed to achieve course outcomes and collaboratively working on a final project.

5. Assessment methods and weightages in brief:

Assignments: 30 marks, Mid Semester Examination in Theory: 20 marks, End Semester Examination in Theory: 20 marks, Project: 30 marks

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Title of the Course : Digital Systems and Microcontrollers (DSM)

Name of the Faculty : Madhava Krishna K, Harikumar K + Anil Kumar Vuppala
Course Code : EC2.101
L-T-P : 3-1-3
Credits : 5
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Academic Program…… B. Tech in ECE ……

1.PrerequisiteCourse/Knowledge:
Understanding of basic algebra concepts taught up to the 10+2 level

2.Course Outcomes (COs):
After completion of this course successfully, the students will be able to...
CO-1: Solve problems pertaining to the application of Boolean algebra, number systems, simplification of logic expressions using Karnaugh maps.
CO-2: Develop a simplified combinational circuit as a solution for a given problem.
CO-3: Analyze a real-world problem to develop a digital design solution using sequential circuits to solve the problem.
CO-4: Describe the working ofabasic8-bitvonNeumannarchitectureprocessor.
CO-5: Develop skills for simulating circuits using basic components on online simulation tools (example, Tinker CAD).
CO-6: Design, implement and test a given logic circuit using basic electronic components such as bread boards, ICs etc.

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

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

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

4. Detailed Syllabus:

Unit1: Number systems and inter conversions (binary, decimal, hexa decimal), postulates of Boolean algebra, binary logic gates, binary functions
Unit 2: Simplification of binary expressions using K-maps, logic function implementation, combinational circuits
Unit3: Latches and flip-flops, types of flip-flops, internal circuit design and operation
Unit 4: Sequential circuits, state diagrams, state tables, state equations, applications of sequential circuitsUnit5: Registers and counters, memory and processor architecture
Reference Books:
1. M. Morris R. Mano and Michael D. Ciletti (2013), *Digital Design*,6thEd, Pearson.

5. Teaching-Learning Strategies in brief(4to5sentences):

The course instruction is delivered through lectures with examples of real-world application of electronic systems to foster student understanding and interest. The course is structured as a theory and laboratory course, such that the concepts and circuits introduced in the theory classes can be experimentally applied and understood by the students. Assignments are designed to encourage students to critically think about the concepts discussed in the class and to learn to independently solve problems.

6. Assessment method sand weightages in brief(4to5sentences):

Continuous evaluations: Assignments–10%
MCQQuizzes–20%
Lab reports–20%
Comprehensive evaluations:
Lab exam–15%
End semester exam in Theory–35%

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 synthesize 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	PSO4
CO1	3	2	1	1	1	1	2	2	2	1	1	2	3	2	2	2
CO2	3	3	2	2	2	1	1	2	1	1	1	1	3	1	1	1
CO3	3	3	2	2	2	1	1	2	2	2	1	2	3	1	1	1
CO4	3	2	3	3	3	1	1	2	2	2	1	3	3	1	1	1
CO5	2	3	3	3	3	1	1	2	3	3	3	3	3	1	2	1
CO6	2	3	3	3	3	1	1	2	3	3	3	3	3	2	1	1

Each Course Outcome (CO) may be mapped with one or more Program Outcomes (POs). Write '3'in the box for 'High-level'mapping,2for 'Medium-level'mapping,1for '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(gm),Body Effect, Channel-Length Modulation, MOS Transistors as 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 Fin FET 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 DissipationduetoChargeSharing,Statici.e.LeakagePowerDissipation(leakagemechanism): 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.

FinFETtechnologywillalsobediscussedinparallel.Suchdelay/leakageestimationtechniques will also be applied to Fin FET 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", ASystems Perspective, 2nd Edition, Pearson Education Pvt. Ltd.

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

Thecoursewillstartwiththebackgroundthatdriveustothedevelopmentofstate-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 students' understandings of 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 : Discrete Structures

Name of the Faculty : Srinathan K + Shantanav Chakraborty
Course Code : MA5.101
L-T-P : 3-1-0
Credits : 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)

1. Prerequisite Course / Knowledge:
Basic abstract algebra, High School Mathematics

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

CO-1: Demonstrate critical thinking, analytical reasoning, and problem-solving skills
CO-2: Apply appropriate mathematical and probabilistic concepts and operations to interpret data and to solve problems
CO-3: Identify a problem and analyze it in terms of its significant parts and the information needed to solve it
CO-4: Formulate and evaluate possible solutions to problems, and select and defend the chosen solutions
CO-5: Construct graphs and charts, interpret them, and draw appropriate conclusions
CO-6: Apply the concepts of group theory, ring and field in various applications in computer 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	1	2	2	2	2	2	2	2	3	2	2	2	1	2	2	3
CO2	3	3	3	2	2	2	2	2	2	2	1	2	1	2	2	3
CO3	2	2	2	2	2	2	2	2	2	2	1	2	1	1	2	3
CO4	2	2	2	3	2	2	2	2	2	2	2	2	1	1	2	3
CO5	1	1	1	1	1	1	2	2	1	1	1	1	1	1	2	3
CO6	2	2	2	2	2	2	2	2	3	2	2	3	1	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:** Sets, relations, functions, permutations, combinations. Applications to relations. Logic, Propositional Equivalences, Predicates and Quantifiers Sets, Proof Techniques, Contradiction. Mathematical induction, pigeonhole principle.
  Cardinality of sets, finite and infinite sets, countable and uncountable sets, Cantor's numbering.
- **Unit 2:** Group, subgroup/normal subgroup, homorphism/automorphism/isomorphism/epimorphism,kernel,cosets,quotientgroup,productsetina group,centerofagroup,order/conjugateofanelement,commutator.
  Coding theory (Application to group theory).
- **Unit 3:** Ring, Field, Finite field over a prime. Applications to finite fields.
- **Unit4: Recurrence** relations, generating functions, numeric functions. Application store Currence relations.
- **Unit 5:** Basics of probability theory, birthday attacks. Applications on hash functions.
- **Unit6: Graphs,** Adjacency, Special Graphs, Isomorphic Graphs, Paths, Cycles and Circuits, Connected Graphs, Eulerian Graphs, Hamiltonian Graphs and Planar Graphs.

Reference Books:

1. Thomas Koshy, "Discrete Mathematics with Applications", Elsevier Press,2004.
2. C.L.LiuandD. P.Mohapatra, "Elements of Discrete Mathematics: A Computer Oriented Approach," Tata McGraw-Hill Edition,2017.
3. D.S. Malik and M.K.Sen, "Discrete Mathematical Structures: Theory and Applications, "Thomson, 2004.
4. Joseph Gallian, "Contemporary Abstract Algebra", 9th Edition, CENGAGE publications,2019.

5. Gross and Yellen, “Graph Theory and its Applications”, 2nd Edition, Chapman and Hall,2005.
6. Kenneth H. Rosen, "Discrete Mathematics and Its Applications", Sixth Edition,2006

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

This course supports the expected characteristics, capabilities and skills for computer science graduates in the following ways:

* Mastery of Computer Science technical foundations
* Recognition of common Computer Science themes and principles
* Recognition of interplay between theory and practice
* Effective problem solving and critical thinking skills

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

- Assignments:10%
- In-Class Tests:20%
- Mid Semester Examination:30%
- End Semester Examination:40%

Title of the Course : Distributed Systems
Faculty Name : Kishore Kothapalli
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 practicing small examples. HomeWorks assigned as part of the course are useful to impart knowledge of using practical distributed programming tools and libraries. To promote teamwork, some of the homework's are done in a team of two students. The overall learning from the course is enhanced by doing a substantial practice-based project – usually in a team of two students. The course will also have a summative assessment in the form of a final/end-semester exam.

6.Assessment methods and weightages in brief:

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

Title of the Course : Earthquake Resistant Design of Masonry Structures

Name of the Faculty : P. Pravin Kumar Venkat Rao
Course Code : CE1.607
L-T-P : 3-1-0
Credits : 4
Name of the Academic Program: M.Tech in CASE

1.Prerequisite Course / Knowledge: Strength of Materials, Structural Analysis, Structural Design (RC or Steel), and preferably Seismic Design of Structures

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

CO 1: Understand the seismic vulnerability of existing masonry structures against seismic forces.
CO 2: Acquainted with principles of earthquake resistant design of masonry structures

CO3: Understand the failure modes and complete behavior of masonry under different actions like compression, tension, shear, and bending
CO4: Analyze the seismic safety of masonry buildings and suggest the retrofit measures using codal provisions.
CO5: Design the strengthened masonry components of a building using different techniques.

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

4.Detailed Syllabus:

Unit 1: Introduction to masonry, Masonry buildings in India, Material properties, Masonry units-stones, brick and concrete blocks, hollow and solid units, Manufacturing process, Mortar, Grout, and reinforcement; Masonry assemblages, Masonry systems, Various tests, and standards.

Unit 2: Masonry under compression: Prism strength, Failure mechanism, types of construction and bonds, Eccentric loading, Slenderness – effective length and effective height, effect of openings, Code provisions, masonry in tension, flexural strength of masonry, shear and bending capacity of masonry.

Unit 3: Behavior of masonry structures during past earthquakes: Common modes of failures, effect of roof and floor systems, Masonry under lateral loads: In-plane and out-of-plane loads, bending parallel and perpendicular to bed joints, Shear and flexure behavior of piers, Test and standards, lateral force distribution for flexible and rigid diaphragms, Combined axial and bending actions.

Unit 4: Earthquake Resistant Measures: Analysis for earthquake forces, role of floor and roof diaphragm, Pier analysis using equivalent stiffness approach, Concept and design of bands, splints and bandages, Vertical reinforcement at corners and jambs, Code provisions.

Unit 5: Retrofitting of masonry building: Techniques of repair and retrofitting of masonry buildings, IS: 13935 provisions for retrofitting, different strengthening methodologies and techniques.

Reference Books:

1. Drysdale, R. G., Hamid, A. H. and Baker, L. R., "Masonry Structure: Behavior and Design", Prentice Hall, Englewood Cliffs (1994).
2. Schneider, R.R. and Dickey, W. L., "Reinforced Masonry Design", 3rd Ed, Prentice Hall (1994).
3. Paulay, T. and Priestley, M. J. N., "Seismic Design of Reinforced Concrete and masonry Buildings", John Wiley & Sons (1995).
4. Amrhein, J. E., "Reinforced Masonry Engineering Handbook," Masonry Institute of America, CRC Press (1998).
5. Hendry, A. W., "Structural Masonry", Macmillan Press Ltd. (1998).

6. "Prestandard and Commentary for the Seismic Rehabilitation of Buildings," FEMA 356, Federal Emergency Management Agency, Washington, D.C.9 (2000).
7. Tomazevic, M., "Earthquake Resistant Design of Masonry Buildings", Imperial Colleges Press (2000).
8. Donald Anderson and Svetlana Brzev, "Seismic Design Guide for Masonry Buildings," Canadian Concrete Masonry Producers Association (2009).

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

The course aims at elucidating theories on mechanical behavior of masonry assemblages under different actions and introduces the working stress and limit state approaches to analysis and design of masonry structures for gravity and lateral loads due to earthquake. The course will also briefly address structural safety assessment and strengthening of existing masonry structures.

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 : Electronic Workshop-1

Name of the Faculty: Praful Mankar + Sachin Chaudhari
Course Code : EC2.102
L-T-P : 2-0-3
Credits : 2
Name of the Academic Program: B. Tech. in ECE

Pre-requisite Course/ Knowledge:
Basics of Circuit Analysis
Introductory C
Programming

Course Outcome EW1:

CO1 - Familiarization and demonstration of skill in handling electronic equipment and components such as Power Supplies, Signal Generator, CRO, breadboards, soldering iron, passive components and active devices.
CO2 - Design and implementation of electronic circuits that involve analog and digital components, on breadboard and further observing, recording, analyzing and interpreting the results therein.
CO3 - Demonstration of psycho-motor skills in the form of connecting components on a breadboard, wiring, soldering circuits, and understanding of electronic hazards.
CO4 - Understanding and demonstration of tool usage in the form of multi-Sim/LTSpice for simulation, verification and analysis of circuits

CO5 - Understanding the role of software – hardware interface in the form of software implementation on controller boards and their interface to electronic circuits. Demonstrate proficiency on the same

	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 O 1	PS O 2	PS O 3	PSO 4
CO1	1	1	1	1	3	3	1	1	1	1	1	3	3	1	3	3
CO2	3	2	1	3	2	1	1	1	3	3	1	3	3	3	1	1
CO3	1	1	3	2	3	3	3	3	1	1	1	3	2	1	3	3
CO4	1	1	1	1	3	1	1	1	3	1	1	3	3	3	3	1
CO5	1	1	1	1	3	1	1	1	3	1	1	3	1	3	2	3

Detailed Syllabus:

1. **Know your equipment and components** - Lab Equipment and components familiarization such as Power supply, Signal Generator, Oscilloscope, Breadboard, Transistor, Resistor etc...
2. **Design, Implementation and Analysis** - Implement circuits such as Voltage Regulator record, analyse and interpret the results. Around 3-4 circuits will be dealt with in this section.
3. **Electronic Circuit Design Simulation Software** - Learning to install and use Multisim. Design one of the earlier experiments on Multisim and compare hardware and simulation results
4. **The Art of Soldering** - Solder one of the implemented circuits now on a general-purpose PCB/Vector Board, record results, compare with the previous implementation on the bread board
5. **Hardware Software Symbiosis** - Use of controller boards to interface with electronic circuits and actuators, showcase the need for software-hardware interplay

Teaching-Learning Strategies in Brief:

Learning by Implementation and Verification of Theoretical Understanding on Hardware, Individual learning through Experimentation, Participatory Learning and Learning by Interaction and Teamwork through Final Project. The experiments and projects are designed to materialize the above learning strategies. Individual experiments teach and enable real world understanding of concepts of electronic and circuit theory. Quizzes provoke the students towards the connections between theoretical understandings and their actual realization on hardware, often not touched in the regular coursework. Final project materializes an integrated and application driven understanding of the learnings acquired from the experiments.

Reference Books:

1. Hayt, Kemmerly and Durbin, "Engineering Circuit Analysis"
2. Sedra and Smith, "Microelectronic Circuits",
3. Atmel, ATMega2560, User Manual

Grading:

1. Assessment of Lab Performance in 5 Experiments: 30%
2. Quizzes/Viva on Assessment of Theoretical Foundations: 30%
3. Final Project Performance: 40%

Title of the Course Name : Embedded Systems Workshop

Name of the Faculty : Abhishek Srivastava +Zia Abbas
Course Code : EC3.202
L-T-P : 1-0-3
Credits : 3
(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:

10+2 level physics
CS0.101: Computer Programming CS3.303: Introduction to IoT

2. Course Outcomes (COs)

After completion of this course successfully, the students will be able to
(Create)
CO-1: Develop and implement an IoT-based solution for a real-life problem (Evaluate)
CO-2: Assess system designs from IoT application point of view
(Understand)
CO-3: Explain the working on microcontrollers, peripherals and its programming (Analyze)
CO-4: Compare and select the sensors and actuators based on the system requirement
(Analyze)
CO-5: Compare different communication protocols for use in IoT systems
(Apply)
CO-6: Employ techniques pertaining to the security, privacy and inoperability of IoT data
(Analyze)
CO-7: Examine various available solutions for data storage and cloud computing
(Create)
CO-8: Design and fabricate a functional PCB and mechanical enclosure for their IoT project

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	3	2	2	3	2	2	3	1	1	3	1	3	3	2
CO2	2	3	3	3	2	2	1	2	2	1	3	2	1	3	2	1
CO3	2	3	1	1	1	1	2	1	1	3	2	1	3	1	3	3
CO4	3	3	1	1	1	3	3	1	1	3	1	1	3	1	2	3
CO5	2	1	2	3	3	2	1	1	3	1	2	2	1	2	2	1
CO6	2	3	2	2	2	3	2	3	1	2	2	3	3	3	2	2
CO7	3	2	2	3	1	2	2	2	1	2	2	2	3	3	2	2
CO8	1	2	3	1	3	2	2	1	3	2	3	1	1	2	1	3

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

4. Detailed Syllabus:

1. **Sensing/Actuators and Interfacing**

    1. Sensor/Actuator selection (using datasheets)

    2. Physics of sensors and actuators related to projects
    3. Interfacing: Serial interfaces, Analog out, SPI, UART, I2C, "propriety" such asDHT22

2. **Controller, Embedded Systems and Peripherals**-

    - Platform selection – ATMEL328, ESP32, STM8 Architecture; timers, interrupts, AVR, SAMR architectures

    - Embedded Systems: power management, interrupts, memory managements, leaks, OTA firmware update, reliability, onboard debugging

    - Peripherals: RTC, ADC channels, resolution, onboard memory, power, external/internal watchdog

3. **Communications, Networking and IoT Architecture**

    1. Different IoT communication protocols: Comparison of
    Zigbee/WiFi/BLE/4G/5G/eSim/LoRaWAN

    2. Data Protocols: MQTT/HTTPS/CoAP

4. Data Storage and Computation
    1. Cloud storage and computing
    2. Data retrieval optimization
    3. IoT standards for interoperability: Implementation usingoneM2M
5. PCB and Enclosure Design
6. Data privacy and security
7. Dashboard and Visualization
    1. Software/Approaches: UI/UX and Time Series Data Visualization; Front-end and back- end technologies
8. **Documentation**
    1. User document and developer's documentation
    2. Best practices for writing the two documents
    3. Referring style manual. For example, *Microsoft/Chicago manual of style*

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:

Mid semester Quiz 10%
EndSem exam 30%
Project 60%

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

Name of the Faculty : Indranil Chakrabarty
Course Code : CS1.407
LTP : 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

Prerequisite Course / Knowledge:

The Basic Probability Theory and the school level mathematics knowledge.

Course Outcomes (COs):

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

CO-1. Explain the basic concepts of Entropy, Joint Entropy Conditional Entropy, Relative Entropy and Mutual Information, Chain Rules, Differential Entropy, Maximal Entropy, Probability as a measure, Data Compression, Entropy Rates, Markov Chain, Entropy Rate, Random Walk, Data Compression and Channels

CO-2. Demonstrate familiarity with process of constructing codes/optimal codes, carrying out data compression, finding out the channel capacity of the channel.

CO-3. Synthesize proofs of theorems The Uniqueness Theorem, Fundamental Theorem, Maximum Entropy Principle, using clear mathematical and logical arguments.

CO-4. Apply the concepts like source coding, channel capacity to real world problems in Communication Theory

CO-5. Create communication models using principles of Information Theory and analyze them.

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	1	2	2	-	-	-	-	-	-	-	3	3	-	-	3
CO2	2	1	2	2	-	-	-	-	-	-	-	3	3	-	-	3
CO3	2	2	2	2	-	-	-	-	-	-	-	3	3	-	-	3
CO4	1	1	3	2	-	-	-	-	-	-	2-	3	3	-	-	3
Co5	1	1	3	2	-	-	-	-	-	-	-	3	3	1	-	3

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

Detailed Syllabus:

1. **ENTROPY CONCEPT IN PROBABILITY THEORY:** Entropy of Finite Schemes, Joint Entropy and Conditional Entropy, Relative Entropy and Mutual Information, Chain Rules, The Uniqueness Theorem, Jensen's Inequality and its consequences, Log Sum Inequality and its applications, Data Processing Inequalities, Sufficient Statistics, Fano's Inequality.
2.**PROBABILITY MEASURE AND ASYMPTOTIC EQUIPARTION PROPERTY:** Probability as a measure, Law of Large Number, Asymptotic Equipartition Theorem (AEP), Data Compression, Typical Sets, Gambling and Data Compression.
3. **ENTROPY RATES OF A STOCHASTIC PROCESS:** Entropy of Markov Chains, Entropy Rate, Entropy Rate of a random walk on a weighted graph, Hidden Markov Models, Fundamental Theorems.
4. **DATA COMPRESSION:** Kraft Inequality, Optimal Codes, Bound on the optimal code length, Kraft inequality for Uniquely Decodable Codes, Huffman Codes, Optimality of Huffman code
5. **CHANNEL CAPACITY:** Examples of Channel Capacity, Symmetric Channels, Properties of Channel Capacity, Joint Typical Sequence, Channel Coding theorem, Zero Error Codes, Fano's Inequality and Converse of Channel Coding Theorem, Feedback Capacity
6. **DIFFERENTIAL ENTROPYMAXIMUM ENTROPY AND SPECTRAL ESTIMATION:** Definition, AEP for Continuous Random Variable, Relation of Differential Entropy to Discrete Entropy, Joint and Conditional Entropy, Relative Entropy and Mutual Information, Maximum Entropy distributions, Anomalous Maximum Entropy Problem, Spectrum Estimation.

Reference Books:

Preferred Textbook: Elements of Information Theory, Thomas. M. Cover, Joy. A. Thomas; Wiley Series in Telecommunication.

Other Books:

1. Mathematical Foundation of Information Theory by A.Ya. Kinchin (Dover book on Mathematics)
2. Information Theory by Robert Ash Dover book on Mathematics)

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

Lectures will initially introduce the motivations, concepts, definitions along with simpler examples. On basis of that there will be assignments and quizzes to make sure that the students have understood the concepts. These will also be supplemented with real world problems so that they can apply the concepts learned by them.

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

Type of Evaluation	Weightage (in %)
Quiz-1	**10%**
Mid Sem Exam	**15%**
Quiz-2	**10%**
End Sem Exam	**30%**
Assignments	**15%**
Project	**20%**

Title of the Course: **Environmental Science and Technology**

Name of the Faculty Ramachandra Prasad P
Course Code: CS9.428
L-T-P: 3-1-0.
Credits: 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Open Elective (Monsoon)(UG and PG)

1. **Prerequisite Course / Knowledge:**

Basics Science (Biology, Physics, Chemistry, Earth systems) to understand environmental issues and phenomenon.

2. **Course Outcomes (COs)**

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

CO-1: Understand various environmental issues of concern
CO-2: Identify various driving factors of environmental degradation
CO-3: Evaluate different environmental technologies
CO-4: Integrate IT in designing solutions to combat environmental problems
CO-5: Comprehend green accounting and evaluation methods for ecosystem goods and services
CO-6: Develop sense of environmental ethics and environmental legislation

3. **Mapping of Course Outcomes (COs) with Program Outcomes (POs) andProgram 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	2	1	1	1	1	1	1	2	2	2	2	2
CO2	1	1	2	2	2	1	1	1	1	1	1	2	2	2	2	2
CO3	2	2	2	2	3	1	2	1	1	1	1	2	2	2	2	2
CO4	2	2	3	2	3	1	2	1	1	1	1	2	2	2	2	2
CO5	2	3	2	2	3	2	3	2	1	1	1	2	2	2	2	2
CO6	2	2	2	2	2	2	2	2	1	1	1	2	2	1	2	2

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

Unit-1: Basics of Environmental Science & Technology: Comprehend environment and its issues,Environmental problems and challenges, Environmental Events,
Unit-2: Earth components; Climate Change: Climate system, Climate feedback loops, Climate Models, Climate impact on environment; Global Catastrophes, unexpected climate changes
Unit-3: Role of geospatial technology: in assessing environmental degradation
Unit-4: Carbon sequestration methods – vegetation, ocean and geological sequestration, IPCC, Clean Development Mechanisms, Co_2, Environmental Stress - Mitigation: Impact on vegetation
Unit-5: Environmental Impact Assessment: Procedure, regulations and case studies
Unit-6: Environment and Information technology: green computation, green energy, Green Engineering and technology, e-waste-disposal mechanism – impact on health.
Unit-7: Green accounting- Evolution of process, history, case studies, Accounting of goods and Services, Sustainability concepts-weak and strong, Hicksian income concept
Unit-8: Environmental movements
Unit-9: Environmental Legislation & Impact Assessment: Important legislations related to Environment; Environmental Auditing; Environmental Ethics

References:

1. Environmental Science – The natural environment and human impact (1998): A. R. W. Jacksonand J. M. Jackson, Longman
2. Environmental Science (2001): S. C. Santra, New Central Book Agency (P) Ltd
3. Environmental Science (6^{th} ed) (1997): Jr. G. T. Miller, Wadsworth Pub. Co.
4. Dimensions of Environmental and Ecological Economics (2005): N. C. Sahu & A. K. Choudhury(Ed), Universities Press
5. Khoiyangbam, R.S., and N Gupta. 2012. Introduction to Environmental Sciences. New Delhi:TERI
6. Y.K Singh 2006. Environmental Science. New Age International (P) Ltd., Publishers (e-book).
7. Tery Sloan 2016. Introductory Climate Science: Global Warming Explained. New AgeInternational (P) Ltd., Publishers (e-book).
8. Clifford Jones 2015 Global trends and patterns in carbon mitigation (e-book).

5. Teaching-Learning Strategies in brief:

Teaching, discussing current environmental issues, presentations by students on chosen topic, writing as well as drawing assignments, periodical evaluation of course project implemented with open data and tools to understand various environmental processes and possible solutions to combat anthropogenic driven environmental degradation and problems.

6. Assessment methods and weightages in brief:

Theory (%): Quiz (10), Assignments (15), Mid exam-1(20), End exam (30)= **75%**

Project (%): Literature Survey**,** Preliminary and final presentation along with report **= 25%**

***PROJECT:** Simulation and modeling of environmental processes, development of open-source tools related to environmental problems / applications, replication of case studies orworking on new problem using open data and tools.

Course Name : Fairness, Privacy and Ethics in AI

Name of the Faculty : Sujit P Gujar
Course Code : CS7.504
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 CSE

1.Prerequisite Course / Knowledge: Course: Statistical Methods in AI,
Knowledge: Machine learning, probability theory, Complexity Theory and Advanced Algorithms

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 sources of unfairness in AI systems
CO-2 Demonstrate familiarity with different notions of individual fairness as well as group fairness
CO-3 Synthesize algorithms designed to ensure individual fairness such as envy-free ness, proportionality, max-min share etc. and apprehend the complexities involved in ensuring
CO-4 Create algorithms methods to mitigate discrimination based on sensitive attributes such gender/race/age etc. (group fairness) for fairness measures such as disparate impact, equalized odds, accuracy equity, predictive parity etc.
CO-5 Explain the attacks on the machine learning models and databases to interpret the data
CO-6- Apply different techniques using differential privacy to ensure privacy of individuals leading to transparency in the system

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	1	2	1	3	1	3	1	2	1	2	2	3	1	2
CO2	1	1	1	2	1	1	1	2	1	2	1	3	3	2	1	2
CO3	2	3	3	2	1	1	1	3	2	1	1	3	2	2	1	2
CO4	2	3	3	3	1	1	1	3	3	2	1	3	2	2	3	3
CO5	1	1	2	2	1	1	1	1	1	3	1	2	3	2	1	2
CO6	2	3	3	2	1	1	1	3	2	2	1	3	2	2	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: Bias in the data, causality, Individual fairness vs group fairness

Unit 2: Individual fairness: envy freeness, max-min share, proportionality. Algorithms to achieve them such as round robin, cycle elimination, etc.

Unit 3: Impossibility of fair classifier with perfect calibration

Unit 4: Group fairness (equalized odds, disparate impact, accuracy parity, predictive parity). Different preprocessing, post processing techniques and over all approach to build AI to mitigate discrimination

Unit 5: Differential Privacy (DP), Need for newer privacy measures, especially when federated learning is on rise. Possible attacks even data is anonymized

Unit 6: Techniques such as Laplace mechanism, gaussian mechanism, local DP, Bayesian DP

Reference Books:

1. Solon Barocas, Moritz Hardt, Arvind Narayanan, 'FAIRNESS AND MACHINE LEARNING Limitations and Opportunities'.
2. Cynthia Dwork and Aaron Roth, 'The Algorithmic Foundations of Differential Privacy'.
And also, relevant recent papers.

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

This course is good mix of mathematical foundations of ethical AI and practice. Hence, it will involve lot of discussion in class. The students will be expected to solve problems in the class regularly and will also be tested through surprise quizzes. To enable group based learning and better exposure, the students will be assigned two programming assignments, reading assignment and use case study. These activities will be in groups. Also students will be asked to scribe the lectures – produce high quality notes for a lecture assigned to the group that can be used by other students.

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

Type of Evaluation	Weightage (in %)
Mid Sem Exam	15
End Sem Exam	25
Quizzes (Option of Reading Assignment + Viva in lieu of in class quizzes)	15
Programming Assignments (2)	15
Reading Assignment	10
Use Case Development	10
Scribes	5
Course Participation	5

Title of the Course : Finite Element Method

Name of Faculty : Jofin George
Course Code : CE4.501
Credits : 4
L - T - P : 3-1-0
Semester, Year : Monsoon 2024
Name of the Program: Computer-Aided Structural Engineering

Pre-Requisites

Structural Analysis, Calculus, Linear algebra, Engineering Mechanics

Course Outcomes:

CO1: Develop a comprehensive understanding of finite element principles.

CO2: Formulate and solve boundary value problems using approximate methods and finite elementtechniques.

CO3: Analyze structural components using the finite element method

CO4: Apply advanced finite element method to elasticity problems.

CO5: Apply numerical integration to identify the solution of boundary value problems.

Detailed Syllabus:

Module 1: Introduction to finite element method (FEM): Need for FEM, General finite element solution procedure, Boundary value problems: types of boundary conditions, Approximate solutionto boundary value problems: Method of weighted residuals,

Module 2: General one-dimensional (1D) boundary value problem and its applications: Axial deformation of bars: Approximate solution using Rayleigh-Ritz method, Galerkin method, Axial Spring element. Applications: One-dimensional heat flow, Column buckling. Higher order elementsfor 1D problems: Shape functions for second order problems, Isoparametric mapping concept, Quadratic isoparametric element.

Module 3: Beams, Frames and Trusses: Beam bending-governing differential equation, Two node

beam element: Exact solution, Calculation of stresses in beams, Thermal stresses in beams. Analysis of structural frames-Plane frame element, space frame element, Introduction to truss analysis.

Module 4: 2D boundary value problems: triangular elements, isoparametric quadrilateral elements, Isoparametric mapping for quadrilateral elements, Numerical integration for quadrilateral elements, Four node quadrilateral element for 2D BVP, Eight node serendipity element. Isoparametrictriangular elements: Natural coordinates for triangles, Shape functions for triangular elements, Natural coordinate mapping for triangles, Numerical integration for triangles, Six node triangular element for general 2D BVP.

Module 5: Applications based on general 2D boundary value problem: Torsion of prismatic bars. 2D elasticity-Governing differential equations, Constant strain triangular element, Four node quadrilateral element, Eight node isoparametric element. Constitutive equations, governing differential equations, stress equilibrium equations, finite element equations for plane stress and plane strain conditions, three-noded triangular elements, and axisymmetric elasticity problems.

Module 6: Numerical integration-Newton-Cotes rules, Trapezium rule, Simpson's rule, Error term, Gauss-Legendre rules, Gauss-Leguerre rule, Numerical integration for quadrilateral elements, Numerical integration for triangular elements.

Reference Books:

1. Bhatti, M.A., Fundamental Finite Element Analysis and Applications: with Mathematical and MATLABComputations, Wiley, 2005.
2. Reddy, J. N., An Introduction to the Finite Element Method, 3rd Edition, McGraw-HillScience/Engineering/Math, 2005.
3. Logan D. L., A First Course in the Finite Element Method, Thomson- Engineering, 5th edition,2010.

Additional Reading

1. Chandrupatla T. R., and Belegundu, A. D., Introduction to Finite Elements in Engineering,Pearson Education, 4th edition, 2015.
2. Buchanan, G. R., and Rudramoorthy, R., Schaum's Outline of Finite Element Analysis, McGraw Hill Education (India) Private Limited, 2005.
3. Zienkiewicz, O.C. and Taylor, R.L., The Finite Element Method for Solid and Structural Mechanics, Butterworth-Heinemann, 6th edition, 2005.
4. Zienkiewicz, O.C., Taylor, R.L., and Zhu, J.Z., The Finite Element Method: Its Basis and Fundamentals, Butterworth-Heinemann, 7th edition, 2013.

Grading Plan

Type of Evaluation	Weightage(in %)
Quiz-1	10
Mid Sem	15
Quiz 2	10
End Sem Exam	30
Assignments	15
Term Project	20

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

	Program Outcomes										Program Specific Outcomes			
	PO1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO1 0	PSO1	PSO 2	PSO 3	PSO 4
CO1	3	2	3	1	3	1	2	3	3	2	3	3	3	2
CO2	3	2	3	1	3	1	2	3	3	3	3	3	3	3
CO3	3	3	3	-	3	1	2	3	2	3	3	3	3	3
CO4	3	3	3	-	2	1	2	3	2	1	3	3	3	3
CO5	3	3	3	-	1	1	2	3	3	1	3	3	3	3

Teaching-Learning Strategies in Brief:

- Classroom Lectures
- Weekly tutorials on problem solving.
- Term project involving the use of Finite element concepts to solve structural engineeringproblems.
- Active learning by students.

Title of the Course : Foundations for Signal Processing and Communication

Faculty Name : Praful Mankar and Arti Yardi
Course Code : EC5.412
Credits : 4
L - T - P : 3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Monsoon, 2024
Name of the Program : ECE

Pre-Requisites : 1) Basics of probability, vector, and matrices.
2) Signal and System, and Digital Communication.
This course is intended for students who wants conduct research in the field of communication or signal processing.

Course Outcomes :
(List about 5 to 6 outcomes for a full 4 credit course)

After successful completion of this course, the students will
CO1: build strong foundation in the fundamental mathematical concepts used for the design of digital communication systems.

CO2:be able to apply mathematical tools to analyze and solve complex problems related to signal processing.
CO3: be equipped with basic models/modules to conduct research in the field of communication and signal processing.
CO4: develop critical thinking and problem-solving skills to address practical problems in communication systems and signal processing.

Course Topics :

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

Module 1: (5-6 lectures)
Rigorous Math Part: Probability Axioms, Random Variables and their distributions (CDF, PDF, PMF), Some Important Distributions, Joint and Conditional Distributions, Distributions of functions of Random Variables, Expectation of RVs and their functions
SPCOM Part: Random quantities in SPCOM, Notion of Communication Channel, Hypothesis testing, Simple Detection and Estimation problems in Signal Engineering.

Module 2 (4-5 lectures)
Rigorous Math Part: Concentration inequalities (Markov, Chebyshev, Chernoff), Central Limit Theorem, Mean vector and covariance matrix, Joint Gaussian Distribution, Random Processes
SPCOM Part: Discrete Memoryless Channels and Notion of Channel Capacity, Gaussian Noise, Wireless Channel.

Module 3: Sets with structure (4-5 lectures)
Rigorous Math Part: Groups (Cyclic groups, Abelian groups), Rings (polynomials and matrices), Fields (Finite and Infinite), Vector spaces, Inner Product on Vector Spaces.
SPCOM part: The Vector Space of Finite Energy Continuous Signals (L_2 signals, over R) with inner product, Vector Space of Sampled Signals (over R and C), Vector Space of discrete-time quantized signals (over finite fields), Distinguishing features of Digital Signal Processing and Communication

Module 4: (5-6 lectures)
Rigorous Math part: Linear Independence/dependence, Span, Column space and row space of matrices, Basis and Dimension of subspaces, Basis Extension Theorem, Rank of a matrix, Change of Basis.
SPCOM part: Fourier Series of L_2 signals as representation of signals using Fourier basis, Finite dimensionality of bounded-time, bounded-bandwidth L_2 signals, standard basis for Discrete-time signals, Standard Basis for Finite-field Signals, Discrete Fourier Transform as Change of Basis.

Module 5: (4-5 lectures)
Rigorous Math Part: Linear Transformations between vector spaces and their associated Matrices, Eigen Values and Vectors, Triangularization, Diagonalization, SVD.

SPCOM part: Continuous-time and Discrete-Time LTI systems and their Transfer Functions, Role of linear transformations in coding theory for forward-error correction, Do Estimation, MIMO Wireless Communication.

Preferred Textbooks:

1. Henry Stark and John Wood: Probability and Random Processes with Application to Signal Processing
2. Sheldon Axler: Linear Algebra Done Right

Reference Books :

1. Robert G. Gallagher, "Principals of Digital Communication"
2. Lin and Costello, "Error Control Coding"
3. Steven Kay, "Fundamentals of Statistical Processing: Estimation Theory", Volume 1
4. Steven Kay, "Fundamentals of Statistical Processing: Detection Theory", Volume 2

E-book Links :
Grading Plan : Relative grading

(The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz-1	**10**
Mid Sem Exam	**20**
Quiz-2	**10**
End Sem Exam	**40**
Assignments	**10**
Project	**-**
Term Paper	**10**
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	PSO1	PSO2	PSO3	PSO4
CO1	5	5	5	4	3	5	1	1	1	5	1	1
CO2	5	5	5	4	3	5	1	1	1	5	1	1
CO3	5	5	5	4	3	5	1	1	1	5	1	1
CO4	5	5	5	4	3	5	1	1	1	5	1	1

Teaching-Learning Strategies in brief (4-5 sentences):
The objective of this course is to provide students with the necessary knowledge in linear algebra and probability for signal processing and crucial for analysing and designing communication systems. The course syllabus is divided into five modules, with three focusing on linear algebra and two on probability. Each module will be taught through a two-step approach. In the initial lectures, we will concentrate on establishing a solid foundation in the fundamental mathematical tools required. Subsequently, the following lectures will delve into applying these tools to communication and signal processing engineering. To foster critical thinking skills, students will be assigned innovative theoretical and simulation problems as part of their assignments. In addition, the students will be exposed to the seminal research works through the exercise of writing term papers.

Title of the Course : Gender and Society
Faculty Name : Sushmita Banerji
Course Code : HS8. 201
L-T-P : 3-0-0
Credits : 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
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 Introduce students to basic concepts in gender theory and Feminist practice

CO-2 Help students question their prior opinions and think in more informed ways about the nature of gender relations, individual roles, and socio-cultural formations.

CO-3 Literature shall be taught to demonstrate the various ways in which culture establishes, represents and perpetuates

CO-4 Film shall used to demonstrate the various ways in which popular culture establishes, represents and perpetuates

CO-5 Examples of Literature and film shall be used to discuss how culture can disrupt generic roles

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						1										
CO3								2								
CO4												1				
CO5						2										

4.Detailed Syllabus:

Unit 1: Core concepts and terms: Differences between terms like Gender, Sex, Normative and Non-normative sexuality, Trans-bodies.

Unit 2: Power, Ideology and Intersectionality's: Concepts of Power, Ideology, Patriarchy, and Privilege. What are intersectionality's, and why is it important to study them when we study gender?

Unit 3: Feminist Movements: Rights struggles, Gains and losses, women in the workplace, Women in India

Unit 4: Representation of Gender: Who writes women? Short Stories on, about, and by women.

Unit5: Popular representations of women in cinema. How does popular visual culture shape gender politics?

Reference Books:

Adichie, Chimamanda Ngozi (2014). We Should All Be Feminists. Fourth Estate.

Beauvoir, Simone (2010), The Second Sex. Trans. Constance Borde and Sheila Malovany-Chevalliar. Vintage Books: London

Butler, Judith (1990), Gender Trouble: Feminism and the Subversion of Identity, New York: Routledge.

Kumar, Radha (2002), *A History of Doing: Movements for Women's Rights and Feminism in India, 1800-1990.* India, Kali for Women.

Menon, Nivedita (2012), *Seeing Like a Feminist.* New Delhi, Penguin.
Tharu, Susie and K. Lalita eds. *Women Writing in India: 600 B.C. to the Present. I and II. Delhi: Oxford University Press, New York: Feminist Press and London: Harper Collins, 1990-1993.*

Uberoi, Patricia (2006) *Freedom and Destiny: Gender, Family, And Popular Culture In India.* USA: Oxford University Press.

5.Teaching-Learning Strategies:

Students are expected to read up to 30 pages a week and attend film screenings 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.

6.Assessment methods and weightages:

Type of Evaluation	Weightage (in %)
Quiz 1	**10%**
Mid Sem- Exam	**20%**
End Sem Exam	**20%**
Term paper 1	**25%**
Term Paper 2	**25%**

Title of the Course : Geospatial Technology for Disaster Risk Modelling

Faculty Name **:** Kiran Chand Thumaty and Rehana Shaik
Course Code : **TBD**
L-T-P : **3-1-0**
Credits : **4**
Prerequisite Course / Knowledge:

Basic Physics and computational knowledge

Course Outcomes (COs)

CO-1: Basic understanding on how geospatial technology helps in decision support for major disasters

CO-2: Exposure to (a) retrieving space-based parameters/proxies for decision support, (b) Handling, interpretation and processing of analysis ready satellite data, (c) real time mapping of disasters and (d) modeling of different disasters

CO-3: Exposure to existing models of decision support and early warning system for major disasters

CO-4: To enable application of ML in development of decision support system (DSS)

Mapping course outcomes to project outcomes and project specific outcomes

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

Detailed Syllabus:

Unit-1: Basics of geospatial data analysis (3 hrs)

- (a) Different types of geospatial data (Raster & Vector data format), (b) data acquisition and storage, (c) data preprocessing, (d) reanalysis (e) analysis ready and gridded climate data
- Approach to retrieval of satellite data products and the concept of Algorithm Theoretical Basis Document (ATBD)
- Basics of Hydrometeorological data, measurements, storage, retrieval, and mapping

Unit-2: Flood risk and impact (12 hrs)

- Urban, riverine and coastal flooding - causes and impacts
- Flood inundation mapping – sensors, techniques & methods
- Hydrological and hydraulic models for flood risk and vulnerability assessment.
- Flood forecasting and risk assessment using statistical and machine learning models
- Development of DSS tools for the flood disaster management and early warning systems

Unit-3: Drought (9 hrs)

- Meteorological, hydrological and agricultural drought - causes and impacts
- Drought indices, climate indices and hydrometeorological variables in drought modelling
- Types of models - Regression analysis, time-series analysis, probability models, ANN models & hybrid models

- Machine learning models and statistical models for monitoring and forecasting of drought and risk assessment
- Development of DSS tools for the drought disaster management and early warning systems

Unit-4: Forest fires & open biomass burning (12 hrs)

- Forest fires – types, sources, distribution and affects
- Space-based near real time monitoring of fires - methods and retrieval algorithms for essential fire variables.
- Evolution of different 'fire danger rating' models (physical process based models)
- Machine learning for characterizing spatio-temporal trends of fires and fire prediction (short and long-term fire forecast)

Unit-5: Landslides (6 hrs)

- Landslides – types, sources and impacts.
- Methods for detection of landslides using optical and microwave (synthetic aperture radar data) sensors on-board different space platforms
- Landslide susceptibility and hazard assessment.
- Machine learning methods and applications for landslides risk assessment

Teaching-Learning Strategies in brief:

- Students will be taught on how geospatial technology and relevant modelling techniques can help in decision support for major disasters that occur in India, and how ML can augment, gap-fill and add-on to the existing operational methods of spatial decision support.
- Hands on sessions and term-projects with real-time case studies for understanding disaster modelling and management related issues using computer programming skills and open sources software tools.
- Projects based on existing open-source software tools; development of DSS tools for disaster management; machine learning algorithms based processing, predictions; and statistical models based disaster risk assessment

Assessment methods and weightages in brief *:*

- **Theory (%):** Quiz (10), Mid exam-1(25), End exam (40) = **60**%
- **Projects and Assignments (%):** Group and Individual projects based on the real-time data and models= 40%

Reading

- Jonathan Chipman, Ralph W. Kiefer, 2015. Thomas Lillesand. Remote Sensing and Image Interpretation, 7th Edition; ISBN: 978-1-118-34328-9, February 2015 736 pages
- Emilio Chuveico, 2003. Wildland Fire Danger Estimation and Mapping: The Role Of Remote Sensing Data: 4 (Series In Remote Sensing). DOI; https://doi.org/10.1142/5364
- Claudio Margottini, Paolo Canuti, Kyoji Sassa, 2013. Landslide Science and Practice, Volume 6: Risk Assessment, Management and Mitigation. Springer. DOI; https://doi.org/10.1007/978-3-642-31319-6
- Kyoji Sassa, Matjaž Mikoš, Shinji Sassa, Peter T. Bobrowsky, Kaoru Takara, Khang Dang,

2021. Understanding and Reducing Landslide Disaster Risk, Volume 1.
Sendai Landslide Partnerships and Kyoto Landslide Commitment. DOI; https://doi.org/10.1007/978-3-030-60196-6.

- K. Subramanya. Engineering Hydrology, Published by McGraw Hill Education (India) Private LimitedVol-4, 2013.
- CT Haan, Statistical Methods in Hydrology, Ames : Iowa State University Press,1977

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=Pracocalhours)
Semester, Year : Monsoon, 2024

1. Prerequisite Course/Knowledge:

No prerequisites are required

2. Course Objecoves &Outcomes (COs)

This course provides knowledge about the interaction between human (user), computer(machine) and environment. The course will examine the HCI from the science, technology and human-centered design perspective.

Lecture topics are aimed at guiding the students through analyzing and discussing the interaction between products and people based on cognitive, physical and emotional 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 interaction and how it affects the people intended goals and objectives. How a good HCI design delivers higher perceive usefulness, usability or ease of use leading to positive and delighPul user experience. It will build understanding the factors that influence the interaction between people and products in a desired direction. The course will explain the process of User-centeredsoRware design and development and the deliverables within the same such as user cases, user stories, work flow, task analysis, information architecture, wireframes, storyboards and low fidelity and high fidelity prototypes. The course will also introduce the concept and practice of usability testing and evaluation. The course will also looks into the technology trends such as AI, Chatbots. etc. and their influence on the interactions 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, Interaction designer, UX Designer and design interaction layer of the soRware/IT products 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.

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

CO-1 Demonstrate good understanding of Human-Computer Interaction and How it influences the User Experience of digital products, systems, solutions and services.
CO-2 Demonstrate good understanding of methods and tools used to understand the HCI from the perspectives of technology, human-centered design and human/social sciences such as cognitive, and digital anthropology perspective.
CO-3 Demonstrate good understanding of incorporating human-centered approach in HCI to deliver useful and easy to use soRware and IT products including Mobility, Healthcare, Learning, E-commerce and Utility etc.
CO-4 Demonstrate the ability to create, document and present the various deliverables and communications related to HCI, UX and UI Design including Human-Action Cycle, Personas, Use Cases, Task Flow and Analysis, Information Architecture diagram, Wireframes, UI Design, and Usability Testing etc.
CO-5 Demonstrate the ability to plan and execute usability testing including creating test cases, usability matrix, performs testing, record test data and analysis method? Fyusability issues and report the same for updating 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:

UNIT1.Introduction to Human-Computer Interaction *(Week 1- Lecture1)*

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

UNIT2.UNDERSTANDINGHuman-Machine System *(Week1-Lecture 2)*

- Understanding Human-Machine System
- Human-Action Cycle (HAC)
- 7stagesofHuman-action cycle.
- Classroom exercise on HAC

- User Experience

UNIT3.Art and Science of User Experience and UI Design *(Week2 -Lecture 3&4)*

- Aaention and Memory
- Gestalt theory and principles
- UI Elements including colour and interaction model
- Information and Interaction Design principles

UNIT4.User-Centered approach to the SoLware Design *(Week3 -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-centeredsoRware Design Workflow.

UNIT5.User Experience and UI Design *(Week4-Lecture7&8)*

- Information Architecture
- Wireframes and Storyboards
- Low and High-Fidelity prototypes

UNIT6.Usability Engineering and Testing (*Week5-Lecture9&10)*

- What is Usability, usability requirements and how to measure it?
- Heuristics evaluation
- Usability Test planning and conducting usability test.
- Usability matrix and test reporting

UNIT7.Usability Engineering and Testing *(Week6-Lecture11&12)*

- Short term project
- Project completion, documentation and submission

Reference Books& Case Studies:

1. Book: Human-Computer Interaction in the New Millennium, by Carroll, John
2. Book: Learn Human-Computer interaction: Solve human problems and focus on rapid prototyping and validating solutions through user testing., by Christopher Reid Becker
3. Book: Lean UX: Designing Great Products with Agile Teams, by JeffGothelf&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 ing the Design Right and the Right Design, by Bill Buxton
6. Book: Human-Computer Interaction: Solve human problems and focus on rapid prototyping and validating solutions through user testing, by Christopher Reid Becker
7. Book: Interaction Design: Beyond Human-Computer Interaction, By Helen Sharp, Jennifer Preece& Yvonnes Roger
8. Book: Designing User Interfaces: Exploring User Interfaces, UI Elements, Design Prototype sand the Figma UI Design Tool, Dario Calonaki

9. Book: Designing Interfaces: Paaerns for Effective Interaction 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 Artificial Intelligence Needs User Experience, by Gavin Lew, Robert M. Schumacher Jr.
12. Book: Information Visualization: Design for Interaction, by Prof. Robert Spence
13. Book: Moderating Usability Test: Principles and Practices for Interacting, by Dumas, Joseph
14. Case study: Design of a complex so Rware system-CMS of a media organisation
15. Casestudy: Defining a Mainframe System
16. Case Example: Conversation a lUI's

4. Teaching-Learning Strategies in brief (4to5sentences):

- The Course will divide into lectures (around12nos.) and hands-on work including assignments, classroom exercises and homework.
- The course will also include field work, 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. 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 : Human Sciences Lab

Faculty Name : Anirban Dasgupta

Course Code : HS7.101
Credits : 2
L-T-P : 3-0-0
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Program: B. Tech in Computer Science and M.S. in Computing and Human Sciences by Research

1.Prerequisite Course / Knowledge: Admission to Human Sciences Dual Degree Programme

2.Course Outcomes (COs):

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

CO-1: Students will get an introduction to computational tools which can be used in social science research.

CO-2: Students will start using social theory to read, analyze and interpret various kinds of data.

CO-3: Students will be exposed to the potential of computational humanities and social sciences. They will identify not just the potential, but equally the limitations of computational methods in the 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		3	1	1	3	2	1	1	1	1	1	1	1	1	3	1
CO2	1		3	1	1	3	2	1	1	1	1	1	1	1	1	3	1
CO3	1		3	1	1	3	2	1	1	1	1	1	1	1	1	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: Bag of Words exercise, followed by analysis of the results.

Unit 2: Identification and interpretation of correlations in social data. Statistical analysis, followed by study of the historical/sociological/political context.

Unit 3: Crawling of tweets, followed by an analysis of the results from a social science perspective.

Unit 4: Scraping of newspaper articles, followed by an analysis of the results from a social science perspective.

Unit 5: Working with Political Data: Extracting electoral data from various sites, followed by an analysis of the results from a social science perspective.

Reference Books:

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

All the computational exercises are hands-on, where a teaching assistant and the faculty in-charge work together with the students. All classes are interactive. The computational exercises are followed by brief lectures on social theory which can help in the social science analysis. Discussions are highly encouraged, especially during the analysis from a social science perspective. Students will be trained develop a good graspofdistilling a research work to its core meaning while drawing out their implication and affectations.

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

Class exercises: 75% (5 exercises, each accounting for 15%)
Project: 25%

Title of the Course : Hydrological Modeling and Software Development
Name of the Faculty : Shaik Rehana
Course Code : CE5.502
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 Open Elective (Monsoon)

1.Prerequisite Course / Knowledge:
General awareness about water and climate related problems and computational programming skills to develop tools for an effective water resources management.

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

CO-1: Develop awareness about various water and climate change related problems and help to provide best possible optimal solutions for better management of water resources
CO-2: Integrate hydrological models with computational techniques
CO-3: Employ computer science skills in developing hydrological modelling and water management tools
CO-4: Design and develop open-source tools for mapping, analyzing and predicting hydrological processes
CO-5: Develop critical thinking to help in solving real-time water related issues using computational algorithms and technologies
CO-6: To improve the problem-solving skills for solving water resources management 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	3	1	2	2	3	1	1	3	1	1	1	2	2	3	2	3
CO2	1	3	2	3	2	1	1	1	1	3	1	2	2	2	2	2
CO3	2	2	2	2	3	1	2	1	1	1	1	2	2	2	2	2
CO4	2	2	3	2	3	1	2	1	1	1	1	2	2	2	2	2
CO5	2	3	2	2	3	2	3	2	1	1	1	2	2	2	2	2
CO6	2	2	3	2	2	2	2	2	1	3	1	2	2	1	2	2

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

4. Detailed Syllabus:

- **Introduction:** fundamentals of fluid mechanics and open channel flows; hydrology, rainfall and runoff processes and hydro-climatology, statistical analysis, optimization methods.
- **Water Resources Systems**: river basin and urban hydrology, river water quality modelling, flood and drought management, irrigation and reservoir operation and climate change.
- **Technologies and Software**: Open-source public domain software based on Microsoft Windows environment: US Environmental Protection Agency's Qual2k; MATLAB Tools: Air2stream; Windows based decision support systems.
- **Development and Application of Software**: Real-world applications at various scales for water resources management

References:

- Subrahmanya, K., 2008, Engineering Hydrology, Tata Mc Graw Hill Pub. Co., New Delhi.
- Chow, V. T., Maidment and Mays, L. A., 2010, Applied Hydrology, Tata Mc Graw Hill Pub. Co., New York.
- Haan T. C., *Statistical Methods in Hydrology*, East West Publishers, 1998.
- SK Som and G Biswas, Introduction to Fluid Mechanics and Fluid Machines

5.Teaching-Learning Strategies in brief:

Lectures and tutorials on various tools to analyze, visualize and map various water resources systems such as rivers, basins, catchments, etc. Hands on sessions and term-projects with real-time case studies for understanding water and climate related issues and to develop tools with the use of computer programming skills and open sources software tools.

6.Assessment methods and weightages in brief:

Theory (%): Quiz (10), Assignments (10), Mid exam-1 (20), End exam (30) = **70%**
Projects (%): Term project and final presentation along with report **= 30%**

Title of the Course : Information Retrieval and Extraction

Name of the Faculty : Rahul Mishra
Course Code : CS4.406
L-T-P : 3-1-1
Credits : 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Academic Program: B.Tech. in Computer Science and Engineering

1.Prerequisite Course / Knowledge:

Basic principles of Computer programming, Statistical Methods in Artificial Intelligence, Programming experience in Python, and Algorithms.

2.Course Outcomes (COs)

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

CO-1. Develop algorithms to retrieve information from unstructured data

CO-2. Design and architect information retrieval systems for worldwide web

CO-3: Design Web crawling systems

CO-4. Design algorithms to process noisy data in document repositories

CO-5. Develop information extraction system's

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

'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 Information retrieval, Information Extraction and Information Access systems. (6 hours)

Unit 2: Information Retrieval Models and Evaluation of IR systems (7.5 hours);

Unit 3: Web Information Retrieval (4.5 hours)

Unit 4 Natural Language Processing in IR (7.5 hours)

Unit 5: Machine Learning in Information Retrieval Systems (12 hours)

Unit 6: Information Extraction (4.5 Hours)

Unit 7: IR Applications (12 Hours)

References:

1. Introduction Information Retrieval – Chris Manning et al (the Stanford IR Book) (ISBN-13: 978-0521865715)
2. Search Engines: IR in Practice – Bruce Craft et al (ISBN-13: 978-0136072249)
3. Research papers

5.Teaching-Learning Strategies in brief:

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

6.Assessment methods and weightages in brief:

Assignments (theory and programming): 20 marks

Seminar: 10 marks

Project: 35 marks

Mid Semester Examination: 15 marks

End Semester Examination: 20 marks

Karma Points: Exceptional performance, active participation in class/tutorials, and help provided to other students, which a TA or instructor notices deem worthy of 3 marks.

Title of the Course : Information Theory

Name of the Faculty: Arti Yardi
Course Code : EC5.410
Credits : 4
L - T - P : 3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year_____: Monsoon 2024
Name of the Program: B. Tech in Electronics and Communication Engg.

Pre-Requisites : Basics course in probability is a must. Ability to read and write basic formal mathematics.

Course Outcomes (COs) :
After completion of this course successfully, the students will be able to:
CO-1: Explain the definition and properties of various basic concepts in information theory such as entropy, relative entropy, and mutual information for discrete and continuous random variables
CO-2: Interpret and apply the concept of asymptotic equipartition property and random binning proof technique.
CO-3: Discuss the basics of data compression and source codes such as Huffman codes, Lempel-Ziv.
CO-4: Employ random coding ideas to prove the Shannon's source coding and channel coding theorems for some simple sources and channels

CO-5: Analyze the capacity of a communication channel through various illustrative examples
CO-6: Apply Information Theory for Converse Proofs in various settings: Umbrella Converse for Data Exchange, Coded Caching, Private Information Retrieval

Course Topics :

Unit 1: Random Variables as Signals at Source and Receivers, Source Coding - Entropy and its properties, Relative entropy, Mutual information, Huffman codes and optimality, Asymptotic Equipartition Property and Typical set-based source coding.
Unit 2: Channel coding - Channel capacity motivation and definition, Discrete memoryless channel, Channel coding theorem for DMC- achievability and converse, Differential Entropy, Guassian Channel Capacity
Unit 3: Polar Codes as Efficient Capacity Achieving Codes for DMCs
Unit 4: Converse Results using Information Theoretic Arguments: Private Information Retrieval, Data Exchange between Nodes, DNA Storage, Adversarial Channels.

Preferred Textbooks: "Elements of Information Theory", Thomas Cover and Joy Thomas.
Reference Books :

1. "Information Theory, Inference and learning algorithms", David McKay (available online)
2. Research Papers

Grading Plan : (The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz-1	**10%**
Mid Sem Exam	**20%**
Quiz-2	**10%**
End Sem Exam	**30%**
Assignments	**15%**
Term Paper	**15%**

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' ash 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	3	2	3	2	1	1	2	3	3	2	3	3	3	2	3
CO2	2	3	2	3	2	1	1	2	3	3	2	3	3	3	2	3
CO3	3	3	2	3	2	1	1	2	3	3	2	3	3	3	2	3
CO4	2	3	2	3	2	1	1	2	3	3	2	3	3	3	2	3
CO5	3	3	2	3	2	1	1	2	3	3	2	3	3	3	2	3
CO6	3	3	2	3	2	1	1	2	3	3	2	3	3	3	2	3

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

The course materials will be delivered through a systematic set of lectures, assignments, tutorials, and a term paper. The lectures will be highly interactive, where students will be encouraged to participate in class activities. In order to evaluate overall understanding of students, there will be short quizzes with multiple choice questions during the lectures. There will be one tutorial session per week and periodic set of assignments consisting of practice questions throughout the semester. Students will be divided into groups (of appropriate sizes) and each group will be asked to study and present a research paper. These research papers are carefully chosen by the instructor such that they will aid students to understand and apply the concepts studied during the course duration.

Title of the Course : Intro to Cognitive Science
Course Code : CG1.402

Course Information

Instructor Information

Faculty: Dr Vishnu Sreekumar
TAs: TBD
Day/Time: TBD.
Virtual Office Hours: By appointment (please email).
E-mail: vishnu.sreekumar@iiit.ac.in
First point of contact – TAs; emails: TBD

Course Information

Course Description: Cognitive Science is a highly interdisciplinary field of study that seeks to understand how the mind works. In this course, we will discuss a diverse range of perspectives from philosophy, linguistics, psychology, neuroscience, and computer science, on how to unravel the mysteries of human cognition.
Credits: 4
L-T-P: 3-1-0 (L = lecture hours, T = tutorial hours, P = practical hours)
Prerequisite: None

Textbook & Course Materials

Recommended Texts & Other Readings: Lecture slides and supplementary readings will be posted to Moodle.

Course Technology Requirements

- You will need access to the following tools to participate in this course.
  - Laptop/desktop computer
  - webcam
  - microphone
  - a stable internet connection (don't rely on cellular)

Course Structure

This course will be delivered fully in-person in a physical classroom.

Student Expectations

In this course you will be expected to complete the following types of tasks.

- communicate via email
- complete basic internet searches
- download and upload documents to the course site on Moodle
- read documents online
- view online videos
- participate in online discussions
- complete quizzes/tests online
- upload documents to a Dropbox/Moodle
- participate in synchronous online discussions

Expected Instructor/TA Response Times

- We will attempt to respond to student emails within 24 hours. If you have not received a reply from us within 24 hours, please resend your email.
  - ***If you have a general course question (not confidential or personal in nature), please post it to the Course Q&A Discussion Forum found on the course homepage on Moodle. We will post answers to all general questions there so that all students can view them. Students are encouraged to answer each other's questions too.
- We will attempt to reply to and assess student discussion posts within 48 hours.

Course Outcomes (COs)

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

- CO-1: demonstrate familiarity with seminal research findings in cognitive science.
- CO-2: read, interpret, critique, and evaluate research in cognitive science.
- CO-3: critically think about the relationship between diverse fields such as AI, philosophy, neuroscience, and cognitive science.
- CO-4: identify flaws in how scientific results are communicated and critique scientific work in terms of confounds, experimental design, etc.
- CO-5: appreciate the nature of scientific debate in cognitive science and be able to generate well-informed perspectives on these debates.

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

- Attend lectures and participate in class discussions (CO-1, CO-2, CO-3, CO-4, CO-5)
- Debate sessions (CO-1, CO-2, CO-3, CO-5)
- Quiz 1, Quiz 2, mid-semester, and end-semester exams (CO-1, CO-2, CO-3, CO-5)
- Complete a term paper/debate reaction paper (CO-1, CO-2, CO-3, CO-5)

List of topics and activities

Students are encouraged to ask questions and steer the lecture in directions that are interesting to them. We will still manage to cover a range of topics from the ones listed below, but we will learn via the Socratic Method.

- **Introduction**
- **Evolution of Cognitive Science**
- **A free-form discussion on consciousness**
- **Empirical approaches in cognitive science**
- **Brain: Organization; Intro to sensation and perception**
- **Sensory systems**
- **Perception and Perceptual Learning, Cross-modal interactions**
- **Vision**
- **Attention**
- **Learning**
- **Development**
- **Memory**
- **Language and Cognition**
- **Knowledge Representation**
- **Special topics: e.g. Music, mind, and technology**
- **Several debate sessions with student debate teams**

Grading Policies

Graded Course Activities

Description	Percentage
Quiz 1 (10 marks)	10%
Quiz 2 (10 marks)	10%
Debate reaction paper or debate team participation (25 marks)	25%
Mid-Sem exam (20 marks)	20%
End semester exam (35 marks)	35%
Total (100 marks)	100

Quizzes

Quiz 1 will cover topics covered until Quiz 1, and Quiz 2 will cover topics taught between Quiz 1 and Quiz 2. They will contain mostly multiple-choice questions.

Mid-semester exam (20 marks)

The mid-semester exam will cover all material taught up to that point and may include both multiple choice and descriptive questions.

End semester exam (35 marks)

The end semester exam will cover material taught during the whole semester and will include both multiple choice and descriptive type questions.

Debate participation (25 marks = 10 marks for presenting + 10 marks for a short report + 5 marks for chatGPT critique)

We will reserve at least 3-4 lecture slots for student debates on contemporary issues in Cognitive Science. A list of representative topics are as follows:

1. Are there top-down influences on basic perception? Evidence for and against.
2. Do 3-year-olds have a theory of mind?
3. Is cognition/consciousness a computational process?
4. Do we need representations for cognition?

Each debate team will have 3 members. They will read the recommended material for the chosen topic, and organize their arguments distributed across the 3 members. Each member gets 5 minutes to present their arguments (15 minutes per team). They may choose to use slides or not but the arguments must be clearly presented. At the end of both teams' presentations, each team gets 5 minutes for rebuttal when they can pick 2-3 claims made by the opposite team and present counterarguments.

The students participating in debate teams will only be required to write a short report but the ***remaining students will need to write a reaction paper to any one debate session OR write a term paper on any other topic that they choose (see next main section).***

For debate team students (each person writes this separately without discussion with other team members, plagiarism software will be used to check your work), your short report should contain the following:
The paper will first summarize the problem (2 marks), and then summarize the arguments made by both sides (3 marks), and then will provide the student's OWN opinion about where they stand on the debate and what arguments were convincing to them (5 marks).

Recommended: 2-3 pages, font size 12, single-spaced.

The debate teams will be made on a first-come first-serve basis. TAs will open sign-up forms and make announcements on the course page on Moodle. It is important to check announcements on Moodle regularly for this reason.

IMPORTANT: See the last section of this syllabus for policies about plagiarism. There will be no exceptions to those policies.

Term Paper or debate reaction papers for non-debate team students (25 marks: 20 marks for term paper + 5 marks for chatGPT critique)

1. Introduction and clarity of describing the background literature and specifying the nature of the problem – 3 marks
2. Describing the different schools of thought that tackle the question – 7 marks
3. Offer your own thinking on the matter (either siding with one school of thought, or offering a new insight or suggestions for experiments or investigations, providing appropriate justifications) – 5 marks
4. Overall clarity, organization of thoughts, and originality – 3 marks
5. Formatting (Citations, References) – 2 marks

Recommended: 8-10 pages, font size 12, single-spaced.

Those opting to do a project will have the same requirements for their project report as above.

Everyone: Needs to include chatGPT output on the same topic along with your critique of the output as explained in class by the TA. Worth 5 marks.

1. The links and list of prompts used to generate the 2000-2500 chatGPT output – 1 marks
2. Critique of the output – 3 marks (0.5 marks for verifying the sources and citations, 2.5 marks for substantive critique of the output by citing what you learned from the course or from additional reading)
3. Quality of your critique – 1 mark (this will directly depend on whether you did your human-generated essay by yourself first and the quality of that).

Submission window for the term paper/debate reaction/project paper: Nov 5-15
No extensions will be given because this is a wide window.
You are welcome to make multiple submissions within this window. Feedback will be given to people who submit within the first three days of this window and they will be allowed to revise and resubmit their work during the same window.

Bonus credit opportunities (upto a maximum of 3%)

We will provide some opportunities for you to earn bonus marks. For example, you can participate in cognitive science studies to help you understand how we study the mind using empirical methods in cognitive science. These bonus activities can count upto a maximum of 3% points of your overall marks for the course. This means that if you are diligent and complete the bonus activities, you stand a higher chance of crossing a grade

cutoff (we will apply the bonus after we decide the cutoffs so that you receive this benefit). Because we offer this opportunity, emails requesting grace marks to cross grade cutoffs at the end of the semester will not be entertained.

Participation

Students are expected to participate in all activities as listed on the course calendar. *Failure to participate will result in students being unable to complete the term paper satisfactorily. The exams may also include questions from the in-class activities such as the debates and any resulting effect on the final grade is entirely the student's responsibility.*

Complete Assignments

All assignments for this course will be submitted electronically through the course page on Moodle unless otherwise instructed. Assignments must be submitted by the given deadline or special permission must be requested from the instructor *before the opening of the submission window with documented evidence of an emergency*.
Late or missing assignments will affect the student's grade.

Late Work Policy

Be sure to pay close attention to deadlines—there will be no make-up assignments or quizzes, or late work accepted without a serious and compelling reason and instructor approval.

Viewing Grades on Moodle

Points you receive for graded activities will be posted to the course page on Moodle. Click on the Grades link to view your points.

Letter Grade Assignment

Final grades assigned for this course will be based on the percentage of total points earned. The exact cutoffs will be announced after the end semester exam is graded.

Course Policies

Netiquette Guidelines

Netiquette is a set of rules for behaving properly online. Your instructor and fellow students wish to foster a safe online learning environment. All opinions and experiences, no matter how different or controversial they may be perceived, must be respected in the tolerant spirit of academic discourse. You are encouraged to comment, question, or critique an idea but you are not to attack an individual. Working as a community of learners, we can build a polite and respectful course community.

The following netiquette tips will enhance the learning experience for everyone in the course:

- Do not dominate any discussion.
- Give other students the opportunity to join in the discussion.
- Do not use offensive language. Present ideas appropriately.
- Be cautious in using Internet language. For example, do not capitalize all letters since this suggests shouting.
- Avoid using vernacular and/or slang language. This could possibly lead to misinterpretation.
- Never make fun of someone's ability to read or write.
- Share tips with other students.

- Keep an "open-mind" and be willing to express even your minority opinion. Minority opinions have to be respected.
- Think and edit before you push the "Send" button.
- Do not hesitate to ask for feedback.
- Always assume good intentions and ask for clarification. Communication online is difficult without facial and gestural cues.

Adapted from:

Mintu-Wimsatt, A., Kernek, C., & Lozada, H. R. (2010). *Netiquette: Make it part of your syllabus*. Journal of Online Learning and Teaching, 6(1). Retrieved from http://jolt.merlot.org/vol6no1/mintu-wimsatt_0310.htm

Shea, V. (1994). Netiquette. Albion.com. Retrieved from: http://www.albion.com/netiquette/book/.

Build Rapport

If you find that you have any trouble keeping up with assignments or other aspects of the course, make sure you let your instructor know as early as possible. As you will find, building rapport and effective relationships are key to becoming an effective professional. Make sure that you are proactive in informing your instructor when difficulties arise during the semester so that we can help you find a solution.

Inform Your Instructor of Any Accommodations Needed

If you have a documented disability and wish to discuss academic accommodations, please contact your instructors as soon as possible.

Statement of Policy

The instructors of this course will modify requirements as necessary to ensure that they do not discriminate against qualified students with disabilities. The modifications should not affect the substance of educational programs or compromise academic standards; nor should they intrude upon academic freedom. Examinations or other procedures used for evaluating students' academic achievements may be adapted. The results of such evaluation must demonstrate the student's achievement in the academic activity, rather than describe his/her disability.

If modifications are required due to a disability, please inform the instructor

Commit to Integrity

As a student in this course (and at IIIT Hyderabad) you are expected to maintain high degrees of professionalism, commitment to active learning and participation in this class and also integrity in your behavior in and out of the classroom.

IIIT Hyderabad Academic Honesty Policy & Procedures

Student Academic Disciplinary Procedures

(1) Academic misconduct is an act in which a student:

(a) Seeks to claim credit for the work or efforts of another without authorization or citation;

(b) Uses unauthorized materials or fabricated data in any academic exercise;

(c) Forges or falsifies academic documents or records;
(d) Intentionally impedes or damages the academic work of others;
(e) Engages in conduct aimed at making false representation of a student's academic performance; or
(f) Assists other students in any of these acts.

(2) Examples of academic misconduct include, but are not limited to: cheating on an examination; collaborating with others in work to be presented, contrary to the stated rules of the course; submitting a paper or assignment as one's own work when a part or all of the paper or assignment is the work of another; submitting a paper or assignment that contains ideas or research of others without appropriately identifying the sources of those ideas; stealing examinations or course materials; submitting, if contrary to the rules of a course, work previously presented in another course; tampering with the laboratory experiment or computer program of another student; knowingly and intentionally assisting another student in any of the above, including assistance in an arrangement whereby any work, classroom performance, examination or other activity is submitted or performed by a person other than the student under whose name the work is submitted or performed.

We will be using plagiarism detection software. Please do not copy-paste from other papers or use AI/LLMs in ways that are not authorized by the faculty. If you use direct quotes, you have to use the quotation marks "xyz" and cite your source: e.g. (Johnson & Johnson, 1988, p. 5). Please use APA format. If plagiarism is detected, for the first violation, you will get 0 for the term paper or assignment in question. If plagiarism is detected a second time in another assignment/project write-up, then one letter grade will be deducted from the final grade (e.g if you get a B/B-, that will be changed to C/C-) and you will be reported to the appropriate authorities for further disciplinary action.

Note: This syllabus was adapted from a template provided at www.uwsp.edu

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Title of the Course : Introduction to Psychology

Name of the Faculty : Priyanka Srivastava
Course Code : HS2.202
L-T-P : 3-0-1
Credits : 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)

Name of the Academic Program Humanities Electives (UG3 and UG4)

1. **Prerequisite Course / Knowledge:** None

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

After completion of this course successfully, the students will be able to.. CO-1: apply psychology knowledge base –

- describe and discuss major concepts, theories, models and overarching themes in psychology
- describe applications of psychology
- analyse and compare the major goals of psychological science and will be able to utilize different research methods used by psychological research.
- evaluate the challenges and merits of psychological observations and analyses, assess the brain and behaviour research complexity.
- explain the major historical landmarks in psychological science and their links to contemporary research.

CO-2: apply scientific inquiry and critical thinking –

- apply major perspectives of Psychology and levels of analyses to explain psychological phenomenon, e.g., cognitive, biological, social, health, behavioural, and cultural etc.
- analyse and evaluate the difference between the personal anecdotal incidences and scientific inquiry to our everyday psychological experiences. Students will be able to use different level of complexity to interpret psychological behaviour
- compare common fallacies like confirmation bias, causation to correlation etc.
- design, conduct, analyse, evaluate and interpret basic psychological research.
- analyse, interpret, and evaluate the individual experience and socio-cultural perspectives to explain psychological phenomenon

CO-3: Evaluate and Analyze research ethics of human/ behavioral sciences

- analyse and compare the benefits and risk of given psychological research
- apply key principles of APA Ethics guidelines for participants' right protection

CO-4: demonstrate effective communication skills

CO-5: demonstrate personal and professional development

- apply psychological learning to their personal and professional development, self-regulation, project management, coordinate teamwork, and develop life directions

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
CO 1	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
CO 5	1	1	1	1	1	1	1	1	3	2	1	3	1	1	1	1

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

4. Detailed Syllabus:

Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6
Introduction	**Methods**	**Health & Psychology**	**Social & Personality**	**Cognitive**	**Learning & Development**
Psychology as a Science	Research methods for psychological observations	Psychological health and disorders	Social	Attention	Learning
Goals of Psychology	Neuroscience and behaviour	Psychological interventions and treatments	Gender	Perception	Life-span development
History of Psychology			Emotion	Memory	
			Personality	Intelligence	

3 hours	3 hours	6 hours	6 hours	6 hours	3.5 hours
2 Lectures	2 Lectures	4 Lectures	4 Lectures	4 Lectures	3 Lectures
CO 1 & 2	CO 1, 2 & 3	CO 1, 2, & 5	CO 1, 2, & 5	CO 1, 2, & 5	CO 1, 2, & 5

Reference Books:

1. Lilienfeld, S., Lynn, S. J., Namy, L., Woolf, N., Jamieson, G., Marks, A., & Slaughter, V. (2014). *Psychology: From inquiry to understanding* (Vol. 2). Pearson Higher Education AU.
2. Schacter, D., Gilbert, D., Wegner, D., & Hood, B. M. (2011). *Psychology: European Edition*. Macmillan International Higher Education.
3. Anderson, J. R. (1984). Cognitive psychology. *Artificial Intelligence*, *23*(1), 1-11.
4. Elliot, A., Timothy, W., & Samuel, R.S. (2017). Social Psychology (9th Ed.) Pearson Education.

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

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

The psychology course in monsoon 2021 will be primarily lecture and project-based learning course. Students will be required to make presentations for one of the assigned reading materials and project. Students will be introduced to undergraduate-level introductory topics and issues in psychology. Reading material will be assigned. Students will be required to engage in discussions, and to present topics based on the assigned reading topics. Each student will be required to do at least two presentations, one reading material and another accounted for their project. Students will be encouraged to take assignments inspired from their everyday experiences and will be asked to evaluate the event/phenomenon/ processes critically and scientifically using psychological methods. They will be asked to perform some of the activities in team and demonstrate the individual contribution to the team activities. Students may be asked to perform peer review as well.

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

1.	Assignment / Term Paper	N=1	10%
2.	Home and Class Activities (Student presentation)	N=2	5%
3.	Quiz	N=2	20%
4.	Project in Group – with 2-3 students	N=1	30%
5.	Final Exam	N=1	30%
6.	Experiment participation based on credits	N=2	5
		TOTAL	**100%**

Project Evaluation Breakdown:

1.	Idea presentation / Proposal	4%

2.	Progress Report 1: with hypothesis, experiment design, paradigms, tasks, measures, prediction, and statistical analyses to use	8%
3.	Progress Report 2: with pilot data and preliminary analysis	8%
4.	Final Presentation + Peer evaluation (should be based on critical feedback)	8% + 2%
	TOTAL	**30%**

Grading Policy: Absolute grading policy scheme

A	**>=90**
A-	**>=80**
B	**>=70**
B-	**>=60**
C	**>=50**
C-	**>=45**
D	**>=40**
F	**<40**

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

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

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

Project Evaluation – Rubric (100)

S.No.	Topic Description	Marks
1.	Clarity in Problem Statement, Method, Result, and Discussion	15
2.	Critical understanding of Literature – motivation for your research project	20
3.	Method: Participants, material, stimuli, procedure, task, measure of performance, sampling	20

4.	Results (Statistics), and Discussion and conclusion	20
5.	Future direction: Limitation and Scope of the current research/ objective, and Impact	10
6.	Citations and Reference (APA style)	10
7.	Organization	5

Assignment/ Term Paper Evaluation – Rubric (50 marks each)

S.No.	Topic Description	Marks
1.	Clarity and coherence in describing topic	10
2.	Summary and Critical Evaluation to find the gaps in the given literature	15
3.	Future direction: Limitation and Scope of the current research/ objective, and Impact	15
4.	Citations and Reference (APA style)	10
5.	Organization	5

Title of the Course : **Introduction to Biology**

Name of the Faculty : Vinod PK
Course Code : SC3.101
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: Identify levels of organization (in different time and length scales) in living organisms

CO-2: Describe the characteristics of living organisms
CO-3: Apply principles of physics to biology
CO-4: Distinguish different cellular and biomolecular structures and functions
CO-5: Explain different cellular and biochemical processes and their control
CO-6: Outline the applications of computers in biology
CO-7: Evaluate and synthesize information from the scientific literature

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	3	3	1
CO2	3	1	1	1	1								1	3	3	1
CO3	3	2	1	1	1								1	3	3	1
CO4	3	1	1	1	1								1	3	3	1
CO5	3	1	1	1	1								1	3	3	1
CO6	3	2	1	1	2								1	3	3	2
CO7	3	1	1	1	1								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: Cellular foundations: Cell organelles, Membranes and cellular compartments, Tree of life
Unit 2: Chemical foundations: Biomolecules, Structure and function
Unit 3: Physical foundations: Bioenergetics, Catalysis, Enzymes, Photosynthesis, Respiration
Unit 4: How cells obtain energy from the food - metabolism
Unit 5: Genetic foundations: DNA, Genes, chromosomes, Genomes, Mutations
Unit 6: Evolutionary foundations, Systematics
Unit 7: DNA Replication, Repair, and Recombination - an overview
Unit 8: How Cells Read the Genome: From DNA to Protein
Unit 9: Control of Gene expression
Unit 10: Cell Signaling, Cell cycle
Unit 11: Analyzing and manipulating DNA
Unit 12: Introduction to sequencing and computational challenges

Reference Books:

1. Lehninger Principles of Biochemistry by David Nelson, Michael Cox
2. Molecular biology of the cell, Sixth Edition by Alberts B by Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter.
3. Fundamentals of Biochemistry by Voet, Voet& Pratt

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

The topics are presented through examples of its applications (e.g., to the human body, disease), of the latest research developments and of the history of the subject. Tutorials are designed to show how computers can be used to tackle biological problems. Evaluations test their ability to understand the relationships between topics and synthesize information
from scientific literature.

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

- Assignments - 30%
- Review essay - 10%
- Quiz - 30%
- Exams - 30%

Title of the Economics	**:**	**Introduction to Economics**
Name of the Faculty	:	Anirban Dasgupta
Name of the Program	:	B.Tech in Computer Science and Engineering
Course Code	:	HS5.202
Credits	:	4
L - T - P	:	L-3, T-1
(L - Lecture hours, T-Tutorial hours, P - Practical hours)		
Semester, Year	:	Monsoon 2024

Pre-Requisites **:** Introduction to Human Sciences

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

CO1: Identify the different definitions of economics

CO2: Distinguish between schools of thought in economics and understand their evolution

CO3: Understand the foundations of micro, macro and international economics

CO4: Analyze how the conditions of economic life are distinct in developing countries like India

CO5. Comprehend how other disciplines can complement economics in explaining social phenomena and relevant policy interventions

Course Modules:

1. **'Ways of doing economics:** Different views on scope and definition of economics. Alternative schools of economic thought- Neoclassical, Marxist, Keynesian
2. **Theoretical foundations of microeconomics:** Agent based understanding of decision making- individuals and firms. Market structure and game theory. Welfare economics, Information economics

3. **Theoretical foundations of macroeconomics:** Macroeconomic measurement. Aggregate demand, aggregate supply and determination of output. Inflation and Unemployment, Monetary and Fiscal Policy. Banking and the role of finance in the economy
4. **Introduction to the open economy:** Basic trade theory- absolute advantage, comparative advantage, Heckscher-Ohlin Model. Exchange rate determination. External accounts of an economy
5. **Interdisciplinary engagements with economics:** Economics and psychology. Economics and computational science, economics and climate science

Textbooks :

- CORE Econ. The Economy: A South Asian Perspective (free e-book available)
- Neva Goodwin *et.al*. Principles of Economics in Context. Routledge.
- Richard Wolff and Stephen Resnick. Contending Economic Theories: Neoclassical, Keynesian and Marxian. MIT Press.
- **Reference Books & Articles (indicative list, more will be added in the course of teaching):**
- Michelle Baddeley: Behavioural Economics: A very short Introduction. Oxford University Press
- Samuel Bromley *et.al. (eds.):* Making the International: Economic Interdependence and Political Order. Open University Press.
- International Monetary Fund: Balance of Payments Manual.
- K. Vela Velupillai & Stefano Zambelli (2015) Simulation, computation and dynamics in economics, Journal of Economic Methodology, 22:1, 1-27,

E-book Links :

Grading Plan : (The table is Indicative)

Type of Evaluation	**Weightage (in %)**
Mid Sem Exam	**30%**
Class Presentation	**15%**
End Sem Exam	**40%**
Assignment	**15%**

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 and class presentations. Relevant chapters from the textbooks and articles will be referred to for each lecture. As an introductory course, the assignments will be designed to evaluate the theoretical clarity attained by students. The lectures and reading material will be designed to highlight both the logical structure of economic theory as well as the plural approaches to economic problems that originate from alternative theoretical perspectives.

Title of the course **: Introduction to Film Studies**

Faculty Name : Sushmita Banerji
Name of the Program : Open Elective
Course Code : HS1.208
Credits : 4
L - T - P : 3 – 1- 0
Semester, Year : Monsoon 2024

Pre-Requisites **: Introduction to Human Sciences**

Course Outcomes

1. Introduce students to basic terms of film analysis and interpretation.
2. Introduction to Fundamental theories of cinema studies
3. Understand cinema as a medium, a phenomenon, art, and industrial practice.
4. Introduction to Global Cinema Movements
5. Introduction to Cinema in Art and Politics

Course Topics
Unit 1: Basic terms of analysis and interpretation. Misè-en-Scène, Cinematography, Editing, Sound, Narrative, Genre.
Unit 2: Fundamental conversations on medium specificity, Realism in Cinema, Phenomenology of film, the Soviet School, Digital Cinema.

Unit 3: Introduction to cinema movements. May include – German Expressionism, New Wave/s, Noir, Indian art film movement.

Preferred Textbooks

Leo Braudy and Marshall Cohen, eds. *Film Theory and Criticism*, 6th Edition, (Oxford: 2004)
J. Dudley Andrew. *The Major Film Theories: An Introduction* (Oxford University Press, 1976)
Jill Nelmes (ed.) *An Introduction to Film Studies* (5th ed) (Routledge, 2012)

Reference Books

David Bordwell and Kristin Thompson. *Film Art: An Introduction* (10th ed) (Mc Graw-Hill Education, 2013)
David Bordwell and Kristin Thompson. *Film History: An Introduction.* McGraw-Hill Education; 9th ed. (2010)
J. Dudley Andrew. *Concepts in Film Theory* (Oxford University Press, 1984)
Sergei Eisenstein, Jay Leyda (ed.) *Film Form: Essays in Film Theory* (Mariner Books, 1969)
André Bazin *What Is Cinema* (vol 1 and 2) (University of California Press, 2004)

Grading Plan

Type of Evaluation	Weightage (in %)
Quiz 1	**10%**
Mid Semester Exam	**20%**
Quiz 2	**10%**
Assignment 1	**25%**
Assignment 2	**25%**

Mapping of Course Outcomes to Program Objectives

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

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

Students will learn to engage and interpret cinema critically; will be familiar with basic theoretical tools, and with the ways in which cinema has changed over time.
Students are expected to read up to 30 pages a week, watch recommended films, and attend film screenings when required.

Title of the Course : Introduction to History

Name of the Faculty : Isha Dubey
Course Code : HS3.201
Credits : 4
L - T - P :
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Monsoon 2024
Name of the Program: B. Tech in Computer Science and Engineering

Pre-Requisites : Introduction to Human Sciences, HS8.102

Course Outcomes :

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

CO1: Define the concept of History and describe the development of the discipline.
CO2: Explain range of academic theories relating to the discipline of History.
CO3: Analyze features of historical writings and appreciate the importance of the past.
CO4: Evaluate the different methods of historical analysis.
CO5. Assess primary evidence,
CO6.Developtheirown understanding about History and the Past.

Course Topics :

(1) **Historical Time and Space:** In this module students will be introduced to how historians have understood the flow of time and periodised time into historical ages. They will also appreciate how historians define regions and territory. Apart from this the module will also teach about the development of the idea softime, and of space; and how the modern map and watches came to define society in new ways.
(2) **Historical Fact and Objectivity**: This module will define the historical fact, the different interpretations of what a fact is, and the debate among historians relating to historical objectivity: its possibility and desirability.
(3) **The Main Theories of History**: In this module students will be exposed to the main theoretical models of historical interpretation. These will include, but not be limited to, Rankean and Whig history, Annales history, Marxist history, Structuralist and Post-Structuralist history, etc. Students will also be introduced to the newer theories like ecological history, black history, herstory, etc.
(4) **The Main Methods of Historical Analysis**: This module will focus on source criticism, the advantages and limitation sof the inductive and deductive methods, oral history,
qualitative and quantitative methods, etc. that historians deploy in their identification off acts and their interpretations.
(5) **Memory, heritage and public history**: This module will provide students brief introductions to the fields of memory studies, heritage studies and public history and acquaint the with the debates around the relationship between the past and the present, memory and history, remembrance and forgetting and the opening of the discipline of history beyond the academy.

Preferred TextBooks:

- E.H. Carr: *What is History*.
- Marc Bloch: *The Historian's Craft*
- Umberto Eco: *This is not the end of the Book.*
- Shawn Graham, etal: *The Historian's Macroscope*.

Reference Books:

- Romila Thapar: *From Lineageto State*.
- Mircea Eliade: *The Mytho the Eternal Return*.
- Edward Said: *Orientalism*.
- Sumit Sarkar: *Modern Times*.
- Vanessa Ogle: *The Global Transformation of Time*.
- Richard Eaton: *Indi ain the Persianate Age*.
- Michael Mann: *South Asia's Modern History.*
- R.C. Majumdar: *An Advanced History of India*.
- Alfred Crosby: *The Measure of Reality.*
- Fernand Braudel: *A History of Civilization*.
- James C. Scott; *Against the Grain*.
- Ibn-e-Khaldun: *Muqadimah*.
- Barbara Freese: *Coal –A Human History*.
- Sidney W. Mintz: Sweetness and Power –The Place of Sugarin Modern History.
- Douglas A.Boyd, MaryA. Larson: *Oral History and Digital Humanities–Voice, Access, and Engagement*
- AnneKellyKnowles: *Placing History*.
- Ann Laura Stoler: *Along the Archival Grain*
- David Lowenthal: *The Heritage Crusade and the Spoils of History*

ARTICLES:

- William H. McNeil: "Why Study History".
- BernardS.Cohen: "The Command of Language and the Language of Command".
- E.P.Thompson: "Custom, Law, and Common Right".
- E.P.Thompson: "Time, Work-Discipline, and Industrial Capitalism".
- RanajitGuha: "On Some Aspects of the Historiography of Colonial India".
- RanajitGuha: "The Prose of Counter-Insurgency"
- ShahidAmin: "Gandhi as Mahatma"
- DavidArnold: "Touching the Body: Perspectives on the Indian Plague"
- JacquesleGoff: "Merchant's Time and Church Time in the Middle Ages"
- Marianne Hirsch: "The Generation of Post memory"
- David C. Harvey: "Heritage Pasts and Heritage Present: Temporality, meaning and the scope of Heritage Studies"
- Cameron and Gatewood: "Excursions into the Unremembered Past: What People Want from Visits to Historic Sites" Lucien Febvre: "Sensibility and History–How to Reconstitute the Emotional Life of
  The Past"
- EmmanuelleRoyLadurie: "The History of Rain and Fine Weather"

- Philippe Aries: "Pictures of the Family"
- MauriceAymard: "The Costs of War"
- FernandBraudel: "History and the Social Sciences-The Longue Duree"
- JeanMeuvret:"Food Crises and Demography in France during the Ancien Regime"
- KarlMarx: Communist Manifesto, Chapter1.
- KarlMarx: "British Rule in India,10June1853"
- KarlMarx: "Future Results of BritishRuleinIndia,22July1853"
- DDKosambi: "Social and Economic Aspects of the Bhagvad Gita"
- IrfanHabib:"PotentialitiesofCapitalistDevelopmentintheEconomyofMughalIndia"
- RomilaThapar: "Somnatha"
- RobertDarnton: "Peasants Tell Tales"
- CliffordGeertz: "The BalineseCock-Fight"
- ArthurCononDoyle: "SignofFour"

E-bookLinks :

GradingPlan : (The table is only indicative)

Type of Evaluation	**Weightage (in%)**
Quiz-1	**10**
Mid Sem Exam	**20**
Project	**30**
End Sem Exam	**40**
TOTAL	**100**

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

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

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

The course will be based on classroom lectures and will require intensive reading and writing. On average, each student will be required to read around 500 – 800 pages of books and articles, and work on a project that tests their understanding of the concepts, theories and methodologies of historical research taken up in the course. A major component of the project would be an oral class presentation.

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 to the topics on hand.

Title of the course	**:**	**Introduction to Linguistics 1**
Name of the Faculty	:	Rajakrishnan P Rajkumar
Course Code	:	CL1.101
Credits	:	3-0-1-4
Type when	:	Monsoon 2024
Prerequisite	:	None

COURSE OUTCOME:
CO-1: Students will have a good understanding of linguistic analysis
CO-2: Students will be introduced to different word and sentence level theories
CO-3: It will enable them in building text processing tools and systems
CO-4: They will explore different languages in class working in teams.
CO-5: Using real examples, they will analyse language data to understand the concepts.

COURSE TOPICS:
1. What is language? Difference between human language and Animal languages. Natural language, Formal language and Artificial language, Characteristic features of human language, what we know about language.
2. Study of Human language – the field of Linguistics
3. Looking at language from synchronic and diachronic points of view
4. Areas of Study from structural perspective
a) Syntagmatic and paradigmatic aspects of language structure,
b) Levels of struct ureal analysis: Phonetics: Place and manner of articulation of speech sounds, IPA.
Phonology: Phone, phoneme, allophone; Distinctive features; Phonological rules; Syllable.
Morphology: Units of word's internal structure, word formation processes, inflectional and derivational morphology, compound words and how they are formed.
Syntax: Types of sentences, Sentence structures, Phrase structure grammar.
c) From evolution perspective: Historical Linguistics
d) From usage perspective: Sociolinguistics
e) From Psychological perspective: Mechanisms of language acquisition, knowing more than one language
f) Indian Grammatical Tradition: A communication model for language study. Paninian grammatical model.
g) Writing Systems: Representing language through graphic characters.

Mapping of Course Outcomes to Program Objectives

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

GRADING:
Assignments: 15%,
Mid Sem: 30%, End Sem: 35% and Project: 20%
PROJECT: The students will work on a hands-on project on language analysis. In the project they are expected to work with real time data and understand its nature.

PREFERRED TEXTBOOK:

Language: Nature, Psychology and Grammatical Aspects by Victoria Fromkin, Robert Rodman and Nina Hyams, Cenage Learning (Indian Edition)

REFERENCE BOOKS:
1.Linguistics by Jean Aitchison, 5thedition. London: Hodder Headline, Teach Your self-Books, 1999. ISBN:0-340-73733-6. Retitledandre printed with corrections as: Linguistics: An Introduction. 2ndedition.London: Hodder Headline, 1999.ISBN:0-340-75792-2).
2. Introduction to Language by from kin, V.A. and Rod man, R.,1997. Harcourt Brace.6th edition

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Title of the Course : Introduction to Neural and Cognitive Modeling

Faculty Name : Bapi Raju Surampudi
Course Code : CG3.401
L-T-P : 3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Credits : 4
Name of the Academic Programme: B.Tech in CSE

Prerequisite Course/Knowledge:
Interest in Neuroscience and Cognitive Science is desirable. Basic background in Calculus, Probability and Statistics, Linear Algebra, Ordinary Differential Equations (ODE) and aptitude for programming would be desirable.

Course Outcomes (COs):
After completion of this course successfully, the students will be able to:
CO-1: develop understanding of how principles of mathematics and computation are applied for problems in neuroscience

CO-2: identify the differences and similarities of how mathematical principles are applied for various levels of nervous system – from neuron to behavior.
CO-3: analyze and evaluate model components and relate them to the functions of the neural system
CO-4: design computational solutions to novel problems and phenomena of neuroscience and evaluate their goodness of fit to the actual empirical data from neuroscience
CO-5: analyze and compare the strengths and limitations of computational models in explaining brain/mind/behavior
CO-6: Appreciate the functional insights that computational model gives about the complex cognitive system, develop novel computational models and reflect on how these enable practical solutions

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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	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	3	1	2	2	1	2	1	3	2	3	2	2
CO6	2	2	3	2	1	1	2	2	2	1	1	3	3	1	3	3

Detailed Syllabus:

Part I: Single-Neuron Level Models (1/3rd of the semester)
Introduction to Neuroscience; Passive membrane models, Leaky Integrate and Fire (LIF) models, Hodgkin-Huxley model, Cable models of dendrites, Synapse model, Compartmental models.
Part II: Network Level Models (1/3rd of the semester)
Neural population codes; information representation; neural encoding and decoding; hierarchy and organization of sensory systems; Spiking Network models of sensory systems; Neuroplasticity and learning.
Part III: Abstract Models (1/3rd of the semester)
Introduction to Hebbian, Competitive and Error-driven learning rules; Reinforcement learning, Neural Network models of Perception, Attention, Memory, Language and Executive Function.

Reference Books:

1. R. O'Reilly & Y. Munakata (2000). *Computational Explorations in Cognitive Neuroscience: Understanding the Mind by Simulating the Brain*. MIT Press.
2. J. M. Bower and D. Beeman (2003). *The Book of GENESIS: Exploring Realistic Neural Models with the General Neural SImulation System*, Internet Edition.
3. Peter Dayan and L. F. Abbott (2005). *Theoretical Neuroscience: Computational and Mathematical Modeling of Neural Systems*. MIT press.
4. Thomas Trapp Enberg (2009). *Fundamentals of Computational Neuroscience* (2nd

edition), OUP Oxford.
5. Daniel S. Levine (2018). *Introduction to Neural and Cognitive Modeling* (3rd Edition), Routledge, USA.
6. V. Srinivasa Chakravarthy (2019). *Demystifying the Brain: A Computational Approach* (1st Edition), Springer, Singapore.

Teaching-Learning Strategies in brief(4to5sentences):

Lectures emphasize the understanding of how modeling is used in Neuroscience to get a functional understanding of the biological nervous system. While basic background of Neuroscience, Cognitive Science, Calculus, ODEs are mentioned as desirable background, several of the relevant concepts will be revised before their applications are described in the INCM course. Basic modeling ideas are explained in detail along with mathematical derivations. Students further their understanding by doing the programming assignmentsdesignedtoachievecourseoutcomesandcollaborativelyworkingonafinalproject. The assignments and the final project are designed to give hands-on experience as to how modeling frameworks are deployed to solve neuroscience problems. The organizing principles of brain function are brought out clearly during the lectures and explored further in assignments and projects. This allows them to appreciate how a complex, dynamic system such as the brain and cognition can be understood from afunctional and computational points of view.

Assessmentmethodsandweightagesin brief(4to5sentences):

1.	Assignment	N=3	15%
2.	Mid Semester Exams	N=2	30%
4.	Project in Groups of2 students	N=1	25%
5.	End Semester Exam	N=1	30%
		TOTAL	**100%**

Grading Policy: Relative grading policy scheme

Project Evaluation Breakdown:

1.	Proposal/idea Submission: details of the model being taken up for replication, dataset to be used for modeling/validation, software system to be used for simulations, expected outcome	5%
2.	Implementation demonstration + Final Report	15%
3.	Final Presentation + Viva	5%
	TOTAL	**25%**

Title of the Course : Introduction to Philosophy

Name of the Faculty : Saurabh Todariya
Course Code : HS0.214
Credits : Four (4)
L - T - P : 3-0-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Monsoon, 2024
Name of the Program : B.Tech in CSE

Pre-Requisites : NONE

Course Outcomes :

- CO1: Explain the nature and scope of Philosophical inquiry.
- CO2: Identify the issues pertaining to the validity of Knowledge.
- CO3: Distinguish between the objective and subjective knowledge and to be able to identify the different approaches.
- C04: Analyze the questions and methods related to self-understanding as different from the scientific inquiry.
- CO5: Evaluate the debates in the domain of knowledge and belief-formation.

Course Modules:

Unit 1: Nature and the Scope of Philosophy: Philosophy as a Rational Inquiry, Second-order discipline, Phronesis and the Good Life (Aristotle).

Unit 2: Epistemology: Impression and Ideas (David Hume), Cogito Ergo Sum(Descartes), Transcendental Aesthetic and Categories (Kant)

Unit 3: Existentialism: Übermensch and Eternal Recurrence of the Same (Nietzsche), Bad Faith and Authenticity (Sartre)

Unit 4: Phenomenology: Intentionality and Horizon (Edmund Husserl); Ready-to-hand and Disclosure (Martin Heidegger)

Unit 5: Hermeneutics: Hermeneutical Circle (Gadamer); Narrative Identity (Paul Ricouer)

Primary Readings:

Aristotle. Nichomachean Ethics. Penguin Classics.

Hume. Treatise of Human Nature. Dover Philosophical Classics.

Descartes. Meditations on First Philosophy. Cambridge University Press.

Kant. Prolegomena to Any Future Metaphysics. Cambridge University Press.

Nietzsche. The Gay Science. Penguin Classics

Nietzsche. Thus Spoke Zarathustra. Penguin Classics.

Sartre. Being and Nothingness. Routledge.

Husserl. Ideas 1. Martinus Nijhoff Publishers.

Heidegger. Being and Time. Harper and Collins Publishers.

Gadamer. Truth and Method. Routledge

Secondary readings:

E-book Links :

Grading Plan : (The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz-1	**10**
Mid Sem Exam	20
Quiz-2	**10**
End Sem Exam	**50**
Project	**10**

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

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

Teaching-Learning Strategies in brief (4-5 sentences):
In this course, teaching would be based on the lectures and the students will be encouraged to participate in the group discussion. As the course aims at perspective building and developing critical thinking, therefore, the teaching will mainly follow the problem-solving approach. The students are expected to read the selected chapters from the original texts with the help of secondary sources which will be provided in the class. The evaluation will be based on the student's ability to grasp the philosophical problems and critically evaluate the original works of the philosophers.

Course Title : **Introduction to Politics**

Faculty Name : Aakansha Natani
Course Code : HS4.201
Credits : 4
L - T - P: (L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year: Monsoon 2024
Name of the Program: B.Tech in Computer Science and Engineering

Pre-Requisites : None

Course Outcomes :

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

CO1: Describe the concept of politics and identify the general scope and methods ofPolitical Science at an introductory level.
CO2: Explain range of academic theories relating to key concepts of Political Science.
CO3: Analyze the different features of Constitution and democratic institutions in India
CO4: Evaluate the political process in India and suggest policy recommendations forreforms.
CO5. Assess the nature of Constitutional Government and Democracy in India fromvarious perspectives.
CO6. Develop one's own understanding on how to address contemporary challenges inthe Indian Political System.

Course Topics :
(Please list the order in which they will be covered, and preferably arrange these as fiveto six modules.)
The course is divided into five modules:

(i) Introduction to Political Science- Politics, State and Government
(ii) Key Concepts in Political Science- Liberty, Equality, Justice, Rights, Democracy
(iii) Constitutional Government and Democracy in India- Features of Constitution, Organs of government- Legislature, Executive, Judiciary
(iv) Nature of Indian Political System- Federalism, Secularism, Multiculturalism
(v) Political Process in India- Party System, Electoral Process, Contemporary Challenges and Reforms

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 ofState: divine theory and social contract theory; Forms and functions of government **Module 2:** Brief introduction to key concepts of Political Science; Liberty: Negative andPositive; Equality: Equality of Opportunity; Justice: Social Justice; Rights: Legal Rightsand Human Rights; Democracy: Idea and Practice
Module 3: Philosophy and features of Indian constitution, Structure and functions of Parliament (Legislature), Prime Minister and his cabinet (Executive), Supreme Court of India (Judiciary); Balance of Power
Module 4: Structure and functioning of federalism in India; centre-state relations;Meaning and interpretation of secularism in the Indian context; Provisions for unity in diversity
Module 5: History and Features of Party system in India; National Parties and State Parties; Trends in the Party System; Electoral Process, Election Commission, Contemporary Challenges and Reforms.

Preferred Textbooks:
Selected Chapters from-

1. Andrew Heywood: *Politics (fourth edition)*
2. Andrew Heywood: *Political Theory: An Introduction*
3. Kenneth Minogue: *Politics: A Very Short Introduction*

4. Neerja Gopal Jayal and Pratap Bhanu Mehta (Eds): *The Oxford Companion to Politicsin India*
5. Bidyut Chakrabarty and Rajendra Kumar Pandey: I*ndian Government and Politics*

Reference Books :

1. Rand Dyck: *Studying Politics: An Introduction to Political Science, Third edition*
2. Larry Johnston: *Politics: An Introduction to the Modern Democratic State*
3. Eric Mintz, David Close, and Osvaldo Croci: *Politics, Power and the Common Good:An Introduction to Political Science.*
4. Rajeev Bhargav and Ashok Acharya (eds): P*olitical Theory: An Introduction*
5. Granville Austin: *The Indian Constitution: Cornerstone of A Nation*
6. Paul R Brass: *The Politics of India Since Independence*
7. Niraja Gopal Jayal: *Democracy in India (Themes in Politics)*
8. Atul Kohli and Prerna Singh, (ed.): *Routledge handbook of Indian politics*
9. Sujit Choudhry, Madhav Khosla, And Pratap Bhanu Mehta, (ed.): *The OxfordHandbook of The Indian Constitution*
10. B L Fadia: *Indian Government and Politics*
11. Ramchandra Guha: *India after Gandhi*
12. Rajni Kothari: Politics in India

Grading Plan : (The table is only indicative)

Type of Evaluation	**Weightage (in %)**
Quiz-1	**10%**
Quiz-2	**10%**
Mid-Sem	**20%**
End Sem	**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
Matrix for CSE

	P O1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	P O 10	P O 11	P O 12	P SO1	P S O2	P S O3	P S O4
C O1						2	2	3		2		3				2
C O2				1		2	2	2		2		3				3
C O3						2		2				2				2
C O4						2		2		2		2				2
C O5			2	2	3	2	2	1	2	2	2	2	1	2		3
C O6			2		2	2		3	2	2		2	1	2		3

Matrix for ECE

	P O1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	P O 10	P O 11	P O 12	P SO1	P SO2	P SO3	P SO4
C O1						2	2	3		2		3				2
C O2				1		2	2	2		2		3				3
C O3						2		2				2				2
C O4						2		2		2		2				2
C O5			2	2	3	2	2	1	2	2	2	2	1	2		3
C O6			2		2	2		3	2	2		2	1	2		3

Teaching-Learning Strategies in brief (4-5 sentences):
The course will be based

The course will be based on classroom lectures and in class discussion of assignedreading material. On an average, each student will be required to read between 500 to700 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 developmentsin India 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 Quantum Field Theory

Name of the Faculty : Diganta Das + Monalisa Patra
Course Code : SC1.421
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:
Quantum Mechanics, Special Theory of Relativity.

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

CO-1 Explain the need for a quantum field theoretic description of nature
CO-2 Recognize the basic differences between wave function and quantum field.
CO-3 Discuss the idea of second quantization
CO-4 Apply second quantization to scalar, spinor, and electromagnetic field
CO-5 Calculate transition amplitudes and scattering cross-section for different processes
CO-6 Recognize the conceptual challenges in the quantum field theory

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		3	1	1
CO2	1	1										1		3	1	1
CO3	1	2										1		2	1	1
CO4	2	3												1		3
CO5	3	1												1		3
CO6	3	3										1		2	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: review of backgrounds, motivations for QFT
Unit 2: Elements of Classical Field Theory: symmetries and No ether's theorem
Unit 3: Functional Formalism: path integral formalism, functional quantization, Feynman diagrams, quantization of scalar field, phi-4 theory
Unit 4: S-matrix: scattering cross-section and decay rates, from Feynman diagrams to S-matrix
Unit 5: Dirac Field: Dirac equation and its solutions, gamma matrices, quantization, Green's function
Unit 6 Quantum Electrodynamics (QED): Feynman rules for QED, cross-section of simple QED processes
Unit 7 Introduction to Renormalization

Reference Books:

1. A. Zee: Quantum Field Theory in a Nutshell
2. Ashoke Das: Field Theory—A Path integral Approach
3. Michio Kaku: Quantum Field Theory—A Modern Introduction
4. Lewis H. Ryder: Quantum Field Theory
5. Amitabha Lahiri&Palash B. Pall: A First Book of Quantum Field Theory
6. David Tong: Quantum Field Theory
7. Michael E. Peskin& Daniel V. Shroeder: An Introduction to Quantum Field Theory

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

Aim of the course is to introduce to the students the main concepts and mathematical framework of Quantum Field Theory. A typical class consists of discussion of a new concept and its inderlysing mathematical structure. To make teaching more interactive in the online mode, instead of showing sides, mathematical derivations are done live during the class. Refined versions of the class materials is then circulated to the students. Students are encouraged to go through the materials and work out the mathematical derivations for better understanding of the concepts. Assignments are given on a regular basis. The assignments are designed in such a way that students can apply the concepts to solve problems. At the end of the course students will acquire several tools of Quantum Field Theory.

6.Assessment methods and weightages in brief (4 to 5 sentences):
Assignments: 30%, Quizzes (Mid-Sem exams): 30%, End Semester: 40%

Title of the Course : **Introduction to Remote Sensing**

Name of the Faculty : RC Prasad
Course Code : CS9.440
Credits : 4
L-T-P : 3-0-1
(L= Lecture hours, T=Tutorial hours, P=Practical hours)

Open Elective (spring/Monsoon) (UG and PG)

1. Prerequisite Course / Knowledge:

Basic Physics and computational knowledge.

2.Course Outcomes (COs)

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

CO-1: Explain the processes of optical remote sensing

CO-2: Describe various sensors and their image characteristics

CO-3: Extract information from satellite imagery using conventional methods

CO-4: Apply advanced computational techniques for feature extraction

CO-5: Discuss satellite imagery applications (ex. Forest, Urban, Agriculture)

CO-6: Explain the basics of advanced remote sensing technologies

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

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

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

Unit-1: Introduction to Remote sensing: What is remote sensing? Earth Observation Satellites and Platforms
Unit-2: Physics of Electro Magnetic Radiation (EMR) Radiation laws applicable to remote sensing: EMR interaction with Atmosphere and Earth materials.
Unit-3: Data acquisition and image characteristics, Image pre-processing, Image Enhancement
Unit-4: Information extraction- Multispectral classification – Visual Interpretation- Digital classification. Object based image classification, Stereo Imagery.
Unit-5: Major applications in Vegetation /wildlife; Hydrology/Agriculture, Disaster management:
Unit-6: Overview of Advanced topics: Drone, Hyperspectral and thermal, Microwave/Radar

References:

1. Introduction to Remote Sensing by James B. Campbell

2. Remote Sensing and Image Interpretation by Thomas.M.Lillesand

3. Remote sensing Digital Image Analysis by J.A Richards and Xiuping Tia

4. Fundamental of Remote Sensing by CCRS (Online)

5. Principles of Remote sensing by ITC (online)

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

Teaching, discussing current approaches of information extraction, challenges and limitations with satellite data; Current research papers presentations by students on chosen topic, writing assignments, periodical evaluation of course project implemented with open data and tools.

<u>6.Assessment methods and weightages in brief:</u>

1. Assignments [written, lab and presentations] **- (30%)**
2. Theory [Mid exams-2] **- (20%)**
3. Project - **(35%)**
4. End Semester Exam in Theory **- (15%)**

Title of the Course : **IoT Workshop**

Name of the Faculty : Sachin Chaudhari +Nagamanikandan Govindan + TBD
Course Code : CE9.609
L-T-P : 1-0-3
Credits : 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Academic Program: MTech CASE

1. Prerequisite Course / Knowledge:

Basic computer programming (C), 10+2 level physics, basics of structural engineering

2. Course Outcomes (COs)

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

CO-1(Understand) : Explain the basic elements of an IoT system and the application of IoT for structural engineering.
CO-2(Analyze): Analyze and solve basic electrical circuits using Kirchhoff's laws
CO-3(Understand) : Describe the working principle of commonly available sensors and actuators.
CO-4(Understand) : Explain the working on microcontrollers, peripherals and its programming.
CO-5(Apply) : Write simple embedded programs and interface common sensors and actuators with Arduino and ESP 32 boards
CO-6(Remember) : State and identify different technologies related to Communications and Networking, Cloud Computing and Data Analysis, Interoperability Standards and security, Dashboard and Visualization
CO-7(Create) : Assess simple designs from IoT application point of view
CO-8(Create) : Develop and implement an IoT-based solution for a real-life problem in the domain of structural engineering

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

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	2	1	3	-	-	1	-	2	-	-	-	3	1	1
CO2	2	-	-	-	-	-	-	2	-	1	-	-	-	-
CO3	2	1	1	-	-	1	-	2	-	1	-	-	-	-
CO4	2	-	2	-	-	-	-	2	-	-	-	1	1	-
CO5	1	-	2	-	2	1	1	2	-	-	-	2	2	-
CO6	1	-	3	-	-	1	-	2	-	-	-	2	2	-
CO7	2	-	3	1	2	-	2	2	2	2	-	2	2	-
CO8	3	3	3	3	3	1	3	2	3	3	1	3	3	3

4. Detailed Syllabus:

1. Basic properties of electricity and electrical circuits - DC, Voltage, Current, Power, Energy, Resistance, Ohm's Law, Circuit Diagrams
2. Kirchoff's voltage and current laws, series and parallel resistance, Voltage and Current divider
3. Online Simulations using TinkerCAD
4. Basic Circuits, Mesh analysis, Node analysis.
5. What is IoT, Embedded Systems, Components of Embedded Systems, Microcontrollers, Sensors and Actuators, Analog/Digital conversion, Internet structure, Protocols, TCP/IP
6. Arduino Environment, C Programming, Arduino programming and debugging, URAT Protocol
7. Interfacing with Arduino, Pulse Width Modulation, Arduino Libraries, I2C communication, Arduino Shields
8. Peripherals: RTC, ADC channels, resolution, onboard memory, power, external/internal watchdog
9. Communications and Networking in IoT
10. Cloud Computing and Data Analysis
11. Interoperability Standards and security
12. Dashboard and Visualization
13. Documentation and Productization

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
6. Neil, Storey. Electronics: A Systems Approach, 4/E. Pearson Education India, 2009.

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:

Mid Semester exam	20%
End Semester exam	30%
Lab work	20%
Mid Project Evaluation	10%
Final Project Evaluation	20%

Title of the Course : Language and Society

Name of the Faculty	:	Aditi Mukherjee
Name of the Program	:	CLD
Course Code	:	CL2.203
Credits	:	4
L - T - P	:	3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)		
Semester, Year	:	Monsoon 2024

Pre-Requisites : None

Course Outcomes :

1. The course intends to familiarize students with the social dynamics of language in use.
2. After doing the course, the students should be able to identify and recognize various phenomena which are at play. They should develop an understanding of social behavior such as identity assertion, attitudes in language use and choices that people make while using variants of linguistic items depending on social circumstances.
3. The students are expected to be able to classify these phenomena and explain some of their consequences. For example, code mixing and code switching are very common in multilingual societies such as India. How people use code mixing for better communication or how they use code switching for social reasons are some of the concepts the students should be able to explain given a social context.
4. At the end of the course, the students are expected to be able to analyze language data and employ basic concepts learned during the course for interpreting language data for computational models.
5. The course should give them the confidence to be able to design and develop computational models in real case scenarios.
6. The students will be working on real data projects in teams which will give them experience of working as teams to solve a real problem.

Course Topics :

1. Language Variation: Sociolinguistics and sociology of language, Variation in language, Linguistic variables and social variables. Speech Communities, Language, Dialects and Varieties. Standard language and Standardization, Regional and social dialects. Register, styles. Dialectology.

2. Language Contact: Bilingualism/Multilingualism, borrowing, code mixing/switching, pidginization and creolization, convergence, language maintenance/shift, language acquisition in a multilingual setting. Diglossia with or without bilingualism.

3. Social stratification of language. Inherent variability. Sociolinguistic variables: indicator, marker, stereotype. Style shifting. Hypercorrection. Language variation and language change. Social motivation for sound change.

Sociolinguistic devices for effective communication. Communicative competence. Politeness strategies. Pronouns of power and solidarity.

4. Language and Culture: Directions of influence. The Whorfian hypothesis

5. Critical Sociolinguistics. Language and power. Language and social attitudes: gender, race, education.

6. Language planning: codification and elaboration.

Preferred Textbooks:

- Ronald Wardaugh: *Introducing Sociolinguistics*
- R. A. Hudson: *Sociolinguistics*
- Suzanne Romaine: Language in Society

Reference Books :

- J.B. Pride and J. Holmes (ed): Sociolinguistics
- Paolo Giglioli (ed): Language and Social Context
- Robert Bayley and Ceil Lucas (ed): Sociolinguistic Variation

E-book Links :

1. http://staffnew.uny.ac.id/upload/132107096/pendidikan/Book+for+Sociolinguistics.pdf
2. https://pdfcoffee.com/cambridge-textbooks-in-linguistics-r-a-hudson-sociolinguistics-cambridge-university-press-1996pdf-3-pdf-free.html

Grading Plan : (The table is only indicative)

Type of Evaluation	Weightage (in %)
Quiz-1	**No**
Mid Sem Exam	**20**
Quiz-2	**10**
End Sem Exam	**25**

Assignments	**15**
Project	**20**
Seminar	**10**
Other Evaluation	**None**

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	X															
CO2				X												
CO3																
CO4		X														
CO5			X													
CO 6									X							

Teaching-Learning Strategies in brief (4-5 sentences):
There will be regular classes with interactive sessions to cover the theory. Since actual learning happens through practical work, each student will take up a project which will involve some field work, literature survey and working with real data. Classic research papers will be distributed for the students to read critically and present them in class. So, the idea is that learning happens through listening and discussions (classes), reading (seminar papers) and working with data (project). For each topic some assignment will be given for the students to get a better grip on the topic.

Title of the Course Name : Learning and Memory

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

Credits : 4
L - T - P : 3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Name of the Program : Cognitive Science
Semester, Year : Monsoon 2024

Pre-Requisites : not applicable

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

Course Outcomes :

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

Course Topics :

Introductory Module
- Psychology of Learning and Memory
- Neuroscience of Learning and Memory

Learning Module
- Habituation, Sensitization, and Familiarization: Learning About Repeated Events
- Classical Conditioning: Learning to Predict Significant Events
- Operant Conditioning: Learning the Outcome of Behaviours
- Generalization, Discrimination Learning, and Concept Formation

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

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

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

Reference Books :
E-book Links :https://www.macmillanlearning.com/college/ca/product/Learning-and-Memory/p/1319107389
Grading Plan : (The table is only indicative)

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

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

PO1- Demonstrate conceptual knowledge of cognition at brain and behavior level
PO2 - Evaluate and analyze scientific work done in the field
PO3 – Apply the knowledge to address important unanswered questions in the field

PO4 - Demonstrate ability to think of potential experiments
PO5 – Apply the scientific ability to work on real-world problems in the field of cognitive science

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

Teaching-Learning Strategies in brief (4-5 sentences):
The textbook will be used as a reference to cover the important topics and basics in the field of learning and memory. Published experimental results will be discussed in class with students to understand how experimental work is conducted and analyzed. Students will then choose a topic of their interest, understand it in-depth, design a study that fills a gap and explain it to the class.

Title of the Course : The Making of Contemporary India

Name of the Faculty : Aniket Alam
Course Code : HS4.102
L-T-P : 3-1-0
Credits : 4
Name of the Academic Program: B.Tech In Computer Science And M.S. In Computing And Human Sciences By Research

1.Prerequisite Course / Knowledge: Admission to CHD programme
2.Course Outcomes (COs):

On successful completion of this course, students will be able to
CO-1: Identify and explain major political, social, and economic trends and milestones that have made India what it is today.
CO-2: Understand and describe major frameworks and methods that scholars have used to study India.
CO-3: Compare and assess the potential as well as limitations of these frameworks and methods;
CO-4: Apply the essential conceptual foundations taught in this course to other courses that offer in-depth study of related topics and themes; and
CO-5: Develop a critical vocabulary and perspective that will contribute to the growth of their individual research voice and expertise at the confluence of computing and human sciences.
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	PSO1	PSO2	PSO3	PSO4
CO 1	1	1	1	1	1	2	3	1	1	1	1	3	1	3	2	3
CO 2	1	2	1	2	1	1	3	2	1	3	1	3	1	3	3	3
CO 3	1	2	1	2	1	1	3	2	1	3	1	3	1	3	3	3
CO 4	1	3	1	2	1	2	3	2	1	3	1	3	1	3	3	3
CO 5	1	3	1	3	1	2	3	2	2	3	1	3	1	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:

Colonial Background: overview of the main features of colonial rule and of India's independence movement; important social and economic trends beginning in the late 19th and early 20th centuries.

Unit 2:

Independence, Partition, Constitution of the New Nation-State: detailed study of Independence and the making of the Constitution of India.

Unit 3:

1950s to 2000s: overview of how India's polity and society passed through transition and faced new challenges; major landmarks of independent India's political, social, economic, and development journey.

Unit 4:

Long-term Processes: literacy and education, infant mortality and sex-ratios, migration and urbanization, and travel and communication.

Reference Books:

1. Sugata Bose and Ayesha Jalal, *Modern South Asia* (Second Edition, 2004)
2. Michael Mann, *South Asia's Modern History: Thematic Perspectives* (2014)
3. Paul Brass, *The Politics of India since Independence* (Second Edition, 2001)
4. Pranab Bardhan, *The Political Economy of Development in India* (Expanded Edition, 1998)

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

The teaching-learning strategy in this course will consist of lectures, which will incorporate prompts for classroom discussion and activities to enable active learning and critical thinking. The tutorial slots enable students to undertake small in-class assignments related to assigned readings. This learning will be further consolidated through assessments that will be designed to test and develop students' knowledge and skills in conducting research and writing. Students will be expected to read about 2000 pages of academic literature and write about 12,000 words of essays and answers over the semester.

6.Assessment methods and weightages in brief (4 to 5 sentences):
There will be one writing assignment, worth 15% of the total grade in this course, for each of the four Units. The project, amounting to 25% of the total grade, will consist of a research essay that students will write and then present. Class participation will account for the remaining 15% of the grade.

Title of the Course : **MCS 1 – Probability and Statistics**

Name of the Faculty : Naresh Manwani
Course Code : MA6.301
L-T-P : 3-1-0
Credits : 2

Prerequisite Course / Knowledge:
Knowledge of UG (BTech) course in Discrete Maths.

Course Outcomes (COs):
After completion of this course successfully, the students will be able to...
CO-1: Understanding the basic probability concepts sample space, events, probability mass function, conditional probability, Bayes Rule, Random Variables, Probability Mass and Density functions, Cumulative distribution function, Expectation, Variance, Bernoulli Binomial, Gaussian, Geometric, Exponential, Poisson distributions.
CO-2: Demonstrate familiarity with use of Linearity of Expectation, Markov's and Chebyshev's Inequalities, Law of Large Numbers, Central Limit Theorem.
CO-3: Apply principles of Tail bounds and Central Limit Theorem to real world problems in Estimation, Randomized Algorithms, etc.
CO-4: Derive formulas for finding Maximum Likelihood Estimates (MLE) and Maximum Apriori Estimates (MAE) for Probability Models.
CO-5: Create mathematical models using principles of Probability 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	PSO 1	PSO 2	PSO 3	PSO 4
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: Sample Spaces, Counting, Uniform Probability, Axioms of Probability, Continuous Probability Spaces, Conditional Probability, Bayes Rule, Independence.

Unit 2: Random Variables, PMFs, Discrete Probability Distributions, Multiple Random Variables, Expectation, Variance, Covariance, Standard distributions of Bernoulli, Binomial, Geometric, Gaussian, Exponential, Poisson.
Unit 3: Continuous Probability Distributions, Tail Bounds (Markov, Chebyshev, Chernoff), Law of Large Numbers, Central Limit Theorem.
Unit 4: Bayesian Statistics, Maximum Aposteriori Estimation, Maximum Likelihood Estimation, Confidence Intervals.

Reference Books:

1. Introduction to Probability, 2nd Edition by Dimitri P. Bertsekas and John N. Tsitsiklis.
2. Introduction to Probability, Statistics and Random Processes. by Hossien Pishro-Nik. Texbook available online: https://www.probabilitycourse.com/
3. Introduction to Probability and Statistics for Engineers and Scientists by Sheldon M. Ross.
4. An Introduction to Probability Theory and Its Applications, Volume 1 by William Feller.
5.

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: 20%
- Class Test 2: 20%
- End Exam: 30%

Title of the Course	**:**	**MCS 2 - Linear Algebra**
Name of the Faculty	:	Pawan Kumar
Course Code	:	MA6.302
L-T-P	:	3-1-0
Credits	:	2

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	PSO 1	PSO 2	PSO 3	PSO 4
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 : Mobile Robotics

Name of the Faculty : Madhava Krishna K
Course Code : CS7.503
L-T-P : 3-1-0
Credits : 4
Name of the Academic Program: B. Tech. in CSE, BTech in ECE

Prerequisite Course / Knowledge:
Should have completed Computer Programming – 1 course. Knowledge of Linear Algebra, Optimization and Probability Theory is helpful.

Course Outcomes (COs):

After completion of this course successfully, the students will be able to...
CO-1: Demonstrate familiarity with different modalities of robotic perception
CO-2: Analyze robotic perception algorithms in the context of mapping an environment and localizing the robot in the environment
CO-3: Explain the significance of mathematical frameworks of functional optimization and probabilistic reasoning in robotic perception and localization tasks.
CO-4: Apply principles of functional optimization and visual/lidar based sensing to propose analytical frameworks, algorithms for solving real world problems in robotic perception and 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)

	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	1	1	1	1	1	2	2	1	1	2	1	1	1	2
CO 2	3	3	1	2	1	1	1	2	2	1	1	1	1	1	1	2
CO 3	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
CO 5	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: Representation of Coordinate Frames, Rotation Matrices, Homogenous Transforms, Quaternions and Axis Angle Representations
Unit 2: LIDAR based Mapping and Localization
Unit 3: Principles of Computer Vision: Camera Modelling, Calibration, Reconstruction and Resection
Unit 4: Backend Optimization for LIDAR Based SLAM, Bundle Adjustment

Reference Books:

1. Introduction to Robotics: Mechanics and Control by John J Craig
2. Invitation to 3D Vision: Ma, Soatto, Koseca and Shastry
3. Multiple View Geometry in Computer Vision: Richard Hartley and Andrew Zisserman

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 vision. 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: 60%
- Mid Sem: 20%
- End Exam: 25%

Title of the Course : Modern Coding Theory
Name of the Faculty : Prasad Krishnan

Name of the Program : B.Tech ECE (Elective)

Course Code : EC5.411
Credits : 3-1-0
L - T - P :
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Monsoon 2024

Pre-Requisites :
Linear Algebra (must have good conceptual understanding of vector spaces, basis, subspaces, null space and rank of linear transformations),
Probability and Random Processes (or Probability and Statistics): must have understanding of important distributions (Gaussian, Bernoulli, Binomial), concept of joint probability distributions and conditional distributions with associated chain rule, Bayes theorem, Central Limit Theorem, basic ideas of functions of random variables and their expectation.

Course Outcomes :
Students at the end of the course should be able to:

1. Define and name some examples the notion of channels, channel capacity and capacity achieving codes, with examples such as LDPC codes, Reed Muller Codes and Berman Codes, and their application to 5G communication.
2. Understand principle of message passing decoding (MPD) and employ MPDfor LDPC Codes for Binary Erasure Channel and Binary Symmetric Channel.
3. Define Reed Muller Codes and demonstrate majority logic decoding.
4. Illustrate Capacity Achieving properties of Reed Muller Codes via Boolean function analysis.
5. Demonstrate principles of recursive code construction in Berman Codes and Polar Codes, with corresponding capacity achievability results.

Course Topics :

1. Channels and their Capacity; Notion of Capacity achieving Codes; Examples codes achieving capacity on various channels. Application in 5G and beyond.
2. Basics of Block Codes, Concept of LDPC Codes, Idea of Code Ensembles
3. Message Passing Decoding of LDPC Codes, Analysis of decoding via Density evolution
4. Reed Muller Codes: Definition, Properties, and Proof of Capacity achieving nature in Binary Erasure Channels, Idea of Capacity Achieving nature in other binary memoryless channels..
5. Recursive Constructions for Berman Codes and Polar Codes: Definitions, basic properties, idea of capacity achieving nature in BMS channels.

Preferred Textbooks:

1. T. Richardson and R. Urbanke, Modern Coding Theory, Cambridge Press, 2008

Reference Books :

1. E. Sasouglu, Polarization and Polar Codes, Now Publishers.
2. M. Mezard and A. Montanari, Information, Physics, and Computation, Oxford Press, 2009
3. Research papers.

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

Type of Evaluation	Weightage (in %)
Mid SemExam	**20**
End Sem Exam	**40**
Assignments	**20**
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	3	2	2	1	2	1	2	3	1	2	2	2	2	3		2
CO2	3	2	2	2	2	2	2	3	2	3	2	2	2	3		2
CO3	2	2	3	2	2	2	2	3	3	3	2	2	2	3		2
CO4	2	2	3	2	2	2	2	3	3	3	2	2	2	3		2
CO5	2	2	3	2	3	2	2	3	3	3	2	2	2	3		3

Teaching-Learning Strategies in brief (4-5 sentences) :
The students' learning in this course would strongly supported by project and assignments which would be done in teams possibly. The assignments would have a number of programming questions where the students learn how to simulate the encoding and decoding algorithms of various codes being discussed in the classroom to effectively learn about how these codes perform when deployed in the field.

Title of the Course : Modern Complexity Theory

Name of the Faculty : Ashok Kumar Das,
Course Code : CS1.405
L-T-P : 3-1-0
Credits : 4
Name of the Academic Program: B.Tech in Computer Science

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: Understand different models of computation including Turing Machines, Boolean Circuitsand complexity measures of time, space, depth.
CO-2: Demonstrate familiarity with various complexity classes including P, NP, PSPACE, NC and problems like Halting Problem, 3SAT.
CO-3: Design reductions between problems to show hardness of solving a problem in a complexityclass.
CO-4: Synthesize proofs of upper and lower bounds of resources required for solving a computational problem using clear mathematical and logical arguments.
CO-5: Apply principles of NP-Completeness and NP-Hardness to avoid intractability in design of computational problems.

CO-6: Create mathematical models and complexity measures for novel computational models.

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

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

Unit 1: Models of Computation and Impossibility Results: Turing Machines, Circuits, Encoding of Problems, Halting Problem, Shannon's Counting Lower bound.

Unit 2: Complexity Measures and Classes: Time, Space, Depth measures of complexity, Time, Space hierarchy theorems, Nondeterminism, Savitch's theorem, P, NP, P/poly, PSPACE, EXP, L, NL.**Unit 3:** Completeness and Hardness Reductions: 3SAT, Cook-Levin Theorem, NP-Complete, NL- Complete, Hardness reductions for common problems like Vertex Cover, Independent Set, Knapsack etc.

Unit 4: Advanced Topics: Definitions and relationships between PH, RP, BPP, NC including theorems like Karp-Lipton, Adleman's theorem, Der and omization Techniques.

Reference Books:

- S. Arora and B. Barak (2000), Computational Complexity: A Modern Approach, CambridgeUniversity Press.
- C. Moore & S. Mertens (2011), The Nature of Computation, Oxford University Press.
- M. Sipser (2014), Introduction to Theory of Computation, Cengange Learning.
- C. Papadimitriou (1994), Computational Complexity, Addison Wesley Longman.

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. The students will be given an advanced topic andwill be required to summarize it in a presentation or a term paper. This will encourage self-exploration and lead the student to do research on fundamental questions.

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

- Light In-class Quizes: 20%
- Assignments: 20%
- Deep Quiz 1: 10%
- Deep Quiz 2: 10%
- Mid and End Exam: 30%
- Student Presentation and Scribe notes: 10%

Title of the Course : Music Workshop

Name of the Faculty : T K Saroja
Course Code : **HS1.210**
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 on music
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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	-	1	1	-	2	1	2	2	2	-	2	-	2	1	3
CO2	1	-	1	1	-	1	1	2	2	2	-	2	-	2	1	3
CO3	1	-	1	1	-	1	1	2	2	2	-	2	-	2	1	3
CO4	1	-	1	1	-	1	1	2	2	2	-	2	-	2	1	3
CO5	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 Divine Pushpa Mittra Bhargava, Chandana Chakrabarti, map in 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, Amnaya Prakasana, 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 research related 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 on students 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 : **Network, Signals & Systems**
Name of the Faculty : Aftab Hussain and Prasad Krishnan
Course Code : EC5.101
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 ECE
Semester, Year : **Monsoon, 2024**

Pre-Requisites : A prior knowledge of calculus and complex numbers is required.

Course Outcomes :

CO-1 Describe various circuit elements (R, C, L), supply (current, voltage), devices (op amp, diode) and Explain the operation and characteristics of each circuit element, behavior in specific circuit configuration (DC, AC, series, parallel, mixed).
CO-2 Calculate equivalent circuit parameters (Thevenin, Norton), node voltages, branch currents etc. using reduction, KCL, KVL and reduction techniques.
CO-3 Calculate circuit response (steady state, transient) to various input stimulation. Calculate and understand the concept of time constant for RC, RL and RLC circuits. Demonstrate understanding of and calculate Power, Energy, Loss and phasors w.r.t. circuit.
CO-4 Describe signals using various representations including Fourier series representation for periodic signals
CO-5 Describe systems abstractly using block diagrams and differential equations and apply convolution operation and impulse responses for system analysis
CO-6 Analyze signals and systems in time and s-domains.

Course Topics :

Unit 1: Signals, representation, sinusoids, and Fourier series
Unit 2: Systems and representations – differential equations, block diagram, operator, and functional form
Unit 3: Impulse Response and Transfer functions – Laplace transform, poles and zeros
Unit 4: Circuit elements and Network theorems
Unit 5: Transient and Steady state analysis
Unit 6: Sinusoidal input and phasors, two port network

Preferred Textbooks:
1. Engineering Circuit Analysis by Hyatt, Kimmerley & Durbin
2. Signals and Systems by A.V. Oppenheim, A.S. Willsky and S.H. Nawab (2015)

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

Type of Evaluation [3 credit- lecture]	Weightage (in %)
Quiz 1	10
Quiz 2	10
Mid	25
End Exam	35
Assignments	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	1	1	1	1	1	1	1	1	1	1	3	1	1	1
CO2	1	3	3	3	1	1	1	1	1	2	1	2	3	1	1	1
CO3	2	2	3	3	1	1	1	1	1	1	1	3	3	1	1	1
CO4	3	3	3	3	1	1	1	1	1	1	1	3	3	3	1	1
CO5	3	3	3	3	1	1	1	1	1	1	1	3	3	3	1	1
CO6	3	3	2	3	1	3	1	1	3	3	1	3	3	3	1	1

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

Students will be applying the lecture discussion to solve examples shared with them in the class. The assignments given will reinforce the concepts and to promote their application to difficult problems. Classroom learning will be done in interactive method as much as possible. A short question may be posted at beginning of class to gauge understanding of previous lecture. Occasionally self-assessment tests (1minute paper) will be given. In tutorial class, students will make simple circuits using basic components and solve problems. The course project is done in a way to encourage collaborative problem solving, team participation, and coming up with solution as a team.

Title of the Course : Open Quantum systems and Quantum Thermodynamics

Name of the Faculty : Samyadeb Bhattacharya
Course Code : SC1.310
Credits: : 4
L - T - P :
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Monsoon semester, 2024
Name of the Program : Open Quantum systems and Quantum Thermodynamics

Pre-Requisites : Basic understanding of Quantum mechanics (graduate level), Hilbert space and linear algebra.

Course Outcomes :

1. After the course, the students will have a fundamental understanding about kinematics and dynamics of noisy quantum systems.
2. Students will also have basic ideas on current research directions in quantum thermodynamics, a little of quantum communication, quantum information and quantum entanglement detection.
3. Students will have basic training on research in related topics through projects.
4. Students will have a firm background for pursuing a MS thesis in quantum information, communication and thermodynamics.
5. The course can be understood as a pre-PhD course related to quantum information science in general.

Course Topics :

1. Review on basic linear algebra; Metric space, Dual space, Hilbert space and bra-ket algebra.
2. Review on unitary quantum mechanics; Unitary evolution, state vectors, uncertainty principle, Schroedinger equation etc.

3. Pure and mixed states, basics on measurement theory, projective measurements, positive operator valued measures etc.
4. non-unitary evolution, tensor product space, bi-paretite quantum systems, global evolutions, non-unitary dynamics, completely positive trace preserving maps, operator-sum representation.
5. Monotones under completely positive operations, basics of distance measures and entropic measures.
6. Selected topics on complete positivity, positivity, Choi-Jamiolkowski isomorphism, Stinspring dilation, entanglement detection.
7. General quantum dynamical equations, master equation, Lindblad equation and its derivation from a few different perspectives, properties of Lindblad dynamics.
8. Basic idea on Markovianity and non-Markovianity from quantum mechanical perspectives.
9. Basic ideas on quantum heat engines and a few other selected topics on thermodynamics.

Preferred Textbooks: 1. Theory of open quantum systems by H.P. Breuer and F. Petruccione, 2. Modern quantum mechanics by J J Sakurai.

Reference Books **:** Lecture notes on quantum dynamical semigroups and applications by R. Alicki and k. Lendi (2nd edition 2007)

E-book Links **: 1.** https://books.google.co.in/books/about/The_Theory_of_Open_Quantum_Systems.html?id=0Yx5VzaMYm8C&redir_esc=y
2. https://link.springer.com/book/10.1007/3-540-70861-8

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	**NA**
Other Evaluation	**NA**

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

Teaching-Learning Strategies in brief (4-5 sentences) :
The course is also self-evolving. Since this course is a pre-PhD level course, it is heavily dependent on the evolution of current research in said topics. Therefore, I have to modify and upgrade the course structure in regular intervals of a few years.

Title of the Course : **Operating Systems and Networks**

Name of the Faculty : Karthik Vaidhyanathan
Course Code : CS3.301
Name of the Academic Program: B.Tech. in CSE
L-T-P : 3-1-0.
Credits : **4**
(L= Lecture hours, T=Tutorial hours, P=Practical hours)

1.Prerequisite Course / Knowledge:

Programming languages, Digital Logic Design, Computer Organization

2.Course Outcomes (COs)

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

CO-1. Extend the concepts of layering and modularity to build new software systems
CO-2. Develop appropriate scheduling/synchronization/memory management/ virtual memory/protection module for a new task-specific operating system.
CO-3: Implement an application on the top of given operating system in an efficient manner based on process and thread framework available in the given operating system.
CO-4. Architect the given system on the top of operating systems by exploiting the system calls of the given operating system services as far as possible.
CO-5. Develop a network-based application by exploiting networking related system calls.

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

4.Detailed Syllabus:

Unit 1: Introduction, Process and Memory Virtualization – Scheduling, Memory addressing and Paging, and Networking Overview (10 hours);

Unit 2: Concurrency – Threads and locking mechanisms, Common concurrency problems, Data transmission and Network Technologies (10 hours);

Unit 3: Persistence – File Systems, Protection, Network File Systems and basics of Network Security (6 hours);

Four mini projects and one overall project related to the above syllabus will be done by students in the laboratory

Reference Books:

1. Operating systems in three easy pieces by Andrea Arpaci-Dusseau and Remzi Arpaci-Dusseau, 2018 (https://pages.cs.wisc.edu/~remzi/OSTEP/)
2. Computer Networks (5th Edition) Andrew S. Tanenbaum, David J. Wetherall Prentice Hall, 2013
3. Wlliam Stallings, Operating Systems, Prentice-Hall, 2018.
4. Tanenbaum, A., Modern Operating Systems, Prentice-Hall, Second Edition (latest edition, 2015.

5. Teaching-Learning Strategies in brief

Lectures by integrating ICT into classroom teaching, weekly tutorials involving problem solving and active learning by students on a Unix-based OS like xv6 and Project-based Learning by doing 4 mini-projects and one overall project.

6.Assessment methods and weightages in brief (Tentative)

Component	Weightage
Final Exam	35%
Mid-term Exam	15%
Quizzes	10%
Mini-projects	25%
In-class activities	5%
Final Project	10%

Note: Instructor reserves the right to make any changes in the above distribution based on the progress of the course

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Title of the Course : Physics of Early Universe

Name of the Faculty : Diganta Das
Name of the Academic Program : CNS, HSME
Course Code : SC1.415
L-T-P : 3-1-0.
Credits : 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)

1.Prerequisite Course / Knowledge:
Differentiation and integration, classical mechanics, electricity and magnetism

2.Course Outcomes (COs) (5 to 8 for a 3 or 4 credit course):
After completing this course successfully, the students will be able to
CO-1 **Explain** the large-scale structure of the universe and its observational components
CO-2 **Demonstrate** understanding of how mass, radiation distribution shapes the dynamics of the universe
CO-3 **Apply** their knowledge and **calculate** dynamical properties of few model universe
CO-4 **Discover** the thermal history of the early universe
CO-5 **Familiarize** themselves with several unsolved problems in the research of cosmology

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		3	1	2
CO2	2	1										2		3	1	2
CO3	1	1												2	3	1
CO4	2	2										1		2		3
CO5	3	1										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: Universe Observed: Expansion. Isotropy and homogeneity. Age. Cosmic microwave background

Unit-2: Geometry and Dynamics: Universe in the eyes of Newton**.** Geometry**.** Mass and curvature. Freedman equations. Model universes: empty universe, matter or radiation dominated universe, multi-component universe

Unit-3: Black-body radiation and the early history: Observation of CMB. Recombination and decoupling. Last scattering. Temperature fluctuations

Unit-4: Very early history of the Universe: Thermal history. Nucleosynthesis. Cold dark matter

Unit-5: Inflation: Flatness, horizon, and monopole problem. Physics of inflation

Reference Books:

1. **Barbara Ryden: Introduction to Cosmology**
2. **Matts Roos: Introduction to Cosmology**

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

This is an introductory course to cosmology. The course is for students who do not have any knowledge of cosmology. It is also designed to be taught to students from diverse backgrounds of science. In each lecture session, the focus will be on building concepts and intuition about physics. It will be followed by a hands-on session where application of the concepts to simple problems will be practiced.

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

Assignments: 30%,
Quizzes : 30%,
End Semester: 35%,
Attendance: 5%

Title of the Course : Principles of Programming Languages (PoPL)

Name of the Faculty: Venkatesh Choppella + Mrityunjay
Course code: CS1.402

1 Course structure

Name Principles of Programming Languages
Credits 4, Lectures-Tutorials-Practicals=3-1-0 (hours/week)

2 Prerequisite courses

1. Computer Programming
2. Discrete Mathematics (with some exposure to writing proofs)
3. Automata Theory

3 Course outcomes

A student graduating from a PoPL course should be able to perform each ofthe following sample tasks:

1. **CO1: Document Abstract Syntax** Document and critique the ab-stract syntax of industrial scale programming language like C or Java.
2. **CO2: Design domain specific languages** Design a small, domain pur-pose languages like a language for propositional logic and implement them.
3. **CO3 Design object small, oriented language** Design a small object-oriented language implement it either using an interpreter or by em-bedding it into a base language.
4. **CO4: Compare languages** Compare and analyse the semantic express-ibility (in terms of first-class values) between imperative languages like C and functional languages Racket, and object-oriented languages like Java and Python.
5. **CO5: Specify application interfaces** Specify the structure of a soft- ware application like a spreadsheet or a word processor in terms of its interface as a language of user operations and its internal structure asan abstract machine.

4 Mapping to Programme and Programme Specific Outcomes

Table 1: Mapping of Course Outcomes to programme andprogramme specific outcomes

Programme Outcome (PO/PSO)	CO1	C02	C03	C0 4	C05
PO1 Engg. Knowledge	3	3	3	3	3
P02 Problem Analysis	3	3	3	3	3
PO3 Design/Develop	1	3	3	2	2
PO4 Complex Problems	2	3	3	3	3
PO5 Modern tool usage	3	3	3	2	2
PO6	1	2	2	2	2

Engr. & Society					
PO7 Environment & Sustainability	1	1	1	1	1
PO8 Ethics	2	1	1	1	1
PO9 Team work	2	3	3	2	2
P10 Communication	3	3	3	3	3

Programme Outcome (PO/PSO)	CO1	C02	C03	C04	C05P11
	1	1	1	1	1
Project Mgmt & Finance					
P12 Life learning	3	2	2	2	3
PS01 Specialised knowledge	3	3	3	3	2
PS02 Roadmap for technologies	3	3	3	3	3
PS03 Research & Development Skills	2	3	3	3	3
PS04 Potential for PG study	3	3	3	3	2

5 Syllabus

Functional Programming: Abstract vs. Concrete Syntax. Racket syn-tax, Functions, recursion, syntactic extensions, higher-order functions, map, reduce and other combinators.

Operational Semantics: Abstract Reduction Systems, , Transition Sys- tems, Reduction, Simplification and Evaluation relations. Judgements and Rules. Rule Induction.

Scope: Identifiers, Scope and extent, Lexical scope, Environments, 'Dy- namic scope' and parameters. Closures

State: Stores and imperative constructs, explicit and implicit store refer- ences, objects, invariants and safety, interfaces and constructors, in- heritance, Parameter passing. Call-by-value, call-by-name and lazy evaluation.

Control: Tail calls, Contexts, continuations, continuation passing style, exceptions, threads.

Types: Types syntax, type safety theorems. Type inference

Special Topics (if time permits): Monads, Concurrency.

6 Texts and References

Textbook

EOPL *Essentials of Programming Languages* 3rd Edition. Friedman andWand. This is the main text for the course. Available on Amazon.in.

References

HtDP *How to Design Programs*. Felleisen et al. Available online.

SICP *Structure and Interpretation of Programs*. Abelson and Sussman.Available online. Accompanying video lectures also available online.

TRaAT *Term Rewriting and All That*. Baader and Nipkow. Chapters 1and 2.

PLAI *Programming Languages: Application and Interpretation* 2nd Edi-tion. Available online.

SSICS *Simply Scheme: Introducing Computer Science*. Brian Harvey andMatthew Wright. Available online.

RG *Racket Guide*. Available as part of Racket language documentation.

7 Teaching and Learning strategies

Lectures will cover the theoretical aspects of operational semantics but willhave plenty of examples explaining interpreters of programming languages visually and interactively. Question-answer discussion will accompany each class. Quizzes each week will test student's attention diligence, and con- cept recall, understanding and application. Summative assessments will be through a mid-semester and a final exam or project. Reading assignments will precede each lecture. Homework (programming) assignments will mostly involve implementation of interpreters discussed in the class and the textbook. Tutorials will walk-through abstract syntax tree annotation, compo-nents of the interpreter implementation, and inductive proofs of propertiesin operational semantics.

8 Assessment (Tentative)

Item	Weight (%)
Quizzes (1 per week)	25
HW	25
Mid-semester exam	20
Final exam/Project	30

Appendix: Programme and Programme Specific Out-comes

Programme Outcomes

PO1 :: Engineering knowledge Use concepts from varied disciplines in- cluding Computer Science, Electronics, Mathematics, and the Sciences, to engineer and develop systems of varying scale.

PO2 Problem analysis Identify, formulate and analyze complex engineer- ing 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 ex-trapolate 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 largescale systems

PO6 The engineer and society Make judicious use of resources and un- derstand the impact of technology across the societal, ethical, environ- mental, and economic aspects.

PO7 Environment and sustainability Find technological solutions byconsidering 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 accom- plishments, and technological backgrounds.

PO10 Communication Effectively communicate and exchange ideas and solutions to any individual including peers, end-users, and other stake- holders.

PO11 Project management and Finance Apply the principles of projectmanagement in general and software project management in particu- lar with focus on issues such as the life cycle, scoping, costing, and development.

PO12 Life-long learning Exhibit the aptitude for independent, continu- ous, and life-long learning required to meet their professional and careergoals.

Programme Specific Outcomes (PSOs)

PSO1 Exhibit specialized knowledge in some sub-areas of Computer Science and Engineering such as Theoretical Computer Science, Computer Sys- tems, 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 pre-pare roadmaps for incorporating state-of-the-art technology into sys- tem 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 breadthto excel in post-graduate and research programs.

Title of the Course : Principles of Semiconductor Devices
Course Code : EC2.409
Name of the Faculty : Aftab Hussain
L-T-P : 3-1-0
Credits : 3
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Academic Program B. Tech in ECE

1.Prerequisite Course / Knowledge:
EC, EW1 & EW2

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 quantum mechanics basics: Heisenberg's principle, energy band (conduction & valance bands, energy gap).
CO-2 Explain the basic physics for PN junctions, MOS, MS junctions, MOSFET & BJT
CO-3 Calculate basic semiconductor device parameters and solve problems related to design of above-mentioned semiconductor devices.
CO-4 Design very simple diode & MOSFET circuits

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	PO 10	PO 11	PO 12	PSO1	PSO 2	PSO 3	PSO 4
CO1	3	1	1	1	1	1	1	1	1	1	1	3	2	2	1	3
CO2	3	3	1	1	1	1	1	1	1	3	1	3	2	3	3	3
CO3	2	2	3	2	1	1	1	1	1	1	1	3	2	2	3	3
CO4	2	1	2	3	3	1	2	1	1	1	1	3	2	3	1	3

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 Properties

Unit 2: Quantum Mechanics and Energy Band Theory

Unit 3: Carriers in equilibrium, G-R processes

Unit 4: Carrier Transport

Unit 5:PN Junction physicsUnit6: MOS & MOSFETUnit7: BJT

Reference Books: 1. Advanced Semiconductor Fundamentals by Robert Pierret

2. Semiconductor Device Fundamentals by Pierret

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. Classroom 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	**25***
Assignments	**15**
Mini Project	**25**
1 minute paper (in class) [weekly prescheduled]	**5**

Title of the Course : Probability and Random Processes

Name of the Faculty : Gowtham Kurri
Course Code : MA6.102
L-T-P : 3-1-0
Credits : 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Course: ECE
Name of the Academic Program: B. Tech in Electronics and Communication Engineering

1. Prerequisite Course / Knowledge:
Basic idea of set theory, counting

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

CO-1: Describe the probability space associated with an experiment, conditional probability and Bayestheorem
CO-2: Give examples of discrete and continuous random variables and their distributions
CO-3: Calculate conditional and marginal distributions, distributions of functions of random variables, expectation and variance
CO-4: Analyze the properties of independent random variables, sums of random variables
CO-5: Interpret the tail bounds, law of large numbers and central limit theorem
CO-6: Evaluate the real-world applications of random variables and random processes

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

4.Detailed Syllabus:

Unit 1 : Sets and set operations, Probability space, Conditional probability and Bayes theorem.
Unit 2: Discrete random variables, probability mass function, probability distribution function, example random variables and distributions, Continuous random variables, probability density function, probability distribution function, example distributions.
Unit 3: Joint distributions, functions of one and two random variables, expectation and variance, Conditionaldistribution, densities, conditional expectation, moment generating functions, characteristic functions.
Unit 4: Markov, Chebyshev and Chernoff bounds. Random sequences and modes of convergence, Strong andweak laws of large numbers, central limit theorem.
Unit 5: Random processes, Mean and covariance functions, Stationary processes and wide-sense stationaryprocesses, power spectral density, linear filtering of random processes.

Reference Books:

1. Bertsekas, Dimitri P., and John N. Tsitsiklis. Introduction to Probability. Vol. 1. Belmont, MA: AthenaScientific, 2002.
2. Henry Stark, John. W. Woods, Probability and Random Processes with Applications to SignalProcessing, 3rd edition, Prentice Hall, 2002.
3. Gallager, R. (2008). Principles of Digital Communication. Cambridge: Cambridge University Press. doi:10.1017/CBO9780511813498.
4. Sheldon Ross, Introduction to Probability Models, Academic Press, 2010.

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. Quizzes and group learning activities are conducted periodically so that students can actively engage with the course material. An assignment is given towards the end of thecourse, which requires the students to understand various applications of the theory and prepare a report.

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

Type of Evaluation	Weightage (in %)
Mid Semester Exam	15%
Quizzes/Viva	35%
End Semester Exam	25%
Home Assignments	25%

Title of the Course: **Probability and Statistics**

Name of the Faculty: Tajas Bodas
Course Code: MA6.101
L-T-P: 3-1-0.
Credits: 4
(L= Lecture hours, T=Tutorial hours,
P=Practical hours)
Course: CSE
Name of the Academic Program: **B.Tech. in Computer Science and Engineering**

1. Prerequisite Course / Knowledge:
Linear Algebra, Real Analysis

2. Course Outcomes (COs)

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

CO-1. Explain the axioms of probability and rules, discrete and continuous random variables.
CO-2. Derive the density function of transformations of random variables and use these to generate data corresponding to various distributions.
CO-3: Derive marginal and conditional distributions of multivariate random variables and probability bounds.
CO-4. Discuss the classical and Bayesian inference theory and applications.
CO-5. Discuss the basic random processes and their applications.
CO-6. Outline a proof of stated theorem and write the logically derived proof.

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

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

4. Detailed Syllabus:

Unit 1: Discrete Random Variables: Probability mass function, expectation and variance. Bernoulli distribution, Geometric distribution, Binomial distribution. Derivation of mean and variance. Sampling with and without replacement. Hypergeometric distribution and Poisson distribution. Derivation of the Poisson distribution as limiting form of Binomial. Derivation of mean and variance. Bounding probabilities, tail sum formula, Markov's inequality and Chebyshev's inequality. Probability generating functions and moment generating functions. (9 hours)

Unit 2: Continuous Random Variable: Probability density function, cumulative distribution function, expectation, mean and variance. Moment generating functions and uniqueness theorem. Chebyshev's inequality. The uniform distribution on (a, b), the normal distribution. Mean and variance of the normal distribution. The Cauchy distribution. The exponential distribution, moments, memoryless property, hazard function. Gamma distribution, moments, Chi-square distribution. (9 hours)

Unit 3: Multivariate Distributions: Cumulative distribution function method for finding the distribution of a function of random variable. The transformation rules. Discrete bivariate distributions, marginal and conditional distributions, the trinomial distribution and multinomial distribution. Continuous bivariate distributions, marginal and conditional distributions, independence of random variables. Covariance and correlation. Mean and variance of linear combination of two random variables. The joint Moment generating function (MGF) and MGF of the sum. The bivariate normal distribution, marginal and conditional distributions, conditional expectation and variance, joint MGF and marginal MGF. Linear combinations of independent random variables. Means and variances. Sequences of independent random variables and the weak law of large numbers. The central limit theorem, normal approximation to the binomial distribution. (9 hours)

Unit 4: Statistical Inference and Random Processes: Point Estimation, Interval Estimation, Hypothesis Testing, Linear Regression, Bayesian Inference. Point Processes, Poisson Process, Discrete Time Markov Chains. (9 hours)

References:

- Sheldon Ross, Introduction to Probability Models, Academic Press, 2010.
- Online resource: https://www.probabilitycourse.com/

- A first course in Stochastic Models, H. C. Tijms, Wiley, 2003.
- Introduction to Probability and Statistics for Engineers and Scientists, S. Ross, 5th Edition, Academic Press, 2014.

5.Teaching-Learning Strategies in brief:

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

6. Assessment methods and weightages in brief:

Assignments in theory: 15 marks, Mid Semester Examination-1: 25 marks, Mid Semester Examination-2: 30 marks, End Semester Examination: 30 marks

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Title of the Course: **Product Management 101**

Faculty Name: Ramesh Swaminathan
Course Code : PD2.401
L-T-P: 3 -1- 0
Credits: 2
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Program: M Tech Product Design & Management
Semester, Year : Monsoon, 2024

Pre-Requisites : No prerequisite

Course Outcomes :
CO1: Understand the key role of a product manager in ideating & developing technical products for the Digital World
CO2: Create a Product Strategy by using various market research techniques
CO3: Develop a product mindset to create innovative product & solutions that solve complex technical problems that is required by the Market
CO4: Execute product strategy through Roadmaps & Release Plans
CO5: Learn various product development methodologies that can be applied to enable faster Go to Market

Course Topics :

Module 1: Introduction to Product Management – the Art & Science of Product Management

1. What is product management
2. Types of Product Management
3. Product life cycle

Module 2: Product Strategy

1. Market Research
2. Product Value Proposition
3. Product Strategy
    a. Market Needs
    b. Key Differentiators
    c. Business Goals

Module 3: Product Ideation & Market fit
1. Product Ideation
2. Product Feasibility
3. Product market Fit
4. User Journeys

Module 4: Adopting a Product Mindset
1. Prioritization
2. People
3. Process
4. Progress

Module 5: Product Roadmap
1. Top-Down Product Strategy
2. Featureless Roadmaps to feature roadmaps
3. Roadmaps to Release plans

Module 6: Product release execution
1. Product Prototyping & Market Validation
2. Product Development Process
    a. Agile development process
    b. Lean product development
3. Product release to market

Preferred Textbooks: None

Reference Books :
1. Inspired: How to create Tech Products Customers Love by Marty Cagan
2. The Lean Product Playbook by Dan Olsen

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

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

Assignments	**10%**
Mini Project	**40%**
Other Evaluation (Product Workshop)	**20%**

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	2	3	3	3	3	2	2	3	3	3	3
CO2	3	3	3	3	3	3	3	3	2	3	3	2	3	2
CO3	3	2	2	2	3	3	2	3	2	2	2	2	2	2
CO4	3	3	3	3	3	3	3	2	2	3	3	2	2	3
CO5	2	2	3	2	3	3	2	3	2	3	2	2	3	3

Teaching-Learning Strategies in brief (4-5 sentences):
This Course will be taught through a Hands-on train model wherein the students will learn by doing. Theory will be taught through Power Point presentation and will be followed up by Assignments. The Assignments will conclude in a mini project that needs to be submitted at the end of semester. A Role play driven workshop at the end of the Semester will be a major evaluation factor for this Semester.

Title of the Course: **Product Marketing**

Faculty Name : Ravi Warrier
Course Code: PD2.501
Credits: 4
L - T - P: 3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Monsoon 2023

Pre-Requisites **: No pre-requisites**
Course Outcomes :
The outcome of the Product Marketing course is to ensure that participants acquire skills and understand the processes involved in defining a complete and functional strategy to take their product or service to the market.
CO1- Learn methods, models and frameworks that can be employed to developing strategy artifacts relevant to product marketing.
CO2- Apply the concepts and tools in the development of go-to-market strategy and sales playbooks
CO3- Learn the principles of effective marketing, specifically those of pricing, positioning, narratives with respect to targeted segments and types of customers in each segment.

CO4- Understand the synthesis between product management and product marketing as to design and build better products from the beginning

Course Topics:

Unit 1 – Product Marketing and Product Management

Sub-topics covered: Recap of 1) how marketing is an integral part of Product Management, 2) Product Management fundamentals, 3) Product Market Fit – problem and solution validation

Unit 2 – Marketing Mix

Sub-topics covered: 1) Value Model (4Cs), 2) Marketing Mix (4Ps) and how to use them in tandem to strategize product launch

Unit 3 – Value Proposition and Promotion

Sub-topics Covered – 1) Segmentation and User Personas, 2) Customer Journey Mapping, 3) Pricing Mix, 4) Positioning, and 5) Product Branding

Unit 4 – Customer Engagement

Sub-topics – 1) Introduction to Marketing Communication, 2) Building a comprehensive narrative for marketing, and 3) Customer Engagement at all stages of acquisition

Unit 5 – Sales Playbooks

Sub-topics covered: 1) What are playbooks? and 2) how to develop an actionable playbook for sales

Unit 6 – Go-to-Market Strategizing

Sub-topics covered: 1) Customer Acquisition Strategies, 2) Defining the GTM Strategy, and 3) Executing the GTM Strategy successfully

Preferred Textbooks: None

Reference Books:

There are a few books I will recommend during the course. Will make a list and add them here shortly.

E-book Links: TBD

Grading Plan:

Type of Evaluation	**Frequency**	**Weightage (in %)**
Assignments	**10**	**50**
Final Submissions	**1**	**25**
Final Exam	**1**	**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	PO 4	PO5	PO 6	PO7	PO 8	PO 9	PO1 0	PO1 1	PS O1	PS O2	PS O3	PS O4
CO1	3	3	3	2	3	2	2	2	2	3	3	2	2	2	2
CO2	3	3	3	2	3	2	2	2	2	3	3	2	2	2	2
CO3	3	3	3	2	3	3	2	2	2	2	3	3	2	2	2
CO 4	3	3	3	2	3	2	2	3	3	2	3	3	2	2	2

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

1. Each class will have prerequisite reading material that will be announced or provided at the end of the previous seminar. Discussions will cover subjects of interest or concern from the pre-reads with respect to that topic of the class.
2. Seminars will always cover the fundamentals and cover detailed concepts only when the participants need additional assistance grasping those concepts.
3. Assignments will be given in each seminar session and will be followed by a discussion session to review and discuss the assignment
4. The course leans more on practice and completion of assignments which will form a larger chunk of their efforts and grading.

Title of the Course **: Quantum Information Theory**

Name of the Program **:** Elective for PhD/PG/senior UG students (Maximum intake: 25 students)
Course Code **:**
Credits **:** 4
Faculty : Siddhartha Das
L - T - P **:** 3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year **:** Monsoon, 2024
Pre-Requisites **:** Introductory courses on Linear Algebra and Probability. Any (or some) exposure to quantum mechanics or information theory would be helpful.
Course Outcomes **:**
After completion of this course, the students will be able to

1. Understand the mathematical formulations of postulates of quantum theory
2. Understand the application of quantum systems for information processing tasks
3. Examine basic mathematical tools and physical concepts used in quantum information theory.
4. Identify different types of quantum correlations and apply them in communication protocols.
5. Analyse information-theoretic aspects of quantum systems and processes.

Course Topics :

This is an advanced level course on quantum information theory.

Unit 1: Overview of why the need of quantum information theory: In this part, we will overview the need for quantum information theory. Outline briefly what Shannon information theory means and why and how can we study information theoretical aspects of physical systems obeying quantum theory.

Unit 2: Mathematical formulations of the postulates of the quantum theory: In this part, we will study the postulates of quantum theory pertaining to quantum information theory. We will mainly describe postulates in the form of mathematical statements and rules. We will deal with both closed (unitary evolution) and open (noisy evolution) quantum systems. We will discuss standard theorem statements (e.g., Choi-Jamiołkowski isomorphism) after introducing quantum states, quantum channels, and quantum measurements.

Unit 3: Quantum correlations: In this part, we will discuss different kinds of quantum correlations. We will mainly focus on quantum correlations like entanglement and nonlocal quantum correlations. We will discuss measures and tests to quantify or test these correlations. We may touch upon local hidden variable theories to derive Bell tests for nonlocal quantum correlations.

Unit 4: Tools in quantum information theory: In this part, we will introduce and discuss some of the important tools that are employed widely in the domain of quantum information theory. Some of these tools are trace-distance, relative entropy, fidelity, etc. We will discuss formula and bounds for quantum entropy, quantum conditional entropy, quantum mutual information, quantum conditional mutual information. We will discuss quantum data-processing inequality, strong subadditivity, and other entropic measures and inequalities.
Unit 5: Quantum communication protocol: In this part, we will discuss quantum typicality, packing lemma, covering lemma, and some examples of quantum communication protocols. We may touch upon quantum resource theories and their frameworks if time permits.

Preferred Textbooks:

1. Quantum Information Theory (Second Edition) by Mark M Wilde
2. Theory of Quantum Information by John Watrous
3. Quantum Systems, Channels, Information: A Mathematical Introduction by Alexander Holevo

Reference Books :

E-book Links :

https://www.markwilde.com/qit-notes.pdf
https://arxiv.org/abs/2011.04672
https://johnwatrous.com/the-theory-of-quantum-information/

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	25
Assignments	20
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 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	3	2	-	3	2	3	-	1	2	1	-	3	1	3	3	3
CO2	3	2	-	3	2	1	-	1	2	1	-	1	3	3	3	3
CO3	3	2	-	3	2	2	-	1	2	1	-	1	3	3	3	3
CO4	3	2	-	3	2	2	-	1	2	1	-	1	3	3	3	3
CO5	3	2	-	3	2	3	-	1	2	1	-	3	3	3	3	3

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

- Classroom teaching with emphasis on interaction and discussion among instructor and the students.
- Supplementing classroom discussions with tutorials and thought-provoking questions apart from assignment.
- Paper reading and presentation by groups of students.
- Solving some new problems emerging from the paper reading or class discussions.

Title of the Course: **Quantum Mechanics**

Name of the Faculty: Subhadip Mitra
Course Code: SC1.203
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:
Basic linear algebra, complex numbers.

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

CO-1 **Recognize** the basic differences between the inherently probabilistic description in quantum mechanics with the deterministic description in the classical theories.
CO-2 **Discover** the role of linear algebra, complex analysis and probability theory in quantum mechanics and modern physics.
CO-3 **Calculate** and **solve** simple 1D quantum problems like particle in a box, the simple harmonic oscillator, and the free particle, etc.
CO-4 **Apply** their knowledge of basic problems in more complicated problems like the Hydrogen atom and **discover** advanced techniques.
CO-5 **Recognize** the conceptual challenges in quantum mechanics

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3											1		2		1
CO2	3	2		1								1		2		3
CO3	1	2	2	2									1	2		2
CO4	2	3	2	3									2	2		3
CO5		3		3								1	2	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: The Schrödinger equation and the uncertainty principle
Unit 2: Mathematical Formalism: Review of linear algebra, complex functions, Fourier transformation etc. and the generalized statistical interpretation, Heisenberg picture
Unit 3: Time independent Schrödinger equation: Infinite square well, harmonic oscillator, free particle, delta function potential, finite square well
Unit 4: 3D Problems: Spherical coordinates - Hydrogen atom, angular momentum, spin, two-particle systems, atoms
Unit 5: Advanced topics: Time independent perturbation theory, the variational principle, Bell's theorem

Reference Books:
1. Introduction to Quantum Mechanics by David J Griffiths
2. Molecular Quantum Mechanics by P W Atkins and R S Friedman
3. Principles of Quantum Mechanics by R Shankar
4. Modern Quantum Mechanics by J J Sakurai
5. Quantum Physics by Stephen Gasiorowicz

5.Teaching-Learning Strategies in brief:

This is the first course on Quantum Mechanics. The students will see most of the topics for the first time. The focus would be on concepts and intuition building with reasonable stress on the mathematics of Quantum Mechanics.

6.Assessment methods and weightages in brief:
Assignments + Quizzes – (30%), Mid-term evaluation (30%), Final exam (40%)

Title of the Course: **Readings from Hindi Literature**

Faculty Name : Harjinder Singh
Course Code : **HS1.303**
Credits : 4
L - T - P: (24-0-0)
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year: **Monsoon 2024**

Pre-Requisites **:** Ability to read and comprehend Hindiच Assignments and exams may be done in English or any of the Indian languages comprehensible to the instructor.

Course Outcomes :

1. Greater interest and appreciation of literature in general

2. Reasonable amount of knowledge of contemporary writing.
3. Motivation to continue reading and writing in creative literature in future
4. Comparative understanding of literature in different languages
5. Elementary understanding of literary criticism

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://intranet.iiit.ac.in/offices/static/files/HelponpreparationofCoursedescriptions-2022.pdf

Course Topics :
I. History of Hindi literature – 2 L
2. Fiction: Nirmal Varma, Bhishm Sahani, Manto, Gyanranjan, Kamaleshwar, Uday Prakash, Ismat Chugtai, etc. - 7-8 L.
3. Poetry: Ajnyeya, Muktibodh, Nagarjun, Shamsher Bahadur Singh, Raghuveer Sahay, Faiz Ahmed Faiz, Nand Kishore Acharya, Sarveshwar Dayal Saksena, Manglesh Dabral, Vinod Kr Shukla, Kumar Vikal, Gagan Gill, Katyayani, Anamika, etc. - 8-9 L,
4. Play: Mohan Rakesh (Aadhe-adhoore) – 2 L.
5. Non-fiction and criticism: (i) Pleasure readings; (ii) aesthetics versus committed literature; (iii) Sociology of literature; - 4L.
(Please list the order in which they will be covered, and preferably arrange these as five to six modules.)

Preferred Textbooks: Works of writers available in IIIT library. Additional handouts may be given.

Reference Books : Same as above

E-book Links : Material available from Kavitakosh.org, rekhta.org, hindwi.org and hindisamay.com and other sites may be used.

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

Type of Evaluation	Weightage (in %)
Mid Sem Exam	**20**
End Sem Exam	**35**
Assignments	**25**
Project	**20**

Mapping of Course Outcomes to Program Objectives: (1 – Lowest, 2—Medium, 3 – Highest, or a '-' dash mark if not at all relevant). Program outcomes are posted at https://intranet.iiit.ac.in/offices/static/files/PEOs%2CPOs%26PSOs-ofAllProgrammes-Jan2023.pdf

	PO1	PO2	PO3	PO 4	PO5	PO 6	PO7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1																
CO2																
CO3																
CO4																
CO5																

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

Title of the Course: **Real Analysis**

Faculty Name: Samyadeb Bhattacharya +Abhishek Deshpande
Course Code: MA4.101
L-T-P: 3-1-0.
Credits: 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Course: CSE

1.Prerequisite Course / Knowledge:

Elementary knowledge of Calculus Much of mathematics relies on our ability to be able to solve equations, if not in explicit exact forms, then at least in being able to establish the existence of

solutions. To do this requires a knowledge of so-called "analysis", which in many respects is just Calculus in very general settings. The foundations for this work are commenced in Real Analysis, a course that develops this basic material in a systematic and rigorous manner in the context of real-valud functions of a real variable.

2.Course Outcomes (COs)

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

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

CO1. describe the fundamental properties of the real numbers that underpin the formal development of real analysis;
CO2. demonstrate the knowledge of an understanding of the theory of sequences and series
CO3. demonstrate skills in constructing rigorous mathematical arguments;
CO4. apply the theory in the course to solve a variety of problems at an appropriate level of difficulty;
CO5. demonstrate skills in communicating mathematics
CO6: analyse how abstract ideas and regions methods in mathematical analysis can be applied to important practical problems.

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

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

4.Detailed Syllabus:

Unit 1Sequence of real No, Bounded and Unbounded Sets, Supremum, Infimum, Limit points of a set, Closed Set, Countable and uncountable sets. Sequences, Limit points of a Sequence. Limits Inferior and Superior, Convergent sequence, Non convergent sequence, Cauchy General Principle of Convergence, bounded and monotone sequence, Infinite Series, Positive Term Series, Convergence of series of real numbers, Necessary condition, Absolute convergence and power series, Convergence tests for series.

(9 hours)

Unit 2Mean value theorems (Rolle's Theorem, Cauchy Mean Value Theorem, Lagrange's Mean Value Theorem), Indeterminate forms, Taylors Series, Partial derivatives. Integration as a limit of

a sum, some integrable functions, Fundamental theorem of Calculus, Mean Value Theorems of Integral calculus, Integration by parts, Change of variable in an integral, Second Mean value theorem, Multiple integrals,

(9 hours)

Unit 3: Vector, Vector operations, Products, Areas and Determinants in 2D, Gradients, Curl and Divergence, Volumes and Determinants in space. Differential equations of first order and first degree. Linear ordinary differential equations of higher order with constant coefficients. Elements of Partial Differential Equation (PDE).

(7.5 hours)

Unit 4: Analytic function of complex variable, CR Equation, harmonic functions, Laplace equation, applications (7.5 hours);

Unit 5Integration of a function of a complex variable, M-L inequalities. Cauchy's Integral Theorem. Cauchy's Integral formula. Taylor's and Laurent Expansion, Poles and Essential Singularities, Residues, Cauchy's residue theorem, Simple contour integrals.

(9 hours)

4. A project related to the above syllabus will be done by students to be submitted by the end of the semester.

References :

- Rudin, Walter, *Principles of Mathematical Analysis*, third edition, International Series in Pure and Applied Mathematics. McGraw-Hill Book Co., New YorkAuckland-D¨usseldorf, 1976
- Bartle, Robert G., *The Elements of Real Analysis*, second edition, John Wiley & Sons, New York-London-Sydney, 1976. (for Fourier Series) Ross, Kenneth A., *Elementary Analysis. The Theory of Calculus*, second edition, in collaboration with Jorge M. L´opez, Undergraduate Texts in Mathematics, Springer, New York, 2013.
- *Kreyszig, Erwin. (1983). Advanced engineering mathematics. New York: Wiley,*
- Goldberg, Richard R., *Methods of Real Analysis*, second edition, John Wiley & Sons, Inc., New York-London-Sydney, 1976.
- Churchill, Ruel V. and Brown, James Ward, *Complex Variables and Applications*, fourth edition, McGraw-Hill Book Co., New York, 1984
- Ahlfors, Lars V., *Complex Analysis: An Introduction to the Theory of Analytic Functions of One Complex Variable*, third edition. International Series in Pure and Applied Mathematics, McGraw-Hill Book Co., New York, 1978.

5.Teaching-Learning Strategies in brief:

Lectures in the classroom teaching, weekly tutorials involving problem solving and active learning by students and Project-based Learning

5. Assessment methods and weightages in brief:

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

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Title of the Course: **Real-Time Embedded Systems**
Name of the Faculty: Deepak Gangadharan
Course Code: CS3.502
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

For CS students Computer Systems Organization, Basics of Operating Systems for ECE students CS3.306 Algorithms and Operating Systems

2. Course Outcomes (COs)

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

CO-1. Explain the features of real-time systems and classify different types of real-time systems such as hard real-time, soft-real time based on the timing requirements.
CO-2. Apply an appropriate task model (such as periodic, sporadic, aperiodic, etc) based on task/application characteristics to model a real-time system.
CO-3. Analyze the schedule ability of a real-time system with different types of scheduling algorithms (static vs dynamic, preemptive vs non-preemptive) on a uniprocessor
CO-4. Analyze the schedule ability of a real-time system with different types of scheduling algorithms (global, partitioned, semi-partitioned) on a multiprocessor platform
CO-5. Analyze the schedule ability of a real-time system with shared resources
CO-6. Assess the theory and experimental results presented in a relevant research paper and present it.
CO-7. Develop scheduling algorithms in a RTOS simulator

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	1	1	-	1	-	-	-	2	-	3	1	3	2	2
CO2	3	3	1	2	1	1	2	1	-	1	-	3	3	1	2	2
CO3	3	3	-	3	1	2	2	1	-	1	-	3	3	3	2	3
CO4	3	3	-	3	1	2	2	1	-	1	-	3	3	3	2	3
CO5	3	3	-	3	1	2	2	1	-	1	-	3	3	3	2	3
CO6	1	3	-	1	-	1	1	-	-	3	-	3	2	1	-	3
CO7	3	2	-	2	3	2	1	2	3	1	-	3	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: Real-Time Systems – Introduction and Concepts, Modeling Real-Time Systems **Unit 2:** Commonly used approaches to Real-Time Scheduling – Clock Driven approach, Weighted Round Robin approach, Priority Driven Approach, Dynamic vs Static Systems, Offline vs Online Scheduling, Preemptive vs non-preemptive

Unit 3: Clock Driven Scheduling – Scheduling Aperiodic and Sporadic Jobs, Schedulability test

Unit 4: Priority Driven Scheduling – Static Priority: Rate Monotonic and Deadline Monotonic Algorithms, Dynamic Priority: EDF Algorithm, Schedulability tests

Unit 5: Scheduling Aperiodic and Sporadic jobs in Priority Driven Systems – Deferrable Server, Sporadic Server, Constant Utilization Server, Total Bandwidth Server and Weighted Fair Queuing Server

Unit 6: Multiprocessor Scheduling

Unit 7: Resources and Resource Access Control

Reference Books:

1) Jane W S Liu, Real-Time Systems, Pearson Education
2) Giorgio C Buttazo, Hard Real-Time Computing Systems: Predictable Scheduling Algorithms and Applications, 3rd edition, Springer
3) C.M. Krishna & Kang G. Shin , Real Time Systems, McGraw Hill
4)

5. Teaching-Learning Strategies in brief

Weekly lectures cover the topics in the syllabus and the advanced topics from research in real-time systems. Tutorials cover how to solve some design and analysis problems related to topics covered in the lectures. There are couple of assignments that will provide the students experience in programming schedulers for RTOS platforms. There is a project which is either based on an idea the student wants to explore from the course topics or based on an existing research paper implementation and evaluation. Finally, there will be a presentation/discussion of a research paper.

6. Assessment methods and weightages in brief

Type of Evaluation	Weightage (in %)
Quizzes	15
Assignments	15
End Sem Exam	20
Project	30
Research Paper Presentation	20

Title of the Course: **Research in Information Security**

Name of the Faculty: Ashok Kumar Das + Srinathan K
Course Code: CS8.501
L-T-P: 3-1-0
Credits: 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Academic Program B.Tech. In CSE / M.Tech. in CSE/CSIS

1. Prerequisite Course / Knowledge:
Cryptography, Network Security, System Security, Programming Languages

2.Course Outcomes (COs) :
After completion of this course successfully, the students will be able to
CO-1: Demonstrateskills in solving research problems and critical thinking skills
CO-2: Demonstrate security protocols practically
CO-3: Analyse various techniques for security protocols against different potential attacks
CO-4: Demonstrate the knowledge ofFormal security verification using automated software validations tools
CO-5: Survey the literature in detail on existing security protocols to enable oneself to design, analyse and implement new security protocols

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 1 0	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: 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:** Elliptic-Curve Cryptography (ECC), Key management in hierarchical access control, Key management, user authentication and access control, Proxy signature

- **Unit2: Security in vehicular adhoc networks**/Internet of Vehicles (IoV), Security in smart grid/smart
  home, Security in Cloud/Fog computing
- **Unit 3:** Wireless Sensor Networks (WSNs) and Internet of Things (IoT)security
- **Unit 4:** Intrusion detection and prevention
- Unit 5: Blockchain and its security and privacy issues, Blockchain-based AI/ML security

Reference Books:

1. Top research papers (journals and conferences) from the IEEE Transactions, ACM Transactions, Elsevier, Springer, Wiley, etc.
2. William Stallings, "Cryptography and Network Security: Principles and Practices", Pearson Education, 2010.
3. Bernard Menezes, "Network Security and Cryptography", Cengage Learning,2010.
4. Behrouz A. Forouzan, "Cryptography and Network Security", Special Indian Edition,2010.

5. **<u>Teaching-Learning Strategies in brief</u> (4 to 5sentences):**

***** Recognition of interplay between theory and practice
***** Design of efficient and secure research problems
***** Various security analysis techniques against potential attacks
***** Automated software validations tools based formal security verification

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

- In-Class Tests:20%
- Assignments:20%
- Research Project: 40% (including report and presentation)
- End Semester Examination:20%
-

Title of the Course : Retrofit of Existing Infrastructure

Faculty Name : Shubham Singhal
Course Code : TBD
Credits : 2
L - T - P : 3-1-0 (H2- 2 credits)
(L - Lecture hours, T-Tutorial hours, P - Practical hours)

Name of the Program: M.Tech.- Computer Aided Structural Engineering
Semester, Year : Monsson, 2024

Pre-Requisites : Solid Mechanics, Reinforced Concrete Design, Earthquake Engineering

Course Outcomes :

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

1. Explain the theory and concepts of Structural Retrofit and identify the damage mechanism anddistress in masonry and RC buildings.
2. Quantify damage and stresses in structurally deficient building though computational methods.
3. Propose suitable retrofit techniques depending upon the extent and type of damage and thetype of building.
4. Apply the concepts of solid mechanics and structural analysis in analysis and design ofretrofitted structural elements.
5. Evaluate retrofitted masonry and reinforced concrete buildings under seismic loading throughcomputational methods.

Course Topics:

Module 1: Basic Concepts

Introduction; Retrofit and its concept; Advantages and challenges; Retrofit materials; Difference between repair, retrofit, strengthening and rehabilitation; Codal provisions, Different techniques of retrofit, Mesh techniques: poly-propylene band, industrial geo-grid, chicken mesh, welded wire mesh; Section enlargement techniques: RC jacketing, shotcrete; Addition of structural components:shear walls, frames and bracing; Retrofit of foundation system: micro-piles.

Module 2: Damage Assessment of Existing Buildings

Causes of structural damage; Purpose of assessment; Detailed vulnerability assessment; Rapid visual survey; Non-destructive and semi-destructive testing; Numerical assessment of structurally deficient building; Computational stress analysis of structurally deficient building.

Module 3: Numerical Modelling of Retrofit Techniques for Existing Buildings

Local and global methods of retrofit; Modelling of various retrofit techniques in software - RC jacketing, shotcrete, shear walls, frames and bracing.

Module 4: Re-evaluation of Retrofitted Building

Numerical assessment of retrofitted building; Comparison between structurally deficient and retrofitted building; Check for capacity/drift and strength parameters; Codal provisions and acceptance criterion.

Preferred Textbooks:

1. Tomazevic, M., "Earthquake Resistant Design of Masonry Buildings", Imperial Colleges Press.
2. Amarnath Chakrabarti et al. "Handbook on Seismic Retrofit of Buildings", Indian Building Congress.

Reference Books :

1. "NEHRP Handbook for the Seismic Evaluation of Existing Buildings", Federal EmergencyManagement Agency, Building Seismic Safety Council, Washington, D.C. FEMA 178.
2. "Building Seismic Safety Council", Federal Emergency Management Agency, Washington, D.C,FEMA 356, 2000, FEMA 440 / ATC 55, 2005, FEMA 310.

E-book Links :

1. https://nehrpsearch.nist.gov/static/files/FEMA/PB2009105376.pdf

Grading Plan :

Type of Evaluation	Weightage (in %)
Quiz	15
End Sem Exam	30
Assignments	20
Project	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	2	2	1	2	2	-	-	-	1	-	-	2	-	2	2
CO2	3	2	3	1	3	1	-	-	-	3	-	-	3	3	3	2
CO3	3	2	2	3	2	2	-	-	-	2	-	-	3	1	2	3
CO4	3	3	3	2	3	1	-	-	-	2	-	-	3	3	3	3
CO5	3	3	3	2	3	2	-	-	-	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 classin individual assignments and group projects. Project based learning through application of computer software/programming language.

Title of the Course **Robotics: Dynamics and Control**

Faculty Name - Nagamanikandan Govindan
Name of the Program: B.Tech in Electronics and Communication Engineering
Course Code: EC4.401
Credits: 4
L - T - P: 3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Monsoon, 2024

Pre-Requisites : Must be familiar with Linear Algebra, Differential Calculus, and Numerical methods for solving system of nonlinear equations.

Course Outcomes :
After completion of this course successfully, the students will be able to
CO-1 Describe coordinate frames, spatial transformations, and mathematical representation of joints and links.
CO-2 Describe the kinematics and dynamics of rigid body systems - serial manipulator.
CO-3 Formulate and analyze the forward and inverse model using analytical and numerical methods.
CO-4 Develop software programs to generate trajectory and control the robot to track the commanded trajectory.
CO-5 Apply the learned robot model for joint space control and end-effector control of the manipulator and analyze them.

Course Topics :
Unit 1: Introduction to robotics and rigid body motion – robot structure and workspace, transformation matrices, mathematical representation of joints and links, mobility analysis and constraints
Unit 2: Manipulator forward and inverse kinematics – position analysis and velocity analysis, singularities
Unit 3: Robot Dynamics – Euler-Lagrangian formulation and simulation of equations of motion
Unit 4: Trajectory planning and generation
Unit 5: Robot control – joint space control and operation space control

Preferred Textbooks:
1. J.J. Craig, Introduction to Robotics: Mechanics and Control, 3rd Ed., Prentice Hall, 2004.
2. Kevin M. Lynch and Frank C. Park, Modern Robotics, Cambridge Press 2017.

Reference Books :
1. M. Spong, S. Hutchinson, M. Vidyasagar, Robot Dynamics and Control, John Wiley & Sons, 2004.
2. R.M. Murray, Z. Li, S.S. Sastry, A Mathematical Introduction to Robotic Manipulation, CRC Press, 1994.
3. Ashitava Ghosal, Robotics: Fundamental Concepts and Analysis, Oxford University Press, 2006.

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

Type of Evaluation	Weightage (in %)
Quiz-1	**10**
Quiz-2	**10**
End Sem Exam	**40**
Assignments	**30**
Other Evaluation (Seminar presentation-critique a research paper and submit a one-page report)	**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	2	1	1	2	1	2	1	2	3	1	2	3
CO2	3	3	2	3	2	2	2	2	2	3	2	3	3	1	3	3
CO3	3	3	3	3	3	1	1	2	2	3	2	3	3	2	3	3
CO4	3	3	2	2	2	1	2	2	3	2	2	2	3	3	2	3
CO5	3	3	3	3	2	3	2	2	2	3	2	3	3	3	2	3

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

The course focuses on imparting knowledge, developing problem-solving skills, and motivating students for continued learning on various aspects of robot dynamics and control. Each student must critique a research article related to advanced topics of mechanisms and robotics to hone their knowledge in the current state of the art and presentation skills by giving a seminar. Exams will include similar problems encountered in the assignments and cover the content from the lectures.

Title of the Course **: Science I**

Name of the Faculty : Prabhakar B + (Harjinder Singh)
Name of the Academic Program : B. Tech. (CSE)
Course Code **: SC1. 110**
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):
Outcomes of the Second Half (Introduction to Biology):

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

CO-1: Analyze the aims, methodology of science and technology, and their impact on society

CO-2: Explain Special Theory of Relativity and compute its consequences for typical scenarios of relevance

CO-3: Demonstrate familiarity with Lagrangian and Hamiltonian formulations of mechanics, by formulating the equations of motion from basic principles for mechanical systems

CO-4: Explain connections between thermodynamics and statistical mechanics and their use in modern chemical computations

Co-5: Infer the stability of molecules using the concepts of hybridization and molecular orbital theory

CO-6: Recognize the role of symmetry in nature

CO-7: Demonstrate problem solving skills up to a level that allows application to research topic of their interest

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	2	2	2	2	1	1	2	1	2	2	1	1	1
CO2	2	2	2	2	1	1	2	1	1	1	1	2	0	3	2	1
CO3	2	2	1	2	1	1	2	1	1	1	1	2	0	3	2	1
CO4	2	2	1	2	1	1	2	1	1	1	1	2	1	3	2	1
CO5	2	2	1	2	1	1	2	1	1	1	1	2	1	3	2	1
CO6	2	2	1	2	1	1	2	1	1	1	1	2	2	2	2	2
CO7	2	2	1	2	1	1	2	1	1	1	1	2	1	1	1	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: Mathematical modeling in sciences, (i) geometry and linear algebra, (ii) change and calculus and (iii) chance and probability. Simple models can have complicated behavior: logistic map demonstrates deterministic chaos

Unit-2: Forms in nature. Scales of length, time and energy in nature.

Unit 2: Special theory of relativity: postulates, Lorentz Transformation, Length Contraction, Time dilation, Doppler effect, relative velocity determination, twin paradox, relativistic momentum and energy. Space time graphs, and relativity of simultaneity.

Unit 3: Review of Newtonian Mechanics and its difficulties / failures. Introduction to Lagranian and Hamiltonian formulations, and application to mechanical problems.

Unit 5: Need for Quantum Mechanics. Schrodinger equation for time-dependent and time-independent scenarios. Application to atoms and molecules; provide qualitative picture of orbital hybridization to explain the molecular structures

Unit 6: Review of Thermodynamics and introduction Statistical Mechanics and applications to problems of relevance. Lasers. Fermi statistics, bandgap in semiconductors.

Reference Books:

1. "Concepts in Modern Physics" A Beizer (6th Edition)

2. "Classical dynamics of particles and systems" by Stephan Thornton and Jerry Marion (5th edition)
3. "Physical Chemistry" Atkins and de Paula (8th Edition)

5.Teaching-Learning Strategies in brief (4 to 5 sentences):
The objective of the course is to give the CSE/ECE students a good understanding of the concepts in Modern Physics and modern chemistry. To familiarize the students with available web-based resources, and problem solving (whenever possible with scientific programming).

6.Assessment methods and weightages in brief (4 to 5 sentences):
Assignments – (20%), Class notes (10%) Preannounced and surprise In-class quizzes (25%), End semester exam (35%)

Title of the Course:	**Science Lab -I**
Name of the Faculty:	Tapan K Sau, Prabhakar B
Course Code:	SC4.110
L-T-P	0-0-3
Credits	2

(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Academic Program …… Dual Degree CNS…

1.Prerequisite Course / Knowledge:
None
2.Course Outcomes (COs):
After completion of this course successfully, the students will be able to

CO-1: Setup and perform optics experiments to measure properties of material like optical rotation, wavelength of monochromatic light etc
CO-2: Setup and perform chemistry experiments to measure properties like pH, concentration of chemicals and
CO-3: Perform physical measurements to measure properties like frequency of osciallator, young's modulus etc.

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

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

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

4.Detailed Syllabus:

1. Unit-1: Determination of the Specific Rotation of Sucrose and Composition of Sucrose Solution by a Polarimeter
2. Unit-2: Potentiometric Titration of a Mohr Salt Solution with Standard $K_2Cr_2O_7$
3. Unit-3: Kinetic Study of the Decomposition of H_2O_2 in the Presence of $FeCl_3$ Solution and the Effect of the Catalyst on the Rate Constant
4. Unit-4: Verification of the Beer-Lambert's Law with a given solution and the determination of the concentration of a solution
5. Unit-5: Determination of pKa of a Weak Acid by pH-Metric Titration Method
6. Unit-6: Newtons Ring Method to measure Radius of Curvature of Plano-Convex Lens
7. Unit-7: Determination of Young's Modulus of Material of a Beam by Method of Flexure
8. Unit-8: To determine the number of rulings per unit length of a diffraction grating
9. Unit-9: Stewart and Gee's Method for Determining the Magnetic Field of the Earth
10. Unit-10: To Measure Slit-Width and the Separation between two Slits of Double Slit, by Observing Diffraction and Interference Fringes and to Compare them by Microscopic Measurement

Reference Books:

1. Introduction to Protein by Branden and Tooze
2. Fundamentals of Biochemistry by Voet, Voet and Pratt

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

Course is a hands-on laboratory course requiring student to perform experiment after showing some prerequisite preparation. Then, the student's setup of the experiment is checked, before allowing to proceed to experimental measurements. After completion of all measurements, student will perform required calculations for drawing the conclusions. Finally, a viva voice examination is conducted for the experiment to check a broad level knowledge of the experiment.

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

- Laboratory record- 40%
- Quiz - 30%
- Exams - 30%

Title of the Course:	**Signal Detection and Estimation Theory**
Name of the faculty :	Santosh Nannuru
Course Code:	EC5.406
L-T-P:	3-1-0
Credits:	4
Course :	ECE
Name of the Academic Program	B. Tech. in Electronics and Communication Engineering

Prerequisite Course / Knowledge: Probability Theory and Random Processes

Course Outcomes (COs):

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

CO-1: Describe the various detection methods for detecting/classifying the deterministic/random signals with perfect or statistical knowledge of their parameters.
CO-2: Discuss the various estimation methods for estimating the parameters of linear and non-linear signal models in the presence of Gaussian and non-Gaussian noise.
CO-3: Analyze and design an optimal detector for a given false alarm rate to detect deterministic/random signals.
CO-4: Analyze and design a minimum variance unbiased estimator, if it exists, for estimating the parameters of a signal.
CO-5: Implement and perform numerical analysis of the estimation and detection methods using Matlab.
CO-6: Apply a suitable method for the estimation/detection problems in the diverse engineering fields.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	0	0	0	0	0	0	0	1	0	2	0	2	1	0
CO2	3	2	0	0	0	0	0	0	0	1	0	2	0	2	1	0
CO3	3	3	3	2	0	0	0	0	0	0	0	2	0	3	2	1
CO4	3	3	3	2	0	0	0	0	0	0	0	2	0	3	2	1
CO5	3	2	2	1	0	0	0	0	0	0	0	1	0	2	1	1
CO6	3	2	2	1	0	0	0	0	0	0	0	1	0	2	3	2

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

Detailed Syllabus:

Unit 1: Estimation Theory - Minimum Variance Unbiased (MVU) Estimation, Cramer Rao lower bound, Fisher Information, Neyman-Fisher factorization, Sufficient and complete test statistics, Rao-Blackwell-Lehmann-Scheffe theorem.

Unit 2: Estimation methods - Best linear unbiased estimation (BLUE), Least square estimation (LSE), Maximum likelihood estimation (MLE), Bayesian Approach, Numerical methods - Newton Raphson and Expectation maximization (EM) methods.

Unit 3: Detection Theory - Hypothesis testing, Neyman-Pearson (NP) theorem, Likelihood ratio test (LRT), Receiver operating characteristic (ROC), Minimum probability of error, Bayes Risk, Minimum Bayes risk detector, MAP detector.

Unit 4: Detection methods–Detection of deterministic signals - Matched filter for WGN and non-WGN, Binary and M-array signal detection using matched filter.
Detection of random signals - Estimator-correlator and linear model;
Detection of deterministic signal with unknown parameters - Composite hypothesis testing, Generalized LRT (GLRT), Bayesian approach, Rao test, Wald test.

Reference Books:

1. **Steven M. Kay, *Fundamentals of Statistical Signal Processing: Estimation Theory*, Vol. 1, Prentice-Hall, 1993**

2. **Steven M. Kay, *Fundamentals of Statistical Signal Processing: Detection Theory*, Vol. 2, Prentice-Hall, 1998**

Teaching-Learning Strategies in brief

This course includes the topics on theoretical understanding and the optimal designs of the detection and estimation methods. The lectures are designed to teach complex theoretical concepts using simplistic examples while assuming that students have prerequisite knowledge in probability theory and random processes. The tutorials are focused on applying estimation/detection methods learned in class to more complex signal processing and communication engineering problems. The grading plan of this course includes one mid semester exam and one end semester examalong with the homework assignments and term paper presentation. While 50% of the weightage is given for the mid semester and end semester exams, the remaining weightage is reserved for the term paper presentation and the homework assignment for engaging students in research-oriented thinking. The assignments problems are designed to compel students to creatively apply the complex concepts learned in the class for the designing optimal estimation/detection methods for various problems. Besides, the assignments also include the MATLAB/Python programming problems for implementing some of the estimation methods learned in the class. Students in the group of two are encouraged to choose their term paper presentation topics based on the seminal research articles on estimation and detection theory and its applications.

Assessment methods and weightages in brief

- Home Assignments: 30%
- Term Paper: 30%
- Mid Semester Exam: 20%
- End Semester Exam: 30%

Title of the Course: **Signal Processing**

Course Code:	EC5.201
Name of the Faculty:	Chiranjeevi Yerra, Santosh Nannuru
L-T-P	3-1-3
Credits	5
Name of the Academic Program	B. Tech. in ECE

Prerequisite Course / Knowledge:

Should have taken the course Network Signals and Systems.
A prior knowledge of calculus and complex numbers is required.

Course Outcomes (COs):

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

CO-1: Describe continuous-time and discrete-time signals using various representations

CO-2: Apply various transforms including Fourier transform, DTFT, and Z-transform to studysignals and systems
CO-3: Apply sampling theorem to do analog-to-digital conversion of signals, perform idealand non-ideal reconstruction of signal from its samples
CO-4: Examine computational complexity of efficient DFT implementations using FFT

CO-5: Design digital filters with specified requirements to process signals

CO-6: Analyze systems and real-world signals using signal processing tools in MATLABsoftware
CO-7: Analyze a signal processing application or problem by reading research papers andperforming simulations as part of the course project

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

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

Detailed Syllabus:

Unit 1: Fourier transform (FT) of continuous-time signals, analysis of linear and timeinvariant (LTI) systems using Fourier transform
Unit 2: Sampling and reconstruction of bandlimited signals, analog-to-digital conversion,aliasing, quantization
Unit 3: Analysis of discrete-time signals and systems using Fourier transform (DTFT) and Z-Transform
Unit 4: Discrete Fourier transform (DFT) for finite length sequences, efficientimplementation of DFT using radix-2 fast Fourier transform (FFT) algorithms
Unit 5: Digital filter design, techniques for FIR and IIR filter design

Reference Books:

1. Signals and Systems by A.V. Oppenheim, A.S. Willsky and S.H. Nawab (2015)
2. Digital Signal Processing: Principles, Algorithms and Applications by J.G. Proakis and D.Manolakis (2007)
3. Digital Signal Processing: A Computer Based Approach, S.K. Mitra (2013)
4. Principles of Signal Processing and Linear Systems, B.P. Lathi (2009)

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

Lectures are used to explain the core concepts in signal processing and work out a few problems. Detailed handwritten notes are shared along with book sections and practice problems. A short question is posted at beginning of class to gauge understanding of previouslecture. Tutorials are used mainly for doubt clarifications and problem solving. Assignments are given to promote application of concepts to difficult problems. The weekly lab sessions supplement the course lectures with MATLAB software-based signal analysis which are evaluated through short viva. The course project exposes students to advanced concepts and real-world applications in the domain. The lab sessions and final course projects are done in teams of two to encourage collaborative problem solving and team participation.

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

Continuous evaluations:

- Quizzes: 30%
- Assignments: 15%
- Lab viva and evaluations: 20%

Comprehensive evaluation:

- Project: 15%
- End Exam: 20%

Title of the Course : Software Quality Engineering

Name of the Faculty : Raghu Reddy Y
Course Code : TBD
Credits : 4
L-T-P : 3-0-1

Name of the Academic Program: MS/PhD in Computer Science and Engineering

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

Students must have taken a Software Engineering or equivalent course at the undergraduate level.

2. <u>Course Outcomes (Cos)</u>

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

CO-1: Understand software quality concepts and gain skills necessary to design and analyze quality aspects of software systems
CO-2: Apply various measurement techniques to re-engineer software systems
CO-3: Apply specialized knowledge to identify open research problems and disseminate state-of-the art in software quality engineering research.
CO-4: Critique the quality of published research papers with well-known assessment criteria
CO-5: Synthesize novel solutions to open research problems in software quality engineering by following well-established principles of software engineering 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	P10	P11	P12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	1	1	2	2	2	1	2	2	1	2	1	2	2	1
CO2	3	3	3	1	3	2	3	2	3	3	2	2	2	3	2	2
CO3	1	3	3	3	1	2	1	2	3	3	1	3	3	2	2	3
CO4	2	2	2	2	2	1	1	2	3	3	1	3	2	3	2	3
CO5	2	3	3	3	2	1	2	2	3	2	2	3	3	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:

The course will cover the following topics:

- Process and Product Quality
- Measurement Fundamentals – Why, What and How?
- Qualities and Tactics
- Software Development Life Cycle – V & V perspective
- Formal Methods and Quality
- Usability and Accessibility
- Qualities in intelligent Systems – Model, Data and System
- Secure Software Engineering
- Other research topics

Reference Books/Text:

- Software Metrics: A Rigorous & Practical Approach by Norman E. Fenton and Sheri L. Pfleeger
- Software Quality Engineering – Springer Journal
- Software Quality Engineering: Testing, Quality Assurance, and Quantifiable Improvement by Jeff Tian
- Metrics and Models in Software Quality Engineering by Stephen H. Ka

Seminal work/papers in the area will be used as references

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

The course is delivered using a combination of project based and research-based learning methodology. Various topics including verification and validation methods (generic as well as for specific qualities), metrics and measurements, software quality assurance, standards, etc. are taught and reinforced via assignments and course project. The lectures emphasize on cutting edge research in the software equality engineering. The focus is on imparting knowledge of software engineering research methodologies to students through paper presentations, providing state-of-

the art research papers as well as state-of-practice using tools. The class is run in a working session mode to foster discussion among students and instructors.

6. <u>Assessment Methods and Weightage in brief (4 to 5 sentences)</u>

Research/Project Proposal	5 %
Final Research Paper/Project	35%
Article/Advanced topic Presentation and Critique	10%
Final Exam	20%
Assignments (4 * 6)	24%
Participation	6%

Title of the Course: **Software Systems Development**

Name of the Faculty: Deepak Gangadharan + Rahul Mishra
Course Code : CS6.302
Credits: 4
L - T - P : 3-0-2
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year: Monsoon 2024
Name of the Program: PG Program **(**M.Tech I year I Semester - CSE & CSIS**)**
Pre-Requisites No

Course Outcomes **:** The aim of this course is to

1. Make students to have working knowledge of tools and technologies to build software systems.
2. They can analyze and evaluate the ideas to develop the applications.
3. Comfortable enough to work with various Unix-like computing environments.
4. Able to write simple to complex scripts/programs.
5. In a position to build small to medium sized software applications using various tools and technologies to automate tasks/solve problems.
6. Students will be able to extend the existing applications/software's to add more functionalities.

Course Topics **:** Linux and Shell Scripting, HTML, CSS, JavaScript and related libraries, Python, Basics of SDLC, Simple Queries, Networking and Security concepts.
1. Shell Programming - Linux basic commands, script writing, Swiss-army- knife tools (vi, grep, awk, sed ..)
2. Web Programming - Intro to basic concepts of the World Wide Web (WWW) and tools used to develop web apps. -Client-side & server-side scripting (HTML, XHTML, CSS, Java script, Python,)
3. Database Programming, Networking and Security

Reference Books **:**

- Mastering Linux Shell Scripting: A practical guide to Linux command-line, Bash scripting, and Shell programming, by Mokhtar Ebrahim, Andrew Mallett

- Learning Python: Powerful Object-Oriented Programming, by Mark Lutz
- JavaScript: The Definitive Guide, by David Flanagan

E-book Links :

Grading Plan :

Type of Evaluation	Weightage (in %)
Quiz-1	**10%**
Quiz-2	**10%**
End Sem Exam	**20%**
Assignments	**20%**
Project	**25%**
Other Evaluation (Lab activities + Class activities)	**15%**

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	3	3	3	2	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3
CO6	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3

Teaching-Learning Strategies in brief (4-5 sentences):
The plan is to use the prepared slides/documents in general to explain the problem and methods. This would include the handwritten/typed notes or using board to describe the topics. The outline has quite a few topics from different domains of computer science and would be taught in detail. Coding sessions would be conducted through labs and tutorials to make the topics easier to understand.

Title of the Course: **Spatial Informatics**

Name of the Faculty: Rajan KS
Course Code: CS4.408
Credits: 3-1-0-4
TYPE-WHEN: Open Elective
PRE-REQUISITE: Open to UG-3, UG-4, DD/MS, and PhDstudents

OBJECTIV:
Spatially explicit information like a map (e.g. Google Maps) informs us not just the geographical location but also the relationship between the objects in it. While mapping models focus on the

Spatial (and Temporal) data collection, storage and management (Spatial DBMS) with map generation as one of the key elements; the recent advances in technology have expanded the horizon to include Spatio-temporal Analytics, 3D GIS, Ontology and GML,etc.
This course gives an introduction to the concepts of GIS, the science and algorithms behind it and how this technology can benefit many disciplines, including navigation, transportation and traffic planning, Urban planning, hydrology, environmental management, disaster response, etc.

COURSE TOPICS:
Course Structure (each of approximately 1–2-week duration):

1. What is Geographical Information Systems (GIS)?
2. Fundamental concepts of Space
3. Geospatial data and its Digital representation – Vectors and Raster
4. GIS Data collection, Editing and Data formats
5. Data structures for Spatial data and Spatial data management (Geospatial database)
6. Spatial Data Query and Analysis – Spatial Analysis, Network Analysis
7. Data compatibility - Projections and Georeferencing
8. Spatial reasoning and uncertainty
9. Web-GIS, GML and Map services
10. Geospatial applications in few areas like in Hydrology (Water flows and floods); Ecology and Environment; Land use and Land cover; Urban planning and Transportation; etc.
11. Topics in Spatial Informatics
    1. 3DGIS
    2. Open-Source Initiatives inGIS/RS

A few lectures, may be given by Invited Speakers in related areas during the course to provide the students a wider understanding of its relevance and application.
In addition, there will be a hands-on (lab tutorials) introduction to one or two GIS software and tools at relevant times during the course.

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

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	PO1 1	PO1 2	PS O1	PS O2	PS O3	PS O4
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
CO 4	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

PREFERRED TEXTBOOKS:

1. Geographical information systems and science by Paul A. Longley, Michael F. Goodchild, David J. Maguire, and David W. Rhind
2. Introduction To Geographic Information Systems by Kang-Tsung Chang
3. GIS–A computing perspective by Micheal Worboys and Matt Duckham
4. Concepts and techniques of geographic information systems by C P Lo and Albert K W Yeung

Course Assessment Plan

Assignments	-	10%s
Project	-	20%
Any other	-	30%
Quiz	-	20%
Open Book Exam/ 30 Min Quiz	-	20%

OUTCOME: Students will learn the basic concepts of Geospatial data representation, cartography, visualization, data manipulation and how to extract meaningful information from it. In addition, they will be exposed to the application potential of this fast-developing domain cutting across disciplinary interests.

Title of the Course : **Spatial Thinking and Practice**

Name of the Faculty : Rajan K S
Course Code : **TBD**
Credits : 4
L-T-P : **3-1-0.**

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

1. Prerequisite Course / Knowledge:

Anyone with Physics and Mathematics background

2.Course Outcomes (COs)

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

CO-1: Comprehend concept of spatio-temporal analysis
CO-2: Describe various surveying methods
CO-3: Describe the significance of Global navigation systems
CO-4: Implement a range of photogrammetric measurement techniques
CO-5: Explain the basics of geodesy technology
CO-6: Criticize the relevance of surveying methods in geospatial context

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	3	2	2	2	2	2	1	2	2	3	2	2	2
CO3	2	2	1	2	3	2	1	1	1	1	2	2	2	2	2	2
CO4	3	2	2	2	2	1	2	1	1	1	2	2	2	2	2	2
CO5	2	2	2	2	1	2	2	2	2	1	2	3	3	2	2	2
CO6	1	2	2	1	2	1	1	1	1	1	1	2	2	2	2	1

4. Detailed Syllabus:

Unit-1: **Concept of Space and Time:** Geographical entities and Phenomena, Properties of Space, Size and Scale, comprehend spatial and temporal data throughout the processes of conceptualization, representation, computation, and visualization.
Unit-2: Surveying: Principles of Surveying, Measuring equipment, Techniques, Levelling, Triangulation and Trilateration, Plane Table Surveys, Modern surveying equipment- Total Station, The mathematical model and errors, Random and systematic errors, adjustments techniques.
Unit-3: GNSS: Intro to GNSS; GNSS survey, Keplerian laws, inertial coordinate systems etc., Overview of GNSS: GLONASS, GALILEO, BIDOU, IRNSS satellite systems etc., Differential GPS: GNSS Basic Observables: GNSS Surveying Techniques. Planning and field observations: Networking, data post processing. GNSS applications to Global, Regional and Local issues
Unit-4: Digital Photogrammetry: Fundamental principles and techniques of Photogrammetry surveying, camera calibration, image orientation, stereoscopic viewing, and digital image processing, photogrammetric methods for terrain modeling, Digital elevation model (DEM) generation Integration with other geospatial technologies (LiDAR, UAVs).
Unit-5: Geodesy: Introduction to geodesy & its development; Earth and its gravity field. Earth and its atmosphere – physical properties, Introduction to GPS- its components, Instruments & processing software, GPS signals. GPS data collection, Data Handling-, GPS data processing, Errors in GPS data – Satellite Geometry, Multipath errors & corrections; Accuracy of GPS data. Datum transformation. Geoid modelling.

References:

1. Arora, K.R., "Surveying", Vol. 1, 2 & 3, Standard Book House. 2005 2. Chandra, A.M., "Higher Surveying", New Age International Publications. 2002 3.
2. Subramanian, R., "Surveying and Levelling", Oxford University Press. 2007 4. Gopi, S, Sathi kumar, R. and Madhu, N., "Advanced Surveying, Pearson Publication
3. Torge, W., "Geodesy: An Introduction", Walter de Gruyter, Berlin. 1980 5. Vanicek, Peter and Krakiwsky, E.J., "Geodesy: The Concepts", Elsevier. 1

6.Assessment methods and weightages in brief:

Teaching, discussing current surveying methods, their practical implications. Research papers presentations by students on chosen topic, writing assignments, periodical evaluation of course project implementation.

Assessment methods and weightages in brief:

Theory (%): Quiz (10), Assignments (20), Mid exam (20), End exam (30) = **80**%

Project (%): Literature Survey**,** Preliminary and final presentation along with report **= 20%**

Title of the Course:	**Spectroscopy**
Name of the Faculty:	Marimutu Krishnan
Name of the Academic Program	CND
Course Code:	SC2.304
L-T-P	3-1-0
Credits	2

1.Prerequisite Course / Knowledge:
Basic quantum mechanics 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 Outline the basic principles of different spectroscopic techniques
CO-2 Analyze electronic, vibrational, and rotational spectra of molecules
CO-3 Apply classical and quantum mechanical models to spectroscopy
CO-4 Calculate the normal modes of simple molecules

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

4.Detailed Syllabus:

Unit 1: Introduction: Classical mechanical description of spectroscopy, quantum mechanics and energy quantization, energy-level diagram, energy spectrum: electronic states, vibrational states, rotational states, excitation and relaxation, absorption and emission of electromagnetic waves by materials

Unit 2: Atomic Spectra: Spectral series of hydrogen and alkali atoms, selection rules, L-S coupling, many-electron atoms, isotope shift, hyperfine splitting of spectral lines

Unit 3: Molecular Spectra: Electronic spectra of diatomic and polyatomic molecules, Born-Oppenheimer approximation, Franck-Condon principle, absorption and emission spectra, fluorescence and phosphorescence, Jablonsky diagram, effect of solvation of electronic spectra, rotational spectrum of a diatomic molecule using a rigid rotator model, energy levels and spectrum of a non-rigid diatomic molecule, effect of isotopic substitution on rotational spectra, vibrational spectrum of a diatomic molecule using the harmonic and anharmonic oscillator models. vibrational-rotational coupling in a diatomic molecule, molecular spectra of chain molecules

Unit 4: Raman and Infrared Spectroscopy: Classical and quantum theory of Raman effect, normal vibrations of CO_2 and H_2O molecules, vibrational and rotational Raman spectra, basic concept of infrared spectroscopy, interpretation of Raman and IR spectra, identification of Raman-active and/or IR-active modes based on symmetry arguments

Unit 5: Introduction to Nuclear Magnetic Resonance (NMR), and Electron Spin Resonance (ESR) spectroscopy

Reference Books:

1. Physical Chemistry - P. W. Atkins
2. Fundamentals of Molecular Spectroscopy - C. N. Banwell
3. Molecular Spectroscopy - G. M. Barrow
4. Molecules and Radiation: An Introduction to Modern Molecular Spectroscopy - J. I. Steinfeld
5. Physical Chemistry – A Molecular Approach – D. A. McQuarrie and J. D. Simon

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

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

Quizzes (25%), Assignments (35%), Final Exam (40%)

Title of the Course: **Speech Analysis and Linguistics (SAL)**

Name of the Faculty:	Chiranjeevi Yarra
Course Code:	CL2.405
Credits:	4
L - T - P:	3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)	
Name of the Program:	CLD/CSD/ECD/ECE/CSE
Semester, Year:	Monsoon 2024

Pre-Requisites : No

Course Outcomes :
(list about 5 to 6 outcomes for a full 4 credit course)
CO-1: Explaining the basics of speech and linguistics.
CO-2: Analyzing the linguistics in the state-of-the-art speech applications.
CO-3: Applying computational linguistics foundations for speech analysis.
CO-4: Analyzing the speech applications using phonemic, prosodic and text modelling.
CO-5: Explaining the basics of phonemic, prosodic and text analysis.
CO-6: Designing the algorithms for phonemic, prosodic and text modelling.

Course Topics :

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

Unit-1: Speech and linguistic basics -- Description of frames, phonemes, syllables, words, phrases, sentences and its use in speech-based feature computation.
Unit-2: Linguistics in speech analysis -- Overview of speech applications (such as ASR, TTS, Speech pathology etc..), use of phonemes, graphemes, prosody and text.
Unit-3: Phonemic analysis -- Phonemes and its accents, visual phonetics (Spectrogram, articulatory videos), pronunciation variations and modelling, grapheme to phoneme conversion, phoneme accent variations and identification.
Unit-4: Prosodic analysis -- Prosodic structure, word and syllable prominence, prominence detection and its applications, Intonation and its modelling (such as ToBI etc..), pitch and prominence variations, intonation identification, pauses, disfluencies and its detection, speech rhythm and speaking rate.
Unit-5: Text analysis -- language modelling, neural language models, metrics, text normalization, character-based speech analysis.

Preferred Textbooks:
Speech and Language Processing, Daniel Jurafsky& James H. Martin (2000), Pearson Education/Prentice Hall.
Prosody in Speech Understanding Systems, Ralf Kompe, Springer, 1997.
The Music of Everyday Speech: Prosody and Discourse Analysis, Ann Wennerstrom, Oxford University Press, 2001

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

Type of Evaluation	Weightage (in %)
Quiz-1	**10%**
Mid SemExam	**15%**
Seminar	**20%**
End Evaluation	**15%**
Assignments	**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	1	1	1	1	1	1	2	1	1	2	2	3	-	1
CO2	3	2	2	1	1	1	3	1	2	1	1	2	2	3	-	1
CO3	3	3	3	3	2	1	2	1	3	1	1	3	2	3	-	2
CO4	3	2	3	1	1	2	3	1	2	1	1	2	2	3	-	2
CO5	2	3	1	2	1	2	2	1	2	1	1	2	2	3	-	2
CO6	3	3	3	3	3	2	3	1	3	2	2	3	2	3	-	2

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

Lectures are given by integrating ICT into classroom teaching. Regular software-oriented assignments are given to understand the concepts. Along with assignments, course projects are considered to encourage the students to learn the concepts by doing and the problem-solving ability. As a part of course, seminars are conducted to create awareness of the recent trends in the course research area.

Title of the Course: **Speech Signal Processing**

Course Code:	EC5.408
Name of the Faculty:	Anil Kumar Vuppala
L-T-P	3-1-0
Credits	4
Name of the Academic Program	B.Tech. in ECE

Prerequisite Course / Knowledge:
Suggested to have a Signal Processing course or DSA course.

Course Outcomes (COs):

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

CO-1: Explaining the speech production and modeling of it.
CO-2: Analyzing the algorithms for speech events extraction.
CO-3: Applying mathematical foundations of signal analysis for speech feature extraction.
CO-4: Analyzing the speech signals using excitation source and prosody.
CO-5: Explaining the basics of speech applications.
CO-6: Designing the algorithms for speech events detection and speech applicationsbuilding.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4
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' mappin Mapping with PSOs, where applicable.

Detailed Syllabus:

Unit 1: Overview of signal processing, speech production, speech perception, typesof speech, and LTI model of speech production.
Unit 2: Pitch, formants, epochs and vowel region extraction.
Unit 3: Speech analysis: STFT analysis, Linear prediction analysis and cepstralanalysis.
Unit 4: Prosody analysis and excitation source analysis of speech.
Unit-5: Applications of speech processing such as speech recognition, speakerrecognition and speech synthesis.

Reference Books:

1. Introduction to Digital Speech Processing by Lawrence R. Rabiner andRonald W. Schafer, now Publishers Inc. Hanover, USA, 2007.
2. Discrete Time Speech Signal Processing: Principles and Practice-Thomas F.Quateri, Ed., PE, 2004.
3. Speech Communications Human and Machine by Douglas O Shaughnessy,2nd Edition, IEEE Press, 2000.

4. Speech and Audio Signal Processing, Processing and Perception of Speechand Music- Ben Gold and Nelson Morgan, Wiley- India Edition, 2006.

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

It is an introduction to speech processing course, so regular software-oriented assignments are given to understand the concepts. Surprise class tests are conducted based on assignments to test the seriousness in assignment solving. As apart of teaching, practical systems like speech recognition, speaker recognition etc are demonstrated in the class. Course projects are given on the concepts learned to design speech applications.

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

Quizzes	30%
Assignments	25%
Project	20%
End Viva	25%

Title of the Course:	**Statistical Methods in Artificial Intelligence**
Name of the Faculty:	Ravi Kiran S
Course Code:	CS7.403
L-T-P	3-1-0
Credits	4
Name of the Academic Program	B. Tech. in CSE

Prerequisite Course / Knowledge:
Should have taken Basic courses in maths (related topics: Linear Algebra, Probability, Differential Calculus).

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

CO-1: Demonstrate capability to model and represent physical entities as vectors (feature vectors) and carry out numerical computation.
CO-2: Formulate and solve many practical problems as classification and regression. Also appreciate other problem settings like clustering, structured prediction.
CO-3: Explain the fundamental mathematical ideas behind the popular machine learning algorithms
CO-4: Discuss the practical (computational) challenges in design and implementation of machine learning algorithms including (i) dimensionality reduction (ii) computational complexity (iii) convergence of the algorithm (iv) offline and online computation
CO-5: Apply the learnings on practical problems and real-life data. Appreciate the challenges with the real-world data sets.
CO-6: Discuss the nuances of conducting experiments, analyzing performances and expose the world of empirical science in computation.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	1	1	1	1	1	1	1	2	3	1	1	3
CO2	1	3	3	2	1	2	1	2	2	2	1	3	3	2	1	3
CO3	3	1	1	1	1	1	1	1	1	1	1	1	3	1	1	3
CO4	3	2	3	2	2	1	2	1	2	2	1	3	3	1	2	3
CO5	1	1	3	2	3	2	1	2	2	2	2	3	3	3	3	3
CO6	1	1	3	1	3	1	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: Representation, Vectors, Distributions, Dimensionality reduction, problems and challenges in machine learning
Unit 2: Basic algorithms in machine learning, PCA, Perceptron's, Decision Trees, Analysis
Unit 3: Popular algorithms and settings including unsupervised learning, Support Vector Machines, Kernels, Bias and Variance, Model Selection.
Unit 4: Neural Network Learning, Multi-Layer Perceptron, Backpropagation Algorithms, Exposure to Deep Learning.

Reference Books:

1. MDeisenroth, A. Faisal, C.Ong, Mathematics for Machine Learning, Cambridge Univ Press, 2020
2. R. Duda, P. Hart and D. Stock, Pattern Classification, Wiley, 2007
3. I Goodfellow, Y. Bengio, A. Courville, Deep Learning, MIT Press, 2016

Teaching-Learning Strategies in brief (4 to 5 sentences):
Course lectures will connect the algorithms and approaches to the real-world examples. This motivates the student and also convince the need of formal and mathematical way of approaching the real-world problem solving. Lectures also introduce the visualization skills of the data and distribution with the aim of appreciating the data. Associated sessions and components (tutorials, HomeWorks) expose the popular libraries and software infrastructure for machine learning today.

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

- HomeWorks: 30%
- In-class Objective Tests: 10%
- Projects/Term Papers: 10%
- Mid semester exam1: 15%
- Mid Semester exam2: 15%
- End Semester Exam: 20%

Title of the Course: **Structural Dynamics**

Name of the Faculty: Sunitha Palissery
Name of the Program: M.Tech CASE
Course Code: CE1.501
Credits 4
L - T - P : 3-1-0
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Semester, Year : Monsoon 2024

Pre-Requisites : Mechanics of Materials & Structural Analysis

Course Outcomes :

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

CO-1. Develop knowledge and skills to mathematically express dynamics of structural systems

CO-2. Employ the computer application skills in developing structural dynamics tools for predicting structural response to dynamic loading like earthquakes

CO-3. Demonstrate problem solving skills for various scenarios of structural dynamics and worktowards a research-based approach to the course

CO-4: Develop critical thinking to help improve dynamic responses of structures

CO-5. Analyze ethical and effective structural design practices in line with good dynamic responseof structures under earthquake loading

CO-6. Reorganize inter-personal skills required to manage possible inter-disciplinary, inter-departmental collaborations in structural engineering and thus in structural dynamics

Course Topics :

Unit 1: Response of simple Single Degree of Freedom (SDOF) systems

Introduction to structural dynamics; Definition of DOF; idealization of structure as SDOF system; Formulation of equations of motion for various SDOF systems; Free vibration of systems; Damping in structures; Undamped Systems; Forced vibration of systems; Steady state response to harmonic forces; Experimental determinations of natural frequency; Duhamel's integral and other methods.

Unit 2: Analysis of Multi-Degree of Freedom (MDOF) systems

Static force displacement relationship; Strain energy of system; Formulation of equation of motion; Evaluation of natural frequencies and modes; Free vibration of undamped systems; Forced vibration of damped systems; Review of time history & response spectrum methods.

Unit 3: Numerical Methods, and Approximate methods of computing natural frequencies

Eigen value problems and applications: Mode superposition principle; modal truncation errors; Ritz Vector approach; Direct Integration methods: Explicit methods - Central difference method; Implicit methods - Newmark-ß method; Rayleigh's method; Dunkerley'smethod; Rayleigh-Ritz method

Unit 4: Base excited systems

Formulation of equations of motion for SDOF and MDOF systems; Concept of spectral

quantities; Response spectrum; Fundamentals of earthquake engineering; Discussion onIS 1893 (1:2016 provisions for buildings.

Unit 5: Overview of dynamics of continuous systems
Vibration of flexural beams and shear beams: Equation of motion; Free vibration andForced vibration

Preferred Textbooks:

1. Chopra,A.K., (2017), *Dynamics of Structures: Theory and Applications to Earthquake Engineering*, V edition, Pearson Education, India
2. Clough,R.W and Penzien,J., (1993), *Dynamics of Structures*, II edition, McGraw-Hill International Ed.
3. Paz,M. (2006), *Structural Dynamics: Theory & Computation*, V edition, Kluwer Academic Publishers, Amsterdam

Reference Books :

1. Craig,R.L., and Wiley,J., (1981), *Structural Dynamics: An Introduction to Computational Methods*, Wiley (Publishing)
2. Humar, J.L., (2002), *Dynamics of Structures*, II edition, Swets & Zeitlinger B.V., Lisse, Netherlands
3. Mukhopadhyay,M., (2008), *Structural Dynamics: Vibrations and Systems,* Ane Books Pvt.Ltd, New Delhi
4.

E-book Links :

Grading Plan : (The table is only indicative)

Type of Evaluation	**Weightage (in %)**
Quiz-1	**5**
Mid Sem Exam	**20**
Quiz-2	**5**
End Sem Exam	**30**
Assignments	**20**
Project	**20**

Mapping of Course Outcomes to Program Objectives:

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

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

1. Lectures by integrating ICT into classroom teaching
2. Tutorials involving numerical examples to reinforce structural dynamics concepts
3. Assignments involving analysing structural data to understand dynamic response earthquake data for predicting earthquake response of SDOF and MDOF structural systems
4. Critical and active learning through projects, and project-based learning by doing term-projects which involves hands-on use of computer programming skills and software tools.

Title of the Course:	**Structural Engineering Design Studio**
Name of the Faculty:	Shubham Singhal
Course Code:	CE1.502
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.

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 structural analysis concepts of structural components, for structural system design.

CO-2 Write computer programs, to develop structural analysis software.

CO-3 Analyse the structure using commercially available software

CO-4 Design the components and systems using commercially available software

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	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	3	3	3	1	-	1	2	-	-	-	-	-	3	3	3	3
CO2	3	2	2	1	-	1	1	-	-	-	-	-	1	3	3	1
CO3	1	1	2	2	1	2	1	-	-	-	-	-	2	1	2	1
CO 4	2	2	3	2	3	2	3	-	-	-	-	-	2	2	3	1
CO5	3	3	1	3	3	3	3	-	-	-	-	-	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: Review of Structural Analysis – Analysis of Planar Trusses, Shear Force and Bending Moment Diagrams, Structural Analysis-Force Methods-Displacement Methods, Deflected Shape-Deflections, Approximate Methods of Analysis- Gravity and Lateral Loads-Beams, Frames.

Unit 2: Numerical Methods – Bi-Section Method, Gauss Elimination, Newton-Raphson

Unit 3: Introduction to MATLAB – Vectors, Arrays and Matrices, Branching Statements and Loops, Introduction to Plotting, Linear Algebra, Curve Fitting, Script and Functions, Graphics -2D and 3D, Development of GUI Tool.

Unit 4: Application of MATLAB – Analysis of Beams & Frames, Gravity and Lateral Load Analysis of Frames, Analysis of Planar Trusses.

Unit 5: Introduction to STAAD, SAP2000 & ETABS – Modelling, Analysis and Design Concepts, Elastic Analysis and Design-Reinforced Concrete Building -Bare Frame Analysis, Analysis of Frames with Unreinforced Masonry Infills, Steel Building, Elastic Earthquake Behaviour of Buildings-Modal Analysis-Linear Dynamic Analyses and Design-Response Spectrum Analysis, Time History Analysis, Introduction to Inelastic Earthquake Behaviour of Buildings-Nonlinear Static Analysis Essentials- Nonlinear Static Analysis.

Reference Books:

1. Hibbeler,R.C., (2011), Mechanics of Materials, Pearson Prentice Hall, New Jersy
2. Hibbeler,R.C., (2012), Structural Analysis, Pearson Prentice Hall, New Jersy (3)Norris,C.H., Wilbur,J.B., and Utku,S., (2003) Elementary Structural Analysis, McGraw-Hill Book Company, Auckland
3. Wang, C.K., (1983), Intermediate Structural Analysis, McGraw-Hill Book Company, Auckland
4. Computers and Structures Inc. (CSI), (2012), Structural Analysis Program (SAP) 2000, Version 16, USA
5. Chapman,S.J., (2007), MATLAB Programming for Engineers, Thomson Learning, Canada
6. Pratap,R., (2003), Getting Started with MATLAb: A Quick Introduction for Scientists and Engineers, OXFORD University Press, Oxford, UK

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 **: Structural Safety of Built Infrastructure**

Name of the Faculty : Jofin George

Name of the Program **:** Computer-Aided Structural Engineering (CASE)
Course Code **:**
Credits **:** 2
L - T - P **:** 3-1-0
Semester, Year **:** Monsoon 2024

Pre-Requisites

1. Strong fundamentals in structural analysis and design principles.
2. Familiarity with analysis software such as ABACUS and ETABS.
3. Understanding of probability concepts in a civil engineering context.

Course Outcomes:

CO1: Evaluate the significance of structural assessment in preventing collapses and analyze structural safety through real-world examples and visual inspection techniques.

CO2: Utilize both traditional methods like thrust line analysis for stability and advanced numerical methods for static and dynamic analysis of structures.

CO3: Develop proficiency in using computational methods, material models, and modelling techniques to assess structural components and systems accurately.

CO4: Apply various non-destructive testing methods to evaluate the integrity and safety of structures through practical applications and case studies.

CO5: Evaluate the safety of existing structures based on reliability-based methods.

Course Topics:

Module 1: Introduction to structural assessment, structural collapse, choice of assessment methodbased on available information, type of collapse, and level of assessment. Rapid visual inspection,relevant recommendations, simple methods: thrust line analysis, stability under self-weight, gravityloads, lateral loads, equilibrium governing systems.

Module 2: Computational methods in structural assessment: failure theories for ductile and brittle materials, material models: continuous, micro and macro models, modelling techniques: Finite element method, discrete element method.

Module 3: Non-Destructive Testing (NDT) Techniques, Overview of non-destructive testing methods, Application of NDT in structural assessment. Introduction to structural reliability.

Module 4: Case Studies: Detailed discussion of case studies on structural failures of built infrastructure, indicators and rehabilitation schemes.

Reference Books and codes :

1. SP:25-1984: Handbook on Causes and Prevention of Cracks in Buildings.
2. IS 13311: Non-destructive testing of concrete-Methods of test.

3. Structural reliability and Risk analysis, Radu Vacarenau, Alexandru Aldea, Dan Lungu.
4. Guidebook on non-destructive testing of concrete structures, International Atomic EnergyAgency, Vienna, 2002.
5. Non-destructive testing of bridges: Indian railway Institute of Engineering, Pune, 2021.
6. FEMA P-58: Seismic Performance Assessment of Buildings.

Grading Plan

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

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

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

Teaching-Learning Strategies in Brief:

- Classroom Lectures
- Active learning by students.
- Field visits to understand the types and causes of structural collapse and suggest mitigationstrategies.
- Term project focusing on the process of structural assessment based on available information.
- Invited lectures and discussion sessions led by industry experts on practical case studiesof structural collapse, assessment and rehabilitation.

Title of the Course: **Systems Biology**

Name of the Faculty : Vinod PK
Course Code : SC3.203
L-T-P : 3-1-0
Credits : 2
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Academic Program

1.Prerequisite Course / Knowledge: ……

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

CO-1: Identify regulatory motifs of biological networks

CO-2: Infer the design principles of biological systems

CO-3: Analyze biological systems by mathematical modelling

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	3	1	3
CO2	3	3	1	3	3								1	3	2	3
CO3	3	3	1	3	3								1	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: Network organization: Motifs, modules, and hierarchical networks
Unit 2: Design principles of biological systems
Unit 3: Dynamic modelling of biochemical systems
Unit 4: Biological Switches and Clocks,
Unit 5: Robustness of Biological systems
Unit 5: Biological noise

Reference Books:

1. An Introduction to Systems Biology: Design Principles of Biological Circuits by Uri Alon, Chapman & Hall
2. Systems Biology: A Textbook by Edda Klipp, Wolfram Liebermeister, Christoph Wierling, Axel Kowald, Hans Lehrach, Ralf Herwig, Wiley-VCH.

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

This course builds the foundation for inferring the principles of biological systems using mathematical modelling. Lectures include solving problems in class and participation of students and include discussion on research articles. Evaluations test their ability to solve and implement models using computers.

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

- Quiz - 20%
- End semester exam – 30%
- Assignments – 30%
- Short project – 20%

Title of the Course: Systems Thinking

Faculty Name: Spandan Roy, Vinod P K
Course Code: EC5.202
L-T-P…… 3-1-0
Credits…… 4
Name of the Academic Program B. Tech. in ECE

Prerequisite Course / Knowledge: None

Course Outcomes (COs):

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

CO-1: Apply knowledge of 1st principles from physics to develop system model
CO-2: Develop state-space formulation for systems and analyze the behavior of 1st and 2ndorder systems via time-domain specification for transients and steady-state
CO-3: Design and develop proportional, derivative and integral controllers
CO-4: Demonstrate a familiarity with organization of biological system and their parts
CO-5: Apply principles of control to biological systems
CO-6: Analyze emergent properties of biological systems by mathematical modeling

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

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

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

Mapping with PSOs, where applicable.

Detailed Syllabus:

Unit 1: Mathematical modelling of systems via transfer functions and state-space
Unit 2: Time-domain performance and stability analysis of first and second order systems
Unit 3: Biological signals and systems (case study)
Unit 4: Design principles of biological systems and control
Unit 6: Modeling and design of biological circuits

Reference Books:

1) Modern Control Engineering by K Ogata, Prentice Hall.
2) An Introduction to Systems Biology: Design Principles of Biological Circuits,Uri Alon, Chapman & Hall.
3) Biomolecular Feedback Systems, Domitilla Del Vecchio and Richard M. Murray,Princeton University Press

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

The course lectures will include activities that promote the understanding of thelecture content by using small examples that students work out during the classitself and promote active and participatory learning. A good part of the lecture will involve problem solving and finding solutions to problems. Homework assignments are designed to reiterate the material covered in class lectures andapply them via simulation.

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

- Assignments: 30%
- Quiz1: 15%
- Quiz 2: 15%
- End Exam: 40%

Title of the Course : Theory of Elasticity
Name of Faculty : P. Pravin Kumar Venkat Rao
Course Code : CE0.501
L-T-P : 3-1-0
Credits : 4
Name of the Academic Program**:** M. Tech in CASE

1.Prerequisite Course / Knowledge: Solid Mechanics/Strength of Materials

2.Course Outcomes (COs):

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

CO 1: Explain the basics concepts of stress, strain, tensor, vector, traction, and important properties of solids.

CO 2: Discuss the fundamental theories of elasticity.

CO3: Idealize the physical systems through mathematical equations.

CO4: Represent the state of stress and strain in a body (2D and 3D) with respect to different planes or orientations.

CO5: Analyze the boundary value problems using equilibrium, compatibility, andconstitutive relations.

CO 6: Derive the governing equations and their solutions for application to problems in plane stress and plane strain state, torsion and bending.

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

4.Detailed Syllabus:

Unit 1: Elasticity and its types, Inelastic material, Difference between theory of elasticity and strength of material, Materials and its properties, Assumptions in elasticity, Mathematical preliminaries: cartesian co-ordinates, introduction to tensor, matrix representation, operators and symbols.

Unit 2: Concept of stresses and strains, Infinitesimal area and volume, 2D and 3D stress tensor, Stress and strain transformation at a point in an elastic body, Difference between stress and

traction, Cauchy's stress, Components of traction, Strain tensors, Types of deformation, Measurement of surface strains

Unit 3: Rigid body translation and rotation of an element in space, Generalized Hook's law, Stress-strain relationships, Equilibrium equations, Strain-displacement relationships, Compatibility conditions, Constitutive relations.

Unit 4: Principal planes, Principal stresses and invariants, Octahedral plane and stresses, Deviatoric stress, Hydrostatic stress, Plain stress, Plain strain, Formulation of boundary value problems in equilibrium and compatibility, Stress functions, Biharmonic equation, Solution of 2D problems by the use of polynomials.

Unit 5: Torsion of bars, Saint venant principle, Rigid body rotation, bending of beams, Elastic stability, Factors affecting lateral stability, Analysis of beam-column with different loading conditions, Different types of buckling.

Reference Books:

9. Ugural, A. C., & Fenster, S. K. (2003). Advanced strength and applied elasticity. Pearson education.
10. Timoshenko, S. P., & Goodier, J. N. (1971). Theory of Elasticity, McGraw-Hill, New York, 1970. Fok-Ching Chong received the BS degree from the Department of Electrical Engineering,National Taiwan University, Taipei, Taiwan, in.
11. Shames, I. H. (1964). Mechanics of deformable solids.
12. Srinath, L. S. (2003). Advanced mechanics of solids. Tata McGraw-Hill.
13. Timoshenko, S. (1953). History of strength of materials: with a brief account of the history oftheory of elasticity and theory of structures. Courier Corporation.
14. Boresi, A. P., Chong, K., & Lee, J. D. (2010). Elasticity in engineering mechanics. John Wiley& Sons.
15. Popov, E. P., & Balan, T. A. (1968). Mechanics of solids. Mexico City, Mexico:Pearson Education, 2000) (in Spanish).
16. NPTEL Lecture Notes: IIT, Madras.

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

In this course the concept of elasticity, an important property of solids, will be discussed in a comprehensive way. Idealization of physical system, representing the idealized system through mathematical equation and finally finding solution of those equations are the key features that constitute the structure of this course. In this course emphasis will be given on both theory and applications.

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: **Thinking and Knowing in the Human Sciences – II**

Name of the Faculty: Aniket Alam
Course Code: HS0.202
L-T-P: 3-1-0
(L= Lecture hours,
T=Tutorial hours, P=Practical hours)
Credits: 4
Name of the Academic Program: CHDCore offered to UG2 (third semester of the CHD program)

1.Prerequisite Course / Knowledge:
Making of Contemporary India and Making of the Contemporary World(Core coursesin the CHD program).

2.Course Outcomes (COs) (5 to 8 for a 3 or 4 credit course):
After completion of this course successfully, the students will be able to.
CO-1: Students will understand how a historical and sociological perspective helps to understand society. They will be learn to see the human world appears through the lens of these two disciplines and their insights.
CO-2: Students will understand the methods, assumptions, principles, and the foundational ideas of the various schools of history.
CO-3: Students will understand key concepts and theoretical and methodological tools in sociology.
CO-4: Students will see the potential as well as the limitations of historical and sociological approaches to social analysis.
CO-5: Students will use sociological and historiographical theories and frameworks. They will gain some experience in engaging with academic texts as well as primary sources in a theoretically informed manner.

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

	PO 1	PO 2	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	1	3	3	3	1	3	3	3	1	1	1	3	1	3	2	3
CO2	1	3	3	3	1	3	3	3	1	1	1	3	1	3	2	3
CO3	1	3	3	3	1	3	3	3	1	1	1	3	1	3	2	3
CO 4	1	3	3	3	1	3	3	3	1	1	1	3	1	3	2	3
CO5	1	3	3	3	1	3	3	3	1	1	1	3	1	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:

Unit 1: Sociological Concepts: Social Structures, Individuals and Groups, Socialisation, Structure/Agency, Status and Roles, Rules, Values, Norms, Culture, Discourse, Deviance.
Unit 2: Sociological Frameworks and Theories: Understanding social stratification through the structural functionalist, Marxist and the Weberian methods. Introduction to key ideas of Emile Durkheim, Karl Marx and Max Weber.
Unit 3: Social Institutions and Processes in India.
Unit 4: Ideas of History (Progress, Decline, Morality; Facts, Objectivity, Interpretation)
Unit 5: Concepts of Time and Space
Unit 6: Main methods of knowing the past (Inductive and deductive methods; structuralism and post-structuralism).

Reference Books:
Anthony Giddens, *Sociology* (Malden: Polity Press, 2009).
D.P. Mukerji, *Basic Concepts in Sociology* (New Delhi: Rupa and Co., 1932).
E. H. Carr, *What is History* (London: Cambridge University Press, 1961).
James Scott, *Against the Grain* (New Haven: Yale University Press, 2017).
Jean-Claude Carriere and Umberto Eco, *this is Not the End of the Book* (London: Random House, 2009).
Mircea Eliade, *The Myth of the Eternal Return: Or Cosmos and History* (New Jersey: Princeton University Press, 1992).
Nandini Sundar, Patricia Uberoi, Satish Deshpande, *Anthropology in the East: Founders of Indian Sociology and Anthropology* (Hyderabad: Orient Black Swan, 2007).

5.Teaching-Learning Strategies in brief (4 to 5 sentences):
Students are introduced to theories and concepts through lectures. This course expects the student to read about 2000 pages of academic literature and write about 12,000 words of essays and answers over the semester. The tutorial slots are used to get students to do small in-class assignments related to assigned readings. Throughout the course, students are equipped to deploy theories and methods to a research question and to draw interconnections between the different ways in which the human world is understood and explained. The course draws connections as well as differences between the historical and the sociological methods.

6.Assessment methods and weightages in brief (4 to 5 sentences):
In the sociology module, students will do 2 assignments (worth 15% each and related to one Unit), and one exam (30%) which covers the entire syllabus of the module. The assignments are designed to test grasp over concepts and theories discussed in the lectures and is also reading based. In the history module, students will do two quizzes (worth 15% each, and covering 1 unit) and 1 reading based writing assignment worth 20%.

Title of the Course: **Topics in Applied Optimization**

Name of the Faculty: Pawan Kumar
Course Code: MA8.401
L-T-P: 3-1-0.
Credits: 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Name of the Academic Program**:** B.Tech. in Computer Science and Engineering

1. Prerequisite Course / Knowledge:
Basic Linear Algebra, Basic Calculus, and Basic Probability and Statistics

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

CO-1. Learn additional theory needed from calculus and linear algebra for optimization.
CO-2. Learn to model various applications from data science as an optimization problem.
CO-3. Learn to prove convergence estimates and complexity of the algorithms.
CO-4. Learn to code optimization solvers efficiently using Python.
CO-5. Demonstrate expertise in applying optimization methods in research problems.

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

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

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

4. Detailed Syllabus:

Unit 1: Convex Sets, Convex Functions, Duality, Convex Optimization Problems (9 hours)

Unit 2: Steepest Descent, Newton methods, Quasi-Newton Methods, Interior Point Methods, Stochastic Optimization algorithms (SGD, RMSprop, ADAM, SVRG, etc.), Convergence Estimates (6 hours)

Unit 3: Applications of optimization: Recommender Systems, Support Vector Machines, Neural networks, Image, and Video Completion, Extreme Classification, Gans (9 hours)

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

References:

- Stephen Boyd and Lieven Vandenberghe, ***Convex Optimization***, Cambridge University Press, 2004.
- Ian Goodfellow, Yoshua Bengio and Aaron Courville, ***Deep Learning***, MIT Press, 2016.
- Léon Bottou, Frank E. Curtis, Jorge Nocedal, ***Optimization Methods for Large-Scale Machine Learning***, 2016.
- Prateek Jain, Purushottam Kar, ***Non-convex Optimization for Machine Learning***, 2017.

5.Teaching-Learning Strategies in brief:

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

6. Assessment methods and weightages in brief:

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

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Title of the Course: **Topics in Nanosciences**

Name of the Faculy: Tapan K. Sau
Course Code: SC2.401
L-T-P: (4-0-0)
Credits: 4
Name of the Academic Program: CND

1.Prerequisite Course / Knowledge:

Science I/II

2.Course Outcomes (COs) :

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

CO-1. Define terminology used in the fields of nanoscience and nanotechnology.

CO-2. Explain the nanoscale confinement effects on various material properties.

CO-3. Discuss various methods of synthesis of nanoparticles.

CO-4. Identify the factors that need control for the preparation of stable and controlled sized and shaped nanoparticles.
CO-5. Explain the determination of the particle size and shape.
CO-6. Identify and formulate appropriate methods and experimental techniques that can be used to study various nanoscale materials and phenomena. **CO-7.** Analyze the size- and shape-dependent physical/chemical properties of nanoparticles.
CO-8. Identify various applications of nanoparticles and their future potential.

CO-9. Describe the advantages and limitations of nanostructured materials.

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
CO3	3															2
CO4		2														2
CO5	3															3
CO6			3													3
CO7	3															3
CO8				2												2
CO9	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 to Nanoscience. (3L)
Nanomaterials: Definitions and Scopes.
Length Scales: Size Scales, Surface and Interface, Surface Energy, Coordination Numbers.
Classification of nanomaterials: Clusters and Magic Numbers, Nanoparticles, and Colloids. Metal, Semiconductor, and Bio Nanomaterials.

Unit 2. Properties of Nanomaterials. (9L)
Electrons in Nanostructures. Discrete states vs. band structure: Effects of dimensionality and symmetry in nanostructures. Metal-to-nonmetal transition.
Thermodynamics and Kinetics of Small-Sized Systems. Capillarity, Liquid droplets, Lotus effect. Self-assembly principles. Adsorption, Electrostatic and Steric Stabilization. Classical nucleation theory. Size and shape control in nanoparticle formation.
Magnetic (Super paramagnetism), *Electrical* (quantized conduction and Coulomb Staircase), *Optical* (size and shape effects), *Thermal* (melting and conduction), *Mechanical and Catalytic properties.*

Unit 3. Making Nanostructures. (3L)
Top-down and bottom-up methods.

Unit 4. Tools for Nano systems. Microstructure/Chemistry/Defects and Structure. (5L)
AFM, SEM, TEM, XRD, SAXS, Nanoindentation.

Unit 5. Applications of Nanomaterials. (4L)

Catalysis, Band Gap Engineered Quantum Devices, Sensors, Field Effect Transistor (FET), Photoelectrochemical Cells, Photonic Crystals and Waveguides, Theragnostics (Magnetothermal Therapy), food and agriculture industries, automobile, textile, water treatment and civil applications, use in energy, space, and defense.

Unit 6. Concerns and Challenges of Nanotechnology. (2L)

Environmental, ecological and health hazards of nanoparticles. Nanotoxicology and its effect.

Reference Books:

1. S. M. Lindsay (2010), *Introduction to Nanoscience*, 1st Edition, Oxford University Press, New York.
2. E. Roduner (2006), *Nanoscopic Materials: Size-dependent Phenomena*, 1st Edition, RSC Publishing, Cambridge.
3. B. S. Murty, P. Shankar, B. Raj, B. B. Rath and J. Murday (2013), *Textbook of Nanoscience Nanotechnology*, 1st Edition, Universities Press (India) Private Limited, Bangalore.
4. G.A. Ozin, A. C. Arsenault, and L. Cademartiri (2009), *Nanochemistry*, 2nd Edition, RSC Publishing, Cambridge.
5. M. Kohler and W. Fritzsche (2004), *Nanotechnology*, 1st Edition, Wiley-VCH, Weinheim.

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

The course involves lectures, quizzes, laboratory demonstrations, assignments, and finding and reading relevant scientific literature.

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

The student assessment in the course involves written tests/quizzes/assignments to determine their learning proficiency in the course and their grades. Grading is done as follows:

1. Assignments	20%
2. Quizzes (2*10)	20%
3. Mid-Term Exam	20%
4. End-Semester Exam (whole syllabus)	40%

Title of the Course: **User Research Methods**

Name of the Faculty: Priyanka Srivastava
Course Code: CS9.501
L - T - P : 3,0,3
(L - Lecture hours, T-Tutorial hours, P - Practical hours)
Credits: 2
Semester, Year: 1st Sem – Year 1 (Monsoon, 2023)
Program: M.Tech I Year I Semester
Product Design and Management

Pre-Requisites Course/Knowledge : None

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: Apply basic qualitative and quantitative research methods, like3-dimensional framework using attitudinal and behavioral, quantitative and qualitative, and context of use; conduct field study, stakeholder interviews, log analysis etc.
CO-2: Design and develop field and lab studies, by employing various research methods like interviews, comparative analyses etc., write proposal
CO-3: Evaluate the users' need and pain points, identify and recognize the problem and gaps, generate possible solutions to user problems
CO-4: Analyze the ethics of conducting study and observations
CO-5: Synthesize the user research data and summary

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

Unit 1: Understanding User
Unit 2: Lab and Field, Quantitative and Qualitative methods
Unit 3: Ethics in User Research
Unit 4: Statistics – How to present User Research Results

Units are not equally distributed in classes but highlight the topic that will be covered under each unit.

Unit 1	Unit 2	Unit 3	Unit 4
Understanding User	Observation Techniques	Ethics	Data Visualization and Presentation
Introduction and Qualitative Research Overview – foundation of user experience, key terms, highlight the hall of shame, why user-centric design and control is important; attitudinal and behavioural dimension	Conducting studies in usability lab, Lab studies – eye-tracking, behavioural observations, control design observations	Code of conduct; Participants Rights, Privacy-data safety, Respect – individual rights, time and effort, Sensitive and Empathetic; Risk analysis; Informed Consent	Qualitative Analysis – Thematic, values, product quality etc. organize and summarise data
User need assessments, Qualitative research method, Interview protocols followed up with activities. Know your user – age, gender, cognitive / psychological	Field study, site visits, naturalistic observations, controlled field experiment, individual and group survey and focused interviews, customer satisfaction, remote		Quantitative Analysis – count, accuracy, response time or time taken to complete the task or speed analysis, visualization, learning curve,

perspectives, people with disability or accessibility,	testing		
How to conduct interview, make observations, and extract data from interview, ethics and consent, user research protocols, survey-based observations	Industry practice - A/B and Multivariate testing, card sorting or tree testing, qualitative and quantitative method, how to deliver user research results		
Analysis – Qualitative and quantitative analysis, survey and questionnaire analyses			

Preferred Textbooks:

1. Elizabeth Goodman and Mike Kunaivsky (2012), Observing the User Experience: A Practitioner's Guide to User Research, 2nd Edition, publisher: Morgan Kaufmann
2. Trochim, W. K. (2003). Research Methods Knowledge Base [on-line]. Retrieved February 15, 2003.

Reference Books :

E-book Links :

Grading Plan : (The table is only indicative)

S.No.	Type of Evaluation	Qty.	Weightage (in %)
1.	Assignment/ White Paper/ Term Paper	N=1	15%
2.	HW/CW activities	N=5	20%
3.	Project in Group – with 2 students	N=1	30%
4.	Final Exam	N=1	40%
		TOTAL	**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

	PO 1	PO 2	PO 3	PO4	PO 5	PO6	PO 7	PO8	PO9	PO 10	PSO 1	PSO 2	PSO 3	PSO 4
CO1	2	3	-	-	2	2	-	3	3	3	3	-	2	2
CO2	-	2	-	-	2	2	-	3	3	3	3	-	2	2
CO3	-	3	-	-	2	2	-	-	-	-	3	-	2	2
CO4	-	-	-	-	-	2	-	-	3	-	3	-	2	2
CO5	-	3	-	-	2	2	-	-	-	-	3	-	2	2

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

- The course will offer primarily lecture and activity-based learning course.
- Students will be required to participate in activities and discuss the observations with their peers in class and will be asked to present their observations.
- Students will be encouraged to take assignments inspired from their everyday experiences and will be asked to evaluate the event/phenomenon/ processes critically and scientifically using user research methods.
- These activities will be performed either as individual or as a team, where they will be asked to demonstrate the individual contribution to the team activities.

Title of the Course: **VALUE EDUCATION – I**

Name of the Faculty: Shatrunjay Rawat
Course Code: OC3.101
L-T-P 12-6-0 (Total number of 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 the self.
CO-2: Look at larger issues that (for many reasons) most are not exposed to: social, political, community, family, individual, etc. in a sensitized way.
CO-3: Understand themselves and their own roles within the bigger context. What are really, truly important to them? What are made important by others?
CO-4: Engage and connect with others and nurture the relationships.
CO-5: Think to shape and change the world, and not be mere technologists or scientists.

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: 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: Gratitude and the need to acknowledge one's gratefulness; Understanding Self and Other.
Unit 3: Living in harmony at 4 levels: self-self, self-family, self-society, self-nature
Unit 4: Understanding needs of body and self; Right understanding of physical facilities and relationships; Understanding human relationships; Trust and Respect - the foundational values in relationships.
Unit5: Harmony in Society; The sense of safety, justice and peace in society; Nature and Sustainability; Self-reliance and Gandhian thought

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 or images to analyze and some activities to keep the students engaged in class throughout. Talks by experts who made a difference are also organized for the batch. Field trips to farms, orphanages, old-age homes, villages and jails are arranged as part of the induction programme, in parallel to the classes in VE for the first year UG 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. (weightage for each kind of assessment may be given.)

Title of the Course: **VLSI Design**

Name of the Faculty: Abhishek Srivastava

Course Code: EC2.201
L-T-P: 3-1-0.
Credits: 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Academic Program: B.Tech. in Electronics and Communication Engineering

1. Prerequisite Course / Knowledge:
Digital electronics, Network theory.

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

CO-1: Analyze delay and noise performances of CMOS inverter
CO-2: Apply the knowledge of delay and noise analysis of CMOS inverter for other logic styles
CO-3: Apply the knowledge of different logic styles for developing digital building blocks such as gates, multiplexors, latches and flip-flops
CO-4: Design delay optimized multistage logic circuits by using method of logical effort
CO-5: Design combinational circuits using CMOS and pass transistor logic for minimum delay and maximum noise margin performances
CO-6: Design a delay optimized sequential CMOS circuit such as 8-bit multiplier for the given load and speed requirements, while ensuring no setup time or hold time violations and verify its post layout performance using SPICE tools

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

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

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

3. Detailed Syllabus:

Unit 1 (Introduction to VLSI design):1) Introduction to VLSI design (top-bottom approach) - flow, applications, technologies, 2) MOSFET, FinFET transistors – Geometry and model, 3) Introduction to basic building blocks - SPICE, HDL, layout, 4) Moore's law, technology scaling, current trends(5-lectures/7.5-hours)

Unit 2 (CMOS Inverter): 1) Static characteristics- VTC, switching threshold, Noise margin, 2) Dynamic characteristics – rise time, fall time, delay, power, 3) Why CMOS Inverter, 4) CMOS inverter design flow- problem of achieving higher speeds (solution/technique discussed in the following unit), 5) From inverters to other logic - pull-up, pull-down networks, tristate inverter, Gates, Mux, Latches, Flip-flops, set-up hold time, clocked CMOS and true single phase clocked (TSPC) latches (7-lectures/10.5-hours)

Unit 3 (Multistage Logic Design and Optimization: 1) Parasitics in layout causing performance degradation – field transistor, active MOS, gate-drain overlap, latch-up, 2) Method of logical effort-fan-out, Stage effort, electrical effort, device sizing, design examples. (5-lectures/7.5-hours)

Unit 4 (Other Logic Styles): Pseudo nMOS, pass transistor logic, Cascode Voltage Switch Logic (CVSL), Dynamic logic. (3-lecturs/4.5-hours)

Unit 5 (Other topics Introduction to System Design using HDL): Finite state machines – Mealy, Moore, Intro to RTL,Data path, Control unit, combinational and sequential circuit design examples (6-lectures/9-hours)

REFERENCES:

1. Neil H. E. Weste, K. Eshraghian, "Principles of CMOS VLSI Design- A Systems Perspective", 2nd Edition, Pearson Education Pvt. Ltd.
2. J. M. Rabaey, A. Chandrakasan, B. Nikolic, "Digital Integrated Circuits - A Design Perspective", 2nd Edition, Prentice Hall of India.
3. Stephen Brown and Z. Vranesic, "Fundamentals of Digital Logic with Verilog Design", Tata McGraw-Hill Edition 2002.
4. Samir Palnitkar, "Verilog HDL – A Guide to Digital Design and Synthesis", Second edition, Pearson, 2003.
5. J. Bhaskar, "Verilog HDL Synthesis- A Practical Primer", Star Galaxy Pub; 1st edition, 2001

5.Teaching-Learning Strategies in brief:

Fundamentals of VLSI design will be discussed in the course with examples. SPICE tools will be introduced, and regular assignments will be given based on topics covered in lectures. Weekly tutorials will be conducted for problem solving and further discussions on any questions related to topics covered in lectures. A course project will be given that will involve analysis, design, layout and simulations (schematic and post-layout level) of an analog circuit for given specifications.

6. Assessment methods and weightages in brief:

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

Title of the Course: **Work, Entrepreneurship and Technology in Contemporary Societies.**
Name of the Faculty: Rajorshi Roy
Course Code **:** HS2.303
L-T-P **:** 3-0-0
(L= Lecture hours, T=Tutorial hours, P=Practical hours)
Credits **:** 4
Name of the Academic Program: HSS Elective for UG3/UG4

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

CO-1
Students will develop a foundational understanding of issues, definitions, and processes related to work, entrepreneurship, and technology.
CO-2
Students will be able to acknowledge the panoply forms of work and their organization. They would be introduced to work across sectors: agriculture, manufacturing, and services. Subsequently, the students would have a sound knowledge of how global economic forces shape local work arrangements.
CO-3
Students will be able to distinguish how economic engagements (work and entrepreneurship) differ in the context of the global north and the global south. They would be able to engage in the transformation of economic engagements in the past century. Thus, the students would engage in diverse working conditions (formal and informal) and spread self-employed entrepreneurial enterprises.
CO-4
Students will be able to analyze how social institutions (such as technology, gender, class, and caste) shape entrepreneurial enterprises and work engagements. The students will be introduced

to concepts of embeddedness, networks, and communities that shape the economic lives of individuals.

CO-5

Students will understand how work and entrepreneurship, rather than being binaries, are deeply interconnected. With an appreciation of multiple economic scales of entrepreneurship and work, the course will highlight the role of capital, labor, and technology in creating deeply connected processes.

CO-6

Students will develop a critical outlook on how technology shapes economic engagements (work and entrepreneurship) and how there is a bottom-up adoption and usage of technology that gives rise to unintended economic consequences.

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

Matrix for CSE

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

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

Matrix for ECE

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

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

4.Detailed Syllabus:

Unit-1

Sociology of work:

- Theories and basic concepts of work.
- Historical discourses and practices around work.
- Introduction to sectoral (agriculture, manufacturing, and service) understanding of work in contemporary markets.

Unit-2

Diverse forms of work: Formal and informal work, and productive and reproductive work. Debt and bondage in labour markets; precarity and dignity within contemporary work arrangements. Role of social institutions (gender, caste, and technology) in shaping work and work relations.

Unit-3

Introduction to entrepreneurship: Definition of entrepreneurship, historical discourses in the sociology of entrepreneurship: charismatic individuals, entrepreneurial groups, entrepreneurship as a process. Types of entrepreneurial engagements: Silicon Valley entrepreneurs, intrapreneurship, main-street entrepreneurs, and self-employed entrepreneurs.

Unit-4

Entrepreneurial processes and outcomes: Value creation and the role of finance in entrepreneurship. Role of social networks (kinship and peer networks) in the entrepreneurial process. Reciprocity and resources within entrepreneurial ventures.

Unit-5

Technology and contemporary economy: Historical transformation technology from the 19th century to the present – highlighting key phases of technological transformation, Globalization and technological adoption, Contingent work and digital technology, Role of technology in contemporary entrepreneurship, and technology as an institution.

Reference Books:

Grint, Keith. 2005. *The Sociology of Work: Introduction*. Polity.

Ritzer, George. 2017. *Introduction to Sociology*. 4th ed. Sage.

Smelser, Neil J., and Richard Swedberg, eds. 2010. *The Handbook of Economic Sociology, Second Edition:* Princeton University Press.

Recommended Readings

Aldrich, Howard E., and C. Marlene Fiol. 1994. "Fools Rush in? The Institutional Context of Industry Creation." *The Academy of Management Review* 19(4):645. doi: 10.2307/258740.

Breman, Jan. 1996. *Footloose Labour: Working in India's Informal Economy*. Vol. 2. Cambridge University Press.

Breman, Jan. 2023. "A Short History of the Informal Economy." *Global Labour Journal* 14(1).

De Neve, Geert. 2019. "The Sociology of Labour in India." *Critical Themes in Indian Sociology* 164–81.
Doody, Sean, Victor Tan Chen, and Jesse Goldstein. 2016. "Varieties of Entrepreneurial Capitalism: The Culture of Entrepreneurship and Structural Inequalities of Work and Business Creation." *Sociology Compass* 10(10):858–76. doi: 10.1111/soc4.12407.
Doussard, Marc. 2013. *Degraded Work: The Struggle at the Bottom of the Labor Market*. U of Minnesota Press.
Gandini, Alessandro. 2019. "Labour Process Theory and the Gig Economy." *Human Relations* 72(6):1039–56. doi: 10.1177/0018726718790002.
Giddens, Anthony, and Phillip W. Sutton. 2021. *Sociology*. 9th ed. Polity.
Grint, Keith, and Steve Woolgar. 2013. *The Machine at Work: Technology, Work and Organization*. John Wiley & Sons.
Kalleberg, Arne L. 2016. "Good Jobs, Bad Jobs." *The SAGE Handbook of the Sociology of Work and Employment. London: SAGE* 111–28.
Lehdonvirta, Vili. 2018. "Flexibility in the Gig Economy: Managing Time on Three Online Piecework Platforms." *New Technology, Work and Employment* 33(1):13–29. doi: 10.1111/ntwe.12102.
Marcus, George E. 1995. *Technoscientific Imaginaries: Conversations, Profiles, and Memoirs*. Vol. 2. University of Chicago Press.
Parry, Jonathan, and T. G. Ajay. 2020. *Classes of Labour: Work and Life in a Central Indian Steel Town*. Routledge.
Parry, Jonathan P. 1999. "Lords of Labour: Working and Shirking in Bhilai." *Contributions to Indian Sociology* 33(1–2):107–40. doi: 10.1177/006996679903300107.
Ruef, Martin. 2009. "Economic Inequality among Entrepreneurs." Pp. 57–87 in *Economic Sociology of Work*. Emerald Group Publishing Limited.
Ruef, Martin. 2010. "Entrepreneurial Groups." in *Historical foundations of entrepreneurship research*. Edward Elgar Publishing.
Ruef, Martin, Howard E. Aldrich, and Nancy M. Carter. 2003. "The Structure of Founding Teams: Homophily, Strong Ties, and Isolation among U.S. Entrepreneurs." *American Sociological Review* 68(2):195–222. doi: 10.1177/000312240306800202.
Schwartz, David. 2018. "Embedded in the Crowd: Creative Freelancers, Crowdsourced Work, and Occupational Community." *Work and Occupations* 45(3):247–82. doi: 10.1177/0730888418762263.
Smelser, Neil J., and Richard Swedberg, eds. 2010. *The Handbook of Economic Sociology, Second Edition:* Princeton University Press.
Standing, Guy. 2011. *The Precariat: The New Dangerous Class*. Bloomsbury academic.

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

Students will be introduced to significant themes in economic sociology: work, entrepreneurship, and technology. The lectures will include videos, interviews, and popular articles to foster active learning. The quiz would include a writing exercise to evaluate the understanding of basic concepts. The first assignment would be a sociological film review, where the students use sociological concepts to dissect the film's narrative. In the second assignment, the students are

expected present a contemporary journal article, where they engage with a state-of-the-art journal article to illustrate their sociological understanding of the paper and present a critique on it. Each assignment requires the students to read 30-50 pages of scholarly material.

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

Type of Evaluation	Weightage (in %)
Mid Sem- Exam	**20%. Questions designed to evaluate understanding of basic concepts.**
End Sem Exam	**30%. Questions designed to evaluate understanding of basic concepts.**
Assignment 1	**20%. Related to Unit I, II, III (Sociological film review)**
Assignment 2	**20%. Related to Units III, IV and V (Project presentation)**
Quiz 1	**10% Related to Unit I and II**

Title of the Course: **Wireless Communications**

Name of the Faculty: Praful Mankar
Course Code: EC5.407
L-T-P: 3-1-0.
Credits: 4
(L= Lecture hours, T=Tutorial hours, P=Practical hours)

1. Prerequisite Course / Knowledge:
Communication Theory, Probability and Random Process

2. Course Outcomes (COs)
After completion of this course successfully, the students will be able to:
CO-1: Identify and explain the fundamental operational and design problems of wireless communication systems.

CO-2: Demonstrate understanding of evolution of different wireless communication systems and standards.

CO-3: Determine the type and appropriate model of wireless fading channels based on the system parameters and the properties of the wireless medium.

CO-4: Design appropriate receiver and transmitter diversity techniques and analyze their performance theoretically and via simulations.

CO-5: Design appropriate multiple-antenna transceivers and evaluate rate and error performance.

CO-6: Demonstrate understanding of OFDM and massive MIMO techniques and application in existing and upcoming wireless 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	3	2	1	1	1					1		2		3	1	
CO2	3	2	1	1						1		2		3	1	
CO3	3	3	1	2	2					1		2		3	1	1
CO4	3	3	3	2	3					1		2	1	3	1	1
CO5	3	3	3	1	3					1		2	1	3	1	1
CO6	3	3	2	1	2					1		2	1	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: Review of digital communication, optimal detection, overview of wireless communication generations and standards
Unit 2: Channel modeling; Multipath propagation; pathloss and fading; types of fading; frequency and time selectivity
Unit 3: Diversity techniques; spatial, time and frequency diversity; performance analysis of various diversity techniques
Unit 4: MIMO communication systems; capacity analysis; MIMO receivers
Unit 5: OFDM, massive MIMO, multiuser communication

References:

Tse and Viswanath, "Fundamentals of Wireless Communications", Cambridge University Press, 2005.
Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2005.

5. Teaching-Learning Strategies in brief:
Lectures cover the topics in the syllabus and tutorials cover how to solve some design and analysis problems related to topics covered in the lectures. Lectures and tutorials emphasize active learning by students. Assignments will provide the students experience in software-based implementation and performance analysis of various wireless communication techniques. There is a long project which is either based on an idea the student wants to explore from the course topics or based on an existing research paper. Project evaluation involves multiple assessments, submission of project report, and a final presentation and viva.

6. Assessment methods and weightages in brief:
Quiz: 10%, Assignments: 20%; Project: 40%, End-Sem exam: 30%.